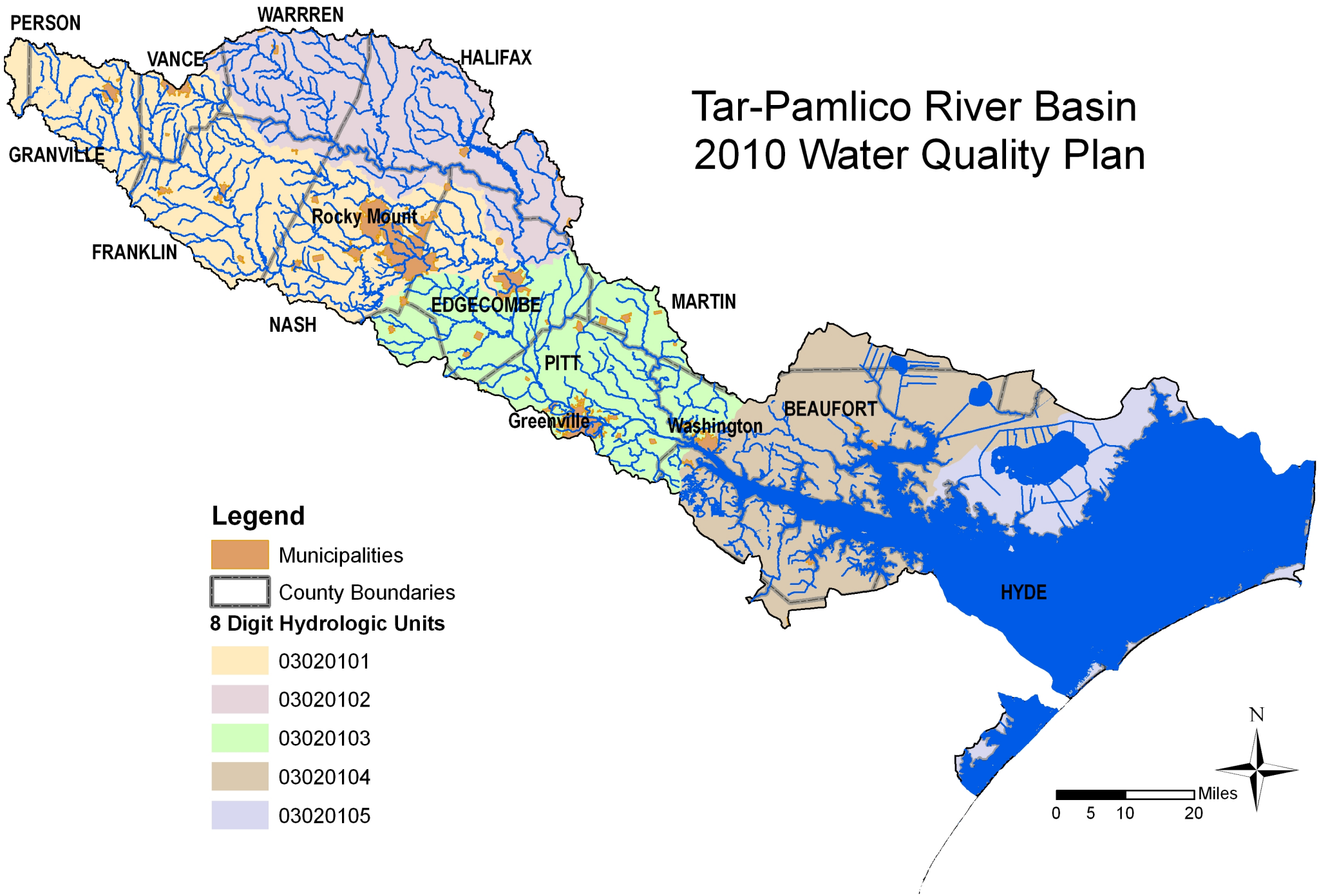
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GRANVILLE
Rocky Mount
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Tar-Pamlico River Basinwide Water Quality Management Plan 2010

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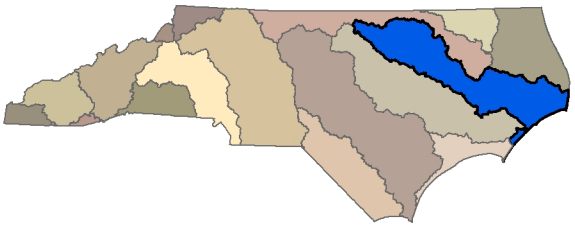
Tar-Pamlico River
Basinwide Water Quality Management Plan
2010 Summary



Introduction

This 2010 document is the fourth five-year update of the Tar-Pamlico River Basinwide Water Quality Plan. Previous basinwide plans for the Tar-Pamlico River Basin were completed in 1994, 1999, and 2004 and are available from the DWQ Basinwide Planning *website*. This basin plan was written to provide guidance for watershed stakeholders, municipal planners, natural resources regulators, and other environmental professionals with identifying and addressing water quality stressors, sources, and emerging issues. This document can be used in conjunction with the *Supplemental Guide to Basinwide Planning* which provides general information about water quality issues and DWQ programs.

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The next and fifth update to this plan is set to be completed in 2014. National Pollution Discharge Elimination System (NPDES) permits were issued in 2009 and will be reviewed for renewal again in 2014. Basinwide biological and lake sampling last occurred in the Tar-Pamlico River Basin in 2007 and will be conducted again in 2012. Collaborative efforts to integrate water quality and quantity in river basin planning will continue as the Division of Water Resources develops a basinwide hydrologic model and water resources plan (Action Plan # 1).

The Tar-Pamlico River Basin spans over 6,148 square miles making it necessary for planning purposes to divide the basin into subbasins. The Division of Water Quality changed how these subbasins are grouped to conform to the federal system of river basin management. Previously, DWQ had its own set of subbasins and numbering system, but is now using the federal cataloging unit know as hydrologic unit codes (HUCs). This report is organized by chapters at the 8-digit hydrologic unit or subbasin level. The conversion from DWQ subbasins to 8-digit hydrologic units is illustrated in Figure 1. In using the federal system slight changes had to be made to the basin boundary with an addition of 619 acres from the Neuse, Pasquotank, Roanoke, and White Oak basins, as shown in Figure 2.

This plan includes five chapters covering water quality information for each of the subbasins:

- Chapter 1, Upper Tar River Subbasin HUC 03020101,
- Chapter 2, Fishing Creek Subbasin HUC 03020102,
- Chapter 3, Lower Tar River Subbasin HUC 03020103,
- Chapter 4, Pamlico River Subbasin HUC 03020104,
- Chapter 5, Pamlico Sound Subbasin HUC 03020105,

along with chapters focusing on special topics:

- Chapter 6, Nutrient Sensitive Waters Strategy,
- Chapter 7, Agriculture & Water Quality,
- Chapter 8, Ecosystem Enhancement Program,
- Chapter 9, Forestry & Water Quality and
- Chapter 10, Source Water Assessment Program.

Figure 1. DWQ Subbasins

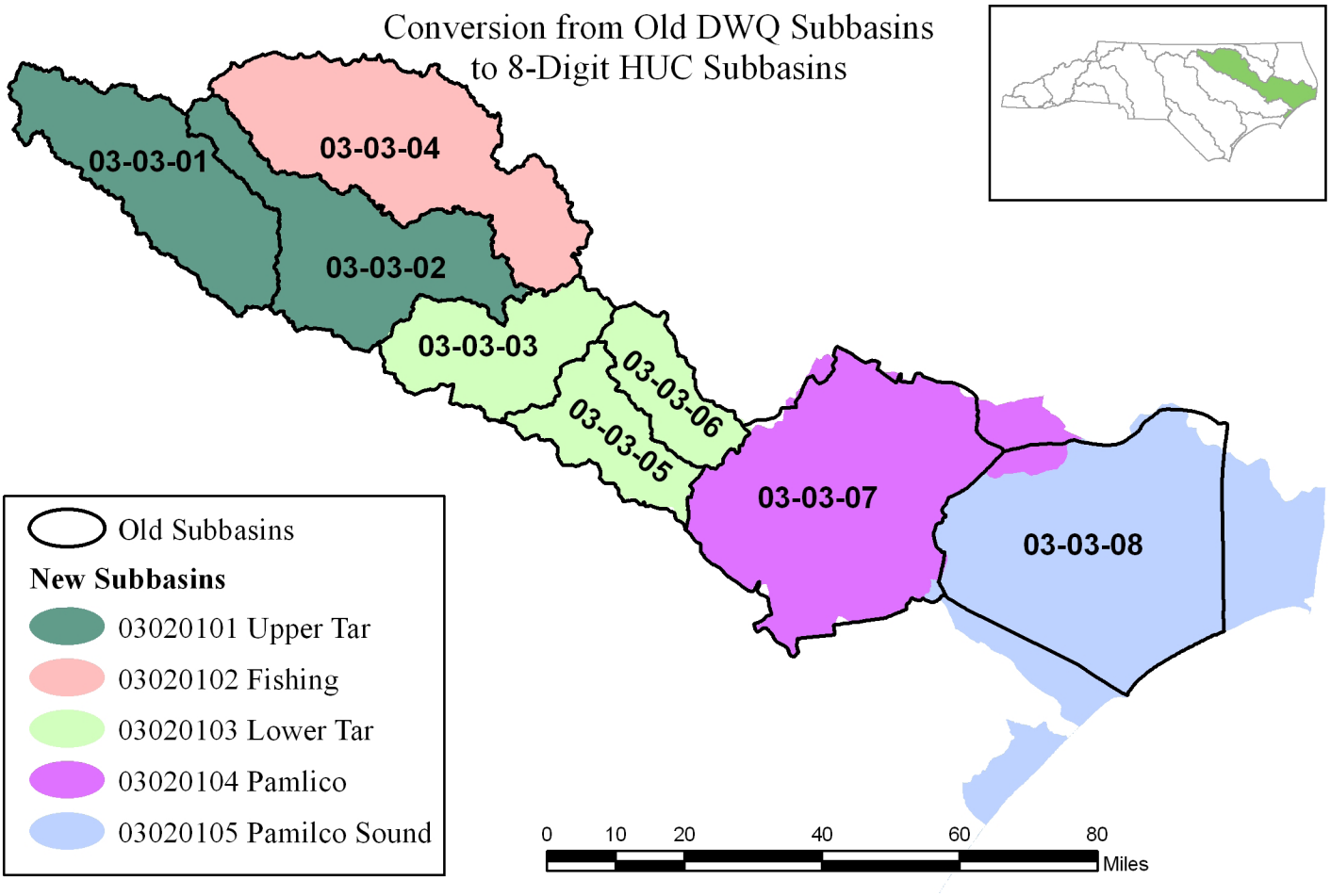
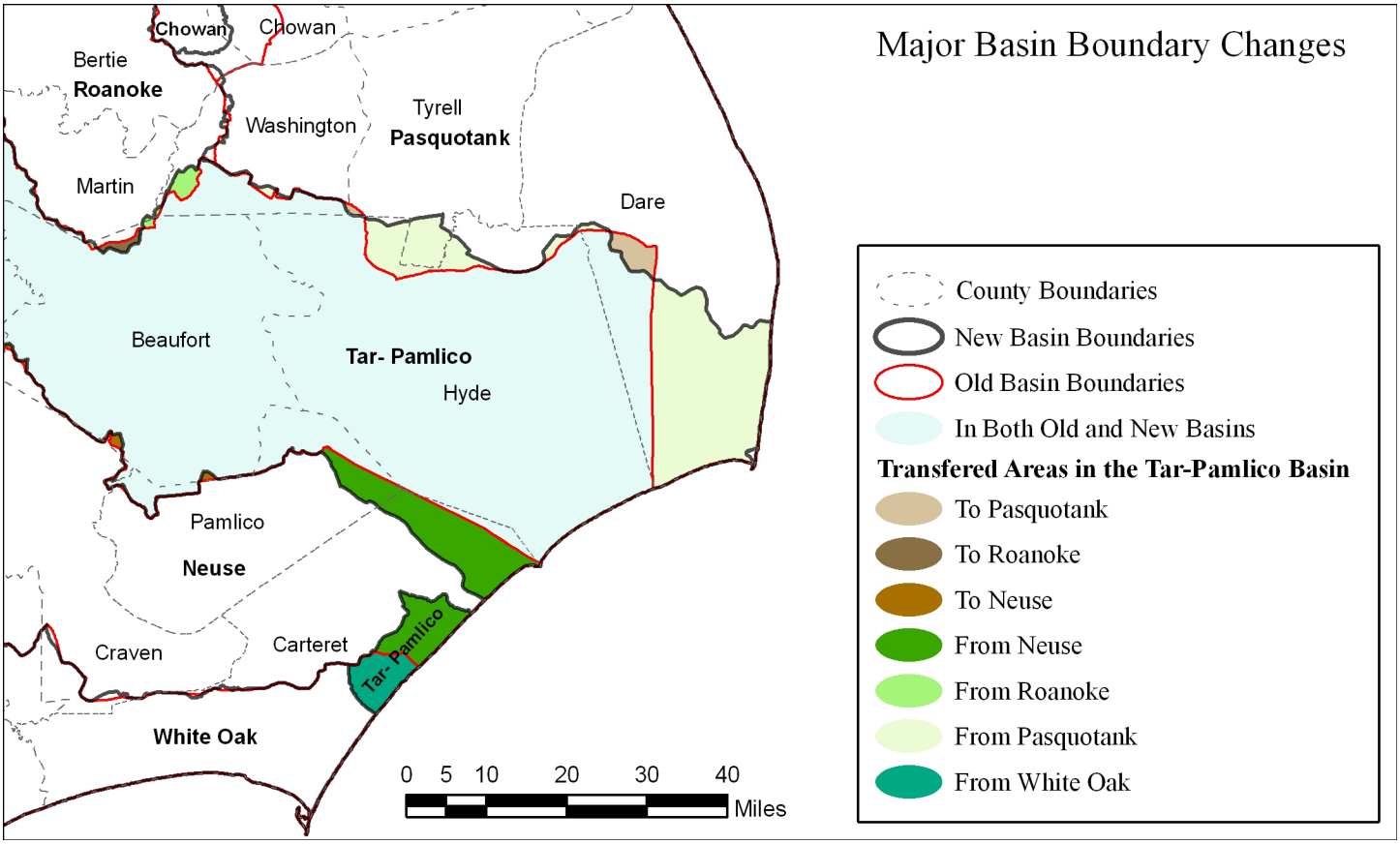


Figure 2. Subbasin Boundary Changes Between Basins

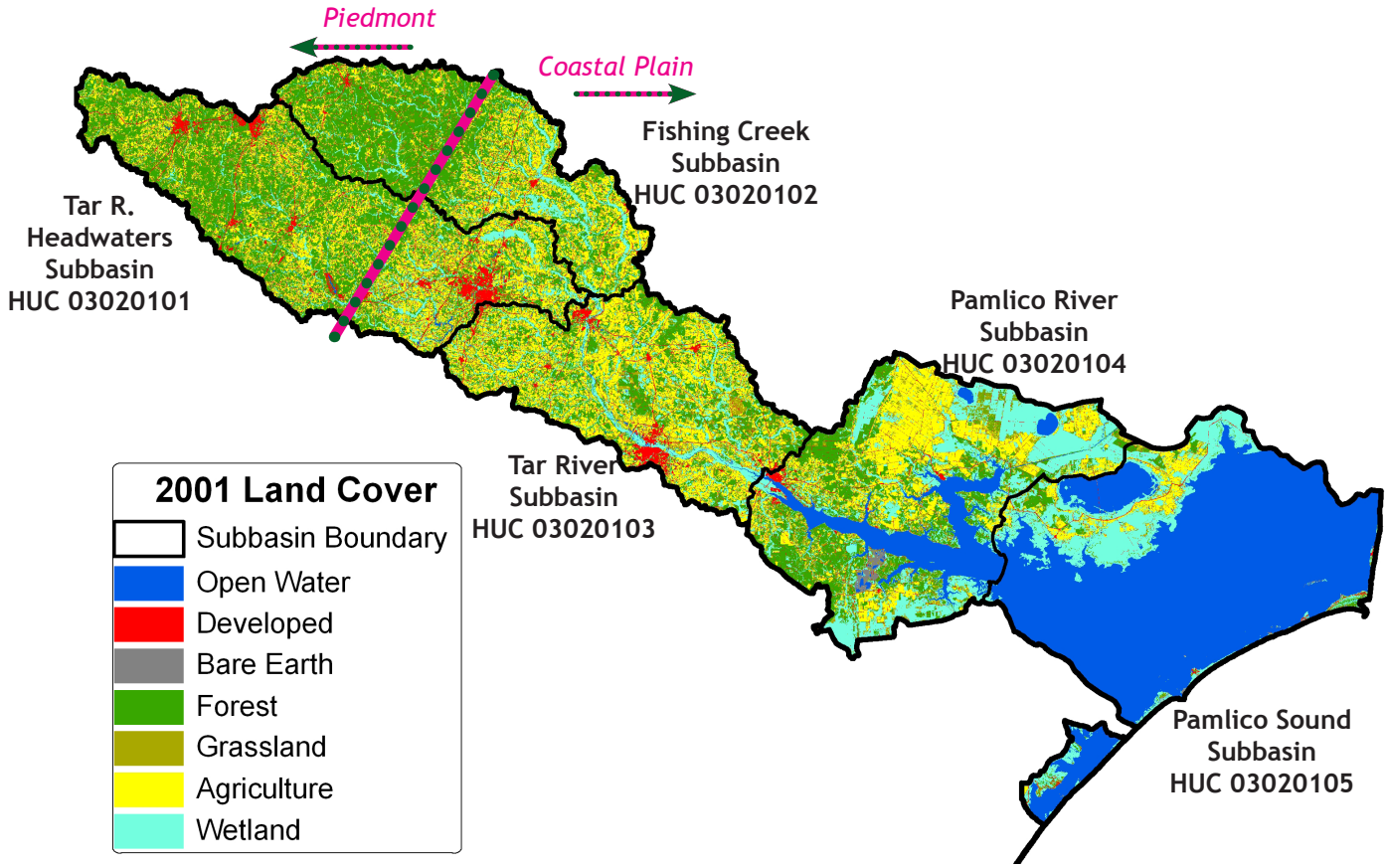


Overview

The Tar-Pamlico River Basin is the fourth largest river basin in North Carolina and is one of only four river basins whose boundaries are located entirely within the state. The Tar River originates in north central North Carolina in Person, Granville and Vance counties and flows southeasterly until it reaches tidal waters near Washington and becomes the Pamlico River and empties into the Pamlico Sound. The entire basin is classified as Nutrient Sensitive Waters (NSW).

The Tar-Pamlico River Basin's estimated developed area is ~7%, agriculture ~28%, and wetlands and forested areas ~55% (remaining 10% is open water) based on 2001 National Land Cover Data (Figure 3). This basin is rural when compared to the Neuse River Basin, which is similar in size and hydrology. Development and population growth center around Greenville, Rocky Mount and smaller municipalities within commuting distance to Raleigh, while other municipalities have experienced negative growth. A better account of population growth will be available upon completion of the 2010 census

Figure 3. Tar-Pamlico River Basin Subbasin Land Cover (NLCD 2001)



Hydrologic Features

There are an estimated 2,520 miles of mapped freshwater streams, and many more miles of small unmapped ephemeral, intermittent and perennial streams located within the basin. The basin includes an estimated 3,977 acres of freshwater reservoirs and lakes, ~663,540 estuarine acres, and ~17 miles of Atlantic coastline. Wetland and swamp systems are located throughout Tar-Pamlico River Basin. The basin starts in the eastern Piedmont physiographic region with about two-thirds of the basin in the Coastal Plain.

Streams in the Piedmont are typically low gradient with sluggish pools separated by riffles with occasional small rapids. Piedmont soils are highly erodible and are underlain by fractured rock formations that have limited water storage capacity. Piedmont streams tend to have low summer

flows and limited ability to assimilate oxygen-consuming wastes. There are no natural lakes in the Piedmont, but there are a few reservoirs that serve as water supplies and flood control structures. Old millponds and beaver impoundments are scattered across this region.

Streams in the Coastal Plain are slow-moving blackwater streams, low-lying swamps and productive estuarine waters. The swamp streams often stop flowing in the summer and are stained by tannic acid. These streams have limited ability to assimilate oxygen-consuming wastes. Swamp streams often have naturally low dissolved oxygen and pH. Coastal Plain soils are deep sands that have high groundwater storage capacity. Natural lakes include the remnants of bay lakes in the lower Coastal Plain. Also, because of low flow conditions, wind and tides saltwater intrusion in the Tar River has been documented up to Greenville.

The Pamlico Sound estuarine system is somewhat protected from oceanic influences because of the Outer Banks. The estuary dynamics, including tidal, climatic, retention time and nutrient loading conditions, enable eutrophication processes within the Pamlico River. Due to excessive levels of nutrients resulting in massive algal blooms and fish kills the entire Tar-Pamlico River Basin was designated as Nutrient Sensitive Water (NSW) in 1989.This designation resulted in the development and implementation of a nutrient management strategy to achieve a decrease in total nitrogen (TN) by 30% and no increase in total phosphorus (TP) loads compared to 1991 conditions.

Nutrient Sensitive Water Strategy

Nutrient enrichment of the waterbodies within this basin continues to be the main water quality issue and the focus of regulatory and strategy related activities. Water quality standards have not been met in the Pamlico River Estuary even though implementation of the NSW strategy by WWTP dischargers, municipal stormwater programs, and agriculture have occurred. A review of the NSW strategy including implementation activities, progress towards meeting the loading goals and additional actions are discussed in Chapter 6.

A statistical analysis was performed by DWQ and the concentrations of total nitrogen (TN) and total phosphorus (TP) had no trends in the Tar River. Further trend analyses of the nitrogen series components indicated a decrease in nitrite+nitrate (NO_2+NO_3), a decrease in ammonia (NH_3) and an increase in Total Kjeldahl Nitrogen (TKN) concentrations. The data suggests the increasing trend in TKN cancels out the decreasing trend in NO_2+NO_3, resulting in no trend for TN. The increase in TKN is likely caused by an increase in organic nitrogen as NH_3 concentrations have decreased. Analyses of estimated daily loads resulted in no trend for TP, TN and TKN, while decreasing trends for NH_3, NO_2+NO_3 and flow were calculated. Specific details about this trend analyses are found in Chapter 6.

The trend analyses point toward a rise in organic nitrogen. This warrants identifying sources and reducing inputs of organic nitrogen throughout the basin. It is likely that there are other nutrient sources besides those regulated under the NSW strategy that are contributing. Some nonpoint sources may have not been accounted for or are exceeding the original source contributions. Potential sources that need more research in regards to their potential contributions include groundwater and atmospheric deposition (Action Plan # 2 & Research Needs).

It is recognized that basin factors (e.g., groundwater, atmospheric deposition, nutrient recycling) may contribute to the results seen in these analyses and conditions in the estuary. The effectiveness and progress of strategy implementation may be better gauged by expanding the analysis outside of the Total Maximum Daily Load (TMDL) compliance point (Washington) and focusing on specific watersheds. Further analysis of existing data and additional years of data collection will provide greater certainty as to the effect of the strategy on the estuary (Action Plan # 3).

Point Source

The Tar Pamlico Basin Association (TPBA) currently has 15 members representing 20 discharge facilities accounting for 98% of the known effluent flow to the basin. The TPBA began water quality monitoring at 36 stations on a monthly basis in March 2007. The TPBA members do not have individual permit nutrient limits but instead function under a collective nutrient cap to meet their reduction requirements of the NSW strategy. EPA is requiring individual nutrient limits by 2014, which will require DWQ and TPBA to conduct additional technical studies (e.g., determine delivery rates for each discharger, develop individual TN and TP allocations) (Action Plan # 4). To date, the TPBA has consistently been under their nutrient cap limits. The remaining 2% of effluent flow is from 18 small facilities that have permits limits based on their size and capability.

Non-point Source

Agriculture

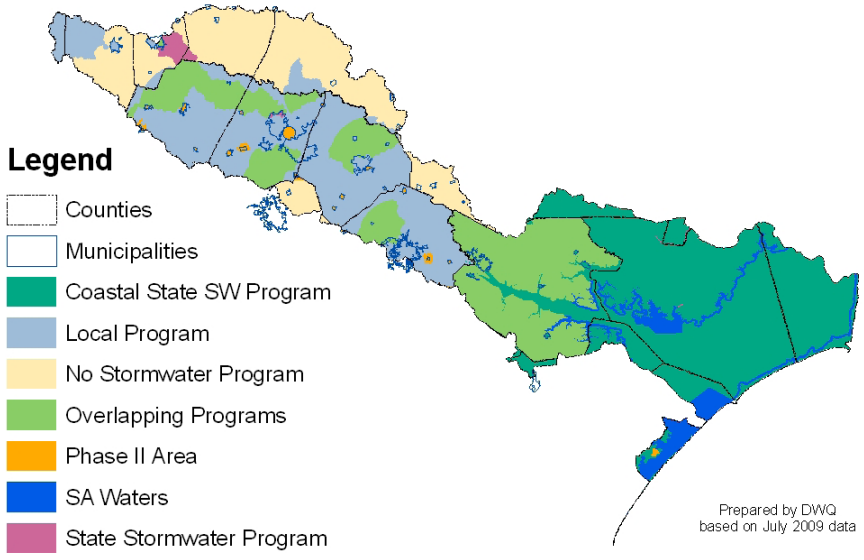
The progress achieved by the agriculture sector in implementing the Tar-Pamlico Agriculture Nutrient Control Strategy Rule is well documented in the Annual Agricultural Progress Reports submitted to the EMC every fall since 2003. As of 2002, the agriculture sector exceeded its collective 30% nutrient reduction goal and in 2008 reported a 50% reduction in estimated nitrogen loss to the basin through a combination of BMP implementation, crop shifts, fertilization rate reductions, and loss of overall cropland acres. During implementation, additional research regarding BMP effectiveness has improved nutrient accounting. Further improvement to the accounting process and identification of additional agricultural sources that may be contributing nutrients that are not accounted for under the current strategy (e.g., more detailed yearly reports capturing the addition, loss or transfer of nutrients, pasture BMPs, tile drainage, ammonia emissions from concentrated animal feeding operations, aquaculture facilities, and the expanding poultry industry) are necessary to continue progress in meeting the overall Tar-Pamlico nutrient loading reductions. (Action Plan # 2,5,6 & 7).

Stormwater

A better understanding of stormwater contributions could assist in refining the NSW implementation strategy. There is a need to target existing development retrofit opportunities and develop a comprehensive stormwater program that captures new development and construction activities in areas not currently subject to regulation (Action Plan # 8). Approximately 55% of the basin is covered by either Phase II or the NSW stormwater rules, 1% is covered by solely ORW or Water Supply Watershed stormwater regulations, 19% by Coastal stormwater rules and 23% of the basin has no stormwater program (Figure 4). Nutrient stormwater controls are in place for only 54% of the basin.

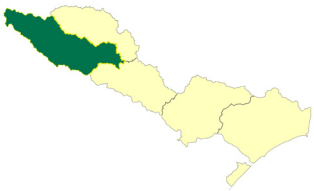
The Tar-Pamlico stormwater rule establishes a nutrient export goal of 4.0 lbs/ac/yr of TN and 0.4 lbs/ac/yr of TP for new residential and commercial development projects within the planning and zoning jurisdictions of six of the largest and fastest-growing local municipalities and five counties within the basin. The municipalities are: Greenville, Henderson, Oxford, Rocky Mount, Tarboro, and Washington. The counties are: Beaufort, Edgecombe, Franklin, Nash, and Pitt. Each of these local governments has successfully implemented its

Figure 4. Stormwater Program Coverage



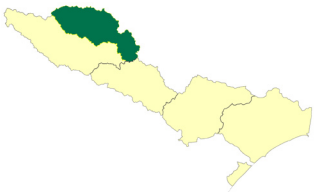
stormwater program since 2006 and continues to achieve nutrient export targets through a combination of onsite BMPs and off site nutrient offsets.

Subbasin Water Quality Summaries and Significant Issues



Upper Tar River Subbasin 03020101

Modest water quality improvements have been made in this subbasin. Water Quality is generally good with fecal coliform bacteria and turbidity as noted stressors. The new 2010 impairments are most likely associated with drought conditions. Nutrient data indicates organic nitrogen has increased over the last several years in this subbasin. Additional efforts are needed to reduce total nitrogen and total phosphorous contributions from this subbasin. Collecting nutrient data from ambient stations representing all watersheds should be a priority to help be able to identify nutrient source watersheds. This subbasin has endangered aquatic mussel species requiring protection (Action Plan # 9). The lower end of Fishing Creek remains the waterbody with the most stressors (e.g, turbidity, copper, zinc, fecal coliform bacteria) in this subbasin. However, substantial restoration and protection activities have been implemented on Fishing Creek and should result in improved conditions in the future.



Fishing Creek Subbasin 03020102

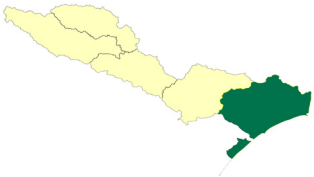
Overall water quality in this rural subbasin is excellent. This subbasin is a priority for aquatic threatened and endangered species protection. It is recommended that biological samples be taken during normal flow conditions to evaluate potential ORW reclassification (Action Plan # 9). The main stressors to water quality include fecal coliform bacteria and incidences of low dissolved oxygen.

Lower Tar River Subbasin 03020103

This subbasin funnels water from the Tar River tributaries before entering the Pamlico Estuary and therefore collectively delivers higher concentrations of stressors (e.g., nutrients) directly to the estuary. Nutrient concentrations from ambient stations within this subbasin indicate TP remaining steady and below the 1991 concentrations, while TN concentrations have increased slightly. Water quality on an individual stream basis has improved; specifically the removal of Chicod Creek from the Impaired waters list is a success due to TMDL and agricultural BMPs implementation. Non-point source and development pressures continue to be a concern in the entire subbasin. Threatened and sensitive aquatic species have been found in the main stem of the Tar River in this subbasin.

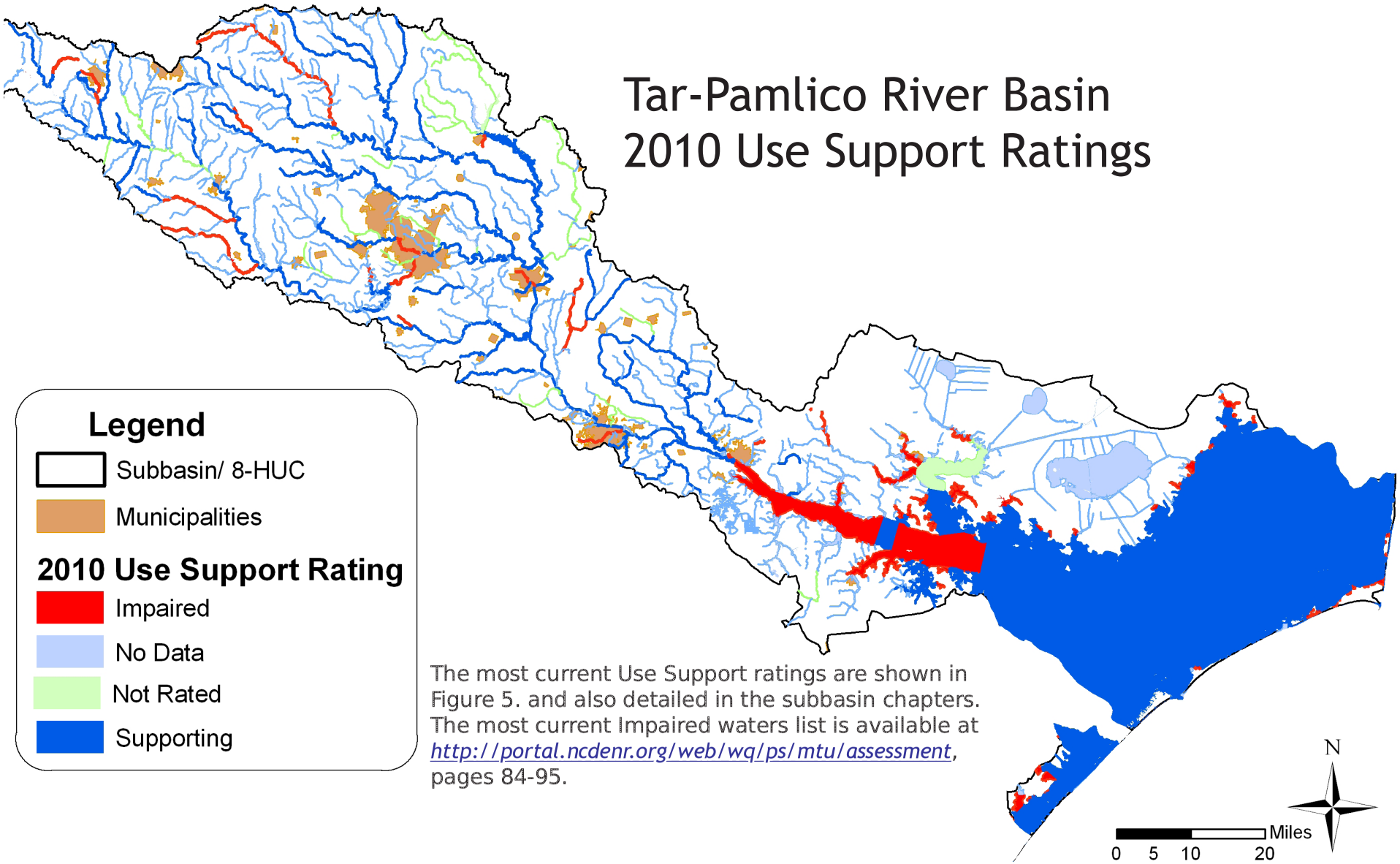
Pamlico River Subbasin 03020104

Water quality in this subbasin is primarily impacted by nutrient loading and resulting chlorophyll *a* impairment in the estuary. The current chlorophyll *a* impairment extends from just below Washington in the Pamlico River to Saint Claire Creek, similar to the 1994 conditions. DWQ also recently began assessing for metal toxicity, resulting in several new impairments because of copper levels.



Pamlico Sound Subbasin 03020105

Water quality concerns in this subbasin are focused on shellfish harvesting and recreational uses. A majority of the Impaired water for shellfish harvesting occur in prohibited shellfish growing areas and not based on collected fecal coliform data. Swanquarter Bay is Impaired for recreational uses due to enterococcus data.



The most current Use Support ratings are shown in Figure 5. and also detailed in the subbasin chapters. The most current Impaired waters list is available at *http://portal.ncdenr.org/web/wq/ps/mtu/assessment*, pages 84-95.

Action Plan

Full implementation of the nutrient reduction strategy has been a measured process and was reached in 2006. Point sources continually have met their targeted nutrient loading caps from the early 1990's. The agriculture community has reduced their estimated nitrogen loss from cropland and pastureland by an average 45%, since 2002. Almost 2,000 fertilizer applicators have received nutrient management training and the six local governments covered under the stepped Stormwater Rule have all adopted and implemented local stormwater programs to limit nitrogen and phosphorus inputs from stormwater runoff resulting from new development. Despite this successful implementation, water quality standards in the Pamlico River Estuary are not being met.

The Pamlico Estuary is a very complex and dynamic system. Climatic variability plays an important role in the mobilization, processing, and delivery of nutrients to the Estuary. Estuarine water quality response is affected by climatic events causing variability that obscures clear trends in nutrient loading and the estuary's response to these loads, despite reductions to point and nonpoint source loads. Due to the decades of chronic overloading, the time lag required for nonpoint source input reductions to be fully expressed, and the likelihood of nutrient cycling within the estuary, it may be some time before current reductions in nutrient loading will reflect improved water quality.

DWQ staff have begun an evaluation of the limitations of the current strategies and identified opportunities for developing a better understanding of the nutrient dynamics for both the Tar-Pamlico and Neuse River systems. While further analysis of existing data and additional data collection will provide greater certainty as to the effect of the strategies on the estuaries, existing strategy's limitations and the other basin factors that contribute to estuarine conditions must be recognized. Listed below are the overarching recommendations and research needs identified in this plan which will be pursued during this next basin plan cycle. It is important to note that at this time, DWQ is not reassessing the TMDL or suggesting that the current NSW rules be modified.

Action Plan

Recommendations & Goals	Actions Needed	Responsible Groups	Date
1) **Water Resources Plan** Continue to work with Division of Water Resources on the development of the Tar-Pamlico River Basin Hydrologic Model and Water Resources Plan.	Participate in planning meetings and identify coordination opportunities for water quality and quantity planning	Division Water Resources and DWQ-Basinwide Planning Unit	2014
2) **Atmospheric Deposition** Assess atmospheric nitrogen contributions to the watershed and develop recommendations on better characterization of atmospheric nitrogen deposition and emission source regulatory considerations. Specifically address better characterization of the contribution of ammonia emissions from Concentrated Animal Feeding Operations (CAFO).	Workgroup with DWQ & DAQ	DWQ-Nonpoint Source Unit & Basinwide Planning Unit & DAQ	2014
3) **Watershed Monitoring and Trends** Identify additional monitoring locations and parameter needs. Conduct additional trend and loading analyses upstream of the Pamlico River Estuary focusing on smaller watersheds. Better characterize basin nutrient sources and relative contributions.	Agreement on monitoring station needs and available resources needed to extend nutrient monitoring	DWQ- Basinwide Planning, TMDL & Modeling Unit, Environmental Sciences Section, Coalition Coordinators & Tar Pamlico Basin Association	2014

Action Plan

Recommendations & Goals	Actions Needed	Responsible Groups	Date
4) **Fate and Transport Model/Analysis** Develop a fate and transport model or other analyses to determine individual NPDES nutrient limits.	Identify appropriate nutrient data needs and flow data requirements	DWQ- NPDES Wastewater Unit, Non Point Source Unit, TMDL & Modeling Unit, Coalition Coordinators & Tar Pamlico Basin Association	2014
5) **Agriculture Nutrient BMP Tracking** More detailed reporting on tracking changes of BMPs and additional BMPs to offset new or increased sources of nutrients from agricultural operations.	Reconvene with Division of Soil & Water Conservation (DSWC) and Basin Oversight Committee (BOC) to explore plausibility of providing more detailed reports.	DWQ-Nonpoint Source Unit & Basinwide Planning Unit & Division of Soil & Water Conservation	2014
6) **Poultry Potential Nutrient Source** Continue to evaluate the impact of the Rose Acres egg-laying operation on the Pocosin Lakes National Wildlife Refuge and the surrounding aquatic ecosystem. Develop recommendations on how to reduce the impacts from this and other large poultry operations.	Summarize research findings to support future policy options and permit needs.	USFW, DSWC, BOC DWQ-Basinwide Planning Unit, & Animal Feeding Operations,	2012
7) **Aquaculture Facilities** Continue follow-up actions on hybrid striped bass farms and other fish farms in the lower Basin to improve their effluent quality and better quantify their impact to the Estuary. If warranted, include their nutrient contributions in the Basin's accounting of progress towards meeting nutrient reduction goals.	Identify fish farms with potential impacts to surface waters.	DWQ-WaRO, DSWC	2014
8) **Stormwater** •Assess stormwater runoff impact in areas within the basin that are currently not under any stormwater program. •Evaluate the magnitude of nitrogen loading in runoff from existing developed areas and assess the need to further address this source under the strategy. •Review stormwater and sediment and erosion control compliance activities; assess need for additional staff for inspection and enforcement needs.	Establish a DWQ working group to evaluate programs and nutrient control issues.	DWQ- Nonpoint Source Unit & Stormwater Permitting Unit	2014
9) **Threatened and Endangered Species** Continue development of threatened and endangered species management plans.	Review EPA ammonia toxicity standards, DWQ regulatory programs and plausibility of development of statewide mussel species management plan and/or rules.	DWQ- Classifications and Standards & Basinwide Planning Unit	2014

Additional Research Needs
• Evaluate impacts to riparian buffers
• Explore additional nutrient offset options to be included in the NSW Point/Nonpoint Phase IV Agreement.
• Implement monitoring to better characterize the nature, magnitude and trends in atmospheric and groundwater derived nutrient contributions to the Tar-Pamlico River Estuary.
• Assess nutrient residence time in the estuary.
• Characterize the location, geographic extent and functionality of tile drains under agricultural fields.
• Quantify the potential magnitude of nutrient loading from spray fields, directly from animal housing and holding, and waste storage facilities on CAFOs.

Additional Research Needs cont.
• Characterize the geographic extent and quantify the potential magnitude of nutrient loading from dry litter poultry facilities, animal housing and waste storage.
• Characterize the potential for groundwater contamination and transport of nutrients from biosolids and wastewater land application fields to the surface waters of the Tar-Pamlico Basin.
• Quantify the nitrogen contributions from conventional on-site wastewater treatment systems to surface waters of the Tar-Pamlico Basin.
• Better quantification of BMP effectiveness (agricultural and stormwater BMPs); improve accounting tools.
• Characterize nutrient loading from various pasture management practices which leads to a better understanding of pasture's nutrient contributions and the value of different management options.
• Quantify the magnitude in which pharmaceuticals are impacting aquatic life. Pharmaceuticals and organic waste compounds were found in the Tar River as reported in a 2009 USGS study[1]. .
• Identify the local Drainage Districts and understand their current role in controlling water flow and drainage issues. Work with the Districts to develop recommendations on how to protect water quality in these areas.

Prepared By:

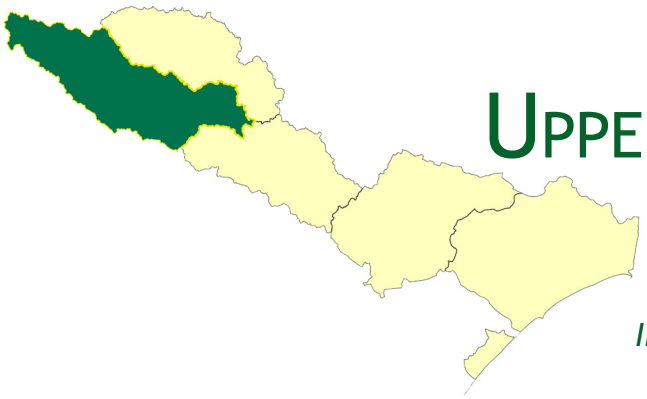
NC Department of Environment & Natural Resources
Division of Water Quality, Planning Section
1617 Mail Service Center
Raleigh, NC 27699-1617

For additional information please contact:
Heather Patt - Basin Planner
(919) 807-6448
heather.patt@ncdenr.gov
http://portal.ncdenr.org/web/wq/ps/bpu

This document was approved and endorsed by the NC Environmental Management Commission on January 13, 2011 to be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities in the Tar-Pamlico River Basin.

Public input and contributing information was provided by:
- NC DENR agencies- Division of Water Resources, Division of Soil and Water Conservation, Natural Heritage Program, Ecosystem Enhancement Program, Division of Environmental Health, & Division of Forest Resources.
- Franklin County, Greenville, Pamlico-Tar River Foundation, PCS Phosphate, Pitt County, Rocky Mount, Tar-Pamlico Basin Association, Tar River Land Conservancy, Upper Coastal Plain COG, US Fish & Wildlife Service, Warren County, & Warrenton.

[1] Ferrell, G.M., 2009, Occurrence of selected pharmaceutical and organic wastewater compounds in effluent and water samples from municipal wastewater and drinking-water treatment facilities in the Tar and Cape Fear River basins, North Carolina, 2003-2005: U.S. Geological Survey Open-File Report 2009-1046: 45 http://pubs.water.usgs.gov/ofr2009-1046.



Upper Tar River Subbasin

Subbasin/HUC 03020101

Includes the Tar River and Tributaries

Water Quality Overview:

Modest water quality improvements have been made in this subbasin. Water quality is generally good with a few stressors (e.g., fecal coliform bacteria, turbidity) indicating additional protection is needed. Drought conditions in 2007-2008 resulted in low dissolved oxygen levels in several streams. Nutrient data indicates organic nitrogen has increased over the last several years in this subbasin. Additional efforts are needed to reduce total nitrogen and total phosphorous contributions from this subbasin. Collecting nutrient data from ambient stations representing all watersheds should be a priority. This subbasin has endangered aquatic mussel species requiring additional protection. The lower end of Fishing Creek remains the waterbody with the most stressors (turbidity, copper, zinc, fecal coliform bacteria) in this subbasin. However, substantial restoration and protection activities have been implemented in Fishing Creek watershed and should result in improved conditions in the future.

Watershed at a Glance

Counties: Person, Granville, Vance, Warren, Franklin, Nash, Edgecombe

Municipalities: Oxford, Kittrell, Henderson, Franklinton, Youngsville, Louisburg, Centerville, Bunn, Castalia, Spring Hope, Momeyer, Nashville, Red Oak, Dortches, Rocky Mount, Whitakers

Permitted Facilities:

NPDES WWTP:.....21
Major:.....4
Minor:.....17
NonDischarge:.....17
Stormwater:
General:.....55
Individual:.....9
Animal Operations:.....43

2000 Population: 181,036

Area: 1,305 sq mi.

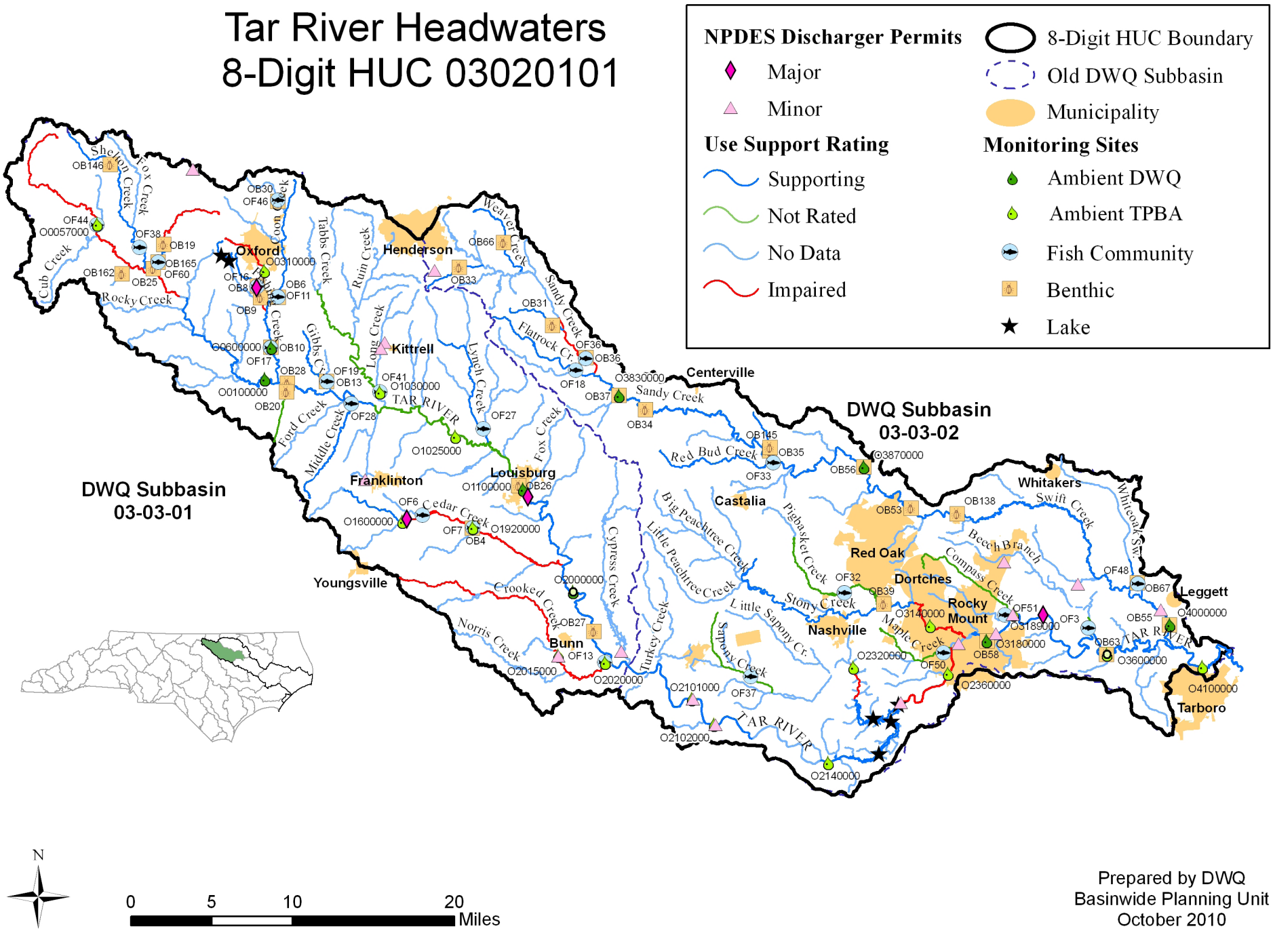
Impervious Surface Estimate: 21 sq mi.

General Description

This subbasin, hydrologic unit code (HUC) 03020101, contains the Tar River headwaters and its tributaries down to Tarboro, covering ~1,305 square miles (Figure 1-1). It was previously delineated as DWQ subbasins 03-03-01 and 03-03-02.

The headwaters of the Tar River originate in eastern Person County, with the majority of the upper portion of this subbasin in Granville, Nash, and Franklin counties. Most of the land use in the upper subbasin consists of a mixture of active and inactive agriculture, rural residences, and remnant patches of forest. The subbasin is represented by several ecoregions, including Northern Outer Piedmont, small portions of the Triassic Basin and Carolina Slate Belt, Rolling Coastal Plain, and small patches of Southeastern Floodplains and Low Terraces. Streams in or near Carolina Slate Belt ecoregion are vulnerable to drying during periods of drought because of poor groundwater recharge. With the exception of the Triassic Basin and Carolina Slate Belt, the infiltration capacity of soils in the less disturbed areas of this subbasin are high and stream flow is maintained during drier periods by base flows via groundwater inputs. However, in more developed areas where impervious surfaces dominate the landscape, overland flow during

FIGURE 1-1. HUC 03020101 MAP



Prepared by DWQ
Basinwide Planning Unit
October 2010

heavy precipitation events can lead to flashier stream flows. Land use in the lower portion of this subbasin is divided relatively evenly between agriculture, undisturbed forest, rural residences, and urbanized areas.

This subbasin provides habitat for several threatened and endangered aquatic species (e.g., tar spinymussel, dwarf wedgemussel). Shelton Creek, Fox Creek, North Fork Tar River, and Cub Creek provide good habitat conditions, supporting a stable dwarf wedgemussel population considered to be some of the best in North Carolina. Swift Creek supports populations of the tar spinymussel. However, increased urbanization and other disturbances could increase pollutant delivery to these areas and potentially threaten these species. Therefore, protection of the upper Tar River and Swift Creek watersheds are crucial for the continuation of the species.

There are several major and minor NPDES dischargers to the Tar River in this subbasin. Major dischargers include the Oxford WWTP (3.5 million gallons/day (MGD)) which discharges into Fishing Creek, the Franklin County WWTP (3 MGD) discharging to Cedar Creek, and Louisburg WWTP (1.37 MGD) and the Tar River Regional WWTP (21 MGD) which discharge to the Tar River.

Current Status and Significant Issues

Use Support Assessment Summary

All surface waters in the state are assigned a classification reflecting the best-intended use of that water. Chemical, physical, and biological parameters are regularly assessed by DWQ to determine how well waterbodies are meeting their best-intended use. These data are used to develop use support ratings every two years and reported to EPA. The collected list of all monitored waterbodies and their water quality rating is called the Integrated Report (IR). Water not meeting surface water standards are rated as Impaired and reported on the 303(d) list. Water quality evaluation levels and how a waterbody earns a rating of Supporting or Impaired is explained in detail in the IR methodology. The 2010 IR is based on data collected between 2004 and 2008; the IR and methodology are available on the DWQ Modeling/TMDL website: http://portal.ncdenr.org/web/wq/ps/mtu/assessment. The most current use support ratings for this subbasin are found in Appendix 1A.

In this subbasin, use support ratings were assigned for aquatic life, recreation, fish consumption, and water supply categories. Waters are either Supporting, Impaired, Not Rated, or No Data in the aquatic life and recreation categories on a monitored or evaluated basis. All waters are Impaired in the fish consumption category on an evaluated basis, based on statewide fish consumption advice issued by the Department of Health and Human Services. All waters are Supporting in the water supply category. This evaluation is based reports from Division of Environmental Health regional water treatment plant consultants.

Primary Classifications found in HUC 03020101:

Freshwater	Miles	Freshwater	Acres*
Total	995	Total	821

Supplemental Classifications:

B;NSW	35	WS-II;HQW,NSW,CA	99
B;NSW+:	36	WS-IV,B;NSW,CA	619
C;NSW	497	WS-IV;NSW,CA	103
C;NSW+:	92		
C;ORW,NSW	14		
WS-II;HQW,NSW	4		
WS-II;HQW,NSW,CA	1		
WS-IV;B,NSW,CA	3		
WS-IV;NSW	241		
WS-IV;NSW,CA	18		
WS-V;NSW	54		

* Reservoirs and impoundments

Classification descriptions are found at:
http://portal.ncdenr.org/web/wq/ps/csu/classifications

General Biological Health

Biological samples were collected during the spring and summer months of 2007 as part of the basinwide sampling five year cycle, with the exception of a few special studies. Twelve benthic macroinvertebrate sites and 15 fish community sites were sampled as part of the basinwide sampling cycle. Tables 1-1 and 1-2 provide summaries of site results and a description of the stream location corresponding to Figure 1-1. Site specific information is available in Appendix 1B and the entire Biological Assessment Report can be found at: http://www.esb.enr.state.nc.us/documents/2008TARbasinwiderptfinal.pdf.

Benthos Community Sampling Summary

Sites that retained the same rating as previous 2002 samples include the Tar River-OB58 (Good-Fair), Sandy Creek-OB35 (Good), Swift Creek-OB55 (Good), White Oak Swamp-OB67 (Moderate Stress), Fishing Creek-OB10 (Good-Fair), and Tar River-OB27 (Good). Bioclassifications from two sites increased from Good-Fair to Good (Cedar Creek-OB4 and Tar River-OB63). The Tar River-OB25 received a Good-Fair bioclassification, the same as it did the last time it was sampled in 1997. The bioclassification of Swift Creek-OB56 decreased from Excellent in 2003 to Good in 2007. The North Fork Tar River-OB19 received a 2007 bioclassification of Fair, this decreased from the last 1997 Good-Fair sample. Due this decrease, 8.8 miles of North Fork Tar River (Assessment Unit # 28-5) is listed on the 2010 303(d) list of Impaired waters for not meeting benthos community narrative standards for biological integrity.

Table 1-1. Benthos Biological Sample Results in HUC 03020101

Station ID*	Waterbody	Assessment Unit #	Description	County	Site Location	Date	Sample Result
Benthos Community Sites							
OB33	Martin Cr	28-78-1-3	From source to Sandy Creek	Vance	SR 1519	4/23/03	Good-Fair
OB66	Weaver Cr	28-78-1-7	From source to Southerlands Pond	Vance	SR 1533	4/23/03	Good-Fair
OB25	Tar R	28-(1)	From source to a point 0.6 mile upstream of Oxford Water Supply	Granville	SR 1150	7/3/07	Good-Fair
OB28	Tar R	28-(5.7)	From Oxford Water Supply Intake to 0.6 mile upstream of Taylors Creek	Granville	SR 1622	7/22/02	Good
OB156	Shelton Cr	28-4	From source to Tar River	Granville	SR 1309	4/20/06	Not Impaired
OB19	N Fk Tar R	28-5a	From source to 0.2 miles south of US 158	Granville	US 158	6/25/07	Fair
OB165	N Fk Tar R	28-5b	From 0.2 miles south of US 158 to the Tar River	Granville	SR 1151	5/22/07	Good
OB13	Gibbs Cr	28-13	From source to Tar River	Granville	SR 1620	3/24/06	Good
OB20	Sand Cr	28-12	From source to Tar River	Granville	SR 1623	3/22/06	Not Rated
OB6	Coon Cr	28-11-5	From source to Fishing Creek	Granville	SR 1609	3/22/06	Good
OB30	UT Coon Cr	28-11-5	From source to Coon Cr	Granville	SR 1515	3/22/06	Excellent
OB162	UT Tar R	28-(1)ut37	From source to Tar River	Granville	SR 1126	4/20/06	Not Rated
Special Study	Hatcher's Run	28-11-3-(2)	From dam at Devin Lake to Fishing Creek	Granville	SR 15	8/25/06	Fair
OB8	Fishing Cr	28-11b	From SR 1649 to #1 outfall	Granville	SR 1607	3/22/06	Not Impaired
OB9	Fishing Cr	28-11c & 28-11d	From #1 outfall to SR 1608 to Coon Creek	Granville	SR 1608	3/2/06	Fair
OB10	Fishing Cr	28-11e	From Coon Creek to Tar River	Granville	SR 1643	6/25/07	Good-Fair
OB26	Tar R	28-(24.7)a	In Louisburg	Franklin	SR 1229	7/22/02	Good-Fair

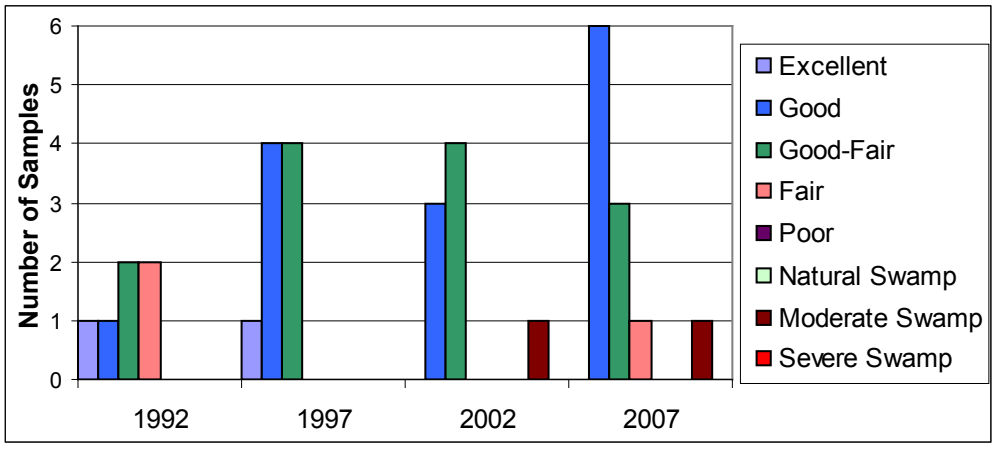
Station ID*	Waterbody	Assessment Unit #	Description	County	Site Location	Date	Sample Result
OB27	Tar R	28-(24.7)a	From Louisburg Water Supply Intake to Cypress Creek	Franklin	SR 1609	6/27/07	Good
OB4	Cedar Cr	28-29-(2)b	From Franklinton Branch to Tar R.	Franklin	SR 1109	6/26/07	Good
OB31	Buffalo Cr	28-78-1-10	From source to Sandy Creek	Franklin	US 401	4/21/03	Not Impaired
OB37	Sandy Cr	28-78-1-(8)b	From Flat Rock Creek to NC 561	Franklin	SR 1436	6/27/07	Good-Fair
OB34	Sandy Cr	28-78-1-(8)b2	From N.C. Hwy. 561 to Nash Co. 1004	Franklin	NC 561	4/24/03	Excellent
OB36	Sandy Cr	28-78-1-(8)b1	From NC 401 to Flat Rock Cr	Franklin	SR 1412	4/21/03	Fair
OB145	Shelly Br	28-78-1-16	From source to Sandy Creek	Nash	SR 1180	7/18/07	Not Impaired
OB35	Sandy Cr	28-78-1-(14)	From N.C. Hwy. 561 to Nash Co. 1004	Nash	SR 1405	6/26/07	Good
OB56	Swift Cr	28-78-(0.5)	From source to Nash Co. SR 1003	Nash	SR 1310	6/26/07	Good
OB53	Swift Cr	28-78-(0.5)	From source to Nash Co. SR 1003	Nash	SR 1003	6/25/04	Excellent
OB138	Swift Cr	28-78-(2.5)	From Nash SR 1003 to 1.4 miles upstream of Edgecombe SR 1409	Nash	I-95	6/25/04	Good
OB39	Stoney Cr	28-68a	From source to Lassiters Creek	Nash	SR 1603	7/24/02	Good-Fair
-	Stoney Cr. Boddies Millpond	28-68b	From Lassiters Cr to Tar R.	Nash	-	1992	Impaired
OB58	Tar R	28-(69)	From dam at Rocky Mount Mills to 0.9 mile downstream of Buck Swamp	Edgecombe	NC 97	6/27/07	Good-Fair
OB63	Tar R	28-(74)a	From a point 0.9 mile downstream of Buck Swamp to Subbasin boundary	Edgecombe	SR 1252	6/27/07	Good
OB55	Swift Cr	28-78-(6.5)	From 1.4 miles upstream of Edgecombe Co. SR 1409 to Tar R.	Edgecombe	SR 1253	6/27/07	Good
OB67	White Oak Swp	28-78-7-(2)	From 1.8 miles upstream of Edgecombe Co. SR 1428 to Swift Cr.	Edgecombe	SR 1428	2/5/07	Moderate Stress

Bioclassification of Excellent, Good, Natural, Good-Fair, Not Impaired or Moderate Stress = Supporting
Fair, Severe Stress or Poor = Impaired
* Corresponds to Station IDs on Figure 1

Biological Trends

Figure 1-2 shows the bioclassification trends for all basinwide benthos sites in this subbasin (results from special studies are not included). Several sites improved in bioclassification from the 2002 sample period, with the number of Good bioclassifications doubling. However, despite these improvements, there has been no summer Excellent bioclassifications at the long-term monitoring stations since 1997. Bioclassifications from swamp waters have remained unchanged.

Figure 1-2. HUC 03020101: Bioclassification Trends



Fish Community Sampling Summary

Eleven fish locations were sampled in 2007 (Table 1-2). Of these, two improved from Good at the previous sampling to a current bioclassification of Excellent (North Fork Tar River-OF60 and Middle Creek-OF28); six retained the same rating of Good (Tabs Creek-OF41, Lynch Creek-OF27, and Red Bud Creek-OF33) or Not Rated (Pig Basket Creek-OF32, Beech Branch-OF3, and White Oak Swamp-OF48); one dropped from Excellent to Good (Tar River-OF44); and two that had not been previously sampled were rated as Not Rated (Maple Creek-OF50 and Compass Creek-OF51).

Four other fish study locations in this subbasin were also compared using data collected in 2006 (BAU Memo F-20060728) with historic data. Cedar Creek-OF6 was rated Excellent in 2002 and 2004. Fishing Creek-OF17 improved from Good to Excellent, Coon Creek-OF11 retained the same bioclassification of Good, and Shelton Creek-OF38 decreased from Excellent to Good.

Table 1-2. Fish Community Sample Results in HUC 03020101

Station ID*	Waterbody	Assessment Unit #	Description	County	Site Location	Date	Sample Result
Fish Community Sites							
OF41	Tabbs Cr	28-17-(0.5)b	From Poplar Creek to Vance County SR 1100	Vance	SR 1100	4/10/07	Good
OF44	Tar R	28-(1)	From source to a point 0.6 mile upstream of Oxford Water Supply	Granville	US 158	4/9/07	Good
OF38	Shelton Cr	28-4	From source to Tar River	Granville	US 158	5/17/06	Good
OF60	N Fk Tar R	28-5	From source to Tar River	Granville	SR 1151	4/9/07	Excellent
OF17	Fishing Cr	28-11e	From Coon Creek to Tar River	Granville	SR 1643	5/18/06	Excellent
OF16 Special Study	Fishing Cr	28-11b	From SR 1649 to #1 outfall	Granville	SR1607	5/17/06	Good-Fair
OF11	Coon Cr	28-11-5	From source to Fishing Creek	Granville	SR 1609	5/18/06	Good
OF46 Special Study	UT Coon Cr	28-11-5ut10	From source to Coon Creek	Granville	SR 1515	5/17/06	Good
OF19 Special Study	Gibbs Cr	28-13	From source to Tar River	Granville	SR 1620	5/18/06	Excellent
OF28	Middle Cr	28-15	From source to Tar River	Franklin	SR 1203	4/9/07	Excellent

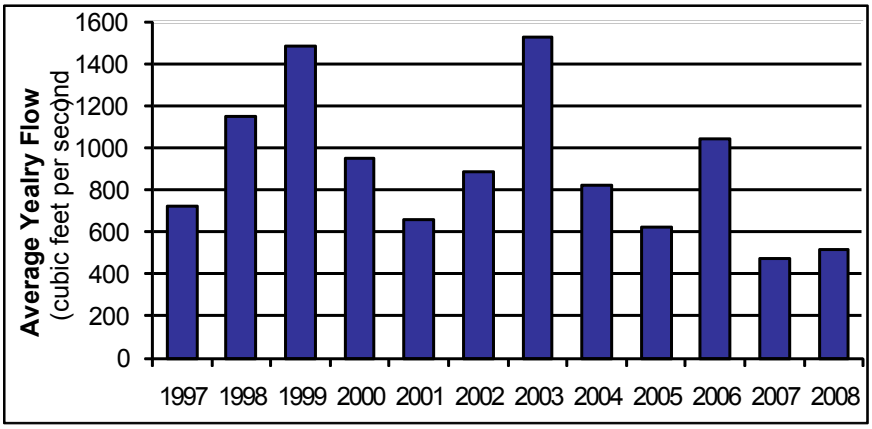
Station ID*	Waterbody	Assessment Unit #	Description	County	Site Location	Date	Sample Result
OF27	Lynch Cr	28-21-(0.7)	From Vance County SR 1547 to Tar River	Franklin	SR 1235	4/10/07	Good
OF6	Cedar Cr	28-29-(2)b	From Franklinton Branch to Tar River	Franklin	SR 1105	6/10/04	Excellent
OF7	Cedar Cr	28-29-(2)b	From Franklinton Branch to Tar River	Franklin	SR 1109	4/10/02	Excellent
OF13	Crooked Cr	28-30b	From NC 98 to Tar River	Franklin	NC 98	4/10/02	Good-Fair
OF37	Sapony Cr	28-55-(1)	From source to mouth of Gabe Branch	Nash	SR 1145	4/18/02	Not Rated
OF32	Pig Basket Cr	28-68-3-(2)	From Nash County SR 1425 to Stony Creek	Nash	SR 1433	4/10/07	Not Rated
OF50	Maple Cr	28-66	From source to Tar River	Nash	SR 1713	5/8/07	Not Rated
OF18	Flatrock Cr	28-78-1-12	From source to Sandy Creek	Franklin	SR 1412	4/9/02	Good
OF36	Sandy Cr	28-78-1-(8)b1	From NC 401to Flatrock Creek	Franklin	SR 1412	4/9/02	Good-Fair
OF33	Red Bud Cr	28-78-1-17	From source to Sandy Creek	Nash	SR 1407	4/11/07	Good
OF51	Compass Cr	28-72	From source to Tar River	Edgecombe	NC 97	5/8/07	Not Rated
OF3	Beech Br	28-75-(4)	From Falling Run to Tar River	Edgecombe	NC 97	5/8/07	Not Rated
OF48	White Oak Swp	28-78-7-(2)	From 1.8 miles upstream of Edgecombe C SR 1428 to Swift Cr.	Edgecombe	SR 1428	5/9/07	Not Rated

Not Rated = Fish community metrics and criteria have yet to be developed for Coastal Plain streams
Excellent, Good or Good-Fair = Supporting
Fair or Poor = Impaired
* Corresponds to Station ID on Figure 1-1

Stream Flow

Stream flow is monitored at US Geological Survey gaging stations. Flow, often abbreviated as "Q", is measured in terms of volume of water per unit of time, usually cubic feet per second (cfs). There are 11 gaging stations in this subbasin. Figure 1-3 provides an example of average stream flow over a 12 year period and gives an idea of which years received heavier precipitation. For more information about instream flow see DWR website: http://www.ncwater.org/About_DWR/Water_Projects_Section/Instream_Flow/welcome.html.

Figure 1-3. Stream flow at USGS 02082585 Tar River in Rocky Mount (Yearly Average based on Daily Means)



Ambient Data

Subbasinwide, monthly chemical and physical samples are taken by DWQ (9 stations) and by the Tar Pamlico Basin Association (18 stations), starting in 2007. A majority of the ambient stations are associated with waterbody locations where potential pollution could occur from known land use activities. There are also portions of the subbasin where no water quality data are collected; therefore, we cannot evaluate the condition of the water quality in those areas. Parameters collected depend on the waterbody classification, but typically include conductivity, dissolved oxygen, pH, temperature, turbidity, nutrient measurements, metals, and fecal coliform. Each classification has an associated set of standards the parameters must meet in order to be considered supporting the waterbody's designated uses. Ten sample results are required within the five year data collection window in order to evaluate the water quality parameter and

compare it to the water quality standards. Stressors are either chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use. Ambient stations are listed in Table 1-3, and their locations are found in Figure 1-1 and on watershed maps provided in Appendix 1D.

Table 1-3. Ambient Stations in HUC 03020101

Station ID	Agency	Active Since	Waterbody	AU#	Station Location	Stressors
O0057000	TPBA	3/1/07	Tar River	28-(1)	US 158 near Berea	Low DO
O0100000	NCAMBNT	6/11/68	Tar River	28-(5.7)	NC 96 near Tar River	Fecal Coliform Bacteria
O0310000	TPBA	3/1/07	Foundry Br	28-11-2	SR 1649 New Commerce Dr at Oxford	Low DO, Turbidity
O0600000	NCAMBNT	6/11/68	Fishing Cr	28-11e	SR 1643 near Clay	Turbidity, Fecal Coliform Bacteria, Copper, Zinc
O1025000	TPBA	3/1/07	Tar River	28-(15.5)	SR 1003 Sims Bridge Rd near Louisburg	Turbidity, Fecal Coliform Bacteria
O1030000	TPBA	3/1/07	Tabbs Cr	28-17-(0.5)b	SR 1100 Egypt Mountain Rd near Kittrell	Fecal Coliform Bacteria
O1100000	NCAMBNT	11/20/80	Tar River	28-(24.7)a	US 401 at Louisburg	Fecal Coliform Bacteria, Copper, Zinc
O1600000	TPBA	3/1/07	Cedar Cr	28-29-(2)a	SR 1116 Cedar Creek Rd near Franklinton	-
O1920000	TPBA	3/1/07	Cedar Cr	28-29-(2)b	SR 1109 Timberlake Rd near Louisburg	Turbidity, Fecal Coliform Bacteria
O2000000	Both	6/17/68	Tar River	28-(24.7)a	SR 1001 near Bunn	Fecal Coliform Bacteria
O2015000	TPBA	3/1/07	Crooked Cr	28-30a	SR 1719 Bunn Elementary School Rd near Bunn	Low DO
O2020000	TPBA	3/1/07	Crooked Cr	28-30b	NC 98 near Bunn	Low DO
O2101000	TPBA	3/1/07	Tar River	28-(24.7)b	SR 1145 Old Spring Hope Rd near Spring Hope	-
O2102000	TPBA	3/1/07	Tar River	28-(24.7)b	NC 581 near Stanhope	-
O2140000	TPBA	3/1/07	Tar River	28-(35.5)	SR 1981 Tar River Church Rd near Cliftonville	Fecal Coliform Bacteria
O2320000	TPBA	3/1/07	Sapony Cr Tar River	28-55-(5.5) 28-(36)b	SR 1704 Batchelor Dr near Nashville to Tar R.	Low DO
O2360000	TPBA	3/1/07	Tar River	28-(64.5)	US 301 Byp at Rocky Mount	Low DO
O3140000	TPBA	3/1/07	Stony Cr (Boddies Millpond)	28-68b	Winstead Ave near Little Easonburg	Low DO, Fecal Coliform Bacteria
O3180000	NCAMBNT	11/20/80	Tar River	28-(69)	NC 97 at Rocky Mount	Fecal Coliform Bacteria
O3189000	TPBA	3/1/07	Tar River	28-(69)	SR 1250 Springfield Rd at Rocky Mount	Fecal Coliform Bacteria
O3600000	Both	7/5/68	Tar River	28-(74)a	SR 1252 near Hartsease	Fecal Coliform Bacteria
O3830000	NCAMBNT	4/9/75	Sandy Cr	28-78-1-(8) b2	SR 1432 near Gupton	-
O3870000	NCAMBNT	7/1/02	Swift Cr	28-78-(0.5)	SR 1310 at Hilliardston	Fecal Coliform Bacteria
O4000000	NCAMBNT	3/14/74	Swift Cr	28-78-(6.5)	SR 1253 near Leggett	Fecal Coliform Bacteria
O4100000	TPBA	3/1/07	Tar River	28-(74)b	NC 33 near Tarboro	-
O0065000	RAMS	2007-2008	North Fork Tar River	28-5	at SR 1151 near Berea	-

Station ID	Agency	Active Since	Waterbody	AU#	Station Location	Stressors
O1190000	RAMS	2009-2010	Cedar Creek	28-29-(1)	at SR 1127 near Pocomoke	?
TPBA=Tar Pamlico Basin Association, NCAMBNT= DWQ, RAMS= Random Ambient Monitoring System, sampled by DWQ "-" indicates no stressors identified. "?" stressors to be determined						

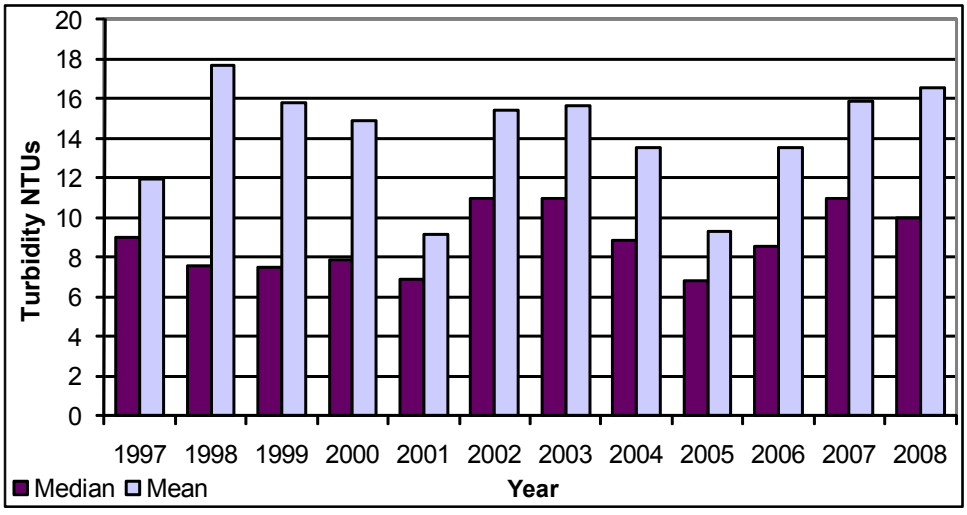
The following discussion of ambient monitoring parameters includes graphs showing the median and mean concentration values for all ambient stations (n=26) in this subbasin for a specific parameter over each year (note: sample size increased with the addition of Tar Pamlico Basin Association sampling in 2007). These graphs are not intended to provide statistically significant trend information or loading numbers, but rather provide an idea of how changes in land use conditions, natural fluctuations, or climate changes effect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the dataset. Box and whisker plots of individual ambient stations were completed by parameter for data between 2002-2007 and can be found in the Ambient Monitoring report: http://portal.ncdenr.org/c/document_library/get_file?uuid=994c08a8-a98d-4ff5-9425-656cadf8cfa4&groupId=38364. Summary sheets for ambient stations are available in Appendix 1C.

Turbidity

The turbidity standard for freshwater (Class C) streams is 50 NTUs. Data from Cedar Creek and Foundry Branch indicate turbidity as a stressor and are therefore listed as Impaired on the 2010 303(d) list. Turbidity is a measure of cloudiness in water and is often accompanied with excessive sediment deposits in the streambed. Excessive sediments deposited on stream and lake bottoms can choke spawning beds (reducing fish survival and growth rates), harm fish food sources, fill in pools (reducing cover from prey and high temperature refuges), and reduce habitat complexity in stream channels. Excessive suspended sediments can make it more difficult for fish to find prey and at high levels can cause direct physical harm, such as clogged gills. Sediments can cause taste and odor problems, block water supply intakes, foul treatment systems, and fill reservoirs. It is important to note that the turbidity standard does not capture incident duration or the amount of sedimentation, both of which can impact aquatic species.

Figure 1-4 shows turbidity results from 1,481 samples collected over the 12 year period of which 41 (3%) of those samples exceeded 50 NTUs. Review of individual station data over a 12 year period indicate stations with the most number of samples over 50 NTUs include the lower end of Fishing Creek and two stations on the Tar River, one at Louisburg and one near Bunn.

Figure 1-4. Summarized Turbidity values for all data collected at Ambient Stations in HUC 03020101



Fecal Coliform Bacteria

The fecal coliform bacteria standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100ml, or 400 colonies/100ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are to be used to indicate whether the stream is Impaired or Supporting. Waters with a classification of B (primary recreation water) will receive priority for 5-in-30 studies. Other waterbodies will be studied as resources permit. Data through 2007 indicate several streams where bacteria colony numbers exceeded 400 colonies/100ml. These streams currently impacted by fecal coliform bacteria include:

-Fishing Creek (C, NSW) at SR 1643 near Clay (AU# 28-11),
-Tar River (WS-IV, NSW) at SR 1003 Sims Bridge Rd near Louisburg (AU# 28-(15.5))
-Tabbs Creek (C, NSW) at SR 1100 Egypt Mountain Rd near Kittrell (AU# 28-17-(0.5))
-Cedar Creek (C, NSW) at SR 1109 Timberlake Rd near Louisburg (AU# 28-29-(2))
-Stony Creek (C, NSW) at Winstead Ave near Little Easonburg (AU# 28-69)

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of humans or other warm-blooded animals. At the time this occurred, the source water might have been contaminated by pathogens or disease producing bacteria or viruses that can also exist in fecal material. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

Figure 1-5. Summarized Fecal Coliform Bacteria numbers for all data collected at Ambient Stations in HUC 03020101

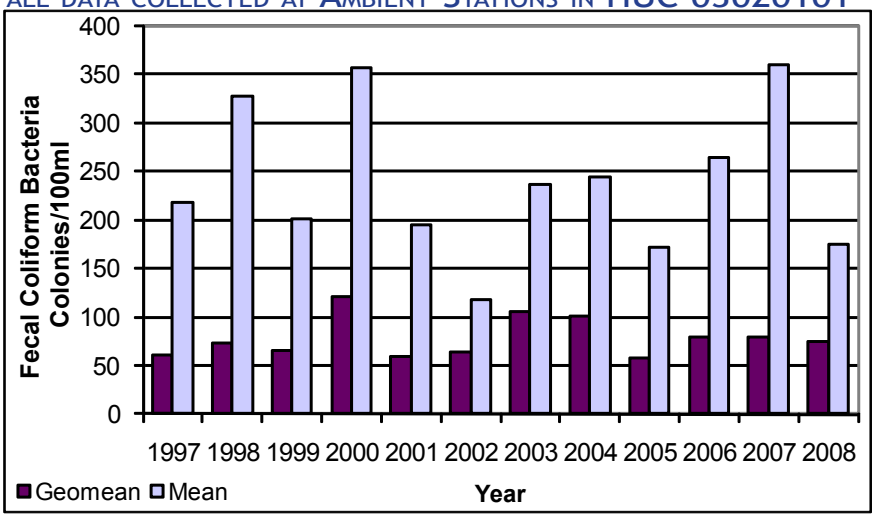
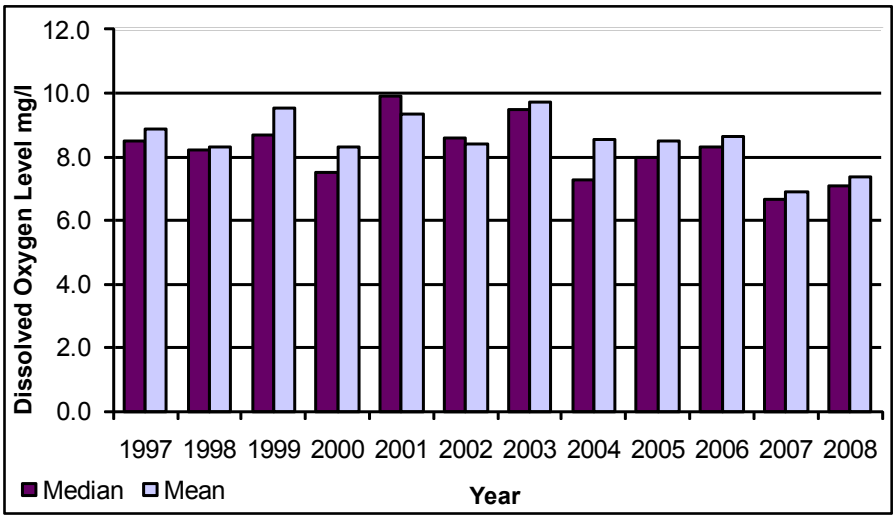


Figure 1-5 shows results from 1,473 samples collected over a 12 year period, 166 of these samples have more than 400 fecal coliform bacteria colonies /100 ml. Review of individual station data over the 12 year period indicate individual stations with the most samples over 400 colonies/100ml were at the lower end of Fishing Creek and in the Tar River in Rocky Mount.

Dissolved Oxygen

The dissolved oxygen (DO) water quality standard for Class C waters is not less than a daily average of 5.0 mg/L with a minimum instantaneous value of not less than 4 mg/L, the latter standard being the most commonly used. Swamp waters may have lower values if the low DO level is caused by natural conditions. Dissolved oxygen can be produced by wind or wave action that mix air into the water or through aquatic plant photosynthesis. During the day, DO levels are higher when photosynthesis occurs and they drop at night when respiration occurs by aquatic organisms. High levels are found mostly in cool, swift moving waters and low levels are found in warm, slow moving waters. In slow moving waters, such as reservoirs or estuaries, depth is also a factor. Wind action and plants can cause these waters to have a higher dissolved oxygen concentration near the surface, while biochemical reactions lower in the water column may result in concentration as low as zero at the bottom.

Figure 1-6. Summarized Dissolved Oxygen Levels for all data collected at Ambient Stations in HUC 03020101



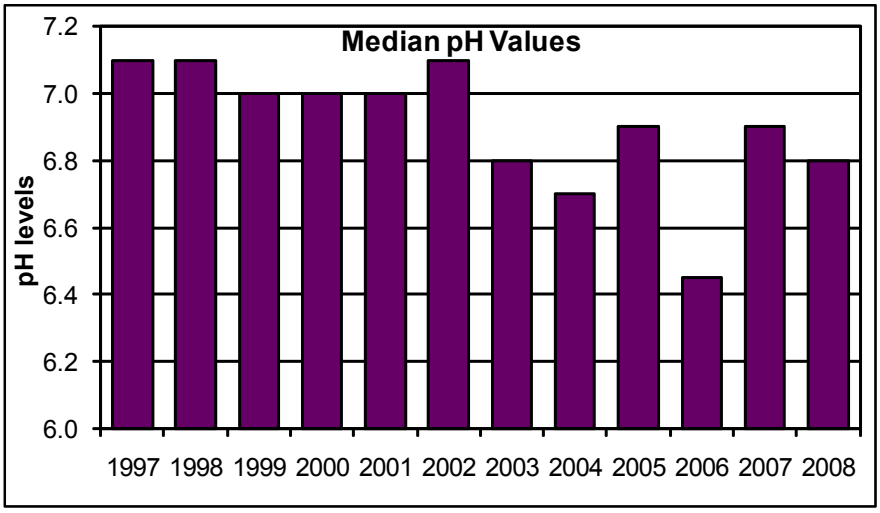
From 1997-2008, 1,623 samples were collected, 82 DO samples (5%) had instantaneous readings below 4 mg/L.; however median and mean values by year were above 6 mg/L. (Figure 1-6.). Review of individual station data over the 12 year period did not indicate significant issues at any particular station.

pH

The water quality standard for pH in surface freshwater is 6.0 to 9.0 standard units. Swamp water (supplemental Class Sw) may have a pH as low as 4.3 if it is the result of natural conditions. pH is a measure of hydrogen ion concentration that is used to express whether a solution is acidic or alkaline (basic). Values outside the 6.0-9.0 standard unit range can have chronic effects on the community structure of macroinvertebrates, fish and phytoplankton.

Figure 1-7 shows data from 1,640 pH samples over a 12 year period, 17 samples had low pH readings below 6 su. Review of individual station data over the 12 year period did not indicate significant issues at any particular station. Data indicate slightly more acidic waters in recent years; however, 99% of the samples meet standards.

Figure 1-7. Summarized pH values for all data collected at Ambient Stations in HUC 03020101



Nutrient Enrichment

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as "nutrients". Nitrogen compounds include ammonia as nitrogen (NH_3), Total Kjeldahl Nitrogen (TKN) and nitrite+nitrate nitrogen (NO_2+NO_3). Total nitrogen (TN) is the sum of TKN and NO_2+NO_3. Phosphorus is measured as total phosphorus (TP) by DWQ. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes or runoff from urban or agricultural land, the growth of algae and other plants may be accelerated. In addition to the possibility of causing algal blooms, ammonia-nitrogen may combine with high pH water to form ammonium hydroxide (NH_4OH), a form toxic to fish and other aquatic organisms.

Due to excessive levels of nutrients resulting in massive algal blooms and fish kills, the entire Tar-Pamlico River Basin was designated as Nutrient Sensitive Water (NSW) in 1989. This designation resulted in the development and implementation of a nutrient management strategy to achieve a decrease in TN by 30% and no increase in TP loads compared to 1991 conditions. Even though implementation of the strategy has occurred by wastewater treatment plant dischargers, municipal stormwater programs, and agriculture, nutrient enrichment continues to be cumulatively impacting the Pamlico Estuary. A review of the NSW strategy, including implementation activities, progress towards meeting the loading goals, and additional actions are discussed in Chapter 6.

Basin trend analyses were completed for nutrient concentration and daily loads to evaluate progress towards meeting TMDL reduction goals, as discussed in detail in the NSW Chapter 6. These analyses detected a statistically significant increase in TKN concentration and a decrease in NH_3 and NO_2+NO_3. There were no basinwide detected trends for TN or TP concentrations. TKN is defined as total organic nitrogen and NH_3. An increase in organic nitrogen is the likely source for the increase in TKN concentrations since NH_3 concentrations have decreased basinwide. Further analysis of these parameters were completed on a subbasin scale to determine concentrations changes over an 11 year time period. Currently, NC does not have nutrient standards; however, NC normal nutrient levels in class C piedmont waters are typically:

TP = < 0.05 mg/L
TN= < 0.8 mg/L
TKN= <0.5 mg/L
NH_3= < 0.05 mg/L

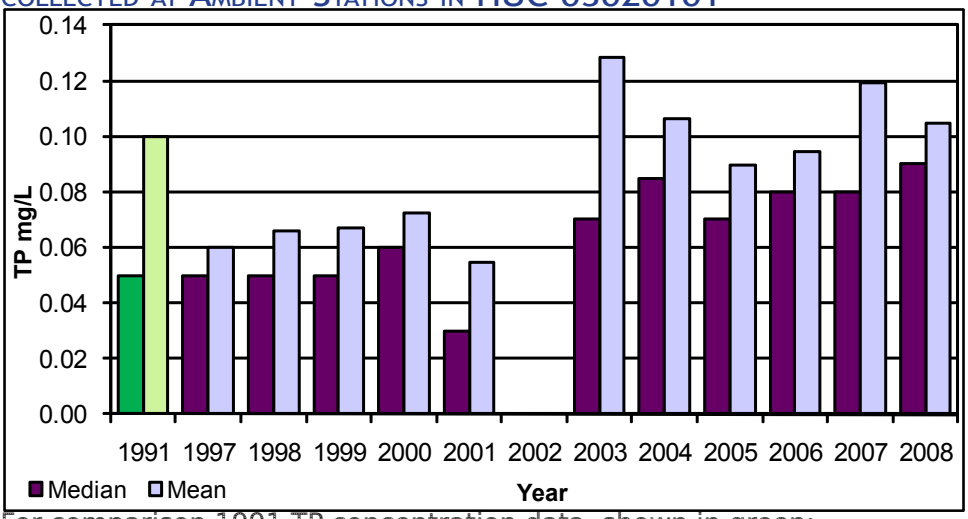
In early 2001, the DWQ Laboratory Section reviewed its internal Quality Assurance/Quality Control (QA/QC) programs and analytical methods. This effort resulted in a marked increase in reporting levels for certain parameters. New analytical equipment and methods were subsequently acquired to establish new lower reporting levels and more scientifically supportable quality assurance. As a result, the reporting levels quickly dropped back down to at or near the previous reporting levels. Nutrients were especially affected by these changes, as shown below:

	Reporting Level by Date (mg/L)			
Parameter	Pre-2001	3/13/2001 to 3/29/2001	3/30/2001 to 7/24/2001	7/25/2001 to present
NH_3	0.01	0.05	0.2	0.01
TKN	0.1	1.0	0.6	0.2
NO_2+NO_3	0.01	0.5	0.15	0.01
TP	0.01	0.5	0.1	0.02
Note: Do not let increased reporting levels be interpreted as a sudden upward trend. The Laboratory Section cautions that the establishment of minimum reporting levels may have been inconsistent and undocumented prior to those established in July 2001.				

Also, from July 2001 to May 2003, insufficient staffing resulted in suspension of nutrient sampling at most stations, resulting in a smaller sample size for 2001-2003.

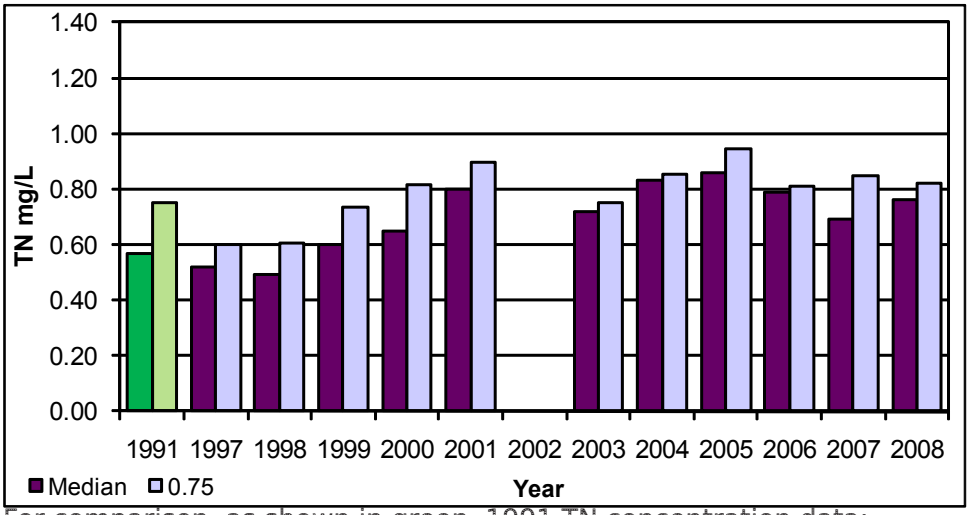
Figure 1-8 shows 943 samples collected over 11 years; 621 samples had TP levels above 0.05 mg/L. A review of individual station data indicates that two stations had the majority of incidences with TP levels above 0.05 mg/L. These include ambient stations below Rocky Mount on the Tar River at SR 1252 and on the lower end of Fishing Creek. However, TP levels above 0.05 mg/L were also detected at other sample locations on corresponding days indicating weather and flow conditions as a factor.

Figure 1-8. Summarized Total Phosphorus values for all data collected at Ambient Stations in HUC 03020101



For comparison 1991 TP concentration data, shown in green: Median= 0.05 Mean = 0.10

Figure 1-9. Summarized Total Nitrogen values for all data collected at Ambient Stations in HUC 03020101

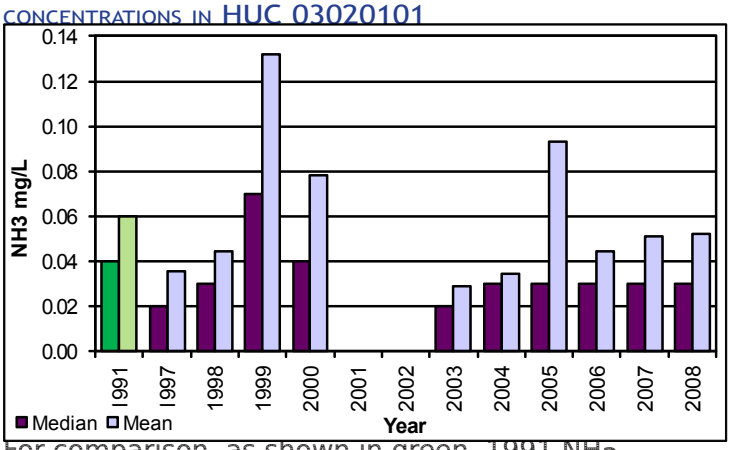


For comparison, as shown in green, 1991 TN concentration data: Median= 0.57 Mean = 0.75

Over 11 years, 942 nitrogen samples were collected; 357 (38%) had TN levels above 0.8 mg/L. (Figure 1-9). Figure 1-10 indicates stable ammonia concentrations, while Figure 1-11 shows a slight increase in TKN. Therefore, increases in organic nitrogen in this subbasin are likely contributing to TN loads. Identifying and reducing organic nitrogen contributions is needed to help meet required TMDL reductions.

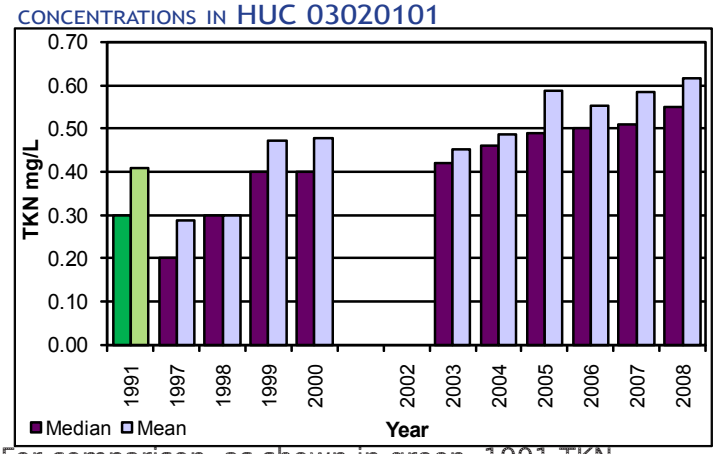
The limited ammonia data in 2001 contained outliers that skewed the data and therefore were eliminated from the ammonia and TKN graphs but were included in the TN graph.

Figure 1-10. Summarized Ammonia concentrations in HUC 03020101



For comparison, as shown in green, 1991 NH_3 concentration data: Median= 0.04 Mean = 0.06

Figure 1-11. Summarized TKN concentrations in HUC 03020101



For comparison, as shown in green, 1991 TKN concentration data: Median= 0.30 Mean = 0.41

Restoration and Protection Opportunities

The following section provides more detail about specific streams where special studies have occurred or stressor sources information is available. Specific stream information regarding basinwide biological samples sites are available in Appendix 1B. Use support information on all monitored streams can be found in Appendix 1A. Detailed maps of each of the watersheds are found in Appendix 1D or by clicking on the following small maps. Interactive elements have been incorporated within all 10-digit HUC watershed maps. To use the new features click on the Layers tab on the left side of the Adobe Reader window. Expand the folder tree by clicking on the (+) sign to the left of the map name. Each item in the subsequent folder tree is a layer on the map. These layers can be turned on or off by clicking the symbol to the left of the layer name. To return to your previous place within the text click the smaller map in the upper left corner of the 10-digit watershed map.

To assist in identifying potential water quality issues, we are requesting information be gathered by citizens, watershed groups and resource agencies through our Impaired and Impacted Stream/Watershed Survey found here: **http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey**.

Aycock Creek Watershed (0302010101)

This watershed is a priority area for protection of threatened and endangered species due to the presence of the dwarf wedgemussel in Shelton Creek (AU# 28-4, 13.9 miles), Fox Creek (AU# 28-4-1, 7.2 miles), Cub Creek (AU# 28-3, 8 miles), Tar River (AU# 28-(1), 20.1 miles) and the North Fork Tar River (AU# 28-5, 8.8 miles). This watershed is a priority for implementation of nonpoint source BMPs, including agricultural BMPs, stormwater control BMPs, buffer enhancement, and sediment and erosion control BMPs.

North Fork Tar River (HUC 030201010104) received both Fair and Good benthos bioclassification ratings during the 2007 sampling period. Site OB19 (Fair) is upstream of site OB144 (Good). The stream segment (AU# 28-5a, 5.9 mi) with site OB19 is Impaired on the 2010 303(d) list. The 2007 biological sample indicated beaver dam activity may have severely interrupted flows. This stream was impaired in the 1990's; however, water quality conditions improved during lower flow conditions, suggesting nonpoint source pollution as a major contributor to the stream's biological impairment during wetter years. Continued efforts to reduce agricultural runoff are needed. A landfill was also indicated as a potential cause contributing to low DO levels as a result of iron oxidation process.

Heritage Meadows WWTP (NC0047279) a minor discharge into an unnamed tributary to the North Fork Tar River but is not perceived to be causing the decline in biological communities. The NPDES permitted flow is 0.01 MGD, but the median daily annual flow is much less at 0.004 MGD (April 2008 to March 2009). Parameters that have exceeded permit limits include: fecal coliform bacteria, ammonia, BOD, and DO. The current operator fixed a piping and pumping problem in 2006, improving operational conditions of the facility. Although there have been several BOD violations, no significant exceedances have been identified since 2007 that warranted a civil penalty assessment. Evaluation of the facility's discharge impact to endangered mussel species found in this segment of the river may be required.

Tabbs Creek Watershed (0302010102)

Tabbs Creek (HUC 030201010203) AU # 28-17-(0.5)b, has been monitored by the Tar Pamlico Basin Association at station O1030000 since 2007, which is below the confluence of Long Creek. Tabs Creek is currently Not Rated because of several incidences of high fecal

coliform bacteria samples (note: five samples collected within 30 days that exceed the standard are needed to rate the creek as Impaired).

Kittrell Job Corps Center (NC0029131) and Long Creek Court WWTP (NC0048631) discharge into Long Creek (AU# 28-17-3). Parameters that have exceeded their permit limits include total suspended solids, fecal coliform bacteria, ammonia, BOD, and flow. Kittrell Job Corps Center's permitted flow is 0.025 MGD with a median annual daily flow 0.013 MGD (April 2008 to March 2009). The facility had been struggling to handle peak flows and slugs from improper use of the garbage disposal at the cafeteria. As of June 2010, the facility completed an upgrade that includes a new secondary clarifier, return activated sludge pump station, tertiary filtration system, post aeration, and UV disinfection. Long Creek Court WWTP's permitted flow is 0.007 MGD with a median daily annual flow 0.0043 MGD (April 2008 to March 2009). The plant's hydraulic problems (piping and pumping) have been repaired and has operated with no major noncompliance issues since 2007.

Lake Devin (HUC 030201010201) is a small lake located in the City of Oxford. Primarily used for public fishing, this lake originally served as the water supply source for the City. DWQ staff sampled Lake Devin from May through September 2007. Nutrient levels were found to support excessive algal growth. Based on the calculated North Carolina Trophic State Index (NCTSI) scores, Lake Devin was determined to be eutrophic (exhibiting elevated biological productivity) in May and August and hypereutrophic (exhibiting excessive biologically productivity) in June and July. This is the first time that NCTSI scores for this lake have indicated hypereutrophic conditions. The 2007 drought may have contributed to increased concentration of nutrients within the lake as the water level decreased through the summer. Lake water circulation and flushing from storm events were significantly reduced in 2007. These processes normally reduce the build up of algae and subsequent elevated chlorophyll *a* concentrations. Further monitoring during more normal rainfall years may help to determine if a change in trophic status is occurring.

Hatcher's Run (HUC 030201010201), AU# 28-11-3-(2), from dam at Devin Lake to Fishing Creek, covering 3.9 miles, received a Fair bioclassification during a special study assessment in 2006. However, DWQ Biologists noted the Fair bioclassification was primarily due to a lack of flow and resulting low DO. Upstream of the sample site, the stream flows through a cattail marsh that, along with the low release of water from Lake Devin, contributes to the low oxygen levels. Flow and low DO will continue to be naturally recurring issues here. Nutrient impacts were also noted. Additional surveys of this stream noted the stream banks as being highly eroded and undercut; sedimentation was observed, causing habitat degradation.

Foundry Branch (HUC 030201010201), AU# 28-11-2, from source to Fishing Creek, covering 5.5 miles, is listed as Impaired on the 2010 303(d) list because of turbidity and low DO standard violations. Foundry Branch runs through the City of Oxford and was sampled as a Tar Pamlico Basin Association coalition station (O0310000) that has now been relocated to Fishing Creek between the mouth of Foundry Branch and the Oxford WWTP discharge. This stream will remain Impaired until new water quality samples are taken showing improvement. DWQ does not plan on taking water quality sampling until evidence suggests activities have occurred in the watershed that have the potential to improve current stream conditions.

Fishing Creek (HUC 030201010201), AU#s 28-11c and 28-11d, from #1 outfall to Coon Creek, covering a total of 1.9 miles, is Impaired for Aquatic Life based on a Fair bioclassification in 2006. These segments have been Impaired since the 1990s because of the poor ecological and biological integrity.

Fishing Creek Impairment Timeline

- 1999 - The entire length (11 miles) of Fishing Creek was Impaired. Above the WWTP, Fishing Creek and Foundry Branch are impacted by urban runoff from the City of Oxford. Oxford WWTP was placed under a moratorium after the Poor bioclassification in 1999. It was recommended that no new or expanding

wastewater dischargers be connected to the Oxford wastewater treatment plant.

- 2004 - 10.4 miles of Fishing Creek were on the 303(d) list of impaired waters. DWQ continued to monitor water quality in the Fishing Creek watershed. DWQ Raleigh Regional Office staff continued to work with the Oxford WWTP to remedy plant problems that were adversely impacting water quality in Fishing Creek, including influent overflows and infiltration and inflow in the Foundry Branch watershed. Oxford was required to address nutrients in stormwater as part of the Tar-Pamlico NSW strategy and were advised to address the more acute impacts to Fishing Creek when developing their stormwater program.
- 2005 - The Fishing Creek subwatershed was chosen by the NC Ecosystem Enhancement Program (EEP) as a Local Watershed Planning Project area; as a result, extensive water quality assessments were completed in 2006-2007. This plan focused on projects that address sedimentation and nutrient issues related to agriculture and forestry, stormwater runoff from Oxford and from highways, and degraded mussel habitat. Information from this study included: freshwater mussel surveys, special study summaries, and a water quality summary. These documents can be found at: http://www.nceep.net/services/lwps/Fishing/Fishing_Creek.pdf.
- 2006 - Fishing Creek remained Impaired, covering 4.8 miles (from source to Coon Creek). Oxford completed its WWTP upgrades expanding the facility from 2.17 MGD to 3.5 MGD and received permit limits of 5 mg/L BOD5 and 1 mg/L NH_3-N, down from 15 mg/L BOD5 and 4 mg/L NH3-N. The new limits as well as those improvements implemented by Oxford were expected to further reduce impacts to Fishing Creek. A description of additional improvements are detailed at: http://cleanwateroxford.org/
- 2007 - EPA completed a special study on Fishing Creek to help assess conditions. This study found that the flow was strongly dominated by effluent from Oxford's WWTP. A detailed report of these results can be found In Appendix 1E. The Albemarle-Pamlico National Estuary Program (APNEP) also chose Fishing Creek for restoration activities.
- 2008 - Benthos data collected in 2006 resulted in a Fair rating leaving 1.9 miles Impaired on the 2008 & 2010 303(d) list. Although the benthic sample in the southern reach of Fishing Creek resulted in a Good-Fair bioclassification in 2007, ambient station indicated high turbidity, copper, zinc and fecal coliform bacteria levels, verifying the waterbody is still impacted.
- 2010 - The Tar Pamlico Basin Association began monitoring at station O0320000 (Knotts Grove Rd near Oxford) in January 2010. This station replaced station O0310000 (Foundry Branch at SR 1649 at Oxford). The new station is located on Fishing Creek upstream of the Oxford WWTP discharge and downstream of the mouth of Foundry Branch.

Water quality is expected to improve in Fishing Creek as long as Oxford WWTP is in compliance with its permit limits and stormwater BMPs are used. Potential water quality improvement results may be reflected in the future.

Lynch Creek-Tar River (0302010103)

Two ambient stations (O1025000 & O1100000) indicated increased levels of turbidity and fecal coliform bacteria. The fish sample resulted in a Good bioclassification in 2007, while the benthic samples resulted in a Good-Fair bioclassification in 2002. Additional information is needed about restoration and protection opportunities in this watershed.

Crooked Creek-Tar River (0302010104)

Crooked Creek (HUC 030201010404), AU#s 28-30a & 28-30b, habitat conditions are described as transitional between Piedmont and Coastal Plain. This creek has not had a biological sample taken since 2002; therefore, it is recommended that a biological sample be taken during the next basinwide sample period. Ambient data through 2008 indicate the stream is impacted by low DO and is Impaired on the 2010 303(d) list.

Bunn WWTP (NC0042269) discharges into Crooked Creek. The wastewater plant's permitted flow is 0.150 MGD and the current median annual daily flow is 0.085 MGD. This facility is in the process of an upgrade and currently benefits from three series-type tertiary lagoons. The plant has experienced problems with fats, oils, and grease discharges that are likely from the Division of Prisons Franklin Correctional Facility. Occasional excursions of the permit limits include the following parameters: high pH, total suspended solids, fecal coliform bacteria, BOD, and flow.

Two of the six ambient stations in this watershed indicated increased levels of turbidity and all had samples with high fecal coliform bacteria levels. Cedar Creek, (HUCs 030201010401 & 030201010402), AU# 28-29-(2)b, is listed as Impaired on the 2010 303(d) list based on exceedance of the turbidity standard.

Stony Creek Watershed (0302010105)

Stony Creek (Boddies Millpond) (HUC 030201010504), AU# 28-68b, from Lassiters Creek to Tar River covering 5.9 miles is Impaired for Aquatic Life based on a historical listing for sediment from benthos samples taken in 1992. This stream segment runs through urban areas in southwest Rocky Mount. This segment is likely a good candidate for an urban stream restoration and education project. A new ambient station was established in 2007; data from this site will help identify additional water quality stressors. This segment should be reassessed for biological integrity during the next basinwide biological assessment in 2012 to determine whether continued Impairment of the segment is warranted. The upper portion of this creek (AU# 28-68a) was removed from the 303(d) list because of a Good-Fair bioclassification in 2002.

Tar River Reservoir-Tar River (0302010106)

Tar River Reservoir is the primary water supply source for the City of Rocky Mount. Located on the confluence of the Tar River and Sapony Creek, the reservoir is open to the public for boating and fishing. Overall, nutrient concentrations in Tar River Reservoir were at levels capable of sustaining nuisance algal blooms. Based on the calculated North Carolina Trophic State Index (NCTSI) scores for 2007, the Reservoir was determined to be eutrophic (exhibiting elevated biological productivity). This reservoir has been eutrophic since 1989 when it was first monitored by DWQ. The dam is required to provide a continuous downstream release of 80 cfs.

Old Webb's Mill Hydro Project is proposed for just south of Lake Royale. This proposed hydropower project is non-jurisdictional to Federal Energy Regulatory Commission regulation and is therefore under the authority of the N.C. Utilities Commission. Conditions of the Certificate of Public Convenience and Necessity include the following: the project will only operate in a run-of-river mode (i.e. project outflow equals project inflow) and the operator will coordinate with the Division of Water Resources and the Wildlife Resources Commission to determine a flow requirement during generation, if needed.

Cypress Creek (HUC 030201010601), AU# 28-31-(3), from dam at Lake Sagamore/Royale down 1.6 miles to the confluence with the Tar River, receives effluent from Lake Royale WWTP. There is currently no monitoring in Cypress Creek but ambient monitoring in the Tar River downstream of this confluence began in 2007 by the Tar Pamlico Basin Association, while the last biological sample was taken in 1992. Lake Royale WWTP (NC0042510) is a small, package-type treatment facility and receives the majority of flow on seasonal basis (summer months). Parameters that

have exceeded the permit limits include fecal coliform bacteria and ammonia. The NPDES permitted flow is 0.080 MGD and the median annual flow is 0.0014 MGD. This discharge occurs downstream of the Lake Royale dam. Based on a 08/21/72 letter, under the Dam Safety Law, the dam is required to release a minimum flow of at least 0.3 cfs at all times. The letter also states that a minimum release requirement of at least 1.0 cfs from the dam will be a condition within the wastewater discharge permit when the plant is in "full capacity operation," unless the permittee chooses to discharge to the Tar River.

Tar River (HUC 030201010603), AU# 28-(24.7)b, from Cypress Creek to a point 3.2 miles downstream of N.C. Hwy. 581 receives effluent from two minor WWTPs. Spring Hope WWTP facility (NC0020061) had problems with inflow and infiltration and was under a Special Order by Consent (expired 7/31/2010). Since 2007, inflow and infiltration into the wastewater collection system have decreased by ~80% through compliance efforts by DWQ's Raleigh Regional Office. The facility plans to upgrade in the next year. Flow permitted at 0.400 MGD and the median daily annual flow is 0.084 MGD. Southern Nash Middle School facility (NC0037885) is a septic tank-sand filter operation with a permitted flow of 0.015 MGD; while their median annual flow has been 0.0033 MGD. Proper operations were interrupted during 2006 and 2007 due to the unauthorized deconstruction of the majority of the treatment unit process. This problem has since been repaired and DWQ's Raleigh Regional Office staff recently conducted a Compliance Evaluation Inspection and found facility to be in compliance.

There were no data available to determine water quality conditions in this reach of the Tar River during the 2002-2006 assessment period. Ambient monitoring began in 2007 by the Tar Pamlico Basin Association and the last biological sample was taken in 1992. It is recommended that biological samples be collected during the next basinwide sample period or a special study conducted for the proposed Old Webb's Mill Hydro project.

Sandy Creek Watershed (0302010107)

Sandy Creek (HUC 030201010703) AU# 28-78-1-(8)b1, from NC 401 to Flat Rock Creek, covering 5.3 miles, is Impaired for Aquatic Life based on a Fair bioclassification result in 2003. Problems with High Roost Poultry Farm's lagoon were previously indicated as a source of pollution with reports of wastewater travelling via groundwater to the creek. In 2008, the lagoon was closed and the land put in a conservation easement. Several conservation easements have been established along Sandy/ Swift Creek with the assistance and facilitation by Tar River Land Conservancy and NC Ecosystem Enhancement Program. Restoration of this segment is especially important to protect the ORW status of this watershed. This site needs to be resampled to assess biological conditions post lagoon removal.

Sandy/Swift Creek ORW Reclassification

The request for reclassification of ~14 miles of Swift Creek and Sandy Creek was submitted by the Pamlico-Tar River Foundation in 1995. Water quality studies indicated that ~14-mile segment of water, from SR 1003 to SR 1004 in Nash County, had excellent water quality. This entire watershed is also recognized for its exceptional State and national ecological significance. As a result of this reclassification request, rule amendments were proposed to reclassify the ~14-mile segment with excellent water quality to C ORW NSW, and to extend the ORW management strategy to the remainder of the Swift Creek watershed. This ORW classification became effective on October 7, 2003 with nearly 142 miles of named waters being affected. As an ORW watershed, regulations that affect new development activities, wastewater discharges, landfills, and DOT activities apply on a permanent basis. No new discharges or expansions of existing discharges are permitted, and stormwater controls for all new development activities requiring

an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an appropriate local erosion and sedimentation control program are required to follow the stormwater provisions as specified in 15A NCAC 02H .1000. Specific stormwater requirements for ORW areas are described in 15A NCAC 02H .1007.

Swift Creek 0302010108

This watershed is a threatened and endangered species protection priority area, which supported the upper reach of Swift Creek receiving ORW status in 2003(AU# 28-78-(0.5), 9.6 miles). Thirty-eight miles of Swift Creek (AU#s 28-78-(2.5) & 28-78-(6.5)) downstream of the designated ORW area are in need of additional protection. The downstream portion of Swift Creek did not meet excellent water quality standards at the time of ORW designation, but the importance of protection in this watershed led to the request for a site-specific strategy to be developed by DWQ and advising agencies (in development). The mainstem of Swift Creek is denoted as a Natural Heritage Area of national significance as recorded by the North Carolina Natural Heritage Program. In addition, the lower portion of Swift Creek contains the Swift Creek Swamp Forest, an approximately 2,000 acre natural area of regional significance, and a wading bird rookery.

There are several wastewater residual application fields in the drainage area; the impacts from potential runoff from fields is unknown. Further research may be needed to identify if any runoff from these fields may be impacting the aquatic species in Swift Creek.

This watershed is a priority for implementation of nonpoint source BMPs, including agricultural BMPs, stormwater control BMPs, buffer enhancement and sediment and erosion control BMPs.

Currently no nutrient data are collected in the Sandy/Swift Creek watersheds. It is recommended that nutrient data be collected at ambient station O4000000 to be able to help identify which watersheds are significantly contributing to the accumulation of nutrients in the estuary.

Beech Branch-Tar River (0302010109)

Rocky Mount Mills Dam, found along the Tar River, is a hydropower facility required to provide, under the Dam Safety Law, a continuous instantaneous minimum flow of 60 cfs in the natural channel directly below the dam. No data are available to describe water quality conditions in the upstream portion (AU# 28-(67)), while downstream of the dam (AU# 28-(69)) is considered Supporting.

Additional Studies

Lake and Reservoir Assessment

Two lakes, Lake Devin and Tar River Reservoir, were sampled by DWQ in 2007. However, not enough samples were collected to determine use support status. The samples that were taken indicated impacts due to 2007 drought conditions. Data collected included chlorophyll *a*, pH, dissolved oxygen, water temperature, turbidity, and chloride. Other parameters include nutrient concentrations, Secchi depth and percent dissolved oxygen saturation. The detailed report can be found on DWQ's website: **http://www.esb.enr.state.nc.us/documents/TARPAMLICORIVERBASIN2007_000.pdf**.

Volunteer Water Information Network

The Volunteer Water Information Network (VWIN) is a partnership of groups and individuals dedicated to preserving water quality in North Carolina. In August 2005, the Pamlico-Tar River Foundation initiated a monitoring program in tributaries to the Tar River. The UNC-Asheville Environmental Quality Institute (EQI) provided technical assistance through laboratory analyses of water samples, statistical analyses of water quality results, and written interpretation of the data. Volunteers collected water samples once a month from selected streams in Edgecombe, Nash and Pitt counties. The results of this data collection are similar to DWQ's sampling results, but VWIN also collected data on streams that DWQ does not monitor. The VWIN report (available in Appendix 1E) provides statistical analyses and interpretation of data from samples gathered from Beech Swamp, Compass Creek, Hornbeam Branch, Little Saponey Creek, Maple Creek, Penders Mill Run, Pig Basket Creek, Red Bud Creek, Saponey Creek, Stoney Creek, Swift Creek, and Turkey Creek.

Aquatic Species Protection

Within this subbasin, two specific management areas are the focus of aquatic species protection, these include: the Upper Tar River headwaters (North Fork Tar River, Fox Creek, Shelton Creek, Cub Creek, and Tar River) and Lower Swift Creek.

The Upper Tar River headwaters (Aycock Creek watershed) and its riparian habitat support rare fish, mussels, and plants, in addition to the federally-listed as endangered dwarf wedgemussel. Based on this diversity, several drainages within the management area have been identified as state (North Fork Tar River and Fox Creek) and nationally (Shelton Creek, Cub Creek, and Tar River) significant. The federal species of concern and state endangered Atlantic pigtoe (*Fusconaia masoni*), green floater (*Lasmigona subviridis*), and yellow lampmussel (*Lampsilis cariosa*) are known to occur in the upper Tar. Other mussels known from this area include the state-listed as threatened triangle floater (*Alasmidonta undulat*a), creeper (*Strophitus undulatus*), and eastern lampmussel (*Lampsilis radiata*), as well as the notched rainbow (*Villosa constricta*), which is a State species of concern.

The Upper Tar River headwaters provide habitat for: the federal species of concern and state significantly rare pinewoods shiner (*Lythrurus matutinus*), the state special concern North Carolina spiny crayfish (*Orconectes carolinensis*), the state special concern Neuse River waterdog (*Necturus lewisi*), the state rare and federal species of concern Roanoke bass (*Ambloplites cavifrons*), and the state and federally endangered plant Harperella (*Ptilimnium nodosum*) .

Lower Swift Creek and its riparian habitat support rare fish, mussels, and plants in addition to the federally-listed endangered Tar spinymussel. The federal species of concern and State endangered Atlantic pigtoe (*Fusconaia masoni*), yellow lance (*Elliptio lanceolata*), and yellow lampmussel (*Lampsilis cariosa*) are known to occur in the lower reaches of Swift Creek. Other mussels known from this reach include the state-listed threatened triangle floater (*Alasmidonta undulata*), creeper (*Strophitus undulatus*), Roanoke slabshell (*Elliptio roanokensis*) and eastern lampmussel (*Lampsilis radiata*), as well as the notched rainbow (*Villosa constricta*), a state species of concern. Two rare fish, the Carolina madtom (*Noturus furiosus*) and pinewoods shiner (*Lythrurus matutinus*), the Neuse River waterdog (*Necturus lewisi*), the state special concern North Carolina spiny crayfish (*Orconectes carolinensis*), two significantly rare plants and two significantly rare insects have also been documented in this portion of the subbasin. While the development of site-specific water quality management strategies are specifically aimed at the Tar spinymussel, they will also benefit other rare species in this watershed.

In 2005, wildlife resource agencies (US Fish & Wildlife, NC Natural Heritage Program and NC Wildlife Resources Commission) wrote a technical support document providing management recommendations for the threatened and endangered aquatic species in the Upper Tar River headwaters. Many of the recommendations include activities that are currently in place or are not

resources that DWQ has regulatory authority over. Therefore, DWQ will identify efforts that can be regulated by DWQ to protect water quality for the propagation of threatened and endangered aquatic life (e.g., tar spinymussel & dwarf wedgemussel). DWQ is currently considering the development of a statewide mussel species management plan to avoid the lengthy process of individual site specific plans and rulemaking.

Permit Programs

Wastewater Dischargers

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States, as authorized by the Clean Water Act. Non-compliance with permit limits on wastewater flow and constituents can lead to discharge of pollutants that degrade surface waters making them unsafe for drinking, fishing, swimming, and other activities. The NPDES Permitting and Compliance Programs of DWQ are responsible for administering the program for the state. These permits are reviewed and are potentially renewed every five years. A list of NPDES permits is found in Table 1-4 and locations shown on Figure 1-1.

The Federal and State Pretreatment Program gives regulatory authority for EPA, States, and Municipal Governments to control the discharge of industrial wastewater into municipal Wastewater Treatment Plants (WWTPs) or Publicly Owned Treatment Works (POTWs). The objectives of the Pretreatment Program are to prevent pass-through, interference, or other adverse impacts to the POTW, its workers and the environment; to promote the beneficial reuse of biosolids; and to assure all categorical pretreatment standards are met. There are currently around 700 Significant Industrial Users (SIUs) who discharge industrial wastewater to over 120 POTWs throughout the state of North Carolina. The WWTPs covered by POTW Pretreatment Programs in this subbasin are Oxford, Rocky Mount, and Franklin County

All NPDES permitted facilities use 7Q10s (the lowest stream flow for seven consecutive days that would be expected to occur once in ten years) as critical flow in determining permit limits for non-carcinogen toxicants. If a toxicant is a known carcinogen, then the QA (the mean annual stream flow) is used in determining permit limits. In cases where an aesthetic standard is applicable to a pollutant then the permit limit is based on 30Q2 (the minimum average flow for 30 consecutive days that would be expected to occur once in 2 years). These critical flow values used to determine permit limits for all NPDES facilities may need to be reviewed as the permits come up for renewal. Currently, a 7Q10 is only evaluated in the initial application of the permit and upon expansion. Low flow conditions impact a stream's ability to assimilate both point and nonpoint source pollutants. Droughts as well as the demand for water resources, are very likely to increase; therefore, the reevaluation of stream flow will become more critical to water quality within the next decade or so. DWQ will work with Division of Water Resources and other agencies to discuss the need and resource availability to update 7Q10 values.

Table 1-4. NPDES Discharge Permits

Permit #	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0002852	Franklinton WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Taylors Creek	0
NC0020061*	Spring Hope WWTP	Government - Municipal	Municipal Wastewater Discharge, < 1MGD	Minor	Tar River	0.4
NC0020231*	Louisburg WWTP	Government - Municipal	Municipal Wastewater Discharge, Large	Major	Tar River	1.37
NC0025054*	Oxford WWTP	Government - Municipal	Municipal Wastewater Discharge, Large	Major	Fishing Creek	3.5

Permit #	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0029131	Kittrell Job Corps Center	Non-Government	Discharging 100% Domestic < 1MGD	Minor	Long Creek	0.025
NC0030317*	Tar River Regional WWTP	Government - Municipal	Municipal Wastewater Discharge, Large	Major	Tar River	21
NC0037885	Southern Nash Middle School	Government - County	Discharging 100% Domestic < 1MGD	Minor	Tar River	0.015
NC0042269*	Bunn WWTP	Government - Municipal	Municipal Wastewater Discharge, < 1MGD	Minor	Crooked Creek	0.15
NC0042510	Lake Royale WWTP	Non-Government	Discharging 100% Domestic < 1MGD	Minor	Cypress Creek	0.08
NC0047279	Heritage Meadows WWTP	Non-Government	Discharging 100% Domestic < 1MGD	Minor	N. Fork Tar River	0.01
NC0048631	Long Creek Court WWTP	Non-Government	Discharging 100% Domestic < 1MGD	Minor	Long Creek	0.007
NC0050415	Phillips Middle School	Government - County	Discharging 100% Domestic < 1MGD	Minor	Moccasin Creek	0.01
NC0050431	North Edgecombe High School	Government - County	Discharging 100% Domestic < 1MGD	Minor	Swift Creek	0.02
NC0069311*	Franklin County WWTP	Government - County	Municipal Wastewater Discharge, Large	Major	Cedar Creek	3
NC0072125*	Tar River WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Tar River	0
NC0072133*	Sunset Avenue WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Tar River	0
NC0077437	Battleboro plant	Non-Government	Industrial Process & Commercial	Minor	Tar River	0.904
NC0083038	Saint-Gobain Containers	Non-Government	Industrial Process & Commercial	Minor	Martin Creek	
NC0001589	Hospira, Inc. -RM1	Industrial Process & Commercial		Minor		
NC0084697	Amoco Fabrics & Fibers	Groundwater Remediation		Minor		
NC0079227	Nash remediation site	Groundwater Remediation		Minor		

* Indicates Tar-Pamlico Basin Association Permittee Member
+ Indicates pretreatment

Non-Discharge

Non-discharge systems have been the preferred alternative to discharge to surface waters for NSW waterbodies and DWQ requires all new and expanding NPDES permit applicants to provide documentation that considers all alternatives to surface water discharges. Non-discharge wastewater disposal options include spray irrigation, rapid infiltration basins, and drip irrigation systems (Table 1-5). Although these systems are operated without a discharge to surface waters, they still require a DWQ permit. The permit insures that treated wastewater is land applied at a rate that is protective of groundwater and does not produce ponding or runoff into a waterbody. More information about land application and non-discharge requirements can be found on the DWQ Aquifer Protection Section – Land Application Unit website: http://portal.ncdenr.org/web/wq/aps/lau.

Run-off and spills are not common at non-discharge facilities. In general, maintaining compliance with permit conditions largely falls back to having a properly managed facility. Aging collection systems may lead to increased flows from inflow and infiltration or a facility may not be properly

prepared to expand as flows increase and the upper limits of a plant's capacity are reached. Non-discharge facilities, just like any other, must properly plan for any elevated flows and take action to ensure that the facility is capable of managing the wastewater.

Groundwater moving into surface water is a mechanism to introduce nutrients into the surface water system in the absence of direct discharges and in NSW systems it is important to be able to better quantify these potential nutrient loads. Some facilities have a groundwater monitoring program to measure compliance with groundwater quality standards. However, it should be noted that a facility can be compliant with groundwater quality requirements while still contributing to the overall nutrient loading of a surface water system. A better understanding of the groundwater/surface water interaction process at non-discharge facilities may help to identify and quantify nutrient loading from these locations .

Novozymes (WQ0002806) is permitted to apply wastewater on an ~900 acre sprayfield. Their wastewater is currently low in nitrogen; however, past applications (>10 yrs ago) were not. Novozymes has groundwater standard violations associated with nitrates in the groundwater; the nitrate groundwater standard is 10 mg/L whereas expected total nitrogen level, in surface waters are around 0.8 mg/L N. The excess nitrates may be discharging off-site into local surface waters, but the amount of nitrogen contributions from groundwater to surface waters has not been quantified. In September 2009, Novozymes initiated a partial groundwater treatment system to address contaminated groundwater. Additional remediation of groundwater will likely be required.

Table 1-5. Non-Discharge Permits

Facility Name	Permit Type	Permit #	Size
Saint Gobain Containers Incorporated	Wastewater Recycling	WQ0000221	Minor
Novozymes North America Inc - Franklin County	Surface Irrigation	WQ0002806	Major
Ball's Laundromat	Surface Irrigation	WQ0002848	Major
Eastern Minerals Incorporated-Henderson	Surface Irrigation	WQ0003075	Minor
Granville Family Park Incorporated	Surface Irrigation	WQ0004410	Major
Single Family Residence	Surface Irrigation	WQ0007524	Minor
Pretty Good Sand Co Incorporated-Arm	Wastewater Recycling	WQ0007574	Minor
McCracken Enterprises Incorporated	Groundwater Remediation	WQ0012614	Minor
Green Hill Country Club (golf course)	Reuse	WQ0020302	Minor
Curtis Insulation	Wastewater Recycling	WQ0001122	Minor
Bass Farms Inc.	Surface Irrigation	WQ0002004	Minor
Town of Tarboro Residuals Land Application	Land Application of Residual Solids	WQ0002047	Major
NZNA Franklinton, NC Manufacturing Facility	Distribution of Residual Solids	WQ0003487	Major
Town of Louisburg Residuals Land Application	Land Application of Residual Solids	WQ0005981	Minor
Wilton Elementary School WWTP	Gravity Sewer Extension, Pump Stations, & Pressure Sewer	WQ0020807	Minor
Single Family Residence	Surface Irrigation	WQ0022963	Minor
Eastern Compost	Wastewater Recycling	WQ0033492	Minor

Major = Wastewater irrigation, high-rate infiltration, other non-discharge wastewater and reclaimed water facilities with an average daily flow >or= to 10,000 gallons per day (GPD); Class A residual management systems distributing > or = to 3,000 dry tons; Class B residual management systems containing > or = to 300 acres. Minor= < than above amounts.

Wastewater Residuals (Biosolids)

Residuals, biosolids or treated sludge, are by-products of the wastewater treatment process. After pathogen reduction, vector attraction reductions, and metal limits are met, these residuals are disposed in a manner to protect public health and the environment. Disposal sites include land fills, dedicated and non-dedicated residual disposal sites, agricultural land for crops not for human consumption, and distribution to the public for home use. When applied to the land, steps must be taken to assure that residuals are applied at or below agronomic rates based on the soil and crop types present at the disposal site. If these criteria cannot be met, permitted disposal must take place at a dedicated residual disposal site or landfill.

In this subbasin, four facilities that produce wastewater residuals (Class B) apply their treated sludge on 165 available fields covering 2,776 acres (not all fields are used every year). A rough estimate of 194,320 lbs/yr of nitrogen and 249,840 lbs/yr of phosphorous are applied to these fields. This estimate does not include Class A residuals which are not monitored by DWQ but can also contribute nitrogen and phosphorus loading (which is not accounted for) within the basin. Additional research would be necessary to determine if organic nitrogen from biosolids is contributing to the basinwide increase in organic nitrogen. For more information about residuals please see DWQ's Aquifer Protection Section: **http://portal.ncdenr.org/web/wq/aps/lau**.

On-Site Wastewater Treatment Systems (Septic Systems)

Wastewater from many households is treated on-site through the use of permitted septic systems instead of being sent to a wastewater treatment facility. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from failing septic systems can contaminate groundwater and surface water. Failing septic systems are health hazards and are considered illegal discharges of wastewater if surface waters are impacted. Local health departments are responsible for ensuring that new systems are sited and constructed properly and an adequate repair area is available. Municipal planners need to understand the economic and human health ramifications caused by failing septic systems and plan for long-term septic system sustainability. Information about the proper installation and maintenance of septic tanks can be obtained by contacting the Department of Environmental Health and local county health departments.

In 2007, North Carolina Agricultural Research Service completed a report concerning nitrogen contributions from on-site wastewater systems for each river basin. The results for this subbasin based on 1990 census data indicate a population of 73,318 people using 29,169 septic systems resulting in a nitrogen loading of 733,179 lbs/yr and nitrogen loading rate of 564 lbs/mi^2/yr. These numbers reflect the TN discharged to the soil from the septic system and does not account for nitrogen used because of soil processes and plant uptake. (Pradhan et al. 2007).

Wetland Or Surface Water Disturbance (401 Certification)

The "401" refers to Section 401 of the Clean Water Act. The North Carolina DWQ is the state agency responsible for issuing 401 water quality certifications (WQC). When the state issues a 401 certification, this certifies that a given project will not degrade waters of the state or violate state water quality standards. A 401 WQC is required for any federally permitted or licensed activity that may result in a discharge to waters of the U.S. Typically, if the United States Army Corps of Engineers determines that a 404 Permit or Section 10 Permit is required because a proposed project involves impacts to wetlands or surface waters, then a 401 WQC is also required. Locations of 401 WQCs are included on each watershed map. Examples of activities that may require WQCs include:

- Any disturbance to the stream bed or banks,
- Any disturbance to a wetland,
- The damming of a stream channel to create a pond or lake,

• Placement of any material within a stream, wetland or open water, including material that is necessary for construction, culvert installation, causeways, road fills, dams, dikes or artificial islands, property protection, reclamation devices and fill for pipes or utility lines and

• Temporary impacts including dewatering of dredged material prior to final disposal and temporary fill for access roads, cofferdams, storage and work areas.

Riparian Buffers

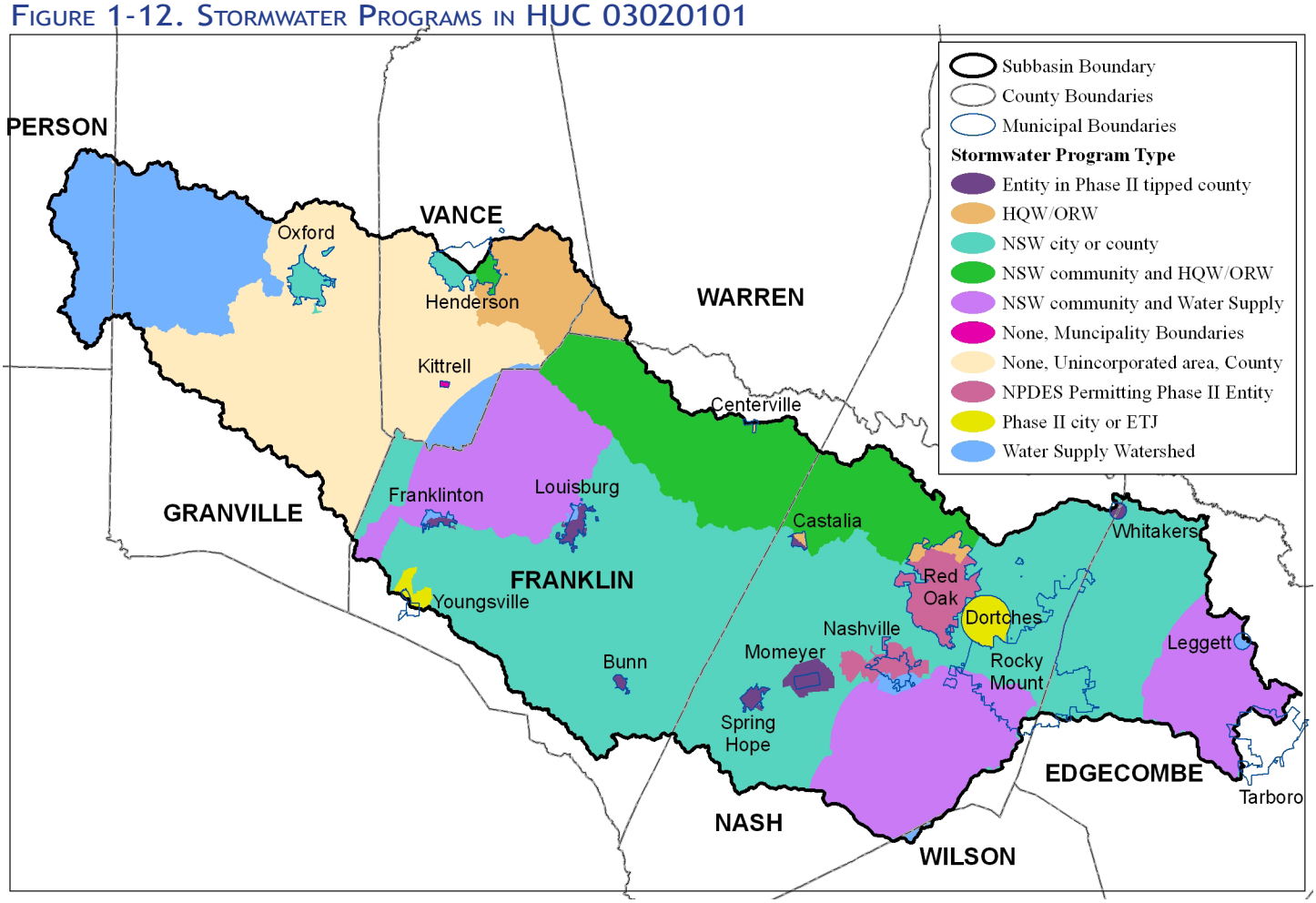
Riparian buffers in the basin are to be protected and maintained on both sides of intermittent and perennial streams, lakes, ponds, and estuarine waters. Tar-Pamlico River Basin Buffer Rules **(15A NCAC 2B.0259)** do not establish new buffers unless the existing use in the buffer area changes. The footprints of existing uses such as agriculture, buildings, commercial, and other facilities, maintained lawns, utility lines, and on-site wastewater systems are exempt. A total of 50 feet of riparian area is required on each side of waterbodies; within this 50 feet, the first 30 feet is to remain undisturbed and the outer 20 feet must be vegetated. Activities that disturb this buffer require a buffer authorization from DWQ or may require a major variance approval from the Environmental Management Commission. More information about the buffer rules are available at: **http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers**.

Stormwater

There are several different stormwater programs administered by DWQ. One or more of these programs affects many communities in the Tar-Pamlico River Basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state through the use of stormwater runoff controls. Active stormwater control programs include Phase II NPDES and State post-construction, coastal stormwater, HQW/ORW stormwater, Tar-Pamlico River Basin NSW stormwater, and Water Supply Watershed Program requirements. Figure 1-12 shows that the different stormwater programs in this subbasin cover over two-thirds of the subbasin.

Henderson, Oxford, and Rocky Mount and Franklin, Nash, and Edgecombe counties are required to implement actions to prevent and treat stormwater runoff under the Tar-Pamlico NSW stormwater rules. These local programs include new development controls to reduce nitrogen runoff by 30 percent compared to pre-development levels and to keep phosphorus inputs from increasing over pre-development levels. Local programs must also identify and remove illicit discharges; educate developers, businesses, and homeowners; and make efforts toward treating runoff from existing developed areas. As of July 2009, there are 55 general stormwater permits and nine individual stormwater permits issued in this subbasin.

Figure 1-12. Stormwater Programs in HUC 03020101



Interbasin Transfers

In 1993, the North Carolina Legislature adopted the Regulation of Surface Water Transfers Act (G.S. §143-215.22L) which was subsequently modified in 2007. This law regulates large surface water transfers between river basins by requiring a certificate from the Environmental Management Commission (EMC). A transfer certificate is required for a new transfer of 2 million gallons per day (MGD) or more and for an increase in an existing transfer by 25 percent or more (if the total including the increase is more than 2 MGD). Certificates are not required for facilities that existed or were under construction prior to July 1, 1993 up to the full capacity of that facility to transfer water, regardless of the transfer amount.

The Kerr Lake Regional Water System (KLRWS) is a regional provider of potable water service for portions of Vance, Granville, Franklin, and Warren counties. KLRWS has an existing grandfathered surface water transfer capacity of 10 MGD that allows the system to move water from the Roanoke River Basin (Kerr Lake) to the Upper Tar and Fishing Creek subbasins. On February 18, 2009, KLRWS submitted a Notice of Intent to Request an Interbasin Transfer (IBT) Certificate to the Environmental Management Commission. The request is to increase the authorized transfer from 10 MGD to 24 MGD, based on water use projections to the year 2040. More information about this project is available from The Division of Water Resources: http://www.ncwater.org/Permits_and_Registration/Interbasin_Transfer/.

Agriculture

Agriculture is NC's leading industry and is especially strong in the Tar-Pamlico River Basin. Nonpoint source pollution from agriculture is a significant source of stream degradation in the Tar-Pamlico River Basin. The approach taken in North Carolina for addressing agriculture's contribution to the nonpoint source water pollution problem is to primarily encourage voluntary participation by the agricultural community and is supported by financial incentives, technical and educational assistance, research, and regulatory programs.

The conversion of agricultural lands to developed lands with impervious surfaces is another potential nonpoint source of pollution. A report by the American Farmland Trust organization identifies this subbasin as having high quality farmland with large areas threatened by development. A map of these areas is available at: http://www.farmland.org/. Some farmers are protecting their land from developement through the Conservation Reserve Enhancement Program (CREP). CREP is a voluntary program utilizing federal and state resources to achieve long-term protection of environmentally sensitive cropland and marginal pastureland. These voluntary protection measures are accomplished through 10-, 15-, 30-year and permanent conservation easements. In this subbasin, there are approximately 3,442 acres in easements, of which 44% are in 30 year or permanent easements.

North Carolina Agriculture Cost Share Program

Financial incentives are provided through North Carolina's Agriculture Cost Share Program, administered by DENR's Division of Soil and Water Conservation to protect water quality by installing BMPs on agricultural lands. In the Upper Tar River Subbasin, $1,441,667 was spent between 2003-2008 on BMPs to reduce nonpoint source pollution from agriculture. Approximately 16,248 acres were affected by BMPs that prevented an estimated 136,150 tons of soil, 233,067 lbs of nitrogen and 43,979 lbs of phosphorous from running off into surface waters. Animal waste BMPs also accounted better management of an estimated 83,689 lbs of nitrogen and 111,338 lbs of phosphorous.

DWQ's Animal Feeding Operations Unit

The Animal Feeding Operations Unit is responsible for the permitting and compliance monitoring of animal feeding operations across the state. Poultry farms with dry litter waste are not regulated or monitored by DWQ. Table 1-6 summarizes the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight (SSLW) in this subbasin. These numbers reflect only operations required by law to be registered and, therefore, do not represent the total number of animals in the subbasin.

Table 6. Animal Operations in HUC 03020101

Type	# of Facilities	# of Animals	SSLW
Animal Individual	10	9,600	1,296,000
Cattle	4	1,400	1,365,000
Wet Poultry	6	731,600	2,822,400
Swine	24	94,897	14,153,090

*Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service (NRCS) guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

Animal waste is often stored in lagoons before it is applied to fields. Therefore there is concern that several animal operations in the basin may be abandoned without proper closeout of the lagoons. Numerous environmental hazards exist from these lagoons including: ammonia emissions, overflows into surface waters, and groundwater contamination.

A better understanding of groundwater quality in relation to animal feeding operation locations is needed. Often animal operations are located immediately adjacent to surface water bodies. Groundwater that is moving from beneath a facility into the surface water system may transport significant levels of nutrients. However, lack of groundwater quality data at animal operations hampers quantifying their impacts.

Restoration, Protection & Conservation Planning

Population

The 2000 census estimated population for this subbasin is 181,038 and this is expected to increase with the results of the 2010 census. As population increases so does our demand for clean water from aquifer and surface water sources and for the land and water to assimilate wastes. Population estimates for each of the watersheds in this subbasin are listed in Table 1-7.

Table 1-7 Watershed Population Estimates* for HUC 03020101

10-Digit HUC	2000 Population	2000 Population Density (per sq mi)	2010 Estimated Population	2020 Estimated Population	2030 Estimated Population
0302010101	8,405	50	9,866	11,181	12,443
0302010102	26,412	155	29,916	33,198	36,406
0302010103	14,262	103	17,373	20,686	24,103
0302010104	16,259	120	20,563	25,133	29,851
0302010105	18,944	161	20,786	22,618	24,342
0302010106	31,249	156	34,530	37,819	40,952
0302010107	20,389	127	21,973	23,703	25,462
0302010108	5,764	52	5,797	5,836	5,858
0302010109	39,350	375	39,143	38,995	38,739
03020101	181,038	139	199,949	219,172	238,158

*NC Office of State Budget and Management: http://www.osbm.state.nc.us/

Land Use

Land use in this subbasin shows increasing urbanizing areas and a strong agriculture use, both of which continue to place increasing demands on water quality and quantity. Table 1-8 lists the percentage of predominant land cover types within this subbasin (based on 2001 land cover data). A map showing these land types can be found in Appendix 1D.

Table 1-8. Land Cover Percentages in HUC 03020101

Land Cover Type	Percent
Developed Open Space	6.53
Developed Low Intensity	1.76
Developed Medium Intensity	0.61
Developed High Intensity	0.22
Total Developed	9.12
Bare Earth Transition	0.19
Deciduous Forest	24.74
Evergreen Forest	16.04
Mixed Forest	5.64
Total non-Wetland Forest	46.42
Scrub Shrub	1.75
Grassland Herbaceous	7.03
Pasture Hay	16.52
Cultivated Crops	12.15
Total Agriculture	28.68
Woody Wetlands	6.55
Emergent Herbaceous Wetland	0.26
Total Wetlands	6.81

Local Initiatives & Conservation Planning

Resources & Guides

NCDENR's One North Carolina Naturally initiative promotes and coordinates the long-term conservation of North Carolina's threatened land and water resources. Each DENR division specializes in management of a specific natural resource, while a collaborative coordination and planning process results in cost-effective implementation and management of multiple resources. Natural resource planning and conservation provides the science and incentives to inform and support conservation actions of North Carolina's conservation agencies and organizations. The Conservation Planning Tool was developed to assist in building partnerships through the exchange of conservation information and opportunities, support stewardship of working farms and forests, inform conservation actions of agencies and organizations, and guide compatible land use planning. A link to the interactive map view is found here: http://www.onencnaturally.org/pages/ConservationPlanningTool.html.

Conservation planning is important on a local level to protect natural resources that provide recreational, aesthetic, and economic assets important to community growth and sustainability. The NC Wildlife Resource Commission has developed a Green Growth Toolbox: http://www.ncwildlife.org/greengrowth/, to assist municipalities to grow in nature-friendly ways. The tools provide assistance with using conservation data, green planning, green ordinances and green development and site design. Also, a guide to help local governments protect aquatic ecosystems while streamlining environmental review is available here: http://www.ncwildlife.org/planningforgrowth/swimming_with_the_current.pdf.

Land conservation, accompanied with stream restoration projects can be very successful at protecting water quality. Prevention and protection activities are known to be more cost effective than retrofits and restoration. DWQ strongly encourages conservation in this watershed. Local land trusts can help landowners explore conservation options and identify potential funding sources. For more information about land trusts in North Carolina see the Conservation Trust for North Carolina at: http://www.ctnc.org/site/PageServer. With the assistance of the Tar-River Land Conservancy and several state and federal agencies ~9,837 acres are protected within this subbasin, much of which are riparian buffers.

Local Initiatives

DWQ has authority to enforce the Clean Water Act and to develop state regulations to protect water quality. However, local governments can also regulate and promote activities that protect water quality. Several local governments provided information on local activities, ordinances, and concerns about protecting their natural resources and water quality. The following information reflects projects and practices on a local level that protect water quality:

Bunn Middle School Stream Restoration Project

This project was funded through the EPA Section 319 Program in the amount of $46,600. The primary objective of this project was to address the severe sedimentation problems that existed on the Bunn Middle School campus and negatively impacted water quality in an unnamed tributary of Crooked Creek. The project's goal was to restore degraded waters by implementing best management practices (BMPs) to directly reduce sediment delivery to the tributary. Additional benefits are anticipated as many of the implemented BMPs also prevent off-site movement of pesticides, phosphorus, nitrogen, and fecal coliform. Since implementation, stream bank stability and habitat conditions have shown improvements. This site also provides an excellent learning opportunity for students and the community about nonpoint source pollution, water quality, and conservation practices. A detailed final report is available from DWQ's 319 website: http://h2o.enr.state.nc.us/nps/2004Projects.htm.

Tar River Riparian Corridor Conservation Design Implementation

This project was funded through the EPA Section 319 Program in the amount of $702,900. Tar River Land Conservancy (TRLC) was chartered in 2000 as a regional land trust in an eight county region of the Upper Tar River Basin. Working voluntarily with private landowners to protect working farms and riparian corridors through perpetual conservation easements is critically important in the Upper Tar River Basin due to its nationally significant aquatic biodiversity. Project implementation has targeted land owners along the Upper Tar River, Fishing Creek, Sandy Creek, Swift Creek, and Stony Creek, resulting in 49 conservation easements. Five conservation easement projects are considered ongoing with the anticipation that additional acres and stream frontage will be protected through perpetual conservation easements. Conservation easements were signed protecting 3,441 acres and an additional 39.6 miles of streams are protected with permanent forested riparian buffers.

City of Rocky Mount

While the City of Rocky Mount does not have any LID or Green Growth specific ordinances, the application of the Tar-Pamlico NSW and NPDES Phase II rules necessitate that developers

and builders utilize such practices. Specifically, many developers choose to provide permanent conservation easements in order to meet nutrient reduction requirements under the Tar-Pamlico rules. Additionally, the City of Rocky Mount requires detention of the 10 year/24-hour and 25- year/24-hour storms.

In reference to stormwater controls, the City applies a holistic approach to overseeing development activities. Prior to construction, the City's Stormwater Engineer reviews Sediment and Erosion Control Plans (S&EC) and overall site plans for adherence to S&EC ordinances, as well as stormwater management requirements. During construction, inspectors monitor sites for compliance with approved S&EC plans, issue inspection reports, and, if needed, the Stormwater Engineer issues NOVs to non-complying property owners. Upon completion, the city requires as-built drawings for all stormwater BMPs and infrastructure to ensure that improvements installed are consistent with those designed. Finally, after construction is complete, the City assumes responsibility for BMPs located within residential subdivisions. For commercial BMPs, the property owners are required to submit an annual inspection report. The owners of BMPs are required to enter into an Operation and Maintenance Agreement with the City, thus ensuring long term maintenance for the BMP is provided. However, maintenance of these documents (i.e., ensuring that new agreements are entered into when property changes hands) continues to be a challenge. Post construction operation and maintenance is and will continue to be the most challenging aspect of administration of the NPDES and Tar-Pamlico rules. Continued education about implementing the NSW strategy and Phase II from DWQ is necessary.

Franklin County

The County's adopted Unified Development Ordinance states: "The purpose of flexible development is to preserve agricultural and forestry lands, natural and cultural features, and rural community character that might be lost through conventional development approaches. To accomplish this goal, greater flexibility and creativity in the design of such developments is encouraged and allowed."

Franklin County has adopted stormwater ordinances and enforces the Tar-Pamlico NSW regulations, but does not enforce erosion and sedimentation control plans. In 2008, the County contracted with NC State Watershed Education for Communities and Officials program (WECO) to initiate a stakeholder process to ascertain ways to better improve water quality within the County. The main recommendation from the stakeholder process was for the County to initiate its own erosion and sedimentation control program in accordance with current state regulations. However, due to current economic trends, funding for the implementation of a County erosion and sedimentation program has been delayed.

Franklin County does not conduct water quality sampling. The County has identified certain streams as candidates for stream restoration and is working with the Franklin County Conservation District as well as the Tar River Land Conservancy to identify areas for restoration and protection. Additionally, a watershed plan was recently completed for Cypress Creek that identified multiple sites for restoration and or protection.

Erosion and Sedimentation Control

The Sedimentation Control Commission was created to administer the Sedimentation Control Program pursuant to the **N.C. Sedimentation Pollution Control Act of 1973**. It is charged with adopting rules, setting standards, and providing guidance for implementation of the Act. The Division of Land Resources (DLR) is the primary agency responsible for managing land disturbing activities that have the potential to violate the Sedimentation Pollution Control Act. For those land disturbing activities, an Erosion and Sedimentation Control Plan must be approved by DLR prior to land disturbing activities. Due to the large number of land disturbing activities and the limited number of DLR staff available to do inspections, cities and counties have been encouraged to adopt a local erosion and sediment control ordinance in compliance with State

requirements. The Sedimentation Control Commission can then delegate the local government authority to administer the erosion and sedimentation control program within its jurisdiction. The local programs' staff then performs plan reviews and enforces compliance with plans within their jurisdictions. Within this subbasin the Cities of Henderson and Rocky Mount have local erosion and sediment control ordinances and Franklin County is considering developing a local program.

Construction Grants and Loans

The NC Construction Grants and Loans (CG&L) Section of DWQ provides grants and loans to local government agencies for construction, upgrades, and expansion of wastewater collection and treatment systems. As a financial resource, the Section administers five major programs that assist local governments. Of these, two are federally funded programs administered by the State, Clean Water State Revolving Fund (SRF) Program and the State and Tribal Assistance Grants (STAG). The STAG is a direct congressional appropriation for a specific "special needs" projects within NC. The High Unit Cost Grant Program, the State Emergency Loan (SEL) Program, and the State Revolving Loan (SRL) Program are state funded programs, with the later two being below market revolving loan money. The Section also received an additional $70,729,100 Capitalization Grant authorized by the American Recovery and Reinvestment Act of 2009. These funds are administered according to existing SRF procedures. All projects must be eligible under Title VI of the Clean Water Act. For more information please see the CG&L webpage at: **http://portal.ncdenr.org/web/wq/cgls/news**. Projects currently underway in this subbasin are listed in Table 1- 9.

Table 1-9. CG&L Projects in HUC 03020101

Location	Project Description	Date	~Amount
Youngsville	Cripple Creek sewer replacement	5/18/2009	$919,280
Oxford	Install 24" effluent outfall parallel to existing 21" effluent outfall for WWTP improvement; Expansion to 3.5 MGD from 2.17 MGD.	3/10/2005	$1,823,148
Rocky Mount	Tar River Regional Wastewater Treatment Plant digester mixing and aeration improvements	9/15/2005	$3,595,500
Rocky Mount	Headworks improvements	8/6/2004	$1,177,000
Oxford	WWTP upgrade and expansion to 3.5 MGD	12/15/2003	$7,934,580
Henderson	Upgrade to Red Bud pump station	Not yet made	$112,780
Granville County	Sewer Service to Wilton School	3/6/2002	$952,000
Louisburg	Rehab & Reuse	7/29/2002	$2,295,500
Nash County	New interceptor and collection lines	4/24/2001	$2,870,000
Franklinton	New collection lines	1/4/2000	$1,280,000

Clean Water Management Trust Fund

Created in 1996, the Clean Water Management Trust Fund (CWMTF) makes grants to local governments, state agencies, and conservation non-profits to help finance projects that specifically address water pollution problems. The fund has made several investments in the Upper Tar River Subbasin. Table 1-10 includes a list of recent projects and their cost. These projects include several land acquisitions.

Table 1-10. Clean Water Management Trust Fund Projects in HUC 03020101

Application ID	Proposed Project Description	Amount Funded	County
2003D-005 Tar River Land Conservancy - Donation Minigrant, Brittain Tract/ Lynch Creek	Minigrant to pay for transactional costs for a donated easement on 39 acres along Lynch Creek.	$12,400	Franklin

Application ID	Proposed Project Description	Amount Funded	County
2004A-407 Franklin Soil & Water Conservation District - Rest./ Hog Lagoon Closeout, Sandy Creek	Fund the close out of a failing abandoned egg layer waste lagoon and eliminate its input of fecal coliform bacteria and nutrient inputs into Deer Branch and Sandy Creek. Protect 33 acres through a permanent conservation easement.	$335,000	Franklin
2004B-602 Edgecombe Water & Sewer District #5 - Septic/ Leggett Septic Tanks, Swift Creek	Reduce fecal coliform and nitrogen loading to Swift Creek by hooking up 72 septic tank systems (includes 66 failing), removing 2 school package WWTPs, and 1 school septic system. Reroute wastewater to the Rocky Mount WWTP for treatment.	$2,945,000	Edgecombe
2004D-011 Tar River Land Conservancy - Donated Minigrant, Taylor Tract	Minigrant to pay for transactional costs for a donated permanent conservation easement on 140 acres along the Tar River.	$19,675	Franklin
2005B-048 Tar River Land Conservancy - Acq/ Blackley Farm Tract, Tar River	Protect through a permanent conservation easement 266 riparian ac along the Tar River & tribs, a Nationally Significant Aquatic Habitat. Conservation easement will conform to CWMTF's Working Forest easement and be partially funded by USDA Farm & Ranchland Preservation Program.	$471,000	Granville
2005B-050 Tar River Land Conservancy - Acq/ Perry Tract, Sandy Creek	Protect through purchase of a permanent conservation easement 70 riparian ac along Sandy Creek. Landowner to donate working farm and forestry easement on upland 128 acres. Tract is within the Nationally Significant Swift Creek Aquatic Habitat.	$219,000	Franklin
2005B-051 Tar River Land Conservancy - Acq/ Thorp Tract, Fox Creek	Protect through purchase of a permanent conservation easement 75 riparian ac along Fox Creek, a State Significant Aquatic Habitat. Landowner donated conservation easement on upland 400 acres. Compliments nearby EEP projects.	$306,000	Granville
2005B-052 Tar River Land Conservancy - Acq/ Wood Farm Tract, FRPP, Sandy Creek	Protect through purchase of a permanent CWMTF Working Forest CE 314 riparian ac along Sandy Ck. CWMTF to purchase CE on 114 ac. Funding from USDA Farm & Ranch Land Protection Program and landowner donation to protect additional 200 acres.	$345,000	Franklin
2005M-009 Conservation Fund - Minigrant/ Gateway Wetland, Rock Spring	Minigrant to pay for acquisition and transactional costs associated with the fee simple purchase of a one-acre wetland in the headwaters of Rock Spring.	$18,000	Vance
2006A-008 Conservation Trust for North Carolina - Acq./ Averette Tracts 1-9, Tar River	Protect 513 ac along the Tar River through purchase of a working forest conservation easement on the riparian 201 ac (CWMTF funds) & a Farm and Ranchland Preservation Program easement on the remaining 312 ac. Protects a Nationally Significant Aquatic Habitat.	$716,000	Granville
2006A-009 Conservation Trust for North Carolina - Acq./ Averette Tracts 10&12, Tar River	Protect through purchase of a permanent conservation easement 108 ac along the Tar River & Fishing Creek. CWMTF funds to purchase CE on 21 riparian ac & landowner to donate an easement on 87 upland ac. Protects a Nationally Significant Aquatic Habitat.	$117,000	Granville
2006A-022 Nature Conservancy, The - Acq /IP Timber Tracts, Upper Tar River; 19 Tracts (Transferred to NC WRC)	Protect through fee simple purchase 9,165 acre along Shocco & Fishing Creeks. Tracts to become part of Shocco Creek Game Land. Project aids in the protection of rare aquatic species & a Nationally Significant Aquatic Habitat.	$9,136,313	Nash

Application ID	Proposed Project Description	Amount Funded	County
2006A-044 Tar River Land Conservancy- Acq./ Jones Farm, Flatrock Creek	Protect a total of 73 ac, including 16 riparian acres, along Flatrock Creek through permanent conservation easements (16 ac purchased and 57 ac donated). Tract aids protection of rare aquatic species & a Significant Aquatic Habitat.	$62,000	Franklin
2006A-803 Bunn, Town of - Plan/ WW/ Engineering Report on I&I Evaluation, Crooked Creek	Produce Preliminary Engineering Report on WWTP upgrade needs to reduce infiltration and inflow into the Town's sanitary sewer system. Complete sanitary sewer video inspection and smoke testing of the remainder of the sewer system.	$24,000	Franklin
2006B-608 Rocky Mount, City of - Septic/ Legget Park, Tar River	Design, permit & construct approx 3,960 lf of gravity sewer collection lines & pumping station to transport waste from 82 homes (with 74 failing septic systems) to the City's WWTP. Will reduce untreated wastewater discharges to Tar River by 37,500 gpd.	$512,000	Edgecombe
2006D-002 Tar River Land Conservancy- Donated Mini/ Martha Morton Tract, Tar River	Minigrant to pay for transactional costs for a donated easement on 181 acres along Fox Creek, a tributary of Shelton Creek. Fox Creek is a state significant aquatic natural area.	$25,000	Granville
2006D-003 Tar River Land Conservancy- Donated Mini/ Goodfred Tract, Tar River	Minigrant to pay for transactional costs for a donated easement on 147 acres along the Tar River.	$25,000	Edgecombe
2006D-004 Tar River Land Conservancy- Donated Mini/ Jane Morton Tract, Tar River	Minigrant to pay for transactional costs for a donated easement on 320 acres along the Tar River.	$25,000	Granville
2006D-007 Tar River Land Conservancy- Donated Mini/ Wilde Tract, Tar River	Minigrant to pay for transactional costs for a donated easement on 10.5 acres along the Tar River Reservoir.	$21,725	Nash
2006D-008 Tar River Land Conservancy- Donated Mini/ Perry,Bagwell,Powell Tracts; Tar River	Minigrant to pay for transactional costs for a donated easement on 67 acres along the Tar River.	$25,000	Granville
2006D-026 Tar River Land Conservancy- Donated Mini/ Lynch Creek Farm, Lynch Creek	Minigrant to pay for transactional costs for a donated easement on a 54-acre tract on Lynch Creek.	$20,800	Franklin
2006D-034 Tar River Land Conservancy- Donated Mini/ Jenkins Farm, Sand Creek	Minigrant to pay for transactional costs for a donated easement on a 116-acre tract on Sand Creek and tributaries.	$25,000	Granville
2006M-003 Tar River Land Conservancy- Minigrant; Daniels Tract, Big Peachtree Creek	Minigrant to pay for pre-acquisition costs associated with acquisition of a conservation easement on the 26 acre Daniels tract on Big Peach Creek	$2,575	Franklin
2006M-004 Tar River Land Conservancy- Minigrant; Foster Tract, Sandy Creek	Minigrant to pay for pre-acquisition costs associated with the future purchase of an approximately 20 acre conservation easement on the Martin Foster tract on Sandy Creek.	$3,100	Vance
2007-053 Tar River Land Conservancy - Acq/ Barnes - Goode Tract, Knaps of Reeds Creek	Protect through conservation easements 105 acres along Knap of Reeds Cr. The property borders Butner Military Training Camp.	$263,000	Granville
2007-054 Tar River Land Conservancy - Acq/ Daniels Farm Tract, Big Peachtree Creek	Protect through conservation easement 49 acres, including 26 riparian acres along Big Peachtree Cr. The project would protect rare aquatic species and was identified as a priority in a Riparian Corridor Plan.	$135,000	Franklin

Application ID	Proposed Project Description	Amount Funded	County
2007-512 Franklinton, Town of - WW/ I&I and Collection Rehabilitation, Cedar Creek	Design, permit and replace or rehabilitate portion of sewer system. The project will reduce I/I and overloading and overflows at pump stations with will improve water quality in Cedar Cr	$1,030,000	Franklin
2007-540 Spring Hope, Town of - WW/ Collection System Rehabilitation, Sapony Creek	Design, permit and repair 5 pump station, rehabilitate portion of sewer system, and repair the WWTP to improve performance and compliance with NPDES permit	$840,000	Nash
2007-617 Red Oak, Town of - Septic/ Red Oak Schools Septic Tank Elimination, Stony and Swift Creeks	Design and permit the construction of pump station and force main to eliminate septic systems at 2 schools and connect to Rocky Mount	$74,000	Nash
2007-810 Franklin County - Plan/ Storm/ Cypress Creek Watershed Assessment		$45,000	Franklin
2007D-010 Tar River Land Conservancy - Donated/Mini/ Knoop-Pfister Tract, Aycock Creek	Minigrant to pay for transactional costs for a donated easement on a 67-acre tract on Aycock Creek.	$25,000	Granville
2008-070 Tar River Land Conservancy - Acq/ Morton Tract, Tar River	Protect through conservation easement 106 acres, including 42 riparian acres along Tar R and unnamed tributaries. The project will protect Nationally Significant Aquatic Habitat and rare aquatic species.	$228,000	Vance
2008-071 Tar River Land Conservancy - Acq/ Whitfield Farm, Cedar Creek	Protect through conservation easement 325 acres, including 40 riparian acres along Cedar Cr. Upland acres will be protected by easement held by land trust.	$283,000	Franklin
2008-543 Youngsville, Town of - WW/ Sewer Rehabilitation, Hattles Branch	Design, permit and rehabilitate a portion of a sewer system to mitigate overflows, and improve water quality in Hattles Br.	$734,000	Franklin
2008D-001 Butner, Town of - Mini (pre-acquisition)/ Lake Holt Tract, Knap of Reeds Creek	Minigrant to pay for transactional costs for a donated easement on a 1,656 acre tract along Knapp of Reeds Cr and Lake Holt.	$25,000	Granville

This list does not include regional or statewide projects that were in multiple river basins, or projects that were funded and subsequently withdrawn.

Section 319-Grant Program

The Section 319 Grant Program was established to provide funding for efforts to reduce nonpoint source (NPS) pollution, including that which occurs though stormwater runoff. The EPA provides funds to state and tribal agencies, which are then allocated via a competitive grant process to organizations to address current or potential NPS concerns. Each fiscal year, North Carolina is awarded nearly 3 million dollars to address NPS pollution through its 319 Grant Program. Thirty percent of the funding supports ongoing state nonpoint source programs. The remaining 70% is made available through a competitive grant process. Table 1-11 list the most current 319 contracts in this Subbasin, more information can be found about these contracts and the 319 Grant Program: http://portal.ncdenr.org/web/wq/ps/nps/319program.

Table 1-11. 319 Grant Contracts

Fiscal Year	Contract Number	Name	Description	Agency	Funding
2004	EW05021	Upper Tar Riparian Corridor Conservation Design	Conservation Easement & Protection Project	Tar River Land Conservancy	$702,900

Fiscal Year	Contract Number	Name	Description	Agency	Funding
2004	EW07037	Bunn Middle School Stream Restoration Project	BMP Implementation	Franklin SWCD	$46,600
2006	EW07042	Tar Pamlico Coordinator	Agricultural Staffing	DSWC	$89,182
See Local Initiatives for more information on the Bunn Middle School and Upper Tar Riparian Corridor Projects					

Recommendations

- More research is needed to understand the amount nutrients entering the Tar River and its tributaries through baseflow and how this contribution can be managed. The NSW strategy targets point and some nonpoint source nutrient contributions to surface waters; however, some nonpoint sources are not specifically addressed in the strategy. Nutrients from non-discharge spray field systems, wastewater residual applications, septic systems, animal feeding operations, dry litter poultry farms, and tiled agriculture may all be contributing to nutrient loads in surface waters via groundwater. DWQ's Aquifer Protection Planning Unit is currently compiling a few select watershed-scale estimates of total nutrient loads from permitted land application facilities which will help determine the potential nutrient loading magnitude.

- Identify sources of organic nitrogen that could be contributing to the increase in basinwide TKN concentrations. Basinwide, the ammonia component of TKN shows a decrease in concentration since 1991; however, in this subbasin ammonia concentrations have remained fairly constant. Also TKN has steadily risen since 1997, indicating an increase in organic nitrogen.

- Total phosphorus concentrations have increased over an 11 year time period, this may be related to an increase in development, soil erosion, and general increase in population. The Tar-Pamlico NSW strategy requires no increase in phosphorus loads from the 1991 conditions. To achieve this reduction, older laws should be examined to identify where new technology alternatives may be able to assist in meeting nutrient goals (e.g., G.S 143-214.4. prohibits certain cleaning agents from containing phosphorus, household dishwashing machine detergent is exempt.) Several states have recently **banned phosphorous** in dishwasher detergent and lawn fertilizers.

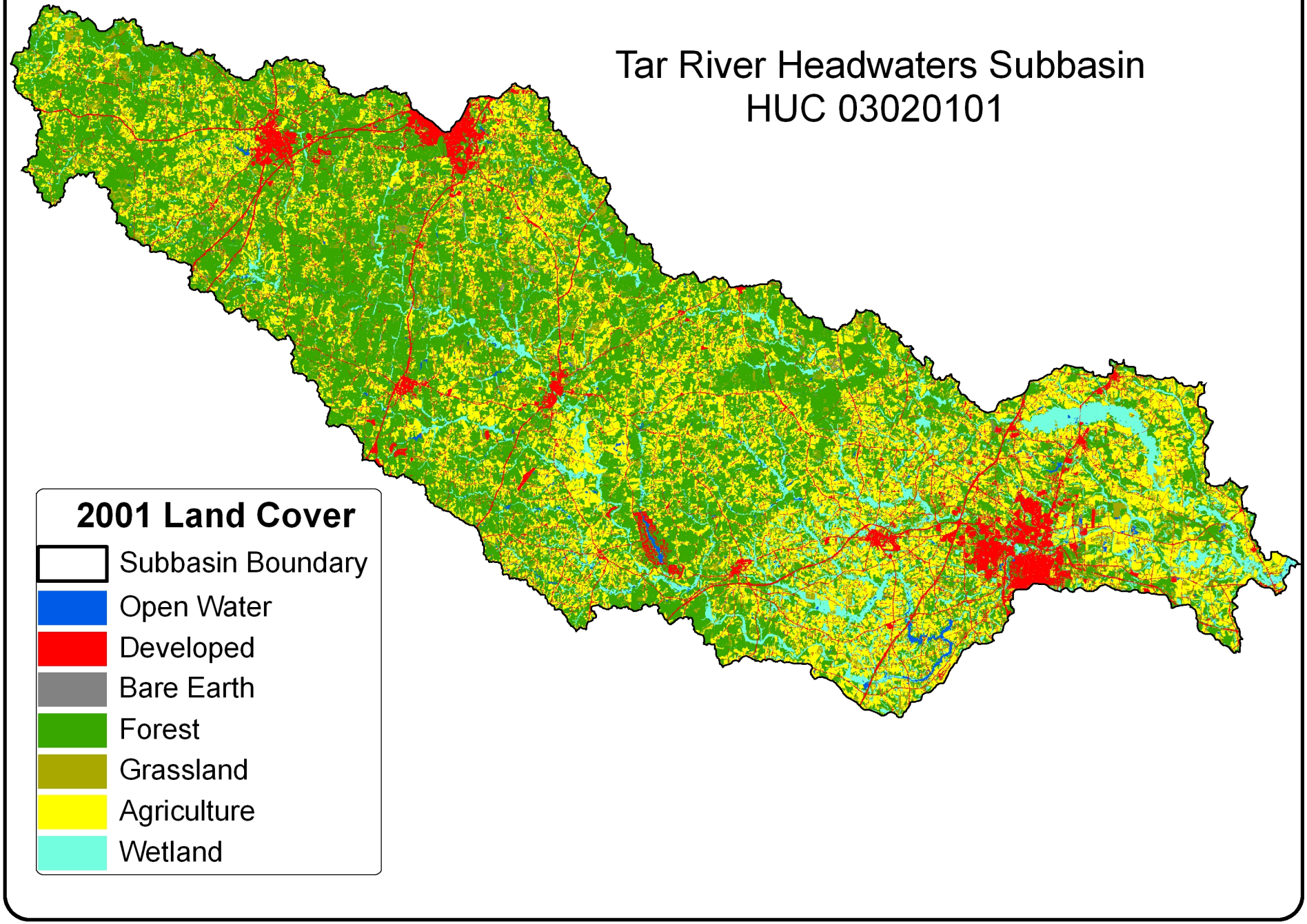
- Explore development of a more comprehensive basinwide stormwater management to prevent uncontrolled development in areas currently exempt from stormwater regulations and to protect watersheds with threatened and endangered species.

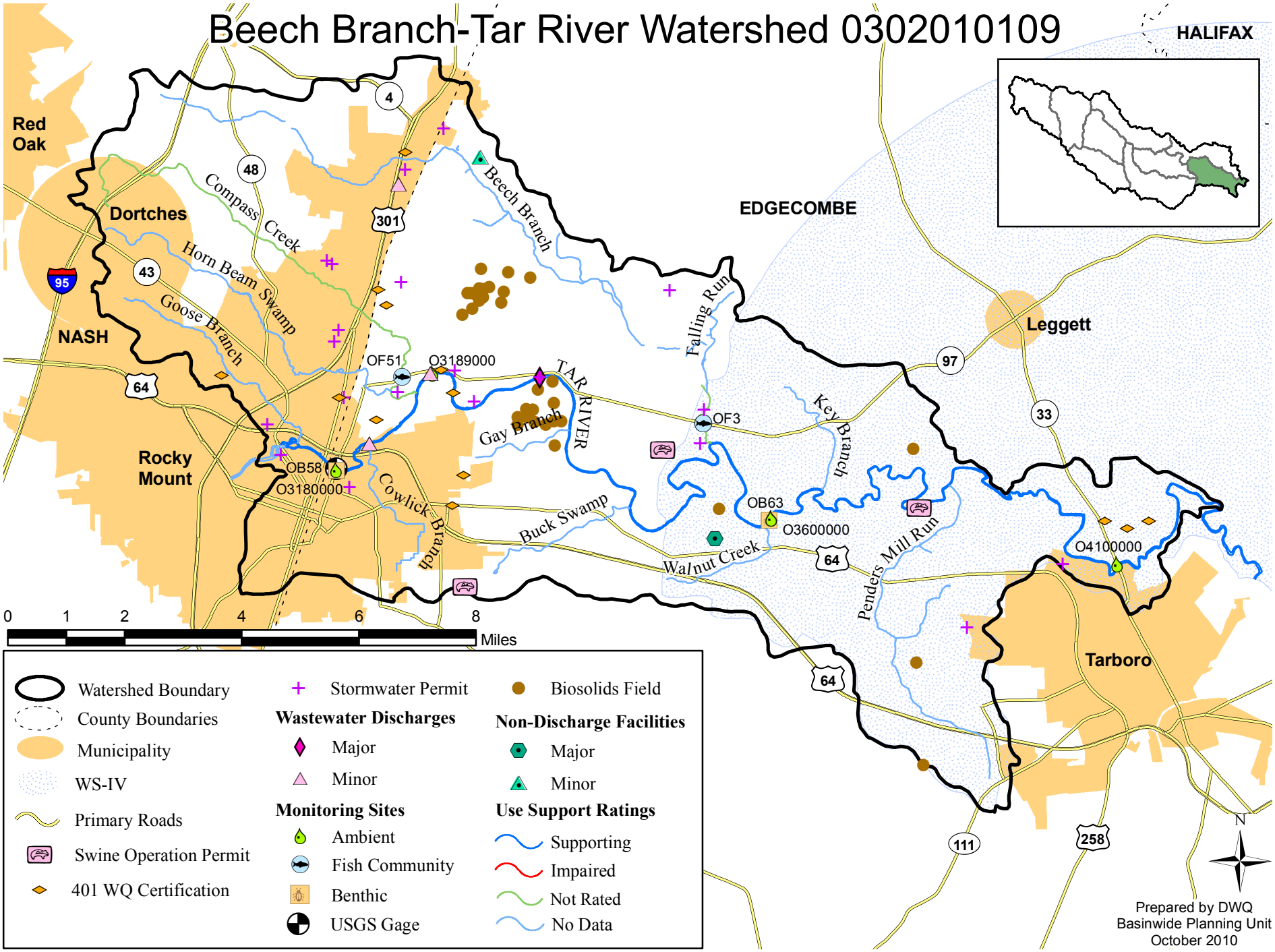
- Continue to work with advising agencies on developing a site-specific management plan, a statewide mussel protection plan or ORW/HQW protection for the threatened and endangerd mussel species in this subbasin.

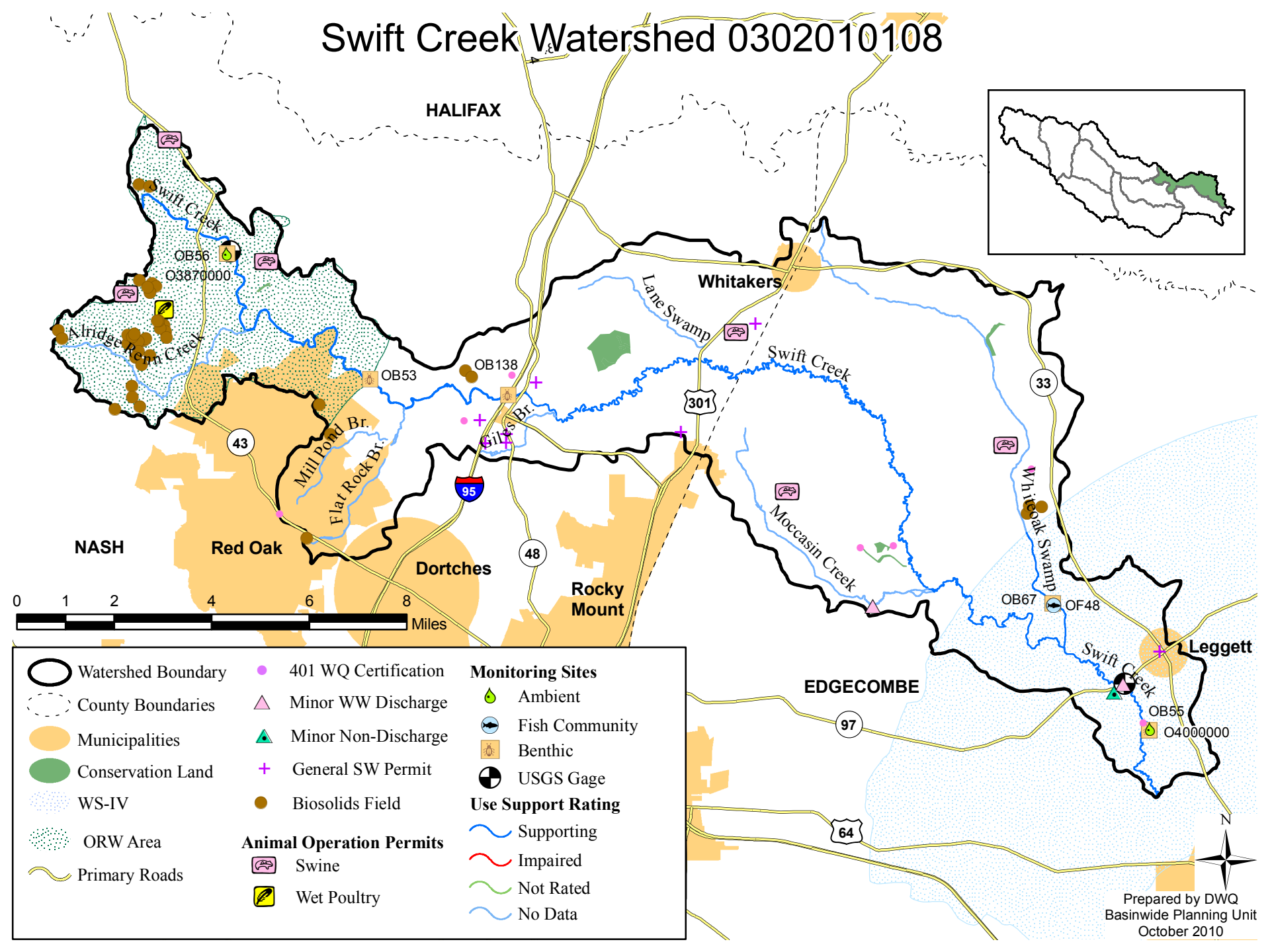
References

American Farmland Trust. Farming on the Edge: North Carolina State Map. http://www.farmland.org/resources/fote/states/map_northcarolina.asp.

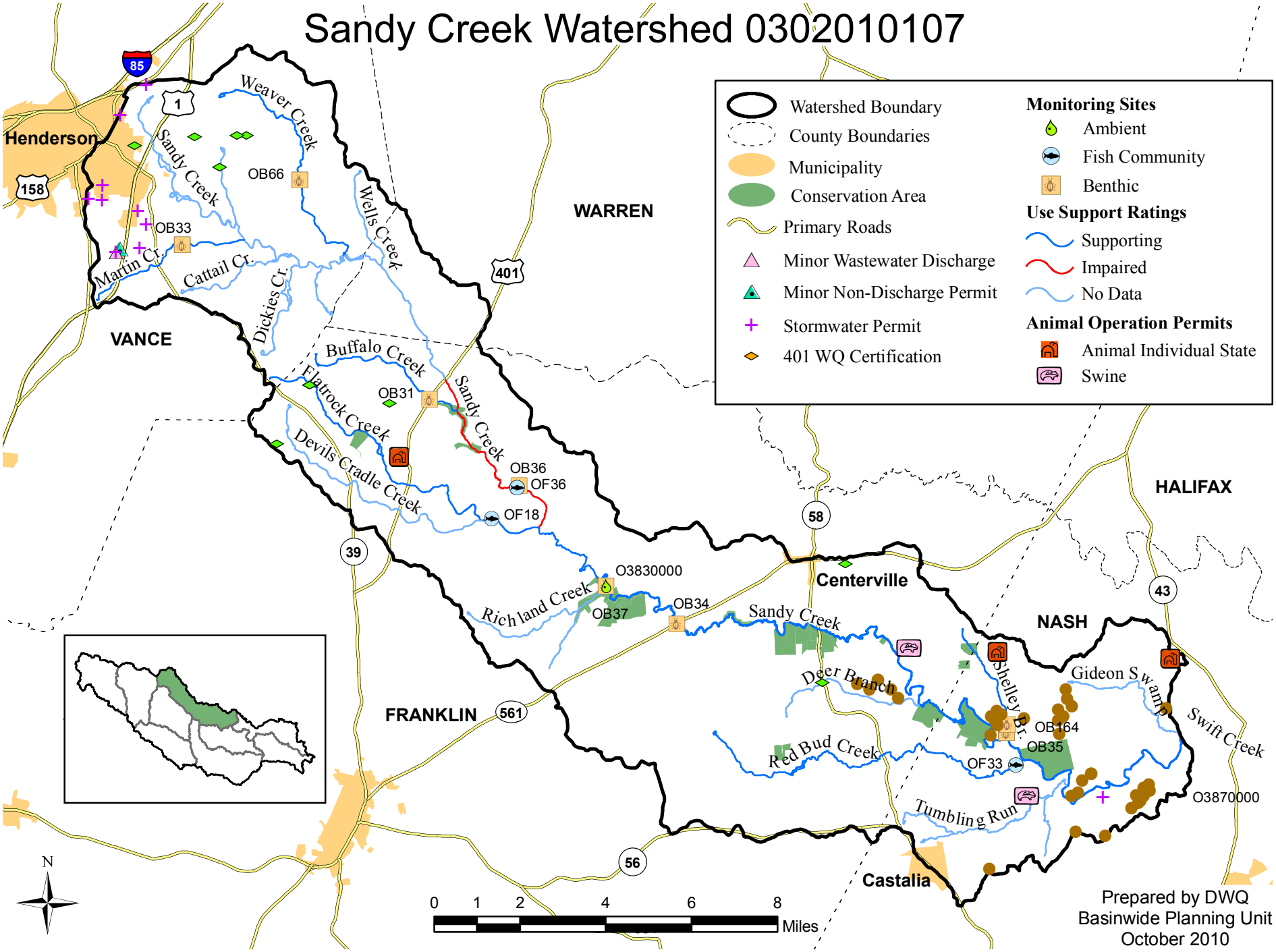
Pradhan, S.S., Hoover, M.T., Austin, R.E. and H. A. Devine. 2007. *Potential Nitrogen Contributions from On-site Wastewater Treatment Systems to North Carolina's River Basins and Sub-basins* Technical Bulletin 324. North Carolina Agricultural Research Service North Carolina State University Raleigh, NC.


Tar River Headwaters Subbasin
HUC 03020101
2001 Land Cover
Subbasin Boundary
Open Water
Developed
Bare Earth
Forest
Grassland
Agriculture
Wetland

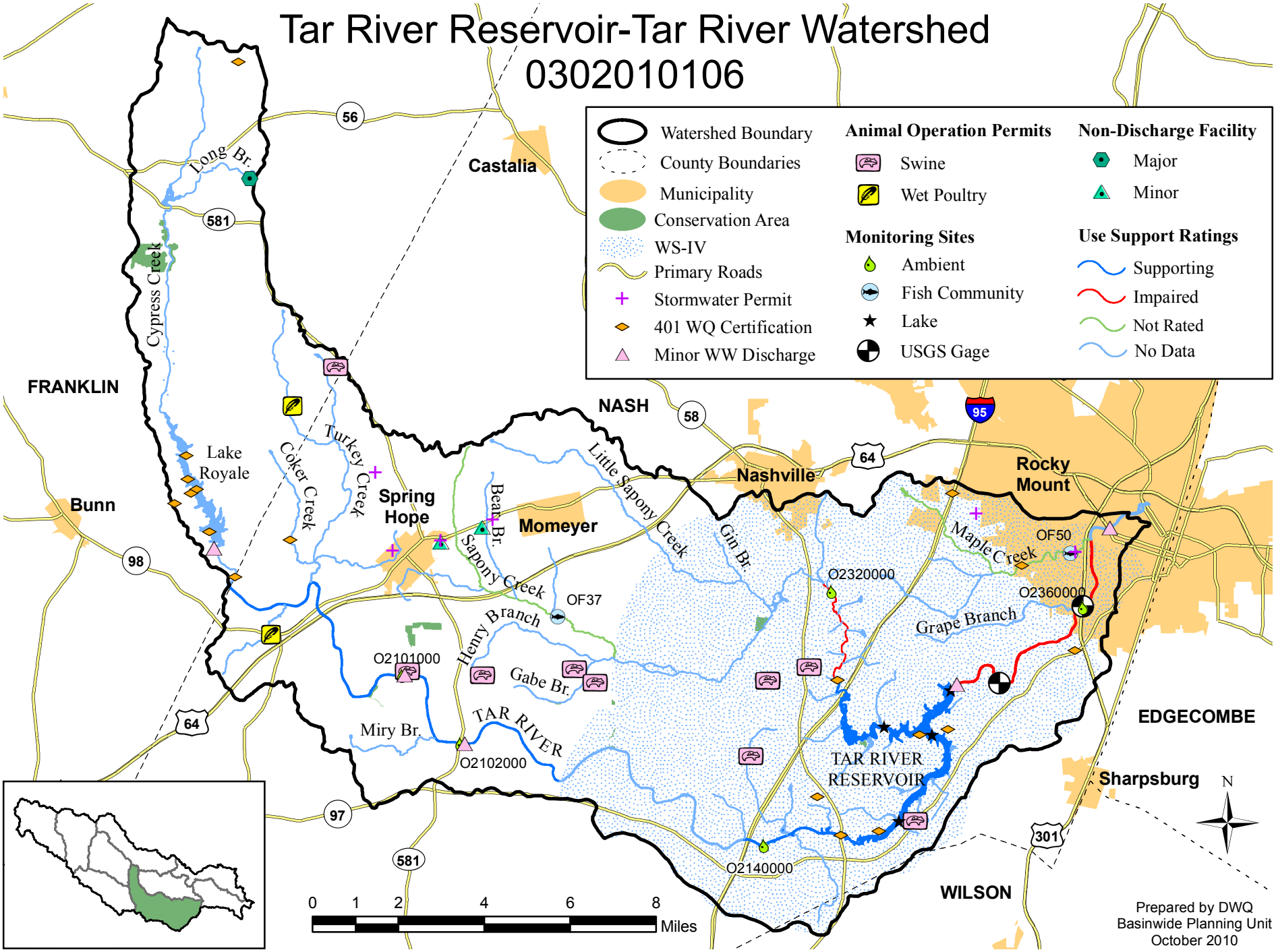

Beech Branch-Tar River Watershed 0302010109
HALIFAX
EDGECOMBE
Red Oak
Dortches
NASH
Rocky Mount
Leggett
Tarboro
Compass Creek
Horn Beam Swamp
Goose Branch
Beech Branch
Falling Run
TAR RIVER
Gay Branch
Cowlick Branch
Buck Swamp
Walnut Creek
Key Branch
Penders Mill Run
OF51
O3189000
OF3
OB58
O3180000
OB63
O3600000
O4100000
4
48
301
43
95
64
97
33
111
258
0 1 2 4 6 8
Miles
Watershed Boundary
County Boundaries
Municipality
WS-IV
Primary Roads
Swine Operation Permit
401 WQ Certification
Stormwater Permit
Wastewater Discharges
Major
Minor
Monitoring Sites
Ambient
Fish Community
Benthic
USGS Gage
Biosolids Field
Non-Discharge Facilities
Major
Minor
Use Support Ratings
Supporting
Impaired
Not Rated
No Data
N
Prepared by DWQ
Basinwide Planning Unit
October 2010


Swift Creek Watershed 0302010108
HALIFAX
Swift Creek
OB56
O3870000
Nkridge Rcnn Creek
OB53
OB138
Whitakers
Lane Swamp
Swift Creek
301
33
Gills Br.
Mill Pond Br.
Flat Rock Br.
43
95
48
NASH
Red Oak
Dortches
Rocky Mount
Moccasin Creek
Whiteoak Swamp
OB67
OF48
Leggett
Swift Creek
OB55
O4000000
EDGECOMBE
97
64
0 1 2 4 6 8
Miles
N
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
WS-IV
ORW Area
Primary Roads
401 WQ Certification
Minor WW Discharge
Minor Non-Discharge
General SW Permit
Biosolids Field
Animal Operation Permits
Swine
Wet Poultry
Monitoring Sites
Ambient
Fish Community
Benthic
USGS Gage
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Prepared by DWQ
Basinwide Planning Unit
October 2010

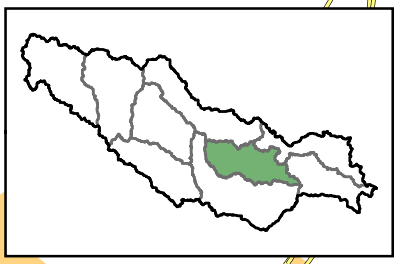
Sandy Creek Watershed 0302010107



Tar River Reservoir-Tar River Watershed
0302010106



Stony Creek Watershed 0302010105



Watershed Boundary
County Boundaries
Municipalities

Use Suport Rating
Supporting
Impaired
Not Rated
No Data

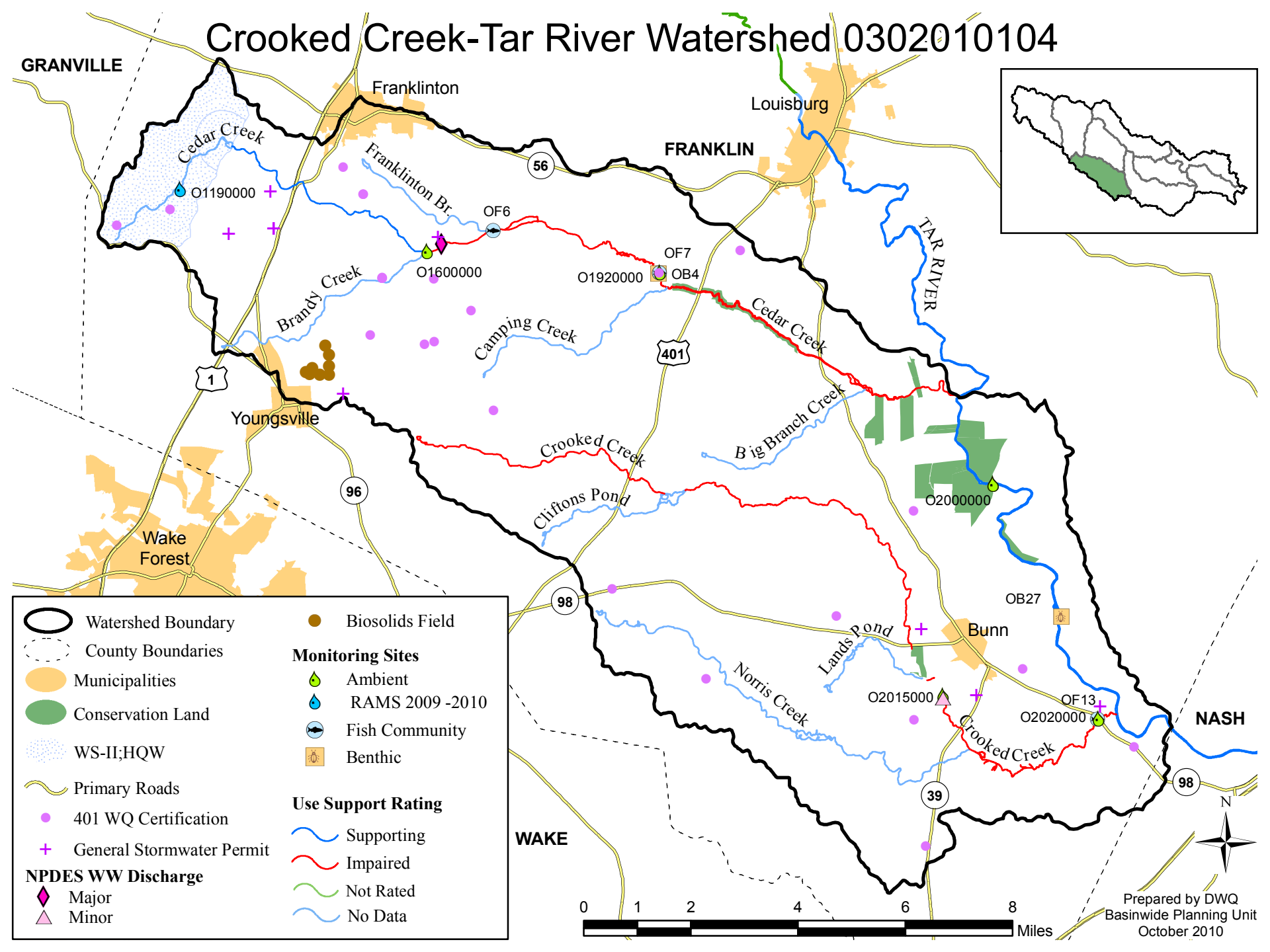
Conservation Land
Primary Roads
Biosolids Field

Monitoring Sites
Ambient
Fish Community
Benthic
USGS Gage

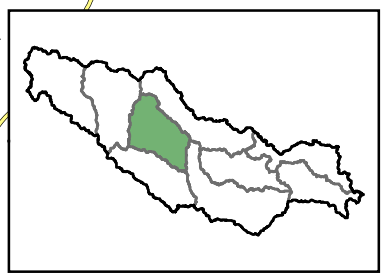
401 WQ Certification
Stormwater Permit

Animal Operation Permits
Animal Individual
Wet Poultry
Swine
Cattle

Prepared by DWQ
Basinwide Planning Unit
October 2010


Crooked Creek-Tar River Watershed 0302010104
GRANVILLE
Franklinton
Louisburg
FRANKLIN
Cedar Creek
Franklinton Br.
O1190000
OF6
O1600000
OF7
O1920000
OB4
Brandy Creek
Camping Creek
Cedar Creek
TAR RIVER
56
401
1
Youngsville
Crooked Creek
B ig Branch Creek
Cliftons Pond
O2000000
96
Wake Forest
98
OB27
Lands Pond
Bunn
Norris Creek
O2015000
OF13
O2020000
Crooked Creek
NASH
39
WAKE
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
WS-II;HQW
Primary Roads
401 WQ Certification
General Stormwater Permit
NPDES WW Discharge
Major
Minor
Biosolids Field
Monitoring Sites
Ambient
RAMS 2009 -2010
Fish Community
Benthic
Use Support Rating
Supporting
Impaired
Not Rated
No Data
0 1 2 4 6 8
Miles
N
Prepared by DWQ
Basinwide Planning Unit
October 2010

Lynch Creek-Tar River Watershed 0302010103



VANCE
WARREN
Kittrell
Franklinton
Louisburg
FRANKLIN
Gills Little Mill Creek
Lynch Creek
Eaves Creek
Buffalo Creek
Kings Creek
Billys Creek
Tooles Creek
Giles Creek
Bear Swamp Creek
Fox Creek
Sycamore Creek
Coole Creek
Neal Gut
Wolfpen Branch
Jumping Run
TAR RIVER
O1025000
OF27
OB26
O1100000
OB29
39
1
56
561
581
0 1 2 4 6 8 Miles
N

Watershed Boundary
County Boundaries
Municipality
Conservation Land
WS-IV
Primary Roads
Major WW Discharge
Biosolids Field
Stormwater Permit
401 WQ Certification

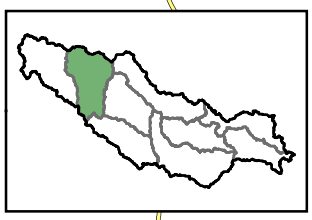
Monitoring Sites
Ambient
Fish Community
Benthic
USGS Gage

Non-Discharge Facility
Major
Minor

Use Support Rating
Supporting
Impaired
Not Rated
No Data

Prepared by DWQ
Basinwide Planning Unit
October 2010

Tabbs Creek-Tar River 0302010102



- Watershed Boundary
- County Boundaries
- Municipality
- Conservation Land
- Primary Roads
- Animal Operation Permit
- Minor Non-Discharge
- 401 WQ Certification
- Biosolids Application Field
- Stormwater Permit

NPDES WW Discharge

- Major
- Minor

Monitoring Sites

- Ambient
- Fish Community
- Benthic
- Lake
- USGS Gage

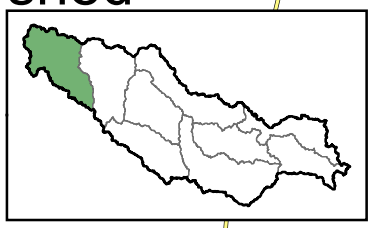
Use Support Rating

- Supporting
- Impaired
- Not Rated
- No Data

0 1 2 4 6 8 Miles

Prepared by DWQ
Basinwide Planning Unit
October 2010

Aycock Creek-Tar River Watershed
0302010101



Heritage Meadows WWTP

OB146

Fox Creek

Shelton Creek

Crooked Run

TAR RIVER

North Fork Tar River

O0057000

OF44

OB19

OF38

OF60

OB144

OB154

OB25

Owen Creek

Cub Creek

Rocky Creek

Cattail Creek

Boulding Creek

Jackson Creek

Bollens Creek

TAR RIVER

Johnson Creek

Aycock Creek

O0100000

PERSON

DURHAM

Oxford

GRANVILLE

Stem

Creedmoor

96

15

158

85

56

0 1 2 4 6 8 Miles

N

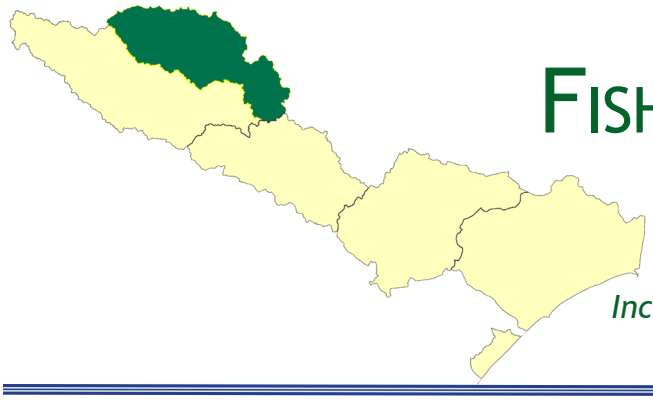
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
WS-IV
Primary Roads
Stormwater Permit
401 WQ Certification
Cattle Operation Permit
Minor WW Discharge

Non-Discharge Facility
Minor

Monitoring Sites
Ambient
Fish Community
Benthic
USGS Gage

Use Support Rating
Supporting
Impaired
Not Rated
No Data

Prepared by DWQ
Basinwide Planning Unit
October 2010



Fishing Creek Subbasin

Subbasin HUC 03020102

Includes the Fishing Creek and Tributaries

Water Quality Overview:

Overall, water quality in this rural subbasin is excellent. This subbasin is a priority for aquatic threatened and endangered species protection. It is recommended that biological samples be taken during normal flow conditions to evaluate potential ORW reclassifications. The main stressors to water quality include fecal coliform bacteria and incidences of low dissolved oxygen.

General Description

The Fishing Creek Subbasin, hydrologic unit code (HUC) 03020102, in the upper portion of the Tar-Pamlico River Basin was previously delineated as DWQ's Subbasin 03-03-04. The Fishing Creek Subbasin encompasses the ~894 square miles from its headwaters northeast of the City of Henderson to its confluence with the Tar River near the town of Tarboro (Figure 2-1).

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. These southeastern streams are characterized by naturally low dissolved oxygen, low current velocity, and low pH. However, only the Beech Swamp watershed has a supplemental classification of Swamp Waters.

The Fishing Creek Subbasin is recognized by NC Wildlife Resource Commission as a priority area for habitat protection because of threatened and endangered aquatic species found in the subbasin (e.g., tar spinymussel & drawf wedgemussel). There are no waters currently classified as High Quality Waters (HQW) or Outstanding Resource Waters (ORW) in this subbasin.

Watershed at a Glance

Counties:

Vance, Warren, Franklin, Nash, Halifax, Edgecombe

Municipalities:

Middleburg, Norlina, Warrenton, Littleton, Enfield, Scotland Neck, Hobgood, Speed

Permitted Facilities:

NPDES WWTP:.....9
- Major:.....2
- Minor.....7

NonDischarge:.....6

Stormwater:
- General.....5
- Individual.....2

Animal Operations:.....19

2000 Population: 36,744

Area: 894 sq mi.

Impervious Surface Estimate: 4 sq mi.

Primary Classifications:

Freshwater ~Miles.....575

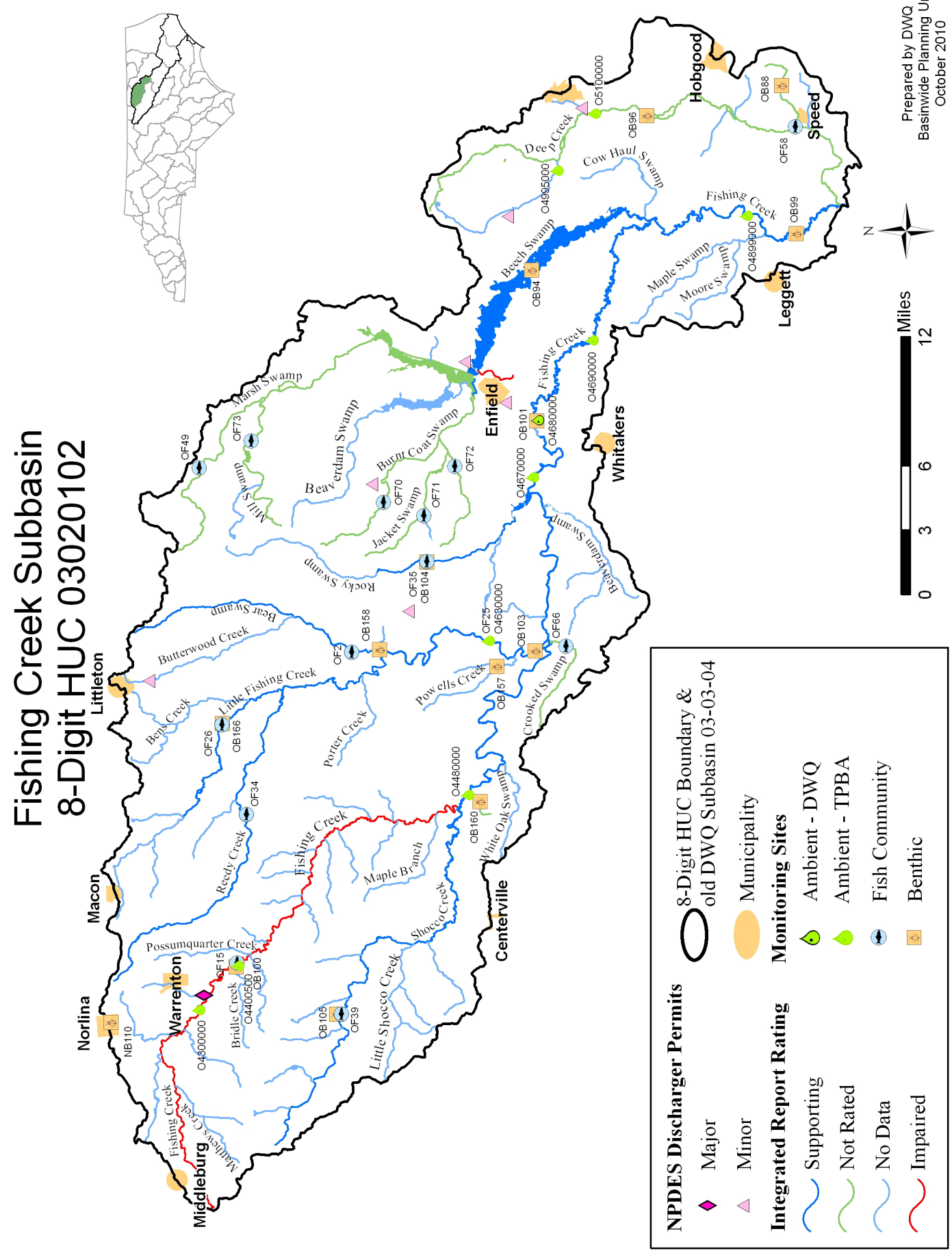
Supplemental Classification miles:

C;NSW.....354
C;Sw,NSW.....104
WS-IV;NSW.....99
WS-V;NSW.....17

Classification descriptions are found at: *http://portal.ncdenr.org/web/wq/ps/csu/classifications*

The small towns of Warrenton, Enfield, and Scotland Neck are the only urban areas and their wastewater treatment plants (WWTP) are the only major dischargers in this watershed. Warrenton WWTP discharges 2.0 million gallons/day (MGD) and Enfield WWTP discharges 1.0 MGD to Fishing Creek; the Scotland Neck facility discharges 0.675 MGD 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.

FIGURE 2-1. HUC 03020102 MAP



Several small parcels within the Shocco Creek subwatershed in Warren, Franklin, and Halifax counties are managed as part of the Shocco Creek Gameland by the NC Wildlife Resources Commission. Other gameland in the subbasin 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 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.

Current Status and Significant Issues

Use Support Assessment Summary

All surface waters in the state are assigned a classification reflecting the best-intended use of that water. Chemical, physical, and biological parameters are regularly assessed by DWQ to determine how well waterbodies are meeting their best-intended use. These data are used to develop use support ratings every two years as reported to EPA. The collected list of all monitored waterbodies and their water quality rating is called the Integrated Report (IR). Water not meeting surface water standards are rated as Impaired and reported on the 303(d) list. Water quality evaluation levels and how a waterbody earns a rating of Supporting or Impaired is explained in detail in the IR methodology. The 2010 IR is based on data collected between 2004 and 2008; the IR and methodology are available on the DWQ Modeling/TMDL website: http://portal.ncdenr.org/web/wq/ps/mtu/assessment. The most current use support ratings for this subbasin can be found in Appendix 2A.

In this subbasin, use support ratings were assigned for aquatic life, recreation, fish consumption, and water supply categories. Waters are Supporting, Not Rated, or No Data in the aquatic life and recreation categories on a monitored or evaluated basis. All waters are Impaired in the fish consumption category on an evaluated basis based on statewide fish consumption advice issued by the Department of Health and Human Services. All waters are Supporting in the Water Supply category. This evaluation is based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants.

General Biological Health

Biological samples were collected during the spring and summer months of 2007 as part of the basinwide sampling five year cycle with the exception of a few special studies. Eight benthic macroinvertebrate sites and 13 fish community sites were sampled as part of the basinwide sampling cycle. Tables 2-1 and 2-2 provide a summary of site results and a description of the stream location to correspond to Figure 2-1. Site specific information is available in Appendix 2B and the entire Biological Assessment Report at: http://www.esb.enr.state.nc.us/documents/2008TARbasinwiderptfinal.pdf.

Benthos Community Sampling Summary

No changes in the bioclassifications were observed at three sites between 2002 and 2007. Two sites along Fishing Creek (OB101 & OB99) improved to Excellent from either Good-Fair or Good. Fishing Creek-OB100 in Warren County, which had not been sampled for benthic macroinvertebrates since 1997, declined from Good in 1997 to Good-Fair in 2007. The decline was attributed to drought, low flow conditions, and habitat alterations by beavers.

Table 2-1 Benthos Biological Sample Results

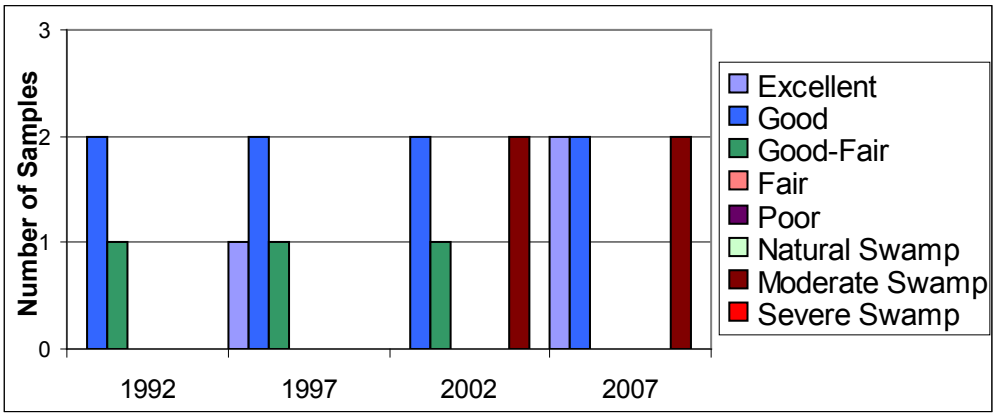
Site ID*	Waterbody	AU #	Description	Location	County	Date	BioClass
OB100	Fishing Cr	28-79-(1)	From source to Shocco Creek	SR 1600	Warren	7/3/07	Good-Fair
OB101	Fishing Cr	28-79-29	From Enfield Raw Water Supply Intake to a point 1.7 miles downstream of Beech Swamp	US 301	Edgecombe	6/28/07	Excellent
OB99	Fishing Cr	28-79-(30.5)	From a point 1.7 miles downstream of Beech Swamp to Tar River	SR 1500	Edgecombe	6/28/07	Excellent
OB105	Shocco Cr	28-79-22	From source to Fishing Creek	SR 1613	Warren	7/3/07	Not Rated
OB166	L Fishing Cr	28-79-25	From source to Fishing Creek	SR1509	Warren	3/9/09	Good-Fair
OB103	L Fishing Cr	28-79-25	From source to Fishing Creek	SR 1343	Halifax	6/29/07	Good
OB160	UT Fishing Cr	28-79-(21)ut2	From source to Fishing Creek	SR 1004	Nash	7/18/07	Not Rated
OB158 special study	UT Bear Swp	28-79-25-7ut34	Small stream criteria reference site on unnamed tributary to Bear Swp	Medoc Mt State Park	Halifax	6/9/05	Not Impaired
OB 157 special study	UT Powells Cr	28-79-25-8ut13	Small stream criteria reference site on unnamed tributary to Powells Cr	NC 481	Halifax	4/21/06	Not Impaired
OB104	Rocky Swp (Bellamy Lake)	28-79-28-(0.7)	From a point 1.0 mile downstream of N.C. Hwy. 561 to Fishing Creek	SR 1002	Halifax	6/28/07	Good
OB94	Beech Swp	28-79-30	From source to Fishing Creek	SR 1003	Halifax	2/5/07	Moderate
OB96	Deep Cr	28-79-32-(0.5)	From source to a point 1.3 miles upstream of N.C. Hwy. 97	SR 1100	Halifax	2/5/07	Moderate
OB88	Savage Mill Run	28-79-32-4	From source to Deep Creek	SR 1508	Edgecombe	10/16/00	Not Rated

Bioclassification of Excellent, Good, Natural, Good-Fair, Not Impaired or Moderate Stress = Supporting
Fair, Severe Stress or Poor = Impaired
* Corresponds to Station ID on Figure 2-1

Biological Trends

The bioclassification trends for all basinwide benthos sites in this subbasin can be seen in Figure 2 (results from special studies not included). Most of this subbasin is comprised of a mix of forest and agriculture, and there are very few large point source dischargers present. Bioclassifications generally improved from earlier samples. Notable examples of this could be seen at Fishing Creek (OB101) and Fishing Creek (OB99). Swamp bioclassifications remained unchanged in this subbasin.

Figure 2-2. Bioclassification Trends in HUC 03020102



Fish Community Sampling Summary

Thirteen fish community sites were sampled. Of those, seven sites 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. Shocco Creek, whose fish community rated Excellent

in 2002, was not rated in 2007 due to hydrologic modifications by beavers.

Table 2-2. Fish Community Sample Results

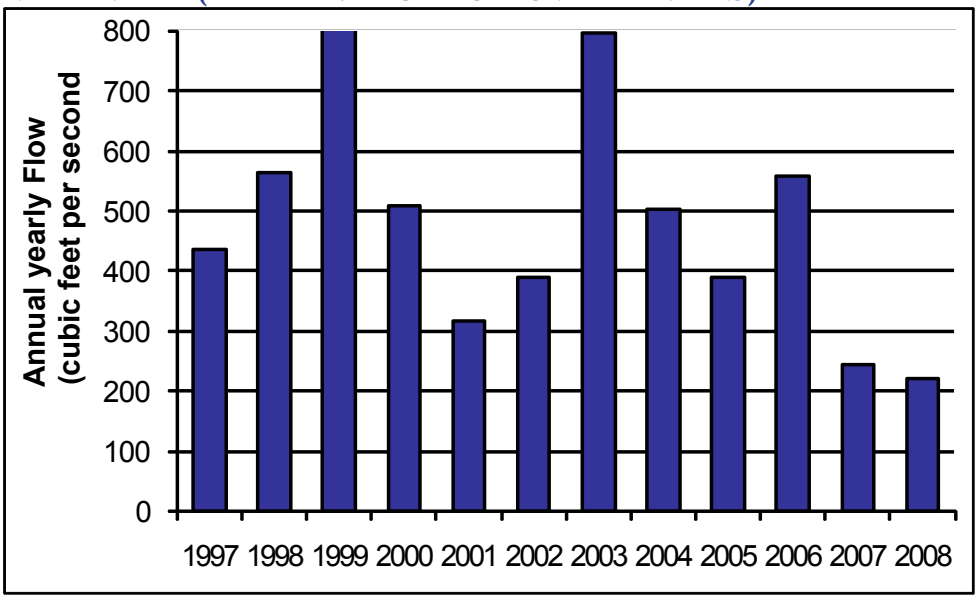
Site ID*	Waterbody	AU #	Description	Location	County	Date	BioClass
OF15	Fishing Cr	28-79-(1)	From source to Shocco Creek	SR 1600	Warren	05/07/07	Excellent
OF39	Shocco Cr	28-79-22	From source to Fishing Creek	SR 1613	Warren	04/11/07	Not Rated
OF66	Crooked Swp	28-79-24	From source to Fishing Creek	SR 1501	Nash	04/11/07	Not Rated
OF26	L Fishing Cr	28-79-25	From source to Fishing Creek	SR 1509	Warren	04/12/07	Excellent
OF34	Reedy Cr	28-79-25-5	From source to Little Fishing Cr	SR 1511	Warren	04/12/07	Good
OF2	Bear Swp	28-79-25-7	From source to Little Fishing Cr	NC 561	Halifax	05/07/07	Good
OF35	Rocky Swp	28-79-28-(0.7)	From a point 1.0 mile downstream of N.C. Hwy. 561 to Fishing Creek	SR 1002	Halifax	05/07/07	Good
OF49	Marsh Swp	28-79-30-1	From source to Beech Swamp	SR 1210	Halifax	05/08/07	Not Rated
OF73	Mill Swp	28-79-30-1-0.5	From source to Marsh Swamp	SR 1615	Halifax	04/13/07	Not Rated
OF70	Burnt Coat Swp	28-79-30-2	From source to Beech Swamp	SR 1216	Halifax	04/13/07	Not Rated
OF71	Jacket Swp	28-79-30-2-1	From source to Burnt Coat Swamp	SR 1216	Halifax	04/13/07	Not Rated
OF72	Breeches Swp	28-79-30-2-1-2	From source to Jacket Swamp	SR 1002	Halifax	04/13/07	Not Rated
OF58	Deep Cr	28-79-32-(1.5)	From a point 1.3 miles upstream of N.C. Hwy. 97 to Fishing Creek	SR 1506	Edgecombe	05/11/07	Not Rated

Not Rated = Fish community metrics and criteria have yet to be developed for Coastal Plain streams
Excellent, Good or Good-Fair = Supporting
Fair or Poor = Impaired
* Corresponds to Station ID on Figure 2-1

Stream Flow

Stream flow is monitored at US Geological Survey gaging stations. Flow, often abbreviated as "Q", is measured in terms of volume of water per unit of time, usually cubic feet per second (cfs). There are six gaging stations in this subbasin. Figure 2-3 provides an example of average stream flow over a 12 year period and gives an idea of which years received heavier precipitation. For more information about instream flow see DWR website: http://www.ncwater.org/About_DWR/Water_Projects_Section/Instream_Flow/welcome.html.

Figure 2-3 Stream Flow at USGS 02083000 Fishing Creek near Enfield (Yearly Average based on Daily Means)



Ambient Data

Subbasinwide, monthly chemical and physical samples are taken by DWQ (1 station) and by the Tar Pamlico Basin Association (9 stations) starting in 2007. A majority of the ambient stations are associated with waterbody locations where potential pollution could occur from known land use activities. There is also a significant portion of the subbasin where no water quality data are collected; therefore, we cannot evaluate the condition of the water quality in those areas. Parameters collected depend on the waterbody classification, but typically include conductivity, dissolved oxygen, pH, temperature, turbidity, nutrient measurements, metals, and fecal coliform. Each classification has an associated set of standards the parameters must meet in order to be considered supporting its designated uses. Stressors are either chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use. Ten sample results are required within the five year data collection window in order to evaluate the water quality parameter and compare it to the water quality standards. Ambient stations are listed in Table 2-3, and their locations are found in Figure 2-1 and on watershed maps provided in Appendix 2D.

Table 2-3. Ambient Stations in HUC 03020102

Station ID	Agency	Active Since	Waterbody	AU#	Station Location	Stressors
O4300000	TPBA	3/1/07	Fishing Cr	28-79-(1)	SR 1001 Dr King Blvd near Warrenton	Low DO
O4400500	TPBA	3/1/07	Fishing Cr	28-79-(1)	SR 1600 Baltimore Rd near Warrenton	-
O4480000	TPBA	3/1/07	Fishing Cr	28-79-(21)	NC 561 near Wood	Low DO
O4630000	TPBA	3/1/07	Little Fishing Cr	28-79-25	NC 481 near White Oak	Low DO
O4670000	TPBA	3/1/07	Fishing Cr	28-79-(25.5)	SR 1222 Bellamy Mill Rd near Enfield	-
O4680000	NCAMBNT	11/25/80	Fishing Cr	28-79-(29)	US 301 near Enfield	-
O4690000	TPBA	3/1/07	Fishing Cr	28-79-(29)	SR 1109 Etheridge Farm Rd near Enfield	-
O4899000	TPBA	3/1/07	Fishing Cr	28-79-(30.5)	NC 97 near Lawrence	-
O4995000	TPBA	3/1/07	Deep Cr	28-79-32-(0.5)	SR 1104 near Scotland Neck	Low DO, Fecal Coliform Bacteria
O5100000	TPBA	3/1/07	Deep Cr	28-79-32-(0.5)	US 258 near Scotland Neck	Low DO, Fecal Coliform Bacteria
O4805000	RAMS	2007-2008	UT Beech Swamp	28-79-30ut1	SR 1003 at Enfield	zinc, water column mercury

TPBA= Tar Pamlico Basin Association, NCAMBNT= DWQ, RAMS= Random Ambient Monitoring System, sampled by DWQ
"-" indicates no stressors identified

The following discussion of ambient monitoring parameters includes graphs showing the median and mean concentration values for all ambient stations (n=10) in this subbasin for a specific parameter over each year. Because only one ambient station (O4680000) was monitored until March 2007 all the following summary graphs are for one station for 10 years and then the last two years includes an additional nine stations. Please note that these graphs are not intended to provide statistically significant trend information or loading numbers. The difference between median and mean results indicate the presence of outliers in the dataset. Box and whisker plots of individual ambient stations were completed by parameter for data between 2002-2007 and can be found in the Ambient Monitoring report: http://portal.ncdenr.org/c/document_library/get_file?uuid=994c08a8-a98d-4ff5-9425-656cadf8cfa4&groupId=38364. Summary sheets for ambient stations are found in Appendix 2C.

Turbidity

The turbidity standard for freshwater (Class C) streams is 50 NTUs. Currently, there are no streams impaired because of turbidity exceedances in this subbasin. Turbidity is a measure of cloudiness in water and is often accompanied with excessive sediment deposits in the streambed. Excessive sediments deposited on stream and lake bottoms can choke spawning beds (reducing fish survival and growth rates), harm fish food sources, fill in pools (reducing cover from prey and high temperature refuges), and reduce habitat complexity in stream channels. Excessive suspended sediments can make it more difficult for fish to find prey and at high levels can cause direct physical harm, such as clogged gills. Sediments can cause taste and odor problems, block water supply intakes, foul treatment systems, and fill reservoirs. (USEPA, 1999 and Waters, 1995). It is important to note that the turbidity standard does not capture incident duration or the amount of sedimentation, both of which can impact aquatic species.

Figure 2-4. Summarized Turbidity values for all data collected at Ambient Stations in HUC 03020102

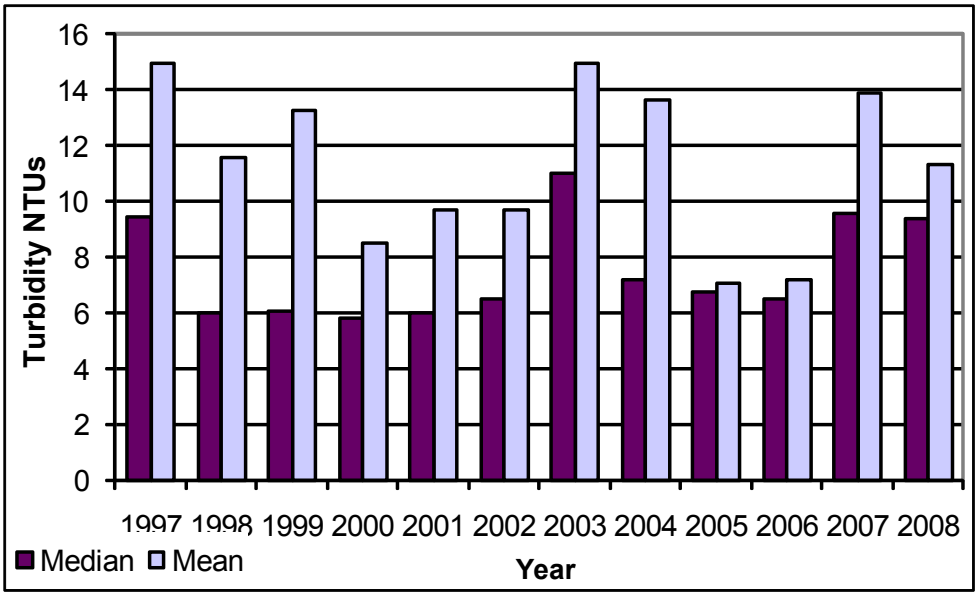


Figure 2-4 shows data over a 12 year period, representing 325 samples, of which only 3 samples had turbidity levels above 50 NTUs. Turbidity does not appear to be a problem in this subbasin.

Fecal Coliform Bacteria

The fecal coliform bacteria standard for freshwater streams is not to exceed the geomean of 200 colonies/100ml or 400 colonies/100ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are to be used to indicate whether the stream is Impaired or Supporting. Waters with a classification of B (primary recreation water) will receive priority for 5-in-30 studies. Other waterbodies will be studied as resources permit. Data through 2007 indicate several streams where bacteria colony numbers exceeded 400 colonies/100ml. These streams currently impacted by fecal coliform bacteria include:

Fishing Creek, C;NSW, (from Little Fishing Creek to 1.7 miles downstream of Beech Swamp) AU#s 28-79-(25.5) & 28-79-(29)
Deep Creek C;NSW, (from source to 1.3 miles upstream of Hwy. 97) AU# 28-79-32- (0.5)

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of humans or other warm-blooded animals. At the time this occurred, the source water might have been contaminated by pathogens or disease producing bacteria or viruses that can also exist in fecal material. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

Figure 2-5. Summarized Fecal Coliform Bacteria numbers for all data collected at Ambient Stations in HUC 03020102

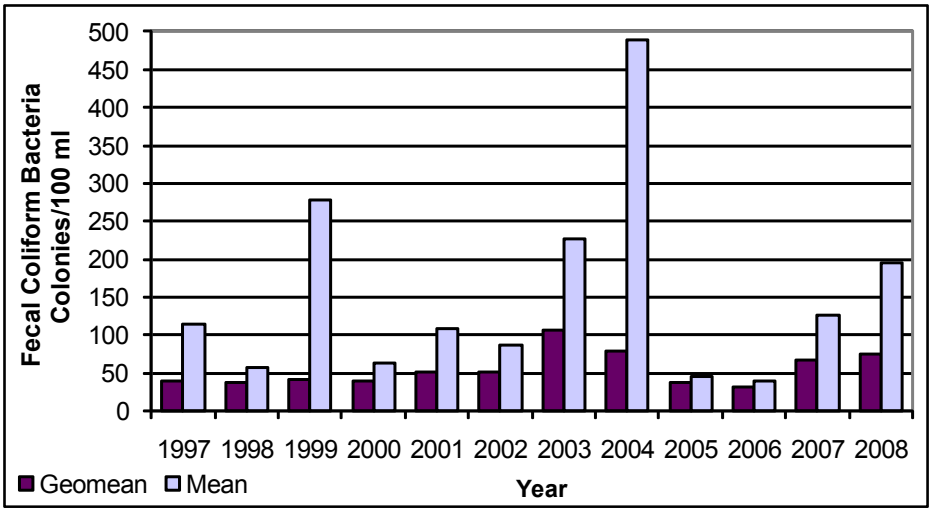


Figure 2-5 represents data over a 12 year period, representing 323 samples, of which 27 samples (8%) had fecal coliform bacteria levels above 400 colonies/100ml. A majority of these high fecal numbers occurred in 2007 & 2008 when sampling increased.

pH

The water quality standard for pH in surface freshwaters is 6.0 to 9.0 standard units. Swamp waters (supplemental Class Sw) may have a pH as low as 4.3 if it is the result of natural conditions. pH is a measure of hydrogen ion concentration that is used to express whether a solution is acidic or alkaline (basic). Values outside the 6.0-9.0 standard unit range can have chronic effects on the community structure of macroinvertebrates, fish and phytoplankton.

Figure 2-6. Summarized pH values for all data collected at Ambient Stations in huc 03020102

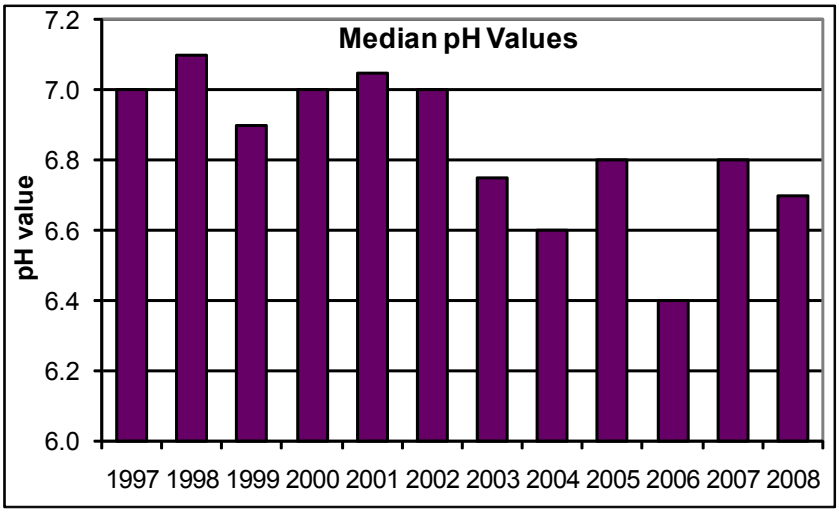


Figure 2-6 represent data over a 12 year period, representing 415 samples, of which 18 (4%) had pH levels below 6. A majority of these low pH readings occurred during 2008 and may be associated with drought conditions and the increase in monitoring by the TPBA sites.

Dissolved Oxygen

The dissolved oxygen (DO) water quality standard for Class C waters is not less than a daily average of 5.0 mg/L with a minimum instantaneous value of not less than 4 mg/L, the latter standard being the most commonly used. Swamp waters may have lower values if the low DO level is caused by natural conditions. Dissolved oxygen can be produced by wind or wave action that mix air into the water or through aquatic plant photosynthesis. During the day, DO levels are higher when photosynthesis occurs and they drop at night when respiration occurs by aquatic organisms. High levels are found mostly in cool, swift moving waters and low levels are found in warm, slow moving waters. In slow moving waters, such as reservoirs or estuaries, depth is also a factor. Wind action and plants can cause these waters to have a higher dissolved oxygen concentration near the surface, while biochemical reactions lower in the water column may result in concentration as low as zero at the bottom.

The drought conditions impacted DO levels throughout the basin There were many sites in the basin that had low dissolved oxygen measurements. However, most of these sites were Tar Pamlico Basin Association sites and had only been monitored since March 2007. Nearly the entire monitoring history for these sites was during the 2007-2008 drought, which, due to drops in flow, suppressed dissolved oxygen levels. Data from Fishing Creek (from Enfield Raw Water Supply Intake to a point 1.7 miles downstream of Beech Swamp) AU# 28-79-(29) indicates the creek is impacted because of low DO levels, this is a result of data collected prior to 2007 drought conditions.

Figure 2-7. Summarized Dissolved Oxygen Levels for all data collected at Ambient Stations in HUC 03020102

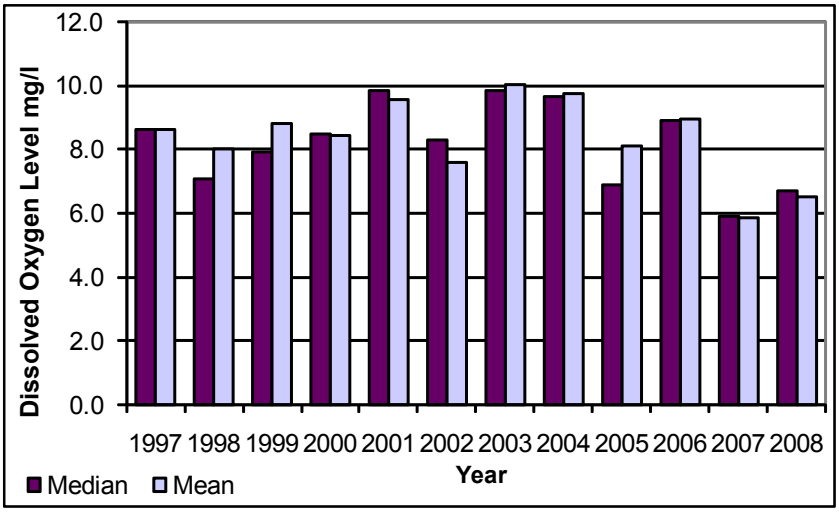


Figure 2-7 shows data over a 12 year period, representing 412 samples, documented 73 samples (18%) with DO levels below 4 mg/L. DO levels in this subbasin were heavily influenced by low flows during dry years, with 71 (97%) of the low DO samples occurring during the drought.

Nutrient Enrichment

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as “nutrients”. Nitrogen compounds include ammonia as nitrogen (NH_3), Total Kjeldahl Nitrogen (TKN), and nitrite+nitrate nitrogen (NO_2+NO_3). Total nitrogen (TN) is the sum of TKN and NO_2+NO_3. Phosphorus is measured as total phosphorus (TP) by DWQ. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes or runoff from urban or agricultural land, the growth of algae and other plants may be accelerated. In addition to the possibility of causing algal blooms, ammonia-nitrogen may combine with high pH water to form ammonium hydroxide (NH_4OH), a form toxic to fish and other aquatic organisms.

Due to excessive levels of nutrients resulting in massive algal blooms and fish kills the entire Tar-Pamlico River Basin was designated as Nutrient Sensitive Water (NSW) in 1989. This designation resulted in the development and implementation of a nutrient management strategy to achieve a decrease in TN by 30% and no increase in TP loads compared to 1991 conditions. Even though implementation of the strategy has occurred by wastewater treatment plant dischargers, municipal stormwater programs, and agriculture, nutrient enrichment continues to be cumulatively impacting the Pamlico Estuary. A review of the NSW strategy, including implementation activities, progress towards meeting the loading goals and additional actions are discussed in Chapter 6.

Basin trend analyses were completed for nutrient concentration and daily loads to evaluate progress towards meeting TMDL reduction goals, as discussed in detail in the NSW Chapter 6. These analyses detected a statistically significant increase in TKN concentration and a decrease in NH_3 and NO_2+NO_3. There were no basinwide detected trends for TN or TP concentrations. TKN is defined as total organic nitrogen and NH_3. An increase in organic nitrogen is the likely source for the increase in TKN concentrations since NH_3 concentrations have decreased basinwide. Further analysis of these parameters were completed on a subbasin scale to determine whether

concentrations changed over an 11 year time period. Currently, NC does not have nutrient standards; however, NC normal nutrient levels in class C waters are typically:

TP = < 0.05 mg/L
TN= < 0.8 mg/L
TKN= <0.5 mg/L
NH_3= < 0.05 mg/L

In early 2001, the DWQ Laboratory Section reviewed it's internal Quality Assurance/Quality Control (QA/QC) programs and some of their analytical methods. This effort resulted in a marked increase in reporting levels for certain parameters. New analytical equipment and methods were subsequently acquired to establish new lower reporting levels and more scientifically supportable quality assurance. As a result, the reporting levels quickly dropped back down to at or near the previous reporting levels. Nutrients were especially affected by these changes, as shown below:

	Reporting Level by Date (mg/L)			
Parameter	Pre-2001	3/13/2001 to 3/29/2001	3/30/2001 to 7/24/2001	7/25/2001 to present
NH_3	0.01	0.05	0.2	0.01
TKN	0.1	1.0	0.6	0.2
NO_2+NO_3	0.01	0.5	0.15	0.01
TP	0.01	0.5	0.1	0.02
Note: Do not let increased reporting levels be interpreted as a sudden upward trend. The Laboratory Section cautions that the establishment of minimum reporting levels may have been inconsistent and undocumented prior to those established in July 2001.				

Also, from July 2001 to May 2003 insufficient staffing resulted in suspension of nutrient sampling at most stations, resulting in a smaller sample size for 2001 and 2002.

Pollution runoff into streams from nonpoint sources decreases during periods of limited precipitation, while point sources may contribute significant effluent to stream flow when surface runoff and baseflow is decreased. During rainier periods discharge effluent makes up less of the total stream volume and runoff from nonpoint sources increases. Although drought data are limited to three years (2001, 2007 & 2008) and likely influenced by the addition of nine Tar Pamlico Basin Association monitoring sites that started sampling in 2007 there is an increase in nutrient concentrations during these years (Figures 2-8 & 2-9). Additional data collection over the next several years with the increased sample size will help determine source influence on nutrient levels. It is unclear whether this subbasin is contributing to the basin increase in TKN as NH_3 and TKN show fluctuations over the years (Figures 2-10 & 2-11).

Figure 2-8. Summarized Total Phosphorus values for all data collected at Ambient Stations in HUC 03020102

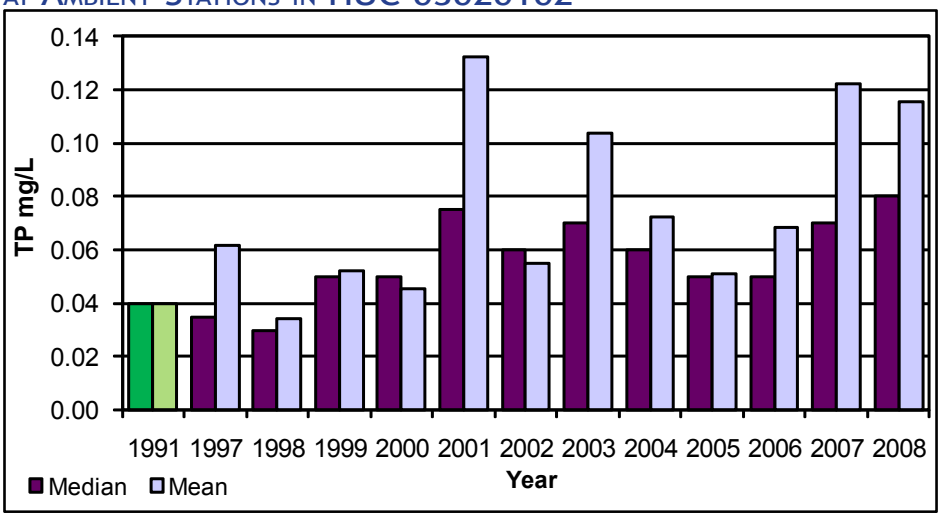
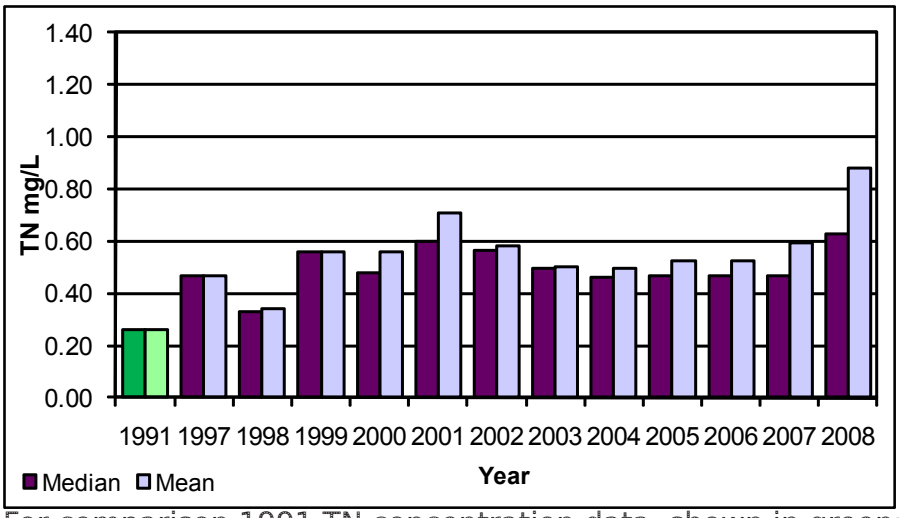


Figure 2-8 represents data from 312 samples which were taken over a 12 year period, of which 191 samples (61%) had TP levels above 0.05 mg/L. A majority of the high TP levels occurred at new TPBA monitoring sites during 2007-08. High TP levels were detected across all monitoring stations and were not focused in one area.

For comparison, 1991 TP concentration data, shown in green: Median= 0.04 Mean = 0.04

Figure 2-9. Summarized Total Nitrogen values for all data collected at Ambient Stations in HUC 03020102

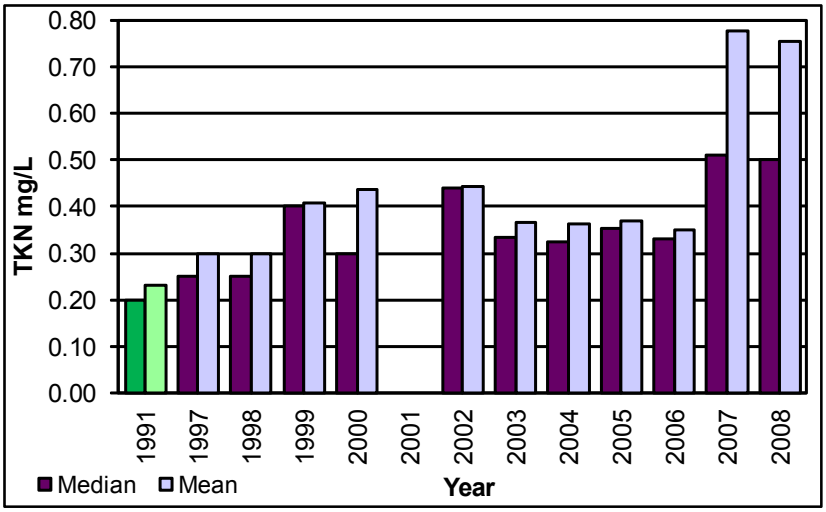


For comparison 1991 TN concentration data, shown in green:
Median= 0.26 Mean = 0.26

Figure 2-9 represents data from 311 samples which were taken over a 12 year period, of which 88 samples (28%) had TN levels above 0.8 mg/L.

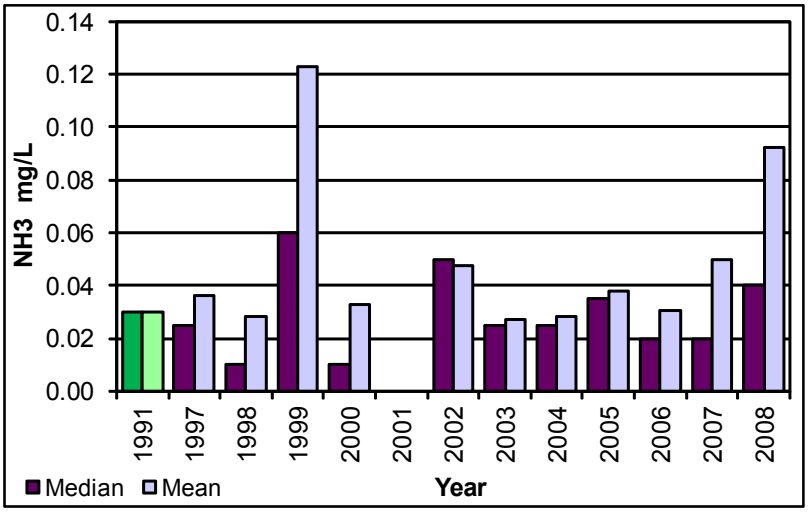
A majority of the high TN levels occurred at new TPBA monitoring sites during 2007-08. Several samples were from a site in the upper reach of Fishing Creek just below Warrenton's WWTP. The other stations with the majority of higher TN were located along Deep Creek.

Figure 2-10. Summarized TKN Concentrations in HUC 03020102



For comparison 1991 TKN concentration data, shown in green:
Median= 0.2 Mean = 0.23

Figure 2-11. Summarized Ammonia Concentrations in HUC 03020102



For comparison 1991 NH_3 concentration data, shown in green:
Median= 0.03 Mean = 0.03

The limited ammonia data in 2001 contained outliers that skewed the data and therefore were eliminated from the ammonia and TKN graphs but were included in the TN graph.

Restoration and Protection Opportunities

The following section provides more detail about specific streams where special studies have occurred or stressor sources information is available. Specific stream information regarding basinwide biological samples sites are available in Appendix 2B. Use support information on all monitored streams can be found in Appendix 2A. Detailed maps of each of the watersheds are found in Appendix 2D or by clicking on the following small maps. Interactive elements have been incorporated within all 10-digit watershed maps. To use the new features click on the Layers tab on the left side of the Adobe Reader window. Expand the folder tree by clicking on the (+) sign to the left of the map name. Each item in the subsequent folder tree is a layer on the map. These layers can be turned on or off by clicking the symbol to the left of the layer name. To return to your previous place within the text click the smaller map in the upper left corner of the 10-digit watershed map.

To assist in identifying potential water quality issues, we are requesting information be gathered by citizens, watershed groups and resource agencies through our Impaired and Impacted Stream/Watershed Survey found here: **http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey**.

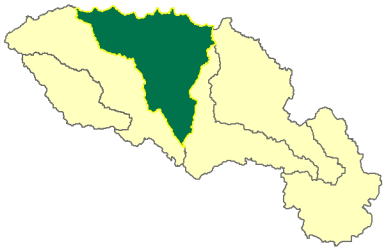
Aquatic Species Protection

Streams within the Fishing Creek Subbasin and associated riparian habitat support significantly rare fish, mussels, and plants in addition to the Tar spinymussel and dwarf wedgemussel. Fishing Creek, in particular, is a designated nationally significant aquatic natural heritage area. The federal species of concern and state endangered Atlantic pigtoe (*Fusconaia masoni*), yellow lance (*Elliptio lanceolata*),and yellow lampmussel (*Lampsilis cariosa*) are known to occur in the management area. Other mussels known from this area include the state-listed as threatened triangle floater (*Alasmidonta undulata*), creeper (*Strophitus undulatus*), Roanoke slabshell (*Elliptio roanokensis*) and eastern lampmussel (*Lampsilis radiata*), as well as the notched rainbow (*Villosa constricta*), a state species of concern. Two rare fish, the Carolina madtom (*Noturus furiosus*) and pinewoods shiner (*Lythrurus matutinus*), the rare North Carolina spiny crayfish (*Orconectes carolinensis*), the state species of special concern Neuse River waterdog (*Necturus lewisi*), the federal species of concern and State rare Roanoke bass (*Ambloplites cavifrons*) and the state threatened brook lamprey (*Lampetra aepyptera*) are also known to occur in this subbasin.

Shocco Creek Watershed (0302010201)

Shocco Creek (AU# 28-79-22, 26.7 miles) and Little Shocco Creek (AU# 28-79-22-6, 7.8 miles) are threatened and endangered aquatic species protection priority areas. In Shocco Creek, the 2007 fish community rating decreased to Good-Fair from its previous rating of Excellent as recorded in 1992. The 2007 benthic site was Not Rated but a decrease in the number of macroinvertebrates likely due to a beaver dam, was noted. The creek should be resampled during non-drought conditions.

Due to the presence of threatened and endangered species, this watershed is a priority for implementation of nonpoint source BMPs, including agricultural BMPs, stormwater control BMPs, buffer enhancement, and sediment and erosion control BMPs.



Little Fishing Creek Watershed (0302010202)

Little Fishing Creek (AU# 28-79-25, 31.4 miles) watershed is a threatened and endangered aquatic species protection priority area. A benthic sample was taken in Little Fishing Creek as part of a DWQ Level IV Ecoregional reference site internal study on 3/9/09 which rated Good-Fair. There is a small concentration of wastewater residual application fields in this watershed.

Littleton WWTP (NC0025691) discharges into Butterwood Creek in the Bear Swamp subwatershed (HUC 030201020204). Butterwood Creek is currently not monitored by DWQ. The NPDES permitted flow is 0.28 MGD and the median annual daily flow is currently 0.088 MGD. The WWTP is presently being well maintained and operated. Evaluation of the facility's discharge impact to endangered mussel species found in this segment of the river may be required.

Due to the presence of threatened and endangered species, this watershed is a priority for implementation of nonpoint source BMPs, including agricultural BMPs, stormwater control BMPs, buffer enhancement, and sediment and erosion control BMPs.

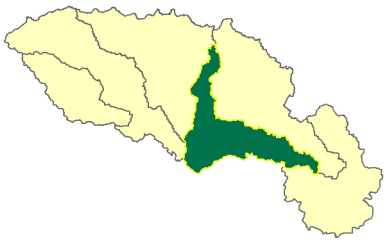
Upper Fishing Creek Watershed (0302010203)

Fishing Creek (AU# 28-79-(1), 36.7 miles) and Maple Branch (AU# 28-79-20.5, 6.5 miles) are threatened and endangered aquatic species protection priority areas. The benthic sample on Fishing Creek in the upper watershed rated Good-Fair in 2007, while the fish sample rated Excellent. The creek should be resampled during non-drought conditions.

The town of Warrenton's WWTP (NC0020834) discharges into Fishing Creek and is a member of the Tar Pam Basin Association. Evaluation of the facility's discharge impact to endangered mussel species found in this segment of the river may be required.
Due to the presence of threatened and endangered species, this watershed is a priority for implementation of nonpoint source BMPs, including agricultural BMPs, stormwater control BMPs, buffer enhancement, and sediment and erosion control BMPs.

Beech Swamp Watershed (0302010204)

There were five fish community samples taken in 2007 in this watershed. All of these samples indicated there were no apparent water quality issues. However, a Random Ambient Monitoring System (RAMS) station (O4805000) did detect zinc above the action level standard and water column mercury in an unnamed tributary to Beech Swamp. This UT to Beech Swamp (28-79-30ut1, 2.2 mi) is on the 2010 303(d) list for these metals exceedances.

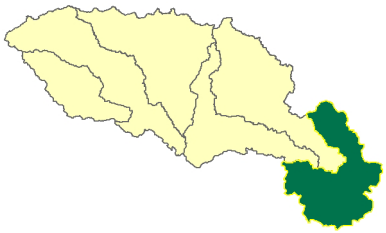


Middle Fishing Creek Watershed (0302010205)

Benthic samples in this watershed resulted in Good and Excellent bioclassifications and no apparent water quality issues. However, two ambient stations did have samples with high fecal coliform bacteria levels.

The town of Enfield WWTP (NC0025402) discharges into Fishing Creek, which has had recent permit exceedances for fecal coliform bacteria, ammonia, BOD, total suspended solids, pH and chlorine. This facility's compliance has improved but there is still a need to address inflow and infiltration to the wastewater collection system.

Rocky Swamp (HUC 030201020502), AU#s 28-79-28-(0.3) & 28-79-28-(0.7), located within this watershed is a threatened and endangered aquatic species protection priority area, making this watershed a priority for implementation of nonpoint source BMPs, including agricultural BMPs, stormwater control BMPs, buffer enhancement, and sediment and erosion control BMPs.



Lower Fishing Creek Watershed (0302010206)

A tributary to Deep Creek (HUC 030201020602), AU# 28-79-32-(0.5)ut18, is not Impaired but is considered impacted because of elevated fecal coliform bacteria levels. Low pH and low DO levels are considered to be a result of natural conditions in this subwatershed. Scotland Neck WWTP (NC0023337) discharges into Canal Creek which is a tributary to Deep Creek. Fecal coliform bacteria exceedances by the WWTP appear to stem from inflow and infiltration and their attempt to use an inadequate UV system. Installation of a permanent chlorine/dechlorination system is planned for when money becomes available, while continuing to use a temporary disinfection system. The town recently received grants to do extensive work on improving the collection system.

The benthic sample on the most downstream portion of Fishing Creek rated Excellent in 2007.

Additional Studies

Volunteer Water Information Network

The Volunteer Water Information Network (VWIN) is a partnership of groups and individuals dedicated to preserving water quality in North Carolina. In August 2005, the Pamlico-Tar River Foundation initiated a monitoring program in tributaries to the Tar River. The UNC-Asheville Environmental Quality Institute provided technical assistance through laboratory analyses of water samples, statistical analyses of water quality results, and written interpretation of the data. Volunteers collected water samples once a month from selected streams in Edgecombe, Nash, and Pitt counties. The results of this data collection are similar to DWQ's sampling results, but VWIN also collected data on streams that DWQ does not monitor. The VWIN report, available in Appendix 2E, provides statistical analyses and interpretation of data from samples gathered from Deep Creek, Fishing Creek, and White Oak Swamp.

Permit Programs

Wastewater Dischargers

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States, as authorized by the Clean Water Act. Non-compliance with permit limits on wastewater flow and constituents can lead to discharge of pollutants that degrades surface waters making them unsafe for drinking, fishing, swimming, and other activities. The NPDES Permitting and Compliance Programs of DWQ is responsible for administering the program for the state. These permits are reviewed and are potentially renewed every five years, a list of NPDES permits in this subbasin is in Table 2-4.

All NPDES permitted facilities use 7Q10s (the lowest stream flow for seven consecutive days that would be expected to occur once in ten years) as critical flow in determining permit limits for non-carcinogen toxicants. If a toxicant is a known carcinogen then the QA (the mean annual stream flow) is used in determining permit limits. In cases where an aesthetic standard is applicable to a pollutant then the permit limit is based on 30Q2 (the minimum average flow for 30 consecutive days that would be expected to occur once in 2 years). These critical flow values used to determine permit limits for all NPDES facilities may need to be reviewed as the permits come up for renewal. Currently, a 7Q10 is only evaluated in the initial application of the permit and upon expansion. Low flow conditions impact a stream's ability to assimilate both point and nonpoint source pollutants. Droughts, as well as the demand for water resources are very likely to increase; therefore, the reevaluation of stream flow will become more critical to water quality within the next decade or so. DWQ will work with Division of Water Resources and other agencies to discuss the need and resource availability to update 7Q10 values.

Table 2-4. NPDES Discharge Permits

Permit #	Owner Name	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0020834*	Town of Warrenton	Warrenton WWTP	Government - Municipal	Municipal Wastewater Discharge, Large	Major	Fishing Creek	2
NC0038580	Halifax County Schools	Eastman Middle School WWTP	Government - County	Discharging 100% Domestic < 1MGD	Minor	Little Fishing Creek	0.0048
NC0038610	Halifax County Schools	Pittman Elementary School WWTP	Government - County	Discharging 100% Domestic < 1MGD	Minor	Burnt Coat Swamp	0.0096
NC0038644	Halifax County Schools	Dawson Elementary School WWTP	Government - County	Discharging 100% Domestic < 1MGD	Minor	Deep Creek	0.0073
NC0084034*	Town of Enfield	Enfield WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Fishing Creek	0
NC0088587	Arcola Lumber Company, Inc.	Arcola Lumber Company	Industrial Process & Commercial	-	Minor	-	-
NC0023337*	Town of Scotland Neck	Scotland Neck WWTP	Government - Municipal	Municipal Wastewater Discharge, < 1MGD	Minor	Canal Creek	0.675
NC0025402*	Town of Enfield	Enfield WWTP	Government - Municipal	Municipal Wastewater Discharge, Large	Major	Fishing Creek	1
NC0025691	Town of Littleton	Littleton WWTP	Government - Municipal	Municipal Wastewater Discharge, < 1MGD	Minor	Butterwood Creek	0.28
* Indicates Tar-Pamlico Basin Association Permittee Member							

On-Site Wastewater Treatment Systems (Septic Systems)

Wastewater from many households is treated on-site through the use of permitted septic systems instead of being sent to a wastewater treatment facility. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from failing septic systems can contaminate groundwater and surface water. Failing septic systems are health hazards and are considered illegal discharges of wastewater if surface waters are impacted. Information about the proper installation and maintenance of septic tanks can be obtained by contacting the Department of Environmental Health and local county health departments. Local health departments are responsible for ensuring that new systems are sited and constructed properly and an adequate repair area is available. County, town and city planners need to understand the economic and human health ramifications caused by failing septic systems and plan for long-term septic system sustainability.

In 2007, North Carolina Agricultural Research Service completed a report concerning nitrogen contributions from on-site wastewater systems for each river basin. The results for this subbasin based on 1990 census data indicate a population of 22,777 people using 8,805 septic systems resulting in a nitrogen loading of 227,768 lbs/yr and nitrogen loading rate of 255 lbs/mi^2/yr. These numbers reflect the TN discharged to the soil from the septic system and does not account for nitrogen used because of soil processes and plant uptake. (Pradhan et al. 2007).

Wastewater Residuals (Biosolids)

Residuals, biosolids or treated sludge, are byproducts of the wastewater treatment process. After pathogen reduction, vector attraction reductions, and metal limits are met, these residuals are disposed in a manner to protect public health and the environment. Disposal sites include land fills, dedicated and non-dedicated residual disposal sites, agricultural land for crops not for human consumption, and distribution to the public for home use. When applied to the land, steps must be taken to assure that residuals are applied at or below agronomic rates based on the soil and crop types present at the disposal site. If these criteria cannot be met, permitted disposal must take place at a dedicated residual disposal site or landfill.

In this subbasin, four facilities that produce wastewater residuals (Class B) apply their treated sludge on an available 30 fields covering 998 acres (not all fields are used every year). A rough estimate of 69,860lbs/yr of nitrogen and 89,820 lbs/yr of phosphorus are applied to these fields. This estimate does not include Class A residuals which are not monitored by DWQ but do contain a potential source of nutrients. Of these permitted facilities, only one is located in the Tar-Pamlico River Basin, the other three permit holders are facilities outside the basin but apply their residuals within the basin. Additional research would be necessary to determine if organic nitrogen from biosolids are contributing to the basinwide increase in organic nitrogen. For more information about residuals please see DWQ's Aquifer Protection Section site: **http://portal.ncdenr.org/web/wq/aps/lau**.

Non-Discharge

Non-discharge systems have been the preferred alternative to discharge to surface waters for some NSW waterbodies and DWQ requires all new and expanding NPDES permit applicants to provide documentation that considers alternatives to surface waters. Non-discharge wastewater options include spray irrigation, rapid infiltration basins, and drip irrigation systems. Although these systems are operated without a direct discharge to surface waters, they still require a DWQ permit. The permit insures that treated wastewater is applied to the land at a rate that is protective of groundwater resources, and does not produce ponding or runoff into a waterbody. More information about land application and non-discharge requirements can be found on the DWQ Aquifer Protection Section – Land Application Unit website: **http://portal.ncdenr.org/web/wq/aps/lau**. Non-discharge permits in this subbasin are listed in Table 2-5.

Run-off and spills are not common at non-discharge facilities. In general, maintaining compliance

with permit conditions largely falls back to having a properly managed facility. Aging collection systems may lead to increased flows from inflow and infiltration or a facility may not be properly prepared to expand as flows increase and the upper limits of a plant's capacity are reached. Non-discharge facilities, just like any other, must properly plan for any elevated flows and take action to ensure that the facility is capable of managing the wastewater.

Groundwater moving into surface water is a mechanism to introduce nutrients into the surface water system in the absence of direct discharges and in NSW systems it is important to be able to better quantify these potential nutrient loads. Some facilities have a groundwater monitoring program to measure compliance with groundwater quality standards. However, it should be noted that a facility can be compliant with groundwater quality requirements while still contributing to the overall nutrient loading of a surface water system. A better understanding of the groundwater/surface water interaction process at non-discharge facilities may help to identify and quantify nutrient loading from these locations .

Table 2-5. Non-Discharge Permits

Facility Name	Permit Type	Permit #	Size
Perdue Farms Incorporated-Hatchery#9	Surface Irrigation	WQ0006058	Major
Enfield Sawmill	Wastewater Recycling	WQ0006962	Major
Highway 97 Truckwash	Surface Irrigation	WQ0014928	Minor
Warren County Transfer Station	Surface Irrigation	WQ0020926	Minor
Scotland Neck WWTP	Reuse	WQ0022697	Minor
International Paper Company-Ridgeway Chip Mil	Wastewater Recycling	WQ0023181	Minor

Wetland Or Surface Water Disturbance (401 Certification)

The "401" refers to Section 401 of the Clean Water Act. The North Carolina DWQ is the state agency responsible for issuing 401 water quality certifications (WQC). When the state issues a 401 certification, this certifies that a given project will not degrade waters of the state or violate state water quality standards. A 401 WQC is required for any federally permitted or licensed activity that may result in a discharge to waters of the U.S. Typically, if the United States Army Corps of Engineers determines that a 404 Permit or Section 10 Permit is required because a proposed project involves impacts to wetlands or surface waters, then a 401 WQC is also required. Locations of 401 WQCs are included on each watershed map. Examples of activities that may require permits include:

- Any disturbance to the stream bed or banks,
- Any disturbance to a wetland,
- The damming of a stream channel to create a pond or lake,
- Placement of any material within a stream, wetland or open water, including material that is necessary for construction, culvert installation, causeways, road fills, dams, dikes or artificial islands, property protection, reclamation devices, and fill for pipes or utility lines and
- Temporary impacts including dewatering of dredged material prior to final disposal and temporary fill for access roads, cofferdams, storage, and work areas.

Riparian Buffers

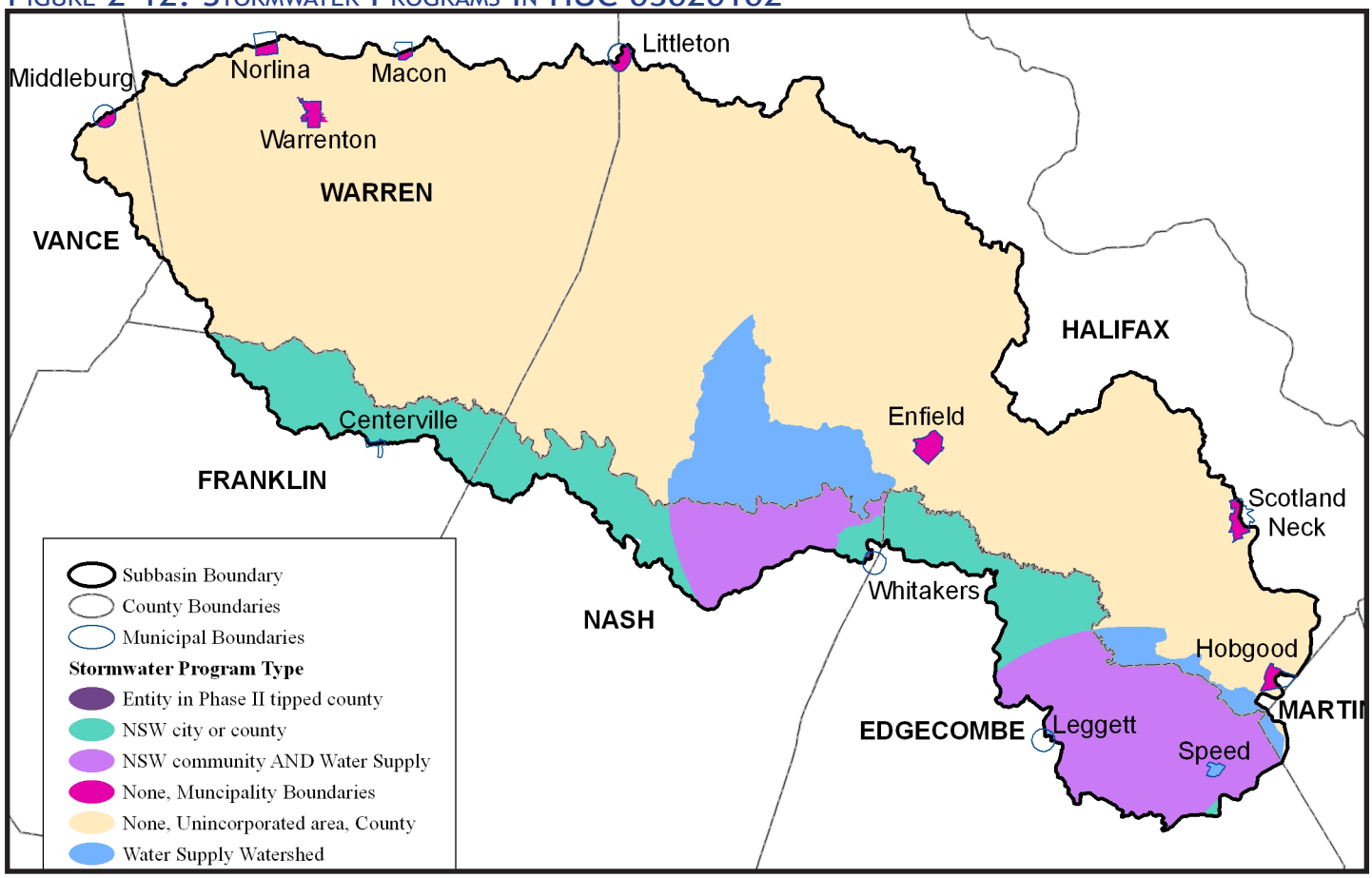
Riparian buffers in the basin are to be protected and maintained on both sides of intermittent and perennial streams, lakes, ponds, and estuarine waters. Tar-Pamlico River Basin Buffer Rules **(15A NCAC 2B.0259)** do not establish new buffers unless the existing use in the buffer area changes. The footprints of existing uses such as agriculture, buildings, commercial, and other facilities, maintained lawns, utility lines, and on-site wastewater systems are exempt. A total of 50 feet of riparian area is required on each side of waterbodies; within this 50 feet, the first 30 feet, is to remain undisturbed and the outer 20 feet must be vegetated. Activities that disturb this buffer require a buffer authorization from DWQ or may require a major variance approval from the Environmental Management Commission. More information about the buffer rules are available at: **http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers**.

Stormwater

There are many different stormwater programs administered by DWQ. One or more of these programs affects many communities in the Tar-Pamlico River Basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state through the use of stormwater runoff controls. Active stormwater control programs in the basin include Phase II NPDES and State post-construction, coastal stormwater, HQW/ORW stormwater, Tar-Pamlico River Basin NSW stormwater, and associated with the Water Supply Watershed Program requirements. The following Figure 2-12 shows that the different stormwater programs in this subbasin.

Franklin, Nash and Edgecombe counties are required to implement actions to prevent and treat stormwater runoff under the Tar-Pamlico NSW stormwater rules. These local programs include new development controls to reduce nitrogen runoff by 30 percent compared to pre-development levels and to keep phosphorus inputs from increasing over pre-development levels. The local programs must also identify and remove illicit discharges; educate developers, businesses, and homeowners; and make efforts toward treating runoff from existing developed areas. As of July 2009, there are five general stormwater and two individual stormwater permits.

FIGURE 2-12. STORMWATER PROGRAMS IN HUC 03020102



Interbasin Transfers

In 1993, the North Carolina Legislature adopted the Regulation of Surface Water Transfers Act (G.S. §143-215.22L) and subsequently modified it in 2007. This law regulates large surface water transfers between river basins by requiring a certificate from the Environmental Management Commission (EMC). A transfer certificate is required for a new transfer of 2 million gallons per day (MGD) or more and for an increase in an existing transfer by 25 percent or more (if the total including the increase is more than 2 MGD). Certificates are not required for facilities that existed or were under construction prior to July 1, 1993 up to the full capacity of that facility to transfer water, regardless of the transfer amount.

The Kerr Lake Regional Water System (KLRWS) is a regional provider of potable water service for portions of Vance, Granville, Franklin, and Warren counties. KLRWS has an existing grandfathered surface water transfer capacity of 10 MGD that allows the system to move water from the Roanoke River Basin (Kerr Lake) to Fishing Creek and Upper Tar subbasins. On February 18, 2009, KLRWS submitted a Notice of Intent to Request an Interbasin Transfer (IBT) Certificate to the Environmental Management Commission. The request is to increase the authorized transfer from 10 MGD to 24 MGD, based on water use projections to the year 2040. More information about this project is available from The Division of Water Resources: http://www.ncwater.org/Permits_and_Registration/Interbasin_Transfer/.

Agriculture

Agriculture is NC's leading industry and is especially strong in the Tar-Pamlico River Basin. Nonpoint source pollution from agriculture is an identified significant source of stream degradation in the Tar-Pamlico River Basin. The approach taken in North Carolina for addressing agriculture's contribution to the nonpoint source water pollution problem is to primarily encourage voluntary participation by the agricultural community and is supported by financial incentives, technical and educational assistance, research, and regulatory programs.

The conversion of agricultural lands to developed lands with impervious surfaces is another potential nonpoint source of pollution. A report by the American Farmland Trust organization identifies this subbasin as having high quality farmland with large areas threatened by development. A map of these areas is available at: http://www.farmland.org/. Some farmers are protecting their land from developement through the Conservation Reserve Enhancement Program (CREP). CREP is a voluntary program utilizing federal and state resources to achieve long-term protection of environmentally sensitive cropland and marginal pastureland. These voluntary protection measures are accomplished through 10-, 15-, 30-year and permanent conservation easements. In this subbasin there are approximately 11,123 acres in easements, of which 55% are in 30-year or permanent easements.

North Carolina Agriculture Cost Share Program

Financial incentives are provided through North Carolina's Agriculture Cost Share Program, administered by DENR's Division of Soil and Water Conservation to protect water quality by installing BMPs on agricultural lands. In the Fishing Creek Subbasin, $1,892,623 was spent, between 2003-2008, on BMPs to reduce nonpoint source pollution from agriculture. Approximately 29,611 acres were affected by BMPs that prevented an estimated 289,170 tons of soil, 386,790 lbs of nitrogen and 152,523 lbs of phosphorous from running off into surface waters. Animal waste BMPs also accounted for better management of an estimated 62,350 lbs of nitrogen and 53,192 lbs of phosphorous.

DWQ's Animal Feeding Operations Unit

The Animal Feeding Operations Unit is responsible for the permitting and compliance activities of animal feeding operations across the state. Poultry farms with dry litter waste are not regulated or monitored by DWQ. Table 2-6 summarizes the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight (SSLW) in this subbasin. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in the subbasin.

Table 2-6. Animal Operations in HUC 03020102

Type	# of Facilities	# of Animals	SSLWt
Cattle	2	1,105	962,000
Wet Poultry	1	64,000	256,000
Swine	15	58,569	16,871,872

*Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service (NRCS) guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

Animal waste is often stored in lagoons before it is applied to fields. Therefore there is concern that several animal operations in the basin will be abandoned without proper closeout of the lagoons. Numerous environmental hazards exist from these lagoons including: ammonia emissions, overflows into surface waters, and groundwater contamination.

A better understanding of groundwater quality in relation to animal feeding operation locations is needed. Often animal operations are located immediately adjacent to surface water bodies. Groundwater that is moving from beneath a facility into the surface water system may transport significant levels of nutrients. However, lack of groundwater quality data at animal operations hampers quantifying their impacts.

Restoration, Protection & Conservation Planning

Population

The 2000 census estimated population for this subbasin is 36,744, this is expected to decrease with the results of the 2010 census. Population estimates for each watershed within this subbasin are listed in Table 2-7.

Table 2-7. Watershed Population Estimates* for HUC 03020102

10-Digit HUC	2000 Population	2000 Population Density (per sq mi)	2010 Estimated Population	2020 Estimated Population	2030 Estimated Population
0302010201	3,325	40	3,586	3,871	4,152
0302010202	7,343	39	7,079	6,849	6,572
0302010203	9,758	56	9,787	9,844	9,846
0302010204	6,808	38	6,464	6,157	5,808
0302010205	4,267	35	4,202	4,154	4,080
0302010206	5,243	35	4,900	4,583	4,246
03020102	36,744	41	36,018	35,458	34,704

*NC Office of State Budget and Management http://www.osbm.state.nc.us/

Land Use

Table 2-8 lists the percentage of predominant land cover types within this subbasin (based on 2001 land cover data). A map showing these land types can be found in Appendix 2D.

Table 2-8. Land Cover Percentages in HUC 03020102

Land Cover Type	Percent
Developed Open Space	4.68
Developed Low Intensity	0.51
Developed Medium Intensity	0.07
Developed High Intensity	0.01
Total Developed	5.27
Bare Earth Transition	0.20
Deciduous Forest	23.38
Evergreen Forest	22.84
Mixed Forest	4.13
Total non-Wetland Forest	50.35
Scrub Shrub	1.86
Grassland Herbaceous	6.55
Pasture Hay	8.49
Cultivated Crops	17.31
Total Agriculture	25.80
Woody Wetlands	9.75
Emergent Herbaceous Wetland	0.23
Total Wetlands	9.97

Local Initiatives & Conservation Planning

Resources & Guides

NCDENR's One North Carolina Naturally initiative promotes and coordinates the long-term conservation of North Carolina's threatened land and water resources. Each DENR division specializes in management of a specific natural resource, while collaborative coordination and planning process results in cost-effective implementation and management of multiple resources. Natural resource planning and conservation provides the science and incentives to inform and support conservation actions of North Carolina's conservation agencies and organizations. The Conservation Planning Tool was developed to assist in building partnerships through the exchange of conservation information and opportunities, support stewardship of working farms and forests, inform conservation actions of

agencies and organizations, and guide compatible land use planning. A link to the interactive map view is found here: http://www.conservision-nc.net/.

Conservation planning is important on a local level to protect natural resources that provide recreational, aesthetic, and economic assets important to community growth and sustainability. The NC Wildlife Resource Commission developed a Green Growth Toolbox: http://www.ncwildlife.org/greengrowth/, to assist towns and cities to grow in nature-friendly ways. The tools provide assistance with using conservation data, green planning, green ordinances and green development and site design. Also, a guide to help local governments protect aquatic ecosystems while streamlining environmental review is available here: http://www.ncwildlife.org/planningforgrowth/swimming_with_the_current.pdf.

Land conservation accompanied with stream restoration projects can be very successful. Prevention and protection activities are known to be more cost effective than retrofits and restoration. DWQ strongly encourages conservation in this watershed. Local land trusts can help landowners explore conservation options and identify potential funding sources. For more information about land trusts in North Carolina see the Conservation Trust for North Carolina at: http://www.ctnc.org/site/PageServer. With the assistance of the Tar-River Land Conservancy and several state and federal agencies ~27,584 acres are protected within this subbasin, much of which are riparian buffers.

Local Initiatives

DWQ has regulatory authority over permitted activities to enforce the Clean Water Act and corresponding state regulations to protect water quality. However, local governments can also regulate and promote activities that protect water quality. Several local governments provided information on local activities, ordinances, and concerns about protecting their natural resources and water quality. The following information reflects projects and practices on a local level that protect water quality:

Warrenton & Warren County

Warrenton currently does not have any stricter stormwater controls than the state minimums, but is considering a local ordinance to address both stormwater and erosion and sedimentation control below one acre. The town felt additional training is needed on a local level for drafting local ordinances as well as having access to relevant templates and example ordinances.

Warren County emphasizes the importance of the NC Agriculture Cost Share program as a method to encourage conservation practices that improve and protect water quality and wildlife habitat.

Franklin County

The County's adopted Unified Development Ordinance states: "The purpose of Flexible Development is to preserve agricultural and forestry lands, natural and cultural features, and rural community character that might be lost through conventional development approaches. To accomplish this goal, greater flexibility and creativity in the design of such developments is encouraged and allowed."

Franklin County has adopted stormwater ordinances and enforces the Tar-Pamlico NSW regulations, but does not enforce erosion and sedimentation control plans. In 2008, the County contracted with NC State Watershed Education for Communities and Officials program (WECO) to initiate a stakeholder process to ascertain ways to better improve water quality within the County. The main recommendation from the stakeholder process was for the County to initiate its own erosion and sedimentation control program in accordance with current state regulations. However, due to current economic trends, funding for the implementation of a County erosion and sedimentation program has been delayed.

Franklin County does not conduct water quality sampling. The County has identified certain

streams as candidates for stream restoration and is working with the Franklin County Conservation District as well as the Tar River Land Conservancy to identify areas for restoration and protection. Additionally, a watershed plan was recently completed for Cypress Creek which identified multiple sites for restoration and or protection.

Erosion and Sedimentation Control

The Sedimentation Control Commission was created to administer the Sedimentation Control Program pursuant to the **N.C. Sedimentation Pollution Control Act of 1973**. It is charged with adopting rules, setting standards, and providing guidance for implementation of the Act. The Division of Land Resources (DLR) is the primary agency responsible for managing land disturbing activities that have the potential to violate the Sedimentation Pollution Control Act. For those land disturbing activities, an Erosion and Sedimentation Control Plan must be approved by DLR prior to land disturbing activities. Due to the large number of land disturbing activities and the limited number of DLR staff available to do inspections, cities and counties have been encouraged to adopt a local erosion and sediment control ordinance in compliance with State requirements. The Sedimentation Control Commission can then delegate the local government authority to administer the erosion and sedimentation control program within its jurisdiction. The local programs' staff then performs plan reviews and enforces compliance with plans within their jurisdictions. Within this subbasin, Franklin County is considering developing a local program.

Construction Grants and Loans

The NC Construction Grants and Loans (CG&L) Section of DWQ provides grants and loans to local government agencies for the construction, upgrades, and expansion of wastewater collection and treatment systems. As a financial resource, the Section administers five major programs that assist local governments. Of these, two are federally funded programs administered by the state, the Clean Water State Revolving Fund (SRF) Program and the State and Tribal Assistance Grants (STAG). The STAG is direct congressional appropriation for a specific "special needs" projects within NC. The High Unit Cost Grant Program, the State Emergency Loan (SEL) Program and the State Revolving Loan (SRL) Program are state funded programs, with the later two being below market revolving loan money. The Section also received an additional Capitalization Grant authorized by the American Recovery and Reinvestment Act of 2009 in the amount of $70,729,100. These funds are administered according to existing SRF procedures. All projects must be eligible under Title VI of the Clean Water Act. For more information please see the CG&L webpage at: **http://portal.ncdenr.org/web/wq/cgls**. Projects currently underway in this subbasin are listed in Table 2-9.

Table 2-9. CG&L Projects

Location	Project Description	Date	~Amount
Scotland Neck	Rehab and Spray Irrigation	pending	$3,000,000
Scotland Neck	Nutrient Removal	pending	$3,000,000
Scotland Neck	Phase III - WWTP modifications	2/12/2004	$400,000
Scotland Neck	Canal Creek Sewer Rehabilitation	pending	$1,534,250

Clean Water Management Trust Fund

Created in 1996, the Clean Water Management Trust Fund (CWMTF) makes grants to local governments, state agencies, and conservation non-profits to help finance projects that specifically address water pollution problems. The fund has made several investments in this Subbasin. Table 2-10 includes a list of recent projects and their cost.

Table 2-10. CWMTF Projects

Application ID	Proposed Project Description	Amount Funded	County
2004D-012 Tar River Land Conservancy - Donated Minigrant, Vaughan Tract	Minigrant to pay for transactional costs for a donated permanent conservation easement on 85 acres along Bear Swamp Creek.	$20,750	Halifax
2005A-503 Enfield, Town of - WW/ WWTP and Collection Rehabilitation, Fishing Creek	Reduce fecal coliform & nutrient contamination of Fishing Ck through infiltration/inflow work (replace or rehabilitate 11,600 LF of collection line), connection of 40 unsewered residences (75% failing), & installing reuse line at WWTP for plant washdown.	$1,010,000	Halifax
2006A-027 NC Div Parks & Recreation - Acq./ IP Timber Tracts, Little Fishing Creek	Protect through fee simple purchase 1,507 acres, including 588 riparian acres, along Little Fishing Creek. Tract expands Medoc Mtn State Park & aids in protection of rare aquatic species & a Nationally Significant Aquatic Habitat.	$744,000	Halifax
2006A-809 Littleton, Town of- Stormwater Minigrant/ Bens Creek Stormwater Plan	Fund a stormwater minigrant to develop a stormwater management plan for the Town. Map stormwater system, evaluate potential BMPs and prepare preliminary engineering report to summarize findings.	$21,000	Halifax
2007-544 Warrenton, Town of - WW/ Pump Station Rehabilitation, Fishing Creek	Install wetwell and replace portion of sewer line to mitigate overflows and reduce pollutant loading in Possumquarter Cr. Perform Sewer System Evaluation.	$271,000	Warren
2007-545 Warrenton, Town of - WW/ WWTP Upgrade, Fishing Creek	Design and permit improvements at WWTP to repair and replace existing worn out equipment to provide more reliable treatment of wastewater and protection of water quality in Fishing Cr	$50,000	Warren
2007-818 Scotland Neck, Town of - Plan/WWW/ I&I Assessment Study, Canal Creek	Perform Phase 2 Inflow/Infiltration Study to reduce Inflow & Infiltration, reduce hydraulic loading at WWTP and improve water quality in Canal Cr, and Deep Cr	$40,000	Halifax
2008-514 Enfield, Town of - WW/ Sewer Rehabilitation & Septic Tanks, Fishing Creek	Design, permit and rehabilitate portion of sewer system; design and permit elimination of failing septic systems. Project would reduce hydraulic load at WWTP and improve effluent quality discharged to Fishing Cr, a National Significant Aquatic Habitat	$1,393,000	Halifax
2008-533 Scotland Neck, Town of - WW/ Sewer Rehabilitation, Canal Creek	Rehabilitate portion of sewer system to reduce I/I to reduce hydraulic loading at WWTP; rehab chlorination/ dechloration contact chamber to improve effluent discharged to Canal Cr.	$1,591,000	Halifax

This list does not include regional or statewide projects that were in multiple river basins, or projects that were funded and subsequently withdrawn.

Recommendations

- More research is needed to understand the amount nutrients entering the river and its tributaries through baseflow and how this contribution can be managed. The NSW strategy targets point and some nonpoint source nutrient contributions to surface waters; however, some nonpoint sources are not specifically addressed in the strategy. Nutrients from non-discharge spray field systems, wastewater residual applications, septic systems, animal feeding operations, dry litter poultry farms, and tiled agriculture may all be contributing to nutrient loads in surface waters via groundwater. DWQ's Aquifer Protection Planning Unit is currently compiling a few select watershed-scale estimates of total nutrient loads from permitted land application facilities which will help determine the potential nutrient loading magnitude.

- Identify sources of organic nitrogen that could be contributing to the increase in basinwide TKN concentrations. Basinwide, the ammonia component of TKN shows a decrease in concentration since 1991. Specifically in this subbasin ammonia concentrations have remained fairly constant. TKN concentrations have also remained fairly constant with spikes occurring during drought years 2007 and 2008. This subbasin contributions to the basinwide increase in organic nitrogen are most likely to occur during drought years suggesting nonpoint source contributions.

- Total phosphorus concentrations have increased over a 12 year time period, this may be related to an increase in development, soil erosion and general increase in population. The Tar-Pamlico NSW strategy requires no increase in phosphorus loads from the 1991 conditions. To achieve this reduction, older laws should be examined to identify where new technology alternatives may be able to assist in meeting nutrient goals (e.g., G.S 143-214.4 prohibits certain cleaning agents from containing phosphorus, household dishwashing machine detergent is exempt.) Several states have recently **banned phosphorous** in dishwasher detergent and lawn fertilizers.

- Explore development of a more comprehensive basinwide stormwater management to prevent uncontrolled development in areas currently exempt from stormwater regulations and to protect watersheds with threatened and endangered species.

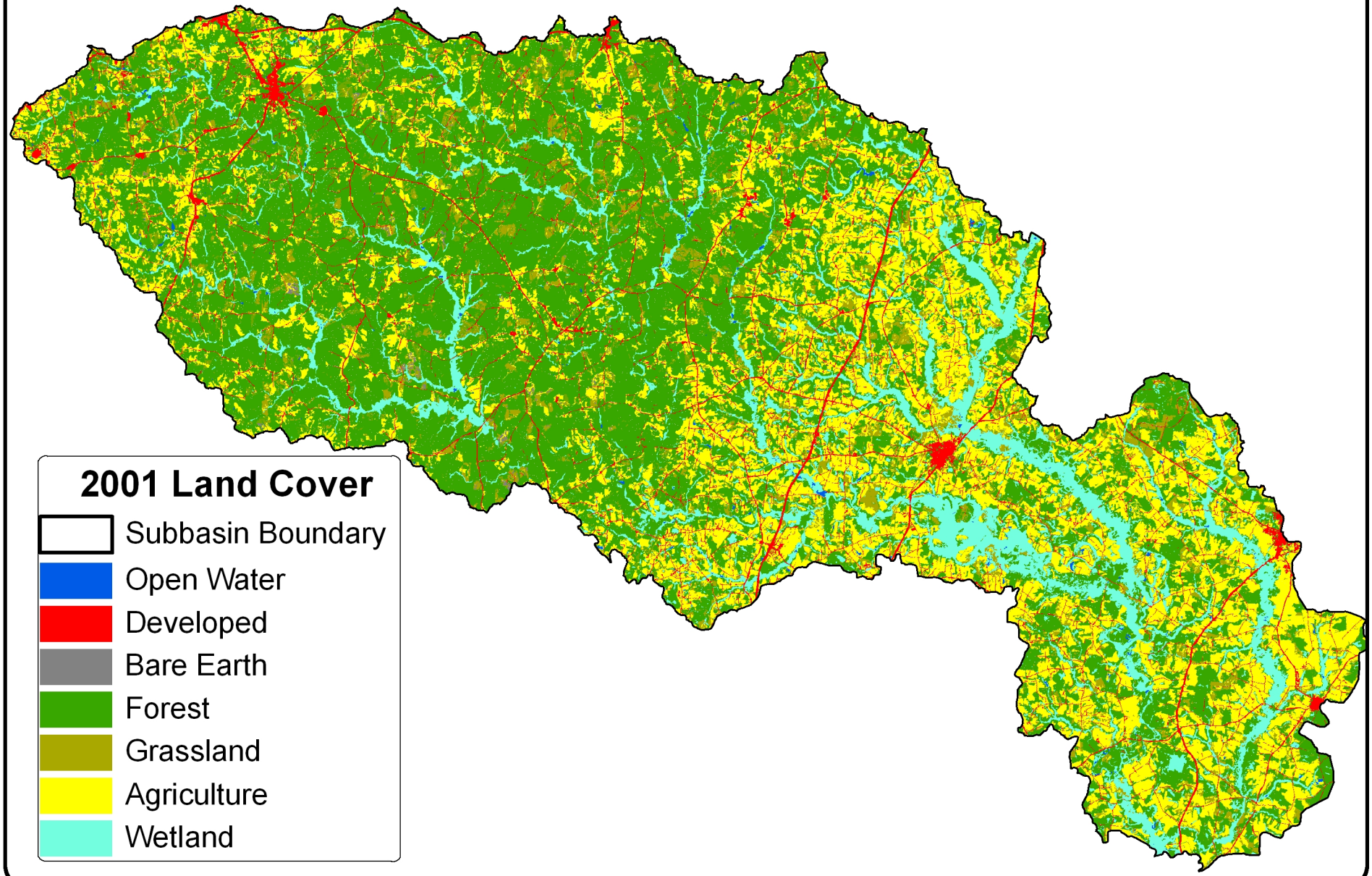
- Continue to work with advising agencies on developing a site-specific management plan, a statewide mussel protection plan or ORW/HQW protection for the threatened and endangerd mussel species in this subbasin.

References

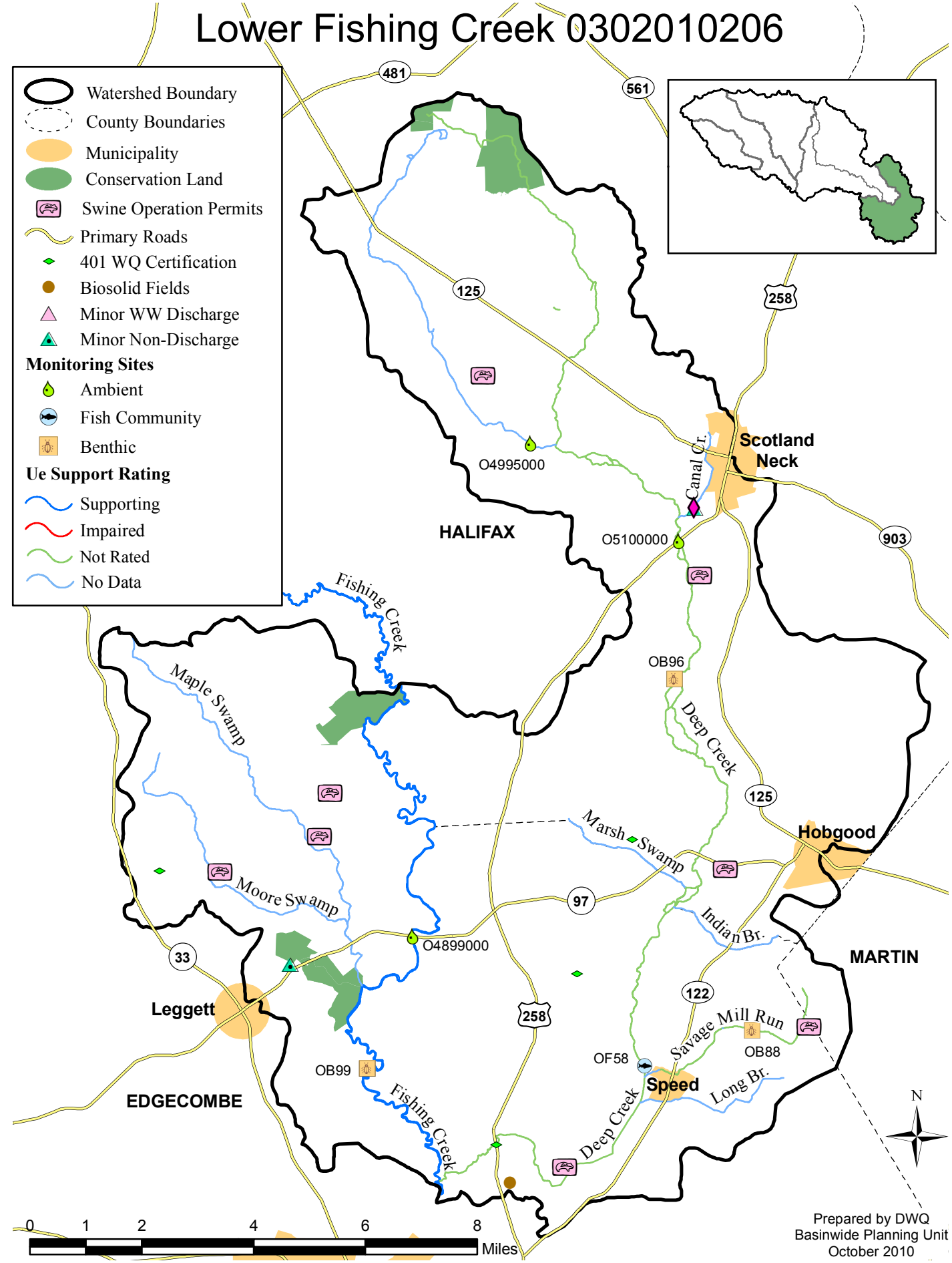
American Farmland Trust. Farming on the Edge: North Carolina State Map. http://www.farmland.org/resources/fote/states/map_northcarolina.asp.

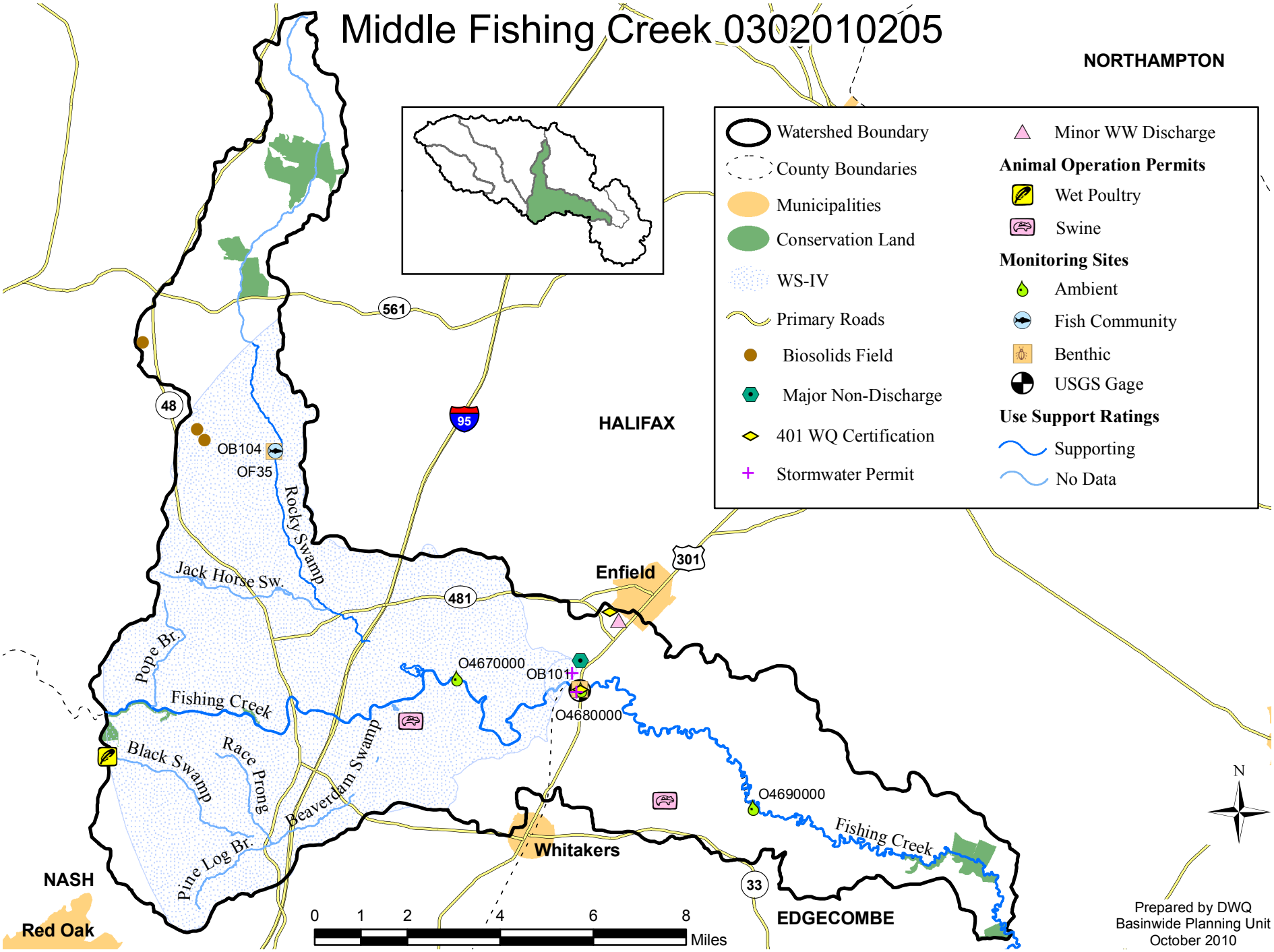
Pradhan, S.S., Hoover, M.T., Austin, R.E. and H. A. Devine. 2007. Potential Nitrogen Contributions from On-site Wastewater Treatment Systems to North Carolina's River Basins and Sub-basins Technical Bulletin 324. North Carolina Agricultural Research Service North Carolina State University Raleigh, NC.

Fishing Creek Subbasin
HUC 03020102

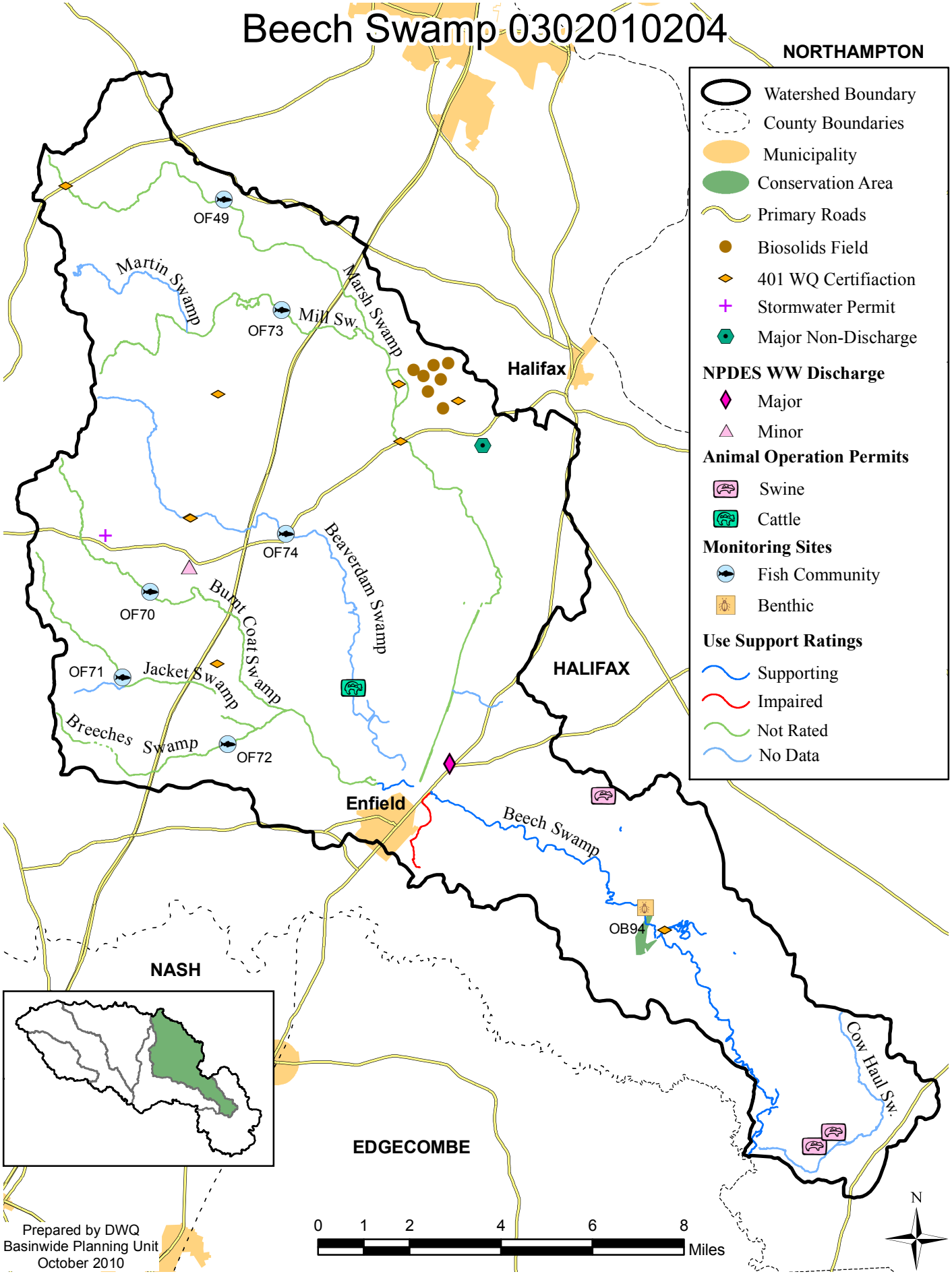


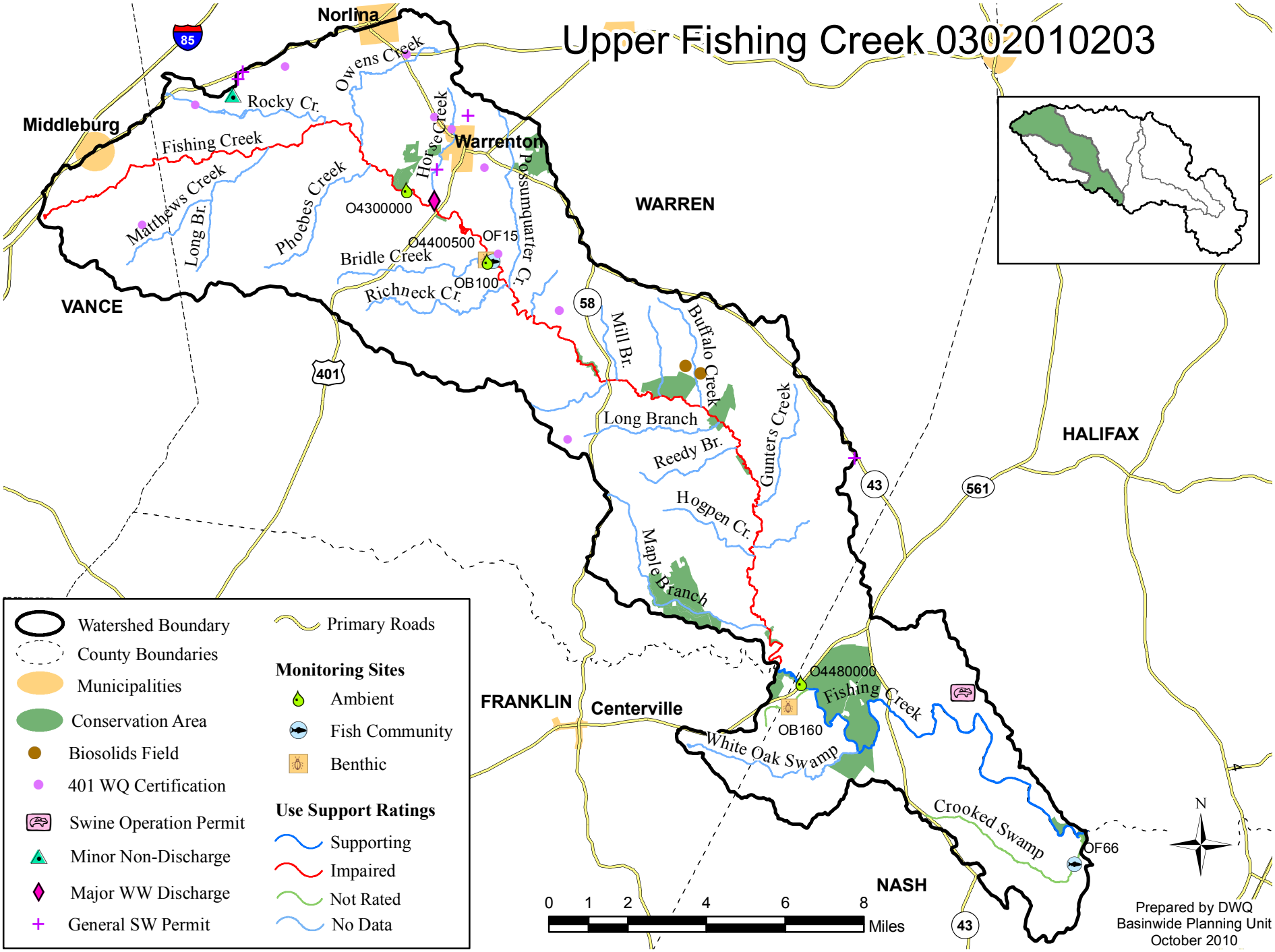
Lower Fishing Creek 0302010206



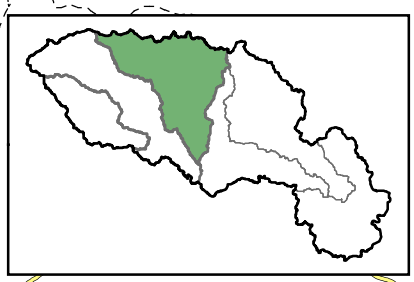

Middle Fishing Creek 0302010205
NORTHAMPTON
HALIFAX
NASH
EDGECOMBE
Red Oak
Enfield
Whitakers
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
WS-IV
Primary Roads
Biosolids Field
Major Non-Discharge
401 WQ Certification
Stormwater Permit
Minor WW Discharge
Animal Operation Permits
Wet Poultry
Swine
Monitoring Sites
Ambient
Fish Community
Benthic
USGS Gage
Use Support Ratings
Supporting
No Data
561
48
95
301
481
33
OB104
OF35
OB101
O4670000
O4680000
O4690000
Rocky Swamp
Jack Horse Sw.
Pope Br.
Fishing Creek
Black Swamp
Race Prong
Beaverdam Swamp
Pine Log Br.
Fishing Creek
0 1 2 4 6 8
Miles
N
Prepared by DWQ
Basinwide Planning Unit
October 2010

Beech Swamp 0302010204




Upper Fishing Creek 0302010203
Norlina
Middleburg
Warrenton
Rocky Cr.
Owens Creek
Horse Creek
Possumquarter Cr.
Fishing Creek
Matthews Creek
Long Br.
Phoebes Creek
O4300000
O4400500
OF15
Bridle Creek
OB100
Richneck Cr.
WARREN
VANCE
58
Mill Br.
Buffalo Creek
Long Branch
Reedy Br.
Gunters Creek
Hogpen Cr.
Maple Branch
401
HALIFAX
43
561
FRANKLIN
Centerville
O4480000
Fishing Creek
OB160
White Oak Swamp
Crooked Swamp
OF66
NASH
Watershed Boundary
County Boundaries
Municipalities
Conservation Area
Biosolids Field
401 WQ Certification
Swine Operation Permit
Minor Non-Discharge
Major WW Discharge
General SW Permit
Primary Roads
Monitoring Sites
Ambient
Fish Community
Benthic
Use Support Ratings
Supporting
Impaired
Not Rated
No Data
0 1 2 4 6 8
Miles
N
Prepared by DWQ
Basinwide Planning Unit
October 2010

Little Fishing Creek Watershed 0302010202



Macon
Littleton
Warrenton
WARREN
HALIFAX
NASH
Reedy Creek
Dowtins Cr.
Walkers Creek
Big Branch
Enon Branch
Bens Creek
Butterwood Creek
Bear Swamp
Bobbitts Branch
Little Fishing Creek
Porter Creek
Powells Creek
OF26
OB166
OF34
OF2
OB158
OB157
O4630000
OB103
903
158
401
58
48
4
561
481
43
0 1 2 4 6 8 Miles
N

- Watershed Boundary
- County Boundaries
- Municipality
- Conservation Area
- Primary Roads
- Minor WWTP Discharge
- Minor Non-Discharge
- Biosolids Field
- 401 WQ Certification
- General SW Permit

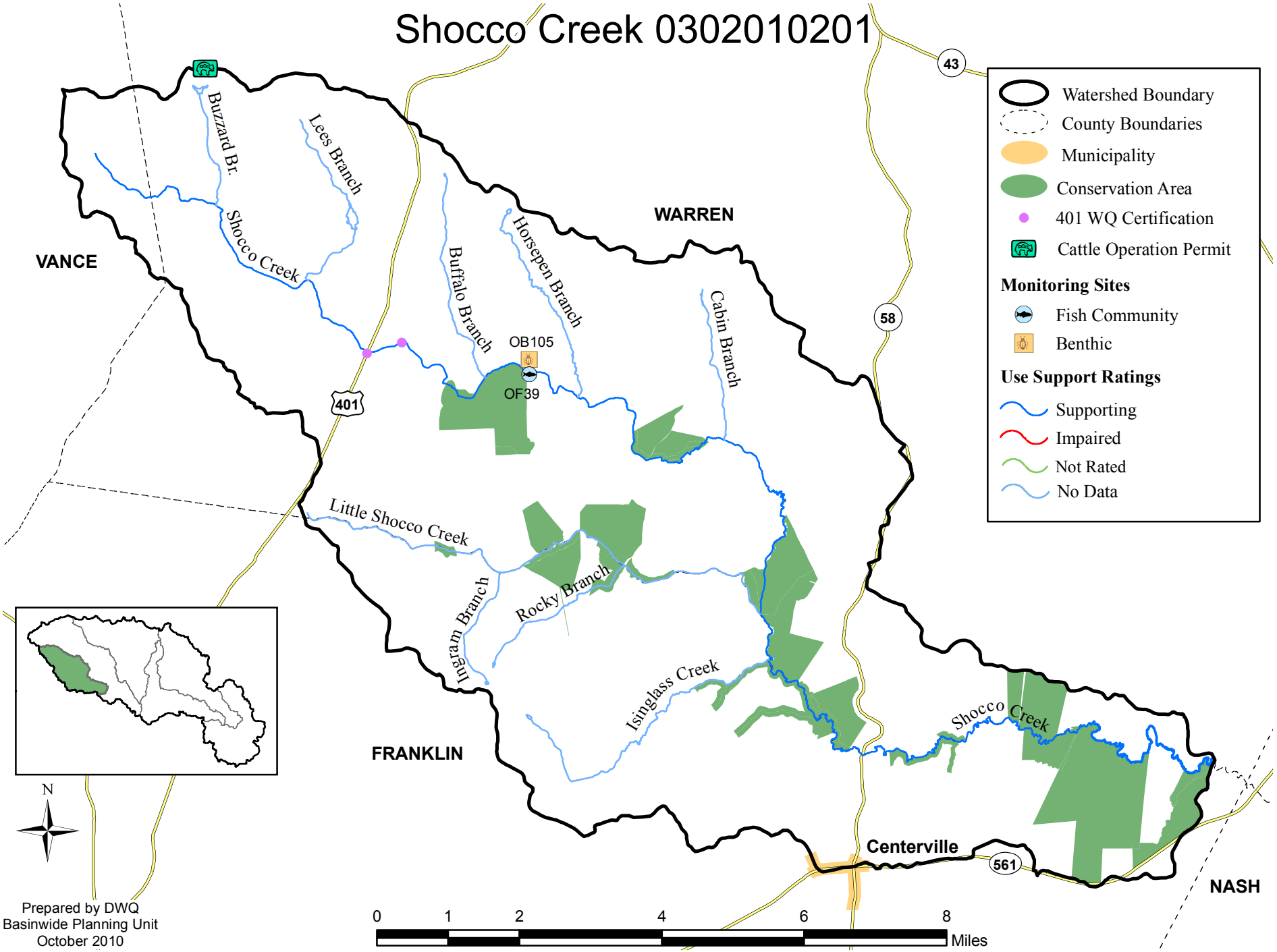
CAFO Permits
- Swine
- Cattle

Monitoring Sites
- Ambient
- Fish Community
- Benthic
- USGS Gage

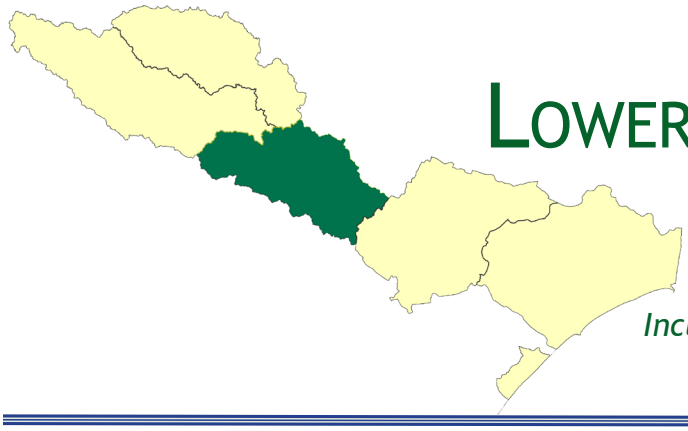
Use Support Ratings
- Supporting
- Impaired
- Not Rated
- No Data

Prepared by DWQ
Basinwide Planning Unit
October 2010

Shocco Creek 0302010201



Prepared by DWQ
Basinwide Planning Unit
October 2010



Lower Tar River Subbasin

Subbasin HUC 03020103

Includes the Tar River and Tributaries

Water Quality Overview:

This subbasin funnels water from the Tar River tributaries before entering the Pamlico Estuary and collectively delivers accumulated concentrations of stressors (e.g., nutrients) directly to the estuary. Nutrient concentrations from ambient stations within this subbasin indicate TP remaining steady and below the 1991 concentrations, while TN concentrations have increased slightly. Water quality on an individual stream basis has improved; specifically the removal of Chicod Creek from the Impaired waters list is a success due to TMDL and agricultural BMPs implementation. Non-point source and development pressures continue to be a concern in the entire subbasin.

General Description

The Lower Tar River Subbasin, hydrologic unit code (HUC) 03020103, contains the mainstem Tar River from Tarboro downstream to Washington covering ~960 square miles; this area was previously delineated as DWQ subbasins 03-03-03, 03-03-05 and 03-03-06 (Figure 3-1).

The western section of the Lower Tar River Subbasin lies within the Southeastern Plains ecoregion while the eastern portion is contained in the Middle Atlantic Coastal Plain ecoregion.

The middle section of the subbasin 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. Land use is primarily forest and agriculture. Many streams in this area were channelized 35 or more years ago. The two areas with the greatest potential for impacts from agricultural nonpoint source pollution are the Cokey Swamp and Conetoe Creek catchments. Cokey Swamp also receives urban runoff from Rocky Mount.

The lower section of the subbasin includes approximately 35 river miles of the Tar River from the confluence of

Watershed at a Glance

Counties: Nash, Edgecombe, Wilson, Martin, Pitt, Beaufort

Municipalities: Rocky Mount, Sharpsburg, Elm City, Pinetops, Macclesfield, Tarboro, Princeville, Conetoe, Bethel, Parmele, Robersonville, Everetts, Bear Grass, Falkland, Fountain, Greenville, Simpson, Grimesland, Washington

Permitted Facilities

NPDES WWTP:.....8
- Major.....3
- Minor.....5

Non-Discharge:.....5

Stormwater:
- General.....34
- Individual.....1

Animal Operations:.....45

2000 Population: 142,407

Area: 960 sq mi.

Impervious Surface Estimate: 15 sq mi.

Primary Classifications:

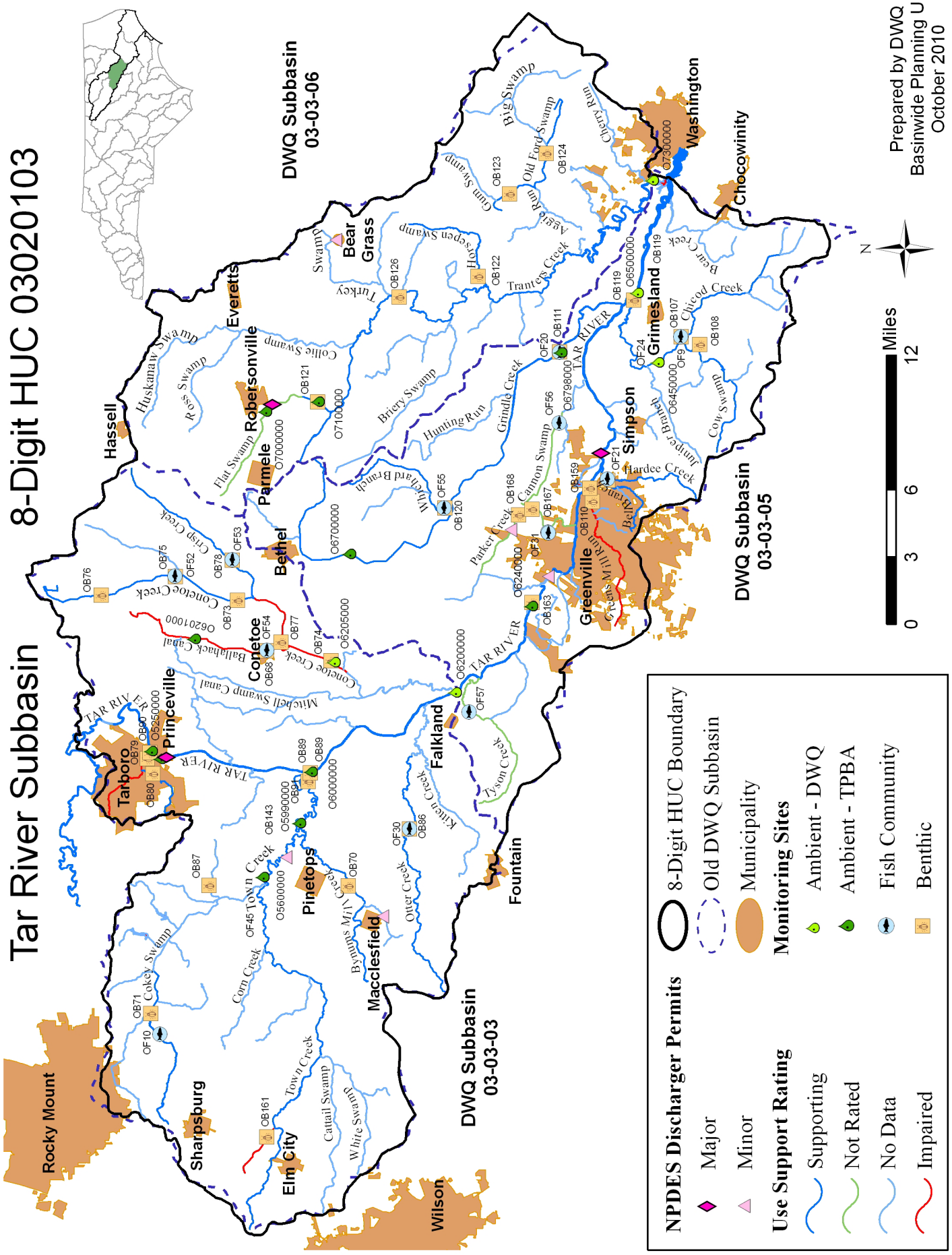
Freshwater ~Miles.....612

Supplemental Classifications miles:

B;NSW.....10
C;NSW.....397
C;Sw,NSW.....154
WS-IV;NSW.....50
WS-IV;NSW,CA.....1

Classification descriptions are found at: http://portal.ncdenr.org/web/wq/ps/csu/classifications

FIGURE 3-1. HUC 03020103 MAP



Conetoe Creek in Pitt County to just upstream of Washington, NC 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. Chicod Creek is the 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). Subwatersheds within the lower Tar River section of this subbasin include, Green Mill Run, Cannon, Flat, Old Ford and Horsepen Swamps, Whichard Branch, Chicod, Grindle, Hardee, Parker, Tranters and Tyson Creeks.

Current Status and Significant Issues

Use Support Assessment Summary

All surface waters in the state are assigned a classification reflecting the best-intended use of that water. Chemical, physical, and biological parameters are regularly assessed by DWQ to determine how well waterbodies are meeting their best-intended use. These data are used to develop use support ratings every two years as reported to EPA. The collected list of all monitored waterbodies and their water quality rating is called the Integrated Report (IR). Water not meeting surface water standards are rated as Impaired and reported on the 303(d) list. Water quality evaluation levels and how a waterbody earns a rating of Supporting or Impaired is explained in detail in the IR methodology. The 2010 IR is based on data collected between 2004 and 2008; the IR and methodology are available on the DWQ Modeling/TMDL website: **http://portal.ncdenr.org/web/wq/ps/mtu/assessment**. The most current use support ratings for this subbasin are in Appendix 3A.

In this subbasin, use support ratings were assigned for aquatic life, recreation, fish consumption, and water supply categories. Waters are either Supporting, Impaired, Not Rated, or No Data in the aquatic life and recreation categories on a monitored or evaluated basis. All waters are Impaired in the fish consumption category on an evaluated basis, based on statewide fish consumption advice issued by the **Department of Health and Human Services**. All waters are Supporting in the water supply category. This evaluation is based on reports from Division of Environmental Health regional water treatment plant consultants.

General Biological Health

Biological samples at 20 benthic macroinvertebrate sites and eight fish community sites were sampled as part of the basinwide sampling cycle. Eastern North Carolina experienced extreme drought in 2007, which was more pronounced than the drought of 2002. Decreased runoff in 2007 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. Tables 3-1 and 3-2 provide summaries of benthic and fish sample site results and a description of the stream location to correspond to Figure 3-1. Site specific information is available in Appendix 3B and the entire Biological Assessment Report can be found at: **http://www.esb.enr.state.nc.us/documents/2008TARbasinwiderptfinal.pdf**.

Benthos Community Sampling Summary

The 20 benthic sites consisted of five summer sites (Coastal A and B) and 15 winter sites (Swamps). Of the five summer sites, one rated Excellent (Tar River-OB89), two rated Good (Tar River-OB90, Town Creek) and two rated Good-Fair (Tar River-OB119, 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 this subbasin appears to have slightly improved since 2002. Most sites (n=12) received the same bioclassification in 2007 that they did in 2002 with five sites showed improved ratings from 2002 to 2007 (Chicod Creek, Cokey Swamp, Bynums Mill Creek, Conetoe Creek-OB75 and Crisp Creek). Only one site declined in bioclassification (Old Ford Swamp). The most downstream site on the Tar River-OB119 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; however, a tributary to Town Creek was sampled as part of a special study and received a Severe rating.

Benthic macroinvertebrate communities and habitat characteristics were surveyed at an additional five stream sites in eastern Edgecombe and central Pitt counties during March 2004, to assist the Ecosystem Enhancement Program in prioritizing restoration sites. Holly Creek, Crisp Creek and Cow Swamp received Moderate bioclassifications and were considered impacted due to rural nonpoint source pollution (e.g., agriculture, residences, deforested areas). Greens Mill Run and Hendricks Creek catchments are dominated by urban runoff and associated high flow events resulting in very severe bank erosion and scour leading to a Severe bioclassification results.

Table 3-1. Benthos Biological Sample Results

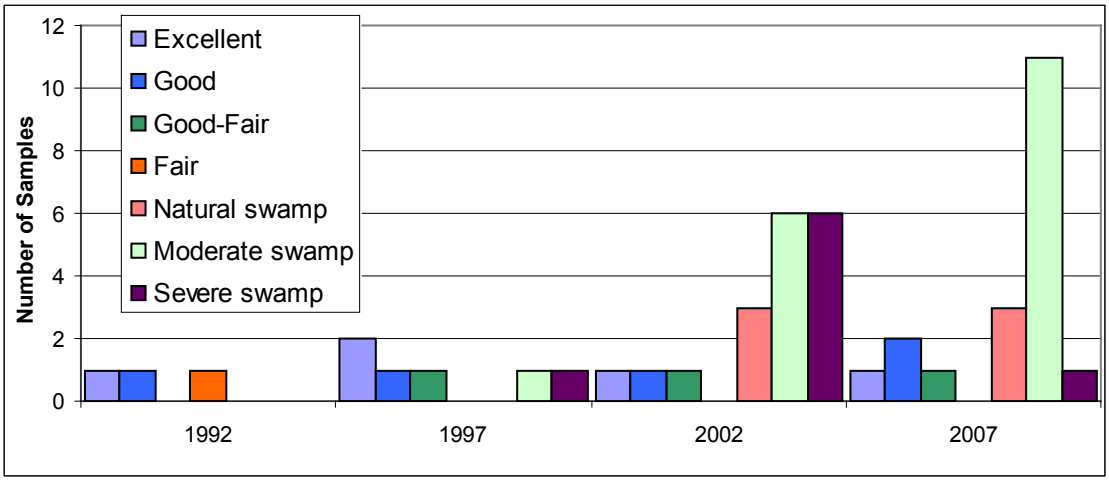
Site ID*	Waterbody	Description	Location	County	AU#.	Date	BioClass
OB87	Sasnet Mill Br	From source to Cokey Swamp	SR 1222	Edgecombe	28-83-3-3	2/7/01	Not Rated
OB161 Special Study	UT Town Cr	From source to Town Creek	SR1400	Wilson	28-83ut8	2/7/07	Severe
OB91	Town Cr	From source to Tar River	SR 1601	Edgecombe	28-83	6/27/07	Good
OB80	Holly Cr	From source to Hendricks Creek	US 64A	Edgecombe	28-81-1	3/1/04	Moderate
OB79	Hendricks Cr	From source to Tar River	St James St	Edgecombe	28-81	3/1/04	Severe
OB90	Tar R	From Tarboro Raw Water Supply Intake to Suggs Creek	US 64 BUS	Edgecombe	28-(80)	6/27/07	Good
OB89	Tar R	From Tarboro Raw Water Supply Intake to Suggs Creek	NC 42	Edgecombe	28-(80)	6/28/07	Excellent
OB163 Special Study	Tar R	From 030303/030305 boundary to Johnsons Mill Creek	US 264	Pitt	28-(84)b	6/25/07	Excellent
OB159	Tar R	From Greenville Raw Water Supply Intake to 1.2 miles downstream of the mouth of Broad Run	US 264A	Pitt	28-(94)	6/25/07	Excellent
OB119	Tar R	From a point 1.2 miles downstream of the mouth of Broad Run to the upstream side of the mouth of Tranters Creek	SR 1565	Pitt	28-(99.5)	6/26/07	Good-Fair
OB91	Town Cr	From source to Tar River	SR 1601	Edgecombe	28-83	6/27/07	Good
OB71	Cokey Swp	From source to Dickson Branch	NC 43	Edgecombe	28-83-3a	2/8/07	Moderate
OB70	Bynums Mill Cr	From source to Town Creek	SR 1120	Edgecombe	28-83-4	2/7/07	Moderate
OB86	Otter Cr	From source to a point 0.7 mile upstream of Kitten Creek	SR 1614	Edgecombe	28-86-(0.3)	2/7/07	Moderate
OB76	Conetoe Cr	From source to SR 1516	SR 1516	Edgecombe	28-87-(0.5)a	2/6/01	Not Rated
OB75	Conetoe Cr	From SR 1516 to 1350 meters North of NC 42	SR 1510	Edgecombe	28-87-(0.5)b	2/6/07	Moderate

Site ID*	Waterbody	Description	Location	County	AU#.	Date	BioClass
OB73	Conetoe Cr	From 1350 meters North of NC 42 to Crisp Creek	NC 42	Edgecombe	28-87-(0.5)c	2/6/07	Moderate
OB77	Conetoe Cr	From Crisp Creek to Pitt County SR 1404	US 64A	Pitt	28-87-(0.5)d	2/6/01	Fair
OB74 special study	Conetoe Cr	From Crisp Creek to Pitt County SR 1404	SR 1409	Pitt	28-87-(0.5)d	11/2/00	Poor
OB78	Crisp Cr	From source to Conetoe Creek	SR 1527	Edgecombe	28-87-1	2/6/07	Moderate
OB68	Ballahack Canal	From source to Conetoe Creek	NC 42	Edgecombe	28-87-1.2	2/6/07	Severe
OB168	Parker Cr	From source to Tar River	SR 1579	Pitt	28-95	6/25/09	Poor
OB167	Parker Cr	From source to Tar River	SR 1591	Pitt	28-95	6/25/09	Poor
OB110	Greens Mill Run	From source to Tar River	Greensprings Park	Pitt	28-96	3/2/04	Severe
OB112	Hardee Cr	From source to Tar River	NC 33	Pitt	28-97	2/14/07	Natural
OB111	Grindle Cr	From Whichard Branch to Tar River	US 264	Pitt	28-100b	6/25/07	Good-Fair
OB120	Whichard Br	From source to Grindle Creek	SR 1521	Pitt	28-100-2	2/13/07	Moderate
OB107	Chicod Cr	From source to Tar River	SR 1777	Pitt	28-101	2/14/07	Natural
OB108	Cow Swp	From source to Chicod Creek	SR 1756	Pitt	28-101-5	3/2/04	Moderate
OB126	Tranters Cr	From source to subbasin 030305/030306 boundary	SR 1552	Edgecombe	28-103a	2/13/07	Moderate
OB121	Flat Swp	From 1.5 miles downstream of Robersonville WWTP discharge to Tranters Creek	SR 1157	Martin	28-103-2b	2/13/07	Moderate
OB124	Old Ford Swp	From source to Aggie Run	US 17	Beaufort	28-103-14-1	2/12/07	Moderate
OB123	Lathams Cr	From source to Aggie Run	SR 1410	Beaufort	28-103-14-2	2/12/07	Natural
OB122	Horsepen Swp	From source to Tranters Creek	SR 1001	Beaufort	28-103-10	2/13/07	Moderate

Bioclassification of Excellent, Good, Natural, Good-Fair, Not Impaired or Moderate Stress = Supporting
Fair, Severe, Severe Stress or Poor = Impaired
* Coordinates with Station ID on Figure 3-1

The bioclassification trends for this subbasin are shown in Figure 3-2. In terms of non-swamp streams, there has been little change in bioclassification trends in this subbasin overtime. However, many of the swamp samples in this subbasin improved in bioclassification, with the largest shift being sites improving from Severe Stress to Moderate Stress. Examples of this trend included Crisp Creek-OB78, Conetoe Creek-OB75, Cokey Swamp-OB71, and Bynums Mill Creek-OB70. The most striking example of a site with a nonpoint dominated

Figure 3-2. Bioclassification Trends in HUC 03020103



watershed improving bioclassification due to drought was observed at Chicod Creek-OB107 which improved from Severe swamp in 2002 to Natural swamp in 2007.

Fish Community Sampling Summary

The fish community metrics for Coastal Plain streams are currently under development; therefore all eight of the fish community samples in this subbasin received a Not Rated classification. The eight waterbodies sampled for fish communities represent either streams with natural channels or channelized streams. Tyson Creek is the best example of a waterbody with a natural channel in this subbasin. 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.

Table 3-2. Fish Community Sample Results

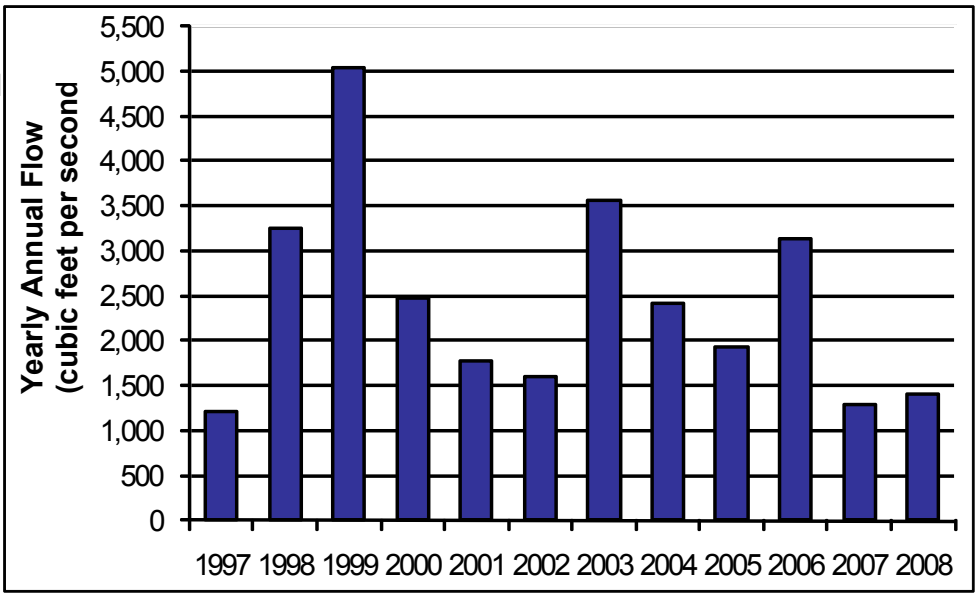
Site ID*	Waterbody	Description	Location	County	AU#	Date	NCIBI Rating
OF9	Chicod Cr	From source to Tar River	SR 1777	Pitt	28-101	4/16/02	Not Rated
OF10	Cokey Swp	From source to Dickson Branch	SR 1135	Edgecombe	28-83-3a	5/09/07	Not Rated
OF20	Grindle Cr	From Whichard Branch to Tar R	US 264	Pitt	28-100b	4/16/02	Not Rated
OF21	Hardee Cr	From source to Tar River	NC33	Pitt	28-97	4/16/02	Not Rated
OF30	Otter Cr	From source to a point 0.7 mile upstream of Kitten Creek	SR 1614	Edgecombe	28-86-(0.3)	4/17/02	Not Rated
OF52	Conetoe Cr	From SR 1516 to 1350 meters North of NC 42	SR 1510	Edgecombe	28-87-(0.5)b	5/09/07	Not Rated
OF53	Crisp Cr	From source to Conetoe Creek	SR 1527	Edgecombe	28-87-1	5/09/07	Not Rated
OF54	Ballahack Canal	From source to Conetoe Creek	NC 42	Edgecombe	28-87-1.2	5/09/07	Not Rated
OF57	Tyson Cr	From source to Tar River	SR 1255	Pitt	28-88	5/10/07	Not Rated
OF31	Parker Cr	From source to Tar River	NC 33	Pitt	28-95	5/10/07	Not Rated
OF56	Cannon Swp	From source to Moyes Run	US 264	Pitt	28-99-1-1	5/10/07	Not Rated
OF55	Whichard Br	From source to Grindle Creek	SR 1521	Pitt	28-100-2	5/10/07	Not Rated

Not Rated = Fish community metrics and criteria have yet to be developed for Coastal Plain streams
* Coordinates with Station ID on Figure 3-1

Stream Flow

Stream flow is monitored at U.S. Geological Survey gaging stations. Flow, often abbreviated as "Q", is measured in terms of volume of water per unit of time, usually cubic feet per second (cfs). There are nine gaging stations in this subbasin. Figure 3-3 provides an example of average stream flow over a 12 year period and gives an idea of which years received heavier precipitation. For more information about instream flow see DWR website: http://www.ncwater.org/About_DWR/Water_Projects_Section/Instream_Flow/welcome.html

Figure 3-3. Stream Flow at USGS 02084000 Tar River in Greenville (Yearly Average based on Daily Means)



Ambient Data

Subbasinwide, monthly chemical and physical samples are taken by DWQ (6 stations) and by the Tar Pamlico Basin Association (10 stations), starting in 2007. A majority of the ambient stations are associated with waterbody locations where potential pollution could occur from known land use activities. There are also portions of the subbasin where no water quality data are collected; therefore, we cannot evaluate the condition of the water quality in those areas. Parameters collected depend on the waterbody classification, but typically include conductivity, dissolved oxygen, pH, temperature, turbidity, nutrient measurements, metals, and fecal coliform. Each classification has an associated set of standards the parameters must meet in order to be considered supporting its designated uses. Stressors are either chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use. Ten sample results are required within the five year data collection window in order to evaluate the water quality parameter and compare it to the water quality standards. Ambient stations are listed in Table 3-3, and their locations are found in Figure 3-1 and on watershed maps provided in Appendix 3D.

Table 3-3. Ambient Stations in HUC 03020103

Station ID	Agency	Active Since	Waterbody	AU#	Station Location	Stressors
O5250000	Both	8/6/73	Tar River	28-(80)	NC 33 And US 64 Bus at Tarboro	-
O5600000	TPBA	3/1/07	Town Creek	28-83	NC 111 SR 1202 near Wiggins Crossroads	Low DO, Low pH
O5990000	TPBA	3/1/07	Town Creek	28-83	US 258 near Cobbs Crossroads	Low DO, Low pH
O6000000	TPBA	3/1/07	Tar River	28-(80)	NC 42 at Old Sparta	-
O6200000	NCAMBNT	10/10/73	Tar River	28-(84)a	NC 222 near Falkland	-
O6201000	TPBA	3/1/07	Ballahack Canal	28-87-1.2	SR 1526 near Conetoe	Low DO, Low pH, Turbidity, Fecal Coliform Bacteria
O6205000	NCAMBNT	8/1/84	Conetoe Creek	28-87-(0.5)d	SR 1409 near Bethel	Low DO, Low pH
O6240000	TPBA	11/16/05	Tar River	28-(84)b	US 264 Byp near Greenville	-

Station ID	Agency	Active Since	Waterbody	AU#	Station Location	Stressors
O6450000	NCAMBNT	8/1/84	Chicod Creek	28-101	SR 1760 near Simpson	Low DO, Low pH, Fecal Coliform Bacteria
O6500000	NCAMBNT	7/5/68	Tar River	28-(99.5)	SR 1565 near Grimesland	
O6700000	TPBA	3/1/07	Grindle Creek	28-100a	SR 1427 near Bethel	
O6798000	TPBA	3/1/07	Grindle Creek	28-100b	US 264 at Pactolus	
O7000000	TPBA	3/1/07	Flat Swamp	28-103-2a	SR 1159 Third St at Robersonville	Fecal Coliform Bacteria
O7100000	TPBA	3/1/07	Flat Swamp	28-103-2b	SR 1157 near Robersonville	Turbidity, Fecal Coliform Bacteria
O7300000	NCAMBNT	10/10/73	Tranters Creek	28-103a	SR 1403 near Washington	Chlorophyll a

TPBA= Tar Pamlico Basin Association, NCAMBNT= DWQ
"-" indicates no stressors identified

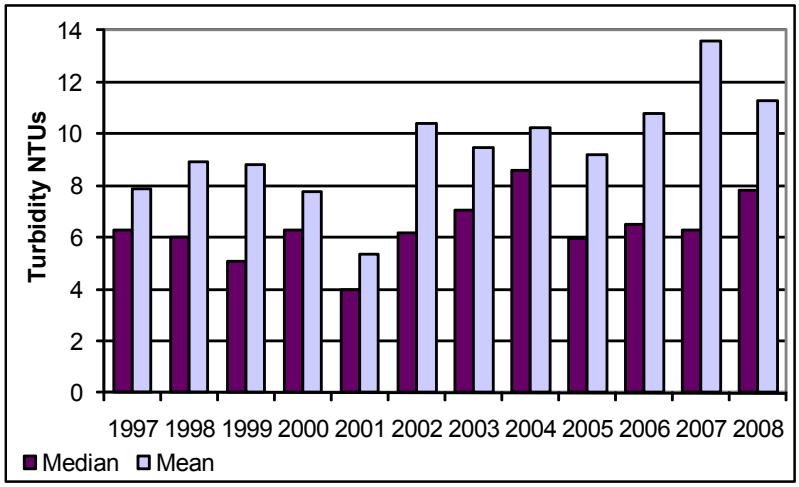
The following discussion of ambient monitoring parameters includes graphs showing the median and mean concentration values for all ambient stations (n=15) in this subbasin for a specific parameter over each year. These graphs are not intended to provide statistically significant trend information or loading numbers, but rather provide an idea of how changes in land use or climatic conditions effect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the dataset. Box and whisker plots of individual ambient stations were completed by parameter for data between 2002-2007 and can be found in the Ambient Monitoring report: http://portal.ncdenr.org/c/document_library/get_file?uuid=994c08a8-a98d-4ff5-9425-656cadf8cfa4&groupId=38364. Summary sheets for ambient data are found in Appendix 3C.

Turbidity

The turbidity standard for freshwater (Class C) streams is 50 NTUs. Currently, Ballahack Canal at SR 1526 near Conetoe (AU# 28-87-1.2) indicated turbidity as a stressor (3 out of 10 samples exceeded 50 NTUs) and is considered Impaired. One out of 10 samples in Flat Swamp at SR 1157 near Robersonville (AU# 28-103-2a) also exceeded turbidity standards.

Turbidity is a measure of cloudiness in water and is often accompanied with excessive sediment deposits in the streambed. Excessive sediments deposited on stream and lake bottoms can choke spawning beds (reducing fish survival and growth rates), harm fish food sources, fill in pools (reducing cover from prey and high temperature refuges), and reduce habitat complexity in stream channels. Excessive suspended sediments can make it more difficult for fish to find prey and at high levels can cause direct physical harm, such as clogged gills. Sediments can cause taste and odor problems, block water supply intakes, foul treatment systems, and fill reservoirs. (USEPA, 1999 and Waters, 1995). It is important to note that the turbidity standard does not capture incident duration or the amount of sedimentation, both of which can impact aquatic species. Increasing turbidity levels is of special concern in

Figure 3-4. Summarized Turbidity values for all data collected at Ambient Stations in HUC 03020103



this basin as phosphorous binds to sediment and is transported downstream and can contribute to nutrient enrichment conditions in the estuary.

Figure 3-4 shows data from 1,078 samples over the 12 year period, of which only 10 samples (1%) had results over 50 NTUs. Turbidity exceedances are likely a result of specific incidences (land use disturbance) and are not a subbasinwide issue.

Fecal Coliform Bacteria

The fecal coliform bacteria standard for freshwater streams is not to exceed the geomean of 200 colonies/100ml or 400 colonies/100ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are to be used to indicate whether the stream is Impaired or Supporting. Waters with a classification of B (primary recreation water) will receive priority for 5-in-30 studies. Other waterbodies will be studied as resources permit. Data through 2007 indicate several streams where bacteria colony numbers exceeded 400 colonies/100ml. Streams currently impacted by fecal coliform bacteria include:

Ballahack Canal (C, NSW) at SR 1526 near Conetoe (AU# 28-87-1.2)
Conetoe Creek (C, NSW) at SR 1409 near Bethel (AU# 28-87-(0.5)d)
Flat Swamp (C, Sw,NSW) near Robersonville (AU#s 28-103-2a & 28-103-2b)
Chicod Creek (C, NSW) at SR 1760 near Simpson (AU# 28-101)

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of humans or other warm-blooded animals. At the time this occurred, the source water might have been contaminated by pathogens or disease producing bacteria or viruses that can also exist in fecal material. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

Figure 3-5. Summarized Fecal Coliform Bacteria numbers for all data collected at Ambient Stations in HUC 03020103

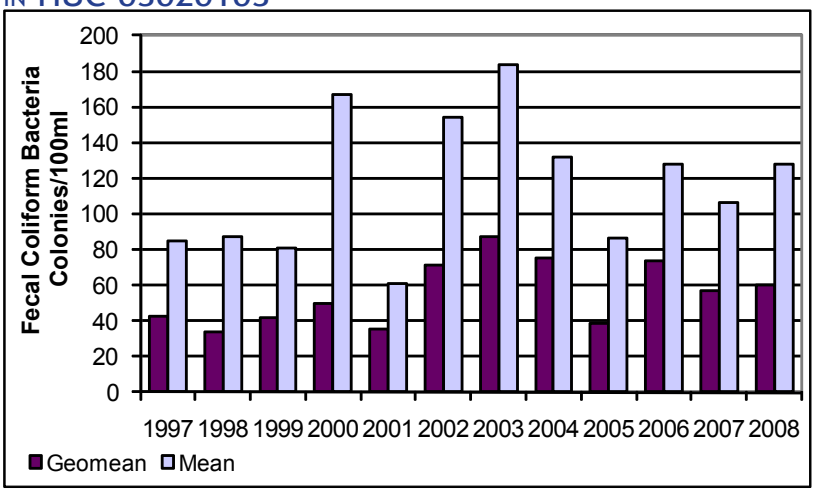


Figure 3-5 shows data from 1,081 samples over the 12 year period, of which 67 samples (6%) had fecal coliform bacteria levels above 400 colonies/100ml.

Dissolved Oxygen

The dissolved oxygen (DO) water quality standard for Class C waters is not less than a daily average of 5.0 mg/L with a minimum instantaneous value of not less than 4 mg/L, the latter standard being the most commonly used. Swamp waters may have lower values if the low DO level is caused by natural conditions. Dissolved oxygen can be produced by wind or wave action that mix air into the water or through aquatic plant photosynthesis. During the day, DO levels are higher when photosynthesis occurs and they drop at night when respiration occurs by aquatic organisms. High levels are found mostly in cool, swift moving waters and low levels are found in warm, slow moving waters. In slow moving waters, such as reservoirs or estuaries, depth is also a factor. Wind action and plants can cause these waters to have a higher dissolved oxygen

concentration near the surface, while biochemical reactions lower in the water column may result in concentration as low as zero at the bottom.

There are many sites in the basin that have low DO measurements. However, most of these sites were first sampled during the 2007 drought; the Tar Pamlico Basin Association sites began monitoring in March 2007. Nearly the entire monitoring history for these sites was during the 2007-08 drought, which, due to drops in flow, suppressed dissolved oxygen levels. Additional monitoring data during non-drought conditions will aid in identifying whether DO conditions are altered by anthropogenic pollutants.

Figure 3-6. Summarized Dissolved Oxygen Levels for all data collected at Ambient Stations in HUC 03020103

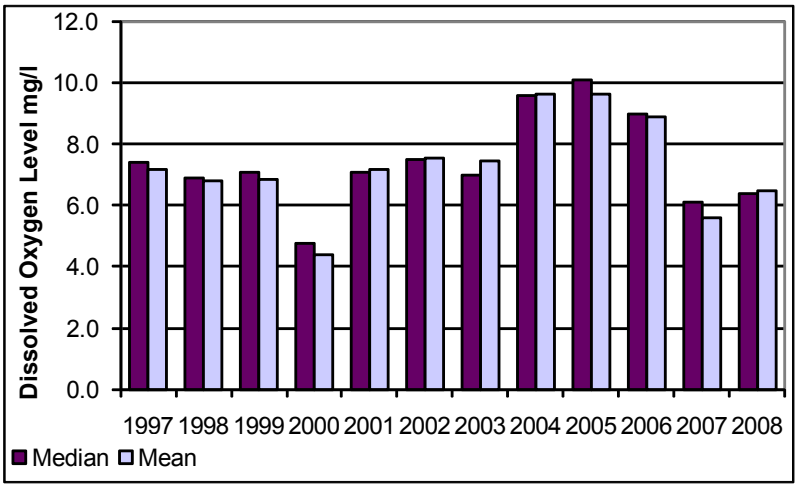


Figure 3-6 represents results from 769 samples collected over a 12 year period, of which 180 samples (23%) had instantaneous readings below 4 mg/L. A majority of the low DO levels occurred during the 2007-08 drought.

pH

The water quality standard for pH in surface freshwater is 6.0 to 9.0 standard units. Swamp water (supplemental Class Sw) may have a pH as low as 4.3 if it is the result of natural conditions. pH is a measure of hydrogen ion concentration that is used to express whether a solution is acidic or alkaline (basic). Values outside the 6.0-9.0 standard unit range can have chronic effects on the community structure of macroinvertebrates, fish and phytoplankton. The following waterbodies have experienced low pH levels at the sample sites.

Town Creek near Wiggins Crossroads (AU#28-83)
Ballahack Canal at SR 1526 near Conetoe (AU# 28-87-1.2)
Conetoe Creek at SR 1409 near Bethel (AU# 28-87-(0.5)d)

Figure 3-7. Summarized pH values for all data collected at Ambient Stations in huc 03020103

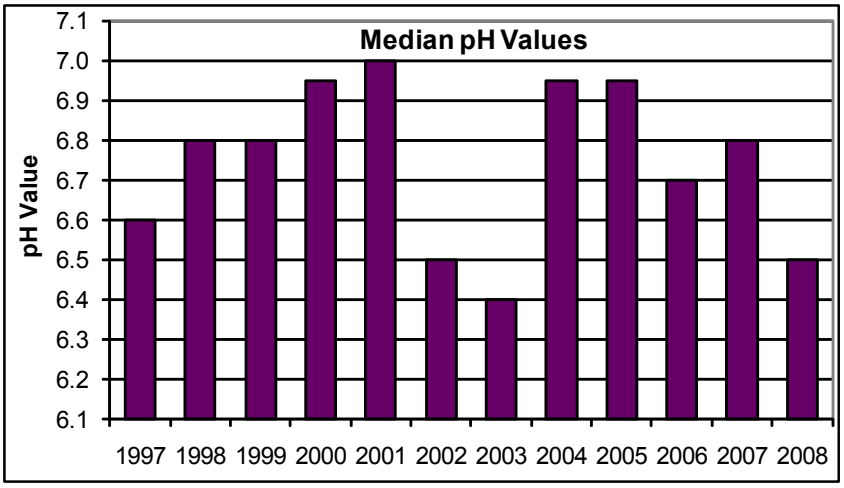


Figure 3-7 graph shows data from 1,329 samples over the 12 year period, of which only 113 samples (9%) had low pH readings.

Nutrient Enrichment

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as "nutrients". Nitrogen compounds include ammonia as nitrogen (NH_3), Total Kjeldahl Nitrogen (TKN), and nitrite+nitrate nitrogen (NO_2+NO_3). Total nitrogen (TN) is the sum of TKN and NO_2+NO_3. Phosphorus is measured as total phosphorus (TP) by DWQ. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes or runoff from urban or agricultural land, the growth of algae and other plants may be accelerated. In addition to the possibility of causing algal blooms, ammonia-nitrogen may combine with high pH water to form ammonium hydroxide (NH_4OH), a form toxic to fish and other aquatic organisms.

Due to excessive levels of nutrients resulting in massive algal blooms and fish kills the entire Tar-Pamlico River Basin was designated as Nutrient Sensitive Water (NSW) in 1989. This designation resulted in the development and implementation of a nutrient management strategy to achieve a decrease in TN by 30% and no increase in TP loads compared to 1991 conditions. Even though implementation of the strategy has occurred by wastewater treatment dischargers, municipal stormwater programs, and agriculture, nutrient enrichment continues to be cumulatively impacting the Pamlico Estuary. A review of the NSW strategy, including implementation activities, progress towards meeting the loading goals and additional actions are discussed in Chapter 6.

Basin trend analyses were completed for nutrient concentration and daily loads to evaluate progress towards meeting TMDL reduction goals, as discussed in detail in the NSW Chapter 6. These analyses detected a statistically significant increase in TKN concentration and a decrease in NH_3 and NO_2+NO_3. There were no basinwide detected trends for TN or TP concentrations. TKN is defined as total organic nitrogen and NH_3. An increase in organic nitrogen is the likely source for the increase in TKN concentrations since NH_3 concentrations have decreased basinwide. Further analysis of these parameters were completed on a subbasin scale to determine whether concentrations changed over an 11 year time period. Currently, NC does not have nutrient standards; however, NC normal nutrient levels in class C waters are typically:

TP = < 0.05 mg/L
TN= < 0.8 mg/L
TKN= <0.5 mg/L
NH_3= < 0.05 mg/L

In early 2001, the DWQ Laboratory Section reviewed its internal Quality Assurance/Quality Control (QA/QC) programs and analytical methods. This effort resulted in a marked increase in reporting levels for certain parameters. New analytical equipment and methods were subsequently acquired to establish new lower reporting levels and more scientifically supportable quality assurance. As a result, the reporting levels quickly dropped back down to at or near the previous reporting levels. Nutrients were especially affected by these changes, as shown below:

	Reporting Level by Date (mg/L)			
Parameter	Pre-2001	3/13/2001 to 3/29/2001	3/30/2001 to 7/24/2001	7/25/2001 to present
NH_3	0.01	0.05	0.2	0.01
TKN	0.1	1.0	0.6	0.2
NO_2+NO_3	0.01	0.5	0.15	0.01
TP	0.01	0.5	0.1	0.02
Note: Do not let increased reporting levels be interpreted as a sudden upward trend. The DWQ Laboratory Section cautions that the establishment of minimum reporting levels may have been inconsistent and undocumented prior to those established in July 2001.				

Figure 3-8 represents data over a 12 year period, where 4,316 samples were taken, of which 4,079 (95%) samples had TP levels above 0.05 mg/L. These data and the estuarine algal response to nutrient loading indicates TP inputs to streams continues to be a problem.

For comparison, 1991 TP concentration data, shown in green: Median= 0.13 Mean = 0.11

Figure 3-8. Summarized Total Phosphorus values for all data collected at Ambient Stations in HUC 03020103

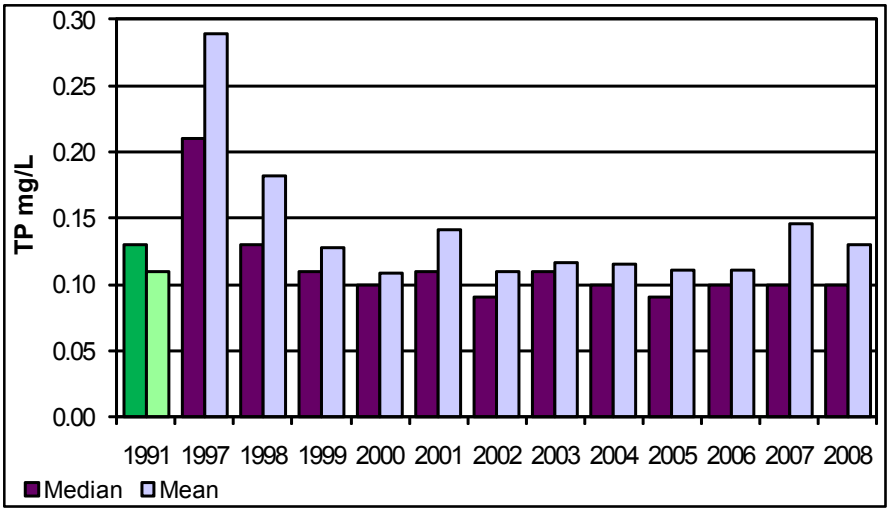


Figure 3-9. Summarized Total Nitrogen values for all data collected at Ambient Stations in HUC 03020103

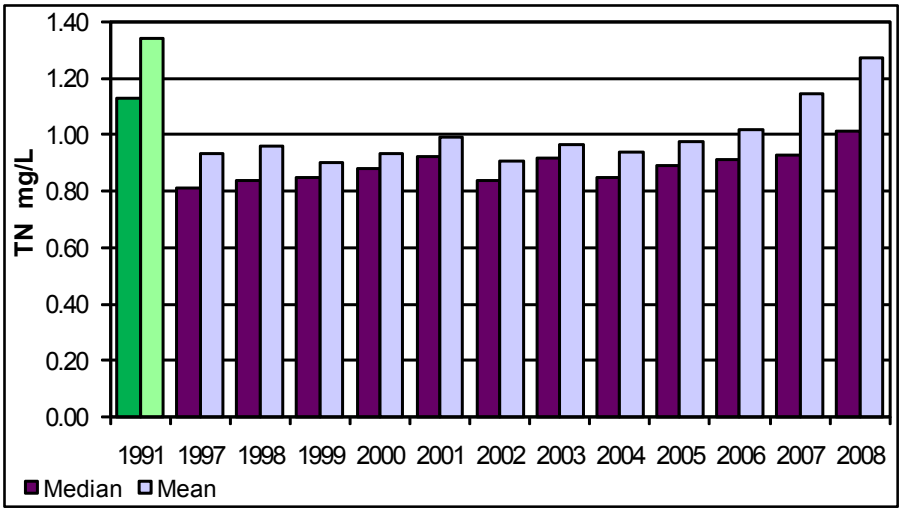


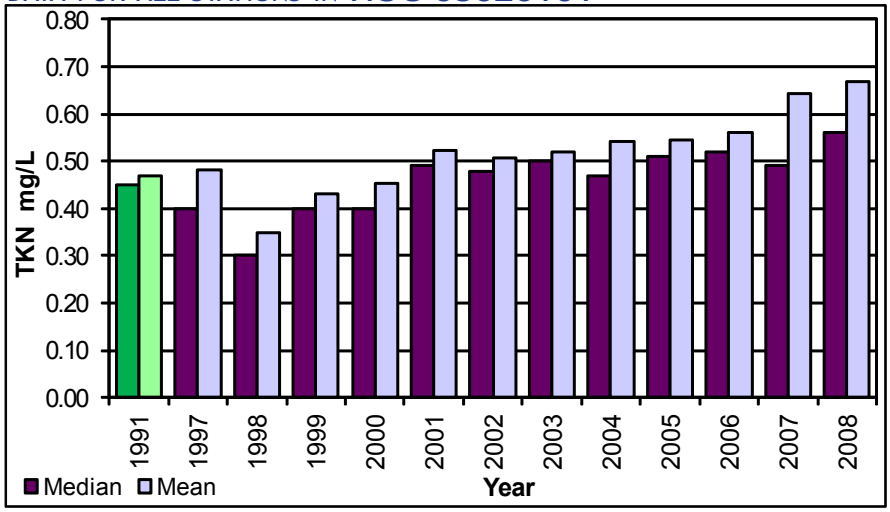
Figure 3-9 represents data from 4,307 samples collected over 12 years, of which 2,717 (63%) of them had TN levels above 0.8 mg/L. These data and the estuarine algal response to nutrient loading indicates TN inputs to streams continues to be a problem.

For comparison, 1991 TN concentration data, shown in green: Median= 1.13 Mean = 1.34

The noted basinwide TKN increase is also seen in TKN concentrations summarized for all stations within this subbasin (Figure 3-10). This subbasin is influenced by organic nitrogen inputs for HUCs 03020101 & 03020103.

For comparison, 1991 TKN concentration data, shown in green: Median= 0.45 Mean = 0.47

Figure 3-10. Summarized TKN concentration data for all stations in HUC 03020101



Restoration and Protection Opportunities

The following section provides more detail about specific streams where special studies have occurred or stressor sources information is available. Specific stream information regarding basinwide biological samples sites are available in Appendix 3B. Use support information on all monitored streams can be found in Appendix 3A. Detailed maps of each of the watersheds are found in Appendix 3D or by clicking on the following small maps. Interactive elements have been incorporated within all 10-digit watershed maps. To use the new features click on the Layers tab on the left side of the Adobe Reader window. Expand the folder tree by clicking on the (+) sign to the left of the map name. Each item in the subsequent folder tree is a layer on the map. These layers can be turned on or off by clicking the symbol to the left of the layer name. To return to your previous place within the text click the smaller map in the upper left corner of the 10-digit watershed map.

To assist in identifying potential water quality issues, we are requesting information be gathered by citizens, watershed groups and resource agencies through our Impaired and Impacted Stream/ Watershed Survey found at: http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey

Town Creek Watershed (0302010301)

Recommendations

Currently, there is not a sample site that can quantify nutrients draining from this watershed. Nutrient data should be collected at ambient site O5990000 to help target areas within the basin for further nutrient reductions.

Restoration Opportunities & Protection Priorities

Cokey Swamp (HUCs 030201030103 & 030201030104) is a tributary to Town Creek and drains eastern Nash and western Edgecombe counties. Cokey Swamp is currently classified as C; NSW even though physically and biologically it appears to be Swamp Waters. NC Natural Heritage Program has designated part of the subwatershed as Significant Natural Heritage Area. Since 2002 the upper 8.6 miles of the stream (AU# 28-83-3a) have been Impaired based on a Severe Stress bioclassification, however the 2007 sample showed some improvement to a Moderate Stress bioclassification leading to the stream to no longer being on the 303(d) list. Urban runoff from Rocky Mount and Sharpsburg and agriculture nonpoint source pollution potentially impact the stream. There are also several waste residual application sites located within the lower subwatershed. The potential runoff impact from these areas is unknown, but should be minimal if applied appropriately.

In 2005, the Upper Coastal Plain Council of Government and the Pamlico-Tar River Foundation received a 205j grant to identify non-point source pollution through a land use assessment of property within 100-300 feet from the stream. Their land use assessment identified potential problem areas including: tilled cropland or pastures draining to the stream or ditch networks, CAFO's, spray fields, and one lagoon located within the 100-yr floodplain. Junk and abandoned cars were found within the riparian areas within Cokey Swamp headwaters.

Upper Town Creek Subwatershed (HUC 030201030102)
Excess runoff from Elm City's WWTP spray fields prompted DWQ's Raleigh Regional Office to request samples be taken in Town Creek in 2007. This spray system consistently exceeded its limits on a weekly basis (calculated ~1.1 million gallons of runoff occurred during 2006) and was under a Special Order by Consent. Sampling results in 2007 resulted in a Severe bioclassification rating indicating degraded water quality in an unnamed tributary (UT) to Town Creek at SR 1400. This UT to Town Creek (AU# 28-83ut8 2.6 mi) is Impaired on the 2010 303(d) list.

The special sample results noted that UT to Town Creek appeared to be in the process of transforming into a wetland from the documented increased volume of water from the upstream spray field. Furthermore, the riparian habitat along this reach of stream and within the channel was degraded. Water chemistry parameters such as pH and temperature indicated warmer waters and higher pH levels characteristic of upstream point sources. The special study results concluded this waterbody 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. The Deformity Analysis 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. DWQ inspections in 2008 indicate improved management of the wastewater collection system, with reduced inflow and infiltration (I&I) maintenance of adequate lagoon freeboard and the possibility of acquiring new lagoons and spray fields locations. Additional benthic surveys will be required to indicate if the WWTP's improved management has allowed stream conditions to restore to full use.

Bynums Mill Creek (HUC 030201030106), AU# 28-83-4-1, is no longer Impaired. The 2007 sample resulted in an improved conditions of Moderate Stress swamp bioclassification, although water quality issues seem to be the main concern versus habitat conditions. Macclesfield WWTP discharges into Bynums Mill Creek; the NPDES permitted flow is 0.175 million gallons/day (MGD) and the median annual daily flow is 0.064 MGD. Parameters that have exceeded the permit limits include: pH, fecal coliform bacteria, chlorine, total suspended solids, ammonia, and BOD. The facility is receiving technical assistance from DWQ's Raleigh Regional Office to better address ammonia.

Otter Creek- Tar River Watershed (0302010302)

Restoration Opportunities

Hendricks Creek (HUC 030201030202), AU# 28-81, from source to Tar River 3.9 miles is Impaired based on a Severe bioclassification in 2004. Hendricks Creek runs through the middle of Tarboro and habitat conditions represent typical conditions in highly urbanized watersheds with very severe bank erosion and scour. The creek's flashiness is apparent (e.g., high wrack lines, scour, severe bank erosion) and is indicative of highly impervious watersheds. Restoration efforts for Hendricks Creek need to focus on both habitat and water quality improvements to significantly improve benthic bioclassifications. This stream is part of an EEP local watershed plan; more information can be found at: **http://www.nceep.net/services/lwps/Tar-Pamlico/Middle_Tar_LWP_Files/Middle_Tar_Rehabilitation_Plans_Appendices/Hendricks_Creek_Rehabilitation_Plan.pdf**.

Protection Priorities

Tar River Watershed (HUC 030201030202 & HUC 030201030204)
In 2005, two sites (OB89 & OB90) were sampled along the Tar River, (AU# 28-(80)) from Tarboro Raw Water Supply Intake to Suggs Creek, in Edgecombe County between Tarboro and Greenville. Both sites received Excellent bioclassifications. However in 2007, a drought year, the OB90 site at US Bus.64 received a Good bioclassification rating. The site needs to be sampled again during a normal rainfall year to determine if it would receive an Excellent rating again. Between 2000 and 2005, Wildlife Resources Commission biologists collected mussel taxa from the Tar River between the two sites and at NC 42. These taxa consisted of Lampsilis radiata, Alasmidonta undulata, and Elliptio roanokensis, which are listed as Threatened by NC and Lampsilis cariosa, which is listed as Endangered by NC, and as a Species of Special Concern in the United States. Due to the presence of listed aquatic species and potential water quality from US Bus. 64 to NC

42, this section of the Tar River might qualify for ORW.The presence of these rare, threatened and endangered species dependent on excellent water quality makes this portion of the Tar River and contributing tributaries priorities for restoration and protection activities.

Conetoe Creek Watershed (0302010303)

Conetoe Creek Watershed, (HUCs 030201030301, 030201030303, 030201030305)
Previously half of this creek was impaired based on a Severe Stress bioclassification; however, 2007 benthic samples resulted in a Moderate bioclassification indicating improved conditions. This improvement results in 9.8 miles being removed from the 2010 303(d) Impaired waters list (AU# 28-87-(0.5)a & 28-87-(0.5)b). The lower 6.7 miles of Conetoe Creek remain Impaired (AU# 28-87-(0.5)d) based on a Poor rating from a special study conducted in 2000. It is recommended this site be sampled during the next basinwide biological sampling period.

Land use is primarily agricultural in this watershed. Water is controlled through a series of canals that are managed by a drainage district board (consisting of local landowners and a technical advisor). Over 95 miles of stream in the watershed were channelized in the 1960s with intermittent de-snagging and dredging since then. The drainage district levies a tax on landowners to maintain the canals for proper drainage including canal access, mowing, de-snagging, and pipe and crossing repairs. Woody debris were noted as sparse and the habitat is generally poor throughout the watershed. Agricultural chemicals are thought to be the cause of toxicity and channelization the cause of the habitat degradation. Reestablishment of buffers along the intermittent and perennial streams should be encouraged to reduce nutrient inputs and provide habitat for aquatic organisms.

There is one swine animal operation (AWS740120) in this watershed that has been in violation with their DWQ permit. The facility has a history of minimal emergency storage volume capacity and the sprayfields are in poor condition and not managed well. DWQ will continue to closely monitor this operation.

Ballahack Canal (HUC 030201030305), AU# 28-87-1.2, from source to Conetoe Creek, 8.4 miles had a Severe benthos bioclassification in 2007. Ballahack Canal is a highly channelized tributary of Conetoe Creek. The benthic station is located in the town of Conetoe and it has been rated Severe since 2002. This site had a very low habitat score 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). Ambient data indicates high turbidity levels, high fecal coliform bacteria levels, and low pH. Water flow has recently been managed by the drainage district through the use of an inflatable fabric dam. Ballahack Canal is listed on the 2010 303(d) list for Aquatic Life because of turbidity exceedances and poor biological integrity.

Crisp Creek (HUC 030201030302), AU# 28-87-1, is a tributary to Conetoe Creek. This channelized creek, has stabilized banks with a mature hardwood riparian zone. Benthic samples have shown improvements from a Severe Stress bioclassification to the recent Moderate bioclassification. This stream is part of an EEP local watershed plan; more information can be found at: **http://www.nceep.net/services/lwps/Tar-Pamlico/Middle_Tar_LWP_Files/Middle_Tar_Rehabilitation_Plans_Appendices/Crisp_Creek_Rehabilitation_Plan.pdf**.

Greenville-Tar River Watershed (0302010304)

Greens Mill Run (HUC 030201030403), AU# 28-96, from source to Tar River, 7.3 miles is Impaired due to a Severe benthos bioclassification in 2004. Stream habitat conditions represent typical conditions in highly urbanized watersheds with very severe bank erosion and scour. Stream flow flashiness is apparent (e.g., high wrack lines, scour, severe bank erosion) and is indicative of highly impervious watersheds. Restoration efforts for Green Mill Run need to focus on both habitat and water quality improvements to significantly improve benthic bioclassifications. This stream is part of an EEP local watershed plan; more information can be found at: http://www.nceep.net/services/lwps/Tar-Pamlico/Middle_Tar_LWP_Files/Middle_Tar_Rehabilitation_Plans_Appendices/Green_Mill_Run_Rehabilitation_Plan.pdf.

Parkers Creek (HUC 030201030404), AU# 28-95, from source to Tar River, 7.3 miles are Not Rated based on a 2007 fish community sample (OF31). This site is Not Rated because criteria are still being developed to rate coastal plain streams; when these criteria are finalized this stream can then be back-rated based on the 2007 sample. The sample indicated an improvement in riparian vegetation and bank stability since the 2002 sample; a diverse and abundant fish community was seen for such a small channelized stream.

In the summer of 2009, two benthic samples were taken upstream of OF31 to determine if stormwater from a specific property was contributing to water quality degradation. The samples indicated Poor ratings both upstream (SR 1579) and downstream (SR 1591) of the facility with impacted habitat in-stream and riparian limitations likely caused by historic channelization and extreme fluctuations in hydrology (flashiness). The poor aquatic macroinvertebrate habitat conditions could not be directly linked to the property of interest. Stormwater runoff and altered hydrology are likely the main reason for degraded water quality in this subwatershed. This subwatershed drains the Pitt-Greenville Airport and Greenville's industrial areas. Parkers Creek will likely be listed as impaired on the 2012 303(d) list.

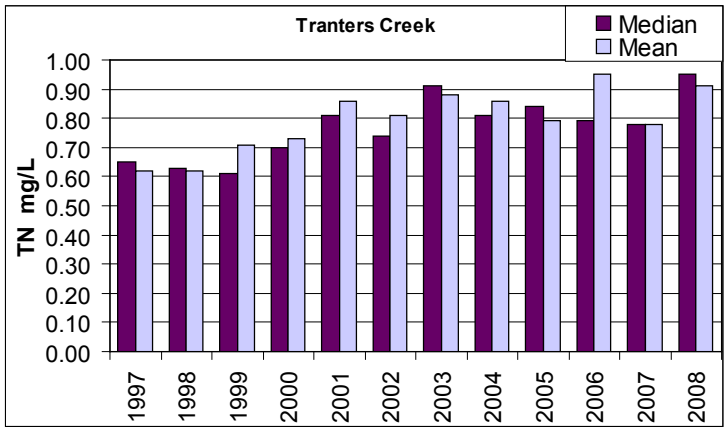
Tranters Creeek Watershed (0302010305)

Old Ford Swamp, (030201030506), AU# 28-103-14-1, had the only benthic sample site to decline in bioclassification rating, going from a natural rating in 2002 to a moderate rating in 2007. The site also had the lowest pH (4.9) recorded at a benthic site in the basin. It is hypothesized that the lack of high pH agricultural runoff during the 2007 drought was supplanted by low pH swamp waters.

Tranters Creek Watershed, AU# 28-103a, runs ~38 miles from its source in Martin County to the Tar River in Beaufort county. Tranters Creek watershed (HUC 0302010305) drains ~243 sq. miles and includes the towns of Parmele, Robersonville, Everetts, and the northwestern parts of Washington. Land use data from 2001 indicates 37% of the watershed is forested, 35% agriculture, 14% wetlands, 8% grasslands, and 6% developed. There are also several waste residual application fields in the upper watershed. Over the past 10 years one swine animal operation facility has had numerous violations, resulting in minimal emergency volume storage capacity and poor spray field conditions.

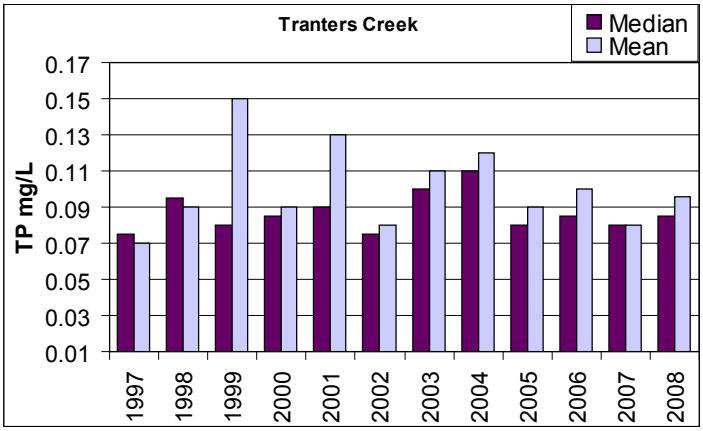
Tranters Creek and its tributaries are nutrient sensitive swamp freshwater systems that are currently supporting their designated uses. However, the TN concentration at the ambient station O7300000 is increasing and the majority of the TP concentrations remain above 0.05 mg/L as shown in Figures 3-11 & 3-12.

Figure 3-11. Total Nitrogen Concentration @ AMS 07300000



Over 12 years 142 samples were collected, of which 57 (40%) of them had TN levels above 0.8 mg/L.

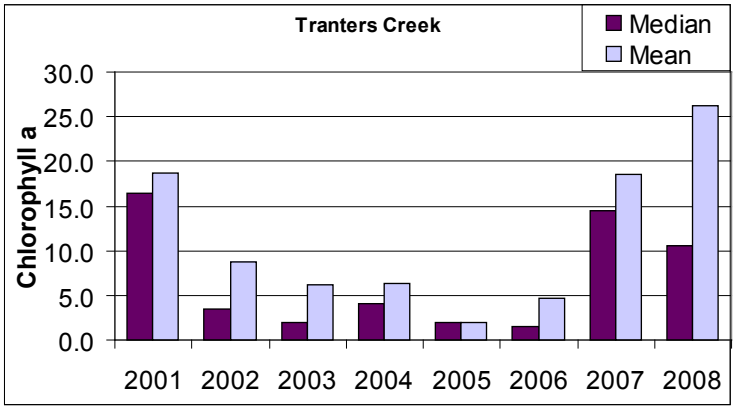
Figure 3-12. Total Phosphorus Concentration @ AMS 07300000



Over 12 years 142 samples were collected, of which 116 samples (82%) had TP levels above 0.05 mg/L.

Chlorophyll *a*, a constituent of most algae, is a widely used indicator of algal biomass. The chlorophyll *a* standard is 40 µg/L (micrograms per liter) for lakes, reservoirs, and slow moving waters in North Carolina. The chlorophyll *a* standard is used to detect an algal response to accumulated nutrients to a waterbody. Figure 3-13 shows chlorophyll *a* data collected at the mouth of Tranters Creek.

Figure 3-13. Chlorophyll A Concentration Data @ AMS 07300000

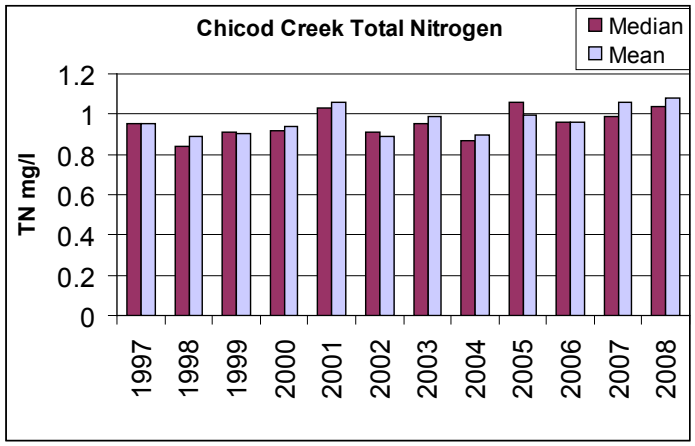


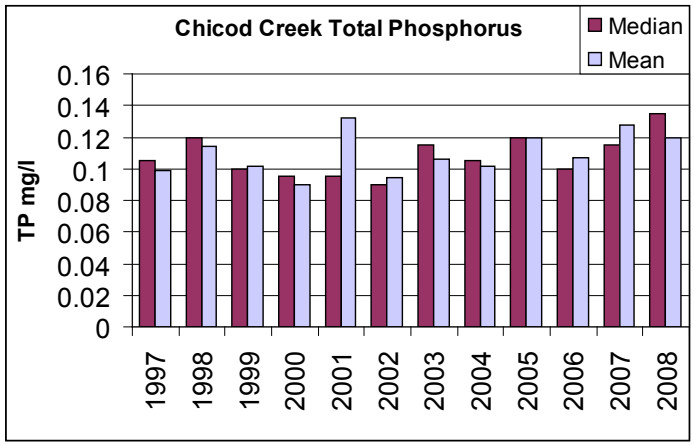
Over 8 years 87 samples were collected, of which 4 samples (4%) had chlorophyll *a* levels above 40 µg/L.

Tar River Chicod Watershed (0302010306)

Chicod Creek Watershed (HUCs 030201030603, 030201030604, 030201030605), AU# 28-101, from source to Tar River, has a history of Poor, Fair, and Severe swamp bioclassification ratings that lead to the Impairment of 14.1 miles of the watershed. However, the 2007 benthic macroinvertebrate sample resulted in a Natural bioclassification. The creek has been removed from the 2010 303(d) list for Aquatic Life use support category. During the early 1990's, the Chicod Creek watershed received federal funds to support agricultural BMP implementation. A trend analysis was conducted in 1998 to determine if statistically significant changes in nutrient loads and concentrations occurred pre and post BMP implementation. The trend results indicated a significant decrease in TN concentration and load and no statistically significant change in TP. Nutrient data from 1997-2008 indicate that for both total nitrogen and total phosphorus the mean and medians numbers for each year were above the normal levels of 0.8 mg/L for TN and 0.05 mg/L for TP, as seen in Figures 14 & 15.

Figure 14 & 15. Total Nitrogen and Total Phosphorus Concentration data for Chicod Creek Ambient Station O6500000





Chicod Creek has numerous hog farms within its drainage area that could be contributing to non-point source pollution if inadequate BMPs are used or if nutrients are traveling via groundwater to the creek. There are five swine animal operations within this subbasin that have been issued NOVs or have come close to being in violation of their permits. These facilities have had various problems including lagoon pump leaking, high freeboard levels, erosion and woody vegetation on lagoon banks, irrigation outside acceptable crop window, poor spray field conditions, and poor record keeping issues. DWQ will continue to closely monitor these facilities.

Chicod Creek was also Impaired because of high levels of fecal coliform bacteria concentrations related to agricultural activities. A **TMDL** was completed in 2004 addressing the fecal coliform bacteria. As of 2010 303(d) list of Impaired waters, the creek is no longer Impaired.

Additional Studies

Ecosystem Enhancement Program (EEP) Middle Tar-Pamlico Local Watershed Plan
Assessment of the middle Tar-Pamlico region by EEP began in 2004 with a focus on four waterbodies including: Cow Swamp, Crisp Creek, Green Mills Run, and Hendricks Creek. All of these subwatersheds have been significantly impacted by development and agricultural practices, resulting in a loss of wetlands and buffers, increased runoff, and a general degradation in water quality. The goal of the EEP plan is to provide a framework for watershed functional rehabilitation and to provide primary supporting information for implementation of the rehabilitation system while taking into consideration development and agriculture. To achieve this, efforts were focused on three investigative methods: 1) land use/land cover trending analysis; 2) watershed system modeling; and 3) riparian reach field investigation. The findings and results from these tasks were tabulated and compared with the concerns of the stakeholder groups. The end result being the location of potential restoration, enhancement, preservation and BMP sites that are best suited to meet the goals of the study. More information about these ongoing restoration opportunities can be found on the EEP website at: **http://www.nceep.net/services/lwps/pull_down/by_basin/TarPamlico_RB.html** or in Appendix 3E.

Lower Tar River (B-071206)
Special study sampling in the lower Tar River indicated dramatic changes (ranging from Excellent to Fair) in the benthic community between Tarboro and downstream of Greenville. Several factors influenced the benthic community in the lower Tar River including saline waters moving upstream towards Greenville during lower flows and wind tides from Pamlico River/Sound. Periodic saltwater events can stress 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. Sampled 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 (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.

Volunteer Water Information Network

The Volunteer Water Information Network (VWIN) is a partnership of groups and individuals dedicated to preserving water quality in North Carolina. In August 2005, the Pamlico-Tar River Foundation initiated a monitoring program in tributaries to the Tar River. The UNC-Asheville Environmental Quality Institute (EQI) provided technical assistance through laboratory analyses of water samples, statistical analyses of water quality results, and written interpretation of the data. Volunteers collected water samples once a month from selected streams in Edgecombe, Nash and Pitt counties. The results of this data collection are similar to DWQ's sampling results, but VWIN also collected data on streams that DWQ does not monitor. Statistical analyses and interpretation of data from samples gathered from Briery Swamp, Chicod Creek, Cokey Swamp, Conetoe Creek, Green Mill Run, Grindle Creek, Hardee Creek, Hendricks Creek, Meeting House Branch, Moye's Run, Parker Creek, and Town Creek are found in the VWIN report located in Appendix 3E.

Permit Programs

Wastewater Dischargers

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States, as authorized by the Clean Water Act. Non-compliance with permit limits on wastewater flow and constituents can lead to discharge of pollutants that degrade surface waters making them unsafe for drinking, fishing, swimming, and other activities. The NPDES Permitting and Compliance Programs of DWQ are responsible for administering the program for the state. These permits are reviewed and are potentially renewed every 5 years, a list of NPDES permits is found in Table 3-4.

The Federal and State Pretreatment Program gives regulatory authority for EPA, States, and Municipal Governments to control the discharge of industrial wastewater into municipal Wastewater Treatment Plants (WWTPs) or Publicly Owned Treatment Works (POTWs). The objectives of the Pretreatment Program are to prevent pass-through, interference, or other adverse impacts to the POTW, its workers, or the environment; to promote the beneficial reuse of biosolids; and to assure all categorical pretreatment standards are met. There are currently around 700 Significant Industrial Users (SIUs) who discharge industrial wastewater to over 120 POTWs throughout the state of North Carolina. The WWTPs covered by POTW Pretreatment Programs in this subbasin are Tarboro, Greenville Utiities and Robersonville.

All NPDES permitted facilities use 7Q10s (the lowest stream flow for seven consecutive days that would be expected to occur once in ten years) as critical flow in determining permit limits for non-carcinogen toxicants. If a toxicant is a known carcinogen then the QA (the mean annual stream flow) is used in determining permit limits. In cases where an aesthetic standard is applicable to a pollutant then the permit limit is based on 30Q2 (the minimum average flow for 30 consecutive days that would be expected to occur once in 2 years). These critical flow values used to determine permit limits for all NPDES facilities may need to be reviewed as the permits come up for renewal. Currently, a 7Q10 is only evaluated in the initial application of the permit and upon expansion. Low flow conditions impact a stream's ability to assimilate both point and nonpoint source pollutants. Droughts, as well as the demand on water resources, are very likely to increase; therefore, the reevaluation of stream flow will become more critical to water quality within the next decade or so. DWQ will work with Division of Water Resources and other agencies to discuss the need and resource availability to update 7Q10 values.

Table 3-4. NPDES Discharge Permits in HUC 03020103

Permit #	Owner Name	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0001058	DSM Pharmaceuticals	DSM Pharm.	Non-Government	Industrial Process & Commercial Wastewater	Minor	Parker Creek	0
NC0020435*	Town of Pinetops	Pinetops WWTP	Government - Municipal	MWD < 1MGD	Minor	Town Creek	0.3
NC0020605*	Town of Tarboro	Tarboro WWTP	Government - Municipal	MWD, Large	Major	Tar River	5.0
NC0023931*	Greenville Utilities Commission	GUC WWTP	Government - Municipal	MWD, Large	Major	Tar River	17.5
NC0026042*	Town of Robersonville	Robersonville WWTP	Government - Municipal	MWD, Large	Major	Flat Swamp	1.8
NC0037231	Martin County Schools	Bear Grass Elementary School WWTP	Government - County	Discharging 100% Domestic < 1MGD	Minor	Turkey Swamp	0.005

Permit #	Owner Name	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0050661	Town of Macclesfield	Macclesfield WWTP	Government - Municipal	MWD < 1MGD	Minor	Bynums Mill Creek	0.175
NC0082139	Greenville Utilities Commission	Greenville WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Tar River	0
* Indicates Tar-Pamlico Basin Association Permittee Member							
MWD = Municipal Wastewater Discharge							

On-Site Wastewater Treatment Systems (Septic Systems)

Wastewater from many households is treated on-site through the use of permitted septic systems instead of being sent to a wastewater treatment facility. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from failing septic systems can contaminate groundwater and surface water. Failing septic systems are health hazards and are considered illegal discharges of wastewater if surface waters are impacted. Information about the proper installation and maintenance of septic tanks can be obtained by contacting the Department of Environmental Health and local county health departments. Local health departments are responsible for ensuring that new systems are sited and constructed properly and an adequate repair area is available. County, town and city planners need to understand the economic and human health ramifications caused by failing septic systems and plan for long-term septic system sustainability.

In 2007, North Carolina Agricultural Research Service completed a report concerning nitrogen contributions from on-site wastewater systems for each river basin. The results for this subbasin based on 1990 census data indicate a population of 49,784 people using 19,583 septic systems resulting in a nitrogen loading of 497,841 lbs/yr and nitrogen loading rate of 519 lbs/mi^2/yr. These numbers reflect the TN discharged to the soil from the septic system and does not account for nitrogen used because of soil processes and plant uptake. (Pradhan et al. 2007).

Wastewater Residuals (Biosolids)

Residuals, biosolids or treated sludge, are by-products of the wastewater treatment process. After pathogen reduction, vector attraction reductions, and metal limits are met, these residuals are disposed in a manner to protect public health and the environment. Disposal sites include land fills, dedicated and non-dedicated residual disposal sites, agricultural land for crops not for human consumption, and distribution to the public for home use. When applied to the land, steps must be taken to assure that residuals are applied at or below agronomic rates based on the soil and crop types present at the disposal site. If these criteria cannot be met, permitted disposal must take place at a dedicated residual disposal site or landfill.

In this subbasin, five facilities that produce wastewater residuals (Class B) apply their treated sludge on an available 86 fields covering 1,431 acres (not all fields are used every year). A rough estimate of 100,170 lbs/yr of nitrogen and 128,790 lbs/yr of phosphorus are applied to these fields. This estimate does not include Class A residuals which are not monitored by DWQ. Of these permitted facilities, two are located in the Tar-Pamlico River Basin, the other three permit holders are facilities outside the basin but apply their residuals within the basin. Additional research would be necessary to determine if organic nitrogen from biosolids are contributing to the basinwide increase in organic nitrogen. For more information about residuals please visit DWQ's Aquifer Protection Section website: http://portal.ncdenr.org/web/wq/aps/lau.

Non-Discharge

Non-discharge systems have been the preferred alternative to discharge to surface waters for

some NSW waterbodies and DWQ requires all new and expanding NPDES permit applicants to provide documentation that considers alternatives to surface waters. Non-discharge wastewater options include spray irrigation, rapid infiltration basins, and drip irrigation systems. Although these systems are operated without a discharge to surface waters, they still require a DWQ permit. The permit insures that treated wastewater is applied to the land at a rate that is protective of groundwater and does not produce ponding or runoff into a waterbody. More information about land application and non-discharge requirements can be found on the DWQ Aquifer Protection Section Land Application Unit website: http://portal.ncdenr.org/web/wq/aps/lau. Non-discharge permits in this subbasin are listed in Table 3-5.

Run-off and spills are not common at non-discharge facilities. In general, maintaining compliance with permit conditions largely falls back to having a properly managed facility. Aging sewer systems may lead to increased flows from inflow and infiltration or a facility may not be properly prepared to expand as flows increase and the upper limits of a plant's capacity are reached. Non-discharge facilities, just like any other, must properly plan for any elevated flows and take action to ensure that the facility is capable of managing the wastewater.

Groundwater moving into surface water is a mechanism to introduce nutrients into the surface water system in the absence of direct discharges and in NSW systems it is important to be able to better quantify these potential nutrient loads. Some facilities have a groundwater monitoring program to measure compliance with groundwater quality standards. However, it should be noted that a facility can be compliant with groundwater quality requirements while still contributing to the overall nutrient loading of a surface water system. A better understanding of the groundwater/surface water interaction process at non-discharge facilities may help to identify and quantify nutrient loading from these locations .

Table 3-5. Non-Discharge Permits in HUC 03020103

Facility Name	Permit Type	Permit #	Size
Elm City Spray Irrigation WWTP	Surface Irrigation	WQ0003405	Major
General Foam Plastics	Groundwater Remediation, Non-discharge	WQ0005620	Minor
Comer Oil Co-Williams & Lamm	Groundwater Remediation, Non-discharge	WQ0014508	Minor
GUC Residuals Land Application Program (D)	Land Application of Residual Solids (503)	WQ0003781	Minor
Macclesfield Reclaimed Water Field	Reuse	WQ0018857	Minor

Wetland Or Surface Water Disturbance (401 Certification)

The "401" refers to Section 401 of the Clean Water Act. The North Carolina DWQ is the state agency responsible for issuing 401 water quality certifications (WQC). When the state issues a 401 certification this certifies that a given project will not degrade waters of the state or violate state water quality standards. A 401 WQC is required for any federally permitted or licensed activity that may result in a discharge to waters of the U.S. Typically, if the United States Army Corps of Engineers determines that a 404 Permit or Section 10 Permit is required because a proposed project involves impacts to wetlands or surface waters, then a 401 WQC is also required. Locations of 401 WQCs are included on each watershed map. Examples of activities that may require permits include:

- Any disturbance to the stream bed or banks,
- Any disturbance to a wetland,
- The damming of a stream channel to create a pond or lake,
- Placement of any material within a stream, wetland, or open water, including material that is necessary for construction, culvert installation, causeways, road fills, dams, dikes, or artificial islands, property protection, reclamation devices and fill for pipes or utility lines, and
- Temporary impacts including dewatering of dredged material prior to final disposal and temporary fill for access roads, cofferdams, storage, and work areas.

Riparian Buffers

Riparian buffers in the basin are to be protected and maintained on both sides of intermittent and perennial streams, lakes, ponds, and estuarine waters. Tar-Pamlico River Basin Buffer

Rules **(15A NCAC 2B.0259)** do not establish new buffers unless the existing use in the buffer area changes. The footprints of existing uses such as agriculture, buildings, commercial and other facilities, maintained lawns, utility lines, and on-site wastewater systems are exempt. A total of 50 feet of riparian area is required on each side of waterbodies; within this 50 feet, the first 30 feet is to remain undisturbed and the outer 20 feet must be vegetated. Activities that disturb this buffer require a buffer authorization from DWQ or may require a major variance approval from the Environmental Management Commission. Pitt County is the only county that is delegated the Tar-Pamlico River Basin buffer rules. Therefore buffer authorizations and minor variances would be reviewed by Pitt County in non-incorporated areas in that County. More information about the buffer rules are available at: **http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers**.

Central Coastal Plain Capacity Use Area

In 2001, the North Carolina EMC enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules. These regulations were developed to control groundwater use in the Cretaceous Aquifers in response to decreasing groundwater levels and increasing saltwater intrusion. The CCPCUA rules require groundwater users in the impacted areas to reduce their consumption in three phases between 2008 and 2018. In this subbasin Beaufort, Edgecombe, Martin, Pitt and Wilson counties are within the CCPCUA. More information about the CCPUA is available from Divsion of Water Resources website: **http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/**.

To meet the requirements of the CCPCUA, Greenville Utilities Commission is proactively planning for its future water supply needs. Greenville has initiated a flow study to estimate the amount of surface water that will be available for withdrawal from the Tar River in the future, and to assist in developing a long-term plan for providing a reliable and sustainable water supply. The goal of the Tar River Flow Study is to identify the environmental issues and potential constraints associated with water withdrawals in the Tar River and provide the basis for evaluating the potential effects of increased withdrawals on instream habitat, water quality, and aquatic resources and values. The study results will also help identify saltwater encroachment upriver during periods of low inflow or drought.

Interbasin Transfers

In 1993, the North Carolina Legislature adopted the Regulation of Surface Water Transfers Act (G.S. §143-215.22L) and was subsequently modified in 2007. This law regulates large surface water transfers between river basins by requiring a certificate from the Environmental Management Commission (EMC). A transfer certificate is required for a new transfer of 2 MGD or more and for an increase in an existing transfer by 25 percent or more (if the total including the increase is more than 2 MGD). Certificates are not required for facilities that existed or were under construction prior to July 1, 1993 up to the full capacity of that facility to transfer water, regardless of the transfer amount.

Greenville Utilities Commission, in 2008, requested the transfer of surface water from the Tar-Pamlico River Basin to the Neuse Basin. The request was in the amount of 8.3 MGD to meet Farmville and Greene County's maximum day demands through 2030, with the ability to transfer 9.3 MGD under emergency conditions to the Contentnea Creek subbasin. Transfer to the Neuse River is for 4.0 MGD to meet Winterville's maximum day demands through 2030, with the ability to transfer 4.2 MGD under emergency conditions. More information about this project is available from the Division of Water Resources website: **http://www.ncwater.org/Permits_and_Registration/Interbasin_Transfer/**.

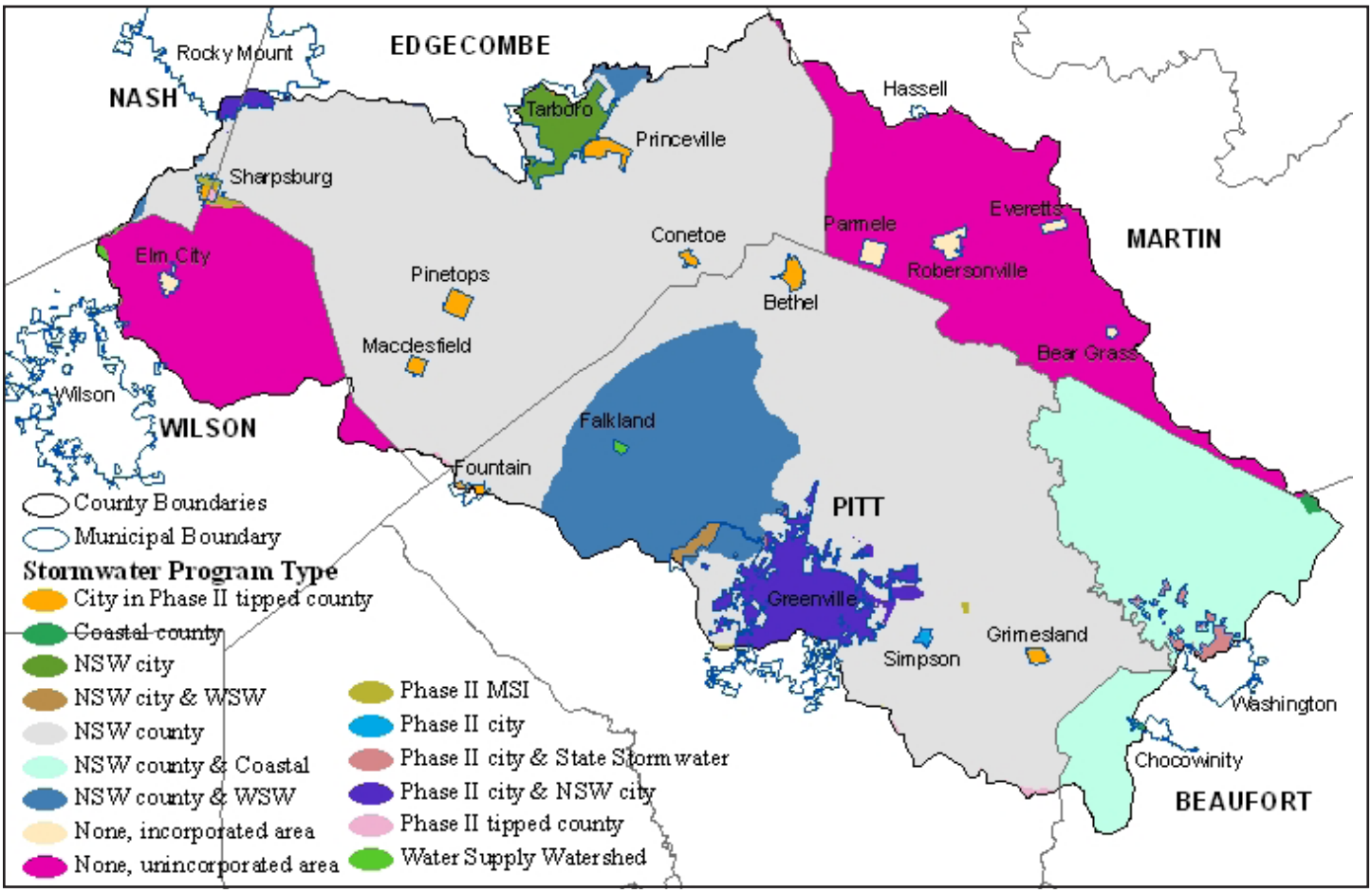
Stormwater

DWQ administers several different stormwater programs. One or more of these programs affects many communities in the Tar-Pamlico River Basin. The goal of the DWQ stormwater discharge

permitting regulations and programs is to prevent pollution from entering the waters of the state through the use of stormwater runoff controls. These stormwater control programs include Phase II NPDES and State post-construction, coastal stormwater, HQW/ORW stormwater, Tar-Pamlico River Basin NSW stormwater, and associated with the Water Supply Watershed Program requirements. Figure 3-16 indicates the different stormwater programs in this subbasin.

Greenville, Tarboro, and Washington and Nash, Edgecombe, and Pitt counties are required to implement actions to prevent and treat stormwater runoff required by the Tar-Pamlico NSW stormwater rules. These local programs are to include new development controls to reduce nitrogen runoff by 30 percent compared to pre-development levels and to keep phosphorus inputs from increasing over those pre-development levels. Local programs must also identify and remove illicit discharges; educate developers, businesses, and homeowners; and make efforts toward treating runoff from existing developed areas. As of July 2009, there are 34 general stormwater permits and one individual stormwater permit issued in this subbasin.

FIGURE 3-16. STORMWATER PROGRAM COVERAGE IN HUC 03020103



Agriculture

Agriculture is NC's leading industry and is especially strong in the Tar-Pamlico River Basin. Nonpoint source pollution from agriculture is an identified significant source of stream degradation in the Tar-Pamlico River Basin. The approach taken in North Carolina for addressing agriculture's contribution to the nonpoint source water pollution problem is to primarily encourage voluntary participation by the agricultural community and is supported by financial incentives, technical and educational assistance, research, and regulatory programs.

The conversion of agricultural lands to developed lands with impervious surfaces is another potential nonpoint source of pollution. A report by the American Farmland Trust organization identifies this subbasin as having high quality farmland with large areas threatened by

development. A map of these areas is available at: http://www.farmland.org/. Some farmers are protecting their land from development through the Conservation Reserve Enhancement Program (CREP). CREP is a voluntary program utilizing federal and state resources to achieve long-term protection of environmentally sensitive cropland and marginal pastureland. These voluntary protection measures are accomplished through 10-, 15-, 30-year and permanent conservation easements. In this subbasin there are approximately 5,215 acres in easements, of which 48% are in 30 year or permanent easements.

North Carolina Agriculture Cost Share Program

Financial incentives are provided through North Carolina's Agriculture Cost Share Program, administered by DENR's Division of Soil and Water Conservation to protect water quality by installing BMPs on agricultural lands. In the Lower Tar River Subbasin, $1,461,965 was spent, between 2003-2008, on BMPs to reduce nonpoint source pollution from agriculture. Approximately, 20,166 acres were affected by BMPs that prevented an estimated 107,515 tons of soil, 304,016 lbs of nitrogen and 154,858 lbs of phosphorous from runoff into surface waters. Animal waste BMPs also accounted for better management of an estimated 105,398 lbs of nitrogen and 143,376 lbs of phosphorous.

DWQ's Animal Feeding Operations Unit

The Animal Feeding Operations Unit is responsible for the permitting and compliance activities of animal feeding operations across the state. Poultry farms with dry litter waste are not regulated or monitored by DWQ. Table 3-6 summarizes the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight (SSLW) in this subbasin. These numbers reflect only operations required by law to be registered, and, therefore, do not represent the total number of animals in the subbasin.

Animal waste is often stored in lagoons before it is applied to fields. It is a concern that several animal operations in the basin will be abandoned without proper closeout of the lagoons. Numerous environmental hazards exist from these lagoons including: ammonia emissions, overflows into surface waters, and groundwater contamination.

Table 3-6. Animal Operations in HUC 03020103

Type	# of Facilities	# of Animals	SSLW
Animal Individual	2	-	-
Swine	42	161,485	30,399,055

*Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service (NRCS) guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

A better understanding of groundwater quality in relation to animal feeding operation locations is needed. Most animal operations are located immediately adjacent to surface water bodies. Groundwater that is moving from beneath a facility into the surface water system may transport significant levels of nutrients. However, lack of groundwater quality data at animal operations hampers quantifying their impacts.

Restoration, Protection & Conservation Planning

Population

The 2000 census estimated population for this subbasin is 141,646 and this is expected to increase with the results of the 2010 census (Table 3-7). As population increases, so does our demand for clean water from aquifer and surface water sources and for the land and water to assimilate wastes.

Table 3-7. Watershed Population Estimates* for HUC 03020103

10-Digit HUC	2000 Population	2000 Population Density (per sq mi)	2010 Estimated Population	2020 Estimated Population	2030 Estimated Population
0302010301	25,355	128	25,036	24,750	24,423
0302010302	15,709	126	14,526	13,402	12,284
0302010303	4,043	41	4,201	4,364	4,529
0302010304	50,117	501	60,017	69,813	79,587
0302010305	13,729	57	13,732	13,700	13,614
0302010306	32,692	169	38,859	44,940	50,984
03020103	141,646	148	156,371	170,969	185,420

*NC Office of State Budget and Management: http://www.osbm.state.nc.us/

Land Use

Land use in this subbasin shows increasing urbanizing areas and a strong agriculture use, both of which continue to place increasing demands on water quality and quantity. Table 3-8 lists the percentage of predominant land cover types within this subbasin (based on 2001 land cover data). A map showing these land types can be found in Appendix 3D.

Table 3-8. Land Cover Percentages in HUC 03020103

Land Cover Type	Percent
Developed Open Space	5.50
Developed Low Intensity	1.82
Developed Medium Intensity	0.67
Developed High Intensity	0.21
Total Developed	8.19
Bare Earth Transition	0.04
Deciduous Forest	7.82
Evergreen Forest	16.43
Mixed Forest	2.69
Total non-Wetland Forest	26.94
Scrub Shrub	3.10
Grassland Herbaceous	9.91
Pasture Hay	2.76
Cultivated Crops	34.90
Total Agriculture	37.66
Woody Wetlands	13.59
Emergent Herbaceous Wetland	0.57
Total Wetlands	14.16

Local Initiatives & Conservation Planning

Resources & Guides

NCDENR's One North Carolina Naturally initiative promotes and coordinates the long-term conservation of North Carolina's threatened land and water resources. Each DENR division specializes in management of a specific natural resource, while the collaborative coordination and planning process results in cost-effective implementation and management of multiple resources. Natural resource planning and conservation provides the science and incentives to inform and support conservation actions of North Carolina's conservation agencies and organizations. The Conservation Planning Tool was developed to assist in building partnerships through the exchange of conservation information and opportunities, support stewardship of working farms and forests, inform conservation actions of agencies and organizations, and guide compatible land use planning. A link to the interactive map view is found at: http://www.conservision-nc.net/

Conservation planning is important on a local level to protect natural resources that provide recreational, aesthetic, and economic assets important to community sustainability and

growth. The NC Wildlife Resource Commission developed a Green Growth Toolbox to assist towns and cities to grow in nature-friendly ways: http://www.ncwildlife.org/greengrowth/. The tools provide assistance with using conservation data, green planning, green ordinances and green development and site design. Also, a guide to help local governments protect aquatic ecosystems while streamlining environmental review is available at: http://www.ncwildlife.org/planningforgrowth/swimming_with_the_current.pdf.

Land conservation, accompanied with stream restoration projects, can be very successful at protecting water quality. Prevention and protection activities are known to be more cost effective than retrofits and restoration. DWQ strongly encourages conservation in this watershed. Local land trusts can help landowners explore conservation options and identify potential funding sources. For more information about land trusts in North Carolina see the Conservation Trust for North Carolina at: http://www.ctnc.org/site/PageServer. With the assistance of land conservancies, and several state and federal agencies ~6,784 acres are protected within this subbasin, much of which are riparian buffers.

Local Initiatives

DWQ has regulatory authority over permitted activities to enforce the Clean Water Act and corresponding state regulations to protect water quality. However, local governments can also regulate and promote activities that protect water quality. Several local governments provided information on local activities, ordinances, and concerns about protecting their natural resources and water quality. The following information reflects projects and practices on a local level that protect water quality.

Pitt County

Pitt County complies with Tar-Pamlico Stormwater Rules established to help reduce nutrient runoff from new developments and limit post construction impacts. County staff are responsible for illicit discharge detection and elimination, while also educating citizens on reducing nitrogen pollution from their lawns and septic systems. Through their efforts of implementing the stormwater rules in the urbanizing areas, they acknowledge a need for a more comprehensive basinwide stormwater approach to help capture new developments rapidly occurring in areas that are exempt from current stormwater regulations. They note developments that occur in the smaller towns are much more intensively developed and have a higher percentage of impervious surface than those managed under the stormwater rules.

City of Greenville

The City of Greenville recently awarded a contract to Pamlico-Tar River Foundation and East Carolina University to complete a Watershed Master Plan. This project will include mapping of the current municipal stormwater system, hydrology and hydraulic modeling, identification and prioritization of CIP projects, potential funding sources, and to establish a water quality baseline. This Plan will be utilized to assess the 3 square mile watershed of Meetinghouse Branch and Bell Branch. After successful completion of the pilot study, all watersheds within the City of Greenville will be assessed using the same criteria.

Erosion and Sedimentation Control

The Sedimentation Control Commission was created to administer the Sedimentation Control Program pursuant to the N.C. Sedimentation Pollution Control Act of 1973. It is charged with adopting rules, setting standards, and providing guidance for implementation of the Act. The Division of Land Resources (DLR) is the primary agency responsible for managing land disturbing activities that have the potential to violate the Sedimentation Pollution Control Act. For those land disturbing activities, an Erosion and Sedimentation Control Plan must be approved by DLR prior to land disturbing activities. Due to the large number of land disturbing activities and the limited number of DLR staff available to do inspections, cities and counties have been encouraged to adopt a local erosion and sediment control ordinance in compliance with state

requirements. The Sedimentation Control Commission can then delegate the local government authority to administer the erosion and sedimentation control program within its jurisdiction. The local programs' staff then performs plan reviews and enforces compliance with plans within their jurisdictions. Within this subbasin the City of Greenville and Pitt County have local erosion and sediment control ordinances.

Construction Grants and Loans

The Construction Grants and Loans (CG&L) Section of DWQ provides grants and loans to local government agencies for the construction, upgrades, and expansion of wastewater collection and treatment systems. As a financial resource, the Section administers five major programs that assist local governments. Of these, two are federally funded programs administered by the state, the Clean Water State Revolving Fund (SRF) Program and the State and Tribal Assistance Grants (STAG). The STAG is a direct congressional appropriation for a specific "special needs" projects within NC. The High Unit Cost Grant Program, the State Emergency Loan (SEL) Program and the State Revolving Loan (SRL) Program are state funded programs, with the later two being below market revolving loan money. The Section also received an additional Capitalization Grant authorized by the American Recovery and Reinvestment Act of 2009 in the amount of $70,729,100. These funds are administered according to existing SRF procedures. All projects must be eligible under Title VI of the Clean Water Act. For more information please see the CG&L webpage at: http://portal.ncdenr.org/web/wq/cgls. Projects currently underway in this subbasin are listed in Table 3-8.

Table 3-8. CG&L Projects

Location	Project Description	Date	~Amount
Pinetops	Rehab & connection to Macclesfield	3/6/2002	$2,983,500
Macclesfield	Rehab and Spray Irrigation	Not yet made	$2,907,940
Everetts	New Collection Lines	9/12/2001	$1,870,141
Bethel	Rahab as part of larger project connecting to Greenville	8/22/2001	$3,000,000
Parmele	New Collection System	4/24/2001	$2,201,625
Bethel	$621,285 Loan for Pretreatment PS & FM along with EPA Grant	1/12/2002	$621,285
Bethel	Pump Station & Force Main	4/23/2002	$1,954,715
Elm City	Sanitary Sewer Rehabilitation-Phase 1	6/28/2006	$425,000
Greenville	Greenville Utilities WWTP & Remote Pumping Stations Electrical & SCADA System Upgrades	11/7/2008	$13,356,080

Clean Water Management Trust Fund

Created in 1996, the Clean Water Management Trust Fund (CWMTF) makes grants to local governments, state agencies, and conservation non-profits to help finance projects that specifically address water pollution problems. The fund has made several investments in the Lower Tar River Subbasin. Table 3-9. includes a list of recent projects and their cost.

Table 3-9. CWMT Projects

Application ID	Proposed Project Description	Amount Funded	County
2004A-012 NC Coastal Land Trust - Acq./ Fletcher Tract, Tranter's Creek	Acquire a permanent conservation easement on 204 riparian acres along the Tar River and Tranters Creek.	$241,000	Pitt
2005B-505 Elm City, Town of - WW/ Sewer Rehabilitation, Town Creek	Rehabilitate or replace approximately 21,600 linear feet of sewer collection line serving 668 residential and 57 commercial customers. Would reduce fecal coliform and nutrient delivery to Town Creek.	$1,000,000	Wilson

Application ID	Proposed Project Description	Amount Funded	County
2006D-003 Tar River Land Conservancy- Donated Mini/ Goodfred Tract, Tar River	Minigrant to pay for transactional costs for a donated easement on 147 acres along the Tar River.	$25,000	Edgecombe
2006S-011 Tarboro, Town of- Storm Mini/ Hendricks Creek		$50,000	Edgecombe
2007D-009 NC Coastal Land trust - Donated/Mini/ Riggs tract, Tar River	Minigrant to pay for transactional costs for a donated easement on a 49-acre tract on the Tar River.	$25,000	Pitt
2008-531 Princeville, Town of - WW/ Pump Station Rehabilitation, Tar River	Design, permit and rehabilitate 4 pump stations to improve reliability and improve water quality in Tar R, which is a Nat. Significant Aquatic Habitat and contains rare aquatic species	$80,000	Edgecombe
2008-804 Tarboro, Town of - Plan/Acq/ Tar River Greenway Plan		$56,000	Edgecombe

This list does not include regional or statewide projects that were in multiple river basins, or projects that were funded and subsequently withdrawn.

Section 319-Grant Program

The Section 319 Grant Program was established to provide funding for efforts to reduce nonpoint source (NPS) pollution, including that which occurs though stormwater runoff. The EPA provides funds to state and tribal agencies, which are then allocated via a competitive grant process to organizations to address current or potential NPS concerns. Each fiscal year, North Carolina is awarded nearly 3 million dollars to address NPS pollution through its 319 Grant Program. Thirty percent of the funding supports ongoing state nonpoint source programs. The remaining 70% is made available through a competitive grant process. More information can be found about these contracts and the 319 Grant Program at their website: http://portal.ncdenr.org/web/wq/ps/nps/319program. In 2010, a 319 grant was awarded to East Carolina University to evaluate septic systems and nutrient transport in Pitt County.

Recommendations

- Explore development of a more comprehensive basinwide stormwater management to prevent uncontrolled development in areas currently exempt from stormwater regulations and to protect watersheds with threatened and endangered species.

- Identify sources of organic nitrogen that could be contributing to the increase in basinwide TKN concentrations. Basinwide, the ammonia component of TKN shows a decrease in concentration since 1991. Specifically in this subbasin ammonia concentrations have decreased with peaks during dryer years, while TKN concentrations have increased over 1997-2008 period.

- Total phosphorus concentrations decreased and have remained steady over the past several years over an 11 year time period from 1997-2008. However, the TP loads measured at Grimesland have not been below the 1991 baseline except for 2007 & 2008. The Tar-Pamlico NSW strategy requires no increase in phosphorus loading from the 1991 conditions, to achieve this it may be necessary to revisit older laws to identify where new technology alternatives may be able to assist in meeting nutrient goals (e.g., G.S 143-214.4. prohibits certain cleaning agents from containing phosphorus, household dishwashing machine detergent is exempt.) Several states have recently banned phosphorous in dishwasher detergent and lawn fertilizers.

- More research is needed to understand the amount nutrients entering the Tar River and its tributaries through baseflow and how this contribution can be managed. The NSW strategy

targets point and some nonpoint source nutrient contributions to surface waters. However, some nonpoint sources are not specifically addressed in the strategy. Nutrients from non-discharge spray field systems, wastewater residual applications, septic systems and tiled agriculture may all be contributing to nutrient loads in surface waters via groundwater. DWQ Aquifer Protection Planning Unit is currently compiling a few select watershed-scale estimates of total nutrient loads from permitted land application facilities which will help determine the potential nutrient loading magnitude.

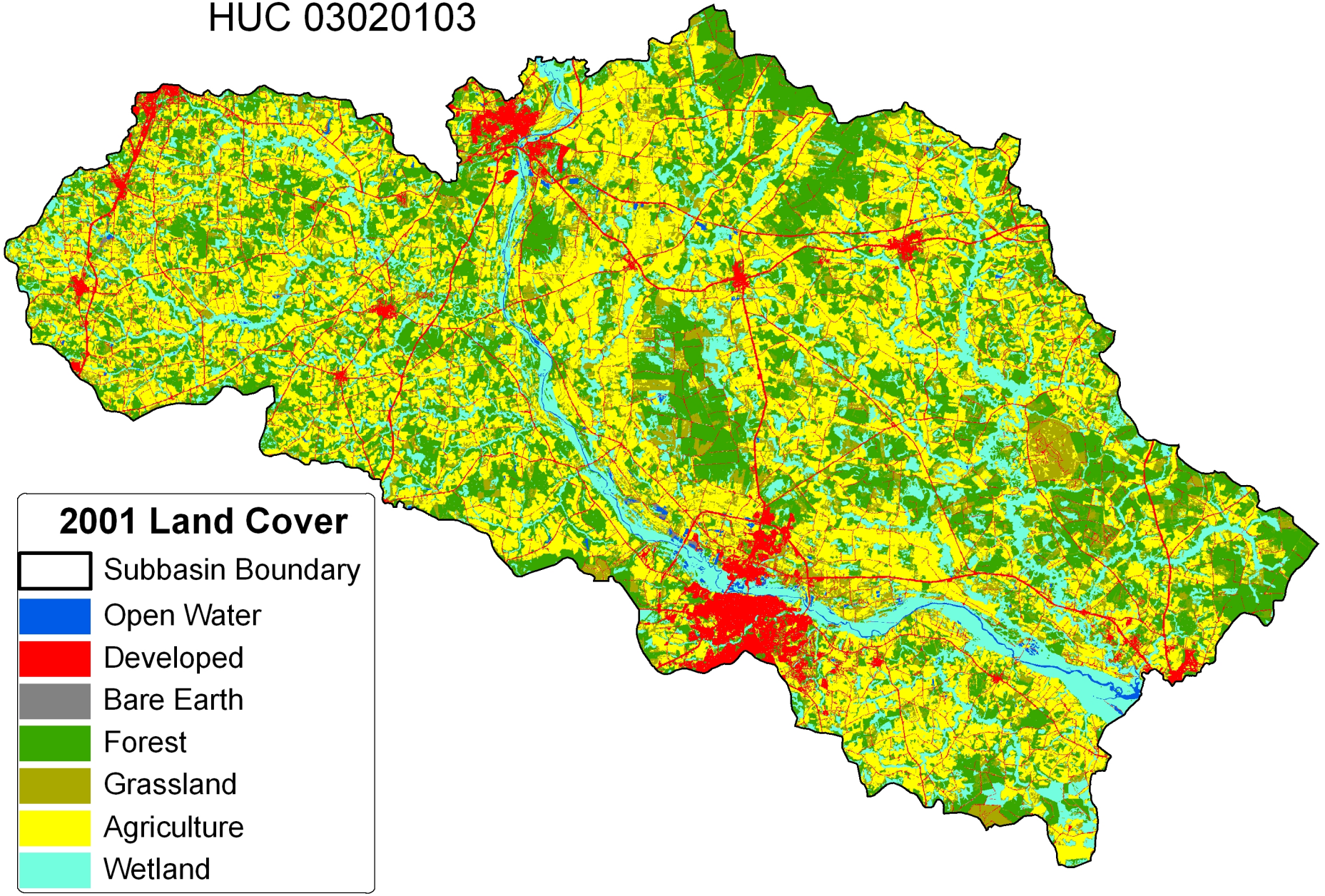
- Identify where local Drainage Districts are active and if their activities impact water quality.

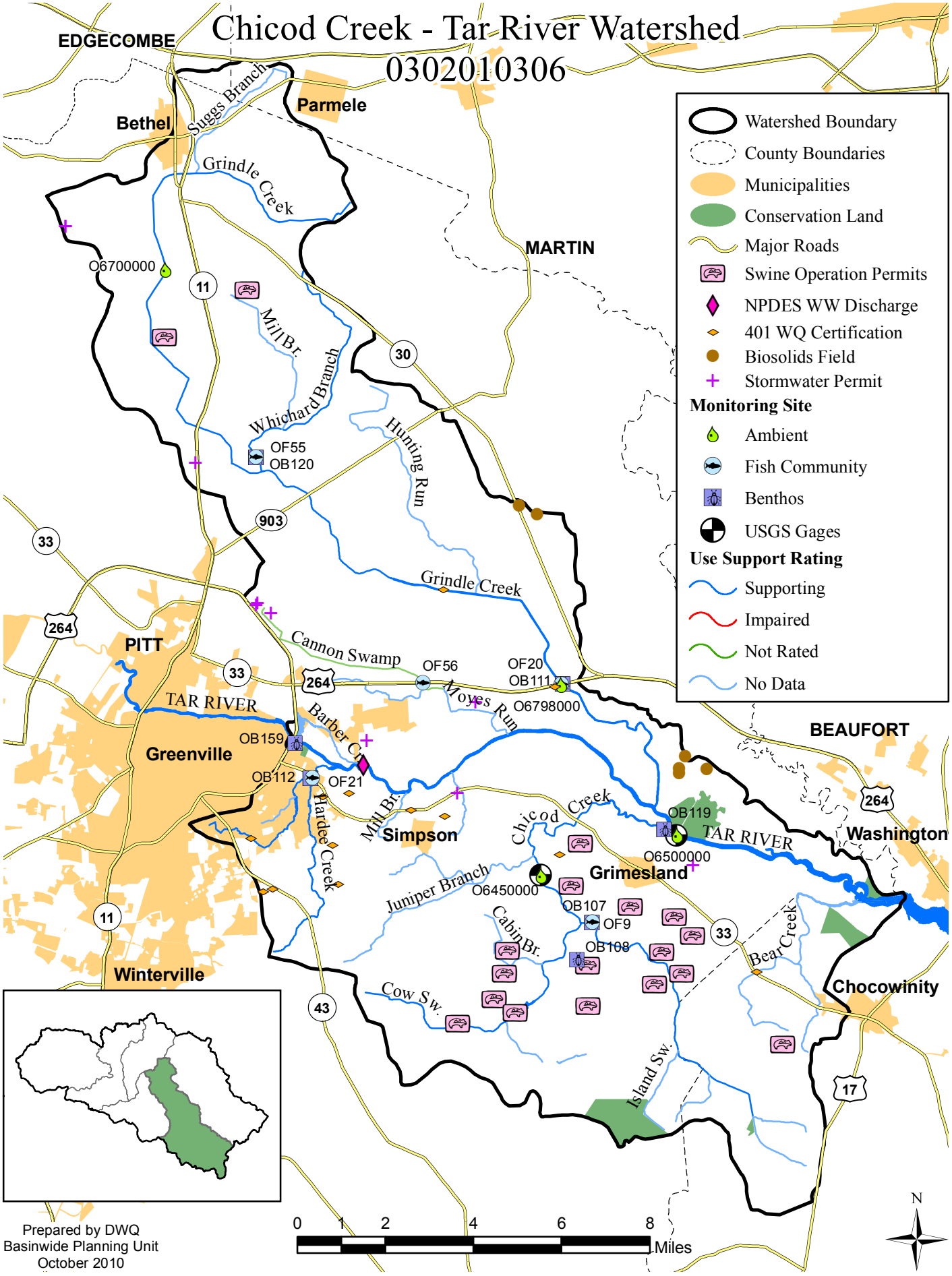
References

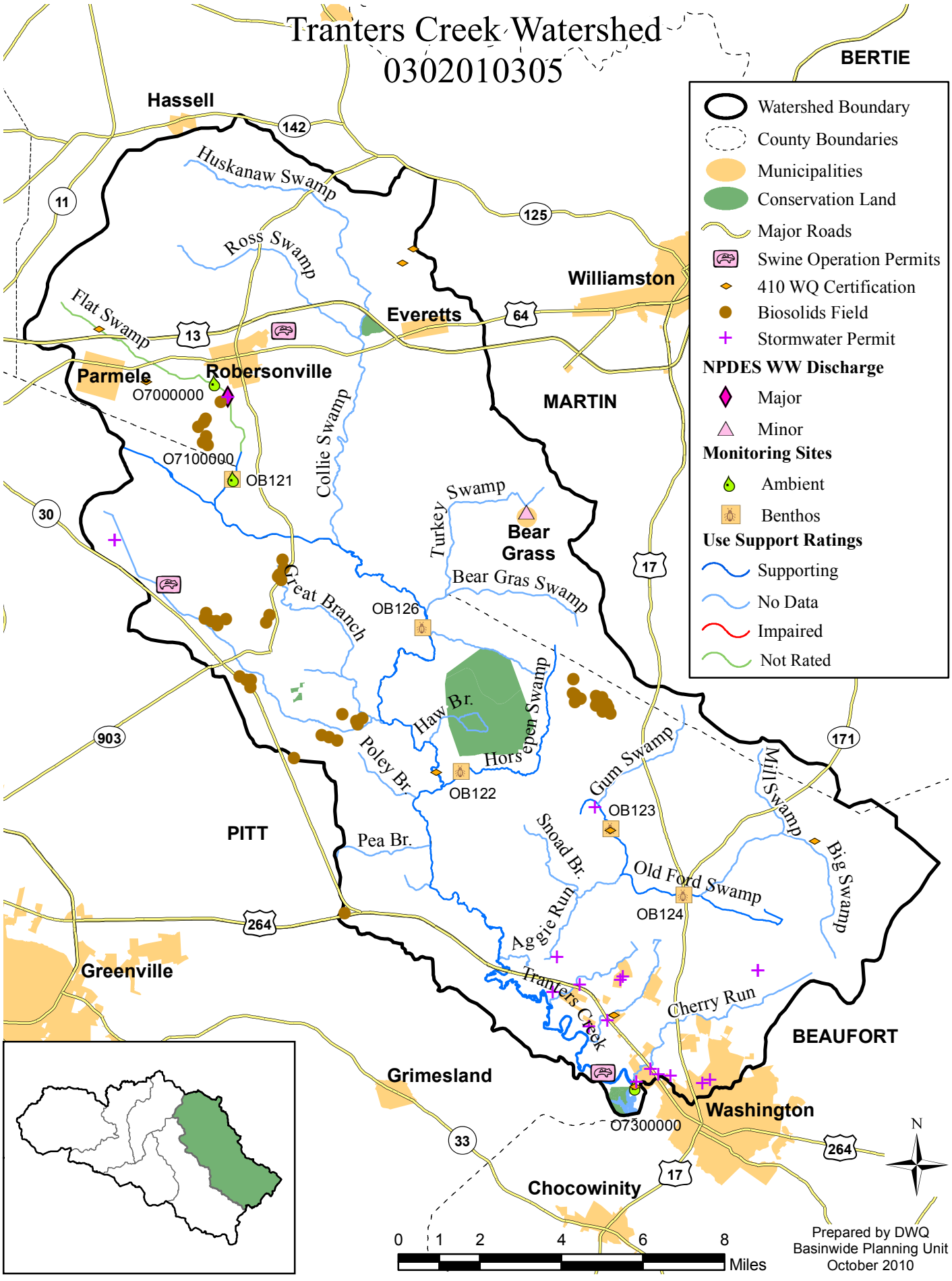
American Farmland Trust. Farming on the Edge: North Carolina State Map. http://www.farmland.org/resources/fote/states/map_northcarolina.asp.

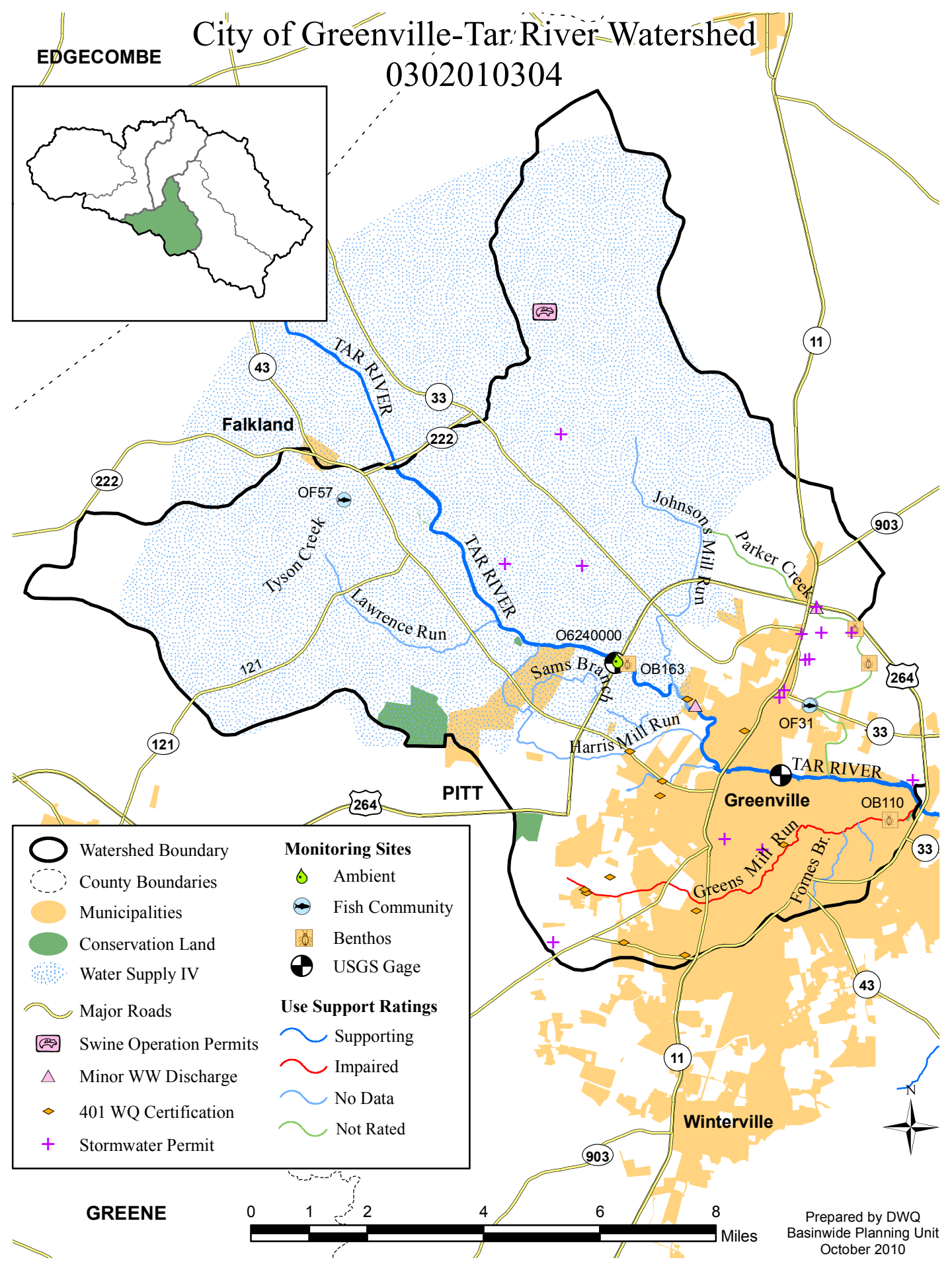
Pradhan, S.S., Hoover, M.T., Austin, R.E. and H. A. Devine. 2007. Potential Nitrogen Contributions from On-site Wastewater Treatment Systems to North Carolina's River Basins and Sub-basins Technical Bulletin 324. North Carolina Agricultural Research Service North Carolina State University Raleigh, NC.

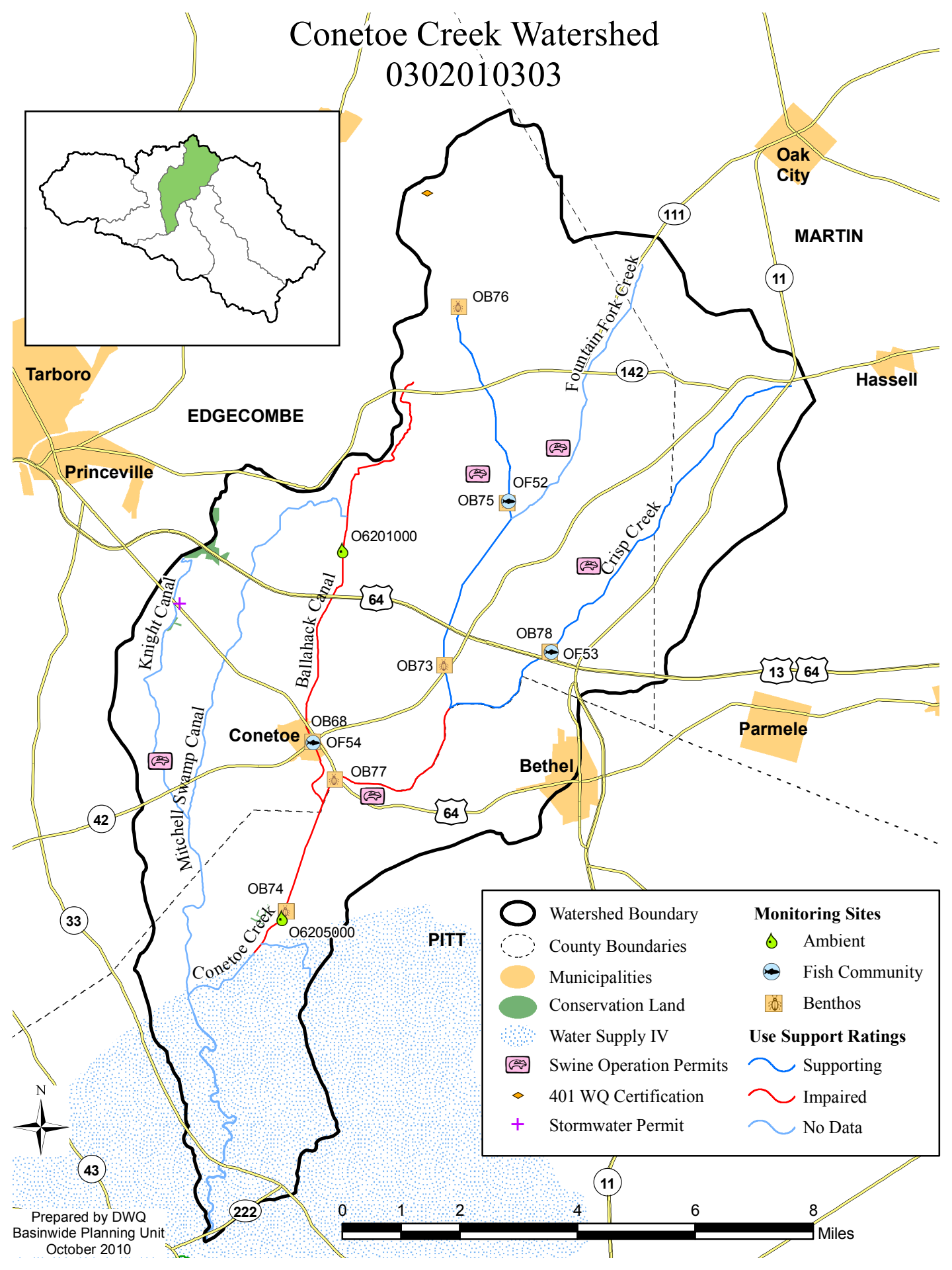
Tar River Subbasin
HUC 03020103



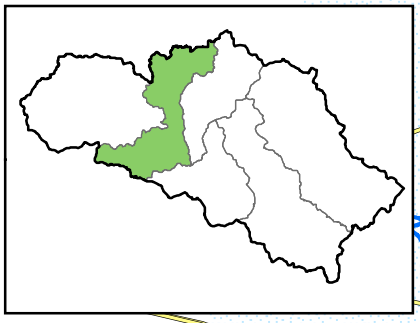

Chicod Creek - Tar River Watershed
0302010306
EDGECOMBE
Bethel
Suggs Branch
Parmele
Grindle Creek
MARTIN
O6700000
11
Mill Br.
Whichard Branch
30
OF55
OB120
Hunting Run
903
33
Grindle Creek
264
PITT
Cannon Swamp
OF56
OF20
OB111
TAR RIVER
Moyes Run
O6798000
Barber Cr.
OB159
Greenville
OB112
OF21
Hardee Creek
Mill Br.
Simpson
Chicod Creek
OB119
TAR RIVER
Washington
O6500000
Grimesland
Juniper Branch
O6450000
OB107
OF9
Cabin Br.
OB108
Bear Creek
Chocowinity
Cow Sw.
Island Sw.
17
43
Winterville
BEAUFORT
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
Major Roads
Swine Operation Permits
NPDES WW Discharge
401 WQ Certification
Biosolids Field
Stormwater Permit
Monitoring Site
Ambient
Fish Community
Benthos
USGS Gages
Use Support Rating
Supporting
Impaired
Not Rated
No Data
Prepared by DWQ
Basinwide Planning Unit
October 2010
0 1 2 4 6 8
Miles
N


Tranters Creek Watershed
0302010305
BERTIE
Hassell
142
Huskanaw Swamp
11
125
Ross Swamp
Williamston
Everetts
64
Flat Swamp
13
Parmele
Robersonville
O7000000
MARTIN
Collie Swamp
O7100000
OB121
30
Turkey Swamp
Bear Grass
17
Great Branch
Bear Gras Swamp
OB126
Haw Br.
Horsepen Swamp
903
Poley Br
OB122
Gum Swamp
OB123
Mill Swamp
171
PITT
Pea Br.
Snoad Br.
Old Ford Swamp
OB124
Big Swamp
264
Aggie Run
Greenville
Tranters Creek
Cherry Run
BEAUFORT
Grimesland
Washington
O7300000
33
264
17
Chocowinity
N
0 1 2 4 6 8
Miles
Prepared by DWQ
Basinwide Planning Unit
October 2010
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
Major Roads
Swine Operation Permits
410 WQ Certification
Biosolids Field
Stormwater Permit
NPDES WW Discharge
Major
Minor
Monitoring Sites
Ambient
Benthos
Use Support Ratings
Supporting
No Data
Impaired
Not Rated


City of Greenville-Tar River Watershed
0302010304
EDGECOMBE
GREENE
PITT
Falkland
Greenville
Winterville
TAR RIVER
Tyson Creek
Lawrence Run
Sams Branch
Harris Mill Run
Johnsons Mill Run
Parker Creek
Greens Mill Run
Fornes Br.
OF57
OF31
OB163
OB110
O6240000
43
33
222
11
903
264
121
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
Water Supply IV
Major Roads
Swine Operation Permits
Minor WW Discharge
401 WQ Certification
Stormwater Permit
Monitoring Sites
Ambient
Fish Community
Benthos
USGS Gage
Use Support Ratings
Supporting
Impaired
No Data
Not Rated
0 1 2 4 6 8
Miles
N
Prepared by DWQ
Basinwide Planning Unit
October 2010


Conetoe Creek Watershed
0302010303
Oak City
MARTIN
Tarboro
EDGECOMBE
Princeville
Hassell
Parmele
Bethel
Conetoe
PITT
111
11
142
64
13
42
33
43
222
OB76
OB75
OF52
OB73
OB78
OF53
OB68
OF54
OB77
OB74
O6201000
O6205000
Fountain Fork Creek
Crisp Creek
Knight Canal
Ballahack Canal
Mitchell Swamp Canal
Conetoe Creek
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
Water Supply IV
Swine Operation Permits
401 WQ Certification
Stormwater Permit
Monitoring Sites
Ambient
Fish Community
Benthos
Use Support Ratings
Supporting
Impaired
No Data
N
0 1 2 4 6 8
Miles
Prepared by DWQ
Basinwide Planning Unit
October 2010

Otter Creek-Tar River Watershed
0302010302



- Watershed Boundary
- County Boundaries
- Municipalities
- Conservation Land
- Water Supply IV
- Primary Roads
- Animal Operation Permits
- 401 WQ Certification
- Biosolid Field
- NPDES WW Discharge
- Minor Non-Discharge
- Stormwater Permit

Monitoring Sites

- Ambient
- Fish Community
- Benthos
- USGS Gage

Use Support Ratings

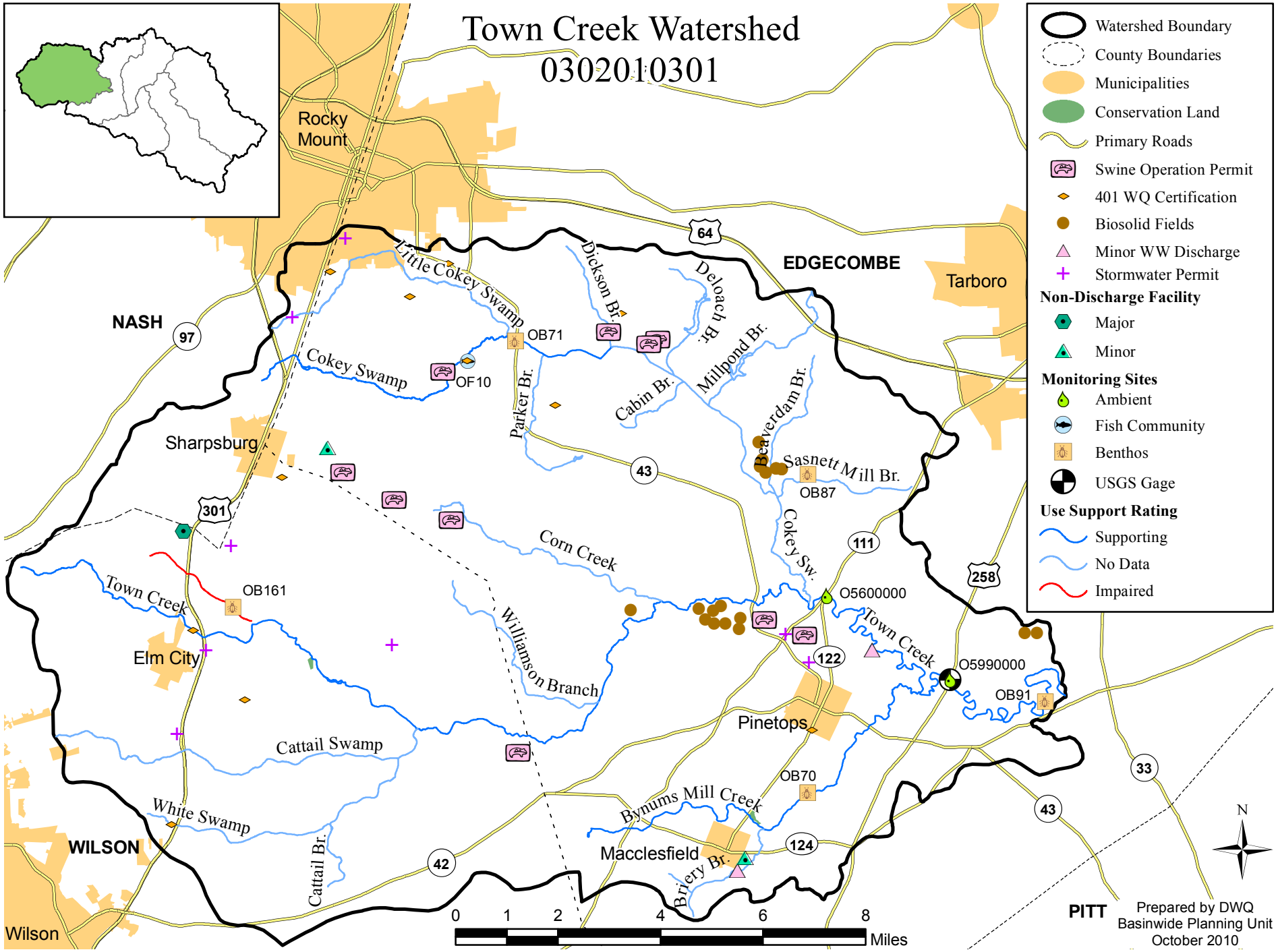
- Supporting
- No Data
- Impaired
- Not Rated

Speed
Tarboro
Princeville
EDGECOMBE
Pinetops
Conetoe
PITT
Falkland
WILSON
Fountain
Hendricks Creek
HollyCreek
TAR RIVER
Cromwell Canal and Connecting Canals
Jerrys Creek
Suggs Creek
Otter Creek
Kitten Creek
OB79
OB80
OB90
O5250000
O5270000
O6000000
OB89
OB86
OF30
O6200000
33
64
258
122
111
42
222
121
43

Prepared by DWQ
Basinwide Planning Unit
October 2010

0 1 2 4 6 8 Miles

N


Town Creek Watershed
0302010301
Watershed Boundary
County Boundaries
Municipalities
Conservation Land
Primary Roads
Swine Operation Permit
401 WQ Certification
Biosolid Fields
Minor WW Discharge
Stormwater Permit
Non-Discharge Facility
Major
Minor
Monitoring Sites
Ambient
Fish Community
Benthos
USGS Gage
Use Support Rating
Supporting
No Data
Impaired
Rocky Mount
EDGECOMBE
Tarboro
NASH
Sharpsburg
Elm City
Pinetops
Macclesfield
WILSON
Wilson
PITT
Little Cokey Swamp
Cokey Swamp
Dickson Br.
Deloach Br.
Millpond Br.
Cabin Br.
Parker Br.
Beaverdam Br.
Sasnett Mill Br.
Corn Creek
Williamson Branch
Town Creek
Cokey Sw.
Cattail Swamp
White Swamp
Cattail Br.
Bynums Mill Creek
Briery Br.
OB71
OF10
OB87
OB161
O5600000
O5990000
OB91
OB70
64
97
301
43
111
258
122
124
42
33
0 1 2 4 6 8
Miles
N
Prepared by DWQ
Basinwide Planning Unit
October 2010

Pamlico River Subbasin

Subbasin HUC 03020104

Includes the confluence of the Tar and Pamlico Estuary and Tributaries

Water Quality Overview: Water quality in this subbasin is primarily impacted by nutrient loading and resulting chlorophyll *a* impairment in the estuary. The current chlorophyll *a* impairment extends from just below Washington in the Pamlico River to Saint Claire Creek, similar to the 1994 conditions. DWQ also recently began assessing for metal toxicity, resulting in several new impairments because of copper levels.

General Description

In 2009, DWQ adopted the national Watershed Boundary Dataset which is based on USGS 1:24,000 ridgelines. The Pamlico River Subbasin, hydrologic unit code (HUC) 03020104, now includes all of old DWQ subbasin 03-03-07 and small portions of 03-03-08, 03-01-51, 03-01-53, and 03-02-09, covering ~1,307 square miles. Some exceptions to this dataset were made in the coastal areas for management purposes; the areas previously part of the Roanoke or Pasquotank Basins now included in the Pamlico River Subbasin maintain their classifications and are not subject to the NSW management strategy, unless reclassification occurs in the future (map provided in Appendix 4D).

This subbasin extends from the town of Washington to Roos Point (Figure 4-1). 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.

In 2007, Goose Creek Tidal Freshwater Marsh and Mallard

Subbasin at a Glance

Counties: Beaufort, Hyde, Pamlico

Municipalities: Aurora, Bath, Belhaven, Chocowinity, Pantego, Washington

Permitted Facilities:

NPDES WWTP: 18
- Major:.....3
- Minor: 15

Non-discharge:.....16

Stormwater:
- General:.....16

Animal Operations:.....19

2000 Population: 47,563

Area: 1,307 sq mi.

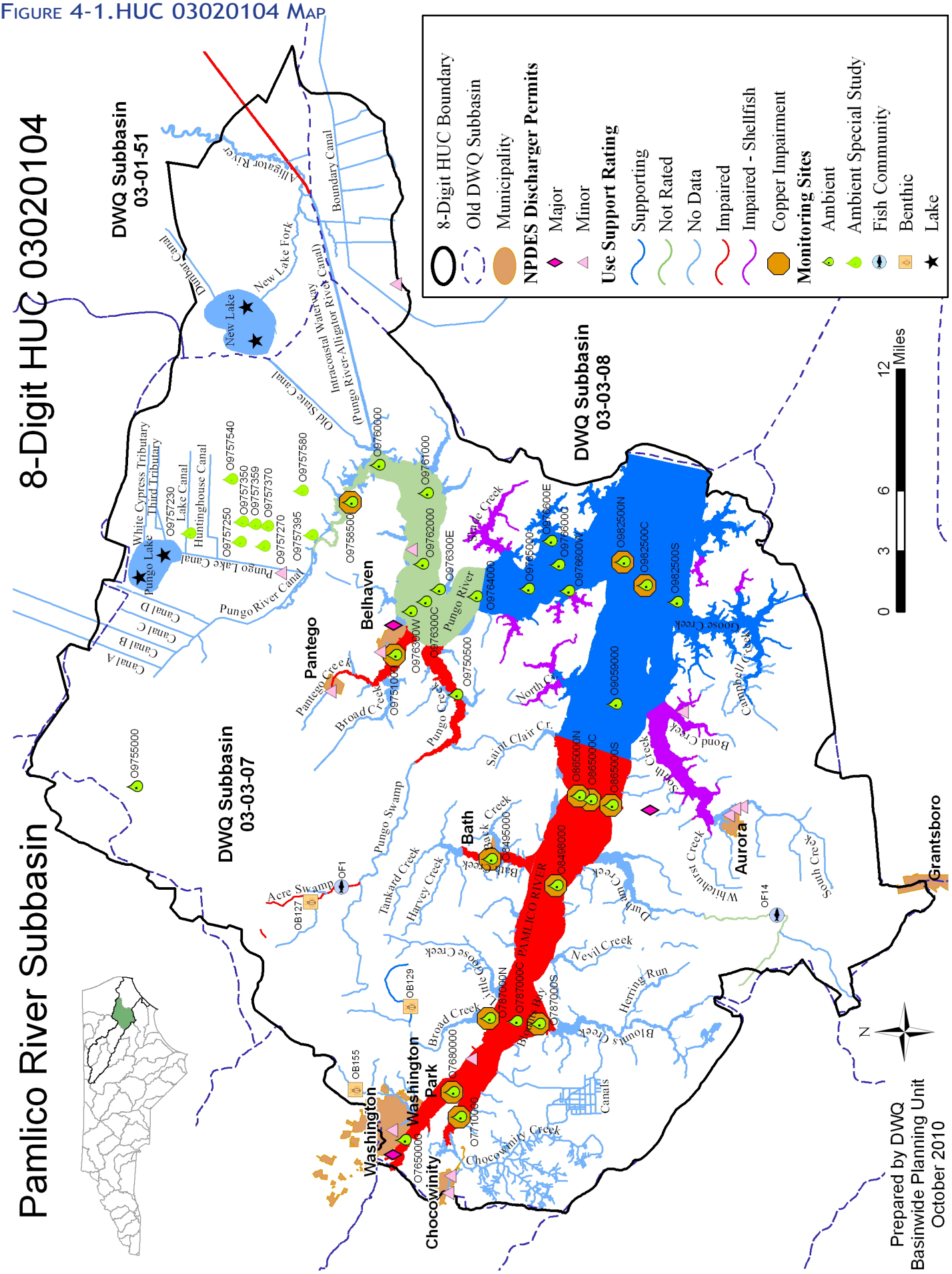
Impervious Surface Estimate: 6 sq mi.

Primary Classifications found in HUC 03020104:

Freshwater	Miles	Freshwater	Acres	Saltwater	Acres
Total...	309	Total...	3,156	Total...	113,249
Supplemental Classifications:					
C;Sw.....	14	C;NSW.....	370	SA;HQW.....	2
C;NSW.....	104	C;Sw,NSW.....	2,786	SA;HQW,NSW..	55,586
C;Sw,NSW.....	190			SB;NSW.....	49,297
C;HQW,NSW....	1			SC.....	176
				SC;HQW,NSW..	57
				SC;NSW.....	8,131

Classification descriptions are found at:
http://portal.ncdenr.org/web/wq/ps/csu/classifications

FIGURE 4-1. HUC 03020104 MAP

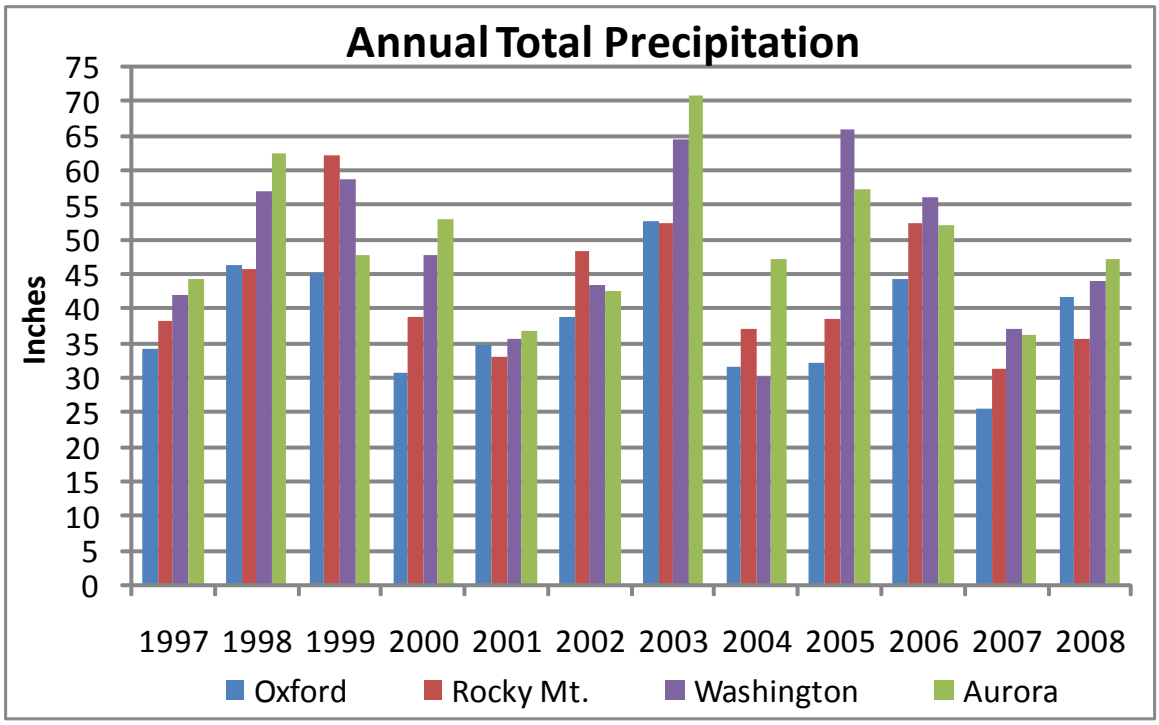


Creek Tidal Freshwater Marsh were reclassified as WL UWL (~272 acres). Unique wetlands (UWL) are of exceptional state or national ecological significance which require special protection to maintain existing uses.

Precipitation

Precipitation data from the State Climate Office of North Carolina are shown in Figure 4-2 for four selected sites to show differences in the upper, middle and lower portions of the basin. The driest years for rainfall in Washington are 2001 & 2004 and 2001 & 2007 for Aurora while 2003 stands out as the year with the most precipitation in the estuary (Hurricane Isabel made landfall on the NC Outer Banks in September 2003). (http://www.nc-climate.ncsu.edu/).

Figure 4-2. Annual Precipitation at selected sites within the Basin



Current Status and Significant Issues

Use Support Assessment Summary

All surface waters in the state are assigned a classification reflecting the best-intended use of that water. To determine how well waterbodies are meeting their best-intended uses, chemical, physical, and biological parameters are regularly assessed by DWQ. These data are used to develop use support ratings every two years as required by EPA; the collected list of all monitored waterbodies and their water quality rating is called the Integrated Report (IR) and Impaired waters are also reported on the 303(d) list. Water quality evaluation levels and how a waterbody earns a rating of Supporting or Impaired is explained in detail in the IR methodology. The 2010 IR is based on data collected between 2004 and 2008; the IR and methodology are available on the DWQ Modeling/TMDL Unit webpage at: http://portal.ncdenr.org/web/wq/ps/mtu/assessment. The most current use support ratings for this subbasin can be found in Appendix 4A.

In this subbasin, use support was assigned for aquatic life, recreation, fish consumption, shellfish harvesting, and water supply categories. Waters are Supporting, Not Rated, or No Data in the aquatic life and recreation categories on a monitored or evaluated basis. All waters are Impaired in the fish consumption category on an evaluated basis based on statewide fish consumption advice issued by the Department of Health and Human Services. All waters are Supporting in the

water supply category on an evaluated basis based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants. Shellfish harvesting assessments are based on DEH Shellfish Sanitation Survey Reports.

Recreation

Recreation uses in tidal saltwaters are rated based on NC's Enterococcus standard which requires a geometric mean of < 35 enterococci per 100 ml based upon a minimum of five samples within any consecutive 30 days. Enterococci are a subgroup of the fecal streptococcus group which generally occur in the digestive systems of humans and other warm-blooded animals along with fecal coliform bacteria. According to the EPA Enterococci bacteria are better able to survive in saltwater and, thus, more closely mimic other pathogens in saltwater than do the fecal coliform bacteria.

Enterococcus samples are collected by the N.C. Recreational Water Quality Program (NCRWQP) within the Division of Environmental Health and not by DWQ. Their sampling results and current swimming advisories are available online at: http://www.deh.enr.state.nc.us/shellfish/Water_Monitoring/RWQweb/home.htm.

Within this subbasin there are 48,299 acres of water classified for primary recreation (SB), of which, 865 acres (2%) are Impaired. An additional 740 acres (9%) out of 8,364 acres of waters classified for secondary recreation are also impaired for recreational uses. Waterbodies with past high levels of enterococcus bacteria include:

Pamlico River upper segment: AU#s 29-(1) & 29-(5)a1
Bath Creek: AU# 29-19-(5.5)
Pungo River near Pantego Creek: AU# 29-34-(12)b

The Recreational Water Quality Program tests recreational beaches during the swimming season beginning on April 1st and ends October 31st. All ocean beaches and high-use sound-side beaches (Tier 1) are tested weekly during the swimming season. Lower-use beaches (Tier II and Tier III) are tested twice a month. All sites are tested twice a month in October and monthly from November through March. The NCRWQP currently uses a running geometric mean and single sample tests to determine compliance with their rules (15A NCAC 18A .3402): (a) The Enterococcus level in a Tier I swimming area shall not exceed either: (1) A geometric mean of 35 enterococci per 100 milliliter of water, that includes a minimum of at least five samples collected within 30 days; or (2) A single sample of 104 enterococci per 100 milliliter of water. (b) The enterococci level in a Tier II swimming area shall not exceed a single sample of 276 enterococci per 100 milliliter of water. (c) The enterococcus level in a Tier III swimming area shall not exceed two consecutive samples of 500 enterococci per 100 milliliter of water."

Shellfish Harvesting Water

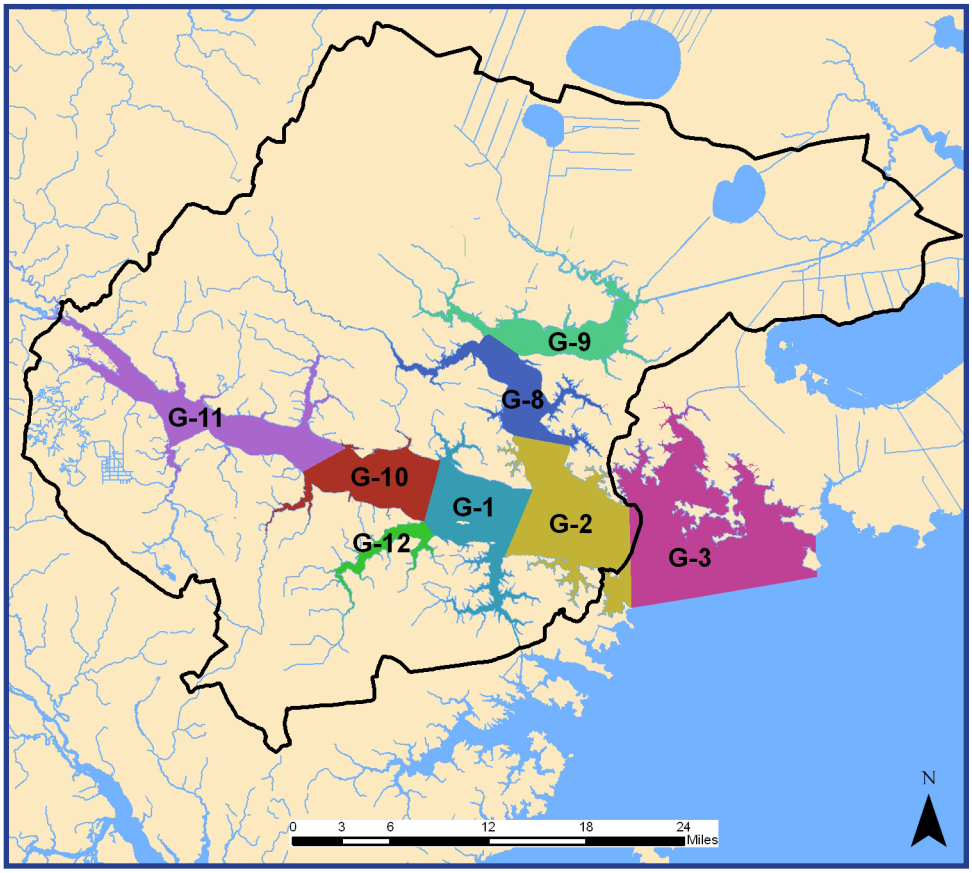
There are 55,569 acres classified as shellfish harvesting waters (SA;HQW), of which 5,397 acres are Impaired because of potential fecal coliform bacteria contamination. Specific Impaired waterbodies are listed in Appendix 4A. The Shellfish Sanitation and Recreational Water Quality Section of the Division of Environmental Health (DEH) is responsible for monitoring and classifying coastal waters as to their suitability for shellfish harvesting for human consumption, and inspection and certification of shellfish and crustacea processing plants.

The Shellfish Sanitation Program is conducted in accordance with the guidelines set by the Interstate Shellfish Sanitation Conference contained in the National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish Model Ordinance. Classifications of coastal waters for shellfish harvesting are done by means of a Sanitary Survey, which includes: a shoreline survey of sources of pollution, a hydrographic and meteorological survey, and a bacteriological survey of growing waters. Sanitary Surveys are conducted for all potential shellfish areas in coastal North Carolina and recommendations are made to the Division of Marine Fisheries of which areas should be closed for shellfish harvesting. Detailed maps are available

from the DEH website showing current shellfish growing areas: http://www.deh.enr.state.nc.us/shellfish/maps.htm.

DWQ uses DEH classifications to assign use support ratings for the shellfish harvesting category. By definition, Conditionally Approved-Open areas are areas that DEH has determined do not, or likely do not, meet water quality standards and these areas are rated Impaired, along with Conditionally Approved-Closed and Prohibited or Restricted areas. Only DEH Approved growing areas are rated as Supporting.

FIGURE 4-3. SHELLFISH GROWING AREAS IN HUC 03020104



This subbasin contains seven DEH shellfish growing areas including: G1, G2, G8, G9, G10, G11 & G12 as shown in Figure 4-3. The following summaries are from the most current and available DEH Shellfish Sanitation Sanitary Surveys. Note, not all growing areas are surveyed by DEH.

Areas G-1 and G-2 include portions of the Pamlico River, Goose Creek, Pungo River and numerous small creeks, covering ~46,000 acres (DEH Shellfish Sanitation Sanitary Survey, May 2005). Area G-1 has little significance as a shellfishing area, producing only a few oysters and *Rangia* clams, while area G-2 has fair oyster production. Pamlico Beach, Lowland, and Hobucken are the most populous (~1,000) towns and industry in this area includes agriculture, silviculture, commercial fishing, and aquaculture. Pollution sources include drainage from aquaculture ponds, waterfowl impoundments, and closed seafood businesses now being used as junk yards. The dispersion of pollution in these areas is wind driven. Rainfall and stormwater were not identified as influencing bacteria levels these areas. Sampling results indicated bacteriological water quality declined near Ross and Bailey Creeks where recent development has occurred, while conditions improved near Satterwaite Creek.

Areas G-8 and G-9 includes the upper portion of the Pungo River. The city of Belhaven is the largest population (~1,900) center in a predominately rural agricultural area. Potential pollution from both crop and animal agriculture, permitted WWTP dischargers, and surface runoff from small businesses are dispersed through the water by prevailing winds. Oyster production in these waters is considered low and produces mostly *Rangia* clams. Bacteriological water quality sampling indicated a decline in conditions in Lower Dowry Creek and waters surrounding Belhaven. The increase in bacteria levels appear to be spreading into the main channel of the Pungo River.

General Biological Health

Due to limited habitat in this subbasin there has been little invertebrate and fish community sampling. Most streams north of the Pamlico River are channelized and drain agricultural catchments. The one on-going macroinvertebrate site on Beaverdam Swamp had a Moderate Stress bioclassification in both 2002 and 2007. Sampling in Acre Swamp (AU# 29-34-35-1-1), in 2002, resulted in a benthic Severe rating and a Not Rated fish community sample. A special study, completed in 2008, conducted on an unnamed tributary to Herring Run (AU# 29-3-3) resulted in a Not Rated benthic rating; this site is co-located with a Random Ambient Monitoring Systems (RAMS) station O7660000. South of the Pamlico Estuary, Durham Creek (AU# 29-3-3) had a fish community sample collected in 2002 resulting in a Not Rated status. There were no fish community or fish tissue collections in this subbasin between 2002 and 2007.

There were 21 reported fishkills in this subbasin 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. The causes of these fishkills include low DO, algal blooms and unknown sources; more details can be found at: **http://portal.ncdenr.org/web/wq/ess/fishkills**.

Ambient Data

Subbasinwide, monthly chemical and physical samples are taken by DWQ. There are 30 stations, of which 11 were discontinued in the Pungo River and 9 new stations were started in 2005 for a special study of the canals draining to the Pungo River. A majority of the ambient stations are associated with waterbody locations where potential pollution could occur from known land use activities. There are also portions of the subbasin where no water quality data are collected; therefore, we cannot evaluate the condition of the water quality in those areas. Parameters collected depend on the waterbody classification, but typically include conductivity, chlorophyll *a*, dissolved oxygen, pH, temperature, turbidity, nutrient measurements, metals, and fecal coliform. Each classification has an associated set of standards the parameters must meet in order to be considered supporting the waterbody's designated uses. Stressors are either chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use. Ten sample results are required within the five year data collection window in order to evaluate the water quality parameter and compare it to the water quality evaluation levels. Ambient stations are listed in Table 4-1, and their locations are found in Figure 4-1 and on watershed maps provided in Appendix 4D.

Table 4-1. Ambient Stations in HUC 03020104

Station ID	Data Collected Since	Waterbody	AU#	Station Location	Stressors
O7650000	7/6/68	Pamlico R.	29-(1)	US 17 at Washington	Low pH, Chlorophyll a
O7680000	3/7/92	Pamlico R.	29-(5)a	Cm 16 near Whichard Beach	Low pH, Copper, Chlorophyll a
O7710000	3/7/92	Chocowinity Bay	29-6-(5)	Above Silas Cr near Whichard Beach	Chlorophyll a, Copper
O787000C	6/13/74	Pamlico R.	29-(5)b1	Mouth of Broad Cr near Bunyon Mid Channel	Chlorophyll a, Copper
O787000N	6/14/89	Pamlico R.	29-(5)b1	Mouth of Broad Cr near Bunyon N Shore	Low pH, Copper, Chlorophyll a

Station ID	Data Collected Since	Waterbody	AU#	Station Location	Stressors
O787000S	5/18/99	Blounts Bay	29-9	Mouth of Broad Cr near Bunyon S Shore	Chlorophyll a, Copper
O8495000	2/14/74	Bath Cr	29-19-(5.5)	NC 92 near Bath	Chlorophyll a, High pH, Copper
O8498000	5/31/89	Pamlico R.	29-(5)b2	Cm 5 near Core Point	Chlorophyll a, Copper
O865000C	5/18/99	Pamlico R.	29-(5)b3	Cm 4 near Gum Point Mid Channel	Chlorophyll a, Copper
O865000N	5/18/99	Pamlico R.	29-(5)b3	Cm 4 near Gum Point N Shore	Copper
O865000S	5/18/99	Pamlico R.	29-(5)b3	Cm 4 near Gum Point S Shore	Chlorophyll a, Copper
O9059000	8/10/77	Pamlico R.	29-(5)b4	Hickory Pt near South Cr	-
O9750500	10/15/81	Pungo Cr	29-34-35	NC 92 at Sidney Crossroads	Chlorophyll a, Copper, Arsenic
O9751000	10/15/81	Pantego Cr	29-34-34-(2)	NC 92 at Belhaven	Low pH, Chlorophyll a, Copper
O9755000	8/1/84	Van Swamp	23-55	NC 32 near Hoke	Low pH, Copper
O9758500	10/15/81	Pungo R	29-34-(5)	US 264 near Ponzer	Low Do, Low pH, Copper
O9760000	5/18/99-10/1/05	Pungo R	29-34-(12)a	Cm 24 near Icw	Low Do, Low pH
O9761000	5/18/99-10/1/05	Pungo R.	29-34-(12)a	Cm 19 near Scranton Cr	-
O9762000	5/18/99-10/1/05	Pungo R.	29-34-(12)a	Cm 14 near Haystack Point	-
O976300C	5/18/99-10/1/05	Pungo R.	29-34-(12)a	Cm 1Bc Between Durants Point and Pantego Cr	-
O976300E	5/18/99-10/1/05	Pungo R.	29-34-(12)a	off Durants Point	-
O976300W	5/18/99-10/1/05	Pungo R.	29-34-(12)a	Cm 6 at Mouth of Pantego Cr	-
O9764000	5/18/99-10/1/05	Pungo R.	29-34-(12)a	Cm 7 near Woodstock Point	-
O9765000	5/18/99-10/1/05	Pungo R.	29-34-(38)	Cm 4 near Sandy Point	-
O976600C	5/18/99-10/1/05	Pungo R.	29-34-(38)	Between Fortescue Cr and Wright Cr Mid Channel	-
O976600E	5/18/99-10/1/05	Pungo R.	29-34-(38)	Mouth of Fortescue Cr	-
O976600W	5/18/99-10/1/05	Pungo R.	29-34-(38)	Marker 2Wc at Mouth of Wright Cr	-
O982500C	5/18/99	Pamlico R.	29-(27)	Between Mouths of Pungo River and Goose Cr Mid Channel	Copper
O982500N	5/18/99	Pamlico R.	29-(27)	Between Mouths of Pungo River and Goose Cr N Shore	Copper
O982500S	5/18/99	Pamlico R.	29-(27)	Between Mouths of Pungo River and Goose Cr S Shore	-
O7660000	RAMS 2007-2008	UT Herring Run	29-3-3	off SR 1518 near Washington	Low DO
O9757230 O9757540 O9757250 O9757350 O9757359 O9757270 O9757370 O9757580 O9757395	1/2005	Pungo Lake Canals	29-34-3	Pungo Lake Canals, south of Pocosin Lakes National Wildlife Refuge and north of Pungo River.	NH_3-N, inorganic nitrogen, TP, and fecal coliform
"-" indicates no stressors identified					

The following discussion of ambient monitoring parameters includes graphs showing the median and mean concentration values for all ambient stations (n=30) in this subbasin for a specific parameter over each year. These graphs are not intended to provide statistically significant trend information or loading numbers, but rather provide an idea of how changes in land use conditions or climate change effect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the dataset. Box and whisker plots of individual ambient stations were completed by parameter for data between 2002-2007 and can be found in the Ambient Monitoring report found at: http://portal.ncdenr.org/c/document_library/get_file?uuid=994c08a8-a98d-4ff5-9425-656cadf8cfa4&groupId=38364. Summary sheets for ambient stations are found in Appendix 4C.

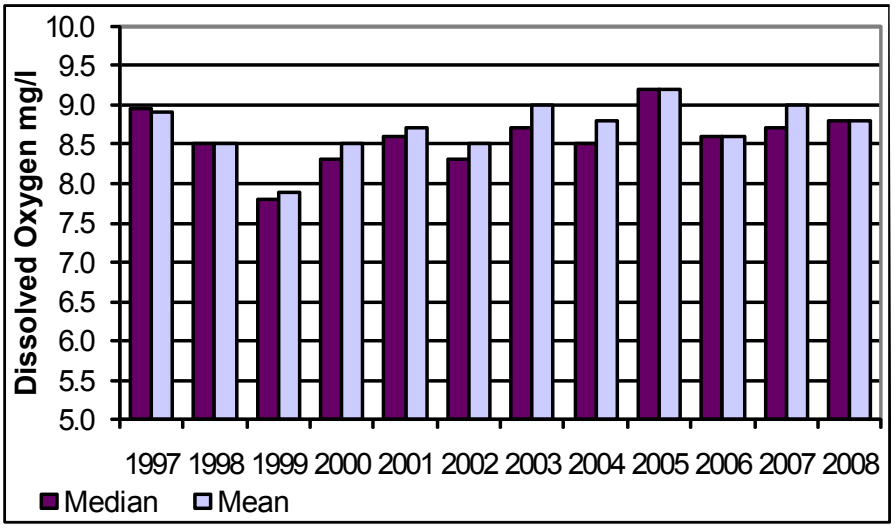
Dissolved Oxygen

The dissolved oxygen (DO) water quality standard for saltwater is not less than 5 mg/L and for freshwater it is not less than a daily average of 5 mg/L or a minimum instantaneous value of not less than 4 mg/L. Swamp waters may have lower values if the low DO level is caused by natural conditions. Dissolved oxygen can be produced by wind or wave action that mix air into the water or through aquatic plant photosynthesis. During the day, DO levels are higher when photosynthesis occurs and they drop at night when respiration occurs by aquatic organisms. High levels are found mostly in cool, swift moving waters and low levels are found in warm, slow moving waters. In slow moving waters, such as reservoirs or estuaries, depth is also a factor. Wind action and plants can cause these waters to have a higher dissolved oxygen concentration near the surface, while biochemical reactions lower in the water column may result in concentration as low as zero at the bottom.

The drought conditions in 2005 and 2007 impacted DO levels throughout the basin. However, low DO levels detected over several years in approximately 16,000 acres of the Pungo River (AU#s 29-34-(5) & 29-34-(12)a) and the upper segment of the Pamlico River (AU# 29-(1)) raise the question of whether drought, low flow or natural conditions are contributing to low DO.

The graph in Figure 4-7 represents results from 4,276 samples collected in estuarine waters over a 12 year period, of which 94 (2%) of these samples had a DO reading below 5 mg/L.

Figure 4-7. Dissolved Oxygen Levels for all data collected at Estuarine Ambient Stations in HUC 03020104 at 1m depth



pH

The water quality standard for pH in surface freshwater is 6.0 to 9.0 standard units and between 6.8-8.5 standard units in saltwater. Swamp water (supplement Class Sw) may have a pH as low as 4.3 if it is the result of natural conditions. Several waterbodies have *low pH* conditions including:

Pamlico River: (Class SC) from US 17 in Washington to the mouth of Broad Creek, AU#s 29-(1), 29-(5)a, & 29-(5)b1

Pungo River: (Class SC) upriver from Woodstock Point & Quilley Point, AU#s 29-34-(5) & 29-34-(12)a

Pantego Creek: (Class SC) AU# 29-34-34-(2)

Van Swamp: (Class C, SW) AU# 23-55

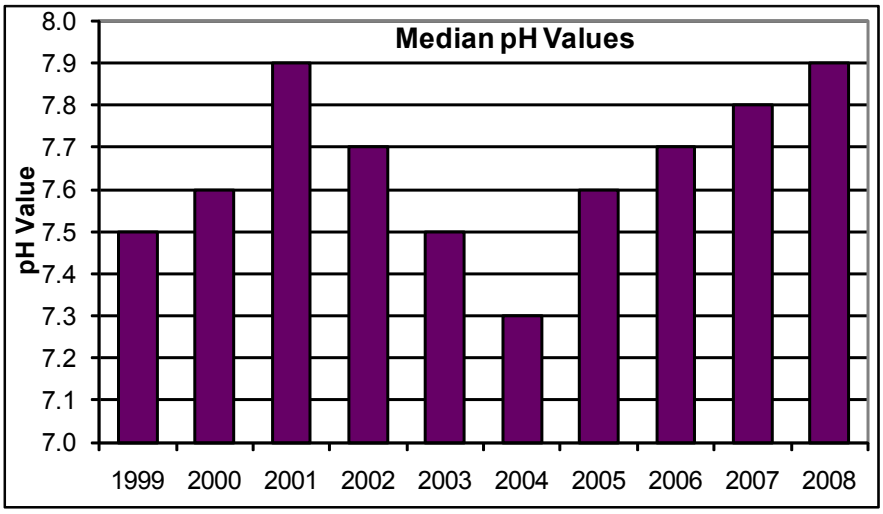
High pH conditions were detected at:

Bath Creek: (Class SC) AU# 29-19-(5.5)

pH is a measure of hydrogen ion concentration that is used to express whether a solution is acidic or alkaline (basic). Low values (< 7.0) can be found in waters rich in dissolved organic matter, such as swamp lands, whereas high values (> 7.0) may be found during algal blooms. Lower values can have chronic effects on the community structure of macroinvertebrates, fish and phytoplankton.

Figure 4-6, graph represents results from 3,759 samples collected over a 10 year period, of which 187 (5%) have low pH levels and and 68 (2%) have high pH levels.

FIGURE 4-6. SUMMARIZED PH VALUES FOR ALL DATA COLLECTED AT ESTUARINE AMBIENT STATIONS IN HUC 03020104 AT 1M DEPTH



Turbidity

The turbidity standard for freshwater streams is 50 NTUs and 25 NTUs for salt waterbodies. There are currently no streams impaired or impacted because of turbidity violations. The majority of monitored waterbodies in this subbasin are estuarine and are held to the 25 NTUs standard. Turbidity is a measure of cloudiness in water and is often accompanied with excessive sediment deposits in the streambed. Excessive sediments deposited on stream and lake bottoms can choke spawning beds (reducing fish survival and growth rates), harm fish food sources, fill in pools (reducing cover from prey and high temperature refuges), and reduce habitat complexity in stream channels. Excessive suspended sediments can make it more difficult for fish to find prey and at high levels can cause direct physical harm, such as clogged gills. Sediments can cause taste and odor problems, block water supply intakes, foul treatment systems, and fill reservoirs.

Figure 4-4. Summarized Turbidity values for all data collected at Ambient Stations in HUC 03020104

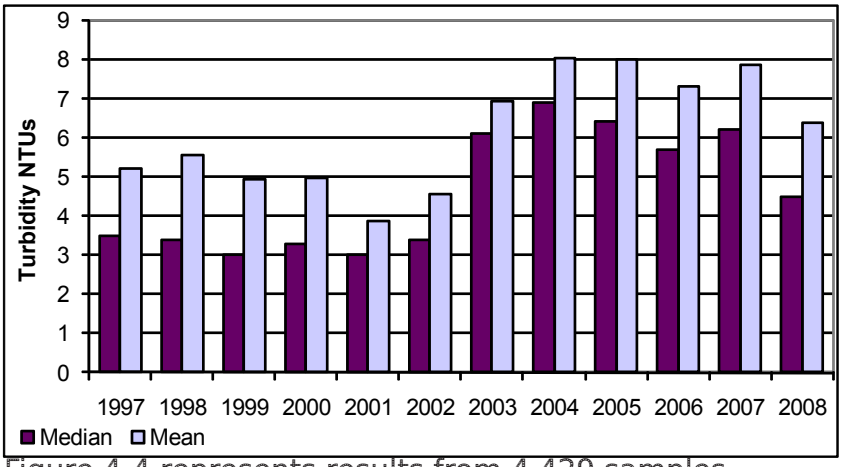


Figure 4-4 represents results from 4,429 samples collected over the 12 year period, of which 52 (1%) of those samples exceed their turbidity standard.

Fecal Coliform Bacteria

The fecal coliform bacteria standard for freshwater streams is not to exceed the geomean of 200 colonies/100ml or 400 colonies/100ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are to be used to indicate whether the stream is Impaired or Supporting. Waters with a classification of B (primary recreation water) will receive priority for 5-in-30 studies. Other waterbodies will be studied as resources permit. Data through 2007 indicate several streams where bacteria colony numbers exceeded 400 colonies/100ml.

Canal B near Rose Acres Farm (Special Study) is the only waterbody where 10% of the samples were over 400 colonies/100ml; this water is considered impacted.

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of humans or other warm-blooded animals. At the time this occurred, the source water might have been contaminated by pathogens or disease producing bacteria or viruses that can also exist in fecal material. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

Figure 4-5. Summarized Fecal Coliform Bacteria numbers for all data collected at Ambient Stations in HUC 03020104

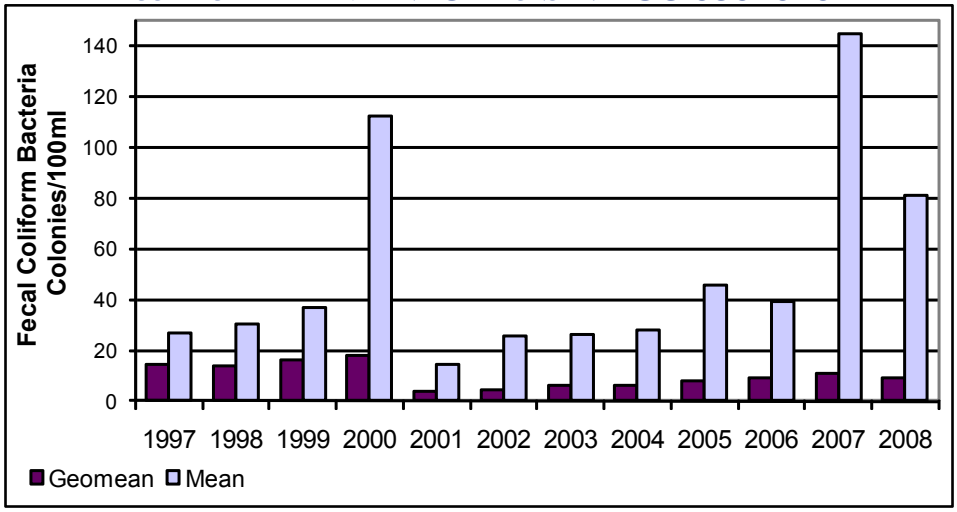


Figure 4-5, graph represents results from 5,006 samples collected over a 12 year period, of which 119 (2%) of these samples had more than 400 fecal coliform bacteria colonies /100 ml. Review of individual station data over the 12 year period indicate 29 samples occurred in waters classified for primary recreation.

Nutrient Enrichment

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as "nutrients". Nitrogen compounds include ammonia as nitrogen (NH_3), Total Kjeldahl Nitrogen (TKN) and nitrite+nitrate nitrogen (NO_2+NO_3). Total nitrogen (TN) is the sum of TKN and NO_2+NO_3. Phosphorus is measured as total phosphorus (TP) by DWQ. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes or runoff from urban or agricultural land, the growth of algae and other plants may be accelerated. In addition to the possibility of causing algal blooms, ammonia-nitrogen may combine with high pH water to form ammonium hydroxide (NH_4OH), a form toxic to fish and other aquatic organisms.

Phosphorus loading to the estuary decreased significantly as a result of two events. Effective January 1, 1988, the NC General Assembly adopted a statewide phosphate detergent ban, which resulted in significant drops in stream phosphorus concentrations statewide, however this ban does not include dishwasher detergent. Also, in the fall of 1992, PCS Phosphate, located on the Pamlico River estuary in Aurora, began a wastewater recycling program that reduced its phosphorus discharge by about 97 percent.

Due to excessive levels of nutrients resulting in massive algal blooms and fish kills the entire Tar-Pamlico River Basin was designated as Nutrient Sensitive Water (NSW) in 1989. This designation resulted in the development and implementation of a nutrient management strategy to achieve a decrease in TN by 30% and no increase in TP loads compared to 1991 conditions. Even though implementation of the strategy has occurred by wastewater treatment plant (WWTP) dischargers, municipal stormwater programs, and agriculture, nutrient enrichment continues to be cumulatively impacting the Pamlico Estuary. A review of the NSW strategy, including implementation activities, progress towards meeting the loading goals and additional actions are discussed in Chapter 6.

Basin trend analyses were completed for nutrient concentration and daily loads to evaluate progress towards meeting TMDL reduction goals, as discussed in detail in the NSW Chapter 6. These analyses detected a statistically significant increase in TKN concentration and a decrease in NH_3 and NO_2+NO_3. There were no basinwide detected trends for TN or TP concentrations. TKN is defined as total organic nitrogen and NH_3. An increase in organic nitrogen is the likely source for the increase in TKN concentrations since NH_3 concentrations have decreased basinwide.

Chlorophyll *a*

The chlorophyll *a* standard is 40 µg/L (micrograms per liter) for lakes, reservoirs and slow moving waters in North Carolina. Almost 29 thousand acres are impaired in the Pamlico estuary because chlorophyll *a* levels exceeded the 40 µg/L standard in more than 10% of the samples. The following waterbodies have high chlorophyll *a* levels:

Kennedy Creek: AU# 28-104

Pamlico River from downstream of Runyon Creek and Rodman Creek to to a line from Huddy Creek (south shore) to Saint Claire Creek (north shore), including Blounts Bay: AU#s 29-(5)a, 29-(5)b1, 29-9, 29-(5)b2, & 29-(5)b3

Chocowinity Bay: AU#s 29-6-(1) & 29-6-(5)

Bath Creek: AU# 29-19-(5.5)

Pungo Creek: AU# 29-34-35

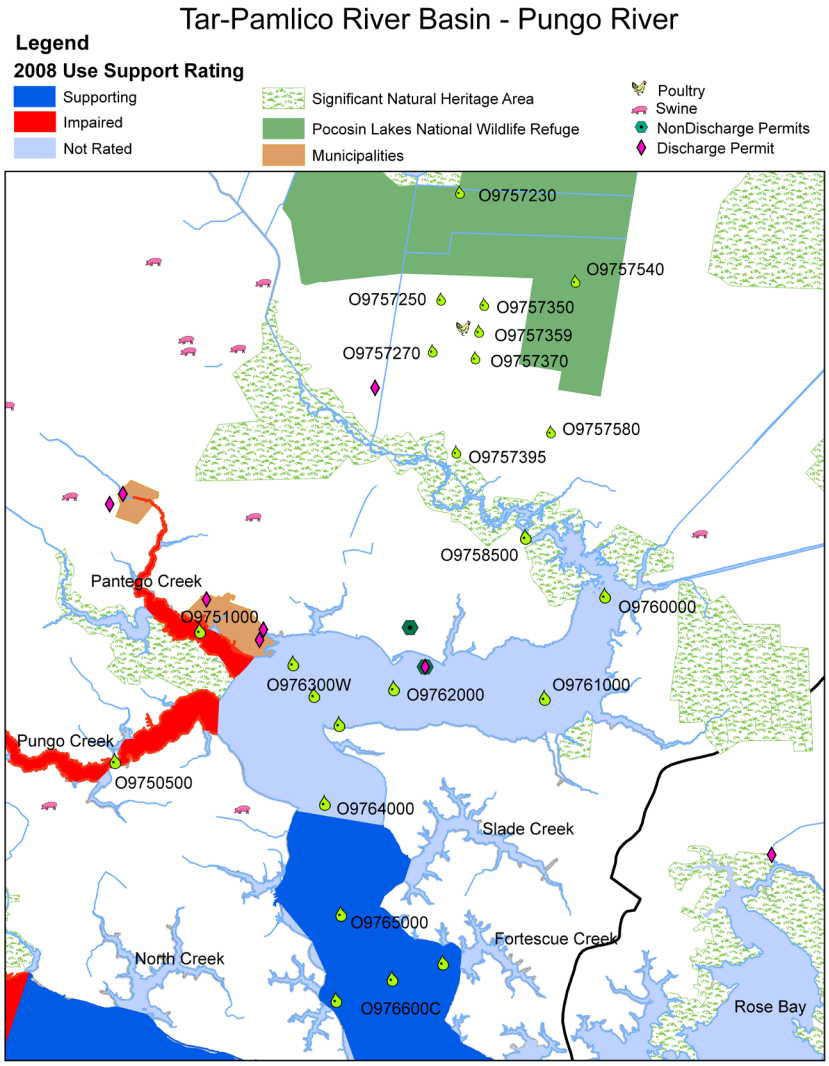
Pantego Creek: AU# 29-34-34-(2)

Water Quality in the Pungo River

The Pungo River watershed drains ~401,926 acres. The area has an extensive ditch network that drains large agricultural areas. Increased waterfront development is also occurring. Although the Pungo River flows into the Pamlico Estuary below the Impaired segments of the estuary, the Pungo River and tributaries are also classified as NSW. Any land use activities (regulated and non-regulated) that contribute nutrients to the system should be using best available technology, BMPs, and mitigation measures to reduce their impacts.

The two major tributaries (Pantego Creek AU# 29-34-34-(2), 952 ac. & Pungo Creek AU# 29-34-35, 1,702 ac.) to the Pungo River are Impaired because of high chlorophyll *a* levels (Figure 4-8). Both Pantego Creek and the Pungo River (AU# 29-34-(5)) headwaters are Impaired because of copper violations. There is one area, near Belhaven, consisting of 2.8 acres within the Pungo River (AU# 29-34-(12)b) that was Impaired for recreation. In the rest of the river, the data are inconclusive or no data are available; the lower segment is Supporting.

Figure 4-8 Pungo River Drainage



Eleven ambient monitoring stations in the mainstem of the Pungo river have been discontinued. To ensure the Pungo River is meeting water quality standards it is recommended that ambient sampling be reestablished at site O9764000 or O9765000. This will help capture the cumulative load of potential pollutants coming from, existing developments/industry, new developments and agriculture before the water enters the Pamlico Sound.

Special Study- Rose Acres

In 2003, DWQ began investigating environmental conditions for a proposed chicken egg laying facility. DWQ collected data before and after the farm was populated with birds. Surface water quality data were collected at nine stations, starting in 2005, located around the farm as shown in Figure 4-8 (near Pocosin Lakes National Wildlife Refuge). The data indicate a significant increase in ammonia nitrogen, total inorganic nitrogen, total phosphorus, and fecal coliform concentrations. When evaluating on a station by station basis, only a few stations had significant differences between the pre and post operation data sets. Station O9757350 in the northeast corner had significantly elevated levels of ammonia, total inorganic nitrogen, total phosphorus and fecal coliform. (DWQ-ESS. 5/6/09. "Summary of the Rose Acres Farm Sampling Program"). These water quality stations will be discontinued by DWQ, but will continue to be sampled by the farm.

Due to concerns about atmospheric emissions and the near and far field deposition of ammonia on water quality, the US Fish & Wildlife Service initiated an investigation to study the effects of atmospheric deposition in the area. Preliminary review of data indicates that the farm is a contributing local source for ammonia and nitrogen deposition. This study report is found in Appendix 4E and more detailed discussion about the farms permit requirements and recommendations are discussed under the Agriculture section of this document.

Presently, ambient data are taken in the headwaters of the Pungo River which is likely only capturing runoff from agriculture and wildlife. Figures 4- 9,10 & 11 show chlorophyll *a*, TN, and TP concentration levels from this station over the last several years. Both TN and TP levels decreased during the 2007-08 drought, while chlorophyll *a* levels increased but not enough to exceed standards.

Figure 4-9. Chlorophyll *a* at Ambient station O9758500

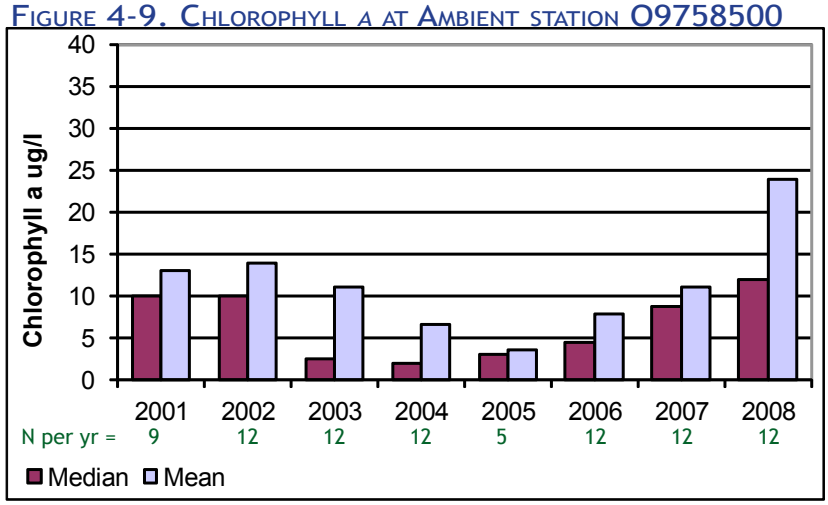


Figure 4-10. Total Nitrogen at Ambient station O9758500

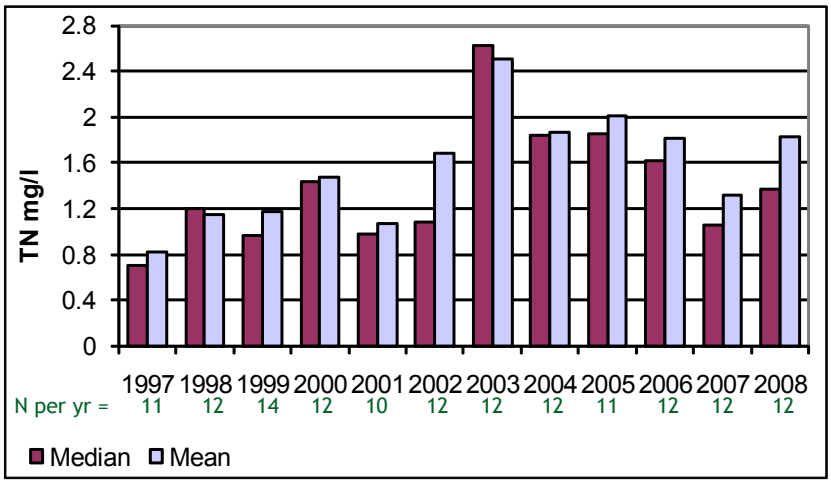
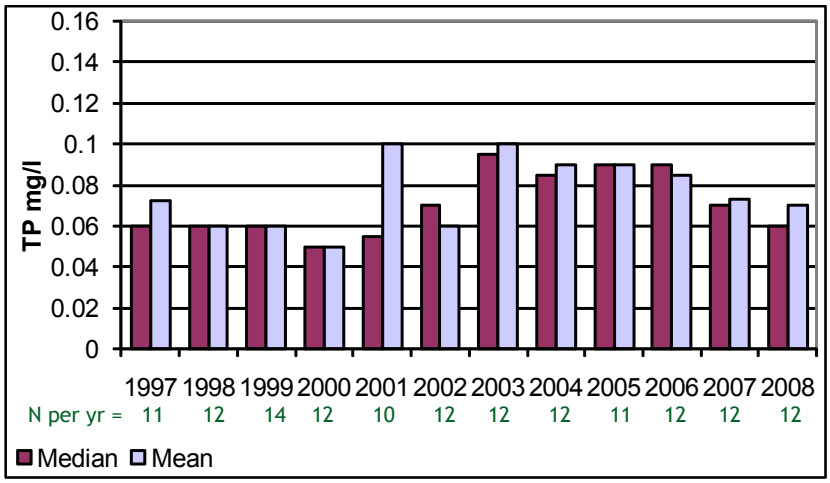


Figure 4-11. Total Phosphorus at Ambient station O9758500



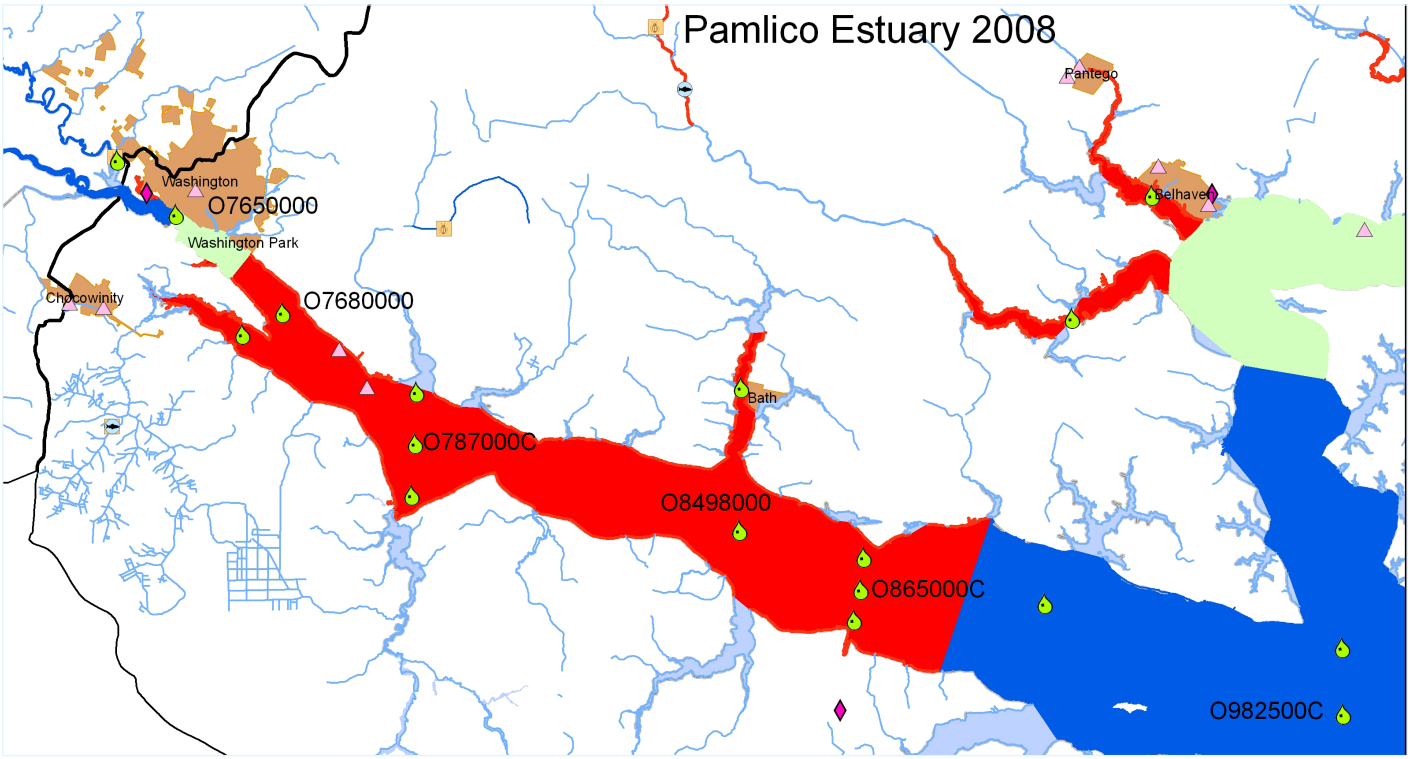
Water Quality in the Pamlico Estuary

Recurring nutrient-related problems have been documented in the Pamlico River estuary through the latter half of the 20th century. The state documented increasing numbers of fish kills in the estuary from the mid-70s through the early 1990s. Researchers in the estuary have investigated the presence of fish and crab diseases, algal blooms, hypoxic conditions, loss of aquatic vegetation, and degradation of the region's water quality. Researchers estimated that there was a several-fold increase in nitrogen inputs to the basin during the last century. Most of the increases were attributed to increased crop fertilization and production, particularly since the 1950s. Increases in farm animals and municipal and industrial discharges also contributed to the rise in nitrogen inputs. However, recent studies have shown that nitrogen levels instream have decreased somewhat in the last thirty years. Although, they are still considered to be sufficiently high to foster harmful algal blooms.

Nitrogen and phosphorus TMDLs were approved by EPA in August 1995 based on results of estuarine response modeling. The TMDL and management strategies were outlined in the 1994 Tar-Pamlico Basinwide Water Quality Management Plan (http://portal.ncdenr.org/web/wq/ps/bpu/basin) and called for reducing instream nitrogen loading at Washington, NC by 30 percent from current levels to 1991 levels and holding phosphorus loading to 1991 levels. These values were based on minimizing exceedances of the 40 µg/L chlorophyll *a* standard.

Water quality in the Pamlico Estuary has been reported in basinwide plans since 1994. In the 1994 basin plan the area known to be exceeding chlorophyll *a* data extended from Washington to a line from Huddy Creek (south shore) to Saint Claire Creek (north shore). In 1999 and 2004, the data indicated the chlorophyll *a* violations only extended to a line 0.65 miles downstream of Chocowinity Bay including Chocowinity Bay. The 2008 and 2010 assessment indicated this impairment extending again to Huddy and Saint Claire Creeks (~28,923 ac). Ambient data are reassessed every two years and it is possible that fluctuations in Supporting (meeting water quality standards) or Impairment (not meeting water quality standards) status will change with each assessment data period. Six estuary ambient sites, shown in Figure 4-12, were selected for nutrient analyses. Chlorophyll a, TP and TN concentration levels over the last several years are graphed in Figures 4- 13-30.

FIGURE 4-12. CORRESPONDING AMBIENT SITES TO NUTRIENT GRAPHS



Figures 4- 13-18 show the differences in chlorophyll *a* concentrations throughout the Pamlico Estuary, moving from a station near Washington to station near the mouth of the Pungo River, between 2001-2008. Station O7650000 is near Washington at the upper most portion of the estuary, this area is currently not Impaired and the last station O982500C is also in an unimpaired segment of the estuary because chlorophyll *a* levels do not exceed standards. Figures 4- 14-17 represent stations where water is considered Impaired because chlorophyll *a* levels exceed the standard. The drought during 2007-2008 appears to have influenced the upper estuary chlorophyll *a* levels more so than waters closer to the sound, whereas during the rainier years chlorophyll *a* levels tend to be higher in the central portion of the estuary. For comparison, 1991 nutrient concentration data at Station O7650000 includes a median chlorophyll *a* level of 12.5 ug/l and a mean of 39.8 ug/l.

Figure 4-13. Station O7650000 Chlorophyll a Yearly Concentrations

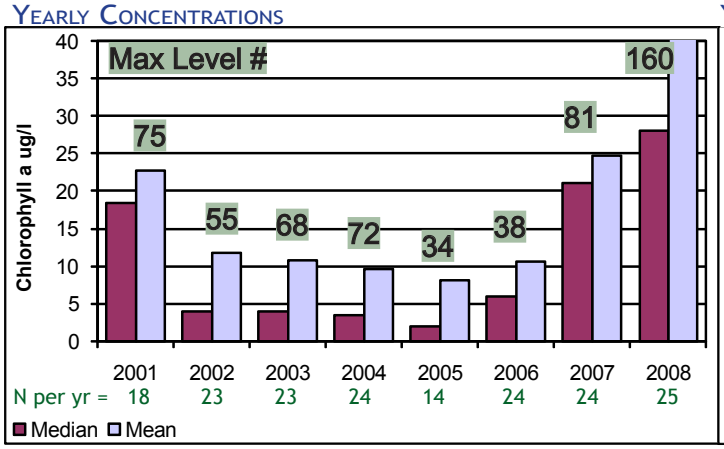


Figure 4-14. Station O7680000 Chlorophyll a Yearly Concentrations

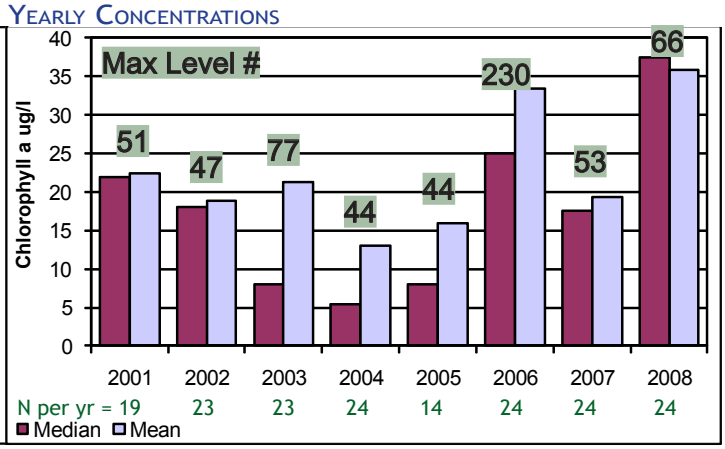


Figure 4-15. Station O787000C Chlorophyll a Yearly Concentrations

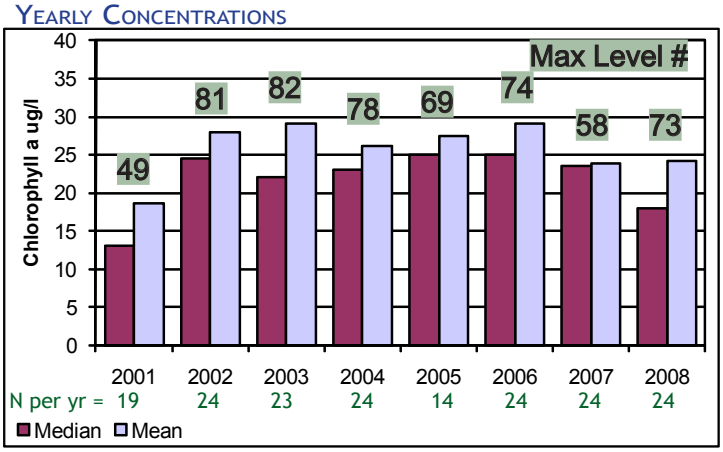


Figure 4-16. Station O8498000 Chlorophyll a Yearly Concentrations

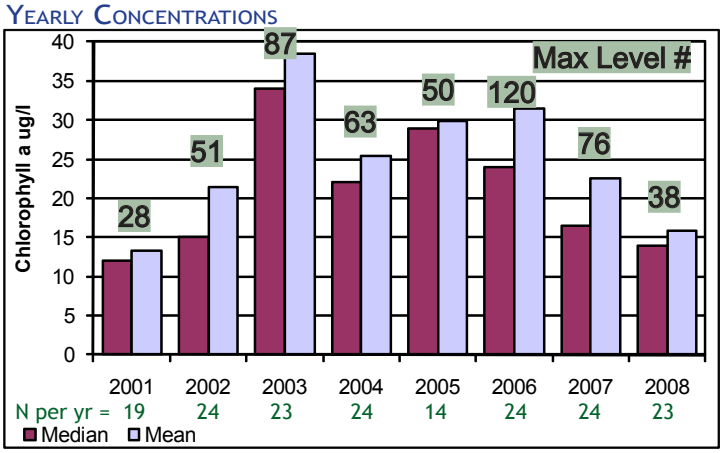


Figure 4-17. Station O865000C Chlorophyll a Yearly Concentrations

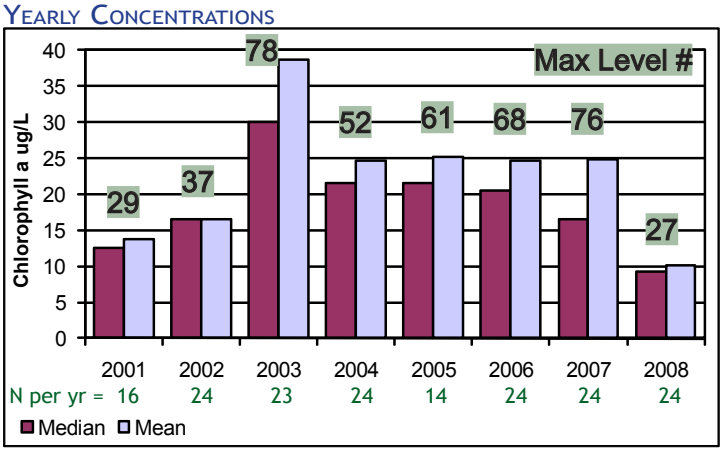
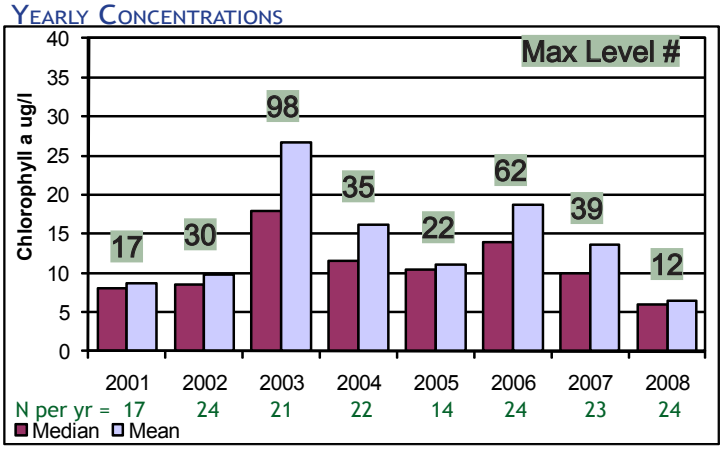


Figure 4-18. Station O982500C Chlorophyll a Yearly Concentrations



Figures 4- 19-24 represent yearly total nitrogen concentrations at selected ambient stations within the Pamlico Estuary. Each graph shows a general increase in total nitrogen over the past decade with total nitrogen concentrations becoming less at stations closer to the sound, which is likely a result of uptake and dilution. The TMDL compliance point is at station O7650000 near Washington where data from 1991 were used for calibration conditions for modeling estuary nutrient conditions. For comparison, 1991 nutrient concentration data at Station O7650000 includes a median total nitrogen level of 1.04 mg/L and a mean of 1.06 mg/L.

Figure 4-19. Station O7650000 Total Nitrogen Yearly Concentrations

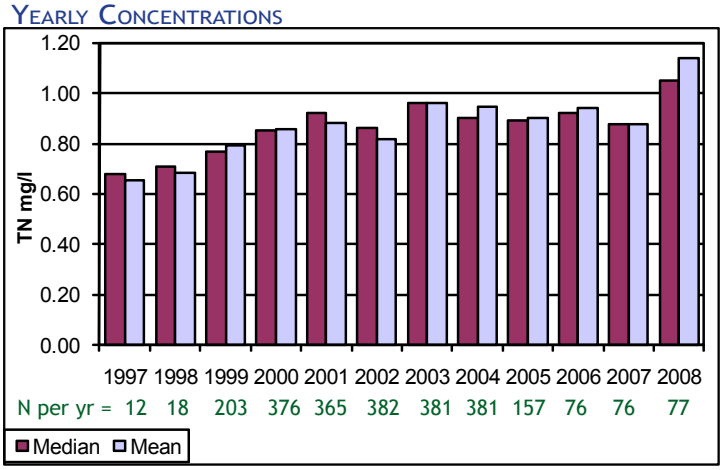


Figure 4-20. Station O7680000 Total Nitrogen Yearly Concentrations

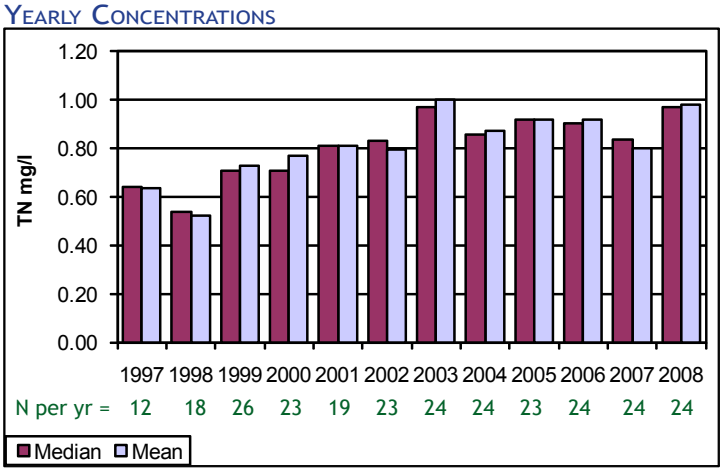


Figure 4-21. Station O787000C Total Nitrogen Yearly Concentrations

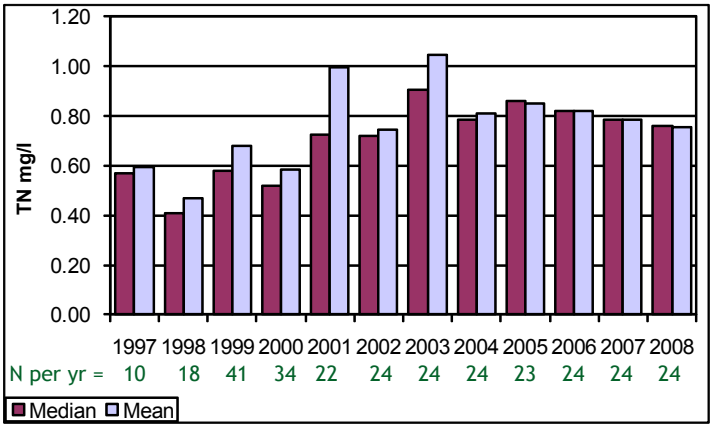


Figure 4-22. Station O8498000 Total Nitrogen Yearly Concentrations

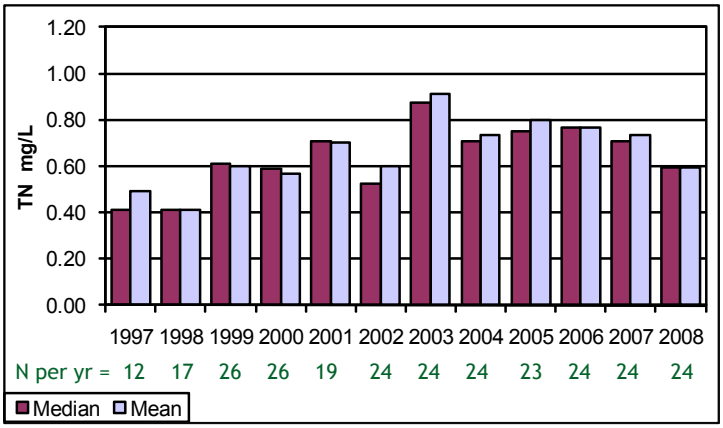


Figure 4-23. Station O865000C Total Nitrogen Yearly Concentrations

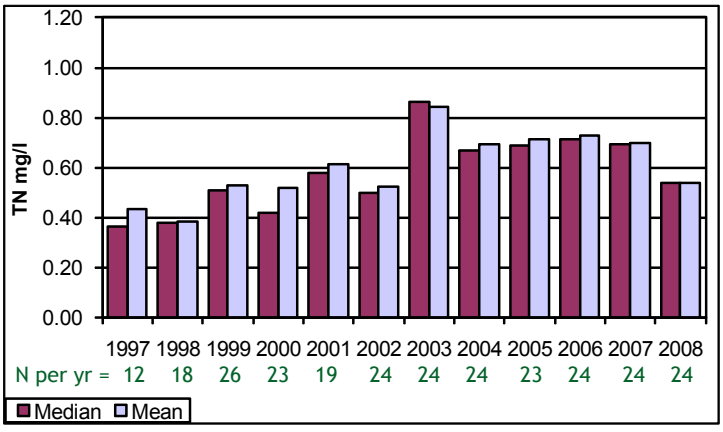
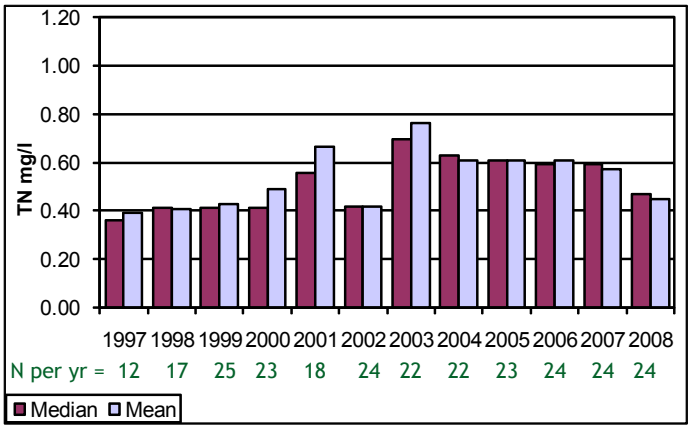


Figure 4-24. Station O982500C Total Nitrogen Yearly Concentrations



Figures 4- 25-30 represent total phosphorus concentrations at ambient stations throughout the Pamlico estuary. With the exception of a few events that likely caused the mean TP to rise, the median TP concentrations have decreased with each station moving progressively further out into the estuary. The TMDL compliance point is at station O7650000 near Washington where data from 1991 were used for calibration conditions for modeling estuary nutrient conditions. For comparison, 1991 nutrient concentration data at Station O7650000 includes a median total phosphorus level of 0.17 mg/L and a mean of 0.16 mg/L.

Figure 4-25. Station O7650000 Total Phosphorus Yearly Concentrations

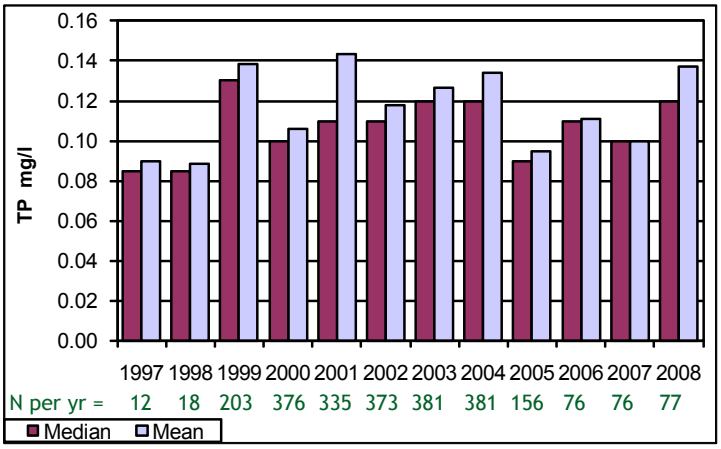


Figure 4-26. Station O7680000 Total Phosphorus Yearly Concentrations

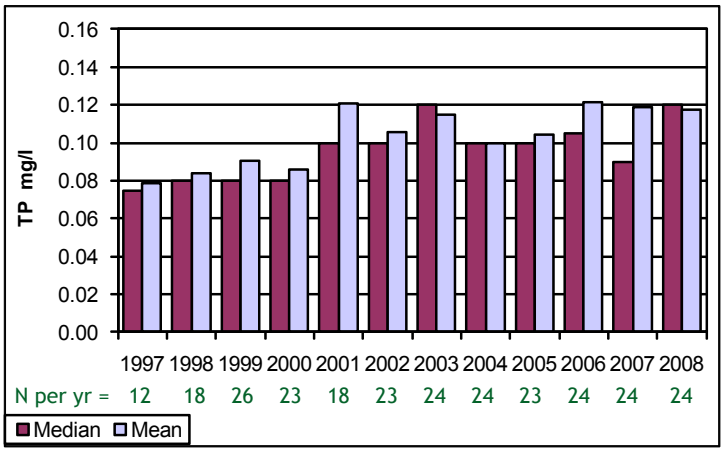


Figure 4-27. Station O787000C Total Phosphorus Yearly Concentrations

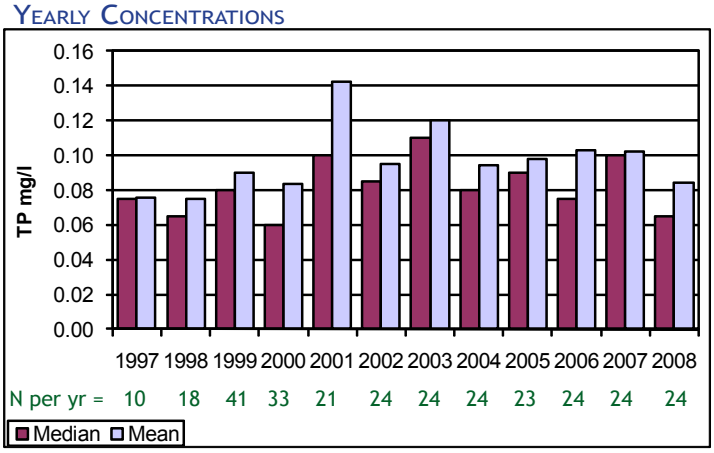


Figure 4-28. Station O8498000 Total Phosphorus Yearly Concentrations

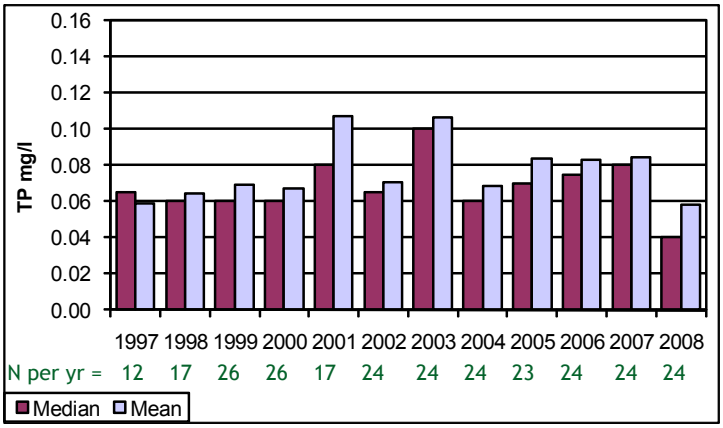


Figure 4-29. Station O865000C Total Phosphorus Yearly Concentrations

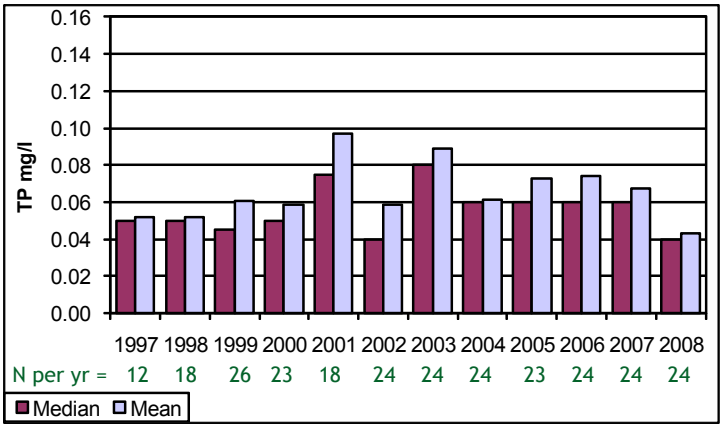
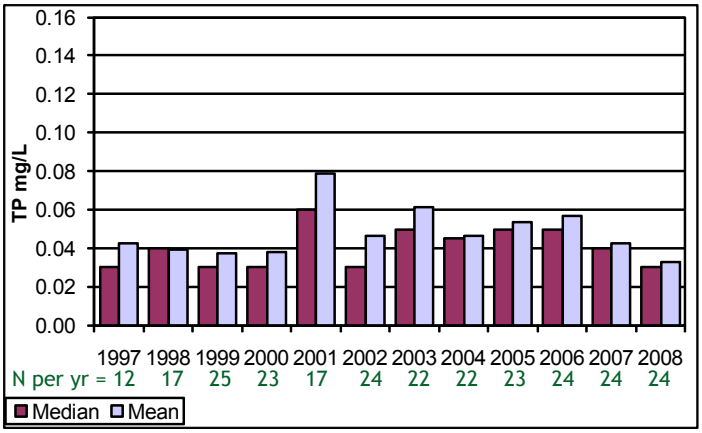


Figure 4-30. Station O982500C Total Phosphorus Yearly Concentrations



Wastewater Dischargers

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States, as authorized by the Clean Water Act. Non-compliance with permit limits on wastewater flow and constituents can lead to discharge of pollutants that degrade surface waters making them unsafe for drinking, fishing, swimming, and other activities. The NPDES Permitting and Compliance Programs of DWQ is responsible for administering the program for the state. These permits are reviewed and are potentially renewed every 5 years. A list of NPDES permits are listed in Table 4-2 and locations on Figure 4-1.

The Federal and State Pretreatment Program gives regulatory authority for EPA, States, and Municipal Governments to control the discharge of industrial wastewater into municipal Wastewater Treatment Plants (WWTPs) or Publicly Owned Treatment Works (POTWs). The objectives of the Pretreatment Program are to prevent pass-through, interference, or other adverse impacts to the POTW, its workers, or the environment; to promote the beneficial reuse of biosolids; and to assure all categorical pretreatment standards are met. There are currently around 700 Significant Industrial Users (SIUs) who discharge industrial wastewater to over 120 POTWs throughout the state of North Carolina. The City of Washington is the only WWTP covered by POTW Pretreatment Program in this subbasin.

Table 4-2 NPDES Discharge Permits in HUC 03020104

Permit #	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0003255	Aurora Mine	Non-Government	Industrial Process & Commercial Wastewater	Major	Pamlico River	0
NC0004057	Carolina Seafood	Non-Government	Industrial Process & Commercial Wastewater	Minor	Muddy Creek	
NC0004081	Aurora Packing Company	Non-Government	Industrial Process & Commercial Wastewater	Minor	South Creek	0.0012
NC0020648*	Washington WWTP	Government - Municipal	Municipal Wastewater Discharge, Large	Major	Tar River	3.65
NC0021521	Aurora WWTP	Government - Municipal	Municipal Wastewater Discharge, < 1MGD	Minor	South Creek	0.12
NC0026492*	Belhaven WWTP	Government - Municipal	Municipal Wastewater Discharge, Large	Major	Battalina Creek	1.0
NC0036919	Pantego Municipal Center WWTP	Government - Municipal	Discharging 100% Domestic < 1MGD	Minor	Pantego Creek	0.006
NC0040584	Pantego Rest Home	Non-Government	Discharging 100% Domestic < 1MGD	Minor	Pantego Creek	0.004
NC0068233	Fairfield WTP	Government - County	Water Plants and Water Conditioning	Minor	Lake Mattamuskeet	0.1
NC0069426	Dowry Creek WWTP	Non-Government	Discharging 100% Domestic < 1MGD	Minor	Pungo River	0.05
NC0077992	Ponzer WTP	Government - County	Water Plants and Water Conditioning	Minor	Pungo Lake Canal	0.108
NC0081191*	Washington WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Pamlico River	0.42
NC0083216	Hughes Street WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Maple Branch	0
NC0083224	Edgewood Drive WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Maple Branch	0
NC0084808	Richland WTP	Government - County	Water Plants and Water Conditioning	Minor	South Creek	0
NC0086584*	Belhaven WTP	Government - Municipal	Water Plants and Water Conditioning	Minor	Pantego Creek	0.22

Permit #	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0087491	Chocowinity/Richland Township WTP	Government - County	Water Plants and Water Conditioning	Minor	Pamlico River	
NC0088072	Sea Safari Ltd	Non-Government	Industrial Process & Commercial Wastewater	Minor	Battalina Creek	
* Indicates Tar-Pamlico Basin Association Permittee Member						

On-Site Wastewater Treatment Systems (Septic Systems)

Wastewater from many households is treated on-site through the use of permitted septic systems instead of being sent to a wastewater treatment facility. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from failing septic systems can contaminate groundwater and surface water. Failing septic systems are health hazards and are considered illegal discharges of wastewater if surface waters are impacted. Information about the proper installation and maintenance of septic tanks can be obtained by contacting the Department of Environmental Health and local county health departments. Local health departments are responsible for ensuring that new systems are sited and constructed properly and an adequate repair area is available. County, town and city planners need to understand the economic and human health ramifications caused by failing septic systems and plan for long-term septic system sustainability.

In 2007, North Carolina Agricultural Research Service completed a report concerning nitrogen contributions from on-site wastewater systems for each river basin. The results for this subbasin based on 1990 census data indicate a population of 26,245 people using 12,429 septic systems resulting in a potential nitrogen loading of 262,449 lbs/yr and nitrogen loading rate of 262 lbs/mi^2/yr. These numbers reflect the total N discharged to the soil from the septic system and does not account for N used because of soil processes and plant uptake. (Pradhan et al. 2007).

Wastewater Residuals (Biosolids)

Residuals, biosolids or treated sludge, are by-products of the wastewater treatment process. After pathogen reduction, vector attraction reductions, and metal limits are met, these residuals are disposed in a manner to protect public health and the environment. Disposal sites include land fills, dedicated residual disposal sites, agricultural land for crops not for human consumption, and distribution to the public for home use. When applied to the land, steps must be taken to assure that residuals are applied at or below agronomic rates based on the soil and crop types present at the disposal site. If these criteria cannot be met, permitted disposal must take place at a dedicated residual disposal site or landfill.

In this subbasin, PCS Phosphate applies residuals on two fields covering 10 acres. A rough estimate of 700 lbs/yr of nitrogen and 900 lbs/yr of phosphorus are applied to these fields. This estimate does not include Class A residuals which are not monitored by DWQ, but are another source of nutrients. For more information about residuals please see DWQ's Aquifer Protection Section: http://portal.ncdenr.org/web/wq/aps/lau.

Non-Discharge

Non-discharge systems have been the preferred alternative to discharge to surface waters for some NSW waterbodies and DWQ requires all new and expanding NPDES permit applicants to provide documentation that considers alternatives to surface waters. Non-discharge wastewater options include spray irrigation, rapid infiltration basins, and drip irrigation systems. Although these systems are operated without a discharge to surface waters, they still require a DWQ permit. The permit insures that treated wastewater is applied to the land at a rate that is protective of groundwater resources, and does not produce ponding or runoff into a waterbody. More information about land application and non-discharge requirements can be found on the

DWQ Aquifer Protection Section Land Application Unit website: http://portal.ncdenr.org/web/wq/aps/lau. Non-discharge permits in this subbasin are listed in Table 4-3.

Run-off and spills are not common at non-discharge facilities. In general, maintaining compliance with permit conditions largely falls back to having a properly managed facility. Aging sewer systems may lead to increased flows from inflow and infiltration or a facility may not be properly prepared to expand as flows increase and the upper limits of a plant's capacity are reached. Non-discharge facilities, just like any other, must properly plan for any elevated flows and take action to ensure that the facility is capable of managing the wastewater.

Groundwater moving into surface water is a mechanism to introduce nutrients into the surface water system in the absence of direct discharges and in NSW systems it is important to be able to better quantify these potential nutrient loads. Some facilities have a groundwater monitoring program to measure compliance with groundwater quality standards. However, it should be noted that a facility can be compliant with groundwater quality requirements while still contributing to the overall nutrient loading of a surface water system. A better understanding of the groundwater/surface water interaction process at non-discharge facilities may help to identify and quantify nutrient loading from these locations.

Table 4-3. Non-Discharge Permits

Facility Name	Permit Type	Permit #	Size
PCS Phosphate Co-Onsite Fac	High-Rate Infiltration	WQ0000889	Major
PCS Phosphate Co-Texasgulf/Co	Wastewater Recycling	WQ0001105	Major
Town of Bath Wastewater Spray Irrigation	Surface Irrigation	WQ0002520	Major
Single Family Residence	Surface Irrigation	WQ0004181	Minor
PCS Phosphate Co-Gypsum 3&4	Wastewater Recycling	WQ0005682	Minor
Acre Station Meat Farm-Huettmann	Surface Irrigation	WQ0010034	Major
E Carolina Council/Boy Scout	Surface Irrigation	WQ0011655	Major
Pamlico River Ferry Terminal	Surface Irrigation	WQ0012696	Minor
Single Family Residence	Surface Irrigation	WQ0015652	Minor
Washington City	Reuse	WQ0019179	Minor
Washington City - Sludge	Land Application of Residual Solids (503)	WQ0001026	Major
Aurora Mine	Land Application of Residual Solids (503)	WQ0004095	Minor
PCS Phosphate-Gypsum Pile 6	Wastewater Recycling	WQ0008570	Major
Single Family Residence	Surface Irrigation	WQ0013969	Minor
Fountain Powerboats Incorporated	Gravity Sewer Extension, Pump Stations, & Pressure Sewer	WQ0020068	Minor
Tree Shade Subdivision	Gravity Sewer Extension, Pump Stations, & Pressure Sewer	WQ0024009	Minor

Riparian Buffers

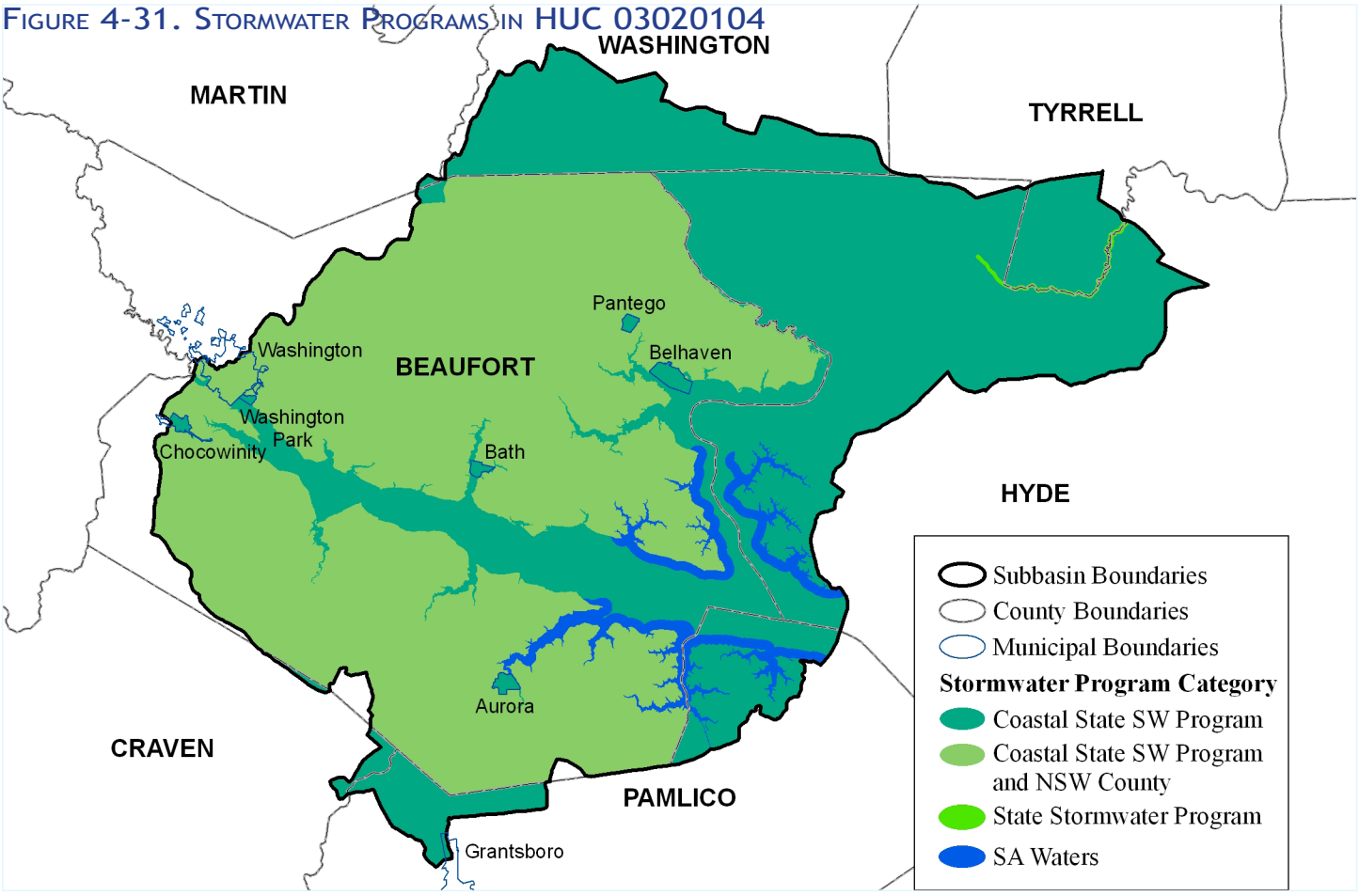
Riparian buffers in the basin are to be protected and maintained on both sides of intermittent and perennial streams, lakes, ponds, and estuarine waters. Tar-Pamlico River Basin Buffer Rules (15A NCAC 2B.0259) do not establish new buffers unless the existing use in the buffer area changes. The footprints of existing uses such as agriculture, buildings, commercial, and other facilities, maintained lawns, utility lines, and on-site wastewater systems are exempt. A total of 50 feet of riparian area is required on each side of waterbodies; within this 50 feet, the first 30 feet is to remain undisturbed and the outer 20 feet must be vegetated. Activities that disturb this buffer require a buffer authorization from DWQ or may require a major variance approval from the Environmental Management Commission. More information about the buffer rules are available at: http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers.

Stormwater

There are several different stormwater programs administered by DWQ. One or more of these programs affects many communities in the Tar-Pamlico River Basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state through the use of stormwater runoff controls. These stormwater control programs include Phase II NPDES and State post-construction, coastal stormwater, HQW/ORW stormwater, Tar-Pamlico River Basin NSW stormwater, and associated with the Water Supply Watershed Program requirements. Figure 4-31 shows the different stormwater programs in this subbasin.

All counties in this subbasin are required to implement the Coastal Stormwater Rules, while Washington and Beaufort County are required to implement Tar-Pamlico NSW stormwater rules. These local programs are to include new development controls to reduce nitrogen runoff by 30 percent compared to pre-development levels and to keep phosphorus inputs from increasing over those pre-development levels. The local programs must also identify and remove illicit discharges; educate developers, businesses, and homeowners; and make efforts toward treating runoff from existing developed areas. As of July 2009, there are 16 general stormwater permits issued in this subbasin.

FIGURE 4-31. STORMWATER PROGRAMS IN HUC 03020104



Central Coastal Plain Capacity Use Area

In 2001, the EMC enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules. These regulations were developed to control groundwater use in the Cretaceous Aquifers in response to decreasing groundwater levels and increasing saltwater intrusion. The CCPCUA rules require groundwater users in impacted areas to reduce their consumption in three phases between 2008 and 2018. In this subbasin Beaufort, Craven, Hyde, Pamlico and Washington counties are within the CCPCUA. More information about the CCPUA is available from Division of Water Resources website: http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/.

Wetland Or Surface Water Disturbance (401 Certification)

The "401" refers to Section 401 of the Clean Water Act. The North Carolina DWQ is the state agency responsible for issuing 401 water quality certifications (WQC). When the state issues a 401 certification this certifies that a given project will not degrade waters of the state or violate State water quality standards. A 401 WQC is required for any federally permitted or licensed activity that may result in a discharge to waters of the U.S. Typically, if the United States Army Corps of Engineers determines that a 404 Permit or Section 10 Permit is required because a proposed project involves impacts to wetlands or surface waters, then a 401 WQC is also required. Locations of 401 WQCs are included on each watershed map. Examples of activities that may require permits include:

- Any disturbance to the stream bed or banks,
- Any disturbance to a wetland,
- The damming of a stream channel to create a pond or lake,
- Placement of any material within a stream, wetland, or open water, including material that is necessary for construction, culvert installation, causeways, road fills, dams, dikes, or artificial islands, property protection, reclamation devices and fill for pipes or utility lines, and
- Temporary impacts including dewatering of dredged material prior to final disposal and temporary fill for access roads, cofferdams, storage, and work areas.

Agriculture

Agriculture is NC's leading industry and is especially strong in the Tar-Pamlico River Basin. Nonpoint source pollution from agriculture is an identified significant source of stream degradation in the Tar-Pamlico River Basin. The approach taken in North Carolina for addressing agriculture's contribution to the nonpoint source water pollution problem is to primarily encourage voluntary participation by the agricultural community. This approach is supported by financial incentives, technical and educational assistance, research, and regulatory programs.

The conversion of agricultural lands to developed lands with impervious surfaces is another potential nonpoint source of pollution. A report by the American Farmland Trust organization identifies this subbasin as having high quality farmland with large areas threatened by development. A map of these areas is available from their website: **http://www.farmland.org/**. Some farmers are protecting their land from development through the Conservation Reserve Enhancement Program (CREP). CREP is a voluntary program utilizing federal and state resources to achieve long-term protection of environmentally sensitive cropland and marginal pastureland. These voluntary protection measures are accomplished through 10-, 15-, 30-year and permanent conservation easements. In this subbasin there are approximately 2,891 acres in easements, of which 76% are in 30 year or permanent easements.

North Carolina Agriculture Cost Share Program

Financial incentives are provided through North Carolina's Agriculture Cost Share Program, administered by DENR's Division of Soil and Water Conservation to protect water quality by installing BMPs on agricultural lands. In the Pamlico River Subbasin $883,682 was spent, between 2003-2008, on BMPs to reduce nonpoint source pollution from agriculture. Approximately, 19,996 acres were affected by BMPs that prevented an estimated 17,940 tons of soil, 240,259 lbs of nitrogen and 130,081 lbs of phosphorous from running off into surface waters. Animal waste BMPs also accounted for better management of an estimated 69,150 lbs of nitrogen and 49,681 lbs of phosphorous.

DWQ's Animal Feeding Operations Unit The Animal Feeding Operations Unit is responsible for the permitting and compliance activities of animal feeding operations across the state. Poultry farms with dry litter waste are not regulated or monitored by DWQ. Table 4-4 summarizes the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight (SSLW) in this subbasin. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in the subbasin.

Animal waste is often stored in lagoons before it is applied to fields. It is a concern that several animal operations in the basin will be abandoned without proper closeout of the lagoons. Numerous environmental hazards exist from these lagoons including: ammonia emissions, overflows into surface waters, and groundwater contamination.

Table 4-4. Animal Operations in HUC 03020104

Type	# of Facilities	# of Animals	SSLW
Animal Individual	2	4,750,000	17,500,000
Swine	15	54,946	15,109,646

*Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service (NRCS) guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

A better understanding of groundwater quality in relation to animal feeding operation locations is needed. Most animal operations are located immediately adjacent to surface water bodies. Groundwater that is moving from beneath a facility into the surface water system may transport significant levels of nutrients. However, lack of groundwater quality data at animal operations hampers quantifying their contributions.

Special Study- Aquaculture

There are many aquaculture farms located in the Eastern portion of North Carolina. They range from small catfish farms to large hybrid striped bass production facilities. Citizen complaints about water quality in creeks (Bond, Muddy, Spring and Campbell Creeks) on the south side of the Pamlico River near Aurora initiated an inquiry by DWQ to find potential pollution sources. As a result, the DWQ Pamlico Response Team was requested to assist the DWQ's Washington Regional Office Surfacewater Protection Section with data collection and quantification of discharge from several hybrid striped bass aquaculture facilities. (Hybrid striped bass farms tend to be larger than other fish farms and can discharge over 30 times a year.) Water quality sample results found that discharges from three hybrid striped bass farms resulted in violation of water quality standards for DO and Chlorophyll *a* in the tributaries receiving fish pond drainage water. (DWQ PRT, 2007). As follow-up to the study, DWQ's Washington Regional Office is working with five hybrid striped bass farms under Special Orders by Consent to eliminate their discharges or require that they obtain permits under the NPDES program. Currently, these farms are covered under a general permit and, up until this study, individual hybrid striped bass farm discharges were not monitored. This situation, however, revealed the need to examine aquaculture discharges to assure the quality of their effluent does not compromise water quality standards in receiving waters. The amount of nutrients entering surface waters from aquaculture facilities is unknown and currently the Agriculture Nutrient Control Strategy does not account for added nutrients from fish farms.

Special Study- Rose Acres

In 2003, DWQ began investigating environmental conditions and permit requirements for a proposed chicken egg laying facility. In 2004, the Rose Acres Chicken Farm was granted a permit (NCA148024) with an animal capacity of no greater than 4,000,000 layers and 750,000 pullets. The waste management system includes waste from 14 high-rise laying houses, 3 pullet houses with manure storage building, 17,849 ft^3 aeration basin, 23,749 ft^3 denitrification basin, a 557,086 ft^3 storage basin, and 17.2 acre wetted land application site. Waste is to be managed according to their Certified Animal Waste Management Plan. DWQ permits the land application of liquid egg wash wastewater on 17.2 acres. The permit requires monthly instream/canal water quality monitoring for NH_3, NO_2-NO_3, TKN, TP, DO, and fecal coliform, pH, temperature and flow. The farm operation includes a composting facility that is permitted by Division of Waste Management (DWM). The composting facility permit includes requirements of an annual report to DWM indicating amount, type, and where the compost is distributed. Nutrient content of the compost is calculated for every 6,000 tons and Rose Acres Farms requires a nutrient management plan from any individual that receives more than 10 tons per visit. The 2009-

2010 annual report indicated over 22 thousand tons of composted Class A chicken litter was distributed in Hyde County. This compost fertilizer is in high demand by other farmers throughout the area and is likely being used instead of inorganic commercial fertilizer, although it is possible that the compost may be being applied at nitrogen application rates which would lead to the over application of phosphorous and vice versa.

The environmental impact of this Concentrated Animal Feeding Operation (CAFO) is currently being evaluated by DWQ and US Fish and Wildlife Service (FWS). DWQ has completed a pre- & post-water quality impact study. DWQ collected nutrient and fecal coliform bacteria samples from January 2005 through August 2006, post chicken occupation sampling started in mid-August 2006 through January 2010, with noted impacts from Evans Road Wildfire during the summer of 2008. The conclusion from 2005-2010 data comparison shows the operating data to be significantly higher then the pre-operating data for ammonia nitrogen, total inorganic nitrogen, total phosphorus, and fecal coliform. Stations near the farm showed a significant difference between pre and post data for ammonia nitrogen and organic nitrogen, while these differences were not detected at the further stations for these parameters. Both near and far stations resulted in significant differences for TP, inorganic nitrogen, nitrites/nitrates and fecal coliform bacteria between pre and post data. A detailed report with results of this study is available by contacting DWQ's Environmental Sciences Section: (919)-743-8400. (DWQ-ESS 5/6/09. "Summary of the Rose Acres Farm Sampling Program" and DWQ-ESS. 6/3/10. "Updated Summary of the Rose Acre Farm Sampling Program").

Due to concerns about atmospheric emissions and the near and far field deposition of ammonia on water quality and to the adjacent Pocosin Lakes National Wildlife Refuge (PLNWR), the FWS initiated an investigation to study the effects of facility emissions and atmospheric deposition in the area. The southern boundary of the PLNWR is located less than 2,000m from the farm operation. The FWS collaborated with several university researchers to develop a weight-of-evidence approach. Their study began in 2005, prior to bird stocking. Wet and dry deposition using several sampling techniques, nutrient bioassays, development of a dry deposition model and additional water quality monitoring are being assessed at this time. A 2009 interim review of the data indicate that the facility is affecting air quality conditions at the PLNWR, particularly near the southern boundary (US Fish and Wildlife Service Memorandum, August 7, 2009).

The preliminary wet depositional data indicate an increasing trend in total nitrogen and ammonium concentrations in rainwater at the closest monitoring station, about 840 meters northeast of the farm. This site captures the seasonal prevailing wind direction in this area, suggesting that as the bird stock increased at the farm so did the concentration of total nitrogen and ammonium in the rainwater overtime at this location. FWS found that the increased concentrations of ammonium in the rainwater was indicative of concentrations at other sampling sites around that state that are influenced by CAFO dominated sources (>2 kg/ha/yr).

The dry depositional data also show an increasing trend overtime with concentrations that are indicative of the presence of local sources of emissions similar to those seen for wet deposition. The early model results indicate a zone of influence with elevated ammonia deposition extending 1.5-2.5 miles into the PLNWR. When the model is complete, it will provide a site-specific air-surface exchange rate and provide estimates of concentrations and dry deposition rates as a function of distance from the facility into the refuge. Based on 1999-2005 wind summary data, the refuge will receive deposition from the farm 53% of the time.

Nutrient enrichment bioassays were performed to assess the effects of an estimated atmospheric depositional rate of nitrogen and/or phosphorus on the phytoplankton productivity of Lake Phelps and the Alligator River. The additional nitrogen and phosphorus contributions resulted in a significant increase in productivity of these two local water sources indicating that local waters in this region are susceptible to farm-based atmospheric nutrient inputs (personal communication

with Dr. Paerl, May 2010 (paper in prep)).

Based on the current preliminary results from the DWQ and FWS study, it appears that this CAFO and others like it in the watershed and airshed are likely contributing to the decline in water quality. As recommended by the hearing officer for the original NPDES permit for the Rose Acres farm, upon completion of these studies it should be determined "if Rose Acres should assist in the development and /or implementation of BMPs to address contributions shown to originate at the proposed facility" (Hearing Officer's Report, 2004. NPDES Permit Application No. NCA148024).

The agricultural Basin Oversight Committee (BOC) was established to oversee the required agricultural nutrient reductions in the Tar-Pamlico basin in response to the NSW strategy. The BOC develops and approves an annual report based on information provided by the Local Advisory Committees (LACs), summarizing local nitrogen and phosphorus loadings and estimated nutrient reductions based on implemented BMPs in the watershed. In 2008, the BOC annual report estimated a 49 % nitrogen loss from the baseline (1991) for Hyde County. Depending on the results of the atmospheric deposition study and the BOC's review of the data it may be recommended that the annual accounting estimates incorporate adjusted N rates from ammonia deposition contributions.

Restoration, Protection & Conservation Planning

Population

The 2000 census estimated population for this subbasin is 39,747. This is expected to increase with the results of the 2010 census. As population increases so does our demand for clean water from aquifer and surface water sources and for the land and water to assimilate wastes. Population estimates for each watershed within this subbasin are listed in Table 4-6.

Table 4-6. Watershed Population Estimates* for HUC 03020104

10-Digit HUC	2000 Population	2000 Population Density (per sq mi)	2010 Estimated Population	2020 Estimated Population	2030 Estimated Population
0302010401	23,906	114	24,751	25,281	25,504
0302010402	5,873	27	6,078	6,206	6,259
0302010403	4,250	25	4,362	4,422	4,430
0302010404	1,098	8	1,061	1,022	975
0302010405	1,200	6	1,161	1,116	1,064
0302010406	2,899	26	2,973	3,013	3,019
0302010407	521	9	527	528	523
03020104	39,747	36	40,913	41,590	41,774

*NC Office of State Budget and Management: http://www.osbm.state.nc.us/

Land Use

Waterfront development and agriculture continue to place increasing demands for achieving water quality and quantity. Table 4-7 lists the percentage of different predominant land cover types within this subbasin based on the 2001 national land cover database.

Local Initiatives & Conservation Planning

Resources & Guides

NCDENR's One North Carolina Naturally initiative promotes and coordinates the long-term conservation of North Carolina's threatened land and water resources. Each DENR division specializes in management of a specific natural resource, while the collaborative coordination and planning process results in cost effective implementation and management of multiple resources. Natural resource planning and conservation provides the science and incentives to inform and support conservation actions of North Carolina's conservation agencies and organizations. The Conservation Planning Tool was developed to assist in building partnerships through the exchange of conservation information and opportunities, support stewardship of working farms and forests, inform conservation actions of agencies and organizations, and guide compatible land use planning. A link to the interactive map view is found here: http://www.conservision-nc.net/.

Table 4-7. Land Cover Percentages in HUC 03020104

Land Cover Type	Percent
Developed Open Space	3.61
Developed Low Intensity	0.60
Developed Medium Intensity	0.12
Developed High Intensity	0.02
Total Developed	4.34
Bare Earth Transition	0.88
Deciduous Forest	3.45
Evergreen Forest	18.43
Mixed Forest	2.23
Total non-Wetland Forest	24.10
Scrub Shrub	4.69
Grassland Herbaceous	7.81
Pasture Hay	0.62
Cultivated Crops	26.20
Total Agriculture	26.82
Woody Wetlands	27.05
Emergent Herbaceous Wetland	4.30
Total Wetlands	31.35

Conservation planning is important on a local level to protect natural resources that provide recreational, aesthetic, and economic assets important to community sustainability and growth. The NC Wildlife Resources Commission developed a Green Growth Toolbox to assist towns and cities to grow in nature-friendly ways: http://www.ncwildlife.org/greengrowth/. The tools provide assistance with using conservation data, green planning, green ordinances and green development and site design. Also, a guide to help local governments protect aquatic ecosystems while streamlining environmental review is available here: http://www.ncwildlife.org/planningforgrowth/swimming_with_the_current.pdf.

Land conservation, accompanied with stream restoration projects, can be very successful at protecting water quality. Prevention and protection activities are known to be more cost effective than retrofits and restoration. DWQ strongly encourages conservation in this watershed. Local land trusts can help landowners explore conservation options and identify potential funding sources. For more information about land trusts in North Carolina see the Conservation Trust for North Carolina at: http://www.ctnc.org/. With the assistance of land conservancies, local governments, and several state and federal agencies ~82,816 acres are protected within this subbasin.

Erosion and Sedimentation Control

The Sedimentation Control Commission was created to administer the Sedimentation Control Program pursuant to the N.C. Sedimentation Pollution Control Act of 1973. It is charged with adopting rules, setting standards, and providing guidance for implementation of the Act. The Division of Land Resources (DLR) is the primary agency responsible for managing land disturbing activities that have the potential to violate the Sedimentation Pollution Control Act. For those land disturbing activities, an Erosion and Sedimentation Control Plan must be approved by DLR prior to land disturbing activities. Due to the large number of land disturbing activities and the limited number of DLR staff available to do inspections, cities and counties have been encouraged to adopt a local erosion and sediment control ordinance in compliance with State requirements. The Sedimentation Control Commission can then delegate the local government authority to administer the erosion and sedimentation control program within its jurisdiction. The

local programs' staff then performs plan reviews and enforces compliance with plans within their jurisdictions.

Construction Grants and Loans

The Construction Grants and Loans (CG&L) Section of DWQ provides grants and loans to local government agencies for the construction, upgrades, and expansion of wastewater collection and treatment systems. As a financial resource, the Section administers five major programs that assist local governments. Of these, two are federally funded programs administered by the state, the Clean Water State Revolving Fund (SRF) Program and the State and Tribal Assistance Grants (STAG). The STAG is a direct congressional appropriation for a specific "special needs" projects within NC. The High Unit Cost Grant Program, the State Emergency Loan (SEL) Program and the State Revolving Loan (SRL) Program are state funded programs, with the later two being below market revolving loan money. The Section also received an additional Capitalization Grant authorized by the American Recovery and Reinvestment Act of 2009 in the amount of $70,729,100. These funds are administered according to existing SRF procedures. All projects (Table 4-8) must be eligible under Title VI of the Clean Water Act. For more information please see the CG&L webpage at: **http://portal.ncdenr.org/web/wq/cgls**.

Table 4-8. CG&L Projects

Location	Project Description	Date	~Amount
Washington	WWTP flow increase from 3.2 to 3.65 & Reuse	12/10/2001	$3,000,000
Washington	WWTP expansion phase II	11/17/2003	$2,986,000

Section 319-Grant Program

The Section 319 Grant Program was established to provide funding for efforts to reduce nonpoint source (NPS) pollution, including that which occurs though stormwater runoff. The EPA provides funds to state and tribal agencies, which are then allocated via a competitive grant process to organizations to address current or potential NPS concerns. Each fiscal year NC is awarded nearly 3 million dollars to address NPS pollution through its 319 Grant Program. Thirty percent of the funding supports ongoing state nonpoint source programs. The remaining 70 percent is made available through a competitive grants process. More information can be found about these contracts and the 319 Grant Program at their website: **http://portal.ncdenr.org/web/wq/ps/nps/319program**.

Clean Water Management Trust Fund

Created in 1996, the Clean Water Management Trust Fund (CWMTF) makes grants to local governments, state agencies, and conservation non-profits to help finance projects that specifically address water pollution problems. The fund has made several investments in the Pamlico River Subbasin. Table 4-9 includes a list of recent projects and their cost.

Table 4-9. CWMTF Projects

Application ID	Proposed Project Description	Amount Funded	County
2002B-601 Beaufort Co. Water District V - Septic Systems/Pantego Cr.	Design, permit and construct a new wastewater collection system to connect 200 existing properties with failing septic tanks or straight pipes that drain to Pantego Creek. Route waste to the Belhaven WWTP for treatment.	$350,000	Beaufort
2003A-026 NC Coastal Land Trust - Acq./ Weyerhaeuser Tract, Nevill's Creek	Acquire through fee simple purchase 126 acres along Nevils Creek.	$489,000	Beaufort

Application ID	Proposed Project Description	Amount Funded	County
2004D-004 Pamlico-Tar River Foundation - Donated Minigrant/ Allan Tract, Blounts Bay	Minigrant to pay for transactional costs for a donated permanent conservation easement on 5.2 acres along the Pamlico River.	$16,000	Beaufort
2006B-040 Washington, City of - Acq/ Barger Tract, Pamlico River	Protect through fee simple purchase & donation of a conservation easement 220 wetland acres, along unnamed tributaries to the Tar River. Will aid in protection of an exceptional wetland and tract will become the Tar River Nature Park.	$60,000	Beaufort
2006B-601 Beaufort County - Septic/ Terra Ceia School, Broad Creek	Design, permit & construct a collection system to transport wastewater from a school's failing septic system, 10 residences and 1 commercial facility to Belhaven's WWTP for treatment. Reduces pollutant delivery to Pantego (303d) & Broad Creeks.	$107,000	Beaufort
2007-601 Beaufort County - Septic/ Autumnfield Assisted Living Center, Broad Creek	Design and permit infrastructure to transport wastewater from a business with failing septic system, to Belhaven WWTP to improve water quality in Broad Cr and Pantego Cr.	$28,000	Beaufort
2008-502 Bath, Town of - WW/ Spray Field Upgrades, Bath Creek	Design and permit package treatment plant to treat to reclaimed standards, and other improvements at WWTP to improve effluent quality, reduce ponding on disposal field and reduce pollutant loading in Carter Cr and Back Cr.	$117,000	Beaufort

Recommendations

- Identify sources of organic nitrogen that could be contributing to the increase in basinwide TKN concentrations. Basinwide, the ammonia component of TKN shows a decrease in concentration since 1991.

- Determine the amount of nutrients being recycled within the estuary that are contributing to algal productivity within the estuary.

- More research is needed to understand the amount of nutrients entering the Tar River and its tributaries through baseflow and how this contribution can be managed. The NSW strategy targets point and some nonpoint source nutrient contributions to surface waters. However, some nonpoint sources are not specifically addressed in the strategy. Nutrients from non-discharge spray field systems, wastewater residual applications, septic systems and tiled agriculture may all be contributing to nutrient loads in surface waters via groundwater.

- As recommended by the hearing officer for the original NPDES permit for the Rose Acres farm, upon completion of the water quality and atmospheric deposition study it should be determined “if Rose Acres should assist in the development and /or implementation of BMPs to address contributions shown to originate at the proposed facility”. Given the requirements of the agricultural rule, it is recommended that the Local Advisory Committee account for added nutrients contributed by Rose Acres Farm as a whole, including contributions from atmospheric deposition once the FWS ammonia deposition model is complete.

- Recommend DWQ Washington Regional Office continue follow-up actions on Hybrid Striped Bass Farms to improve their effluent quality and better quantify its impact to the Estuary. If warranted, include fish farms nutrient contributions in the Basin’s accounting of progress towards meeting nutrient reduction goals.

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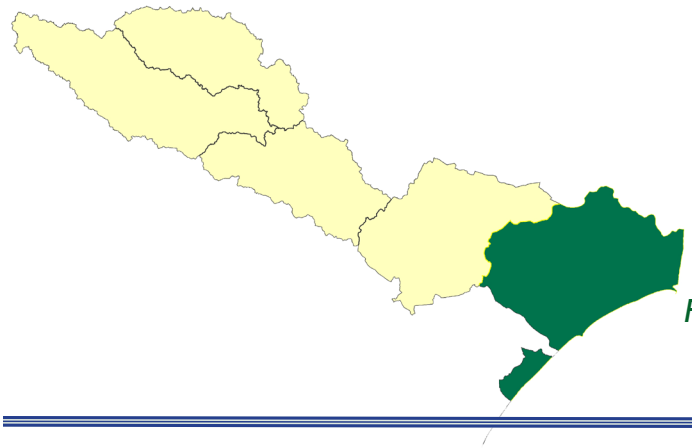


Pamlico Sound

Subbasin HUC 03020105

From the Pamlico Estuary to the Outer Banks

Water Quality Overview: Water quality concerns in this subbasin are focused on shellfish harvesting and recreational uses. A majority of the Impaired water for shellfish harvesting occur in prohibited shellfish growing areas and are not based on collected fecal coliform data. Swanquarter Bay is the only recreationally Impaired area due to enterococcus data. It is important to check current water quality conditions provided by the Division of Environmental Health before swimming or shellfish harvesting in these areas.

General Description

The Pamlico River Subbasin encompasses 1,683 square miles. The predominant land cover is forest and wetland, with some cultivated cropland. With the exception of the Outer Banks, this subbasin is one of the most rural on the coast. Lake Mattamuskeet and the Swanquarter National Wildlife Refuges cover large areas in this subbasin. The subbasin is outlined in Figure 5-1.

There are six NPDES wastewater discharge permits in this subbasin with a total permitted flow of 1.02 million gallons/day (MGD).

Watershed at a Glance

Counties: Hyde, Dare, Carteret, Pamlico

Towns: Swanquarter, Engelhard, Avon, Buxton, Frisco, Hatteras, Ocracoke, Atlantic, Sealevel, Stacy

Permitted Facilities:

NPDES WWTP: 6
Non-discharge:.....8
Stormwater:
General:.....5

2000 Population: 36,680

Area: 1,683 sq mi.

Current Status and Significant Issues

Use Support Assessment Summary

All surface waters in the state are assigned a classification reflecting the best-intended use of that water. To determine how well waterbodies are meeting their best-intended uses chemical, physical, and biological parameters are regularly assessed by DWQ. These data are used to develop use support ratings every two years as reported to EPA; a collected list of all monitored waterbodies and their water quality rating is called the Integrated Report (IR) and Impaired waters are also reported on the 303(d) list. Water quality evaluation levels and how a waterbody earns a rating of Supporting or Impaired is explained in

Primary Classifications found in HUC 03020105:

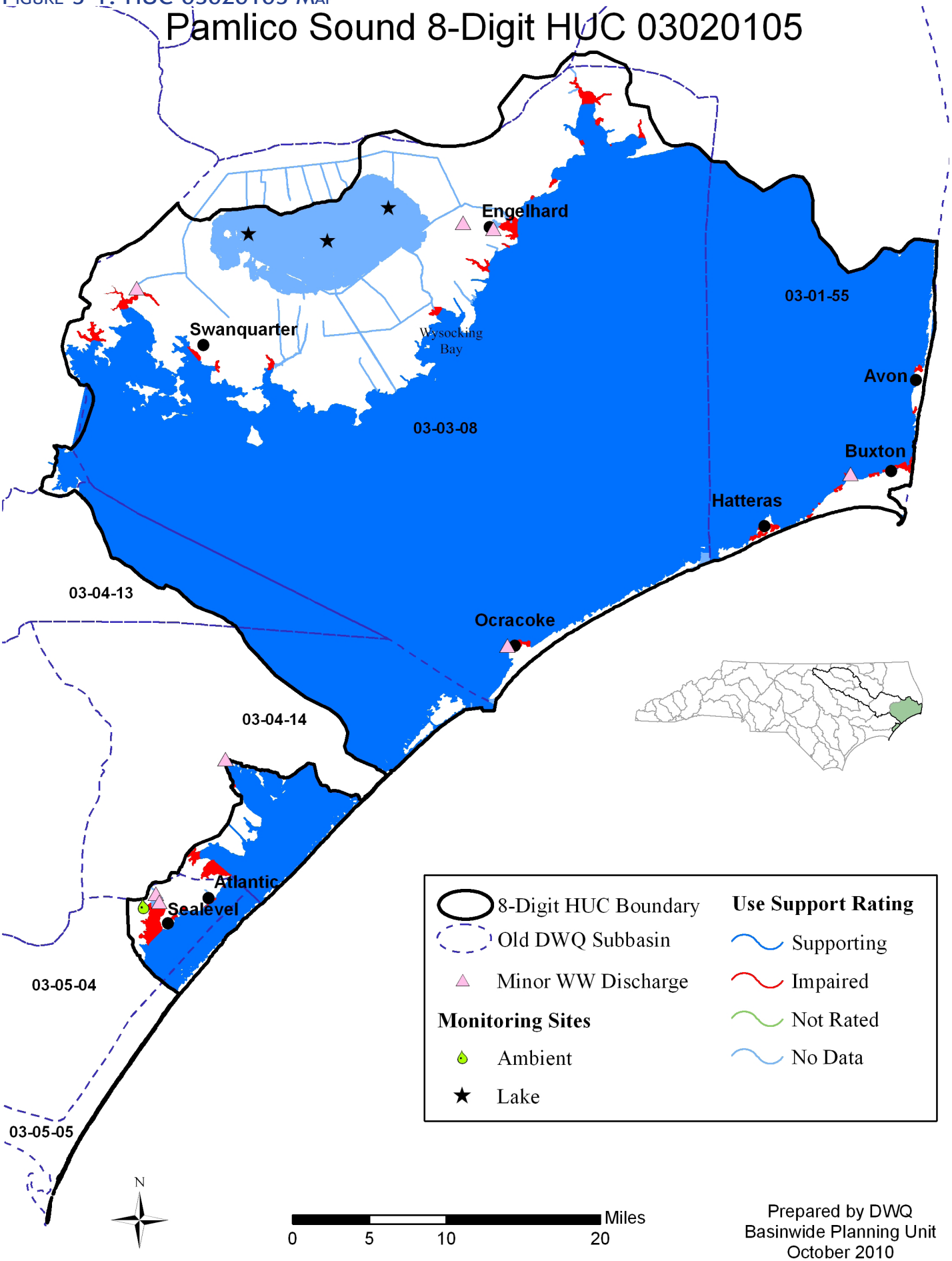
Saltwater	Acres	Freshwater	Miles	Coast	Miles
Total	549,036	Total	14	Total	17

Supplemental Classifications:

SA;HQW.....	484,075	C;Sw.....	13	SB.....	17
SA;ORW.....	24,125	C;Sw,HQW....	1		
SC.....	40,648				
SC;HQW.....	135				
SC;ORW.....	54				

Classification descriptions are found at: http://h2o.enr.state.nc.us/csu/index.html

FIGURE 5-1. HUC 03020105 MAP



detail in the IR methodology. The 2010 (IR) is based on data collected between 2004 and 2008. The most current use support ratings for this subbasin are in Appendix 5A.

In this subbasin, use support was assigned for aquatic life, recreation, shellfish harvesting, fish consumption and water supply categories. Waters are Supporting, Not Rated, or No Data in the aquatic life and recreation categories on a monitored or evaluated basis. All waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the **Department of Health and Human Services** (DHHS). All waters are Supporting in the water supply category on an evaluated basis based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants. Appendix 5A provides a list of waterbodies in this subbasin and their most recent use support rating if monitored.

Recreation

Recreation uses in tidal saltwaters are rated based on NC's Enterococcus standard which requires a geometric mean of < 35 enterococci per 100 ml based upon a minimum of five samples within any consecutive 30 days. Enterococci are a subgroup of the fecal streptococcus group which generally occur in the digestive systems of humans and other warm-blooded animals along with fecal coliform bacteria. According to the EPA, Enterococci bacteria are better able to survive in salt water and, thus, more closely mimic other pathogens than do the fecal coliform bacteria.

Enterococcus samples are collected by the N.C. Recreational Water Quality Program (NCRWQP) within the Division of Environmental Health and not by DWQ. Their sampling results and current swimming advisories are available at: **http://www.deh.enr.state.nc.us/shellfish/Water_Monitoring/RWQweb/home.htm**.

There are 17 coast miles of water classified for primary recreation (SB) in this subbasin. This area from Ocracoke Inlet to Hatteras Inlet is considered Supporting for recreational uses. However, Swanquarter Bay (136 acres), which is not classified for primary recreation, is considered Impaired for recreation based on recreational advisory posting.

The NCRWQP tests recreational beaches during the swimming season beginning on April 1st and ends October 31. All ocean beaches and high-use sound-side beaches (Tier 1) are tested weekly during the swimming season. Lower-use beaches (Tier II and Tier III) are tested twice a month. All sites are tested twice a month in October and monthly from November through March. The NCRWQP currently uses a running geometric mean and single sample test to determine compliance with their rules (15A NCAC 18A .3402): (a) The Enterococcus level in a Tier I swimming area shall not exceed either: (1) A geometric mean of 35 enterococci per 100 milliliter of water, that includes a minimum of at least five samples collected within 30 days; or (2) A single sample of 104 enterococci per 100 milliliter of water. (b) The enterococci level in a Tier II swimming area shall not exceed a single sample of 276 enterococci per 100 milliliter of water. (c) The enterococcus level in a Tier III swimming area shall not exceed two consecutive samples of 500 enterococci per 100 milliliter of water.

Shellfish Harvesting Water

There are 519,897 acres classified as shellfish harvesting waters (SA;HQW), of which 2,419 acres (<1%) are Impaired because of potential fecal coliform bacteria contamination. Specific Impaired waterbodies are listed in Appendix 5A. The Shellfish Sanitation and Recreational Water Quality Section of the Division of Environmental Health (DEH) is responsible for monitoring and classifying coastal waters as to their suitability for shellfish harvesting for human consumption, and inspection and certification of shellfish and crustacea processing plants. Figure 5-2 is a map of DEH shellfish growing areas.

The Shellfish Sanitation Program is conducted in accordance with the guidelines set by the Interstate Shellfish Sanitation Conference contained in the National Shellfish Sanitation Program

(NSSP) Guide for the Control of Molluscan Shellfish Model Ordinance. Classifications of coastal waters for shellfish harvesting are done by means of a Sanitary Survey, which includes: a shoreline survey of sources of pollution, a hydrographic and meteorological survey, and a bacteriological survey of growing waters. Sanitary Surveys are conducted for all potential shellfish areas in coastal North Carolina and recommendations are made to the Division of Marine Fisheries of which areas should be closed for shellfish harvesting. Detailed maps are available from the DEH website showing current shellfish growing areas: http://www.deh.enr.state.nc.us/shellfish/maps.htm.

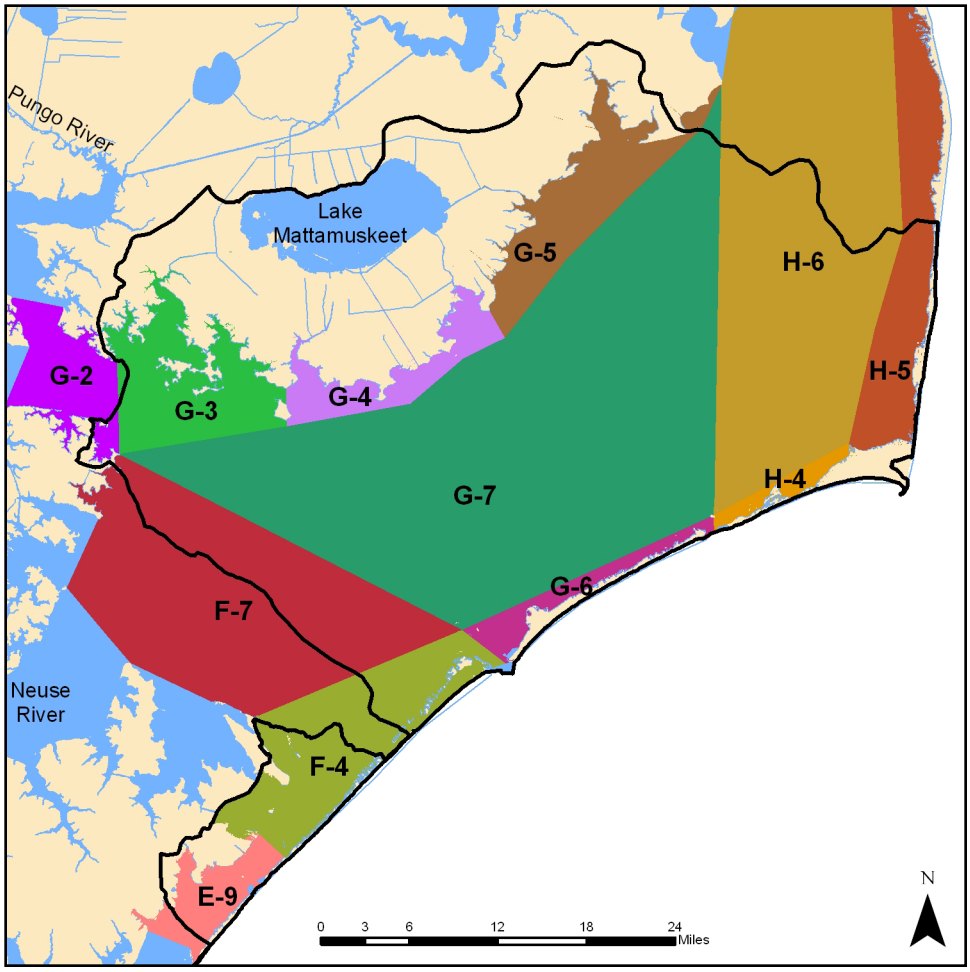
DWQ uses DEH classifications to assign use support ratings for the shellfish harvesting category. By definition, Conditionally Approved-Open areas are areas that DEH has determined do not, or likely do not, meet water quality standards and these areas are rated Impaired, along with Conditionally Approved-Closed and Prohibited or Restricted areas. Only DEH Approved growing areas are rated as Supporting.

This subbasin contains 11 DEH shellfish growing areas including: G-3, G-4, G-5, G-6, G-7, F-4, F-7, E-9, H-4, H-5, & H-6 as shown in Figure 5-2. The following summaries are from the most current and available DEH Shellfish Sanitation Sanitary Surveys. Note, not all growing areas are surveyed by DEH.

According to the Sanitary Survey of Outer Banks, Area H-5, bacteriological water quality has declined in some areas. As a result of the 2006, survey approximately 15 acres are closed to shellfish harvesting in Askins Creek. However, 120 acres of the Cape Creek Area have opened for shellfish harvesting. Area H-5 includes 66,800 acres and oyster and clam production is considered fair. The survey area is characterized by three small-populated areas separated by miles of uninhabited dunes and marshes. The permanent population is estimated at 2,400 while seasonal tourism increases population to 40,000. Several hurricanes impacted this area during this last Sanitary Survey resulting in debris from destroyed houses, fuel tanks and vehicles being washed into the waterways. Most of the area is within Cape Hatteras National Seashore and will never be developed.

The Long Shoal River, Area G-5, 2006 Survey indicates no improvement in overall bacteriological water quality. The land use in the area primarily is forested, agriculture row crops, several non-operational hog farms with lagoons, wildlife refuge, and the largest town is Englehard. Water movement in the area is influenced by wind, and wind is considered

FIGURE 5-2. SHELLFISH GROWING AREAS IN HUC 03020105



the major distributor of pollution. Sampling results indicated a decline in bacteriological water quality in Far Creek and Middletown Creek, while several stations had slight improvements since the 2002 triennial survey.

According to the Sanitary Survey of Hatteras Area, Area H-4, an overall decline in bacteriological water quality has occurred. As a result of the 2007 survey an additional 4.5 acres will be reclassified from Approved to Prohibited for shellfish harvesting. The area covers 5,800 acres, of which 229.5 acres are closed for shellfish harvesting. Oyster production is considered poor and clam production is poor. Samples taken near an area referred to as Little Ditch, showed extremely high bacteria counts, but no major pollution sources were noted. Area H-4 is located along the Outer Banks at the western end of Hatteras Island where tourism is the main industry. Hatteras Village has an approximate population of 1,700 with an increase to 6,000 during peak tourist months; the town of Frisco has approximately 700 permanent residents, increasing seaonally to 5,000. There is no central WWTP within this area and all residences and businesses utilize conventional septic systems. Many of the septic systems are old and are installed in fill or coarse sand, allowing possible discharge to adjacent water via groundwater.

The 2006 Sanitary Survey of the Ocracoke, Area G-6 reports improved bacteriological water quality in the Horsepen Point area and in Silver Lake. Area G-6 is composed of waters adjacent to Ocracoke Island from Shell Island to Hatteras Inlet. The population center of this area is in Ocracoke village, with an estimated permanent population of 790, rising to ~4,500 during the summer. Rainfall is known to have little effect on water quality as the entire area has good tidal movement and high salinity. Bacteriological water quality data collected by DEH resulted in the recommendation of opening shellfish harvesting in the Horsepen Point area; however, Silver Lake will remain closed due to the presence of marinas and other pollution sources.

Cedar Island, Area F-4, consists of the waters of Thorofare Bay, Cedar Island Bay, Back Bay, eastern Core Sound, and the southern portion of Pamlico Sound. There are approximately 300 square miles of water and marshland in this isolated and remote area. The eastern boundary of Area F-4 consists of a chain of uninhabited barrier islands, of which Portsmouth is the most notable. The area has in the past been one of the better oyster producing regions of the state and clam production continues to be good. While the area is predominantly marsh and open water, the communities of Cedar Island and Lola are also located in F-4. The permanent population of this area is just over 300, and little to no population growth can be expected in the future. Quality Seafood maintains a small boat basin adjacent to their fish house, with eight total slips. Runoff from this facility drains to the boat basin and therefore it was recommended that this basin be closed for shellfish harvesting. Both domestic and wild animals are considered to have minor impacts to water quality in this growing area.

Growing Area E-9 is the portion of Core Sound from Hall Point near Atlantic to Oyster Creek and includes Styron Bay, Nelson Bay, Brett Bay, and Oyster Creek. The area is a productive shellfish harvest area for both clams and oysters. The watershed of this area is rural in nature and has experienced little development in recent years, although interest has increased recently in developing the waterfront areas. The area consists mostly of woodland, farmland and marshland. Bacteriological water quality in the majority of Area E-9 is excellent, especially during dry periods. The population has changed very little in recent years and is concentrated mainly around the communities of Atlantic and Sea Level. Drainage from these communities is largely facilitated by a system of ditches running between properties and along roads, and all of these ditches eventually drain into the surrounding creeks and sounds. Overall, stormwater runoff is likely the single largest contributor to water quality degradation in the E-9 area. After periods of heavy rainfall, increases in fecal coliform counts are seen in the Nelson Bay section and in Oyster Creek.

Oyster Restoration

North Carolina Estuary Habitat Restoration project was funded under the American Recovery and Reinvestment Act of 2009. This project aims to create and restore 49 acres of oyster reefs off the inland coast of Hatteras Island. A further goal of the project is documenting the synergistic benefits to other fisheries in the areas around created reefs. The project was approved for $5 million in funds to be managed by the North Carolina Coastal Federation.

Permit Programs

Wastewater Dischargers

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States, as authorized by the Clean Water Act. Non-compliance with permit limits on wastewater flow and constituents can lead to discharge of pollutants that degrade surface waters making them unsafe for drinking, fishing, swimming, and other activities. The NPDES Permitting and Compliance Programs of DWQ is responsible for administering the program for the state. These permits are reviewed and are potentially renewed every 5 years. A list of NPDES permits are listed in Table 5-1 and locations on Figure 5-1.

Table 5-1. NPDES Discharge Permits in HUC 03020105

Permit #	Facility Name	Owner Type	Permit Type	Class	Receiving Stream	Permit Flow MGD
NC0000744	Captain Charlie's Seafood Inc	Non-Gov't	Industrial Process & Commercial Wastewater	Minor	Far Creek	
NC0041530	Ocracoke Reverse Osmosis WTP	Non-Gov't	Water Plants and Water Conditioning	Minor	Pamlico Sound	0.45
NC0070211	Rose Bay Oyster Company	Non-Gov't	Industrial Process & Commercial Wastewater	Minor	Rose Bay Creek	
NC0076571	Gullrock Seafood	Non-Gov't	Industrial Process & Commercial Wastewater	Minor	Gray Ditch	0.005
NC0085707	Cape Hatteras Reverse Osmosis WTP	Non-Gov't	Water Plants and Water Conditioning	Minor	Pamlico Sound	1.8
NC0088668	Engelhard WTP	Gov't - County	Water Plants and Water Conditioning	Minor		0.11

On-Site Wastewater Treatment Systems (Septic Systems)

Wastewater from many households is treated on-site through the use of permitted septic systems instead of being sent to a wastewater treatment facility. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from failing septic systems can contaminate groundwater and surface water. Failing septic systems are health hazards and are considered illegal discharges of wastewater if surface waters are impacted. Information about the proper installation and maintenance of septic tanks can be obtained by contacting the Department of Environmental Health and local county health departments. Local health departments are responsible with ensuring that new systems are sited and constructed properly and an adequate repair area is available. County, town and city planners need to understand the economic and human health ramifications caused by failing septic systems and plan for long-term septic system sustainability.

In 2007, North Carolina Agricultural Research Service completed a report concerning nitrogen contributions from on-site wastewater systems for each river basin. The results for this subbasin

based on 1990 census data indicate a population of 3,763 people using 2,067 septic systems resulting in a nitrogen loading of 37,628 lbs/yr and nitrogen loading rate of 105 lbs/mi^2/yr. (Pradhan et al. 2007).

Non-Discharge

Non-discharge systems have been the preferred alternative to discharge to surface waters for some NSW waterbodies and DWQ requires all new and expanding NPDES permit applicants to provide documentation that considers alternatives to surface waters. Non-discharge wastewater disposal options include spray irrigation, rapid infiltration basins, and drip irrigation systems. Although these systems are operated without a discharge to surface waters, they still require a DWQ permit. The permit insures that treated wastewater is applied to the land at a rate that is protective of groundwater resources, and does not produce ponding or runoff into a waterbody. More information about land application and non-discharge requirements can be found on the DWQ Aquifer Protection Section Land Application Unit website: http://portal.ncdenr.org/web/wq/aps/lau. Non-discharge permits in this subbasin are listed in Table 5-1.

Run-off and spills are not common at non-discharge facilities. In general, maintaining compliance with permit conditions largely falls back to having a properly managed facility. Aging sewer systems may lead to increased flows from inflow and infiltration or a facility may not be properly prepared to expand as flows increase and the upper limits of a plant's capacity is reached. Non-discharge facilities, just like any other, must properly plan for any elevated flows and take action to ensure that the facility is capable of managing the wastewater.

Groundwater moving into surface water is a mechanism to introduce nutrients into the surface water system in the absence of direct discharges and in NSW systems it is important to be able to better quantify these potential nutrient loads. Some facilities have a groundwater monitoring program to measure compliance with groundwater quality standards. However, it should be noted that a facility can be compliant with groundwater quality requirements while still contributing to the overall nutrient loading of a surface water system. A better understanding of the groundwater/surface water interaction process at non-discharge facilities may help identify to quantify nutrient loading from these locations .

Table 5-1. Non-Discharge Permits in HUC 03020105

Facility Name	Permit Type	Permit #	Size
Kinnakeet Shores	Reuse	WQ0002284	Major
Enlisted Mens Barracks - Atlantic Airfield WW	Surface Irrigation	WQ0005233	Minor
Hyde Co Boe-Mattamuskeet Imp	Surface Irrigation	WQ0006131	Minor
NC Prison Facility at Piney Woods	Surface Irrigation	WQ0008489	Major
Single Family Residence	Surface Irrigation	WQ0015234	Minor
Kinnakeet Shores	Gravity Sewer Extension, Pump Stations, & Pressure Sewer	WQ0017527	Minor
Engelhard Sanitary District	Surface Irrigation	WQ0017625	Major
Cape Hatteras Landing	High-Rate Infiltration	WQ0031064	Major

Wetland Or Surface Water Disturbance (401 Certification)

The "401" refers to Section 401 of the Clean Water Act. The North Carolina DWQ is the state agency responsible for issuing 401 water quality certifications (WQC). When the state issues a 401 certification, this certifies that a given project will not degrade waters of the state or violate State water quality standards. A 401 WQC is required for any federally permitted or licensed activity that may result in a discharge to waters of the U.S. Typically, if the United States Army Corps of Engineers determines that a 404 Permit or Section 10 Permit is required because a proposed project involves impacts to wetlands or surface waters, then a 401 WQC is also

required. Locations of 401 WQCs are included on each watershed map. Examples of activities that may require permits include:

- Any disturbance to the stream bed or banks,
- Any disturbance to a wetland,
- The damming of a stream channel to create a pond or lake,
- Placement of any material within a stream, wetland or open water, including material that is necessary for construction, culvert installation, causeways, road fills, dams, dikes, or artificial islands, property protection, reclamation devices and fill for pipes or utility lines, and
- Temporary impacts including dewatering of dredged material prior to final disposal and temporary fill for access roads, cofferdams, storage and work areas.

Riparian Buffers

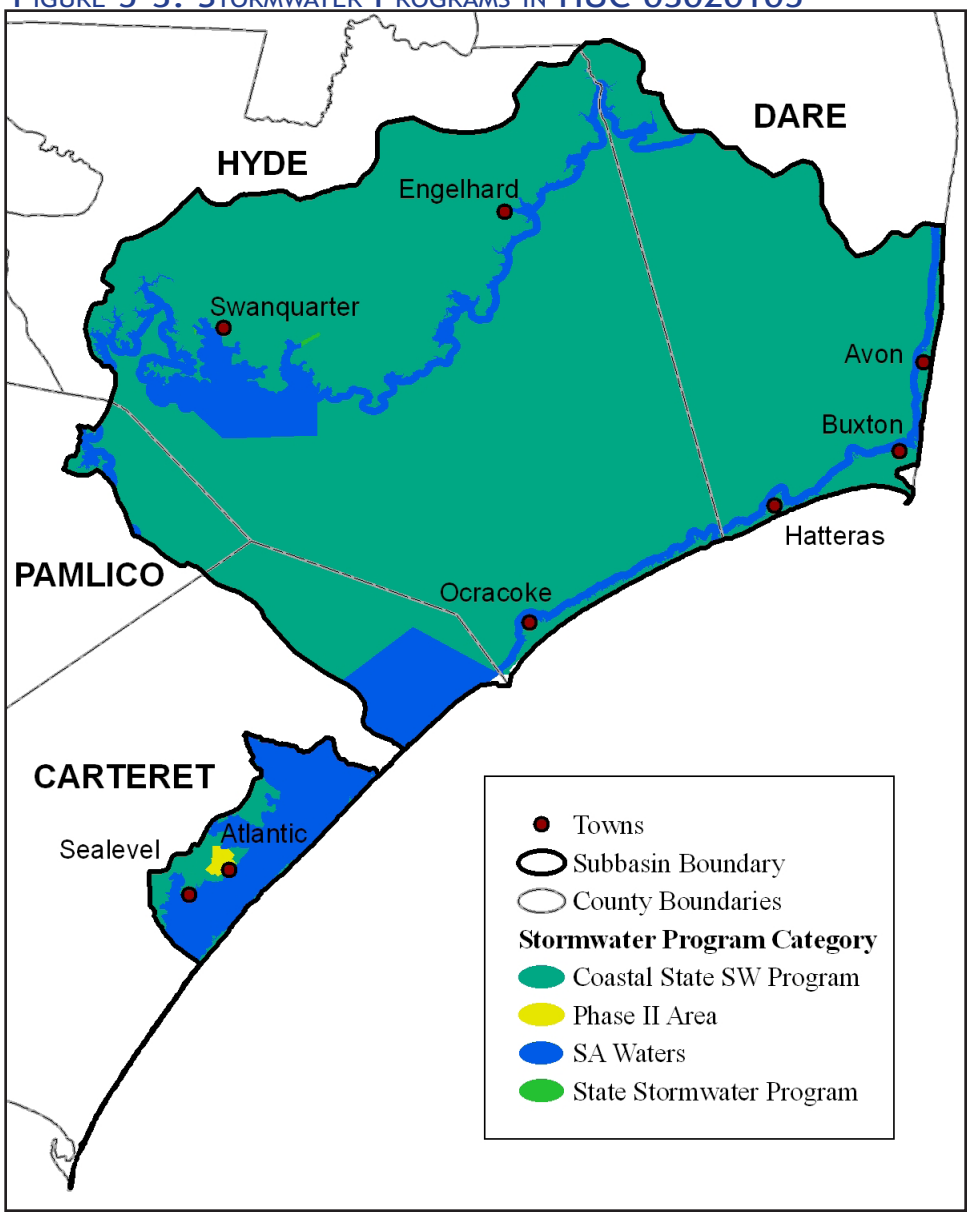
Riparian buffers in the basin are to be protected and maintained on both sides of intermittent and perennial streams, lakes, ponds, and estuarine waters. Tar-Pamlico River Basin Buffer Rules **(15A NCAC 2B.0259)** do not establish new buffers unless the existing use in the buffer area changes. The footprints of existing uses such as agriculture, buildings, commercial and other facilities, maintained lawns, utility lines, and on-site wastewater systems are exempt. A total of 50 feet of riparian area is required on each side of waterbodies; within this 50 feet, the first 30 feet, is to remain undisturbed and the outer 20 feet must be vegetated. Activities that disturb this buffer require a buffer authorization from DWQ or may require a major variance approval from the Environmental Management Commission. More information about the buffer rules are available at: http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers.

Stormwater

DWQ administers several different stormwater programs. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff control. These stormwater control programs include Phase II NPDES and State post-construction, coastal stormwater, HQW/ORW stormwater, Tar-Pamlico River Basin NSW stormwater, and associated with the Water Supply Watershed Program requirements. Figure 5-3 indicates the different stormwater programs in this subbasin.

All counties in this subbasin are required to implement the **Coastal Stormwater Rules**. As of

Figure 5-3. Stormwater Programs in HUC 03020105



July 2009 there are five general stormwater permits issued in this subbasin.

Agriculture

Agriculture is NC's leading industry and is especially strong in the Tar-Pamlico River Basin. Nonpoint source pollution from agriculture is an identified significant source of stream degradation in the Tar-Pamlico River Basin. The approach taken in North Carolina for addressing agriculture's contribution to the nonpoint source water pollution problem is to primarily encourage voluntary participation by the agricultural community and is supported by financial incentives, technical and educational assistance, research, and regulatory programs.

The conversion of agricultural lands to developed lands with impervious surfaces is another potential nonpoint source of pollution. A report by the American Farmland Trust organization identifies this subbasin as having high quality farmland with large areas threatened by development. A map of these areas is available at: http://www.farmland.org/. Some farmers are protecting their land from development through the Conservation Reserve Enhancement Program (CREP). CREP is a voluntary program utilizing federal and state resources to achieve long-term protection of environmentally sensitive cropland and marginal pastureland. These voluntary protection measures are accomplished through 10-, 15-, 30-year and permanent conservation easements. In this subbasin there are approximately 6,655 acres in easements, of which 51% are in 30 year or permanent easements.

North Carolina Agriculture Cost Share Program

Financial incentives are provided through North Carolina's Agriculture Cost Share Program, administered by DENR's Division of Soil and Water Conservation to protect water quality by installing BMPs on agricultural lands. In the Pamlico River Subbasin $879,044 was spent, between 2003-2008, on BMPs to reduce nonpoint source pollution from agriculture. Approximately, 20,786 acres were affected by BMPs that prevented an estimated 5,797 tons of soil, 1,089,537 lbs of nitrogen and 227,321 lbs of phosphorous from running off into surface waters.

DWQ's Animal Feeding Operations Unit The Animal Feeding Operations Unit is responsible for the permitting and compliance activities of animal feeding operations across the state. Poultry farms with dry litter waste are not regulated or monitored by DWQ. Table 5-2 summarizes the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight (SSLW) in this subbasin. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in the subbasin.

Table 5-2. Animal Operations in HUC 03020105

Type	# of Facilities	# of Animals	SSLW
Swine	2	7,045	1,620,085

*Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service (NRCS) guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

Restoration, Protection & Conservation Planning

Population

The 2000 census estimated population for this subbasin is 9,433 people and this is expected to increase with the results of the 2010 census. As population increases so does our demand for clean water from aquifer and surface water sources and for the land and water to assimilate wastes. Population estimates for each watershed within this subbasin are listed in Table 5-3.

Table 5-3. Population Estimates in HUC 03020105

10-Digit HUC	2000 Population	2000 Population Density (per sq mi)	2010 Estimated Population	2020 Estimated Population	2030 Estimated Population
0302010501	2,894	12	2,622	2,381	2,135
0302010502	772	42	701	637	572
0302010503	4,204	40	4,733	5,332	5,867
0302010504	1,563	49	1,706	1,820	1,891
03020105	9,433	24	9,762	10,171	10,464
*NC Office of State Budget and Management: http://www.osbm.state.nc.us/					

Land Use

Wetlands are the predominant land cover in this subbasin, which are especially important in protecting coastal water quality conditions. Most development in this subbasin occurs along the shoreline, with an increase in demand for inland marinas pushing development further inland. Table 5-4 lists the percentage of different predominant land cover types within this subbasin based on 2001 land cover data.

Table 5-4. Land Cover Percentages in HUC 03020105

Land Cover Type	Percent
Developed Open Space	2.58
Developed Low Intensity	1.31
Developed Medium Intensity	0.20
Developed High Intensity	0.01
Total Developed	4.09
Bare Earth Transition	2.91
Deciduous Forest	0.30
Evergreen Forest	6.48
Mixed Forest	0.68
Total non-Wetland Forest	7.46
Scrub Shrub	3.01
Grassland Herbaceous	4.66
Pasture Hay	0.22
Cultivated Crops	13.15
Total Agriculture	13.38
Woody Wetlands	36.63
Emergent Herbaceous Wetland	27.86
Total Wetlands	64.50

Central Coastal Plain Capacity Use Area

In 2001, the North Carolina EMC enacted the Central Coastal Plain Capacity Use Area (CCPCUA) rules. These regulations were developed to control groundwater use in the Cretaceous Aquifers in response to decreasing groundwater levels and saltwater intrusion. The CCPCUA rules require groundwater users in the impacted areas to reduce their consumption in three phases between 2008 and 2018. In this subbasin Carteret, Dare, Hyde, and Pamlico counties are within the CCPCUA. More information about the CCPUA is available from Divsion of Water Resources: http://www.ncwater.org/Permits_and_Registration/Capacity_Use/Central_Coastal_Plain/.

Local Initiatives & Conservation Planning

Land Use Planning

The Coastal Area Management Act (CAMA) requires each of the 20 coastal counties to have a local Land Use Plan in accordance with guidelines established by the Coastal Resources Commission (CRC). A land use plan is a collection of policies, maps, and implementation actions that serves as a community's blueprint for growth. The management goal for water quality is to maintain, protect, and enhance water quality in all coastal wetlands, rivers, streams, and estuaries. The CRC's planning objective is for communities to adopt policies for coastal waters within their planning jurisdiction to help ensure that water quality is maintained if not impaired and improved if impaired. Local communities are required to devise policies that help prevent or control nonpoint source discharges through strategies such as impervious surface limits, vegetated riparian buffers, maintenance of natural areas, natural area buffers, and wetland protection. They are also required to establish policies and future land use map categories that are aimed at protecting open shellfishing waters and restoring closed or conditionally closed shellfishing waters. To find more information about these Land Use Plans see the Division of Coastal Managements website: http://dcm2.enr.state.nc.us/planning/about.htm.

Resources & Guides

Planning for sustainable growth in the Pamlico River Subbasin requires awareness, understanding, and implementation of sound design and management options. The coastal environment and natural resources contribute to our quality of life while supporting and promoting economic growth. Communities should anticipate growth while incorporating Low Impact Development technologies in their planning to promote long-term sustainability of our natural resources. The NC Division of Coastal Management with NC Sea Grant and NCSU College of Design developed "The Soundfront Series," informational guides to assist property owners and community planners and managers: http://www.ncseagrant.org/.

NCDENR's One North Carolina Naturally initiative promotes and coordinates the long-term conservation of North Carolina's threatened land and water resources. Each DENR division specializes in management of a specific natural resource, while the collaborative coordination and planning process results in cost effective implementation and management of multiple resources. Natural resource planning and conservation provides the science and incentives to inform and support conservation actions of North Carolina's conservation agencies and organizations. The Conservation Planning Tool was developed to assist in building partnerships through the exchange of conservation information and opportunities, support stewardship of working farms and forests, inform conservation actions of agencies and organizations, and guide compatible land use planning. A link to the interactive map view is found here: http://www.conservision-nc.net/.

Conservation planning is important on a local level to protect natural resources that provide recreational, aesthetic, and economic assets important to community growth and sustainability. The NC Wildlife Resource Commission developed a Green Growth Toolbox to assist towns and cities to grow in nature-friendly ways: http://www.ncwildlife.org/greengrowth/. The tools provide assistance with using conservation data, green planning, green ordinances and green development and site design. Also, a guide to help local governments protect aquatic ecosystems while streamlining environmental review is available: http://www.ncwildlife.org/planningforgrowth/swimming_with_the_current.pdf.

Land conservation accompanied with stream restoration projects can be very successful for protecting water quality. Prevention and protection activities are known to be more cost effective than retrofits and restoration. DWQ strongly encourages conservation in this watershed. Local land trusts can help landowners explore conservation options and identify potential funding sources. For more information about land trusts in North Carolina see the Conservation Trust for North Carolina at: http://www.ctnc.org/site/PageServer. With the assistance of several private companies, land conservancies and state and federal agencies ~153,600 acres are protected within this subbasin.

Sea Level Rise

Sea level rise will adversely impact North Carolina's coastline, specifically the northern coastline because of its underlying geologic structure (Riggs and Ames, 2003). There is a predicted acceleration in coastal erosion and an increase in estuarine shoreline erosion if oceanic processes are altered by increased barrier island elevation through natural or human modifications (Riggs and Ames, 2003). Major loss of land is predicted in Currituck, Camden, Dare, Hyde, Tyrrell, Pamlico and Carteret counties if glacial melting rates increase significantly, as projected by the Intergovernmental Panel on Climate Change (Riggs and Ames, 2003; IPCC, 2001).

"Drowning the North Carolina Coast: Sea-Level Rise and Estuarine Dynamics" by S. Riggs and D. Ames (2003) published by North Carolina Sea Grant provides information specifically addressing northeastern NC. This book provides images and figures explaining sea level rise and coastal erosion. This book is an excellent resource for coastal municipal planners as new developments, utility infrastructure, and other land use decisions are made. Several universities are researching

the impacts of sea level rise on North Carolina's coastal economy; more information about their findings can be found at: http://econ.appstate.edu/climate/. Information about sea level forecasts being developed by National Oceanic and Atmospheric Association and several universities in North Carolina can be found at: http://www.cop.noaa.gov/stressors/climatechange/current/slr/default.aspx. North Carolina also received a $5 million grant from FEMA to develop a sea level rise risk management study. This study incorporates science-based mitigation and adaptation strategies needed and an assessment of risk to property and living systems. The assessment models should be completed in 2011; please see the Division of Emergency Management website for more information: http://www.ncsealevelrise.com/Home.

Construction Grants and Loans

The NC Construction Grants and Loans (CG&L) Section of DWQ provides grants and loans to local government agencies for the construction, upgrades, and expansion of wastewater collection and treatment systems. As a financial resource, the section administers five major programs that assist local governments. Of these, two are federally funded programs administered by the state, the Clean Water State Revolving Fund (SRF) Program and the State and Tribal Assistance Grants (STAG). The STAG is a direct congressional appropriation for a specific "special needs" projects within NC. The High Unit Cost Grant (SRG) Program, the State Emergency Loan (SEL) Program, and the State Revolving Loan (SRL) Program are state funded programs, with the later two being below market revolving loan money. The Section also received an additional Capitalization Grant authorized by the American Recovery and Reinvestment Act of 2009 in the amount of $70,729,100. These funds are administered according to existing SRF procedures. All projects must be eligible under Title VI of the Clean Water Act. In 2001, Hyde County received 3 million in financial assistance for a new WWTP and Sewer System for Swan Quarter. For more information please see the CG&L webpage at: http://portal.ncdenr.org/web/wq/cgls.

Clean Water Management Trust Fund

Created in 1996, the Clean Water Management Trust Fund (CWMTF) makes grants to local governments, state agencies and conservation non-profits to help finance projects that specifically address water pollution problems. The fund has made several investments in the Pamlico River Subbasin. Table 5-5 includes a list of recent projects and their cost.

Table 5-5. CWMTF Projects in HUC 03020105

Application ID	Proposed Project Description	Amount Funded	County
2004B-032 NC Coastal Land Trust - Acq/ McWilliams Tract, Springer's Point	Protect through fee simple purchase 91 acres, adjacent to the Cape Hatteras National Seashore and a previously funded CWMTF acquisition project.	$2,161,000	Hyde
2005B-023 Nature Conservancy, The - Acq/ Davis Tract, Alligator River	Protect 5,010 ac of the Davis Tract through a permanent conservation easement. Tract drains to Long Shoal and Alligator Rivers. Links Alligator Natl Wildlife Refuge to WRC Gull Rock Game Land & protects USAF Dare Co Bombing Range from encroachment.	$1,025,000	Hyde
2008-410 NC Coastal Federation - Rest/ Hyde County-Alligator River Growers Project, Pamlico Sound	Plan restoration of a 10,000 acre farm that operates ditches and canals that collect excess ag drainage and diverts it to Pamlico Sd. Convene stakeholders, develop a hydrologic model, evaluate potential wq impacts, and cost estimates for restoration.	$80,000	Hyde

Recommendations:

- Continue to support Division of Environmental Health in their efforts to identify failing septic systems and identification of bacteria sources. Continue and encourage local education efforts regarding septic system maintenance and replacement.

- Continue to encourage local governments to prepare for sea-level rise and to use of the **flood mapping tool** in development by NC Division of Emergency Management.

References

Pradhan, S.S., Hoover, M.T., Austin, R.E. and H. A. Devine. 2007. Potential Nitrogen Contributions from On-site Wastewater Treatment Systems to North Carolina's River Basins and Sub-basins Technical Bulletin 324. North Carolina Agricultural Research Service North Carolina State University Raleigh, NC.

NC DENR, Division of Environmental Health Shellfish Sanitation and Recreational Water Quality Sanitary Survey Reports: http://www.deh.enr.state.nc.us/shellfish/survey.htm
E-9 Core Sound Area. April 2006
F-4 Cedar Island Area. September 2006
G-5 Long Shoal River Area. March 2006
G-6, Ocracoke Area. July 2006
H-4, Hatteras Area. May 2002 & March 2007
H-5, Outer Banks Area. October 2002 & September 2006

Nutrient Sensitive Water Strategy

OVERVIEW

Nutrients (nitrogen and phosphorus), which occur in fertilizers, human and animal wastes and air pollution, can promote algal blooms. These blooms, in turn, can deplete the water column of oxygen causing fish kills. Recurring nutrient-related problems have been documented in the Pamlico River estuary through the latter half of the 20th century. Control of nutrients is necessary to limit algal growth potential, to assure protection of the instream chlorophyll *a* standard, and to avoid anoxic conditions and fish kills in the state's waterways. A large portion of the estuarine eutrophication problems have been linked to an overabundance of nutrients from agricultural and urban runoff, wastewater treatment plant discharges and atmospheric deposition.

The entire basin was classified as nutrient sensitive waters (NSW) by the North Carolina Environmental Management Commission (EMC) in 1989. As a result, a NSW strategy was developed to help assess progress towards meeting instream nutrient loading goals of a 30% reduction in total nitrogen (TN) loading and no increase in total phosphorus (TP) loading from the 1991 baseline. The strategy is to be implemented by WWTP dischargers, municipal stormwater programs and agriculture. Each of these programs report to DWQ annually on their progress of meeting nutrient loading goals. Despite the fact that the targeted point and nonpoint pollution sources have been able to meet their nutrient reductions, total nitrogen and total phosphorous concentrations do not show a downward trend and loads have not fallen below the 1991 baseline load goals.

While individual implementation dates varied, all of the rules were fully implemented by 2006. This chapter provides a summary of the nutrient strategy implementation progress followed by an evaluation of the strategy which identifies additional opportunities and research needs to address nutrient loading to the Pamlico River Estuary. For the complete NSW rules, visit **http://portal.ncdenr.org/web/wq/ps/nps/tarpamns.** It is important to note that at this time, DWQ is not reassessing the Total Maximum Daily Load (TMDL) or suggesting that the current NSW rules be modified.

The 2010 water quality assessment of the Pamlico River Estuary indicates ~28,923 acres are Impaired because they failed to meet chlorophyll *a* water quality standards (over 10% of the samples taken within a five year data window exceeded the chlorophyll *a* standard of 40 µg/L). This impairment extends from the mouth of the Pamlico River near the city of Washington to Huddy Creek (south shore) and Saint Claire Creek (north shore). This estuary impairment essentially represents the same area of Impairment as described in the 1994 Basinwide Plan and is covered by the estuarine response modeling and TMDL strategies described in the 1994 Basin Plan. The water quality assessments discussed in the 1999 and 2004 Basinwide Plans showed the impaired area retreating to the area just below where Chocowinity Bay and the Pamlico River merge (~3,430 acres). Water quality assessment of the estuary occurs every two years and it is likely the assessments will fluctuate as data included will represent different climate conditions that influence algal distribution within the estuary.

Trends in Nutrient Loading to the Pamlico River Estuary

Pamlico River Estuary TMDL

A Total Maximum Daily Load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that load among the various sources of that pollutant. Pollutant sources are characterized as either point sources or nonpoint sources. In 1995, the EPA approved the estuarine response modeling reported in the 1994 Basinwide Plan as the TMDL for nutrients in the Pamlico River Estuary.

Due to a combination of hydrologic conditions and nutrient inputs from upstream, the estuary from Washington downstream to Saint Claire Creek has and continues to experience excessive algal activity. Estuary response modeling was conducted to determine appropriate nutrient reduction goals, described in detail in the **1994 Basinwide Plan**. DWQ applied the model under the 1991 calibration conditions as well as under various nutrient reduction scenarios and plotted the results for a site located near Washington in order to evaluate possible management strategies. The model was calibrated under relatively high nutrient loading conditions, but also represented the typical estuary impairment conditions, where chlorophyll a violations occurred 18% of the time. However, 1991 was a much dryer than average year; 1991 mean annual flow measured at the USGS Tarboro gauging station was 1,249 cfs, whereas the average annual flow from 1897-2009 was 2,226 cfs. In wetter years, both nutrient loading and estuary response will differ from dry-year results. Therefore, the modeling results were evaluated within the context of the model calibration.

The model recommendations include an instream reduction goal of 30% for total nitrogen (TN) (1,361,000 kg/yr target) and maintenance of existing total phosphorus (TP) loading (180,000 kg/yr) at Washington. The model indicated that point sources contribute only 5% of the total nitrogen in the entire basin and approximately 8% of the total nitrogen in the basin upstream from the estuary. Nonpoint sources therefore account for 92% of the TN loading. Based on the overall annual TN reduction goal of 583,000 kg/yr at Washington from all sources, annual point and nonpoint source reduction goals at Washington are as follows:

Point Sources = 46,640 kg/yr (583,000 kg/yr x .08)
Nonpoint Sources = 536,350 kg/yr (583,000 kg/yr x .92)

Reductions in nutrient inputs may take time to detect in measured loading, due to year-to-year variability in precipitation and flow. Based on the results of recent trend analysis (see trend analysis summary below) in the basin, it is evident that it will take more time to discern a 30 percent decrease in load to the estuary. The Pamlico River Estuary will continue to be monitored to determine if the chlorophyll *a* criterion is met and the Tar-Pamlico River will continue to be monitored to determine if the 30 percent TN load reduction and no increase in TP load from the 1991 level is being achieved. This information will help direct adaptive management in TMDL compliance activities.

Trend Analysis

Introduction

The DWQ's Modeling and TMDL Unit performed a trend analysis of annual nutrient loads and concentrations focused on data from the ambient monitoring station O6500000, between 1991–2008, to evaluate progress towards meeting TMDL reduction goals. This station is located at Grimesland, which is approximately 7-miles upstream of Washington. Currently, there is enough data to perform statistical analysis of daily load. DWQ does not recommend performing trend analysis on annual load because the effects of flow could lead to confounding results.

The purpose of any statistical trend testing is to determine whether a set of data that arise from a particular probability distribution represent a detectable increase or decrease over time (or space). There are a wide variety of trend testing techniques, all of which have certain assumptions that must be met for the analysis to be valid. The result of false assumptions may

be that interpretations are incorrect or unnecessarily inconclusive.

Detecting trends in a water quality data series is not as simple as drawing a line of best fit and measuring the slope. There are likely to be multiple factors contributing to variation in water quality over time, many of which can hide or exaggerate trend components in the data. Changes in water quality brought about by human activity will usually be superimposed on natural sources of variation such as flow and season. Identification and separation of these components is one of the most important tasks in trend testing.

Methods

Daily load was calculated as measured concentration multiplied by average daily flow and converted to units of kilograms per day. For the 1991-2008 time frame, there are 186 data points, with an average of 10.3 sampling events per year. Trend analysis was performed for TN, TP, Total Kjeldahl Nitrogen (TKN), ammonia (NH_3), and nitrite+nitrate (NO_2+NO_3). TN was not directly measured, but was calculated as NO_2+NO_3 plus TKN. Due to the lack of a stream gage at Grimesland, flow data were generated by multiplying flow from the closest upstream gage, which is approximately 13 miles upstream at Greenville (USGS 02084000), by a drainage area (DA) ratio of 1.07 (Grimesland DA divided by Greenville DA).

The WQStat Plus model was used to evaluate trends in TP, TN, TKN, NH_3, and NO_2+NO_3 in the Tar River. The model is a multi-faceted computer program, which is capable of computing flow-adjusted concentration and the nonparametric Seasonal Kendall test.

For water quality constituents that are closely related to flow, an apparent trend in quality could be caused by a change in flow. By flow adjusting concentrations before trend analysis, one is able to determine the magnitude and statistical significance of trends that are not explained by flow. The WQStat Plus model removes the concentration variation related to stream flow with flow-adjusted data by assuming a log-log relationship between water quality and flow:

$$log\ concentration = b(log\ flow) + a$$

WQStat Plus uses linear regression to estimate the slope (b) and intercept (a) of the line above. The resulting equation is used to predict concentration at each sampling point. Then, from each water quality observation, the corresponding prediction is subtracted, producing a series of residuals. To each residual, the mean of the original log concentration series is added, producing a flow-adjusted series of log concentrations.

Many water quality constituents are also influenced by season. The Seasonal Kendall test accounts for seasonality by computing the Mann-Kendall test on each of the user-specified seasons separately, and then combining the results (Helsel and Hirsch, 2002). For this analysis, seasons are defined as monthly. So, for monthly “seasons,” January data are compared only with January, February only with February, etc.

The Seasonal Kendall test was applied to test a null hypothesis that there was no trend in measured nutrient concentrations or daily load. The alternative hypothesis is that there is a trend. For this analysis, upward trend (positive slope) indicates degradation of water quality, whereas downward trend (negative slope) indicates improvement of water quality. The hypothesis was tested at 95% confidence level.

Trend Analysis Results

Flow-Adjusted Concentration

The results of the Seasonal Kendall test for flow-adjusted concentrations of TP, TN, TKN, NH_3, and NO_2+NO_3 are provided in Table 6-1. The results indicate that there were statistically significant trends for NH_3, NO_2+NO_3, and TKN. There was no statistically significant trend for TN or TP. TKN showed an increasing trend in concentration, while both NH_3 and NO_2+NO_3 showed decreasing trends.

Trend slope (seasonal sen trend slope) represents the median rate of change in flow-adjusted concentrations and is shown in Table 6-1 for each statistically significant parameter. For example, the statistically significant upward slope of TKN suggests that the average increase in median TKN concentration per year was 0.01 mg/L during the study period, representing a 32% increase in median TKN concentration over the 18 years of the study period. Conversely, there was a 28% decrease in NO_2+NO_3 concentrations.

Table 6-1. Results of Seasonal Kendall Trend Analysis for Flow-adjusted Constituents

Parameters	Seasonal Sen Trend Slope (mg/L per year)	Significant Trend at 95%	1991 Median	Avg. % Change in Median from 1991 - 2008
TP (mg/L)	x	No	0.16	x
TN (mg/L)	x	No	1.27	x
TKN (mg/L)	0.01	Yes	0.50	32%
NH_3 (mg/L)	-0.002	Yes	0.07	-45%
NO_2+NO_3 (mg/L)	-0.01	Yes	0.77	-28%
X= slope was not significant and therefore not reported				

Daily Load

The results of the Seasonal Kendall test for daily loads of TP, TN, TKN, NH_3, and NO_2+NO_3 are provided in Table 6-2. Daily average flow was also trend tested to check for bias. The results indicate that there were statistically significant decreasing trends in NH_3 and NO_2+NO_3 daily loads. There was no statistically significant trend for TKN, TN, or TP. As shown in Table 6-2, there was a statistically significant decreasing trend for flow. Therefore, even though there is a statistically significant decreasing trend for NH_3 and NO_2+NO_3 flow adjusted concentrations (Table 6-1), it is possible that the decreasing trends for NH_3 and NO_2+NO_3 loads are also partially explained by the decreasing trend in flow. Trend slope (seasonal sen trend slope) represents the median rate of change in daily load and is shown in Table 6-2 for each statistically significant parameter.

Table 6-2. Results of Seasonal Kendall Load Trend Analysis

Parameters	Seasonal Sen Trend Slope (kg/d/year)	Significant Trend at 95%
TP (kg/day)	x	No
TN (kg/day)	x	No
TKN (kg/day)	x	No
NH_3 (kg/day)	-8.84	Yes
NO_2 + NO_3 (kg/day)	-44.37	Yes
cfs per year		
Flow (cfs)	-20	Yes
X= slope was not significant and therefore not reported		

Annual Load

As mentioned above, there are not enough years to do statistical trend analysis of annual load. As an alternative, the U.S. Army Corps of Engineers' FLUX program was used to estimate annual loads of TP and TN for 1991-2008 and plotted as a time series.

The TP annual load time series is provided in Figure 6-1. Annual total precipitation is also provided for comparison. As shown in Figure 6-1, 2007 and 2008 are the only years with total TP loads less than the 1991 baseline load. It should be noted that both years were impacted by drought conditions. The annual load of TP is closely related to the amount of precipitation. This implies that the total load is being driven more by the amount of precipitation, which drives flow, than by nutrient concentrations.

FIGURE 6-1. TIME SERIES OF ANNUAL LOAD OF TP (KG/YEAR) WITH TOTAL ANNUAL PRECIPITATION PROVIDED FOR COMPARISON

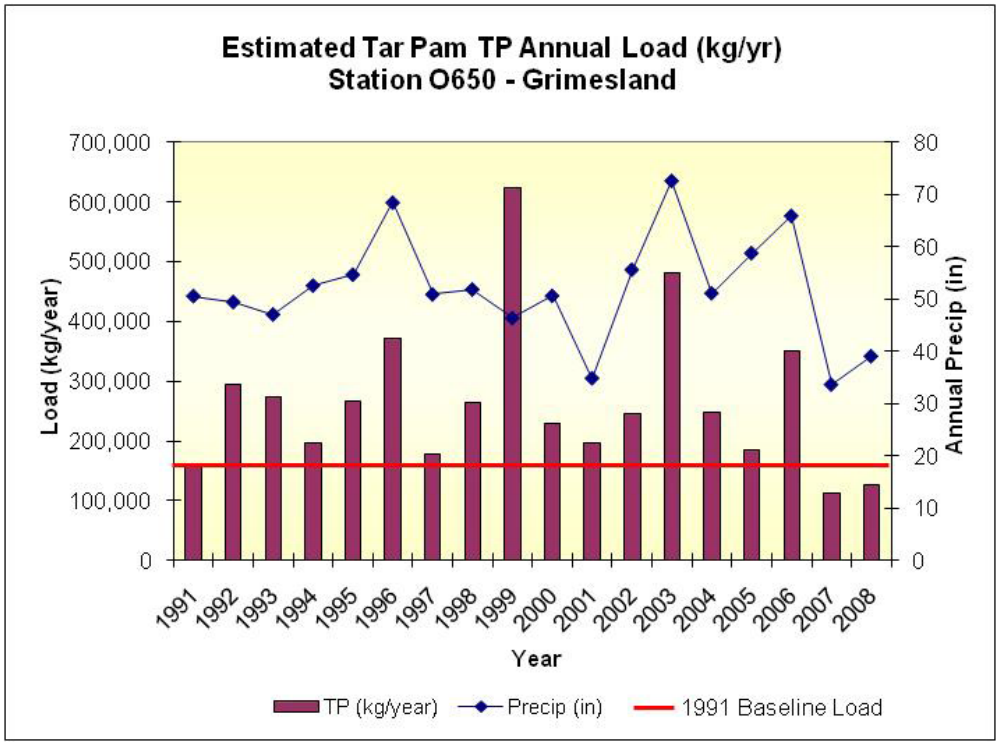
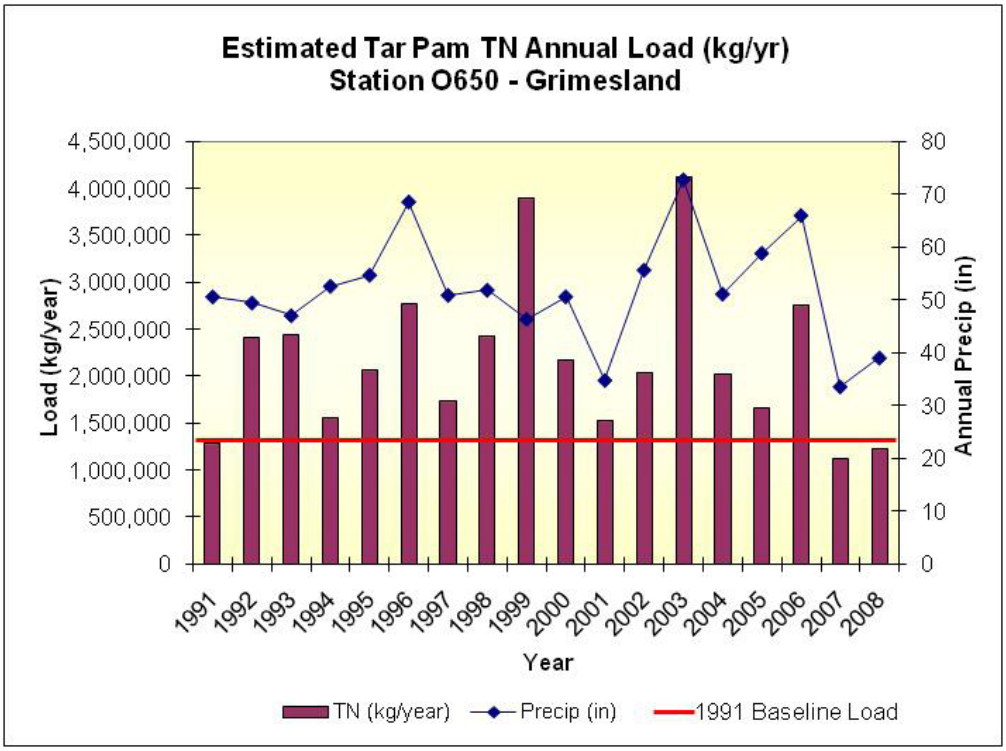


FIGURE 6-2. TIME SERIES OF ANNUAL LOAD OF TN (KG/YEAR) WITH TOTAL ANNUAL PRECIPITATION PROVIDED FOR COMPARISON



The TN annual load time series is provided below in Figure 6-2. As with TP, the only years with estimated total TN loads less than the 1991 baseline load are 2007 and 2008. This is more likely due to the drought conditions than due to decreases in nutrient concentrations.

Conclusion

Trend analyses of TP, TN, TKN, NH_3, and NO_2+NO_3 concentrations and estimated daily loads were performed for the Tar River at Station O650000. The WQStat Plus model was used to test a null hypothesis that no trends in nutrient concentrations or daily loads exist at the 95% confidence level. The results are summarized below in Table 6-3.

Table 6-3. Summary of Trend Analysis Results for concentrations and daily loads

1991-2008		
Constituent	Concentration	Daily Load
TP	No trend	No trend
TN	No trend	No trend
NH_3	Decreasing	Decreasing
NO_2+NO_3	Decreasing	Decreasing
TKN	Increasing	No trend
Flow	-----	Decreasing

The results of the trend analyses indicate that, from 1991 through 2008, concentrations of TP and TN show no trend in the Tar River at Station O650000.

Further analyses of the nitrogen series indicates that the increasing trend in TKN concentrations cancels out the decreasing trends observed for NO_2+NO_3 concentrations, resulting in no trend for TN. TKN is comprised of NH_3 and organic nitrogen. Because there was a decreasing trend observed for NH_3, the increase in TKN is likely explained by an increase in organic nitrogen.

Trend Analysis Discussion & Next Steps

Based on the trend analyses the TN 30% loading reduction goal has not been reached and the TP load has exceeded the 1991 maintenance level. There is also no decrease in TN or TP concentrations trends. Reevaluation of the TMDL is justified when the 30% TN instream load reduction has been achieved and chlorophyll *a* standards are still not being met.

Even though significant efforts have been taken by point sources and the agricultural community to reduce their collective nutrient loading, the implementation of the NSW strategy has thus far not resulted in meeting water quality standards in the Pamlico River Estuary. The decrease in annual loads of TP and TN below the baseline levels as shown in Figures 6-1 and 6-2, during the drought years of 2007-2008, suggest recent nutrient loading to the estuary is likely a result of nonpoint source contributions. The NSW strategy accounts for aspects of agriculture and stormwater nonpoint source contributions however, it is recognized that some nonpoint sources may have not been accounted for or are exceeding the original source contributions. Specifically, looking at the different forms of nitrogen, organic nitrogen has increased and thus warrants identifying sources and reducing inputs of organic nitrogen throughout the basin.

By expanding the analysis outside of the TMDL compliance point and focusing on specific watersheds with dominant land use types, staff may be able to better gauge the effectiveness and progress of strategy implementation. For this reason it will be necessary to conduct additional trend analyses on tributaries within the basin that represent predominately agriculture and urban watersheds respectively. While we believe that further analyses of existing data and additional years of data collection will provide greater certainty as to the effect of the strategy on the estuary, we also recognize other basin factors (e.g., groundwater, atmospheric deposition, nutrient recycling) may contribute to the results seen in these analyses and conditions in the estuary.

NSW Strategy Program Reviews

The goal of a 30 percent reduction in TN loading and no increase in TP loading from 1991 conditions at Washington and the goal of meeting chlorophyll *a* water quality standards within the Pamlico River Estuary have not been achieved to date. However, the efforts to reduce nitrogen from several sources have been very successful and additional reductions are likely needed in areas that were not completely covered by the initial set of management rules. Identifying additional nonpoint source pollution sources and potential reduction measures is a priority to reduce TP & TN loads beyond the >30% reduction already achieved by a majority of dischargers and agriculture. The estuary is a complex and dynamic system and due to the decades of chronic overloading of nutrients and the likelihood of nutrient recycling, it may be some time before current reductions in nutrient loading will reflect in improved water quality.

Point to Nonpoint Source Nutrient Trading Program:

The Tar-Pamlico NSW includes three phases to address both point and nonpoint source pollution contributions to the estuary. A detailed description of the phases are available on the DWQ Nonpoint Source website: http://portal.ncdenr.org/web/wq/ps/nps/tarpamlico.

Phase I

The strategy's first phase, which ran from 1990 through 1994, produced an innovative point source/nonpoint source trading program that allows point sources, such as wastewater treatment plants and industry, to achieve reductions in nutrient loading in more cost-effective ways. The Tar-Pamlico Basin Association (TPBA) made up of 14 point source dischargers, was established and they received collective annual end-of-pipe nitrogen and phosphorus loading caps. The TPBA members did not exceed their cap, but were given 4,608 kg nitrogen credit for financially supporting agricultural BMPs. The credits were predetermined to offset discharger nutrient exceedances with funds to be used for agricultural BMPs.

Phase II

The second phase, which ran through 2004, established nutrient goals of a 30% reduction in nitrogen loading from 1991 levels and holding phosphorus loading to 1991 levels based on estuarine conditions. Phase II required new point source nutrient caps and required nonpoint sources to contribute to estuary goals. It established a set of nonpoint source rules addressing agriculture, urban stormwater, fertilizer management across all land uses, and riparian buffer protection. The Phase II Agreement established requirements for existing and expanding domestic and industrial non-association dischargers and all new facilities that enter the basin.

Phase III

Phase III was approved by the EMC on April 14, 2005 and it spans an additional ten years through December 31, 2014. The Phase III Agreement updates TPBA membership and related nutrient caps. During the first two years, the parties agreed to actions to improve the offset rate, resolve related temporal issues, and revisit alternative offset options. It also establishes 10-year estuary performance objectives and alternative management options. Non-association dischargers are to maintain permit limits required in Phase II. The Agreement further provides that the TPBA may accrue and bank nitrogen credits by funding nonpoint source nutrient reduction measures (e.g., agricultural BMPs) and that it may purchase credits or apply banked credits in anticipation of future cap exceedances. The TPBA has consistently and reliably kept its nutrient loadings beneath the caps without relying on banked credits.

The parties in the Agreement identified actions to be taken by the conclusion of Phase III and addressed in Phase IV, these include:

1. Evaluate the NC Agricultural Cost Share Program to determine if it continues to provide the most efficient method of implementing the pollution credits trading program. This evaluation should consider the effect of delays in BMP implementation relative to nutrient cap exceedance and how such delays may impact the allowable point source nutrient budget.

2. Evaluate the trading offset credit cost calculation method to ensure the offset rate reflects all actual costs incurred in program development and implementation and reflects the costs of the type of agricultural BMPs implemented through this program.
3. Conduct a water quality trend analysis, including evaluation of TN losses occurring during transport to the estuary. This analysis will inform the parties regarding the need for changes in acceptable loads and the relative impacts of point and non-point contributions.

Phase IV

Individual discharger permit limits will be incorporated in 2014 during the fourth phase of the Agreement. Also, based on the Pamlico Estuary's response to nutrient management efforts, additional nutrient reduction options may be considered.

Tar-Pamlico Basin Association Facilities Loading Requirements

The TPBA dischargers (Table 6-4) account for 98.7% of the known effluent flow to the basin. As part of Phase I the TPBA members agreed to optimize their nutrient reduction performance with the goal of each facility attaining TP of 2 mg/L and TN of 4 mg/L in the summer and 8 mg/L in the winter. A collective nutrient cap was established for years 1991-1994 (Table 6-5). The cap was reevaluated for years 1995-2004 after model results suggested the 30% TN cumulative point and nonpoint source reduction and no increase in TP from baseline 1991 levels (Table 6-6). For Phase III, the TPBA's end-of-pipe nitrogen cap is 404,274 kg TN and the final phosphorus cap of 73,060 kg TP (Table 6-7). Cap values are adjusted for any change in TPBA membership.

Since the Tar-Pamlico strategy's inception, the EPA has praised the strategy for its innovative and integrative approach to nutrient management and has touted it repeatedly as a model for others to use. However, guidance released by the EPA's Office of Water Management in 2007 re-iterates that federal NPDES regulations (40 C.F.R. 122.44(d)(1)) and Section 301(b)(1)(C) of the federal Clean Water Act require that NPDES permits include any applicable limitations established in or based upon an approved TMDL. The Tar-Pamlico permits have not included nutrient limits, because the Agreement specified the TPBA's caps and, until recently, the EPA Region 4 office had accepted that approach. In light of the 2007 guidance, Region 4 has modified its position on the matter and is requiring that the members' permits include the group nutrient limits at this time and individual limits in 2014.

In order to establish individual nutrient limits by 2014, the DWQ must conduct additional technical studies (e.g., determine delivery rates for each discharger, develop individual N and P allocations) and work with the TPBA to complete major revisions to the Tar-Pamlico strategy and the Agreement. It is also likely that the DWQ must adopt rules to provide for the operation of the TPBA under a group NPDES permit.

Table 6-4. Tar-Pamlico Basin Association Discharge Members

Permit	Owner	Facility	Permitted Flow (MGD)	Subbasin HUC	Receiving Stream
NC0042269	Town of Bunn	Bunn WWTP	0.15	3020101	Crooked Creek
NC0020061	Town of Spring Hope	Spring Hope WWTP	0.4	3020101	Tar River
NC0020231	Town of Louisburg	Louisburg WWTP	1.37	3020101	Tar River
NC0069311	Franklin County	Franklin County WWTP	3	3020101	Cedar Creek
NC0025054	City of Oxford	Oxford WWTP	3.5	3020101	Fishing Creek
NC0030317	City of Rocky Mount	Tar River Regional WWTP	21	3020101	Tar River
NC0023337	Town of Scotland Neck	Scotland Neck WWTP	0.675	3020102	Canal Creek
NC0025402	Town of Enfield	Enfield WWTP	1	3020102	Fishing Creek
NC0020834	Town of Warrenton	Warrenton WWTP	2	3020102	Fishing Creek
NC0020435	Town of Pinetops	Pinetops WWTP	0.3	3020103	Town Creek
NC0026042	Town of Robersonville	Robersonville WWTP	1.8	3020103	Flat Swamp

Permit	Owner	Facility	Permitted Flow (MGD)	Subbasin HUC	Receiving Stream
NC0020605	Town of Tarboro	Tarboro WWTP	5	3020103	Tar River
NC0023931	Greenville Utilities Commission	GUC WWTP	17.5	3020103	Tar River
NC0026492	Town of Belhaven	Belhaven WWTP	1	3020104	Battalina Creek
NC0020648	City of Washington	Washington WWTP	3.65	3020104	Tar River
		Total Permitted Flow = 62.35			

Table 6-5. Phase I TPBA Nutrient Caps and Reported Loads

Combined N+P	1991[1]	1992[1]	1993[1]	1994[1]
Loading Cap [a] (kg/yr)	525,000	500,000	475,000	425,000
Actual Load (kg/yr)	total= 461,394 TN= 396,916 TP =64,478	total= 436,128 TN= 386,014 TP= 50,113	total= 417,217 TN=371,336 TP= 45,881	total= 371,200 TN=319,181 TP= 52,019
% of Cap	88	87	88	87
Average Daily Flow (MGD)	24.88	26.86	28.46	26.65

Table 6-6. Phase II TPBA Nutrient Caps and Reported Loads

Separate N & P	1995[2]	1996[2]	1997[2]	1998[2]	1999[2]	2000[2]	2001[3]	2002[4]	2003[4]	2004[4]
Loading Cap [a] (kg/yr)	N: 405,256 P: 69,744	N: 405,256 P: 69,744	N: 405,256 P: 69,744	N: 405,256 P: 69,744	N: 405,256 P: 69,744	N: 405,256 P: 69,744	N: 421,972 P: 73,060	N: 426,782 P: 73,694	N: 426,782 P: 73,694	N: 426,782 P: 73,694
Actual Load (kg/yr)	N: 372,582 P: 37,360	N: 354,219 P: 43,266	N: 320,670 P: 36,532	N: 344,781 P: 36,864	N: 309,476 P: 32,052	N: 297,988 P: 30,277	N: 279,958 P: 32,730	N: 279,330 P: 34,076	N: 309,724 P: 30,856	N: 256,791 P: 33,566
% of Cap	N: 92 P: 54	N: 87 P: 62	N: 79 P: 52	N: 85 P: 53	N: 76 P: 46	N: 74 P: 43	N: 66 P: 45	N: 65 P: 46	N: 72 P: 42	N: 60 P: 45
Average Daily Flow (MGD)	31.03	33.57	29.84	33.31	33.39	32.74	30.21	30.54	36.86	29.56

Table 6-7. Phase III TPBA Nutrient Caps and Reported Loads

Separate N & P	2005[5]	2006	2007	2008
Loading Cap [a] (kg/yr)	N: 404,274 P: 73,060	N: 404,274 P: 73,060	N: 404,274 P: 73,060	N: 404,274 P: 73,060
Actual Load (kg/yr)	N: 242,020 P: 39,267	N: 232,568 P: 46,995	N: 246,465 P: 50,077	N: 253,818 P: 43,821
% of Cap	N: 60 P: 54	N: 58 P: 64	N: 61 P: 69	N: 63 P: 60
Average Daily Flow (MGD)	29.21	32.85	27.05	27.39

Loads were estimated by NC Division of Water Quality as the sum of calendar-year monthly load values for each facility, which are based on minimum biweekly nutrient concentrations and daily mass flows.

[a] Cap values and changes result from the following:

[1] Phase I – Original 12-member Association

[2] Phase II through 2000 – 14-member Association.

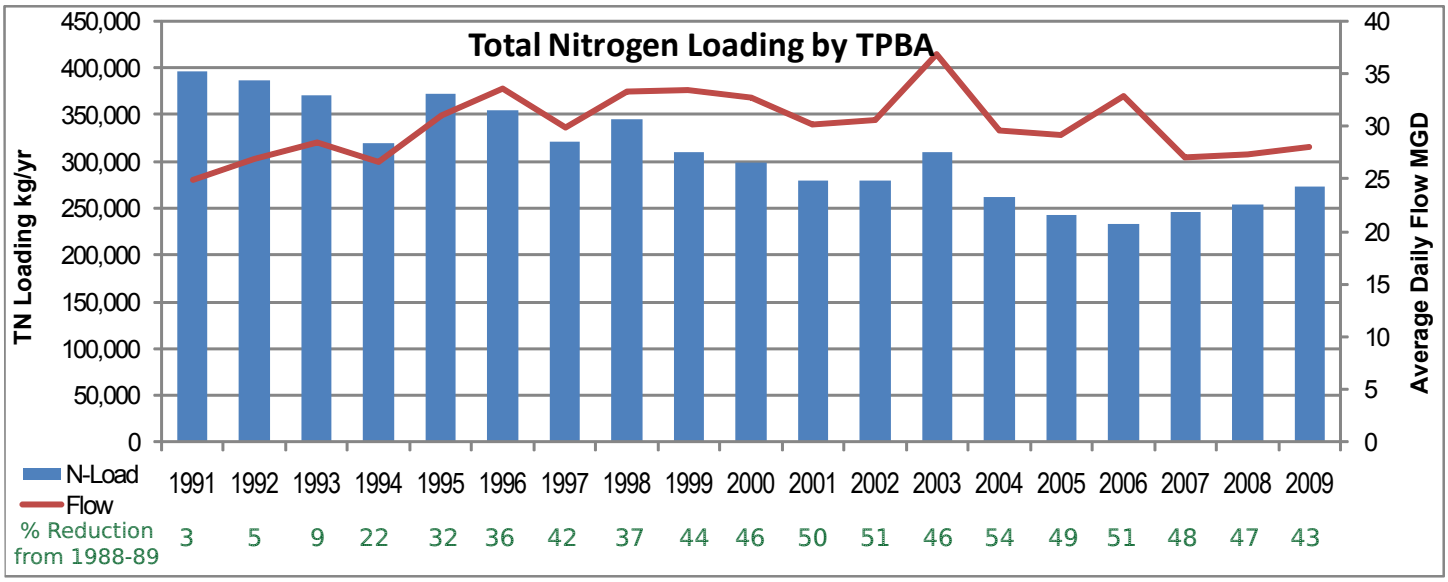
[3] Robersonville added in 2001, making a 15-member Association.

[4] Scotland Neck added in 2002, making a 16-member Association.

[5] National Spinning Removed in 2005, making a 15 member Association in Phase III

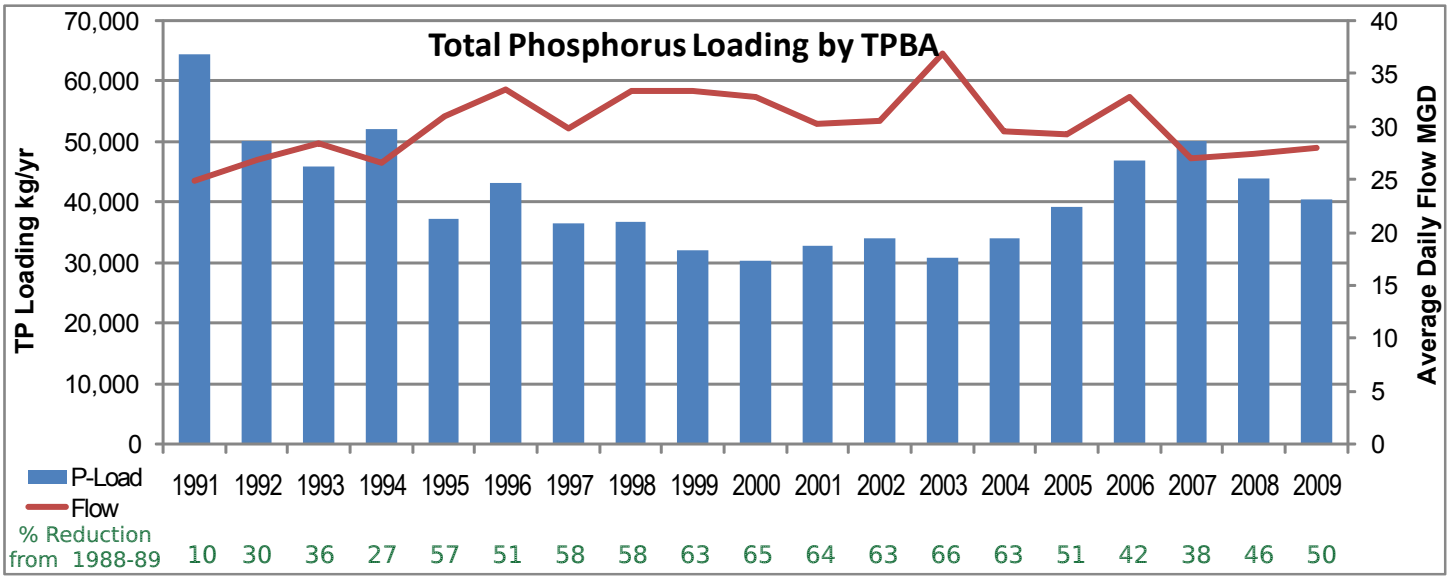
The TPBA has consistently and reliably kept its nutrient loadings beneath the caps without relying on banked credits. Relaxation of these caps in future amendments to this Agreement would only be contemplated if monitoring and modeling results suggest all water quality standards and goals are being met and that assimilative capacity is available to the TPBA while maintaining a margin of safety, all consistent with the TMDL. The dischargers TN loads and MGD average daily flow are seen in Figure 6-3. The percent reduction in TN loads from 1988-89 (pre-reduction) load levels are listed in green below the years; these percents have been adjusted appropriately for the number of TPBA members active for the particular year.

Figure 6-3. Total Nitrogen Loading by TPBA Members between 1991-2009.



The reductions in TP since 1991 are shown in Figure 6-4 in correlation to the discharges average daily flow levels. The percent reduction in TP loads from 1988-89 (pre-reduction) load levels are listed in green below the years; these percents have been adjusted appropriately for the number of TPBA members active for the particular year.

Figure 6-4. total Phosphorus Loading by TPBA Members between 1991-2009



Non-Association Discharge Facilities Loading Requirements

The non-association dischargers account for less than 2% of the effluent flow within the basin (Table 6-8). The Phase II Agreement established requirements for existing and expanding domestic and industrial dischargers and all new facilities to enter the basin. Those requirements are maintained in Phase III. Existing domestic facilities permitted at or above flows of 0.5 million gallons per day (MGD) have received 6 mg/L TN and 1 mg/L TP effluent concentration limits in all NPDES permit renewals beginning in Phase II, while existing industrial dischargers have received Best Available Technology (BAT) limits.

Phase II Agreement requirements for expanding and new facilities were codified as rules 15A NCAC 2B .0229 and .0237, which were effective April 1, 1997. No changes are recommended to these requirements under Phase III. Any future changes would require rule amendment. Domestic and industrial dischargers expanding to 0.5 MGD or greater and all new dischargers are required to offset all new nutrient loads at 110 percent of the rate established. Payment for the life of the permit is required at issuance or renewal. In addition, domestic and industrial dischargers expanding to at least 0.5 MGD are faced with 6 mg/L TN and 1 mg/L TP effluent concentration limits and BAT limits respectively, while new dischargers of any kind receive 1 mg/L TP effluent concentration limits if they exceed 0.05 MGD permitted flow, and additionally 6 mg/L TN effluent concentration limits if they exceed 0.5 MGD permitted flow.

Table 6-8. Tar-Pamlico Basin Non-Association Dischargers

Permit	Owner	Facility	Permitted Flow (MGD)	Subbasin HUC	Receiving Stream
Non-Association Domestic Less than 0.05 MGD					
NC0050415	Edgecombe County Schools	Phillips Middle School	0.010	03020101	Moccasin Creek
NC0050431	Edgecombe County Schools	North Edgecombe H S	0.02	03020101	Swift Creek
NC0037885	Nash/Rocky Mount Schools	Southern Nash Junior H S	0.015	03020101	Tar River
NC0047279	C&J Bradshaw LLC	Heritage Meadows WWTP	0.010	03020101	North Fork Tar River
NC0029131	Kittrell Job Corps Center	Kittrell Job Corps Center	0.025	03020101	Long Creek
NC0048631	Interstate Property Mgmt Inc	Long Creek Court WWTP	0.007	03020101	Long Creek
NC0038580	Halifax County Schools	Eastman M School WWTP	0.0048	03020102	Little Fishing Creek
NC0038610	Halifax County Schools	Pittman El School WWTP	0.0096	03020102	Burnt Coat Swamp
NC0038644	Halifax County Schools	Dawson El School WWTP	0.0073	03020102	Deep Creek
NC0037231	Martin County Schools	Bear Grass El Sc WWTP	0.005	03020103	Turkey Swamp
NC0036919	Town of Pantego	Pantego WWTP	0.006	03020104	Pantego Creek
NC0040584	Pantego Rest Home	Pantego Rest Home	0.004	03020104	Pantego Creek
		Total Permitted Flow =	0.1237		
Non-Association Domestic 0.05 to 0.5 MGD					
NC0042510	Total EnvSolutions Inc	Lake Royale WWTP	0.080	03020101	Cypress Creek
NC0025691	Town of Littleton	Littleton WWTP	0.28	03020102	Butterwood Creek
NC0050661	Town of Macclesfield	Macclesfield WWTP	0.175	03020103	Bynums Mill Creek
NC0021521	Town of Aurora	Aurora WWTP	0.12	03020104	South Creek
NC0069426	Dowry Creek Community Assc.	Dowry Creek	0.05	03020104	Pungo River

Permit	Owner	Facility	Permitted Flow (MGD)	Subbasin HUC	Receiving Stream
		Total Permitted Flow =	0.705		
Non-Association Domestic 0.5 MGD or Greater					
None					
Non-Association Industrial Discharging Nutrients					
NC0003255	PCS Phosphate Company Inc	PCS Phosphate Co- Aurora	No Limit	03020104	Pamlico River
			Total Permitted Flow = 0.83		

Nonpoint Source Controls

The Phase II Agreement called for a nonpoint source strategy, which was approved by the Commission in December 1995. The Commission then received annual reports on the progress of implementation under this voluntary plan. The implementation of this strategy is to help meet the instream TN reduction target of 766,228 kg/yr. After two years of implementation, the Commission found that progress was insufficient and initiated rulemaking for nonpoint sources. Modeled after rules implemented in the adjacent Neuse River Basin in 1998, a set of rules addressing agriculture, urban stormwater, riparian buffer protection and fertilizer management went into effect during 2000 and 2001.

Agriculture Rule

Effective September 2001, the **Tar-Pamlico Agricultural Nutrient Control Strategy Rule** and **Law** provides for a collective strategy for farmers to meet nutrient reductions required by the TMDL. Farmers in the basin are to implement land management practices that achieve certain nutrient reduction goals. The goals are a 30 percent reduction in nitrogen loading from 1991 levels within five to eight years of the rule's implementation, and control of phosphorus levels at or below 1991 levels within four years of the approval of a phosphorus accounting methodology. The main agriculture rule details the process and options for achieving the nutrient goals. Implementation relies on cooperation between a Basin Oversight Committee and Local Advisory Committees. The Basin Oversight Committee has representatives from governmental, environmental, farming and scientific communities. It developed a tracking and accounting methodology to gauge progress toward the nutrient goals based on implementation of various nutrient-reducing management practices. The Soil and Water Conservation Commission approved standard practices in 2002 based on the recommendations of a Technical Review Committee and consultation with farming commodity groups. Each Local Advisory Committee, comprised of farmers and local agriculture agency representatives, developed a local strategy and submit annual reports quantifying progress toward the nutrient goals to the Basin Oversight Committee. Farmers, who are involved in the commercial production of crops or horticultural products, or whose livestock or poultry holdings exceed specified numbers, are subject to the rule and are required to register with their local committee. More information about the Agriculture rules are available on the DWQ Non-Point Source Unit's website: **http://portal.ncdenr.org/web/wq/ps/nps/tarpamagrule**.

Implementation Results

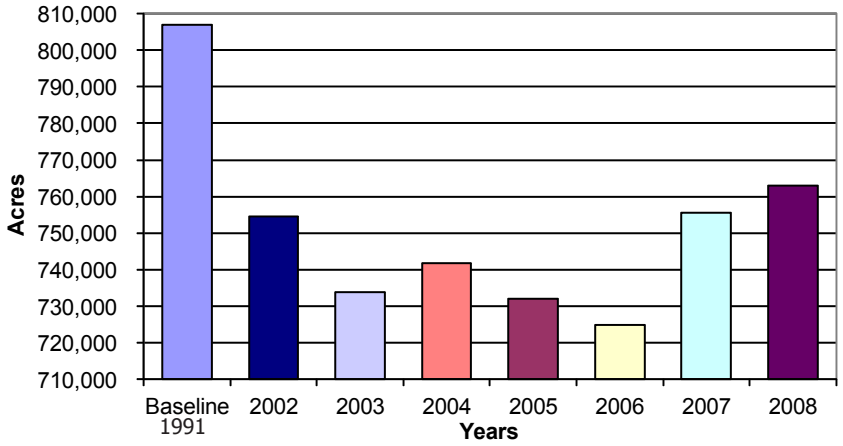
Currently there are five full time Soil and Water Conservation District (SWCD) technicians that work with local farmers on designing BMPs to reduce nutrient runoff from their agricultural operations. These technicians work with Local Advisory Committees (LACs) to coordinate nitrogen and phosphorous management information for the Basin Oversight Committee (BOC) annual reports. Fertilizer information used in these reports are based on best professional judgement and BMPs implemented are often only accounted for if funded through the NC Agricultural Cost Share Program.

In addition to the BOC annual accounting reports, a 319 grant was awarded to NCSU to do an agriculture sample analysis of fertilizer and BMP usage within the basin. The sample analysis conclusions indicate farmers are implementing agricultural practices that minimize their environmental impact. A majority of farmers were found to use a fertilizer plan for a particular crop and did not compensate for soil test results. However, this did not result in an excess of fertilization, except in the application of phosphorus. The reduction of phosphorus fertilizer application is recommended for over 2/3 of the fields. The survey data found that information collected by the LACs tended to over report fertilizer rates, while conservation tillage was under reported. Buffers were found along most stream/field interfaces in the upper portion of the basin while water control structures were more commonly used in coastal areas where topography is suitable. (Osmond et al., 2006). The full report is available here: **Delineating Agriculture in the Tar-Pamlico River Basin**.

The following nitrogen and phosphorus reduction information is summarized from the Basin Oversight Committee Annual Progress Report for Crop Year 2008. The information was collected by the SWCD technicians and summarized to meet annual reporting requirements. This report is available from the Division of Soil and Water Conservation website: **http://www.enr.state.nc.us/dswc/pages/Tar_Annual_Report_CY2008_Final.pdf**

It is estimated that approximately 9,800 acres have been permanently lost to development and more than 31,000 acres have been converted to grass or trees since 1991. Figure 6-4 shows the fluctuation of cropland acres with the 1991 croplands comprising 807,053 acres and over an 11% decrease in 2006.

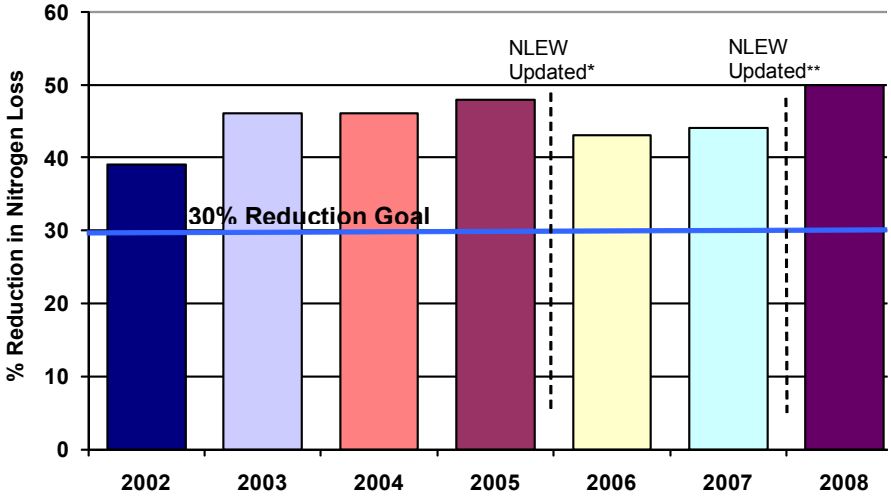
Figure 6-4. Changes in Cropland Acreage



Nitrogen Reductions

All fourteen LACs submitted their first annual report in November 2003, which collectively estimated a 34% reduction in nitrogen, and 10 of 14 LACs individually exceeded the 30%. Collective reductions have gradually increased in succeeding years, and by 2007 only one LAC was shy of the 30% individually. In 2008, all LACs exceeded the 30% nitrogen loss reduction goal. Figure 6-5 shows the percent nitrogen reduction since the implementation of the agriculture rule.

Figure 6-5. Collective Nitrogen Loss Reduction Percent 2002 to 2008



* Between 2005 & 2006 NLEW was updated to incorporate revised soil management units and buffer nitrogen reduction efficiencies were reduced.

** Between 2007 & 2008 NLEW was updated to incorporate revised soil management units and correct some realistic yield errors.

Nitrogen reductions are estimated using the Nitrogen Loss Estimation Worksheet (NLEW); the calculations represent county-wide nitrogen loss from cropland agriculture. NLEW captures application of both inorganic and animal waste sources of fertilizer to cropland. It does not capture the effects of managed livestock on nitrogen movement, including pastured, confined, and non-commercial livestock. NLEW is an "edge-of-management unit" accounting tool; it estimates changes in nitrogen loss from croplands, but does not estimate changes in nitrogen loading to surface waters. Table 6-9 shows the percentage of nitrogen loss reductions through the combination of fertilization rate decreases, cropping shifts, BMP implementation and cropland attenuation.

Table 6-9. Factors Influence on Nitrogen Reduction by Percentage on Agricultural Lands

	2005	2006	2007	2008
BMP implementation	10%	8%	10%	10%
Fertilization Management	21%	20%	20%	21%
Cropping shifts	10%	7%	8%	10%
Reduction in cropland due to idle land	*%	4%	3%	4%
Reduction in cropland due to cropland conversion	*%	3%	2%	4%
Reduction in cropland due to development	*%	1%	1%	1%
TOTAL	**48%**	**43%**	**44%**	**50%**

*Not calculated prior to 2006.

Agriculture Phosphorus Reductions

Phosphorus Technical Advisory Committee (PTAC) developed recommendations for qualitative tracking of relative changes in land use management that either increase or decrease the risk of phosphorus loss from agricultural lands in the basin on an annual basis. The phosphorus predicted loss or gain is shown for several land management practices in Table 6-10. Most parameters indicate less risk of phosphorus loss than in the baseline. Contributing to the reduced risk of phosphorus loss is the increase of nutrient reducing BMPs in the basin. As indicated in the table below, the acres affected in the basin by vegetated buffers and water control structures have steadily increased. It should also be noted that the median phosphorus soil test number reported for the basin fluctuates each year due to the nature of how the data are collected and compiled. The BOC has reviewed the data and determined there has not been an increase risk of phosphorus loss.

Table 6-10. Agriculture Land Use Phosphorus Changes

Parameter	Units	1991 Baseline	2005	2006	2007	2008	1991-08 % Change	2008 P Loss Risk +/-
Agricultural land	Acres	807,026	732,139	724,778	755,489	763,066	-5.4%	-
Cropland conversion (to grass & trees)	Acres	660	22,369	23,083	20,754	31,110	4712%	-
CRP / WRP (cumulative)	Acres	19,241	25,921	30,768	34,614	38,375	199%	-
Conservation tillage	Acres	41,415	362,102	362,102	66,079	31,421	24%	-
Vegetated buffers (cumulative)	Acres	50,836	193,867	195,673	210,488	214,043	421%	-
Water control structures (cumulative)	Acres Affected	52,984	75,980	75,641	79,167	80,418	152%	-
Scavenger crop	Acres	13,272	80,604	97,405	120,565	109,741	827%	-
Animal waste P	lbs of P/yr	13,597,734	14,064,368	14,728,831	14,626,960	NA		+
Soil test P median	mg/kg	83	85	85	89	89	107%	+

Stormwater Rule

The stormwater rule which became effective in April 2001, required six municipalities and five counties in the Tar-Pamlico Basin to develop and implement stormwater programs within two and a half years. The municipalities are: Greenville, Henderson, Oxford, Rocky Mount, Tarboro, and Washington. The counties are: Beaufort, Edgecombe, Franklin, Nash, and Pitt. These local governments were identified based on their potential nutrient contributions to the Pamlico River Estuary. The EMC may add other local governments as appropriate in the future through rule-making. Local programs are to include the permitting of new development to reduce nitrogen runoff by 30 percent compared to pre-development loading conditions, and to keep phosphorus inputs from increasing from 1991 levels. The local programs must also identify and remove illicit discharges, educate developers, businesses, and homeowners, and make efforts toward treating runoff from existing developed areas. More information about the stormwater rules are available on the DWQ Non-Point Source Unit's website: http://portal.ncdenr.org/web/wq/ps/nps/tarpamstorm.

New Development Nutrient Offset

Under the requirements of the rule, the nutrient export goal for new development projects is limited to a total nitrogen export of 4 lbs/acre/yr and 0.4 lbs/acre/yr of total phosphorus with limits on peak flows to not exceed the predevelopment conditions for the 1-year 24-hour storm. The lbs/ac/yr export target represents the 30% reduction goal applied to new development. It represents a 30% reduction from the average pre-development loading conditions. The nitrogen export goal is achieved through a combination of site design and the use of on-site best management practices (BMPs). Developers also have the option to offset the nutrient export offsite by making offset payments to a private party with available offset credits or by making payments to the North Carolina Ecosystem Enhancement Program (NCEEP) nutrient offset program. If the nitrogen export for a planned project site is calculated to be greater than 6.0 lbs/ac/yr or 10.0 lbs/ac/yr for residential or commercial development respectively, the developer must first implement onsite BMPs or take part in an approved regional or jurisdiction-wide stormwater strategy to lower the nitrogen export to at least those levels before being allowed to "buy down" the remainder of their nitrogen export to the lbs/ac/yr target through either a private party with approved nutrient offset credits or the NCEEP nutrient offset program.

Implementation Results

By 2006, each of the six local governments subject to the Tar-Pam Stormwater Rule adopted and implemented their local permitting programs requiring new development projects to control stormwater runoff. The City of Washington was the last municipality to adopt a local stormwater ordinance in April 2006. The other municipalities implemented their stormwater programs in 2004 and began reporting to DWQ in 2005. As of April 2010, EEP has received 94 nutrient offset payments totalling over $1.2 milllion for new development projects to offset ~50,630 lbs of nitrogen and ~3,542 lbs of phosphorus from the Tar-Pamlico River Basin.

A number of public education programs have been implemented in the various communities, as required under the rule. All of the local governments under the rule are supporting partners of the Clean Water Education Partnership (CWEP) which is a cooperative effort between local governments, state agencies, and nonprofit organizations to educate the general public about water quality in the Tar-Pamlico, Neuse, and Cape Fear River Basins. The education and outreach programs conducted include workshops, development of web sites, newsletters, brochures, storm drain stenciling, participation at school programs such as science fairs, field days, development of environmental fact sheets, and implementation of demonstration projects for stormwater control. Several communities have also partnered with other agencies such as the NC Cooperative Extension Service and local Soil and Water Conservation Districts to aid in the development of their public education and outreach programs.

All of the local governments subject to the Tar-Pamlico Stormwater Rule have also developed ordinances and programs that, in addition to requiring the nutrient export goal be met, establish

local authority for the removal of illegal discharges. This includes establishing a 24-hour hotline the public can use to report an illegal discharge. Each local program is also responsible for maintaining a database that tracks illicit discharge detection and removal activities, and a number of local governments have noted in their annual reports to DWQ that this element of the stormwater program has resulted in the removal of several illicit dischargers to date.

Each reporting year, local governments also identify a pre-set number of viable stormwater retrofit sites for existing developments in their jurisdictional areas. These sites are made available to groups that may have funding to implement retrofit activities for nitrogen reduction. In addition to identifying retrofit sites, a few local governments have reported activities completed or underway that have worked to reduce existing nitrogen loading. One example of such an effort is the development of local programs to buy out properties in floodplain areas and restore these areas to natural conditions for water quality improvements.

Buffer Rule- Protection and Maintenance of Existing Forested Riparian Areas

A set of three buffer rules were adopted. The main rule, called the buffer protection rule, requires that existing vegetated riparian buffers in the basin be protected and maintained on both sides of intermittent and perennial streams, lakes, ponds, and estuarine waters. This rule does not establish new buffers unless the existing use in the buffer area changes. The footprints of existing uses such as agriculture, buildings, commercial and other facilities, maintained lawns, utility lines, and on-site wastewater systems are exempt. A total of 50 feet of riparian area is required on each side of waterbodies. Within this 50 feet, the first 30 feet referred to as Zone 1 is to remain undisturbed with the exception of certain activities; the outer 20 feet referred to as Zone 2 must be vegetated, but certain additional uses are allowed. Specific activities are identified in the rule as “exempt”, “allowable”, “allowable with mitigation” or “prohibited”. Examples of “exempt” activities include driveway and utility crossings of certain sizes through Zone 1, and grading and revegetation in Zone 2. “Allowable” and “allowable with mitigation” activities require review by Division staff and include activities such as new ponds in drainage ways and water crossings. The other two buffer rules are the buffer mitigation rule and the buffer program delegation rule. The mitigation rule defines the process applicants would follow to gain approval for activities that are identified in the buffer protection rule as “allowable with mitigation”. It also outlines acceptable mitigation measures. The delegation rule lays out the criteria and process for local governments to obtain authority to implement the buffer rules within their jurisdictions. More information about the Buffer rules are available at: **http://portal.ncdenr.org/web/wq/swp/ws/401/riparianbuffers**.

Implementation Results

Since implementation of the Tar-Pamlico buffer rule there have been a total of 36 general major variances and 59 minor variances. A major variance request pertains to activities that are proposed to impact any portion of Zone 1 or any portions of Zone 1 and Zone 2 of the riparian buffer. A minor variance request pertains to activities that are proposed only to impact any portion of Zone 2 of the riparian buffer.

Buffers are not necessarily part of permitted activity that DWQ tracks through a permit number and DWQ has limited ability to monitor for buffer compliance. DWQ often relies on notification from other agencies or citizen reports and therefore, the true number of buffer impacts that exist in NC are difficult to determine. Most site visits that determine the presence of buffer impacts are reported in a DWQ Notice of Violation. There is always the potential for a buffer impact to result in an enforcement case. DWQ began tracking buffer enforcement cases in 2005. Records indicate that from 2006 through July 2009 there were nine enforcement cases. Of these nine enforcement cases, approximately $81,000 in civil penalties were assessed. Also, during this time, 92 buffer violations that were reported resulted in approximately 176,965 ft^2 of impacted buffers. It is important to recognize that not all NOVs reported the length of buffer impacts; therefore, the

total length of impacted buffers within these years is difficult to determine. DWQ intends to improve the database currently used for tracking buffer compliance to include the length of buffer impacted at each site visit, a description of the type of buffer impact, and impacted buffer location information. These improvements to the database will hopefully allow DWQ to be better measure the success of the buffer rules on reducing nutrient loading.

Delegation of local authority for implementing the buffer rule was granted to Pitt County in 2006 and their ordinance became effective January 1, 2007.

Nutrient Management Rule

The nutrient management rule requires people who apply fertilizer in the basin, except residential landowners who apply fertilizer to their own property, to either take state-sponsored nutrient management training or have a nutrient management plan in place for the lands to which they apply fertilizer. The rule applies to fertilizer applicators, people who own or manage fertilized lands, and consultants who provide nutrient management advice. More information about the Nutrient Management rules are available on the DWQ Non-Point Source website: **http://portal.ncdenr.org/web/wq/ps/nps/tarpamnutrman**.

Implementation Results

Over the winter of 2005 and 2006, 1,969 fertilizer applicators in the Tar-Pamlico River Basin were trained in nutrient management. Training courses were held in 14 counties and applicators attended a 4 hour training and certification program. Trainings are given on an as needed basis. The effectiveness of this program is not known, however expanding this program to include education materials for homeowners is an opportunity to reduce nutrients especially as agricultural land is converted to residential. Recently, in several states, new lawn fertilizer ordinances regulating nitrogen and phosphorus application rates have been adopted at county and municipal levels.

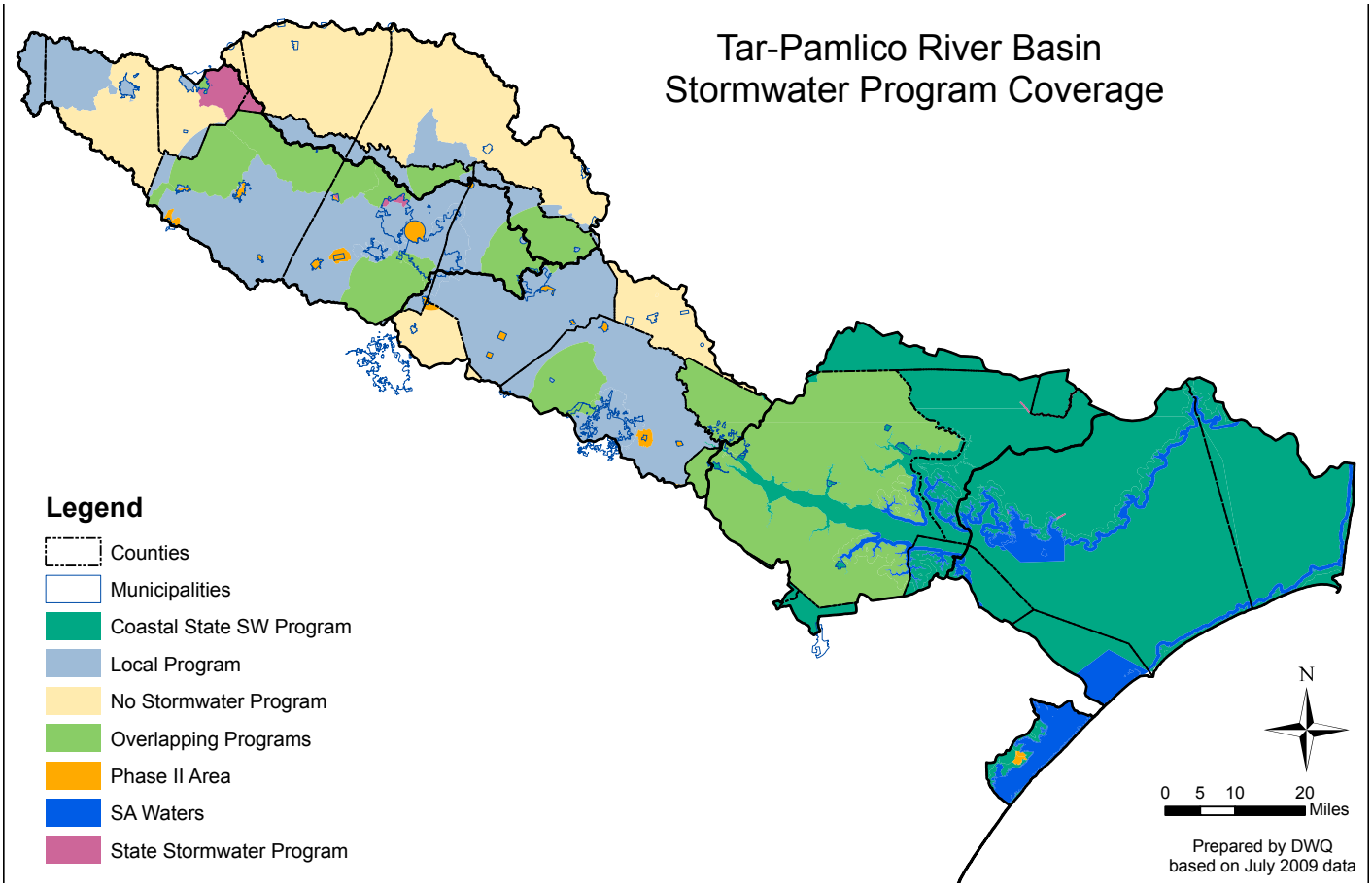
Strategy Analysis and Opportunities for Additional Nutrient Reductions

New Development Stormwater Rule

The Tar-Pamlico stormwater rule establishes a nutrient export goal of 4.0 lbs/ac/yr of TN and 0.4 lbs/ac/yr of TP for new residential and commercial development projects within the planning and zoning jurisdictions of six of the largest and fastest-growing local municipalities and five counties within the basin. Each of these local governments has successfully implemented its stormwater program since 2006 and continues to achieve the nutrient export target through a combination of onsite BMPs and off site nutrient offsets. DWQ has begun to assess the extent to which the stormwater rule does not address new development activities in the basin. A key factor in this assessment is determining the impact of increases in population and the corresponding growth in residential and commercial development activities in municipalities and counties that are currently not subject to the stormwater rule.

Approximately 55% of the basin is covered by either Phase II or the NSW stormwater rules, 1% is covered by solely ORW or Water Supply Watershed stormwater regulations, 19% by Coastal stormwater rules and 23% of the basin has no stormwater program. Nutrient stormwater controls are in place for only 54% of the basin. Figure 6-5 shows how the stormwater programs are distributed throughout the basin, more detailed maps are found within the subbasin chapters.

Figure 6-5. Stormwater Programs in the Tar-Pamlico River Basin



The requirements of Phase II stormwater regulations and the Tar-Pamlico NSW Stormwater Rule do share some similarities; both include provisions for implementing illicit discharge detection and elimination programs, public outreach and education, and some type post construction stormwater controls. However, there are additional protective measures provided for in the NSW Stormwater Rules that specifically address nutrients that are not present in the Phase II regulations. While Phase II stormwater regulations do not currently address nutrients, DWQ could consider including nutrient requirements under Phase II programs when existing permits are renewed or future Phase II designations are made. Table 6-11 details the population growth of the municipalities with a population greater than 500 as of July 2008 and their corresponding stormwater program, if applicable.

Table 6-11. Stormwater Programs in Municipalities with Populations* >500

	April	July	Growth		NPDES Phase II	NSW Stormwater Rules	Coastal Stormwater Rules	State Stormwater Program	Water Supply Watershed Stormwater Requirements
Municipality	2000	2008	Amount	%					
Greenville	61,209	81,092	19,883	328	local	X			X
Rocky Mount	55,977	59,228	3,251	6	local	X			X
Princeville	940	2,368	1,428	152	post				
Oxford	8,338	9,426	1,088	13		X			
Franklinton	1,745	2,497	752	43	local/post				X
Washington	9,619	10,216	597	6		X	X		
Youngsville	651	1,211	560	86	post				
Louisburg	3,111	3,608	497	16	local/post			X	X
Nashville	4,417	4,841	424	10	local				X
Red Oak	2,723	2,991	268	10	local			X	
Sharpsburg	2,421	2,612	191	8	post				
Henderson	16,095	16,273	178	1	local	X			
Warrenton	811	922	111	14					
Dortches	809	873	64	8	post				
Bethel	1,760	1,809	49	3	post				
Spring Hope	1,261	1,307	46	4	local/post				
Fountain	533	578	45	8	post				
Aurora	583	565	-18	-3			X		
Belhaven	1,968	1,945	-23	-1			X		
Littleton	692	668	-24	-3					
Norlina	1,107	1,082	-25	-2					
Chocowinity	733	706	-27	-4			X		
Elm City	1,412	1,373	-39	-3					
Whitakers	799	758	-41	-5	post				
Enfield	2,370	2,250	-120	-5					
Pinetops	1,419	1,277	-142	-10	post				
Robersonville	1,731	1,589	-142	-8					
Scotland Neck	2,362	2,195	-167	-7					
Tarboro	11,138	10,383	-755	-7	local	X			

local= local program satisfies Phase II requirements

post=subject to Phase II post construction

*NC Office of State Budget and Management http://www.osbm.state.nc.us/

Table 6-12 lists county population and growth rates. Counties shaded are subject to the Tar-Pamlico NSW Stormwater Rules in the unincorporated areas of the county.

Table 6-12. County Population Estimates*.

County	April 2000 Estimate	July 2008 Estimate	Growth Amount	Growth Percent	Projected 2020 Population
BEAUFORT	44,958	46,590	1,632	3.6	49,100
CARTERET	59,386	63,520	4,134	7	65,589
DARE	29,967	33,955	3,988	13.3	31,248
EDGECOMBE	55,606	51,800	-3,806	-6.8	51,223
FRANKLIN	47,260	57,923	10,663	22.6	70,900
GRANVILLE	48,498	56,250	7,752	16	63,644
HALIFAX	57,374	55,217	-2,157	-3.8	54,222
HYDE	5,826	5,516	-310	-5.3	5,066
MARTIN	25,546	23,870	-1,676	-6.6	22,792
NASH	87,385	93,981	6,596	7.5	108,955
PAMLICO	12,934	12,892	-42	-0.3	12,786
PERSON	35,623	37,510	1,887	5.3	38,576
PITT	133,719	155,570	21,851	16.3	200,135
VANCE	42,952	43,502	550	1.3	43,919
WARREN	19,972	19,918	-54	-0.3	19,765
WILSON	73,811	78,917	5,106	6.9	92,253

*NC Office of State Budget and Management http://www.osbm.state.nc.us/

DWQ also recognizes that greater oversight of local stormwater programs by the state should provide more assurance of full implementation of the rule as well as provide better data to assess the effectiveness of the rule and its various components. One method being considered by staff is conducting periodic audits of each individual stormwater program. The audits would serve to help identify improvements needed in both implementation and reporting.

In addition to the rule's geographic coverage limitations, it does not set a quantitative reduction target for nitrogen loading from existing developed lands. According to land cover data collected by the National Resources Inventory (NRI), as of 1997 approximately 7% of the entire basin is considered developed. Since the current nutrient strategy addresses stormwater from new development starting in 2006, the stormwater runoff from these ~200,000 acres, plus any lands developed between 1997 and 2006, and any land developed after 2006 on which a vested development right was established, has not been subject to the rule. The great majority of these lands are not being treated to achieve nutrient reductions. Treating nutrient runoff from existing development through stormwater retrofit BMPs and other load reducing measures, both structural and management oriented, represents a real opportunity to further reduce existing nutrient loads to the basin from this significant source. A rule to address nutrient contributions from stormwater runoff from existing development could provide municipalities opportunities to receive nutrient reduction through practices such as removing existing impervious cover, buffer restoration, street sweeping, and removal of illicit discharges, in addition to structural retrofits.

There are also potential low cost opportunities to address existing sources of nutrients in runoff from existing development. Existing sources include nutrients from pet waste and over fertilization of turf and landscape areas. Controls could be incorporated into local stormwater programs and ordinances to address these two sources of nutrients. Educational opportunities should be incorporated into established local stormwater programs' public education and outreach requirement. Some local governments in North Carolina already implement pet waste ordinances. Local governments in other parts of the country are beginning to place limitations on home fertilizer use with success as well. One example is the Minnesota phosphorus fertilizer law

(18C.60, MN Statutes 2006) which prohibits use of phosphorus lawn fertilizer unless new turf is being established or a soil or tissue test shows need for phosphorus fertilization.

Agriculture Rule

The progress achieved by the agriculture sector in implementing the Tar-Pamlico Agriculture Rule is well documented in the Annual Agricultural Progress Reports submitted to the EMC every fall since 2003. As of 2002, the agriculture sector exceeded its collective 30% nutrient reduction goal and in 2008 reported a 50% reduction in estimated nitrogen loss to the basin through a combination of BMP implementation, crop shifts, fertilization rate reductions, and loss of overall cropland acres. During implementation, improvements have been made to the accounting of these reductions as more research and data becomes available concerning the effectiveness of agriculture BMPs. Opportunities remain for further improvement to the accounting process and fuller accounting of contributing agricultural sources.

DWQ staff will continue to consult with university researchers and Division of Soil and Water Conservation staff as more data becomes available concerning the efficiencies of agricultural BMPs and how this information can be used to further refine the nutrient reduction credits applied under the current program. In addition to revisiting BMP efficiencies, DWQ plans to continue collaborating with an interagency workgroup started in 2007 to identify methods to better track land use changes. Specifically, staff will be working to develop a “whole basin” land accounting strategy that will work to ensure that accounting for land that goes out of agriculture does not result in double counting of nutrient reductions.

The agricultural Basin Oversight Committee (BOC) was established to oversee the required agricultural nutrient reductions in the Tar-Pamlico basin in response to the NSW strategy. The Agricultural Nutrient Control Strategy (15A NCAC 02B. 0256) describes the role and expectations of the BOC and the Local Advisory Committees (LACs). The BOC develops and approves an annual report based on information provided by the LACs, summarizing local nitrogen and phosphorus loadings and estimated nutrient reductions based on implemented BMPs in the watershed. According to the rule, the accounting methodology shall provide for quantification of changes in nutrient loading due to changes in agricultural land use, modifications in agricultural activity, or changes in atmospheric nitrogen loading to the extent allowed by advances in technical understanding (15A NCAC 02B. 0256. (f)(3)(E)) and this should be done with sufficient detail to allow for compliance monitoring at the farm level. However, the approved accounting methodology supports aggregated county-wide nutrient accounting in the annual reports. Given the requirements of the agricultural rule, it is recommended that the BOC incorporate in their annual accounting estimates adjusted N rates from ammonia deposition and second year N availability contributions, when the data are available.

One potential limitation of the agriculture rule involves pastured livestock nitrogen contributions. Nutrient loading from pasture-based livestock operations has not been well characterized generally, including in NC, and the accounting tool used for rule compliance does not include the ability to quantify the effects of livestock management on nitrogen loading. Additional research is still needed to better quantify the nutrient benefits of various pasture management practices like fencing out livestock, pasture renovation and restoring riparian buffers. Encouraging the use pasture BMPs could represent an opportunity to achieve additional nutrient reductions.

In addition to better potential nutrient loading from pastures, staff also recognizes the need to better understand the role that artificial drainage, such as subsurface tile drains, plays in contributing nutrient loads to the basin. The interception of shallow ground water beneath agricultural fields through tile drains to ditches can increase nitrogen loading into receiving streams by allowing the runoff to bypass BMP treatment. Quantifying the extent of the drains has proven challenging because tile drain maps are either outdated or nonexistent. Additional research is needed to determine the location and geographic extent of tile drains along with

mitigation options. Better management of tile drains represents an opportunity for improvement that could result in additional nutrient load reductions. Identification of functioning drainage districts and the types of activities being used to maintain drainage within agricultural lands is also needed to help describe conditions near DWQ monitoring sites.

There is also a need to better understand the potential magnitude of nutrient loading from animal housing, holding, waste storage facilities and sprayfields used by confined animal feeding operations (CAFOs), such as dairies, hog farms, and poultry operations. Subsurface seepage from waste lagoons and ammonia emissions from CAFOs are also not captured under the NSW agriculture rule, but are to some degree addressed under other state rules and programs addressing animal operations. The location of hog and cattle CAFOs are known due to the fact that an NPDES permit is required by DWQ. While their direct nutrient contribution is not currently well understood, knowing that these sources exist in the watershed can help water quality managers to better understand the available water quality data and make better regulatory recommendations and decisions.

Due to a hog farm moratorium put in place in 1997 and a new law passed in 2007 prohibiting the construction of new hog waste lagoons and spray fields as the primary method of waste management (SB 1465), nutrient contributions from hog operations have remained fairly constant over the last several years. However, the continued growth in the poultry industry in the coastal plain of NC is adding to the current nutrient loading from non-point sources. Most poultry operations produce a dry litter by-product which is not regulated. The locations of poultry operations and the disposal of their waste is not known to environmental regulators due to the fact that there are no permitting requirements, making it very difficult to get a complete picture of the possible non-point sources contributions within a specific watershed. This makes managing and protecting water quality more challenging.

The 2007 USDA census data indicates in 2007 there were 7,370,874 chickens in the Tar-Pamlico basin. The number of chickens has likely increased by at least another 3,000,000 totaling over 10,000,000 chickens due to the Rose Acres egg farm continuing to stock their facility. This would result in an increase of at least 35% since 2002. The data that is currently available for the Rose Acres Farm indicates that poultry operations are likely having an impact on the water quality in the Tar-Pamlico River Basin and other coastal basins. It is estimated that 40% of the nitrogen entering the Albemarle-Pamlico Sound originate from atmospheric sources (DENR-DAQ, 1999; Costanza et al., 2008). Due to the prevailing wind direction, the highest nitrogen depositional rates from CAFOs are in the Neuse and Tar-Pamlico watersheds (Costanza et al., 2008). This is likely to increase overtime with the continued growth of the poultry industry in coastal North Carolina.

Point Source Rule

Even though the point sources are meeting their yearly cumulative cap limits, efforts should be focused on achieving Best Available Technology levels within their facilities. The 2014 permit renewal process will include individual permit limits.

Nutrient Contributions from Land Application Sources of Waste

Indirect nutrient loads from point sources and agriculture through groundwater is likely a significant source of nutrient loading to the Pamlico River Estuary. There is a limited amount of research available that quantifies changes and the amount of nutrient contributions from groundwater to surface waters in the basin. Initial research indicates that land application of treated wastewater, biosolids from municipal wastewater treatment systems, and animal waste from confined animal feeding operations (CAFOs) are all considered likely sources of nutrients found in groundwater in the Tar-Pamlico River Basin.

The predominant wastewater treatment systems used at swine CAFOs are lagoons and sprayfields, in which waste is flushed from confined animal housing units into large waste lagoons and then periodically sprayed onto agricultural fields. Similarly, municipal wastewater treatment plants commonly land apply the sludge that is a by-product of the treatment process to agriculture fields as a means of disposal. In both cases the nitrogen contained in the land-applied products will either be assimilated by crops, volatilize into the atmosphere, run off into adjacent streams, or infiltrate into the groundwater system and eventually discharge into streams in the basin (Paerl et al., 2002).

Point sources

As the demand for wastewater treatment increases with population growth, the dischargers will still have to comply with the nutrient reduction goals. DWQ requires new and expanding NPDES permit applicants to consider non-discharge alternatives such as spray irrigation, rapid infiltration basins and drip irrigation systems. Land application of treated wastewater is likely to increase as a means of complying with this rule. Evaluation of the extent that land application may be yielding a net increase in nutrient loading is needed. A better understanding of land application program compliance and compliance criteria is also needed to quantify nutrient loading.

High-rate infiltration

High-rate infiltration systems are a variation of land application systems that have become a growing practice in the coastal plain. These systems are being proposed to address wastewater needs of some new developments where receiving waters would not accommodate direct discharge of treated wastewater and no POTW is available. The new nutrient load from these systems is not captured by the point source rule or other strategy accounting mechanisms. Concerns have been raised about the system's use of landscape features to treat effluent prior to entering the surface waters. Nutrient contributions to surface waters from these systems have not been well quantified.

Biosolids

Residuals, biosolids or treated sludge are by-products of the wastewater treatment process. After pathogen reduction, vector attraction reductions and metal limits are met, these residuals are disposed in a manner to protect public health and the environment. Disposal sites include land fills, dedicated and non-dedicated residual disposal sites, agricultural land for crops not for human consumption, and distribution to the public for home use. When applied to the land, steps must be taken to assure that residuals are applied at or below agronomic rates based on the soil and crop types present at the disposal site. Class B residuals are monitored by DWQ and are applied to fields at agronomic rates. Class A residuals are not monitored by DWQ but can also contribute nitrogen and phosphorus loading within the basin which are not currently accounted for. Additional research would be necessary to determine if organic nitrogen from biosolids is contributing to the basinwide increase in organic nitrogen.

A recent example of how nutrient loading to groundwater can occur from land application of biosolids is the situation at Novozymes in Franklin County. The facility has nitrate-nitrogen groundwater standard exceedances and is likely discharging off-site into local surface waters. The current leaching from the site is a result of past applications >10 years ago and has not been quantified. Novozymes has initiated a groundwater treatment system to address contaminated groundwater. Novozymes' wastewater, now low in nitrogen, is applied to approximately 900 acres of sprayfields. They also have a Class A equivalent biosolids permit for spent biomass (another source of N) from their industry process. These systems provide primary treatment of the wastewater along with some means of disinfection and then they dispose of the treated wastewater on irrigation fields.

While most regulations require that land application not exceed realistic yield-based agronomic

rates, studies have shown that nitrate concentrations are higher in groundwater under crop fields sprayed with animal wastes than in groundwater beneath crop fields fertilized with commercial fertilizers (Spruill, 2004). Ideally, nutrient application should be based on crop needs and, for a given crop, there should be no difference in nitrogen loss between nutrient types applied. Given that the use of land application is expected to continue, and in light of the projected increase in human population in the Tar-Pamlico Basin, the continued use of this waste disposal method from such high volume sources highlights the importance of seeking a better understanding of the relative impacts of these practices on nutrient loading to surface waters.

Export of land-applied nutrients to surface waters, whether originating from municipal, commercial, or animal facility is enhanced when the field in question has artificial drainage systems like tile drains. The NLEW accounting tool used for agriculture rule compliance does not capture the effects of drain tiles nor does it reflect the research findings cited above regarding nitrogen concentrations under waste-applied fields.

While not part of the Tar-Pamlico NSW agriculture rule, there are other state rules that regulate land application. These include the 15A NCAC 2T rules, which specify requirements for systems that treat, store and dispose of wastes that are not discharged to surface waters of the state. These rules went into effect in 2006 and replaced the ".0200" or non-discharge rules. While these regulations do not contain nutrient reduction requirements and were not developed to specifically address the 30% nitrogen reduction goal, the rules do require management practices that could help reduce nutrient inputs in the Tar-Pamlico Basin from land application operations.

In addition, in 2007 the NC General Assembly incorporated the findings of the Smithfield Agreement into Senate Bill 1465 (Session Law 2007, Section 523). Senate Bill 1465 prohibits permitting of a new or expanding swine management system utilizing an anaerobic lagoon and sprayfield as the swine farm's primary method of treatment. Senate Bill 1465 also charged the Environmental Management Commission (EMC) to adopt rules to make the performance standards permanent thus allowing for the construction of innovative swine waste management systems for either new farms or for expansion of existing farms. The swine waste management system performance standards are to:

- Eliminate swine waste discharge to surface water and groundwater through direct discharge, seepage or runoff,
- Substantially eliminate atmospheric emission of ammonia,
- Substantially eliminate odor detectable beyond the swine farm property boundaries,
- Substantially eliminate disease-transmitting vectors and pathogens, and
- Substantially eliminate nutrient and heavy metals in soils and groundwater.

In 2007, a petition filed by several environmental groups requested monitoring requirements for general permits for animal feeding operations to ensure compliance with non-discharge effluent limitations. This petition for rulemaking resulted in a public stakeholder process that generated draft rules requiring CAFO facilities to develop monitoring plans that would serve to track the performance of the permitted system, verify that the system is protective of surface water standards and document water quality parameter concentrations in adjacent surface waters and compliance with permit discharge limitations. As of summer 2010 these rules are still draft and it is likely that DWQ and US Geological Services (USGS) will coordinate to do monitoring at swine CAFOs over a two year period. Although, this monitoring is not directly related to the 30% nitrogen reduction goal, the information collected will provide valuable information that will be useful in identifying high priority areas of nutrient inputs from animal waste land application sites.

Nutrient Contributions from Onsite Wastewater Systems

In addition to land application of waste as a potential nutrient source, initial evidence suggests that residential on-site wastewater systems may be a source of nutrients in the basin. A study conducted by researchers at the NCSU Department of Soil Science provided potential nitrogen

loading numbers generated by households in the basin that use onsite wastewater systems. It estimates that approximately 49% of households in the Tar-Pamlico River Basin use onsite systems, and the cumulative nitrogen load generated by these systems is 1.76 million lb N/yr (Pradham, 2007). While the study is somewhat limited in that it used 1990 Census data, were this magnitude of loading delivered directly to streams it would rival that delivered to the Pamlico estuary by all other sources combined. Of course these disposal systems rely on nitrogen removal through landscape processes, primarily denitrification and plant uptake. These processes are believed to remove the vast majority of nitrogen generated by onsite systems before it reaches surface waters. However, such landscape processes are variable in nature, and a question requiring additional study is quantifying the extent to which such ground absorption systems may increase N loading to streams as compared to centralized collection of wastewater, and under what landscape conditions. A second question, which is discussed in the following section, involves understanding the temporal pattern of nitrogen movement through groundwater to surface water toward better understanding the relationship between population increases and nitrogen delivery to streams.

One study that begins to answer this question is an unpublished study conducted through a joint effort between the North Carolina Division of Public Health and the United States Geological Survey (USGS) compared the effects of onsite and offsite wastewater treatment on the occurrence of nitrogen in the Upper Neuse River Basin. It concluded that onsite systems contribute slightly more nitrogen to the nutrient load in recharging surface water than the load contributions from similar residences served instead by municipal sewer systems (Grimes & Ferrell, 2005). In light of these findings it is evident that additional research in this area is needed to better quantify the role on-site wastewater treatment systems play in contributing nitrogen to the Tar-Pamlico River Basin.

Nutrient Loading from Groundwater

An area of growing interest involves improving our understanding of the role of groundwater in nutrient loading to the estuary. Harden and Spruill (2008) reported that in North Carolina's Coastal Plain, shallow groundwater contributes at least 40 percent of the average annual stream flows. They have found that nutrient delivery to surface waters via groundwater can be influenced by various environmental, hydrogeological and geochemical factors.

The denitrification processes was shown to be the most significant factor responsible for decreasing groundwater nitrate concentrations. Additional factors influencing the groundwater nitrate concentrations included soil drainage, presence or absence of riparian buffers, evapotranspiration, fertilizer use, groundwater recharge rates and residence times, aquifer properties, subsurface tile drainage, sources and amount of organic matter and hyporheic processes (Harden and Spruill, 2008). They also reported that in the NC Coastal Plain, the nitrate reducing capacity of the buffer and hyporheic zones combined, substantially lowered the amount of groundwater nitrate discharged to streams from agricultural settings. However, the beneficial effects from these denitrification zones was greatly diminished by the presence of subsurface tile drainage that allows groundwater to bypass these natural streamside buffers and organic carbon-rich streambed (Harden and Spruill, 2008).

While there are no specific studies for the Tar-Pamlico River Basin, a study published by USGS in 2008, estimates groundwater nitrogen flux into the Neuse River Estuary and reported nutrient fluxes from groundwater to the estuary account for 6% of the nitrogen inputs derived from all sources and approximately 8% of the nitrogen annual inputs from surface-water inflow to the Neuse River Estuary (Spruill and Bratton, 2008).

In 1997, Spruill presented results from the U.S. Geological Survey's National Water Quality Assessment study indicating that groundwater was also a significant source of phosphorus loading in Coastal Plain streams of the Albemarle-Pamlico drainage basin. He reported that the

concentrations of phosphorus were significantly higher in discharging groundwater (median = 0.23 mg/L) than in surface water (median = 0.07 mg/L) and that shallow groundwater typically had lower concentrations (median = ≤ 0.01 mg/L) than deeper groundwater (median = 0.2-0.3 mg/L) (Spruill, 1997).

The nitrogen and phosphorus loads delivered by groundwater were not identified as part of the Tar-Pamlico TMDL, nor assigned a reduction requirement. This was in part because quantitative knowledge was limited at the time on either direct groundwater flux into the estuary or the makeup of groundwater's contribution to loading into basin streams. In addition, from a management standpoint DWQ views groundwater primarily as a pathway rather than a source, and currently we look to manage inputs to this pathway rather than considering treatment of groundwater itself. Over sufficient time, the groundwater nitrogen flux should respond to reductions in landscape inputs. Research is increasingly showing that deeper groundwater flow paths may take on the order of decades to express themselves as surface discharges. This raises several questions including:

- Can we characterize the temporal pattern of groundwater nitrogen delivery to streams?
- Can we reliably monitor changes to both stream and estuary nitrogen inputs over time?
- To what extent have the Tar-Pamlico nutrient rules and other regulations resulted in reductions to landscape N and P inputs?

To begin answering these questions, we recognize that the set of landscape activities that add nitrogen to groundwater are primarily the variety of human and animal waste disposal and crop fertilization activities mentioned in sections above. An additional contribution is the overlay of atmospheric deposition of nitrogen across the landscape, as described in the following section. Much of these groundwater additions occur under the practice of agriculture. The agriculture rule focuses on surface water and does not require reduction of groundwater N inputs by 30%. Certain practices used to meet the agriculture rule, primarily decreasing N fertilization rates, should decrease groundwater N concentrations. Applying the 30% goal to N application would be problematic since the business of growing crops relies on certain application rates, and crops have inherent N use efficiencies that result in the loss of a fraction of that N, often on the order of half, to groundwater. But we believe that actions taken by producers to comply with the Tar-Pamlico agriculture rule should yield decreases in cropland N contributions to groundwater. Similarly, as detailed in the previous section, other regulations should result in decreased groundwater N inputs. The state CAFO regulations initiated in the mid-1990's have yielded significant decreases in waste N land application rates. Changes to residuals application included in the 2T rules should yield similar reductions to application rates for this activity.

The other questions will require us to pursue knowledge improvements by seeking additional monitoring and research into groundwater-to-surface water N dynamics. It will be important to assess the magnitude of contributions through this pathway over years and decades.

Nutrient Loading from Atmospheric Deposition

Atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_3) is a significant source of nitrogen input into North Carolina's coastal nutrient sensitive estuaries and sounds (Whitall and Paerl, 2001; Whitall et al., 2003; Costanza et al., 2008). However due to lack of available data at the time, contributions through atmospheric deposition were vastly underestimated in developing the Tar-Pamlico TMDL, nor was it assigned a reduction requirement. Much like groundwater contributions, this was in part because quantitative knowledge was limited at the time on the magnitude of either direct deposition to the surface of the estuary or its contribution to N loading to basin streams. From a management standpoint, atmospheric deposition was viewed primarily as a pathway rather than a source, and currently we look to manage inputs to this pathway rather than considering treatment of atmospheric nitrogen itself. Over sufficient time, atmospheric N deposition rates should respond to reductions by emissions sources. As with groundwater, this raises several questions including:

- To what extent are air quality regulations resulting in reductions to atmospheric N emissions?

- Can we characterize the relationship between reductions in N emissions and reductions in N deposition?
- Can we reliably monitor changes to nitrogen deposition over time?

While the scientific understanding of atmospheric deposition continues to evolve, some general observations can be made about atmospheric deposition as a source of nitrogen input into North Carolina's estuaries. Atmospheric inputs can be divided into two main types:

Direct: those that fall directly into the estuary and
Indirect: those that are deposited on various land surfaces throughout the basin, some portion of which is transported into streams and eventually delivered to the estuary.

As the population grows in the airshed of the Tar-Pamlico River Basin, an increase in NO_x emissions from increased fossil fuel combustion is likely to occur. Ammonia also contributes to atmospheric nitrogen. The majority of atmospheric ammonia in the coastal plan volatilizes from confined animal operations, but sewage treatment plants and fertilizers applied to the land also contribute small amounts (Whitall et al., 2003; Walker et al., 2004). In North Carolina, animal agriculture is responsible for over 90 percent of all ammonia emissions; in turn, ammonia comprises more than 40 percent of the total estimated nitrogen emissions from all sources (Aneja et al., 1998).

In April 1989, the Division of Environmental Management, Water Quality Section reported that 18 percent of the nitrogen budget originated from atmospheric sources (DEM, 1989). The 1994 Tar-Pamlico River Basin Plan noted atmospheric deposition was one of the main cultural sources of nutrients in the estuary along with agricultural runoff, wastewater treatment plants and forestry.

While there are no recent studies indicating the overall amount of atmospheric deposition of nitrogen to the entire Tar-Pamlico River Basin, there are studies that suggest that up to 40 percent of the nitrogen entering the Albemarle-Pamlico Sound comes from atmospheric sources (DENR-DAQ, 1999; Costanza et al., 2008). A recent study on the potential geographic distribution of atmospheric nitrogen deposition from CAFOs in NC reported that due to the high number of CAFO lagoons in the coastal plain and the prevailing southwest wind direction for 10 months of the year, the highest nitrogen depositional rates from CAFOs are in Neuse and Tar-Pamlico watersheds (Costanza et al., 2008). They also reported that between 24 and 47 percent of the Sound receives 50 percent of the atmospheric deposition from these CAFO lagoons (Costanza et al., 2008).

Studies have been conducted to assess the direct and indirect contribution from wet atmospheric N deposition to the Neuse River Basin. The results of one such study completed in 2003 indicates that atmospheric contributions of nitrogen vary seasonally and spatially within the watershed but that overall it accounts for approximately 24% of the total nitrogen load to the Neuse River Estuary, and these contributions have risen over the last twenty years (Whitall et al., 2003). It is likely that these results are similar for the Pamlico River Estuary.

While some of the land-based portion of this loading is addressed through stormwater rules and adjustments to crop fertilization rates, attaining the 30% reduction in nitrogen load to the Pamlico River Estuary may be challenging without first quantifying atmospheric contributions to the watershed more accurately, and eventually seeking appropriate management measures on all significant emission sources.

There is very little data available on the concentrations of dry nitrogen deposition. As with wet deposition, dry deposition rates are expected to vary across the basin depending on the proximity to the source. Initial research by the NC DAQ and EPA suggest that the amount of nitrogen contributed to an area from dry deposition is likely to be at least comparable to if not greater than that contributed through wet deposition.

Emissions from concentrated animal operations comprise the great majority of atmospheric ammonia emissions (Aneja et al., 1998). Currently, these outputs are not directly regulated. However, one recent improvement addresses new and expanding operations. In 2007, the NC legislature enacted a new law (SB 1465) requiring animal waste systems that serve new and expanding swine farms to meet or exceed five performance standards. One of the standards requires such farms to "substantially eliminate atmospheric emission of ammonia." This performance standard specifically requires that "ammonia emissions from the swine farm must not exceed an annual average of 0.9 kg NH_3/wk/1,000 kg of steady state live weight" (15A NCAC 02T .1307 (2) (C)). This new regulation may be expected to substantially cap NH_3 emissions from swine farms at current levels. However, it does not require reductions from existing operations, nor does it apply to other types of CAFOs, such as cattle and poultry operations. Thus NH_3 emissions from existing CAFOs remain the largest unregulated source of atmospheric nitrogen emissions.

Additional research and monitoring is needed to obtain a complete understanding of the magnitude and variability of all atmospheric nitrogen inputs into the Pamlico River Estuary. Due to the dynamic nature of the airshed, it is also necessary to develop a better understanding of the relationship between emission levels and deposition rates of atmospheric nitrogen. DWQ is working with DAQ staff to identify research opportunities. One such opportunity comes from DAQ modeling work using Community Multi-scale Air Quality modeling system (CMAQ) to conduct emissions modeling. The CMAQ modeling system simulates various chemical and physical processes that are thought to be important for understanding atmospheric trace gas transformations and distributions. The modeling system contains three types of modeling components: a meteorological modeling system for the description of atmospheric states and motions, emission models for man-made and natural emissions that are injected into the atmosphere, and a chemistry-transport modeling system for simulation of the chemical transformation and fate. It is possible that the use of an add-on tool to this model in the future may make it possible to use the output of this model to develop estimates of projected atmospheric nitrogen deposition rates.

Phosphorus Reductions

Phosphorus loading to the estuary decreased significantly as a result of two events. Effective January 1, 1988, the NC General Assembly adopted a statewide phosphate detergent ban, which resulted in significant drops in stream phosphorus concentrations statewide, however this ban does not include dishwasher detergent. Also, in the fall of 1992, PCS Phosphate, located on the Pamlico River estuary in Aurora, began a wastewater recycling program that reduced its phosphorus discharge by about 97 percent. Opportunities to further reduce phosphorus loading include eliminating phosphorus in lawn fertilizers and automatic dishwasher detergent. Several other states have taken this easy step to reduce eutrophication including New York State's recent **law amendment** to limit the amount of phosphorus in dishwashing detergent and limit the use of lawn fertilizer's containing phosphorus.

Estuary Dynamics

Climatic variability also plays an important role in the mobilization, processing, and delivery of nutrients and subsequent chlorophyll *a* response in the Pamlico River Estuary. Conditions in Pamlico River and Sound are more influenced by wind driven tides than the lunar cycle, where climate conditions such as hurricanes and drought impact both nutrient loading and cycling within the estuary. Estuary improvement is a generally complex nature of estuary dynamics; more specifically the potential for continual release of stored nutrients in sediments while water column nutrient concentrations decrease. Water residence time varies between 10 days and 2 months, with an average of 24 days in the Pamlico (Stanley, 1992). However, little is known about the residence time and recycling of nutrients within the estuary. A study is needed to gauge the extent to which purging of estuary sediments may be expected to delay improvements in estuary productivity response.

Summary & Necessary Actions

Full implementation of the nutrient reduction strategy has been a measured process and was finally reached in 2006. Point sources continually have met their targeted nutrient loading caps from the early 1990's. The agriculture community has reduced their estimated nitrogen loss from cropland and pastureland by an average 45%, since 2002. Almost 2,000 fertilizer applicators have received nutrient management training and the six local governments covered under the stepped Stormwater Rule have all adopted and implemented local stormwater programs to limit nitrogen and phosphorus inputs from stormwater runoff resulting from new development. Despite this successful implementation, the goal of a 30 percent reduction in instream nitrogen loading and no net increase in phosphorus loading since 1991 does not appear to have been met, and the Pamlico River Estuary remains impaired.

The estuary is a very complex and dynamic system. Climatic variability plays an important role in the mobilization, processing, and delivery of nutrients to the Pamlico estuary. The estuarine water quality response is affected by climatic events and this variability obscures clear trends in nutrient loading and the estuary's response to these loads, despite efforts to reduce point and non-point source loads. It is important to note that the water quality is assessed every two years in the estuary; each assessment represents data from a specific 5-year data window. The 2008 Impairment data includes data from 2002-2006 and the 2010 data window includes data collected during 2004-2008. Therefore, both of these assessments capture point source and agriculture reductions but likely did not capture reductions made from stormwater improvements. Due to the decades of chronic overloading, the time lag required for nonpoint source input reductions to be fully expressed, and the likelihood of nutrient cycling within the estuary, it may be some time before current reductions in nutrient loading will reflect in improved water quality, and before a definitive assessment of the effect of the strategy on the estuary can be made.

DWQ staff have begun an evaluation of the limitations of the current strategies and identified opportunities for developing a better understanding of the nutrient dynamics for both the Tar-Pamlico and Neuse River systems. While we believe that further analysis of existing data and additional years of data collection will provide greater certainty as to the effect of the strategies on the estuaries, we also recognize the existing strategies limitations and other basin factors that contribute to estuarine conditions. Listed below are the more overarching recommendations and research needs identified in this chapter which will be pursued during this next basin plan cycle.

Source Assessment and Trends

- Coordinate efforts with the Division of Air Quality to assess atmospheric nitrogen contributions to the watershed and develop recommendations on better ongoing characterization of atmospheric nitrogen deposition and emission source regulatory considerations.
    - Specifically address better characterization of the contribution of ammonia emissions from CAFO operations.
- Work with Division of Soil and Water Conservation and Basin Oversight Committee to achieve the following:
    - Identify additional opportunities to offset new or increased sources of nutrients from agricultural operations.
    - Increase the focus on local nutrient control strategies that specify the numbers and types of all agricultural operations within their areas, numbers of BMPs that will be implemented by enrolled operations and acres to be affected by those BMPs, estimated nitrogen and phosphorus reductions and schedule for BMP implementation and efficacy. (In accordance to the Agricultural Nutrient Control Strategy Rule 15A NCAC 02B .0256).

•Continue to work with the US Fish and Wildlife Service to evaluate the impact of the Rose Acres egg-laying operation on the Pocosin Lakes National Wildlife Refuge and the surrounding aquatic ecosystem. Develop recommendations on how to reduce the impacts from this and other poultry operations.

•Continue follow-up actions on hybrid striped bass farms and other fish farms in the lower Basin to improve their effluent quality and better quantify their impact to the Estuary. If warranted, include their nutrient contributions in the Basin's accounting of progress towards meeting nutrient reduction goals.

•Identify the need for additional monitoring locations and parameters to better characterize basin nutrient sources and relative contributions.

•Develop a more detailed analysis of current and historic data in order to better quantify the status of nutrient loading to the estuary; conduct additional trend and loading analysis upstream of the Pamlico River Estuary focusing on smaller watersheds with dominant land use types. This will allow staff to better gauge the effectiveness and progress of strategy implementation.

•Develop a fate and transport model. Required in order to develop individual NPDES nutrient limits per agreement with the USEPA by 2014.

•Utilize the CAFO monitoring plan rulemaking data once it becomes available to help identify sources.

•Assess Tar-Pamlico Buffer compliance.

Stormwater Needs

•Develop a full assessment and recommendations on stormwater programmatic coverage gaps and need to meet nutrient strategy goals on new development activities. Include recommendations on most appropriate regulatory approach.

- •Assessment of stormwater Phase II and Tar-Pamlico Stormwater permitting programs. Make recommendations on how to strengthen the current program to be more environmentally protective. Need to address hydrologic, sediment and nutrient issues.
- •Audit local stormwater programs for effectiveness and work with local governments to strengthen their implementation.

•Evaluate the magnitude of nitrogen loading in runoff from existing development areas and develop recommendations on the need to address this source under the strategy.

•Review stormwater and sediment and erosion control compliance activities; assess need for additional staff for inspection and enforcement needs.

Identified Research Needs

•Develop monitoring to better characterize the nature, magnitude and trends in atmospheric and groundwater derived nutrient contributions to the Tar-Pamlico River Estuary.

•Assess nutrient residence time in the estuary.

•Characterize the location, geographic extent and functionality of tile drains under agricultural fields.

•Quantify the potential magnitude of nutrient loading from spray fields, directly from animal housing and holding, and waste storage facilities on CAFOs.

•Characterize the geographic extent and quantify the potential magnitude of nutrient loading from dry litter poultry facilities, animal housing and waste storage.

•Characterize the potential for groundwater contamination and transport of nutrients from biosolids and wastewater land application fields to the surface waters of the Tar-Pamlico Basin.

•Quantify the nitrogen contributions from conventional on-site wastewater treatment systems to surface waters of the Tar-Pamlico Basin.

•Better quantification of BMP effectiveness (agricultural and stormwater BMPs); improve accounting tools.

•Characterize nutrient loading from various pasture management practices which leads to a better understanding of pasture's nutrient contributions and the value of different management options.

•Explore additional nutrient offset option to be included in the NSW Point/Nonpoint Phase IV Agreement.

•Identify the local Drainage Districts and understand their current role in controlling water flow and drainage issues. Work with the Districts to develop recommendations on how to protect water quality in these areas.

Voluntary Opportunities

•Require stormwater best management practices for existing and new development.

•Develop, strengthen and enforce riparian buffer ordinances.

•Develop and enforce local erosion control ordinances.

•Implement pet waste and residential fertilizer reduction ordinances.

•Work with local resource agencies to install appropriate BMPs in order to reduce the contribution of nutrient, sediment, bacteria and toxicants as well as addresses stormwater volume and velocity issues.

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Agriculture & Water Quality

in the Tar-Pamlico River Basin

OVERVIEW

Agriculture is NC's leading industry and is especially strong in the Tar-Pamlico River Basin. Nonpoint source pollution from agriculture is an identified significant source of stream degradation in the Tar-Pamlico River basin. The approach taken in North Carolina for addressing agriculture's contribution to the nonpoint source water pollution problem is to primarily encourage voluntary participation by the agricultural community. This approach is supported by financial incentives, technical and educational assistance, research, and regulatory programs.

Due to the collective nutrient loading to the Pamlico Estuary, the *Tar-Pamlico Agricultural Nutrient Control Strategy Rule* and *Law* became effective September 2001, providing a collective strategy for farmers to meet the 30% nitrogen loss reduction and no-increase phosphorus loss. Farmers in the basin are to implement land management practices that achieve certain nutrient reduction goals. More information about these goals and accomplishments are discussed in the NSW Chapter 6.

Agricultural practices in the Tar-Pamlico River Basin accounts for 28% of the land use activities; of that, 7% are estimated as pasture/hay land and 21% in cultivated crops (Figure 7-1). The primary crops being soybeans, corn and cotton. The USDA completed an agriculture census in 2007 indicating a slight increase (1%) in the numbers of farms in the basin but a decrease (-11%) in the acreage being farmed (Table 7-1). This census data also indicates an increase in farms and acreage using pasture and a decrease in overall fertilizer and chemical usage. This change could be associated with the increase in number of farms with smaller hoofstock (sheep, goats, horses). Hog and poultry animal numbers have also increased although several hog farms have ceased operation or consolidated with another farm. In 2006, a large egg laying facility opened in Hyde County with the capacity to house more than four million birds. The decrease in fertilizer usage is likely associated with costs; according to USDA economic research the cost of fertilizer has more than doubled since 1991 (http://www.ers.usda.gov/Data/FertilizerUse/).

Figure 7-1. Land Cover

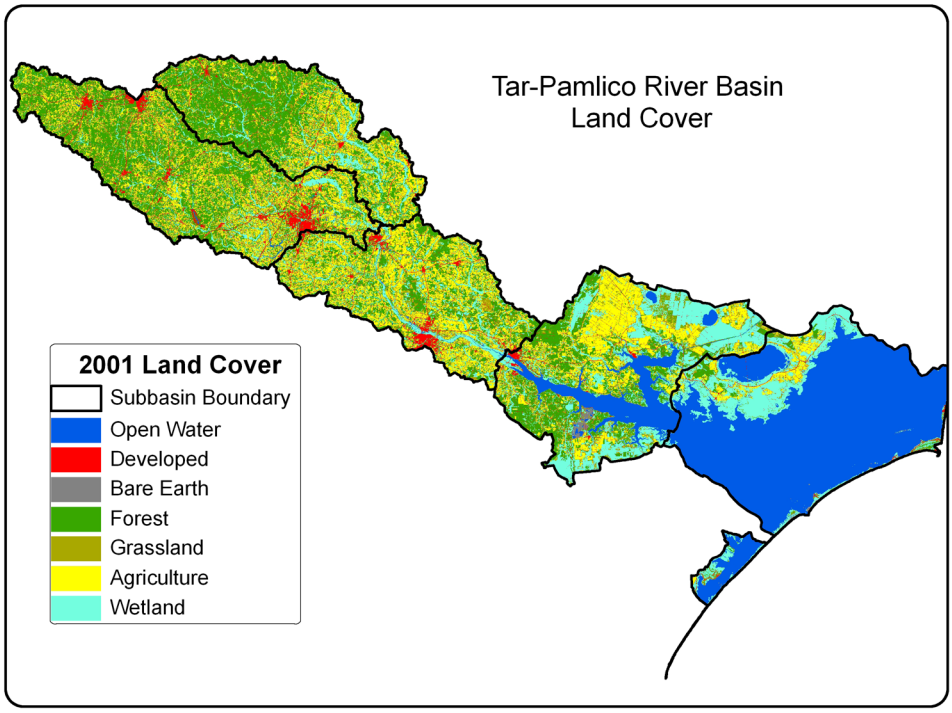

Table 7-1. USDA Agriculture Census Data *http://www.usda.gov/nass/PUBS/TODAYRPT/waters09.pdf*

	% Farm Change	% Acres Change	2002 Farm #	2002 Acres	2007 Farm #	2007 Acres
Farms	1	-	3,277	-	3,307	-
Land acreage in farms	-	-11	-	1,191,263	-	1,077,822
Land Use						
Total cropland:	-13	-12	2,750	801,219	2,424	716,603
Harvested cropland:	-18	-9	2,060	687,252	1,743	629,069
Cropland used only for pasture or grazing:	-49	-22	883	34,796	594	28,449
Cropland w/ failed crops or abandoned:	-46	-79	337	23,538	231	13,150
Cropland idle, cover crops, or soil improvement but not harvested and not pastured or grazed:	-11	-12	769	42,994	690	38,479
Cropland in cultivated summer fallow:	-50	-70	159	12,639	104	7,456
Total woodland:	3	-15	1,977	303,507	2,039	264,435
Woodland pastured:	-24	-170	631	43,296	510	16,050
Woodland not pastured:	8	-5	1,642	260,211	1,791	248,385
Permanent pasture and rangeland:	26	21	861	39,048	1,171	49,526
Land in farmsteads, buildings, livestock facilities, ponds, roads, wasteland, etc.:	-11	0	1,899	47,489	1,716	47,258
Irrigated land:	-30	-30	576	38,181	443	29,464
Harvested cropland:	-32	-32	526	35,863	397	27,110
Pastureland and other land:	-7	2	61	2,318	57	2,354
Land used for organic production:	24	-20	16	477	21	399
Fertilizers and Chemicals						
Commercial fertilizer, lime, and soil conditioners:	-12	-13	1,939	664,245	1,738	586,969
Manure:	-18	-31	326	27,161	276	20,668
Acres treated with chemicals to control -						
Insects:	-49	-17	1,304	463,385	876	396,664
Weeds, grass, or brush:	-30	-22	1,539	579,941	1,182	473,456
Nematodes:	-62	-35	440	95,773	272	70,932
Diseases in crops and orchards:	-50	-27	312	85,442	208	67,351
Selected Crops						
Corn:	1	20	583	120,648	590	150,131
Soybeans:	-12	7	897	207,993	800	223,933
Small grains (wheat, oats, barley, rye):	-23	-4	489	80,405	397	77,512
Cotton:	-64	-75	418	221,033	255	126,243
Vegetables and melons harvested for sale:	8	-8	241	26,468	262	24,612
Fruit and tree nuts:	15	-1	63	330	74	328
Nursery, greenhouse, floriculture, and sod:	-10	65	106	1,186	96	3,428
All other crops (other than those listed above):	-39	-20	1,449	83,390	1,043	69,327
Livestock	% Change Farm #	% Change Animal #	2002 Farm #	2002 Animal #	2007 Farm #	2007 Animal #
Cattle and calves:	-13	-4	885	42,152	786	40,473
Hogs and pigs:	-32	5	179	530,017	136	557,371
Sheep and lambs:	26	0	56	1,928	76	1,921
Horses and ponies:	16	20	510	3,169	609	3,944
Goats:	32	15	225	6,540	332	7,724
Chickens (does not include Rose Acres 4,750,000 birds):	2	12	302	6,484,314	309	7,370,874

Animal Operations & Recommendations

In 1992, the Environmental Management Commission (EMC) adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. Even though the rules adopted by the EMC are focused on managing and reusing animal waste in an environmentally and economically feasible manner, animal operation facilities can have many other impacts on local and downstream water quality.

Currently, DENR has regulatory authority over waste management of swine and cattle feedlots that use dry systems and applications of a wastewater or liquid manure. Most poultry operations produce a dry litter waste which is not regulated. The locations of dry litter poultry operations and the disposal of their waste is not known to environmental regulators due to the fact that there are no permitting requirements, making it very difficult to get a complete picture of the possible non-point sources contributions within a specific watershed. This makes managing, protecting and enhancing water quality that much more challenging. The location of hog and cattle CAFOs are known due to the fact that a State or NPDES permit is required by DWQ. While their direct nutrient contribution is not currently well understood, knowing that these sources exist in the watershed can help water quality managers to better understand the available water quality data and make better regulatory recommendations and decisions.

Due to a hog farm moratorium put in place in 1997 and a new law passed in 2007 prohibiting the construction of new hog waste lagoons and spray fields as the primary method of waste management (SB 1465), nutrient contributions from hog operations have remained fairly constant over the last several years. However, the continued growth in the poultry industry in the coastal plain of NC is continuing to add to the current nutrient loading from non-point sources. The 2007 USDA census data indicates that in 2007 there were 7,370,874 chickens in the Tar-Pamlico basin. The number of chickens has likely increased by at least another 3,000,000 totaling over 10,000,000 chickens due to the Rose Acres egg farm continuing to stock their facility. This would result in an increase of at least 35% since 2002. The data that is currently available for the Rose Acres Farm indicates that poultry operations are likely having a significant impact on the water quality in the Tar-Pamlico River basin and other coastal basins. It is estimated that 40% of the nitrogen entering the Albemarle-Pamlico Sound originate from atmospheric sources (DENR-DAQ, 1999; Costanza et al., 2008). Due to the prevailing wind direction, the highest nitrogen depositional rates from CAFOs are in the Neuse and Tar-Pamlico watersheds (Costanza et al., 2008). This is likely to increase overtime with the continued growth of the poultry industry in coastal North Carolina.

Additional impacts from agriculture include:

- Streambank Erosion & Sedimentation: Livestock grazing with unlimited access to the stream channel and banks can also cause severe streambank erosion resulting in sedimentation and degraded water quality.
- Loss of Riparian Vegetation: As livestock gather near streams, the riparian zone becomes trampled and thinned out. Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs.
- Excessive nutrients: Elevated nutrients levels occur when livestock have direct access to the waterbodies and also from stormwater runoff from pastures, feedlots, barnyards and fertilized fields. There are a variety of BMPs designed to prevent nutrient runoff from animal operations. Functioning riparian zones or buffers are known to greatly reduce instream nutrients loads from stormwater runoff.
- Animal waste is often stored in lagoons before it is applied to fields. Numerous environmental

hazards exist from these lagoons including: ammonia emissions, overflows into surface waters, and groundwater contamination. It is a concern that several animal operations in the basin will be abandoned without proper closeout of the lagoons.

There are a variety of programs available to and used by agricultural facilities throughout North Carolina. Many give incentives for protecting water quality including activities supported by the Federal Farm Bill. For more information on these programs see *Supplemental Guide to North Carolina's Basinwide Planning Chapter 6* and the *2008 Farm Bill*.

DWQ's Animal Feeding Operations Unit is responsible for the permitting and compliance activities of animal feeding operations across the state. Table 7-2 summarizes the number of registered livestock operations, total number of animals and number of facilities, in the basin. These numbers reflect only operations required by law to be registered and, therefore, do not represent the total number of animals in the subbasin (e.g., dry poultry operations and aquaculture facilities not counted).

Table 7-2. DWQ Permitted Facilities

Type	Number of Facilities	Number of Animals
Animal Individual	14	4,759,600
Cattle	6	2,205
Wet Poultry	7	795,600
Swine	96	369,897

Farmland Preservation & Conservation

A report by the American Farmland Trust organization identifies a majority of the Tar-Pamlico River basin as having high quality farmland with large areas threatened by development. A map of these areas is available from their website *http://www.farmland.org/*. Farmers in the basin are protecting their land with the assistance of the Conservation Reserve Enhancement Program (CREP). CREP is a voluntary program utilizing federal and state resources to achieve long-term protection of environmentally sensitive cropland and marginal pastureland. These voluntary protection measures are accomplished through 10-, 15-, 30-year and permanent conservation easements. In this basin, there are approximately 29,326 acres in easements, of which 54% are in 30 year or permanent easements.

North Carolina Agriculture Cost Share Program

Financial incentives are provided through North Carolina's Agriculture Cost Share Program, administered by DENR's Division of Soil and Water Conservation to protect water quality by installing BMPs on agricultural lands. From 2003-2008, 1,783 BMPs were implemented with a value of over $6.5 million. The distribution of these BMPs are shown in Figure 7-2. A quantification of how much these BMPs prevented nitrogen and phosphorus loss is totaled in each subbasin chapter.

Drainage Districts.

Principals for land and water management have changed significantly throughout history. The results of the previous land use management strategies still influence current practices and water quality (e.g., ditches, canals, sediment and nutrient accumulation). Removing water quickly and efficiently from the land was a public health and agricultural priority. To facilitate this North Carolina General Statute *Chapter 156* provides the right to establish local drainage districts.

> "§ 156-54. Jurisdiction to establish districts. The clerk of the superior court of any county in the State of North Carolina shall have jurisdiction, power and authority to establish levee or drainage districts either wholly or partly located in his county, and which shall constitute a political subdivision of the State, and to locate and establish levees, drains or canals, and cause to be constructed, straightened, widened or deepened, any ditch, drain or watercourse, and to build levees or embankments and erect tidal gates and pumping plants for the purpose of draining and reclaiming wet, swamp or overflowed land; and it is hereby declared that the drainage of swamplands and the drainage of surface water from agricultural lands and the reclamation of tidal marshes shall be considered a public use and benefit and conducive to the public health, convenience and welfare, and that the districts heretofore and hereafter created under the law shall be and constitute political subdivisions of the State, with authority to provide by law to levy taxes and assessments for the construction and maintenance of said public works. (1909, c. 442, s. 1; C.S., s. 5312; 1921, c. 7.)"

Drainage Districts are still in use in the Tar-Pamlico River Basin, however little is known about the type of activities (where and how often) being used to maintain drainage within agricultural lands. An inquiry with local governments indicated most county officials are not aware of operating districts within their jurisdiction. The knowledge of instream/in-ditch maintenance activities may be useful to understanding fluctuations in water quality samples that may have been taken near drainage district activities.

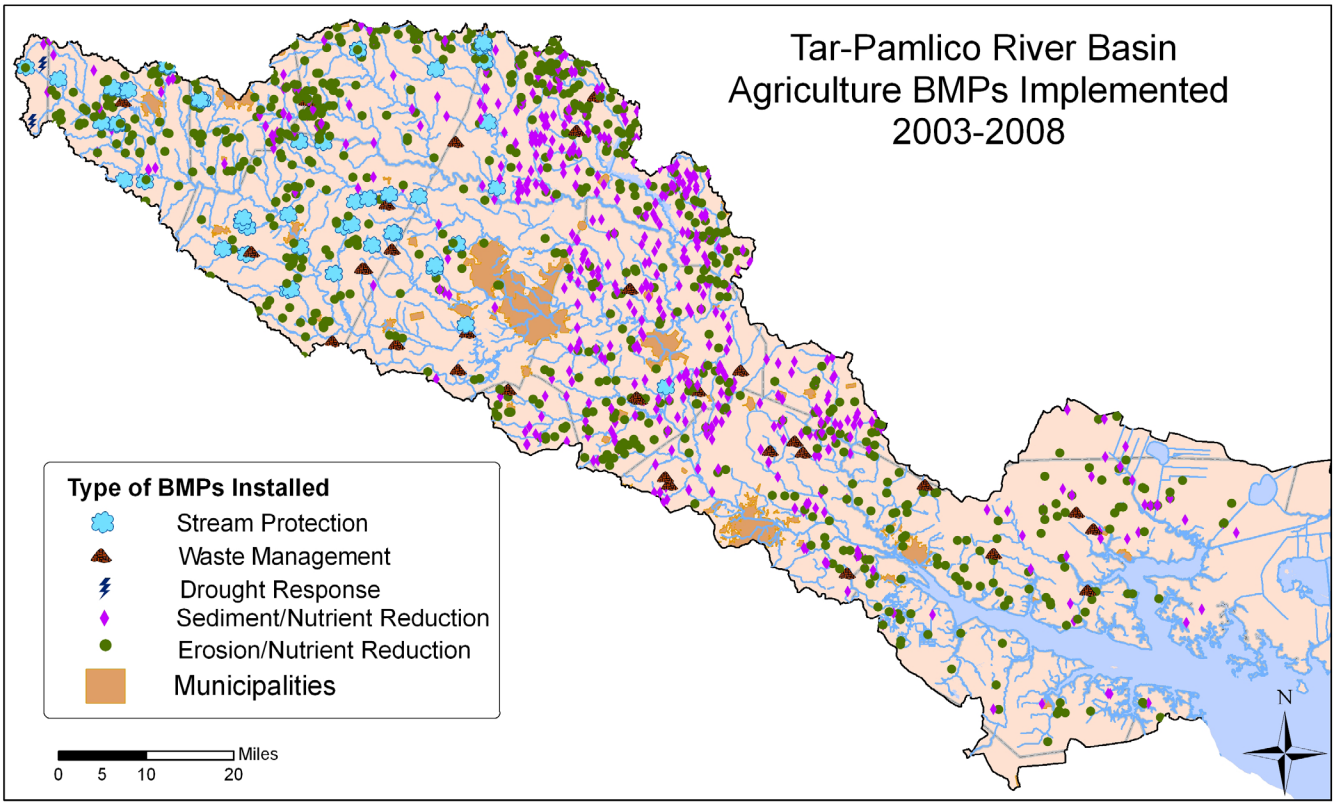

TABLE 7-2. AGRICULTURE BMPS IMPLEMENTED BY DSWC BETWEEN 2003-2008

References

American Farmland Trust. Farming on the Edge: North Carolina State Map. http://www.farmland.org/resources/fote/states/map_northcarolina.asp.

Costanza, J.K., Marcinko, S.E., Goewert, A.E., and C. E. Mitchell 2008. Potential Geographic Distribution of Atmospheric Nitrogen Deposition from Intensive Livestock Production in NC, USA. Science of the Total Environment 398.76-86.

DENR-DAQ 1999. Status Report on Emissions and Deposition of Atmospheric Nitrogen Compounds from Animal Production in NC. http://daq.state.nc.us/monitor/projects/nstatusreport.pdf.

USDA Economic Research Service. The Economics of Food, Farming, Natural Resources and Rural America. US Fertilizer Use and Price. http://www.ers.usda.gov/Data/FertilizerUse/.

USDA, 2007 Census of Agriculture. Watersheds. Volume 2, Subject Series, Part 6. Issued May 2009, http://www.usda.gov/nass/PUBS/TODAYRPT/waters09.pdf.

Ecosystem Enhancement Program

Overview

The North Carolina Ecosystem Enhancement Program (NCEEP) is responsible for providing ecologically effective compensatory mitigation in advance of permitted impacts associated with road projects and other development activities. The fundamental mission of the program is to restore, enhance and protect key watershed functions in the 17 river basins across the state. This is accomplished through the implementation of wetland, stream and riparian buffer projects within selected local watersheds. The vital watershed functions that NCEEP seeks to restore and protect include water quality, floodwater conveyance and storage, fisheries and wildlife habitat.

The NCEEP is not a grant program, but can implement its restoration projects cooperatively with other state or federal programs such as the Section 319 Program. Combining NCEEP-funded restoration or preservation projects with 319 or other local watershed initiatives (e.g., those funded through the Clean Water Management Trust Fund or local/regional Land Trusts) increases the potential to improve the water quality, hydrologic and habitat functions within selected watersheds.

Watershed Planning by NCEEP

The selection of optimal sites for NCEEP mitigation projects is founded on a basinwide and local watershed planning approach that results, respectively, in the development of River Basin Restoration Priorities and Local Watershed Plans.

River Basin Restoration Planning

In developing River Basin Restoration Priorities (RBRP) (formerly called Watershed Restoration Plans), the NCEEP identifies local watersheds with the greatest need and opportunity for restoration, enhancement or preservation projects. These high-priority watersheds are called "Targeted Local Watersheds" (TLWs). Targeted Local Watersheds are identified, in part, using information compiled by DWQ's programmatic activities (e.g., Basinwide Assessment Reports). Local factors considered in the selection of TLWs include: water quality impairment, habitat degradation, the presence of critical habitat or significant natural heritage areas, the presence of water supply watersheds or other high-quality waters, the status of riparian buffers, estimates of impervious cover, existing or planned transportation projects, and the opportunity for local partnerships. Recommendations from local resource agency professionals and the presence of existing or planned watershed projects are given significant weight in the selection of TLWs. Targeted local watersheds represent those areas within a river basin where NCEEP resources can be focused for maximum benefit to local watershed functions. TLWs are therefore given priority by NCEEP for the implementation of new stream and wetland restoration/enhancement or preservation projects.

The 2004 Watershed Restoration Plan for the Tar-Pamlico River Basin can be found on the NCEEP website at *http://www.nceep.net/services/restplans/watershedplans.html*. The NCEEP is currently

updating its selections of Targeted Local Watersheds within the Tar-Pamlico Basin. NCEEP Planning staff will be finalizing TLW selections by the end of 2010 which will be available on the NCEEP website.

Local Watershed Planning

In addition to River Basin Restoration Planning, NCEEP develops Local Watershed Plans (LWPs), usually within targeted local watersheds identified in the RBRPs. Through the local watershed planning process, NCEEP conducts watershed characterization and field assessment tasks to identify critical environmental stressors. The NCEEP planners and their consultants coordinate with local resource professionals and local governments to identify optimal watershed projects and management strategies to address the major functional stressors. The LWPs prioritize restoration and enhancement projects, preservation sites, and best management practices (BMP) that will provide water quality improvement, habitat protection and other environmental benefits to the local watershed.

NCEEP planners assess the need for new LWP initiatives in each basin annually. These decisions are based primarily on the quantity and type of compensatory mitigation projects the Program is required to implement in each 8-digit HUC. Local Watershed Plans are best supported by local partnerships with local governments, resource agencies and non-governmental organizations. LWPs are typically conducted within the boundaries of one or more selected 14-digit hydrologic units. In the Tar-Pamlico Basin, NCEEP has one ongoing LWP in the Fishing Creek watershed around Oxford in HUC 03020101. This plan focuses on projects that address sedimentation and nutrient issues related to agriculture and forestry, stormwater runoff issues around Oxford and from highways, and degraded mussel habitat that may be improved to help reestablish viable populations of mussel species found in adjacent watersheds. In 2005, NCEEP completed a LWP in HUC 03020103 called the Middle Tar-Pamlico LWP. This plan consists of recommendations and project atlases for four separate watersheds around Tarboro and Greenville. The fact sheets for these LWPs with links to plan documents can be found at *http://www.nceep.net/services/lwps/* or contact NCEEP Planner Rob Breeding at 919-733-5311 or via email at rob.breeding@ncdenr.gov.

NCEEP Projects in the Tar-Pamlico River Basin

As of summer 2009, a total of 75 NCEEP mitigation projects have been implemented within the Tar-Pamlico basin. Implemented projects include stream and wetland restoration or enhancement and preservation projects that are in one of three stages: design; construction; or monitoring (construction complete). The 75 NCEEP projects in this river basin include three in design, none in construction, and 18 in monitoring. Of these 75 projects, 11 were acquired through NCEEP's full delivery program. Additionally, four of these projects were focused on nutrient offset and six more yielded significant buffer credit.

For more information on NCEEP mitigation projects in the Tar-Pamlico River Basin, contact Rob Breeding (Eastern Watershed Planner) at (919) 733-5311.

EEP Mitigation Projects in the Tar-Pamlico River Basin

County	Number of Projects
Beaufort	4
Edgecombe	6
Franklin	25
Granville	18
Halifax	1
Hyde	3
Martin	1
Nash	1
Pitt	5
Warren	10

For additional information about NCEEP's Project Implementation efforts, go to: *http://www.nceep.net/abouteep/watershed_planning_project_control.htm*.

For additional information about NCEEP in general, including its various program activities and products, visit *http://www.nceep.net/*.

Forestry & Water Quality

Forestland Ownership

Approximately 73% of the forestland in the basin is privately-owned, with forest industry owning an estimated 15% and the remaining 12% in public ownership (Brown, 2004). However, since the most recent forest inventory was completed, significant shifts have taken place regarding the ownership of forestland across much of eastern North Carolina. Forest products companies have largely sold their forestlands to timberland investment management organizations (TIMO's), private investors/buyers, and conservation groups.

Forest Water Quality Regulations

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (Article 4-GS113A, referred to as "SPCA"). However, forestry operations may be exempted from specific requirements of the SPCA if the operations meet the compliance performance standards outlined in the Forest Practices Guidelines Related to Water Quality (15A NCAC 1I .0100-.0209, referred to as "FPGs") and General Statutes regarding stream and ditch obstructions (GS 77-13 and GS 77-14).

The FPG performance standard rule-codes and topics include:
.0201 Streamside Management Zone (SMZ)
.0202 Prohibition of Debris Entering Streams and Waterbodies
.0203 Access Road and Skid Trail Stream Crossings
.0204 Access Road Entrances
.0205 Prohibition of Waste Entering Streams, Waterbodies, and Groundwater
.0206 Pesticide Application
.0207 Fertilizer Application
.0208 Stream Temperature
.0209 Rehabilitation of Project Site

The NC-DFR is delegated the authority to monitor and evaluate forestry operations for compliance with these aforementioned laws and/or rules. In addition, the NC-DFR works to resolve identified FPG compliance questions brought to its attention through citizen complaints. Violations of the FPG performance standards that cannot be resolved by the NC-DFR are referred to the appropriate State agency for enforcement action. During the period January 1, 2004 through December 31, 2008 there were 2,276 FPG inspections conducted on forestry-related sites in the basin; 97% of the sites were in compliance upon the initial site inspection.

Tar-Pamlico River Basin Riparian Buffer Rule

The Tar-Pamlico River Basin is subject to riparian buffer protection rule 15A NCAC 02B .0259. Forestry activities must comply with this buffer rule in addition to the requirements for SMZ establishment as defined within the FPG rules. The NC-DFR monitors forestry activities for compliance with the buffer rule and notifies the NC-DWQ if violations are observed. During the last five year period, there were 10 referrals for enforcement related to buffer rule violations on forestry sites across the Tar-Pamlico basin. To assist loggers, landowners and foresters with the implementation of the buffer rule, the NC-DFR has developed a 2-page Forestry Leaflet that

is available at local NC-DFR offices and can be downloaded from the website http://dfr.nc.gov/publications/Forestry%20Leaflets/WQ11.pdf.

Other Water Quality Regulations

In addition to the multiple State regulations noted above, NC-DFR monitors the implementation of the following Federal rules relating to water quality and forestry operations:

- The Section 404 silviculture exemption under the Clean Water Act for activities in wetlands;
- The federally-mandated 15 best management practices (BMPs) related to road construction in wetlands;
- The federally-mandated BMPs for mechanical site preparation activities for the establishment of pine plantations in wetlands of the southeastern U.S.

Water Quality Foresters

Nearly the entire river basin falls within the coverage area of a Water Quality Forester. Statewide, there is a Water Quality Forester position in nine of NC-DFR's 13 operating districts. Water Quality Foresters conduct FPG inspections, survey BMP implementation, develop pre-harvest plans, and provide training opportunities for landowners, loggers and the public regarding water quality issues related to forestry. These foresters also assist County Rangers on follow-up site inspections and provide enhanced technical assistance to local agency staff. Water Quality Foresters are the primary point of contact in their districts for responding to water quality or timber harvesting questions or concerns that are suspected to be related to forestry activities.

Forestry Best Management Practices

Implementing forestry Best Management Practices (BMPs) is strongly encouraged to efficiently and effectively protect the water resources of North Carolina. In 2006, the first ever revision to the North Carolina forestry BMP manual was completed. This comprehensive update to the forestry BMP manual is the result of nearly four years of effort by the NC-DFR and a DENR-appointed Technical Advisory Committee consisting of multiple sector stakeholders, supported by two technical peer-reviews. The forestry BMP manual describes measures that may be implemented to help comply with the forestry regulations while protecting water quality. Copies of the forestry BMP manual can be obtained at a County Ranger or District Forester office, or online: http://dfr.nc.gov/water_quality/bmp_manual.htm.

In the basin during this period, the NC-DFR assisted with or observed 2,875 forestry activities in which BMPs were either implemented or recommended, encompassing a total area of over 148,250 acres.

From March 2000 through March 2003, the DFR conducted a statewide BMP Implementation Survey on 565 active forest harvest operations to evaluate the usage of forestry BMPs. This survey evaluated 59 sites in this river basin, with a resulting BMP implementation rate of 90%. The problems most often cited in this survey across the state relate to stream crossings, skid trails and site rehabilitation. A copy of this report is available from the DFR Raleigh Central Office or can be downloaded from the Web site http://dfr.nc.gov/water_quality/water_quality.htm. A subsequent second round of BMP Implementation Surveys was conducted on additional logging sites statewide from 2006 to 2008; at this time, the data is being compiled and a report of the findings is expected to be available by end of 2010. These periodic, recurring BMP surveys serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP development, implementation and training.

Protecting Stream Crossings with Bridgemats

The NC-DFR provides bridgemats on loan to loggers for establishing temporary stream crossings during harvest activities in an effort to educate loggers about the benefits of installing crossings in this manner. Temporary bridges can be a very effective solution for stream crossings, since

the equipment and logs stay completely clear of the water channel. Since 2005 all District Offices in the basin have had bridgemats available for loan-out. Periodic status reports, a list of bridgemat suppliers, and additional information are available at: http://dfr.nc.gov/water_quality/bridgemats.htm.

Forest Management

Forest management is a valued and prevalent land-use across much of the river basin. This area of North Carolina consistently ranks high in the number of acres in which sustainable forestry is being practiced. As a testament to this, over 62,000 acres of land were established or regenerated with forest trees across the basin from January 1, 2004 through December 31, 2008. During this same time period the NC-DFR produced 3,930 individual forest plans for landowners that encompassed nearly 209,000 acres of forestland in the basin.

Bottomland Hardwood/Cypress Swamps

Across the river basin, (and elsewhere in North Carolina) there are prime examples of high-quality and highly productive bottomland hardwood/cypress swamps. These swamps have provided a sustainable source of wood fiber for well over 200 years, and served as the foundation for the creation of the forest products industry in eastern North Carolina. Since the settlement of North Carolina in colonial times, our forests have been harvested multiple times, including these hard-to-access swamps. Practically-speaking, it is inconceivable that any “old growth” or “virgin” timber remain in this region.

A diversity of forest tree species are adapted to grow in these bottomland swamps, some regenerating by seed and others primarily by sprouting from severed stumps. Nearly all swamp-adapted tree species require full sunlight to adequately regenerate, thus necessitating a removal of the shading overstory. The planting of trees to regenerate a swamp after a timber harvest is not commonly observed as a suitable or viable silviculture practice due to the cyclic nature of the hydrology in a specific swamp, fluctuations in the water table, and the obvious difficulty of site access for tree planting.

Management of a swamp forest is relatively passive when compared with pine or upland hardwood forest areas. Once the new stand of trees has successfully regenerated, there is usually little need to conduct intermediate stand treatments that might otherwise be suitable on pine or upland hardwood forests. Implementing a silviculturally-sound swamp timber harvest in a manner that minimizes soil and water impacts has shown to be the practical and viable prescription for forest management in swamps.

Education & Outreach

Each year since 2004 the NC-DFR summarizes its BMP, water quality, and nonpoint source accomplishments in a color brochure entitled “Year In Review”. This report is available on the Web: http://dfr.nc.gov/water_quality/year_in_review.htm.

The North Carolina Forestry Association, in cooperation with forest industry, NC-DFR, and NCSU, conducts educational programs annually at different locations in the North Carolina. The first program is called the Forestry and Environmental Camp, and is for middle and high school aged children. These 3-day long camps introduce children to the basic science and math skills needed when practicing forestry. The second program is the Sustainable Forestry Teachers Academy/Tour, and educates school teachers about forestry practices and how forest products are manufactured. For more information about these programs visit www.ncforestry.org.

North Carolina Forest Service (NC-DFR) Contacts for the Tar-Pamlico River Basin:

Office Location	Contact Person	Phone	Address
Hillsborough District: D11 (Person, Granville, Vance)	Water Quality Forester	(919) 732-8105	3314 NC Highway 86 South Hillsborough, NC 27278
Rocky Mount District: D5 (Franklin, Warren, Nash, Edgecombe, Halifax, Wilson)	Water Quality Forester	(252) 442-1626	737 Smokey Road Rocky Mount, NC 27804
Elizabeth City District: D7 (Martin)	Water Quality Forester	(252) 331-4781	861 Berea Church Road Elizabeth City, NC 27909
New Bern District: D4 (Pitt, Beaufort)	Water Quality Forester	(252) 514-4764	3810 M. L. King Jr. Blvd. New Bern, NC 28562
Fairfield District: D13 (Washington, Hyde)	District Forester	(252) 926-3041	9291 Piney Woods Rd Fairfield, NC 27826
Regional Office: Region I (eastern region)	Asst. Regional Forester-FM	(252) 520-2402	2958 Rouse Road Extension Kinston, NC 28504
Raleigh Central Office (statewide, BMPs)	Nonpoint Source Branch - Forest Hydrologist	(919) 857-4856	1616 Mail Service Center Raleigh, NC 27699
Griffiths Forestry Center (statewide, regulations & wetlands)	Water Quality & Wetlands Staff Forester	(919) 553-6178 Ext. 230	2411 Old US Hwy 70-West Clayton, NC 27520

References

Brown, Mark J. 2004. USDA-Forest Service "Forest Statistics for North Carolina, 2002." Southern Research Station Resource Bulletin SRS-88. January 2004).

Source Water Assessment Program

OVERVIEW

The Federal Safe Drinking Water Act (SDWA) Amendments of 1996 emphasize pollution prevention as an important strategy for the protection of ground and surface water resources. This new focus promotes the prevention of drinking water contamination as a cost-effective means to provide reliable, long-term and safe drinking water sources for public water supply (PWS) systems. In order to determine the susceptibility of public water supply sources to contamination, the amendments also required that all states establish a Source Water Assessment Program (SWAP). Specifically, Section 1453 of the SDWA Amendments require that states develop and implement a SWAP to:

- Delineate source water assessment areas;
- Inventory potential contaminants in these areas; and
- Determine the susceptibility of each public water supply to contamination.

In North Carolina, the agency responsible for the SWAP is the Public Water Supply (PWS) Section of the DENR Division of Environmental Health (DEH). The PWS Section received approval from the EPA for their SWAP Plan in November 1999. The SWAP Plan, entitled North Carolina's Source Water Assessment Program Plan, fully describes the methods and procedures used to delineate and assess the susceptibility of more than 9,000 wells and approximately 207 surface water intakes. To review the SWAP Plan, visit the PWS website at http://swap.deh.enr.state.nc.us/swap/.

Delineation of Source Water Assessment Areas

The SWAP Plan builds upon existing protection programs for ground and surface water resources. These include the state's Wellhead Protection Program and the Water Supply Watershed Protection Program.

Wellhead Protection (WHP) Program

North Carolinians withdraw more than 88 million gallons of groundwater per day from more than 9,000 water supply wells across the state. In 1986, Congress passed Amendments to the SDWA requiring states to develop wellhead protection programs that reduce the threat to the quality of groundwater used for drinking water by identifying and managing recharge areas to specific wells or wellfields.

Defining a wellhead protection area (WHPA) is one of the most critical components of wellhead protection. A WHPA is defined as "the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The SWAP uses the methods described in the state's approved WHP Program to delineate source water assessment areas for all public water supply wells. More information related to North Carolina's WHP Program can be found at http://swap.deh.enr.state.nc.us/swap/pages/whp.htm.

Water Supply Watershed Protection (WSWP) Program

DWQ is responsible for managing the standards and classifications of all water supply watersheds. In 1992, the WSWP Rules were adopted by the EMC and require all local governments that have land use jurisdiction within water supply watersheds to adopt and implement water supply watershed protection ordinances, maps and management plans. SWAP uses the established water supply watershed boundaries and methods established by the WSWP program as a basis to delineate source water assessment areas for all public water surface water intakes. Additional information regarding the WSWP Program can be found at **http://portal.ncdenr.org/web/wq/swp/ws/wswp**.

Susceptibility Determination - North Carolina's Overall Approach

The SWAP Plan contains a detailed description of the methods used to assess the susceptibility of each PWS intake in North Carolina. The following is a brief summary of the susceptibility determination approach.

Overall Susceptibility Rating

The overall susceptibility determination rates the potential for a drinking water source to become contaminated. The overall susceptibility rating for each PWS intake is based on two key components: a contaminant rating and an inherent vulnerability rating. For a PWS to be determined "susceptible", a potential contaminant source must be present and the existing conditions of the PWS intake location must be such that a water supply could become contaminated. The determination of susceptibility for each PWS intake is based on combining the results of the inherent vulnerability rating and the contaminant rating for each intake. Once combined, a PWS is given a susceptibility rating of higher, moderate or lower (H, M or L).

Inherent Vulnerability Rating

Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer. The inherent vulnerability rating of groundwater intakes is determined based on an evaluation of aquifer characteristics, unsaturated zone characteristics and well integrity and construction characteristics. The inherent vulnerability rating of surface water intakes is determined based on an evaluation of the watershed classification (WSWP Rules), intake location, raw water quality data (e.g., turbidity and total coliform) and watershed characteristics (e.g., average annual precipitation, land slope, land use, land cover, groundwater contribution).

Contaminant Rating

The contaminant rating is based on an evaluation of the density of potential contaminant sources (PCSs), their relative risk potential to cause contamination, and their proximity to the water supply intake within the delineated assessment area.

Inventory of Potential Contaminant Sources (PCSs)

In order to inventory PCSs, the SWAP conducted a review of relevant, available sources of existing data at federal, state and local levels. The SWAP selected sixteen statewide databases that were attainable and contained usable geographic information related to PCSs.

Source Water Protection

The PWS Section believes that the information from the source water assessments are the basis for future initiatives and priorities for public drinking water source water protection (SWP) activities. The PWS Section encourages all PWS system owners to implement efforts to manage

identified sources of contamination and to reduce or eliminate the potential threat to drinking water supplies through locally implemented protection planning.

To encourage and support local SWP, the state offers PWS system owners assistance with local SWP planning as well as materials such as:

- Fact sheets outlining sources of funding and other resources for local SWP efforts.
- Success stories describing local SWP efforts in North Carolina.
- Guidance about how to incorporate SWAP and SWP information in Consumer Confidence Reports (CCRs).

Information related to SWP can be found at http://swap.deh.enr.state.nc.us/swap.

Public Water Supply Susceptibility Determinations

In April 2004, the PWS Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. The assessments are updated regularly; the most recent updates were published in May 2010. The results of the assessments can be viewed in two different ways, either through the interactive ArcIMS mapping tool or compiled in a written report for each PWS system. To access the ArcIMS mapping tool, simply click on the "NC SWAP Info" icon on the web page: http://swap.deh.enr.state.nc.us/swap/. To view a report, select the PWS System of interest from the list by clicking on the Source Water Assessment Results-2010 link found on the SWAP webpage.

In the Tar–Pamlico River Basin, 378 public water supply sources were assessed. Nine are surface water sources and 369 are groundwater sources. Of the 369 groundwater sources, 23 of them have a Higher, 290 have a Moderate and 56 have a Lower susceptibility rating. Table 10-1 identifies the surface water sources and their overall susceptibility ratings. It is important to note that a susceptibility rating of Higher does not imply poor water quality. Susceptibility is an indication of a water supply's potential to become contaminated.

Table 10-1. SWAP Results for Surface Water Sources in the Tar-Pamlico River Basin

PWS ID Number	Inherent Vulnerability Rating	Contaminant Rating	Overall Susceptibility Rating	Name of Surface Water Source	PWS Name
0235010	M	L	M	Cedar Creek	Town of Franklinton
0235010	M	L	M	Taylor Creek	Town of Franklinton
0235015	H	M	H	Tar River	Town of Louisburg
0433010	H	M	H	Tar River	Town of Tarboro
0464010	H	M	H	Tar River at Sunset	City of Rocky Mount
0464010	M	M	M	Tar River at Reservoir	City of Rocky Mount
0442025	H	L	M	Fishing Creek	Enfield Water System
0474010	H	M	H	Tar River	Greenville Utilities Commission
0498010	H	M	H	Tar River	City of Wilson