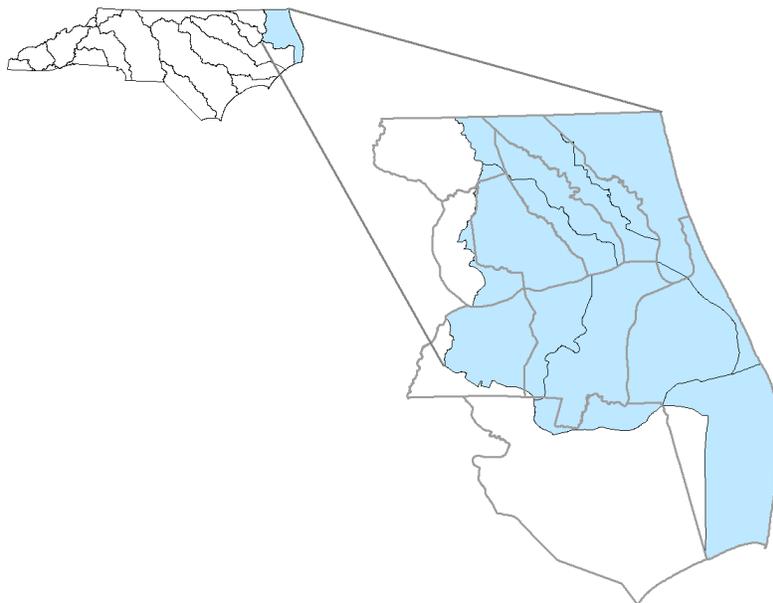


# Pasquotank River Basinwide Water Quality Plan

August 2007



North Carolina Department of  
Environment and Natural Resources



Division of Water Quality  
Basinwide Planning Unit



# PASQUOTANK RIVER BASINWIDE WATER QUALITY PLAN

2007

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*This document was approved and endorsed by the NC Environmental Management Commission on September 13, 2007 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 Pasquotank River basin. This plan is the third five-year update to the Pasquotank River Basinwide Water Quality Plan approved by the NC Environmental Management Commission in September 1997.*



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## North Carolina's Basinwide Approach to Water Quality Management

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. The NC Division of Water Quality (DWQ) prepares basinwide water quality plans for each of the 17 major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by DWQ, implementation and protection of water quality involves coordinated efforts of many agencies, local governments and stakeholders in the state.

The goals of DWQ's basinwide program are to:

- Identify water quality problems and restore full use to impaired waters,
- Identify and protect high value resource waters, and
- Protect unimpaired waters while allowing for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

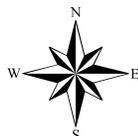
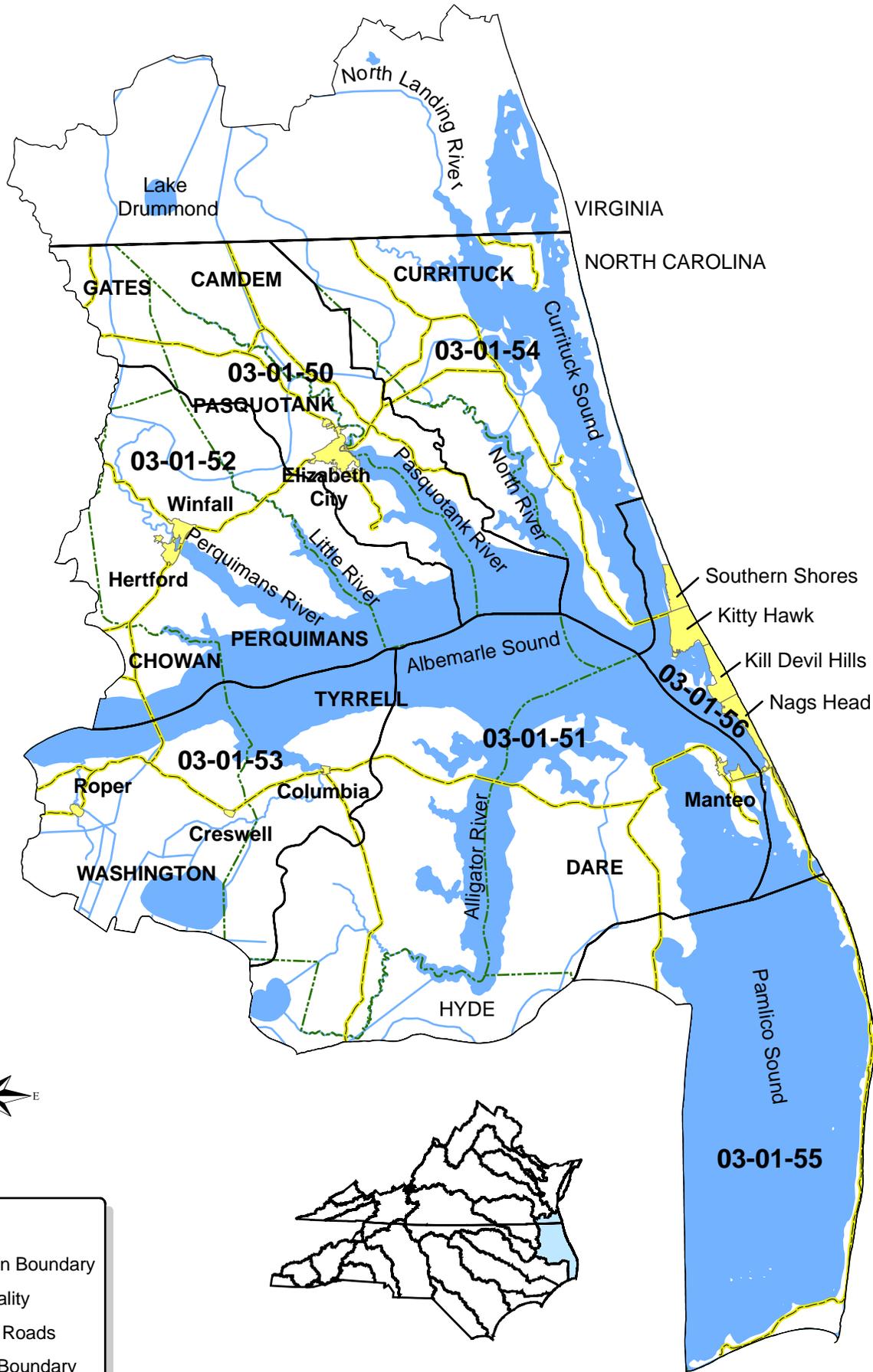
- Evaluate cumulative effects of pollution,
- Assure equitable distribution of waste assimilative capacity for dischargers,
- Regulate point and nonpoint source pollution where other approaches were unsuccessful,
- Improve public awareness and involvement, and
- Collaborate with other agencies to develop appropriate management strategies to protect and restore water quality. This includes providing agencies information related to financial and funding opportunities.

This document is the third edition of the *Pasquotank River Basinwide Water Quality Plan* updated on a five-year cycle. The first basinwide plan for the Pasquotank River basin was completed in 1997 and the second in 2002. The format of this plan was revised in response to comments received during the first planning cycle. DWQ replaced much of the general information in the first two plans with more detailed information specific to the Pasquotank River basin. For this plan, a greater emphasis was placed on identifying water quality concerns on the watershed level in order to facilitate protection and local restoration efforts. Refer to the Introduction for additional information on the Basinwide Planning Program.

### Pasquotank River Basin Overview

The Pasquotank River basin encompasses 3,635 square miles of low-lying lands and vast open waters, including Albemarle Sound, in the state's northeast outer coastal plain (Figure *ii*). The basin includes all or portions of Camden, Chowan, Currituck, Dare, Gates, Hyde, Pasquotank, Perquimans, Tyrrell and Washington counties. The basin also contains numerous small watersheds that drain into Albemarle, Currituck, Croatan, Roanoke and Pamlico Sounds. A small portion (~577 acres) of the Pasquotank River basin is located in Virginia. The Pasquotank River basin is part of the Albemarle-Pamlico Estuarine system, the second largest estuarine system in the United States.

# Figure i General Map of the Entire Pasquotank River Basin in North Carolina and Virginia



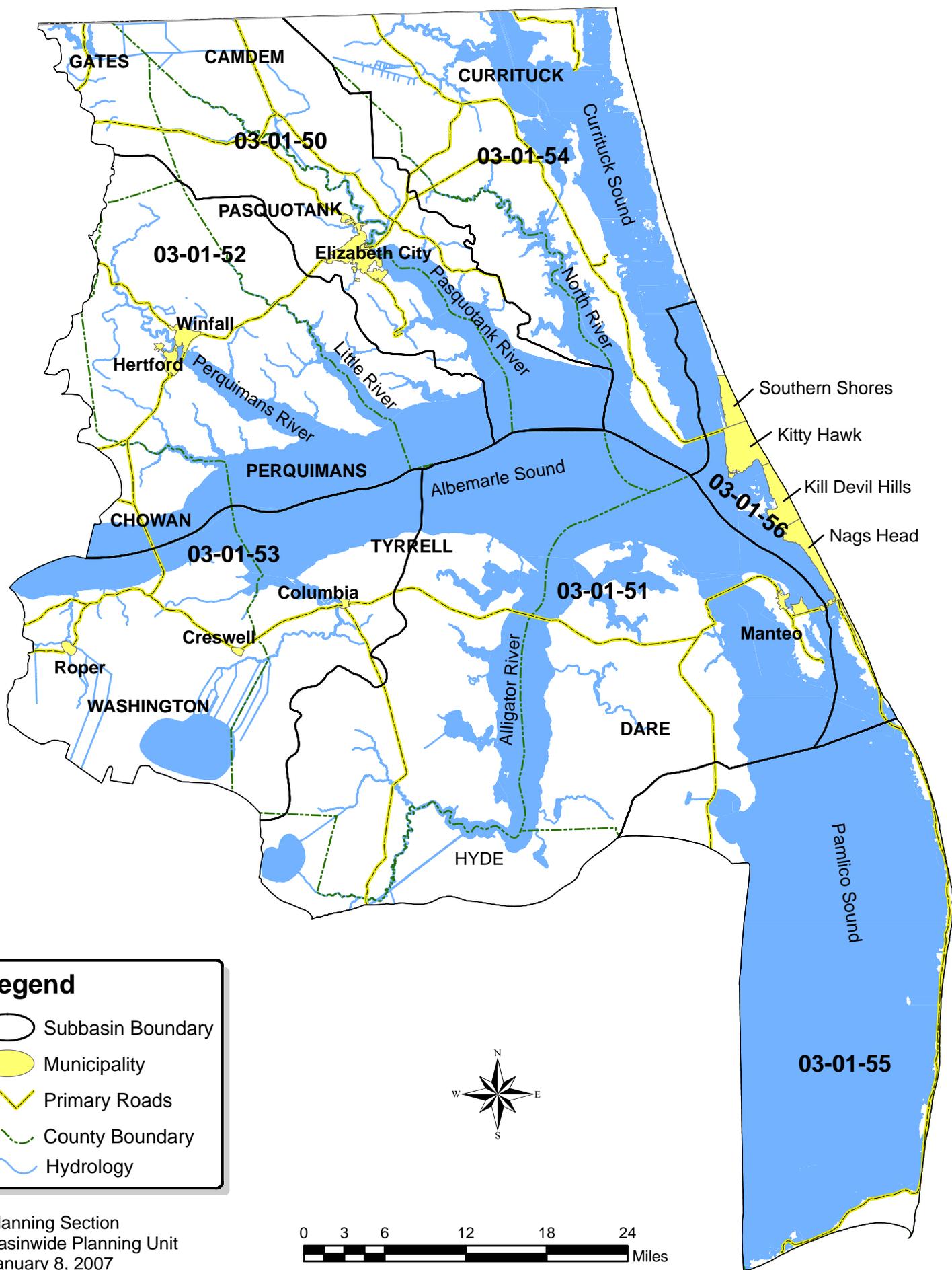
**Legend**

-  Subbasin Boundary
-  Municipality
-  Primary Roads
-  County Boundary
-  Hydrography



Planning Section  
 Basinwide Planning Unit  
 May 8, 2007

**Figure ii General Map of the Pasquotank River Basin in North Carolina**



**Legend**

-  Subbasin Boundary
-  Municipality
-  Primary Roads
-  County Boundary
-  Hydrology

Planning Section  
 Basinwide Planning Unit  
 January 8, 2007



Information presented in this basinwide water quality plan is based on information collected from September 2000 to March 2007 to describe water quality conditions and issues in each of the five subbasins. Specific water quality assessments were based on biological, chemical and physical monitoring data collected between September 2000 and August 2005. A discussion of conditions reflecting whether specific waterbodies support their best-intended use and maps of each subbasin are included in each subbasin chapter (Chapters 1 – 7). Each subbasin has its own unique characteristics and water quality concerns. Each subbasin has a mix of freshwater and saltwater, high quality (Class HQW) and outstanding resource waters (Class ORW), recreational (Class B) and shellfish harvesting (Class SA) uses. Below is a brief description of each subbasin and their water classifications.

**Subbasin 03-01-50**

This subbasin contains the headwaters of the Pasquotank River and its headwaters from the Great Dismal Swamp. Most streams are of low relief and swampy and channelized ditches are common. A significant portion of the waters in this subbasin are brackish estuarine, including Albemarle Sound and the Pasquotank River below Elizabeth City. Land cover generally consists of evergreen forests, mixed forests, forested wetlands and marshes, cultivated crops, such as wheat, cotton and peanuts. Portions of Gates, Pasquotank and Camden Counties are found in this subbasin with the largest population centered around urbanized areas. The population of the subbasin is expected to continue to increase over the next twenty years.

Table *i* Subbasin 03-01-50 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres	Saltwater Miles
C	6.9		
C; Sw	1,057.2		
SB		38,617.2	
SC		12,941.7	2.2
WS-IV;Sw	13.7		
WS-IV; Sw, CA	0.7		
WS-V;Sw	15.9		

C/SC= Aquatic life propagation/protection and secondary recreation, **SB**= Primary recreation and Class C uses, **Sw** = *Swamp Waters*: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen, **WS** = *Water Supply watershed*. There are five WS classes ranging from WS-I through WS-V.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-50 are listed in Table *i*. No previously or newly impaired waters were identified in this subbasin. Chapter 1 presents specific water quality information for each monitored waterbody in this subbasin.

**Subbasin 03-01-51**

This subbasin contains the Alligator River and several tributaries including Callaghan and Broad Creeks. Most streams are of low relief and often swampy. Channelized ditches are common. Most waters in this subbasin are brackish estuarine, including Albemarle, Croatan and Roanoke Sounds, and the Alligator River to the Intracoastal Waterway (ICWW). Portions of Dare, Hyde and Tyrrell Counties can be found in this subbasin with the highest concentration of urbanized areas located on Roanoke Island in the Towns of Manteo and Wanchese. Rapid population growth is occurring in Dare County and along coastal areas.

Table *ii* Subbasin 03-01-51 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres	Saltwater Miles
C;Sw	4,980.6	12.3		
C;Sw,ORW		484.9		
SA;HQW			54,628.7	
SB			107,485.9	
SC			4,988.3	1.1
SC;HQW			32.9	
SC;Sw			23,364.1	8.8
SC;Sw,ORW			43,154.4	

C/SC= Aquatic life propagation/protection and secondary recreation, **SB**= Primary recreation and Class C uses, **SA**= Shellfish waters, **HQW**= High Quality Waters, **ORW**= Outstanding Resource Waters, **Sw** = *Swamp Waters*: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen, **WS** = *Water Supply watershed*. There are five WS classes ranging from WS-I through WS-V.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-51 are listed in Table *ii*. Water quality Impairments in this subbasin are in the shellfish harvesting category (2,081.5 ac). Chapter 2 presents specific water quality information for each monitored waterbody in this subbasin.

**Subbasin 03-01-52**

This subbasin consists of the northwestern edge of Albemarle Sound and the rivers that empty to it. The largest of these rivers are the Little River and the Perquimans River. Most streams are low gradient with substrates of silt and sand. Portions of Perquimans, Pasquotank, Chowan and Gates Counties can be found in this subbasin with the highest concentration of urbanized areas around the Town of Hertford. Although the Town of Hertford experienced a net decline in population based on the 2000 census data, trends for the subbasin show expected growth in all four counties over the next 20 years.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-52 are listed in Table *iii*. The Little River and the Perquimans River both have segments that are Impaired in the aquatic life category, the Albemarle Sound is Impaired for fish consumption because of a dioxin advisory and all monitored waters are Supporting for recreation. Chapter 3 presents specific water quality information for each monitored waterbody in the subbasin.

Table *iii* Subbasin 03-01-52 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres
C; Sw	88.8	
SB		83,576.9
SC		9,087.6

*C/SC*= Aquatic life propagation/protection and secondary recreation, *SB*= Primary recreation and Class C uses, *Sw* = *Swamp Waters*: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen.

**Subbasin 03-01-53**

This subbasin contains the Scuppernong River, Deep Creek, Kendrick Creek and several tributaries, many of which are channelized. Most streams are of low relief and often swampy. Western Tyrrell County and most of Washington County are found in this subbasin with the highest concentration of urbanized areas around the small towns of Columbia, Creswell and Roper.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-53 are listed in Table *iv*. Kendrick Creek and Main Canal both are Impaired in the aquatic life category, the Albemarle Sound is Impaired for fish consumption because of a dioxin advisory and all monitored waters are Supporting for recreation. Chapter 4 presents specific water quality information for each monitored waterbody in the subbasin.

Table *iv* Subbasin 03-01-53 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Acres	Freshwater Miles	Saltwater Acres
B;Sw,ORW	15,938.3		
C;Sw		113.2	
SB			64,313.6
SC			1,813.9

*C/SC*= Aquatic life propagation/protection and secondary recreation, *B/SB*= Primary recreation and Class C uses, *ORW*= Outstanding Resource Waters, *Sw* = *Swamp Waters*: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen.

**Subbasin 03-01-54**

This subbasin contains portions of the Currituck Sound and several tributaries, many of which are channelized. Except for the barrier islands, most streams are of low relief and often swampy. A portion of this subbasin is located on the Outer Banks where there is the potential for high population growth and development. Most of Currituck County and the eastern portion of Camden County can be found in this subbasin, both counties have an estimated population growth of over 45 percent by 2020.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-54 are listed in Table v. Portions of the Currituck Sound are Impaired for recreation in this subbasin. Chapter 5 presents specific water quality information for each monitored waterbody in the subbasin.

Table v Subbasin 03-01-54 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres
B;Sw	25.1	
C;Sw	1,003.0	
SB		10,412.2
SC		113,572.6

C/SC= Aquatic life propagation/protection and secondary recreation, B/SB= Primary recreation and Class C uses, ORW= Outstanding Resource Waters, Sw = Swamp Waters: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen.

**Subbasin 03-01-55**

This subbasin consists of Pamlico Sound from Oregon Inlet to Hatteras Inlet and the Outer Banks in Dare County. Subbasin 03-01-55 contains Black Lake and Stumpy Point Bay on the mainland and the Pea Island National Wildlife Refuge and Cape Hatteras National Seashore on the Outer Banks. Streams on the mainland are few and low gradient with channelized ditches being common and all are either estuarine or oceanic. Dare County experiences a high seasonal population fluctuation with tourists visiting the Outer Banks. Dare County is estimated at having a population increase of 35 percent by 2020.

Table vi Subbasin 03-01-55 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres
C;Sw	117.6	
SA; HQW		319,557.8
SC		22.2

C/SC = Aquatic life propagation/protection and secondary recreation, SA = Shellfish Waters, HQW = High Quality Waters, Sw = Swamp Waters: Recognizes waters that will naturally be more acidic and have lower levels of dissolved oxygen.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-55 are listed in Table vi. There are 2,605 acres Impaired for shellfish harvesting in this basin. Chapter 6 presents specific water quality information for each monitored waterbody in the subbasin.

**Subbasin 03-01-56**

This subbasin includes the Outer Banks from the northern portion of Dare County south to Oregon Inlet. It also includes portions of Currituck Sound, Albemarle Sound and Roanoke Sound. Portions of Currituck and Dare Counties are in this subbasin. The Outer Banks have experienced rapid population growth and development with the Towns of Kill Devil Hills and Nags Head experiencing growth estimated at an increase of 39 and 47 percent by 2020, respectively.

Table vii Subbasin 03-01-56 DWQ Classifications by Acres and Miles

DWQ Classification	Freshwater Miles	Saltwater Acres	Coast Miles
SA;HQW		21,049.4	
SB		7,713.6	111.1
SC		8.4	
WS-III; CA	23.8		

SC= Aquatic life propagation/protection and secondary recreation, SB= Primary recreation and Class C uses, SA= Shellfish waters HQW= High Quality Waters, WS = Water Supply watershed. There are five WS classes ranging from WS-I through WS-V.

Surface water classifications and the amount of acreage or miles in subbasin 03-01-56 are listed in Table *vii*. Colington Creek, portions of the Atlantic coastline and portions of the Roanoke and Albemarle Sounds are Impaired for recreation in this subbasin. Over 1,700 acres of shellfish harvesting waters are Impaired. Chapter 7 presents specific water quality information for each monitored waterbody in the subbasin.

## **Waterbody Classifications and Use Support Assessment of Water Quality**

Surface waters are classified according to their best-intended uses. Determining how well a waterbody supports its designated uses (use support rating) is an important method of interpreting water quality data to assess water quality. The terms Impaired and Supporting refer to whether the classified uses (e.g., aquatic life protection, recreation, shellfish harvesting, and fish consumption) of the water are being met. For example, waters classified for aquatic life protection and secondary recreation (Class C for freshwater or SC for saltwater) are rated Supporting if data used to determine use support did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as Impaired. A single waterbody could have more than one use support rating corresponding to one or more of the multiple use support categories. Use support assessments based on surface water classifications form the foundation of this basinwide plan.

DWQ use support methods were developed to assess ecosystem health and human health risk through the development of use support ratings for five categories: water supply, fish consumption, aquatic life, recreation, and shellfish harvesting. These categories are tied to the uses associated with the primary classifications applied to North Carolina rivers, streams and lakes. A full description of the classifications is available in the DWQ document titled *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (<http://h2o.enr.state.nc.us/csu/>).

Use support methodology has changed significantly since the 2002 revision of the *Pasquotank River Basinwide Water Quality Plan*. In the previous plan, surface waters were rated fully supporting (FS), partially supporting (PS), not supporting (NS) and not rated (NR). The 2002 *Integrated Water Quality Monitoring and Assessment Report Guidance* issued by the Environmental Protection Agency (EPA) requests that states no longer subdivide the Impaired category. In agreement with this guidance, North Carolina no longer subdivides the Impaired category and rates waters as Supporting (S), Impaired (I), Not Rated (NR), or No Data (ND). These ratings refer to whether the classified uses of the water are being met. Detailed information on use support methodology is provided in Appendix II.

Many waterbodies in this basin are classified as swamp waters or receive swamp drainage. Some creeks and rivers flushing rates are influenced by tides and wind. Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. There are three waterbody segments that were not rated because DWQ criteria for Coastal B waters have not been finalized. DWQ has developed draft biological criteria that may be used in the future to assign bioclassifications to Coastal B streams. However, validation of these criteria will require collecting data for several years from Coastal B stream reference sites. The criteria will remain in draft form until DWQ is better able to evaluate such things as: year-to-year variation at reference sites, effects of flow interruption, and variation among reference sites and habitat evaluation.

## Pasquotank River Basin Use Support Summary

### Water Supply

There are 54.1 stream miles currently classified for water supply in the Pasquotank River basin. All are considered Supporting on an evaluated basis, based on information provided by the regional water treatment plant consultant. Local water treatment plant operators monitored all during the past five years.

### Fish Consumption

The fish consumption use support category is applied to all waters in the state. Fish consumption use support ratings are based on fish consumption advice issued by the NC Department of Health and Human Services (DHHS). Currently, there is a statewide advice limiting consumption of several fish species due to high mercury concentrations. Specifically, high mercury levels have been found in catfish, warmouth, blackfish (bowfin), and jack fish (chain pickerel) caught south and east of Interstate 85. Because of this advisory, all waters are considered Impaired for the fish consumption use on an evaluated basis. An advisory is also posted for western portion of the Albemarle Sound due to elevated levels of dioxin. The dioxin advisory recommends that women of childbearing age and children should not eat catfish and carp and others should limit their consumption.

### Aquatic Life

The aquatic life use support category is applied to all waters in North Carolina. A basinwide summary of current aquatic life use support ratings is presented in Table *viii*.

Table *viii* Aquatic Life Use Support Summary

<b>Aquatic Life Use Support Ratings</b>	<b>Freshwater Acres</b>	<b>Freshwater Miles</b>	<b>Saltwater Acres</b>	<b>Saltwater Miles</b>	<b>Coast Miles</b>
Supporting	----	53.1	272,273.8	8.8	----
Impaired	----	12.3	772.7	----	----
Not Rated	15,938.3	49.8	328,006.9	14.7	0.5
No Data	4,980.6	2,847.8	314,357.7	3.3	110.6
<b>Total</b>	<b>20,918.9</b>	<b>2,963.0</b>	<b>915,411.1</b>	<b>26.8</b>	<b>111.1</b>

### Recreation

DWQ and the Division of Environmental Health (DEH) monitor waters for primary recreation (Class B). A basinwide summary of current recreation use support ratings is presented in Table *ix*.

Table *ix* Recreation Use Support Summary

<b>Primary Recreation Use Support Ratings</b>	<b>Freshwater Acres</b>	<b>Freshwater Miles</b>	<b>Saltwater Acres</b>	<b>Saltwater Miles</b>	<b>Coast Miles</b>
Supporting	----	45.3	721,530.1	8.8	110.6
Impaired	----	----	5.1	----	0.5
Not Rated	----	----	----	----	----
No Data	20,918.9	2,917.8	194,806.2	3.3	----
<b>Total</b>	<b>20,918.9</b>	<b>2,963.0</b>	<b>916,341.4</b>	<b>12.1</b>	<b>111.1</b>

### Shellfish Harvesting

There are 395,236 estuarine acres classified for shellfish harvesting (Class SA) in the Pasquotank River basin. The DEH Shellfish Sanitation Section growing area classification is used to determine use support ratings in the shellfish harvesting category. A basinwide summary of current shellfish harvest use support ratings is presented in Table x.

Table x Shellfish Harvest Use Support Summary

Shellfish Waters Use Support Ratings	Saltwater Acres
Supporting	388,762.7
Impaired	6,473.2
<b>Total</b>	<b>395,236.0</b>

Since shellfish harvesting is the primary designated use assessed in the Pasquotank River basin, a comparison between the use support assessments conducted for the 2002 basin plan and this plan are provided in Table xi. It is important to note that there are considerable increases in shellfish harvesting acreage considered impaired in this 2007 basin plan over the 2002 basin plan. Not all of this acreage should be considered to be a degradation in water quality because there are several reasons for the changes in acreage, as follows:

1. The 2002 basin plan used an interim frequency of closures based method for assessment (Refer to the 2002 basin plan, Section A, Chapter 4 for more information) until DEH could fully develop a database of closures;
2. DEH Shellfish Sanitation Section developed the database and GIS expertise to assess shellfish harvesting closures more accurately in terms of days of closure, closure lines and acreage associated with these lines;
3. DEH is required to reclassify some portions of growing areas to conditional or prohibited due to land use changes (presence of marinas or stormwater outfalls, etc.) rather than on actual data;
4. GIS technology has improved and changes in acreage can partially be attributed to technology improvements that allow more accurate mapping.

Table xi Comparison of Shellfish Harvesting Acres Impaired in the Pasquotank River Basin between the 2002 and 2007 Basin Plan

Subbasin	2002	2007
	Acres Impaired	Acres Impaired
03-01-51	1,959.3	2,081.5
03-01-55	1,361.1	2,604.8
03-01-56	1,712.9	1,786.9
<b>Total</b>	<b>5,033.3</b>	<b>6,473.2</b>

### **Water Quality Standards and Classifications**

Chapter 8 discusses water quality standards and classifications and includes maps showing the designated High Quality Waters (HQW) and Outstanding Resource Waters (ORW). There are 395,269 acres of HQW, and 485 miles, 15,938 freshwater acres and 43,154 saltwater acres of ORW in the basin.

Much of the coastal growth in the Pasquotank River basin involves construction and/or development along areas of HQWs and ORWs. Management strategies are associated with these supplemental classifications and are intended to prevent degradation of water quality below present levels from point and nonpoint sources of pollution.

### **Water Quality Stressors**

DWQ identifies the stressors of water quality impact as specifically as possible depending on the amount of information available in a watershed. Most often, the source of the stressor is based on predominant land use in the watershed. In the Pasquotank River basin, new

development/construction, impervious surfaces, stormwater outfalls, and inadequate human and animal waste management were all identified as possible sources. However, unknown sources of stressors impact many waterbodies. The accumulation of multiple stressors leads to water quality degradation. In some way, every resident, tourist, landowner, industry, and municipality in the basin impacts water quality. Therefore, it is important that all stakeholders play a role in management strategies designed to protect and restore water quality in the Pasquotank River basin.

Stressors to recreational use of a waterbody include pathogenic indicators such as fecal coliform bacteria, *escheria coli* (*E. coli*), and *enterrococci*. In the Pasquotank River basin, there are 5.1 acres and 0.5 coast miles where the enterrococcus bacteria standard was exceeded, causing these waters to be rated as Impaired for recreation. Waters are Impaired for recreation when swimming advisories are posted for more than 61 days during the five-year assessment period. Waters with beach monitoring sites with advisories posted less than 61 days are Supporting. Between 2003-2006, DEH Recreational Water Quality Monitoring Program in the Pasquotank River Basin reported 1,259 postings of beach closure days.

Fecal coliform bacteria is the primary stressor for shellfishing waters accounting for the majority of Impaired waters in this basin. Within the shellfish harvesting areas of the Pasquotank River basin, there are 6,473 acres are Impaired and prohibited waters and an additional 388,763 acres are approved and Supporting for shellfish harvesting uses.

Water quality stressors are identified when impacts have been noted to biological (benthic and fish) communities or water quality standards have been violated. In the fish consumption category, mercury and dioxin are the noted stressors. Whenever possible, water quality stressors are identified for Impaired waters as well as waters with notable impacts. Figures *iii* - *iv* show identified stressors and/or sources freshwater miles; see Chapter 9 for more information.

Figure *iii* Stressors Identified in Impaired Freshwater Miles for Aquatic Life

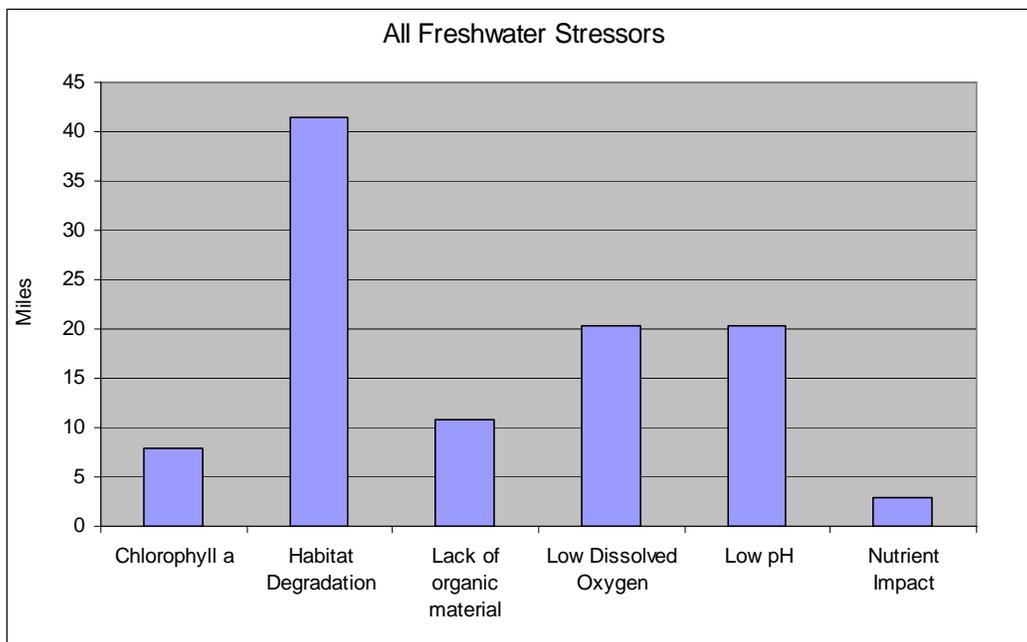
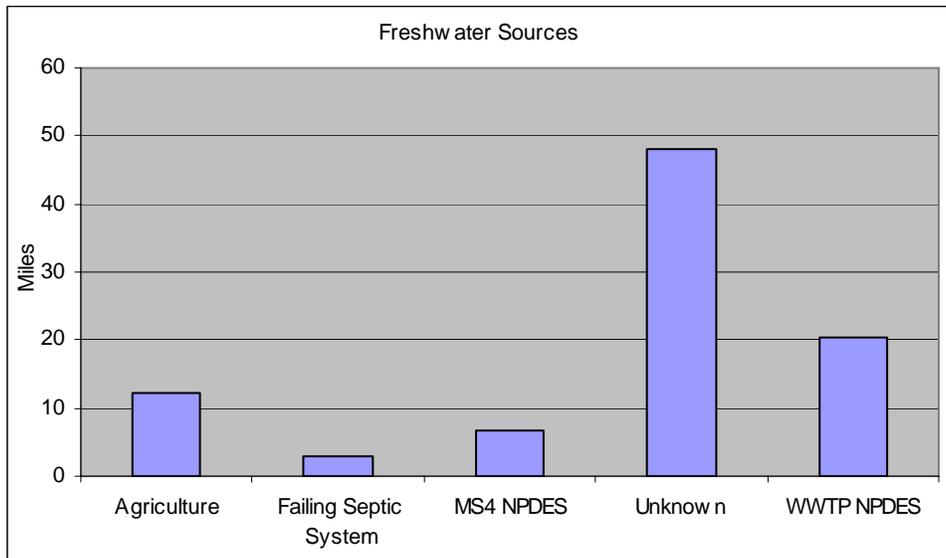


Figure iv Sources Identified in Impaired Freshwater Miles for Aquatic Life



### Impacts from Stormwater Runoff

Stormwater runoff is rainfall or snowmelt that runs off the ground or impervious surfaces (i.e., buildings, roads, parking lots, etc.) instead of absorbing into the soil. In some cases, stormwater runoff drains directly into streams, rivers, lakes and oceans. In other cases, particularly in urbanized areas, stormwater drains into streets and manmade drainage systems consisting of inlets and underground pipes, commonly referred to as a storm sewer system. Stormwater runoff is a primary carrier of nonpoint source pollution in both urbanized and rural areas. Stormwater runoff is a particular concern in the agricultural areas of the Pasquotank River basin. Previous hydrologic alterations of the landscape have ditched and channelized the land to improve drainage. Stormwater currently moves quickly off the land bypassing swamps and enters directly into creeks and rivers untreated. The impact of stormwater runoff is also severe in developing areas where recently graded lands are highly susceptible to erosion. Water quality impacts are also evident in urbanized areas where stormwater runoff is increased by impervious surfaces and is rapidly channeled through ditches and curb and gutter systems into nearby waterbodies.

Coastal communities in the Pasquotank River basin are experiencing significant and rapid population growth. Chapter 11 presents figures for population projections that estimate Camden, Currituck and Dare counties to have over a 35 percent increase in population, between 2000 and 2020. These estimates do not take into account the significant population influxes during the tourist season.

There are several different stormwater programs administered by DWQ that will apply to the coastal communities within the Pasquotank River Basin. In 2009 the communities in the Pasquotank River basin will be assessed by DWQ to determine if they meet the criteria for inclusion in the Phase II stormwater program or these communities may be assessed sooner due to the direction of the EMC. The EMC was given authority by rule to delineate regulated coverage in accordance with the schedule for review and revision of basinwide water quality management plans.

DWQ recommends that other local governments in the basin develop stormwater management programs voluntarily to begin the process of restoring and improving water quality in the region. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government and county stormwater program development.

The goal of DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs accomplish this goal by controlling the source(s) of pollution. Chapter 10 contains more information on federal and state stormwater programs.

## **Wastewater Management**

In the Pasquotank River basin, wastewater is treated by discharge, non-discharge and on-site systems. Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Dischargers in North Carolina must apply for and obtain a NPDES permit. Currently, there are 34 permitted wastewater dischargers in the Pasquotank River basin.

Many municipalities, residential developments, and commercial/industrial operations located in northeastern North Carolina utilize wastewater treatment systems that dispose of the wastewater through land application methods. Such systems are referred to as non-discharge systems, as there is no direct discharge to surface water of the state. Although non-discharge systems should not present high potentials for surface water impacts, some systems within the Pasquotank River basin have problems that may result in impaired surface water quality. In the Pasquotank River basin, 20 non-discharge permits have been issued.

Within the Pasquotank River basin, it is important to note that there is a direct connection between groundwater and surface water in many places. Drainage ditches and canals are widespread in northeastern NC and function as a direct pathway for groundwater that may be impacted from nutrients and coliform bacteria, especially in rural areas where agriculture is widespread, to enter into the surface water system. In other cases, surface water bodies, directly border areas where groundwater quality may be impaired. In many areas, the time it takes for groundwater to move into the surface water system is brief. Although groundwater quality at non-discharge facilities may be compliant with groundwater quality standards, groundwater flux moving into the surface water system has the ability to transport contaminants into surface water bodies and add to total mass loadings. It is recommended that research be conducted to better establish and understand the relationship between groundwater and surface water in eastern North Carolina. Such understanding would provide for more accurate assessment of surface water impairments resulting from groundwater discharges and enable the state to make sound permitting judgments and recommendations to better protect water quality in general.

On-site septic systems are common throughout the Pasquotank River basin. However, soil conditions in the basin may limit the functionality of the septic system treatment allowing untreated effluent to reach surface waters. Precautions should be taken by local septic system permitting authorities to ensure that failing systems are repaired, older systems are updated and new systems are sited and constructed properly allowing an adequate repair area. Chapter 10 provides more information on wastewater permitting regulations.

## **Population Growth and Changes in Land Use**

There are ten counties and 11 municipalities located in whole or in part in the basin. Based on the 2000 Census, the overall population of the Pasquotank basin is 118,786. The most populated areas are located on the Outer Banks and along waterways. The coastal communities in the Pasquotank River basin are changing. Traditional uses of waterfront property are shifting to accommodate increase in permanent residents, seasonal rental properties, and development. Development has also moved inland along tidal creeks and rivers. However, many of the water dependent resources that people seek out from the NC coastal communities are diminishing. Public waterfront access is limited and high fecal coliform levels prevent shellfish harvesting and beach recreation. The rural areas have also begun to shift from agriculture fields to housing developments.

Statistics provided by the US Department of Agriculture, Natural Resources Conservation Service indicates that between 1982 and 1997 (the most recent update available) there was a 31,800ac. increase in the amount of developed land, a 56,100ac. decrease in cultivated cropland, and a 177,000ac. decrease in forestland. Chapter 11 presents information regarding population, growth and development in the Pasquotank River Basin.

## **Water Quality Management Strategies**

The N.C. Divisions of Water Quality, Coastal Management, Land Resources, Marine Fisheries, Soil and Water Conservation, Parks and Recreation and Environmental Health are responsible for many coastal activities and policies including stormwater management, development permits, erosion control programs, agriculture and land preservation, shellfish protection and recreation monitoring. Additional state programs and many interagency and group partnerships work together to protect the resources found in coastal waters and communities. Chapter 12 presents more information regarding these programs and strategies to manage coastal waters.

- Army Corps of Engineers and the State of North Carolina are partnering to conduct a Feasibility Study on the Currituck Sound to identify ways to improve water quality and restore the Sound.
- Coastal Habitat Protection Plan is a plan to manage and restore aquatic habitats critical to North Carolina's commercial and recreational fisheries resources.
- Oyster Action Plan was developed to restore and protect North Carolina's native oyster populations.
- Coastal Nonpoint Source Program was developed to coordinate the state's efforts on managing nonpoint source pollution from agriculture, forestry, urban areas, marinas and recreational boating, and hydrologic modification.
- Community Conservation Assistance Program managed by Soil and Water Conservation Districts was developed to focus its efforts on stormwater retrofits to existing land uses that are non-agricultural.
- Albemarle-Pamlico National Estuary Program (APNEP) has supported a number of research, restoration, and demonstration projects. Several demonstration projects are designed to mitigate the effects of stormwater runoff and pollution.
- Albemarle Resource Conservation and Development Council is leading a 10 county regional study to identify regional water quality, water management, and recreational concerns resulting from land-use changes associated with unprecedented development in these counties.

- Section 319 Nonpoint Source Grant program has allocated over \$660,000 for projects.
- Clean Water Trust Fund has allocated over \$34,000,000 for projects in the Pasquotank basin.

### **Land Use Planning and Sea Level Rise**

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 where possible 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 the 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 (sewage and stormwater) 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. In the Pasquotank River basin, two counties and three communities have completed their land use plans and nine others are in the process. Chapter 12 presents specific information regarding land use plans in communities of the Pasquotank River basin.

Sea level rise has the potential to dramatically alter North Carolina's coast and estuary systems. Coastal infrastructure, residential properties and industry are threatened and water quality conditions will change. Research is currently being conducted by several universities in North Carolina to predict changes in our environmental and economic resources. Links to resources about sea level rise are provided in Chapter 12.

### **Agriculture and Water Quality**

There are 74 animal operations in the Pasquotank basin. Excess nutrient loading, pesticide and/or herbicide contamination, bacterial contamination, and sedimentation are often associated with agricultural activities, and all can impact water quality. In the Pasquotank basin, significant efforts have been made to reduce nitrogen and phosphorus loads originating from agricultural land uses through the implementation of best management practices (BMPs). Additional efforts are needed to redesign drainage from agricultural fields to help filter runoff. The Soil and Water Conservation Districts are working on establishing Special Use Water Management Districts to help identify and manage stormwater issues and drainage. During this five-year assessment period, the North Carolina Agricultural Cost Share Program (NCACSP) funded BMPs totaling more than \$1,280,000. Chapter 13 provides information related to agricultural activities in the Pasquotank River basin and also identifies funding opportunities for BMPs.

### **Natural Resources**

The land comprising the Pasquotank River basin is dominated by open water. Most of the water for human consumption in the basin comes from surface water and groundwater sources, but the vast majority comes from groundwater sources. Forty-one percent of the land use in the basin is water with another 38 percent characterized as forest/wetlands. Approximately 44 percent of forestland in the Pasquotank basin is privately owned, 10 percent is owned by forest industry and the remaining 46 percent is publicly owned. At least 22,362 acres of land were planted or

regenerated with forest trees across the basin from September 1, 2000 through August 31, 2005. During this assessment period, Division of Forest Resources provided 467 written or verbal BMP recommendations on tracts totaling 18,910 acres in the Pasquotank River Basin. Important natural resources in the basin include wetlands, marshes, pocosins, anadromous fish spawning areas, National Seashore and National Wildlife Refuges. There are five federally listed threatened and endangered aquatic species in the basin. Natural resource agencies advocate the priority conservation activities should include the establishment of buffer strips and conservation easements and continued refinement and monitoring of BMPs on lands used primarily for agriculture and silviculture. These activities are also needed for industrial and residential developments. For more information about the natural resources found in the Pasquotank River basin see Chapter 14.

## **Restoring Impaired Waters**

The long-range mission of basinwide planning is to provide a means of addressing the complex problem of planning for increased development and economic growth while maintaining, protecting and enhancing water quality and intended uses of the Pasquotank River basin's surface waters. Within this basinwide plan, DWQ presents management strategies and recommendations for those waters rated Impaired or that exhibit some notable water quality problems.

Addressing water quality impairment in waters that are on the state's 303(d) list are a DWQ priority. Section 303(d) of the federal Clean Water Act requires states to develop a list of waters not meeting water quality standards or which have impaired uses. The waters in the Pasquotank River basin that are on this list are discussed in the individual subbasin chapters. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. EPA issued guidance in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list within 8-13 years. More information on the TMDL process is found in Chapter 15.

## **Challenges and Recommendations for Achieving Water Quality Improvements**

Point source impacts on surface waters can be measured and addressed through the basinwide planning process and do not represent the greatest threat to water quality in the basin. A major water quality problem in the basin is fecal coliform bacteria contamination (affecting shellfish harvesting). Fecal coliform bacteria contamination is primarily attributed to nonpoint source pollution associated with runoff from urban areas and agricultural lands. The task of quantifying nonpoint sources of pollution and developing management strategies for these impaired waters is very resource intensive. Federal and state stormwater regulations and initiatives are in place to help reduce and prevent stormwater runoff in developing coastal communities.

The cumulative effects of nonpoint source pollution are the primary threat to water quality across the state and throughout the Pasquotank River basin. Nonpoint source pollution can be identified through the basinwide plan and the DEH Sanitary Surveys, but actions to address these impacts must be taken at the local level. Such actions should include:

### ***Cumulative Effects***

While any one activity may not have a dramatic effect on water quality, the cumulative effect of land use activities in a watershed can have a severe and long-lasting impact.

- Require stormwater best management practices for existing and new development,
- Develop and enforce buffer ordinances,
- Conduct comprehensive land use planning that assesses and reduces the impact of development on natural resources, and
- Develop and enforce local erosion control ordinances.

Without proactive land use planning initiatives and local water quality strategies, population growth and development in the basin increases the risk of waterbody impairment. Balancing economic growth and water quality protection will continue to be an immense challenge. This basinwide plan presents many water quality initiatives and accomplishments that are underway throughout the basin. These actions provide a foundation on which future initiatives can be built.

### **General Recommendations for the Pasquotank River Basin**

Maintenance and continual improvements in water quality are dependent on proactive planning. The following recommendations are compiled from natural resource agencies and stakeholders working and/or living within the Pasquotank River basin:

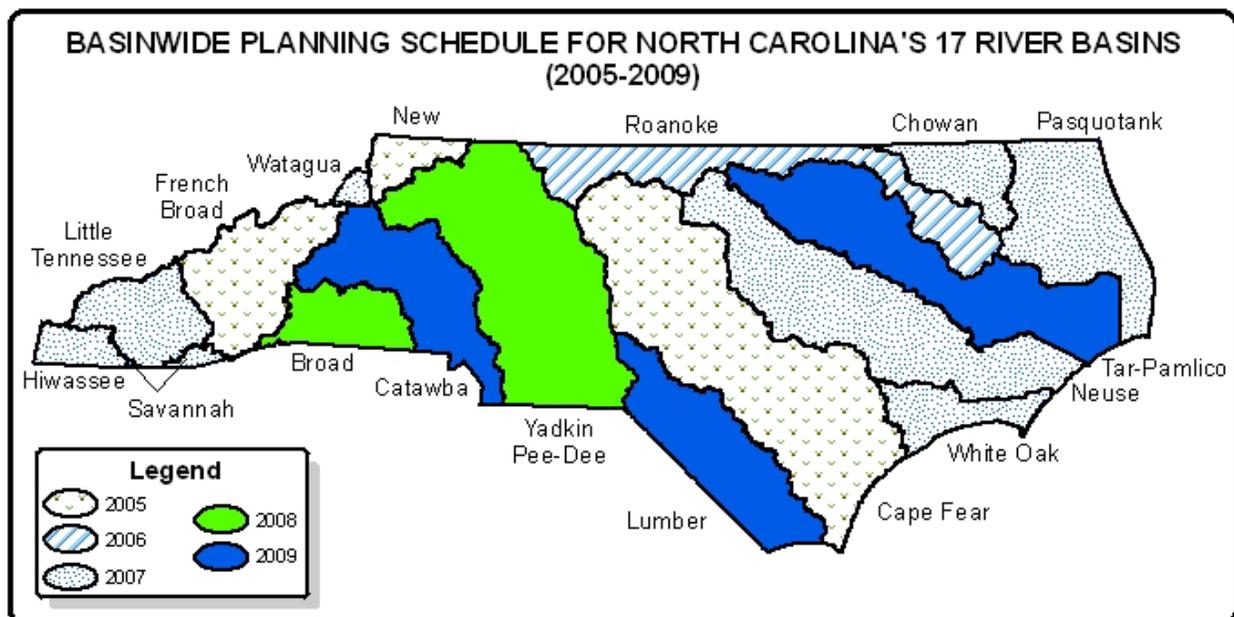
- Conduct additional research to understand possible surface-ground water interactions and possible water quality issues associated with non-discharge wastewater disposal.
- Continue efforts to focus on proper training of facility operators to address non-compliance issues associated with permitted facilities, both non-discharge and discharge, often associated with operator mismanagement.
- Protect human health and maintain water quality by repairing failing septic systems, update older systems, and eliminate straight pipes. Additional monitoring of fecal coliform bacteria throughout tributary watersheds will aid in identifying where straight pipes and failing septic systems are problems. Septic system maintenance outreach is needed in rural areas dependent on on-site wastewater disposal.
- Develop stormwater management programs for new development and to retrofit existing development.
- Develop additional outreach opportunities to incorporate smart growth technologies or low impact development techniques for municipal planners to incorporate into land use plans.
- Establish riparian buffers, as needed throughout the basin, both in residential and agricultural land use areas.
- Reestablish natural drainage and associated wetlands to reduce stormwater runoff, assist with flood control and improve water quality.
- Support the development and implementation of best management practices (BMPs) to help reduce nonpoint source pollution. Monitoring of these BMPs should also be required to improve maintenance, design and functionality. BMPs applicable in residential areas need to be encouraged through public education campaigns.
- Support the implementation of the Coastal Habitat Protection Plan at all levels of government and amongst citizens.
- Continue collaborative efforts between natural resource agencies within North Carolina and Virginia to improve adaptive management and policies on a watershed ecosystem scale.

## What is Basinwide Water Quality Planning?

Basinwide water quality planning is a watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality (DWQ) for each of the 17 major river basins in the state (Figure 1 and Table 1). Preparation of a basinwide water quality plan is a five-year process, which is broken down into three phases (Table 2).

While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholder groups throughout the state. The first cycle of plans was completed in 1998. Each plan is updated at five-year intervals.

Figure 1 Basinwide Planning Schedule (2005 to 2009)



## Goals of Basinwide Water Quality Planning

The goals of basinwide planning are to:

- Identify water quality problems and restore full use to Impaired waters.
- Identify and protect high value resource waters.
- Protect unimpaired waters yet allow for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies. This includes providing agencies information related to financial and funding opportunities.

- Assure equitable distribution of waste assimilative capacity.
- Evaluate cumulative effects of pollution.
- Improve public awareness and involvement.
- Regulate point and nonpoint sources of pollution where other approaches are not successful.

## **Benefits of Basinwide Water Quality Planning**

Basinwide planning and management benefits water quality by:

- Focusing resources on one river basin at a time.
- Using sound ecological planning and fostering comprehensive NPDES permitting by working on a watershed scale.
- Ensuring better consistency and equitability by clearly defining the program's long-term goals and approaches regarding permits and water quality improvement strategies.
- Fostering public participation to increase involvement and awareness about water quality.
- Integrating and coordinating programs and agencies to improve implementation of point and nonpoint source pollution reduction strategies.

## **How You Can Get Involved**

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and local stakeholders to participate in all phases of the planning process. You may contact the basinwide planner responsible for your basin anytime during the plan's development. Upon request, the basin planner can also present water quality information and basin concerns to local stakeholder groups.

To make the plan more inclusive, DWQ is coordinating with the local Soil and Water Conservation Districts (SWCD), council of governments, NC Cooperative Extension Service, the county Natural Resources Conservation Service (NRCS), and stakeholder groups to develop language and identify water quality concerns throughout the basin. Citizens and local communities can also be involved during the planning process by contacting their county extension service or local SWCD.

During the public comment period, the draft plan is available online and by request for a period of at least 30 days. DWQ welcomes written comments and questions during this phase of the planning process and will incorporate comments and suggestions when appropriate.

## **Division of Water Quality Functions and Locations**

For more information on the basinwide planning process, DWQ activities, or contacts, visit <http://h2o.enr.state.nc.us/basinwide/> or call (919) 733-5083 and ask for the basin planner responsible for your basin of interest. You can also contact the appropriate Regional Office (Figure 2) for additional information. For general questions about the Department of Environment and Natural Resources, contact the Customer Service Center at 1-877-623-6748.

Table 1 Basinwide Planning Schedule (2004 to 2011)

Basin	DWQ Biological Data Collection	Draft Out For Public Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Chowan	Summer 2005	7/2007	9/2007	11/2007
Pasquotank	Summer 2005	7/2007	9/2007	12/2007
Neuse	Summer 2005	1/2008	3/2008	1/2008
Broad	Summer 2005	1/2008	3/2008	7/2008
Yadkin-Pee Dee	Summer 2006	3/2008	5/2008	9/2008
Lumber	Summer 2006	3/2008	5/2008	7/2009
Tar-Pamlico	Summer 2007	3/2009	5/2009	9/2009
Catawba	Summer 2007	3/2009	5/2009	12/2009
French Broad	Summer 2007	3/2009	5/2009	7/2010
New	Summer 2008	6/2010	5/2010	1/2011
Cape Fear	Summer 2008	6/2010	9/2010	2/2011
Roanoke	Summer 2004	7/2006	9/2006	1/2007
White Oak	Summer 2004	3/2007	5/2007	6/2007
Savannah	Summer 2004	1/2007	3/2007	8/2007
Watauga	Summer 2004	11/2006	1/2007	9/2007
Hiwassee	Summer 2004	1/2007	3/2007	8/2007
Little Tennessee	Summer 2004	1/2007	3/2007	10/2007

Note: A basinwide plan was completed for all 17 basins during the second cycle (1998 to 2003).

Table 2 Five-Year Planning Process for Development of an Individual Basinwide Plan

<p><b>Years 1 – 2</b></p> <p><b>Water Quality Data Collection and Identification of Goals and Issues</b></p>	<ul style="list-style-type: none"> <li>• Identify sampling needs</li> <li>• Conduct biological monitoring activities</li> <li>• Conduct special studies and other water quality sampling activities</li> <li>• Coordinate with local stakeholders and other agencies to continue to implement goals within current basinwide plan</li> </ul>
<p><b>Years 2 – 3</b></p> <p><b>Data Analysis and Collect Information from State and Local Agencies</b></p>	<ul style="list-style-type: none"> <li>• Gather and analyze data from sampling activities</li> <li>• Develop use support ratings</li> <li>• Conduct special studies and other water quality sampling activities</li> <li>• Work with state and local agencies to establish goals and objectives</li> <li>• Identify and prioritize issues for the next basin cycle</li> <li>• Develop preliminary pollution control strategies</li> <li>• Coordinate with local stakeholders and other state/local agencies</li> </ul>
<p><b>Years 3 – 5</b></p> <p><b>Preparation of Draft Basinwide Plan, Public Review, Approval of Plan, Issue NPDES Permits, and Begin Implementation of Plan</b></p>	<ul style="list-style-type: none"> <li>• Develop draft basinwide plan based on water quality data, use support ratings, and recommended pollution control strategies</li> <li>• Circulate draft basinwide plan for review and present draft plan for public review</li> <li>• Revise plan (when appropriate) to reflect public comments</li> <li>• Submit plan to Environmental Management Commission for approval</li> <li>• Issue NPDES permits</li> <li>• Coordinate with other agencies and local interest groups to prioritize implementation actions</li> <li>• Conduct special studies and other water quality sampling activities</li> </ul>

## Reference Materials

There are several reference documents and websites that provide additional information about basinwide planning and the basin's water quality. These include:

- *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* (January 2007) This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. Visit the website at <http://h2o.enr.state.nc.us/basinwide/> to download this document.
- *Pasquotank River Basinwide Assessment Report* (March 2006). This technical report presents physical, chemical, and biological data collected in the Pasquotank River basin. This report can be found on the DWQ Environmental Sciences Section (ESS) website at <http://www.esb.enr.state.nc.us/>.
- *Pasquotank River Basinwide Water Quality Management Plan* (September 1997; July 2002). These first basinwide plans for the Pasquotank River basin present water quality data, information, and recommended management strategies for the first two five-year cycles.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description* (Creager and Baker, 1991). NC DWQ Water Quality Section. Raleigh, NC.

## How to Read the Basinwide Plan

### Chapters 1 -7: Subbasin and Watershed Information

Summarizes information and data by subbasin, including:

- Recommendations from the previous basin plan
- Achievements, current priority issues and concerns
- Impaired waters and water with notable impacts
- Goals and recommendations for the next five years by subbasin

### Chapter 8 – 15

Presents information on various topics of interest to the protection and restoration of water quality in the basin, including:

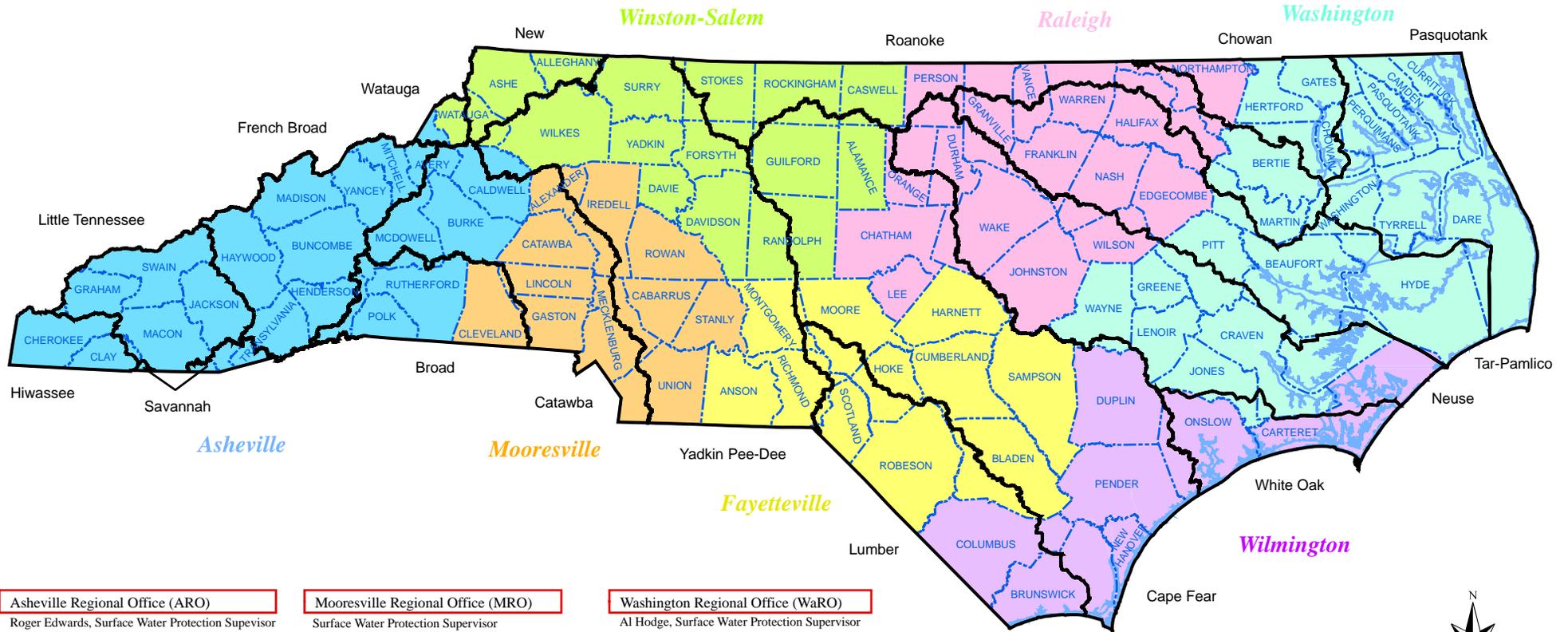
- Surface water classifications
- Water quality stressors
- Stormwater and wastewater management
- Population and land cover changes
- Water quality management strategies
- Agricultural, forestry and natural resources
- Managing Impaired waters and TMDL process

### Appendices

- Water quality data collected by DWQ
- Use support methodology
- NPDES discharger, non-discharge and general stormwater permits
- Points of contact
- Glossary of terms and acronyms

# North Carolina Department of Environment and Natural Resources

## Division of Water Quality Regional Offices



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Buncombe	Henderson	Rutherford
Burke	Jackson	Swain
Caldwell	Macon	Transylvania
Cherokee	Madison	Yancey
Clay	McDowell	
Graham	Mitchell	

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Cabarrus	Mecklenburg
Catawba	Rowan
Cleveland	Stanly
Gaston	Union
Iredell	

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Fax: (252) 975-3716

Beaufort	Gates	Pamlico
Bertie	Greene	Pasquotank
Camden	Hertford	Perquimans
Chowan	Hyde	Pitt
Craven	Jones	Tyrrell
Currituck	Lenoir	Washington
Dare	Martin	Wayne

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Alamance	Forsyth	Watauga
Alleghany	Guilford	Wilkes
Ashe	Randolph	Yadkin
Caswell	Rockingham	
Davidson	Stokes	
Davie	Surry	

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Cumberland	Robeson
Harnett	Sampson
Hoke	Scotland
Montgomery	

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Durham	Lee	Warren
Edgecombe	Nash	Wilson
Franklin	Northampton	
Granville	Orange	
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Brunswick	New Hanover
Carteret	Wake
Columbus	Pender
Duplin	

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1617 MAIL SERVICE CENTER  
RALEIGH NC 27699-1617  
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# Chapter 1

## Pasquotank River Subbasin 03-01-50

Including: Pasquotank River and Tributaries

### 1.1 Subbasin Overview

#### *Subbasin 03-01-50 at a Glance*

##### **Land and Water Area**

Total area:	454 mi <sup>2</sup>
Land area:	390 mi <sup>2</sup>
Water area:	64 mi <sup>2</sup>

##### **Land Cover (percent)**

Forest/Wetland:	46%
Cultivated Crop:	34%
Surface Water:	18%
Urban:	<1%
Pasture/ Managed Herbaceous:	1%

##### **Counties**

Gates, Pasquotank and Camden

##### **Municipalities**

Elizabeth City

##### **Monitored Waterbody Statistics**

###### **Aquatic Life**

Total:	44.0 mi/38,523.8 ac
Supporting:	26.5 mi/29,338.2 ac
Not Rated:	17.5 mi/9,185.6ac

###### **Recreation**

Total:	38,523.8 ac
Supporting:	38,523.8 ac

The Pasquotank River subbasin 03-01-50 contains the headwaters of Pasquotank River and its headwaters from the Great Dismal Swamp. Ecologically, the subbasin contains characteristics of the Chesapeake-Pamlico lowlands and tidal marshes, as well as nonriverine swamps and peatlands. Most streams are of low relief and swampy, and channelized ditches are common. Southward, a significant portion of the waters in this subbasin are brackish estuarine, including Albemarle Sound and the Pasquotank River below Elizabeth City. Land cover generally consists of evergreen forests, mixed forests, forested wetlands and marshes, and cultivated crops, such as wheat, cotton and peanuts.

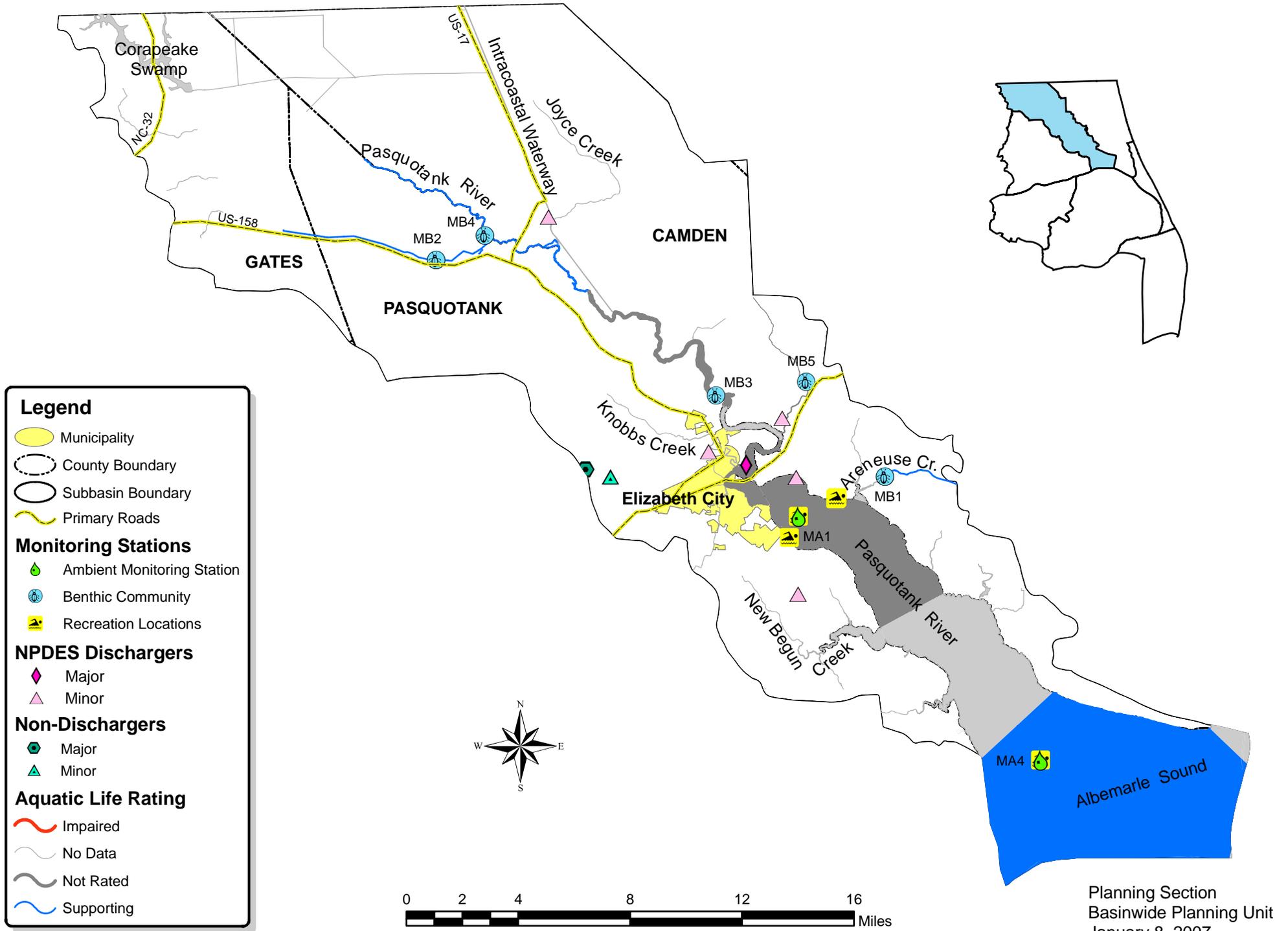
Portions of Gates, Pasquotank and Camden Counties are found in this subbasin with the largest population centered around urbanized areas. Between 1990 and 2000, Elizabeth City has experienced a growth rate of 20 percent. The population of the subbasin is expected to continue to increase over the next twenty years. Refer to Chapter 11 for more information about population growth and trends.

There is one major and five minor National Pollutant Discharge Elimination System (NPDES) dischargers in this subbasin with a total permitted discharge of 5.0 MGD. The major NPDES facility is the Elizabeth City Wastewater Treatment Plant (WWTP) with a permitted flow of 4.5 MGD. The Elizabeth City WWTP is required by permit to monitor whole effluent toxicity (WET). No WET violations were reported during the last two years of

the assessment period. There are two non-discharge permits and ten stormwater discharge permits in this subbasin. Refer to Appendix III for the listing of NPDES permit holders.

A map, including the locations of the NPDES facilities and water quality monitoring stations, is presented in Figure 3. Table 3 contains a summary of monitored waterbodies and their associated assessment unit numbers (AU#) and lengths, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Appendix V provides definitions of the terms used throughout this basin plan.

# Figure 3 Pasquotank River Subbasin 03-01-50



**Table 3 Pasquotank Subbasin 03-01-50**

AU Number	Classification	Length/Area		Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
Description														
<b>ALBEMARLE SOUND</b>														
30a	SB	29,338.2	S Acres	<b>S</b>	MA4	NCE			<b>S</b>	MA4	NCE			
Portion of Albemarle Sound in subbasin 03-01-50. Waters of Albemarle Sound (All waters south and east of a line running in a southerly direction from Horniblow Point (North end of Norfolk-Southern Railroad Bridge) to a point of land on the east side of R														
<b>Areneuse Creek</b>														
30-3-13-(1)	C;Sw	2.9	FW Miles	<b>S</b>					ND				Nutrient Impacts	Failing Septic Syst
From source to N.C. Highway # 343														
					MB1	M	2005							
					MB1	NR	2002							
<b>Newland Drainage Canal</b>														
30-3-1.5	C;Sw	7.7	FW Miles	<b>S</b>					ND				Habitat Degradation	Agriculture
From source to Pasquotank River														
					MB2	M	2005							
<b>Pasquotank River</b>														
30-3-(1)	WS-V;Sw	15.9	FW Miles	<b>S</b>					ND					
From source to a point 1.7 mile upstream of mouth of Turners Cut														
					MB4	M	2005							
					MB4	NR	2002							
30-3-(12)	SB	9,185.6	S Acres	<b>NR</b>	MA1	CE	Low pH 39.1		<b>S</b>	MA1	NCE		Low pH	Natural Conditions
From a line across River from Hospital Point to Cobb Point to a line across River from Miller Point to Pool Point														
										N49	NCE		Nickel	WWTP NPDES
										N49A	NCE			
										N51	NCE			
30-3-(3)	WS-IV;Sw	10.8	FW Miles	<b>NR+</b>					ND				Lack of Organic Material	Unknown
From a point 1.7 mile upstream of mouth to Turners Cut to a point 0.6 mile upstream of Pasquotank County SR 1368 extension														
					MB3	F	2005							
<b>Sawyers Creek</b>														
30-3-6	C;Sw	6.7	FW Miles	<b>NR</b>					ND				Low pH	MS4 NPDES
From source to Pasquotank River														
					MB5	NR	2002						Low Dissolved Oxygen	Natural Conditions



Four sites were sampled for benthic macroinvertebrates in 2005. Three of the sites received a Moderate bioclassification based on swamp criteria. One site received a Fair bioclassification using draft Coastal B criteria. Three of the four sites were also sampled in 2002 as part of a special study. A fourth site was also sampled on Sawyers Creek as part of this special study. None of these sites could be rated for benthic macroinvertebrates due to “naturally harsh conditions” during the time of sampling (DWQ ESS, May 2002). Data were also collected from two ambient monitoring stations. Refer to the *2006 Pasquotank River Basinwide Assessment Report* <http://h2o.enr.state.nc.us/esb/Basinwide/PASQUOTANK2006Final.pdf> and Appendix I for more information on monitoring.

Waters in the following sections and in Table 3 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

## 1.2 Use Support Assessment Summary

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Table 4 provides a summary of use support for waters in subbasin 03-01-50.

In subbasin 03-01-50, use support was 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 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.

Table 4 Summary of Use Support Ratings by Category in Subbasin 03-01-50

Use Support Rating	Aquatic Life		Recreation	
	Freshwater	Saltwater	Freshwater	Saltwater
<b>Monitored Waters</b>				
Supporting	26.5 mi	29,338.2 ac	0	38,523.8 ac
Impaired	0	0	0	0
Not Rated	17.5 mi (39.7%)	9,185.6 ac (23.8%)	0	0
<b>Total</b>	<b>44 mi</b>	<b>38,523.8 ac</b>	<b>0</b>	<b>38,523.8 ac</b>
<b>Unmonitored Waters</b>				
Not Rated	0	915.8 ac	0	0
No Data	1,050.4 mi	2.2 mi 12,119.2 ac	1,094.4 mi	2.2 mi 13,035.1 ac
<b>Total</b>	<b>1,050.4 mi</b>	<b>2.2 mi</b> <b>13,035 ac</b>	<b>1,094.4 mi</b>	<b>2.2 mi</b> <b>13,035.1 ac</b>
<b>Totals</b>				
<b>All Waters</b>	<b>1,094.4 mi</b>	<b>2.2 mi</b> <b>51,558.8 ac</b>	<b>1,094.4 mi</b>	<b>2.2 mi</b> <b>51,558.9 ac</b>

\* The noted percent Impaired is the percent of monitored miles/acres only.

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

### **1.3 Status of Previously and Newly Impaired Waters**

No previously or newly impaired waters were identified in subbasin 03-01-50.

### **1.4 Status and Recommendations for Waters with Noted Impacts**

Based on DWQ's most recent use support methodologies, the surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below and each is identified by an AU#. Refer to Section 1.1 for more information about AU#. Nonpoint source program agency contacts are listed in Appendix IV.

#### **1.4.1 Newland Drainage Canal [AU# 30-3-1.5]**

Newland Drainage Canal, from source to the Pasquotank River (7.7 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site MB2. Newland Drainage Canal is a channelized ditch and was sampled in order to assess water quality in the middle and upper portions of the subbasin.

DWQ biologists sampled three distinct reaches (above and below the road crossing), each with differing streambank and riparian characteristics. Upstream (above SR 1363), the riparian area was wide and mostly intact. Trees, shrubs and grasses were growing along the streambanks; however, areas of erosion were noted. Immediately downstream of the road crossing, there was no riparian area and the streambanks were either bare or covered with grass. Further downstream (approximately 100 meters from the road crossing), the riparian area was wide, intact and wooded. However, despite the intact riparian area and tree cover, the streambanks were unstable and eroding. Substrate consisted of silt and detritus.

Newland Drainage Canal was sampled in 2002 as part of a special study for a wetland restoration project. The Pasquotank River [AU# 30-3-(1)], Sawyers Creek [AU# 30-3-6] and Areneuse Creek [AU# 30-3-13-(1)] were also sampled. None of the streams were rated because of "naturally harsh conditions." Biologists concluded that saltwater intrusions in the lower part of the watershed and low pH in the upper part of the watershed were influencing water quality in the canal, consequently impacting the benthic communities (DWQ ESS, May 2002).

#### **1.4.2 Sawyers Creek [AU# 30-3-6]**

Sawyers Creek, from source to the Pasquotank River (6.7 miles), is Not Rated in the aquatic life category due to a Not Rated benthic swamp bioclassification at site MB5. Sawyers Creek was last sampled in 2002 as part of a special study for a wetlands restoration project. Saltwater intrusions in the lower part of the basin and low pH in the upper part of the basin created “naturally harsh conditions” and likely influenced the benthic macroinvertebrate population. In 2005, Sawyers Creek could not be sampled due to low flow conditions.

Sawyers Creek is also impacted by discharge from the Grandy Primary School (Camden County) (Permit NC0037214). During the last two years of the assessment period, the discharge had significant noncompliance issues with biochemical oxygen demand (BOD), which can lead to lower than normal dissolved oxygen levels in the receiving stream. The most recent notice of violation (NOV) was issued in July 2006 for exceeding BOD limits.

##### 2007 Recommendations

DWQ staff in the Washington Regional office are currently working with Camden County to ensure that the Grandy Primary School discharge is within permit limits; however, the area around Sawyers Creek is rapidly growing and several permits are on file for additional WWTP facilities. DWQ recommends that a county-wide collection system be considered as a viable option for future wastewater needs in the Sawyers Creek watershed. Due to the significant upgrades needed for the school WWTP to meet compliance standards on a regular basis, the school should consider connecting to the county system.

#### **1.4.3 Areneuse Creek [AU# 30-3-13-(1)]**

##### 2002 Status

Numerous algal blooms were identified as a water quality concern for Areneuse Creek by the DWQ regional office staff. Increased development activities in the watershed were identified as a potential source.

##### Current Status & Special Studies

Areneuse Creek, from source to Highway 343 (2.9 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site MB1. Substrate consisted of detritus and sticks. Snags and logs were abundant. Undercut streambanks, root mats and leaf packs were present, but rare. The overall habitat score was good. No new algal blooms were reported during the most recent assessment period.

This basinwide sampling site has been sampled three times – 2000, 2002 and 2005. In 2000, the site was rated Moderate. In 2002, the site was Not Rated as part of a special study for a wetlands restoration project. Saltwater intrusions in the lower part of the basin and low pH in the upper part of the basin created “naturally harsh conditions” and likely influenced the benthic macroinvertebrate population. In 2005, the benthic community was much more diverse, resulting in the Moderate bioclassification.

##### 2007 Recommendations

Although no significant algal blooms have been reported in Areneuse Creek within the last three years, watershed and environmental conditions (i.e., wind and low flow conditions) may promote future blooms. Residential properties are located throughout the watershed, many of which are

on septic systems. Failing septic systems can introduce nutrients and bacteria into the environment. Excess nutrients in any waterbody have the potential to cause excess algal growth. DWQ recommends a targeted educational campaign in Areneuse Creek related to septic system maintenance. Failing septic systems should be identified and repaired per county and state requirements. More information about septic systems can be found in Chapter 10.

#### **1.4.4 Pasquotank River [AU# 30-3-(3) and AU# 30-3-(12)]**

These segments of the Pasquotank River are not classified by DWQ for shellfish harvesting purposes (Class SA). DEH Shellfish Sanitation & Recreational Water Quality Section completed a sanitation survey of this area in 2005 and noted that there has been little change in water quality since the last sanitation survey per the *Sanitary Survey of Albemarle and Currituck Sounds, Areas I-1, I-3 through I-16*. The only shellfish found in this area is *Rangia* clams and no commercial shellfish harvesting occurs. Freshwater runoff is the most significant factor affecting water quality in this region and can be associated with agricultural runoff or natural runoff from swamp waters following heavy rains.

Area I-5 consists of the entire watershed of the Pasquotank River. Most of the area is rural with the exception of Elizabeth City. A significant increase in subdivision development has occurred since the last sanitary survey in 2001. Elizabeth City WTP discharges to the Pasquotank River and the TECOM blimp factory WWTP discharges into New Begun Creek [AU# 30-3-16-(1) and 30-3-16-(2)]. There are also two lime-treated sewage application sites in this area. Outside of Elizabeth City, agriculture is the main land use activity with the production of cabbage, corn, and soybeans.

##### Current Status [AU# 30-3-(3)]

The Pasquotank River, from a point 1.7 miles upstream of the mouth to Turner's Cut to a point 0.6 mile upstream of the Pasquotank County SR 1368 extension (10.8 miles), is Not Rated<sup>+</sup> in the aquatic life category. Site MB3 was sampled using draft criteria for Coastal B Rivers and labeled as NR<sup>+</sup>. Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. Other characteristics may include an open canopy, low pH and low DO. Boat sampling is required for these waters. Site MB3 received a Fair benthic bioclassification, based on the draft criteria for Coastal B rivers. Any bioclassifications derived from sampling data should be considered draft and not used for use support decisions; therefore this section of the Pasquotank River is Not Rated<sup>+</sup>. (BAU, March 2006).

##### Current Status [AU# 30-3-(12)]

Another section of the Pasquotank River, from the line across the river from Hospital Point to Cobb Point to a line across the river from Miller Point to Pool Point (9,185.6 saltwater acres), is Not Rated in the aquatic life category due to low pH values recorded at the ambient monitoring station at site MA1. Low pH values are not unexpected in the Pasquotank River since it receives water from many classified swamp streams including the Great Dismal Swamp. Swamp waters naturally show low pH levels, which can impact freshwater and saltwater found in the Pasquotank River.

##### 2007 Recommendations

Elizabeth City, Pasquotank and Camden Counties are required to implement water supply watershed protection ordinances. Field observations and information from the local resource

agency staff indicated that urban stormwater runoff may be adversely impacting water quality in the Pasquotank River near Elizabeth City. DWQ recommends that Elizabeth City implement Phase II stormwater management strategies. In addition, improved monitoring is needed for permitted stormwater dischargers to improve compliance. Non-permitted facilities need to be evaluated for obtaining stormwater discharge permits and discharge limits. Pasquotank County and Elizabeth City are in the process of trying to develop a regional wastewater treatment facility to help eliminate package plant use and septic systems that commonly fail due to soil conditions in the area. Inflow and infiltration to Elizabeth City's WWTP is a problem and may be addressed with the construction of alternative force mains and additional pump stations. Over two million dollars of Clean Water Management Trust Funds monies have been allocated to improving the efficiency of Elizabeth City's WWTP system.

## **1.5 Additional Water Quality Issues within Subbasin 03-01-50**

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

Agriculture is a significant land use activity in Subbasin 03-01-50. Therefore, there is a need to increase implementation of agricultural best management practices (BMPs) to protect water quality. Conservation tillage, land smoothing to improve surface drainage, critical area planting, and conservation cover crops are potential BMPs that can control erosion. Water control structures, controlled drainage, and constructed wetlands are needed to control and slow runoff, thus reducing nutrient and sediment loss. Riparian buffers and filter strips are also needed to help remove organic materials, sediment, nutrients, and pesticides from stormwater runoff. Technical assistance is needed to help land managers appropriately apply fertilizer to reduce excess runoff and nutrient loss. There are several inactive hog operations in this subbasin. It is important that lagoon closures are completed to prevent water quality contamination. BMPs implemented on existing hog facilities should be monitored to ensure compliance.

Residential development has increased in this subbasin. Local governments and agencies are encouraged to proactively plan, provide public education programs and implement conservation strategies to prevent water quality degradation.



## Pasquotank River Subbasin 03-01-51

Including: Alligator River and portions of the Albemarle, Croatan and Roanoke Sounds

### 2.1 Subbasin Overview

#### *Subbasin 03-01-51 at a Glance*

##### Land and Water Area

Total area:	978 mi <sup>2</sup>
Land area:	568 mi <sup>2</sup>
Water area:	410 mi <sup>2</sup>

##### Land Cover (percent)

Forest/Wetland:	53%
Surface Water:	39%
Cultivated Crop:	8%
Urban:	<1%
Pasture/ Managed Herbaceous:	<1%

##### Counties

Dare, Hyde and Tyrrell

##### Municipalities

Manteo

##### Monitored Waterbody Statistics

###### **Aquatic Life:**

Total:	8.8 mi/106,724.7 ac
Supporting:	8.8 mi/106,724.7 ac

###### **Recreation:**

Total:	8.8 mi/132,564.3 ac
Supporting:	8.8 mi/132,564.3 ac

###### **Shellfish Harvesting:**

Total:	54,628.7 ac
Supporting:	52,547.2 ac
Impaired:	2,081.5 ac

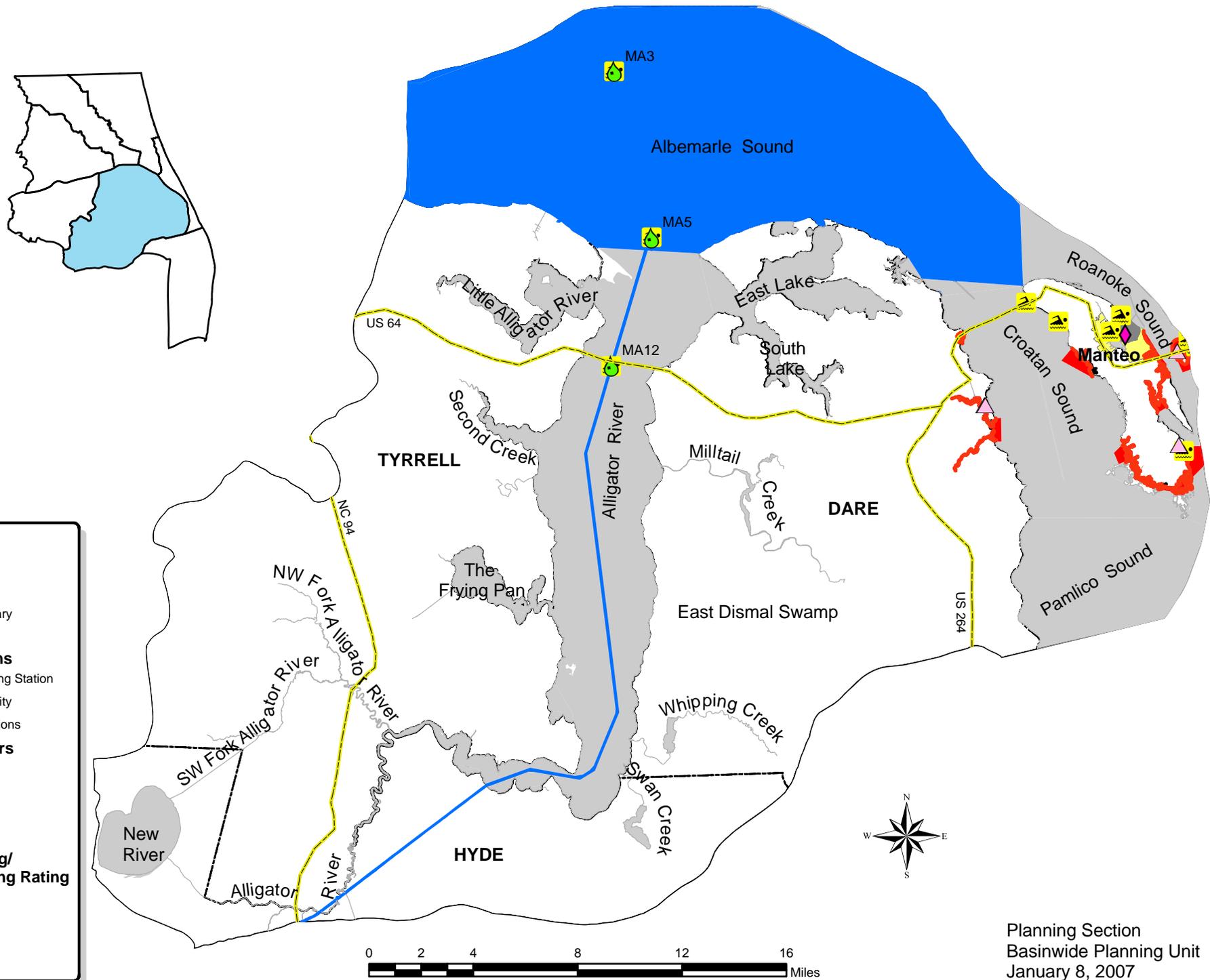
This subbasin contains the Alligator River and several tributaries. Most streams are of low relief and often swampy. Channelized ditches are common. Most waters in this subbasin are brackish estuarine, including Albemarle, Croatan and Roanoke Sounds, and the Alligator River to the Intracoastal Waterway (ICWW). Ecologically, the subbasin contains characteristics of the Chesapeake-Pamlico lowlands and tidal marshes, as well as nonriverine swamps and peatlands. Land cover generally consists of evergreen forests, mixed forests, forested wetlands and marshes.

The Alligator River upstream of US 64 and all of its natural tributaries (not canals, Alligator Lake or ICWW) are classified as Outstanding Resource Waters (ORW). Based on their designations by the Marine Fisheries Commission as primary nursery areas, two tributaries (upper Scarboro Creek and Doughs Creek) to Shallowbag Bay are classified as High Quality Waters (HQW).

This subbasin contains a mixture of public lands and Significant Natural Heritage Areas including Roper Island, Durant Island, Pocosin Lakes National Wildlife Reserve, the Alligator River National Wildlife Refuge and the Preyer Reserve. Portions of Dare, Hyde and Tyrrell Counties can be found in this subbasin with the highest concentration of urbanized areas located on Roanoke Island in the Towns of Manteo and Wanchese. Rapid population growth is occurring in Dare County and along coastal areas. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 11.

There is one major and five minor National Pollutant Discharge Elimination System (NPDES) discharges in this subbasin with a total permitted flow of 1.5 MGD. The major NPDES facility is the Manteo Wastewater Treatment Plant (WWTP) with a permitted flow of 1.0 MGD. The Manteo WWTP discharges to Shallowbag Bay [AU# 30-21-3] on Roanoke Island and significant noncompliance issues were identified during the last two years of the assessment period. There are two stormwater discharge permits in this subbasin. For the listing of NPDES permit holders, refer to Appendix III.

# Figure 4 Pasquotank River Subbasin 03-01-51



**Legend**

- Municipality
- County Boundary
- Subbasin Boundary
- Primary Roads

**Monitoring Stations**

- Ambient Monitoring Station
- Benthic Community
- Recreation Locations

**NPDES Dischargers**

- Major
- Minor

**Non-Dischargers**

- Major
- Minor

**Aquatic Life Rating/  
Shellfish Harvesting Rating**

- Impaired
- No Data
- Not Rated
- Supporting



Planning Section  
Basinwide Planning Unit  
January 8, 2007

**Table 5 Pasquotank Subbasin 03-01-51**

AU Number	Classification	Length/Area	Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
<b>ALBEMARLE SOUND</b>													
30b	SB	106,724.7	S Acres	<b>S</b>	MA3	NCE		<b>S</b>	MA3	NCE		Dioxin	Industrial Site
					MA5	NCE			MA5	NCE			
Portion of Albemarle Sound in subbasin 03-01-51. Waters of Albemarle Sound (All waters south and east of a line running in a southerly direction from Horniblow Point (North end of Norfolk-Southern Railroad Bridge) to a point of land on the east side of R													
<b>Baum Creek</b>													
30-20-5	SA;HQW	10.9	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria
	From source to Croatan Sound												
												H-2	
<b>Broad Creek</b>													
30-21-7a	SA;HQW	126.0	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria Marina
	DEH closed area at head of creek												
												H-1	
30-21-7b	SA;HQW	392.2	S Acres	ND				ND			<b>S</b>	APP	
	Approved area at mouth of creek												
												H-1	
<b>Callaghan Creek</b>													
30-20-4	SA;HQW	24.8	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria
	From source to Croatan Sound												
												H-2	
<b>Cedar Bush Bay</b>													
30-20-7	SA;HQW	207.8	S Acres	ND				ND			<b>S</b>	APP	
	Entire Bay												
												H-2	

**Table 5 Pasquotank Subbasin 03-01-51**

AU Number	Classification	Length/Area	Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources		
			AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating			GA	
<b>Croatan Sound</b>														
30-20-(2)a	SA;HQW	24,496.4	S Acres	ND				<b>S</b>	N68 N69	NCE NCE	<b>S</b>	APP		
	From Northwest Point on Roanoke Island following a line west to Reeds Point on the Dare County mainland to a line running from a point of land just below Long Wretch Creek on Dare County mainland to the Southern tip of Smith Island south of Roanoke Island													
30-20-(2)b	SA;HQW	169.3	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria	
	The waters of Croatan Sound enclosed in a line beginning at a point near north shore of Spencer Creek at 35 degrees 51' 45" N- 75 degrees 44' 53" W; and thence 250 yards in an easterly direction to a point at 35 degrees 51' 45" n- 75 degrees 44' 43" west													
30-20-(2)c	SA;HQW	340.9	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria	
	The waters of Croatan Sound which include all waters within a line beginning at a point on the shore at 35 degrees 53' 56" N- 75 degrees 41' 36" W, thence WSW 800 yards to a point in the sound at 35 degrees 53' 38" N- 75 degrees 41' 53 W, thence 1975 yard													
30-20-(2)d	SA;HQW	156.3	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria	
	The waters of Croatan Sound which include all waters on the North shore of Baum Creek to a straight line to Fl. Beacon number 2 at 35 degrees 50' 27" n-75 degrees 40' 06" W, thence in a straight line tto a point on an island at 35 degrees 50' 05" N- 75 de													
30-20-(2)e	SA;HQW	92.2	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria	
	The waters of Croatan sound which include all waters below Oyster Creek southeast to Cut Through. DEH closed area Croatan Sound 5-e													
30-20-(2)f	SA;HQW	22.1	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria	
	DEH Closure Area at Mann's Harbor													
<b>Cut Through</b>														
30-20-8a	SA;HQW	128.6	S Acres	ND				ND			<b>S</b>	APP		
	From DEH closure line to Croatan Sound													
30-20-8b	SA;HQW	178.5	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria	
	From Roanoke Sound to DEH closure line													

**Table 5 Pasquotank Subbasin 03-01-51**

AU Number	Classification	Length/Area		Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
Description														
<b>Doughs Creek</b>														
30-21-3-2	SC;HQW	21.2	S Acres	ND					<b>S</b>	N86	NCE			
From source to Shallowbag Bay														
<b>Hog I Creek</b>														
30-20-9	SA;HQW	15.4	S Acres	ND					ND			<b>S</b>	APP	
Entire Creek														
<b>Intracoastal Waterway (Pungo River-Alligator River Canal)</b>														
30-16-12	SC;Sw	8.8	S Miles	<b>S</b>	MA12	NCE	Turbidity	9.6	<b>S</b>	MA12	NCE		Turbidity	Unknown
From Currituck-Fairfield Township line to Alligator River														
<b>Johns Creek</b>														
30-21-5	SA;HQW	10.7	S Acres	ND					ND			<b>I</b>	PRO	Fecal Coliform Bacteria
From source to Roanoke Sound														
<b>Long Wretch Creek</b>														
30-20-10	SA;HQW	1.7	S Acres	ND					ND			<b>S</b>	APP	
From source to Croatan Sound														
<b>Mill Landing Creek (Mill Creek)</b>														
30-21-8	SC	29.8	S Acres	ND					<b>S</b>	N67	NCE			
From source to Roanoke Sound														
<b>Oyster Creek</b>														
30-21-9	SA;HQW	84.2	S Acres	ND					ND			<b>S</b>	APP	
Entire Creek														
<b>Oyster Creek (Croatan Sound)</b>														
30-20-6	SA;HQW	62.8	S Acres	ND					ND			<b>I</b>	PRO	Fecal Coliform Bacteria
From source to Croatan Sound														
<b>Pamlico Sound</b>														
30-22j	SA;HQW	18,083.5	S Acres	ND					ND			<b>S</b>	APP	
Portion of Pamlico Sound (from Croatan and Roanoke Sounds to a line running from Sandy Point south of Stumpy Point Bay to the northeast tip of Ocracoke Island) in subbasin 03-01-51.														



**Table 5 Pasquotank Subbasin 03-01-51**

AU Number	Classification	Length/Area	Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
<b>Spencer Creek</b>													
30-20-3	SA;HQW	86.8 S Acres	ND					ND			I	PRO	Fecal Coliform Bacteria
From source to Croatan Sound													H-2

<b>Use Categories:</b>	<b>Monitoring data type:</b>	<b>Results:</b>	<b>Use Support Ratings 2006:</b>
AL - Aquatic Life	MF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	MB - Benthic Community Survey	G - Good	NR - Not Rated
SH - Shellfish Harvesting	MA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	ML- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	N- DEH RECMON	P - Poor	NR+-Not rated because draft criteria used for rating
		NI - Not Impaired	<b>Results</b>
GA - DEH SS Classification and Growing Area		S- Severe Stress	CE-Criteria Exceeded > 10% and more than 10 samples
APP- Approved		M-Moderate Stress	NCE-No Criteria Exceeded
CAO- Conditionally Approved-Open		N- Natural	<b>Miles/Acres</b>
CAC- Conditionally Approved-Closed			FW - Fresh Water
PRO- Prohibited			S- Salt Water

Aquatic Life Rating Summary			Recreation Rating Summary			Fish Consumption Rating Summary			Shellfish Harvesting Rating Summary		
S	m	8.8 S Miles	S	m	8.8 S Miles	I	m	106,724.7 S Acres	S	m	52,547.2 S Acres
S	m	106,724.7 S Acres	S	m	131,806.2 S Acres	I	e	9.9 S Miles	I	m	2,081.5 S Acres
NR	e	534.1 S Acres	ND		1.1 S Miles	I	e	126,031.2 S Acres			
ND		1.1 S Miles	ND		100,949.7 S Acres	I	e	497.2 FW Miles			
ND		125,497.0 S Acres	ND		497.2 FW Miles	I	e	4,980.6 FW Acres			
ND		497.2 FW Miles	ND		4,980.6 FW Acres						
ND		4,980.6 FW Acres									

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 4. Table 5 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Appendix V provides definitions of the terms used throughout this basin plan.

No benthic samples were collected during this assessment period (2000 – 2005); however, data was collected from three ambient monitoring stations (MA3, MA5 and MA12). No water quality standards were exceeded.

Many of the waters in subbasin 03-01-51 are classified for shellfish harvesting (Class SA). Many also have the supplemental classification of High Quality Waters (HQW) or Outstanding Resource Waters (ORW). Several management strategies are in place to protect these waters.

Waters in the following sections and in Table 5 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

## **2.2 Use Support Assessment Summary**

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Table 6 provides a summary of use support for waters in subbasin 03-01-51.

In subbasin 03-01-51, use support was assigned for aquatic life, recreation, fish consumption and shellfish harvesting categories. Waters are Supporting, Impaired, Not Rated, and 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). There are no water supply watersheds designated in this subbasin.

Criteria for making use support determinations for the shellfish harvesting category were based on Division of Environmental Health (DEH) Sanitary Surveys (SS) growing area classifications. The problem parameter for all shellfish waters is the potential for fecal coliform water quality standard exceedances. Differences in acreage estimates between basin cycles are not just related to changes in water quality; they are also due to changes in acreage are related to more refined methods of estimating acreages, changes in growing area classifications, extension of closure areas as a result of additional boat slips, and changes in use support methodology.

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

Table 6 Summary of Use Support Ratings by Category in Subbasin 03-01-51

Use Support Rating	Aquatic Life		Recreation		Shellfish Harvesting	
	Freshwater	Saltwater	Freshwater	Saltwater	Freshwater	Saltwater
<b>Monitored Waters</b>						
Supporting	0	8.8 mi 106,724.7 ac	0	8.8 mi 131,806.2 ac	0	52,547.2 ac
Impaired*	0	0	0	0	0	2,081.5 ac (3.8%)
<b>Total</b>	<b>0</b>	<b>8.8 mi</b> <b>106,724.7 ac</b>	<b>0</b>	<b>8.8 mi</b> <b>131,806.2 ac</b>	<b>0</b>	<b>54,628.7 ac</b>
<b>Unmonitored Waters</b>						
Not Rated	0	534.1 ac	0	0	0	0
No Data	497.2 mi 4,980.6 ac	1.1 mi 125,497 ac	497.2 mi 4,980.6 ac	1.1 mi 100,949.7 ac	0	0
<b>Total</b>	<b>497.2 mi</b> <b>4,980.6 ac</b>	<b>1.1 mi</b> <b>126,031.1 ac</b>	<b>497.2 mi</b> <b>4,980.6 ac</b>	<b>1.1 mi</b> <b>100,949.7 ac</b>	<b>0</b>	<b>0</b>
<b>Totals</b>						
<b>All Waters</b>	<b>497.2 mi</b> <b>4,980.6 ac</b>	<b>9.9 mi</b> <b>232,756 ac</b>	<b>497.2 mi</b> <b>4,980.6 ac</b>	<b>9.9 mi</b> <b>232,756 ac</b>	<b>0</b>	<b>54,628.7 ac</b>

\* The noted percent Impaired is the percent of monitored miles/acres only.

## 2.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state’s 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Chapter 15.

For more information about use support determinations for the Impaired Class SA waters presented in Table 7 below, refer to Appendix II or the *Supplemental Guide to North Carolina’s Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ’s website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>. Refer to Figure 4 for a map of subbasin 03-01-51.

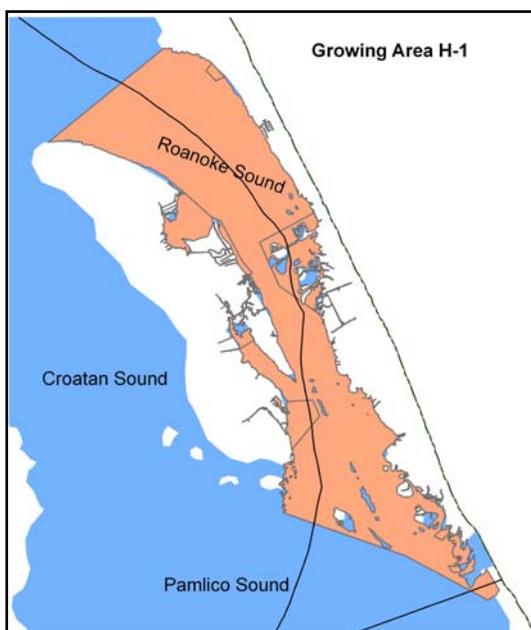
Table 7 Summary of DEH Growing Areas H-1, H-2 and I-2 Classifications in Subbasin 03-01-51

Class SA Waters	Assessment Unit #	Growing Area Classification	DEH Growing Area
Broad Creek	30-21-7a	PRO	H-1
	30-21-7b	APP	
Johns Creek	30-21-5	PRO	H-1
Pond Island	30-21-4a	PRO	H-1
Roanoke Sound	30-21a	APP	H-1, I-2
	30-21b	PRO	
	30-21c	PRO	
	30-21d	PRO	
Rockhall Creek	30-21-6	PRO	H-1

Sand Beach Creek	30-21-5-1	PRO	H-1
Baum Creek	30-20-5	PRO	H-2
Callaghan Creek	30-20-4	PRO	H-2
Croatan Sound	30-20-(2)a	APP	H-2, I-2
	30-20-(2)b	PRO	
	30-20-(2)c	PRO	
	30-20-(2)d	PRO	
	30-20-(2)e	PRO	
	30-20-(2)f	PRO	
Cut Through	30-20-8a	APP	H-2
	30-20-8b	PRO	
Oyster Creek (Croatan Sound)	30-20-6	PRO	H-2
Spencer Creek	30-20-3	PRO	H-2

PRO=Prohibited, CAC=Conditionally Approved Closed, CAO=Conditionally Approved Open

### 2.3.1 West Shore Roanoke Sound Growing Area H-1



The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area H-1. If the entire Class SA water is located within more than one growing area it is noted in Table 7 or refer to the basinwide Growing Area map in the Executive Summary.

According to the *Sanitary Survey of Roanoke Sound, Area H-1* (DEH Shellfish Sanitation & Recreational Water Quality Section, October 2002 and August 2006), little change in bacteriological water quality has occurred since the last review in 2002; however, some water quality improvements have resulted in opening of shellfish waters. Area H-1 includes waters of the Roanoke Sound, Shallowbag Bay, Broad Creek, and Mill Creek. Roanoke Sound is bordered on the east by the Outer Banks and on the

west by Roanoke Island. H-1 is located in Dare County, which is undergoing rapid population growth with large influxes in seasonal populations. Manteo population is estimated at approximately 1,100 permanent residents and with a seasonal peak population of approximately 3,500 people (CAMA LUP-Town of Manteo, 2007). However, much of the survey area in area H-1 is uninhabited marshland. Wildlife and waterfowl are abundant in the marshland areas of this growing area.

Notable activities on Roanoke Island include new housing developments and the construction of wetlands. This area has had significant flooding with heavy rainfall events affecting low-lying areas and flooding septic systems. The growing Pirate's Cove subdivision also hosts the largest marina in the area with 181 boat slips. The survey reports all violations noted from previous surveys have been corrected. The Manteo Municipal WWTP is the only WWTP in H-1 that discharges to the sound. The discharge location is approximately 3,400 feet offshore in Shallowbag Bay. The WWTP has a history of exceeding its permit limits for fecal coliform, petroleum, and ammonia levels in its effluent.

As a result of the DEH 2006 survey report, approximately 45 acres around Manteo have been reclassified from Prohibited to Approved for shellfish harvesting and an additional 240 acres are classified as Approved in the Wanchese area. However, approximately 34 acres are Prohibited east of Wanchese Harbor due to development and observed pollution in runoff waters.

#### **Broad Creek [AU# 30-21-7a]**

Broad Creek (126 acres) is Impaired for shellfish harvesting. Broad Creek is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacteria levels. Broad Creek will remain on the state's 303(d) list of Impaired waters.

The marina along Broad Creek is limited to 29 boats with no boats over 24' in length. Runoff from boat maintenance and from the parking lot of the marina drains to Broad Creek and eventually to waters east of Wanchese Harbor. Constructed wetlands have recently been completed in the mouth of Broad Creek and were observed to be hosting an abundant waterfowl population with associated accumulated fecal matter. Further downstream (AU# 30-21-7b), 392 acres are classified as approved and supporting shellfish harvesting

#### **Johns Creek [AU# 30-21-5]**

Johns Creek (10.7 acres) is Impaired for shellfish harvesting. Johns Creek is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacterial levels. Johns Creek will remain on the state's 303(d) list of Impaired waters.

#### **Pond Island [AU# 30-21-4a]**

Pond Island (165.1 acres) is Impaired for shellfish harvesting. Pond Island is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacterial levels. Pond Island will remain on the state's 303(d) list of Impaired waters.

#### **Roanoke Sound [AU# 30-21b, 30-21c and 30-21d]**

Portions of the Roanoke Sound (590.8 acres) is Impaired for shellfish harvesting. Roanoke Sound is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacterial levels. Roanoke Sound will remain on the state's 303(d) list of Impaired waters. An additional 9,134.1 acres are classified as approved and supporting shellfish harvesting in area I-2.

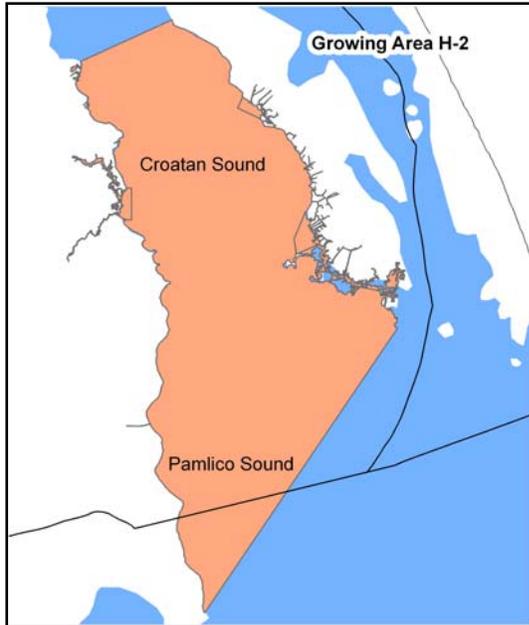
#### **Rockhall Creek [AU# 30-21-6]**

Rockhall Creek (5.7 acres) is Impaired for shellfish harvesting. Rockhall Creek is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacterial levels. Rockhall Creek will remain on the state's 303(d) list of Impaired waters.

#### **Sand Beach Creek [AU# 30-21-5-1]**

Sand Beach Creek (38.7 acres) is Impaired for shellfish harvesting. Sand Beach Creek is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacterial levels. Sand Beach Creek will remain on the state's 303(d) list of Impaired waters.

### 2.3.2 Croatan Sound Growing Area H-2



The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area H-2. If the entire Class SA water is located within more than one growing area it is noted in Table 7 or refer to the basinwide Growing Area map in the Executive Summary.

According to the *Sanitary Survey of Croatan Sound, Area H-2 (DEH Shellfish Sanitation & Recreational Water Quality Section, December 2005)*, water quality remains good. The largest water quality issues are along the backside of Roanoke Island, near Manteo and Wanchese with high bacteria counts. Oyster production is limited to areas surrounding Wanchese and no clams are produced there. Area H-2 is bordered by Roanoke Island in the east and the mainland village of Manns Harbor to the west. The

permanent population is estimated at approximately 2,000 people, but drastically increases during the summer months.

Development is scattered throughout much of the area. In North Manteo, 100+ lots have been created, Sunnyside Subdivision in Manteo has extended to make room for an additional 30 units and several new residential units have been built in Skyco. With the exception of the houses connected to the Manteo WWTP, all the residences utilize onsite septic systems and seven violations were noted during the sanitary survey. Of these violations, one house had a crushed septic system with drainage to the sound and pipes from four mobile homes were disconnected and were found to be discharging directly onto the ground within 20 feet of the marsh.

Other possible water quality pollution sources include landfills, wildlife, and increased impervious surface runoff. Dredge material from Shallowbag Bay in area H-1 was deposited in a 30-acre site in area H-2. Several drainage ditches connect possible runoff from Dare County's demolition landfill to the sound. An illegal dumpsite was discovered in Manteo consisting of boats, appliances and other trash. Possible chemical pollutants may come from the NCDOT Marine Maintenance Facility located on Spencer Creek.

#### **Baum Creek [AU# 30-20-5]**

Baum Creek (10.9 acres) is Impaired for shellfish harvesting. Baum Creek is classified by DEH SS as prohibited in growing area H-2 due to potential fecal coliform bacterial levels. Baum Creek will remain on the state's 303(d) list of Impaired waters.

#### **Callaghan Creek [AU# 30-20-4]**

##### 2002 Status

To evaluate the impact of a fire treatment berm at a Dare County landfill in 1998, DWQ monitored chemicals (metals), toxicity and benthic macroinvertebrates. One station failed

toxicity tests and metals were extremely high (i.e., silver, selenium, copper, zinc, arsenic, aluminum, lead, manganese and iron). Biologists noted some impacts to the benthic communities nearest the landfill. DWQ recommended that a follow-up study be conducted on Callaghan Creek. It was also recommended that DWQ regional office staff work with landfill managers to generate appropriate disposal options.

#### Current Status

Callaghan Creek (24.8 acres) is Impaired for shellfish harvesting. Callaghan Creek is classified by DEH SS as prohibited in growing area H-2 due to potential fecal coliform bacterial levels. Callaghan Creek will remain on the state's 303(d) list of Impaired waters.

DWQ sampled unnamed tributaries to Callaghan Creek and Billys Creek in October 2000 to assess the long-term impacts from the 1998 landfill fire. The sample sites were all channelized drainage ditches without bends or pools. Use of a non-standard sampling methodology precluded assignment of bioclassifications to these sites; however, this method collected enough taxa to make between site comparisons of the invertebrate communities. All sites had dissolved oxygen levels below 4.0 mg/l and no flow conditions existed. Substrate consisted of detritus-mud mixture. Macroinvertebrate communities at all sites in this study were very pollution tolerant. The sample site near the landfill showed a biotic community still impacted from the landfill fire; however, several taxa rarely found in DWQ collections were also found during the study (DWQ ESS, December 2000).

#### **Croatan Sound [AU# 30-20-(2)b, 30-20-(2)c, 30-20-(2)d, 30-20-(2)e and 30-20-(2)f]**

Croatan Sound (580.3 acres) is Impaired for shellfish harvesting. Croatan Sound is classified by DEH SS as prohibited in growing area H-2 due to potential fecal coliform bacterial levels. Croatan Sound will remain on the state's 303(d) list of Impaired waters.

#### **Cut Through [AU# 30-20-8b]**

Cut Through (178.5 acres) is Impaired for shellfish harvesting. Cut Through is classified by DEH SS as prohibited in growing area H-2 due to potential fecal coliform bacterial levels. Cut Through will remain on the state's 303(d) list of Impaired waters. An additional 128.6 acres are classified as approved and supporting shellfish harvesting in area H-2.

#### **Oyster Creek [AU# 30-20-6]**

Oyster Creek (62.8 acres) is Impaired for shellfish harvesting. Oyster Creek is classified by DEH SS as prohibited in growing area H-2 due to potential fecal coliform bacterial levels. Oyster Creek will remain on the state's 303(d) list of Impaired waters.

#### **Spencer Creek [AU# 30-20-3]**

Spencer Creek (86.8 acres) is Impaired for shellfish harvesting. Spencer Creek is classified by DEH SS as prohibited in growing area H-2 due to potential fecal coliform bacterial levels. Spencer Creek will remain on the state's 303(d) list of Impaired waters.

## **2.4 Status and Recommendations for Waters with Noted Impacts**

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix IV.

### **2.4.1 Shallowbag Bay [AU#30-21-3]**

Shallowbag Bay (534.1 acres) is Not Rated on an evaluated basis in the aquatic life category due to significant noncompliance issues with biochemical oxygen demand (BOD) and ammonia permit limits at the Manteo WWTP (Permit NC0079057). Manteo's WWTP is permitted to discharge 0.6 MGD and it has a phased NPDES permit under which it can expand to 1 MGD by obtaining an Authorization to Construct from DWQ. Many of the effluent violations with Manteo WWTP were results of mechanical malfunctions. In 2005 and 2006, there were two Notice of Violations issued against MWWTP and 9 Permit Enforcement penalties issued against the plant. In 2005, the Town of Manteo received a grant from the North Carolina Clean Water Management Trust Fund (CWMTF) to develop a feasibility study of nutrient removal options for wastewater discharged to Shallowbag Bay. The 2007 Manteo Land Use Plan states water quality conditions in Shallowbag Bay are concerns and recommends actions to improve their WWTP and reduce pollutants from stormwater runoff and marinas to improve water quality. BMPS are needed to reduce runoff from highly impervious areas of historic downtown Manteo to reduce stormwater runoff into Shallowbag Bay (CAMA LUP- Town of Manteo, 2007). The Town of Manteo prepared a stormwater management plan in 2000 with intentions to augment its zoning ordinance with stormwater management requirements. The 2005 Zoning Ordinance requires the runoff generated by new development to not exceed the predevelopment site volume for the first 1.5" and it shall be retained on the site. Residential and historic sites are exempt from this ordinance.

Shallowbag Bay is also monitored by the Division of Environmental Health (DEH) Recreational Monitoring Program (RECMON). Based on DEH monitoring data, the bay is Supporting in the recreation category.

## **2.5 Additional Water Quality Issues within Subbasin 03-01-51**

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

The increase in impervious surfaces throughout the basin contributes to the growing water quality issues associated with stormwater runoff. An increase in the numbers of slips at marinas is a concern to water quality because of the limited number of marina facilities with pump out

capabilities. Establishing marinas that meet Clean Marina standards is essential to protect public health and water quality.

According to the *Sanitary Survey of Albemarle and Currituck Sounds, Areas I-1, I-3 through I-16* (DEH Shellfish Sanitation & Recreational Water Quality Section, December 2005), there has been little change in water quality since the last survey. The only shellfish found in this area is *Rangia* clams. No commercial shellfish harvesting occurs. Freshwater runoff is the most significant factor affecting water quality in this region and can be associated with agricultural runoff or natural runoff from swampwaters following heavy rains.

Area I-4 consists mainly of forest and swamps surrounding the Alligator River. Logging is the main industry in this region. There are some farming operations on the western side of the river. The eastern side of the river is part of the Alligator River National Wildlife Refuge.

According to the *Sanitary Survey of Eastern Albemarle Sound, Area I-2* (DEH Shellfish Sanitation Unit, June 2005), water quality has improved with a few exceptions. The only shellfish present in this area is *Rangia* clams. The estimated population of this area is 11,000 people, which is a 50 percent increase since the last survey. With the influx of tourists the population more than triples. There are 15 subdivisions, many of which are located along closed waters.



### 3.1 Subbasin Overview

#### *Subbasin 03-01-52 at a Glance*

##### Land and Water Area

Total area:	541 mi <sup>2</sup>
Land area:	399 mi <sup>2</sup>
Water area:	142 mi <sup>2</sup>

##### Land Cover (percent)

Forest/Wetland:	32%
Cultivated Crop:	39%
Surface Water:	28%
Urban:	<1%
Pasture/ Managed Herbaceous:	1%

##### Counties

Perquimans, Pasquotank, Chowan and Gates

##### Municipalities

Hertford and Winfall

##### Monitored Waterbody Statistics

###### **Aquatic Life:**

Total:	40.0 mi/74,429.3 ac
Supporting:	25 mi/73,736.7 ac
Impaired:	7.9 mi/692.6 ac

###### **Recreation:**

Total:	7.9 mi/74,429.3 ac
Supporting:	7.9 mi/74,429.3 ac

This subbasin consists of the northwestern edge of Albemarle Sound and the rivers that empty to it. The largest of these rivers are the Little River and the Perquimans River. The Perquimans River originates in the Great Dismal Swamp and flows south before emptying into Albemarle Sound. Most streams are low gradient with substrates of silt and sand. Ecologically, the subbasin contains characteristics of Chesapeake-Pamlico lowlands and tidal marshes. Land cover generally consists of cultivated crops, evergreen forests, mixed forests, forested wetlands and marshes. A small portion of the land area near the mouths of the Yeopim, Perquimans and Little Rivers are designated Significant Natural Heritage Areas.

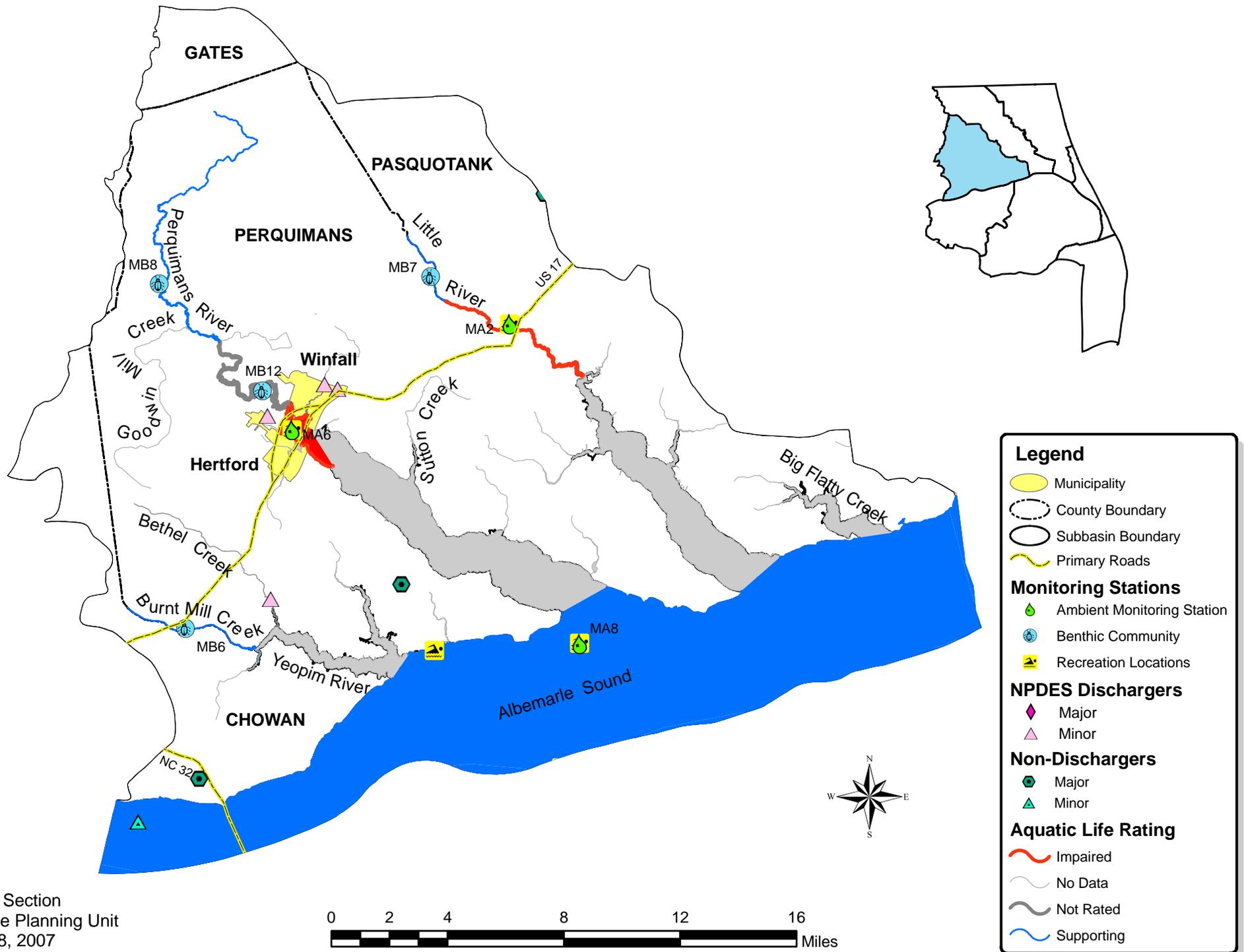
Portions of Perquimans, Pasquotank, Chowan and Gates Counties can be found in this subbasin with the highest concentration of urbanized areas around the Town of Hertford. Although the Town of Hertford experienced a net decline in population based on the 2000 census data, trends for the subbasin show expected growth in all four counties over the next 20 years. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 11.

There are four minor National Pollutant Discharge Elimination System (NPDES) discharges in this subbasin with a total permitted flow of 0.7 MGD. Three of these facilities are water treatment plants (WTP), two of which are required to monitor whole effluent toxicity (WET).

Both facilities are failing to meet their 90 percent acute toxicity target for effluent concentration. Both facilities discharge filter backwash, or reverse osmosis reject water. The Winfall WTP is also experiencing significant noncompliance issues with total suspended solids (TSS) and settleable solids. There are three non-discharge permits and six stormwater discharge permits for this subbasin. For the listing of NPDES permit holders, refer to Appendix III.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 5. Table 8 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Appendix V provides definitions of the terms used throughout this basin plan.

**Figure 5 Pasquotank River Subbasin 03-01-52**



**Table 8 Pasquotank Subbasin 03-01-52**

AU Number	Classification	Length/Area		Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
Description														
<b>ALBEMARLE SOUND</b>														
30c	SB	73,736.7	S Acres	<b>S</b>	MA8	NCE			<b>S</b>	MA8 N54	NCE NCE		Dioxin	Industrial Site
Portion of Albemarle Sound in subbasin 03-01-52. Waters of Albemarle Sound (All waters south and east of a line running in a southerly direction from Horniblow Point (North end of Norfolk-Southern Railroad Bridge) to a point of land on the east side of R														
<b>Burnt Mill Creek</b>														
30-8-1	C;Sw	5.2	FW Miles	<b>S</b>					ND				Habitat Degradation	Unknown
From source to Yeopim River					MB6	M	2005							
<b>Little River</b>														
30-5-(1)a	C;Sw	2.8	FW Miles	<b>S</b>					ND					
From source to SR 1225					MB7	M	2005							
30-5-(1)b	C;Sw	7.9	FW Miles	<b>I</b>	MA2	CE	Chlor a	10.5	<b>S</b>	MA2	NCE		Chlorophyll a	Unknown
From SR 1225 to Halls Creek														
<b>Perquimans River</b>														
30-6-(1)a	C;Sw	17.0	FW Miles	<b>S</b>					ND				Habitat Degradation	Unknown
From source to Bagley Swamp					MB8	M	2005							
30-6-(1)b	C;Sw	7.1	FW Miles	<b>NR+</b>					ND				Habitat Degradation	Unknown
From Bagley Swamp to Norfolk-Southern Railroad Bridge					MB12	F	2005							
30-6-(3)	SC	692.6	S Acres	<b>I</b>	MA6	CE	Low DO	12.3	<b>S</b>	MA6	NCE		Chlorophyll a	Unknown
					MA6	CE	Low pH	45.6					Low pH	Unknown
					MA6	NCE	Chlor a	8.7					Low Dissolved Oxygen	Unknown
From Norfolk-Southern Railroad Bridge to a line across the														



Four sites were sampled for benthic macroinvertebrates in 2005. Three of the sites received a Moderate bioclassification based on swamp criteria. One site received a Fair bioclassification using draft Coastal B criteria. Long-term trends in water quality cannot be assessed with the limited macroinvertebrate data; however, there is one exception. This exception can be found in the Little River where a more diverse benthic community was identified in 2005 than in 2000.

Data were also collected from three ambient monitoring stations (MA2, MA6 and MA8). Ambient monitoring on the Perquimans River (MA6) showed frequent pH measurements below the water quality standard. Perquimans River drains swamps in much of the watershed including a portion of the Great Dismal Swamp. Swamps are naturally low in pH and low pH levels are not unexpected. Refer to the *2006 Pasquotank River Basinwide Assessment Report* <http://h2o.enr.state.nc.us/esb/Basinwide/PASQUOTANK2006Final.pdf> and Appendix I for more information on monitoring.

Waters in the following sections and in Table 8 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

### **3.2 Use Support Assessment Summary**

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Table 9 provides a summary of use support for waters in subbasin 03-01-52.

In subbasin 03-01-52, use support was assigned for aquatic life, recreation, and fish consumption categories. Waters are Supporting, Impaired, Not Rated, and 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).

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>. Appendix V provides definitions of the terms used throughout this basin plan.

Table 9 Summary of Use Support Ratings by Category in Subbasin 03-01-52

Use Support Rating	Aquatic Life		Recreation	
	Freshwater	Saltwater	Freshwater	Saltwater
<b>Monitored</b>				
Supporting	25.0 mi	73,736.7 ac	7.9 mi	74,429.3 ac
Impaired*	7.9 mi (19.8%)	692.6 ac (0.9%)	0	0
Not Rated	7.1 mi	0	0	0
<b>Total</b>	<b>40.0 mi</b>	<b>74,429.3 ac</b>	<b>7.9 mi</b>	<b>74,429.3 ac</b>
<b>Unmonitored</b>				
Not Rated	8.0 mi	14.7 ac	0	0
No Data	40.9 mi	18,220.6 ac	80.9 mi	18,235.3 ac
<b>Total</b>	<b>48.9 mi</b>	<b>18,235.3 ac</b>	<b>80.9 mi</b>	<b>18,235.3 ac</b>
<b>Totals</b>				
<b>All Waters</b>	<b>88.9 mi</b>	<b>92,664.6 ac</b>	<b>88.8 mi</b>	<b>92,664.6 ac</b>

\* The noted percent Impaired is the percent of monitored miles/acres only.

### 3.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state’s 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Chapter 15.

#### 3.3.1 Little River [AU# 30-5-(1)a, 30-5-(1)b and 30-5-(2)]

##### 2002 Status

Upper Little River [AU# 30-5-(1)], from source to Halls Creek (11.8 mi.), was first listed on the 1998 303(d) list of Impaired waters for a water quality standards violation (low DO). Potential sources were identified as nonirrigated crop production, onsite wastewater systems, off-farm animal holding and/or management areas and land development. Lower Little River [AU# 30-5-(2)], from Halls Creek to the Albemarle Sound (6,263.9 acres), was then added to the 2000 303(d) list of Impaired waters for a water quality standards violation (low DO). Agriculture and onsite wastewater systems were identified as potential sources. In both segments, swamp conditions combined with agricultural runoff were thought to be contributing to the low DO levels. DWQ recommended additional sampling in order to evaluate natural and anthropogenic impacts on DO levels in the Little River. Growth management was also recommended to protect water quality from future development activities.

##### Current Status [AU# 30-5-(1)a]

Little River, from source to SR 1225 (2.8 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site MB7. Previous sampling in 2000 also resulted in a Moderate swamp bioclassification. Substrate was composed entirely of detritus and there was no evidence of channel modification. Snags, undercut banks, root mats and leaf packs

were present but rare. The riparian zone on the right streambank was wide and intact, but on the left, there was evidence of timber harvesting. There was also evidence of recent de-snagging. No active NPDES discharges are located upstream of site MB7.

Current Status [AU# 30-5-(1)b]

Little River, from SR 1225 to Halls Creek (7.9 miles), is Impaired in the aquatic life category due to a water quality standards violation at ambient monitoring station MA2. Site MA2 was sampled 46 times for chlorophyll *a* over the course of the five-year assessment period. Nearly 11 percent of the samples were above the water quality standard for chlorophyll *a* indicating nutrient enrichment at this segment of the river.

Current Status [AU# 30-5-(2)]

Little River, from Halls Creek to the Albemarle Sound (6,263.9 acres), was not sampled during this assessment period.

2007 Recommendations

DWQ recommends that the upper 2.8 miles of the Little River be removed from the 2008 303(d) list of Impaired waters as a result of the recent benthic bioclassification. Little River [AU# 30-5-(1)b], from SR 1225 (one mile downstream of SR 1221) to Halls Creek, however, will be listed on the 2008 303(d) list for a water quality standards violations. Lower Little River [AU# 30-5-(2)], should remain on the 2008 303(d) list of Impaired waters of chlorophyll *a* for further assessment of DO and swamp drainage affects.

Land use activities have significantly changed in the Little River watershed with residential and commercial development expanding. As developments occur along channels and ditches to the Little River, riparian buffers are recommended to aid in the filtering of stormwater runoff, promote infiltration and protect water quality. Road construction activity on the NC-17 bypass may have contributed to increased sediment loads in the Little River during the data collection period.

### **3.3.2 Perquimans River [AU# 30-6-(3)]**

Perquimans River, from the Norfolk-Southern Railroad Bridge to a line across the river from Barrow Point to Ferry Point (692.6 saltwater acres), is Impaired in the aquatic life category due to water quality standards violations at ambient monitoring station MA6. Site MA6 was sampled 57 times for dissolved oxygen and pH over the course of the five-year assessment period. Over 12 percent of the samples were below the water quality standard for dissolved oxygen. Nearly 46 percent were below the water quality standard of for pH. Chlorophyll *a* was also elevated with 8.7 percent of the 46 samples collected above the water quality standard.

2007 Recommendations

Excess nutrients continue to be a water quality issue at the mouth of the Perquimans River, resulting in algal blooms and subsequent fish kills. This reach of the Perquimans River also receives drainage from swamp waters, which can contribute to low pH and low DO conditions. However, overall water quality conditions reflect that land use activities are influencing water quality. Continued growth and development in this watershed also contributes towards water quality impairments.

The Town of Hertford WWTP discharges to Mill Creek located downstream of ambient monitoring site MA6. The WWTP continues to have inflow and infiltration problems and the Special Order of Consent (SOC) has been extended until 2008, as planning for expansion continues. The facility has a water reuse permit (WQ0021289) and received a High Unit Cost Grant from DWQ Construction Grants & Loans to install a 325,000 gallon reuse above ground storage tank, dual 1,000 gallon per minute irrigation pumps with flow meters, and a turbidity meter. The water will irrigate 78.1 acres that has been divided into nine zones. DWQ staff will continue to work with the Hertford WWTP, providing technical assistance and ensuring that permit limits are met. Upstream segments of the river are Supporting and Not Rated (See 3.4.1 below).

### **3.4 Status and Recommendations for Waters with Noted Impacts**

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix IV.

#### **3.4.1 Perquimans River [AU# 30-6-(1)a and AU# 30-6-(1)b]**

##### *Current Status [AU# 30-6-(1)a]*

Perquimans River, from source to Bagley Swamp (17.0 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site MB8. Substrate was a mix of silt and organic matter; sticks, snags, logs and root mats were common; and there was some evidence of channelization and recent de-snagging activities. The riparian zone was wide and intact on both sides of the stream. No active NPDES discharges are located upstream of site MB7.

##### *Current Status [AU# 30-6-(1)b]*

Perquimans River, from Bagley Swamp to the Norfolk-Southern Railroad Bridge (7.1 miles), is Not Rated<sup>+</sup> in the aquatic life category. Site MB12 was sampled using draft criteria for Coastal B Rivers and labeled as NR<sup>+</sup>. Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. Other characteristics may include an open canopy, low pH and low DO. Boat sampling is required for these waters. Site MB12 received a Fair benthic bioclassification, based on the draft criteria for Coastal B rivers. Any bioclassifications derived from sampling data should be considered draft and not used for use support decisions; therefore this section of the Perquimans River is Not Rated<sup>+</sup>. (BAU, March 2006).

Site MB12 is located approximately three miles above the Town of Hertford and there are no active NPDES dischargers upstream of this site. The stream is a large deep river, approximately 100 meters wide. Substrate was a mix of silt and detritus; the water was dark and tannic; and snags and logs were abundant. Sticks, undercut banks and aquatic macrophytes were common. The riparian zone on both sides was intact and moderately wide. Several macroinvertebrate taxa

were present in both 2000 and 2005 samples that are indicators of low dissolved oxygen levels in the water. Local residents report this reach is a popular recreational fishing site.

### 2007 Recommendations

Along portions of the Perquimans River, water quality improvements may be obtained by planting critical areas, establishing stormwater wetlands, and encouraging the maintenance of riparian buffers.

#### **3.4.2 Burnt Mill Creek [AU# 30-8-1]**

Burnt Mill Creek, from source to the Yeopim River (5.2 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site MB6. Prior to 2005, the site was sampled twice. In 1995, the site was Not Rated and in 2000, the site was Moderate based on swamp criteria. Substrate was a mix of silt, sand and detritus; sticks, snags, logs and root mats were present but rare; and leaf packs and aquatic macrophytes were absent. Undercut banks were common and the riparian zones on both banks had frequent breaks, but were moderately wide. No active NPDES discharges are located upstream of site MB6.

#### **3.4.3 Bethel Creek [AU# 30-8-3]**

Bethel Creek, from source to the Yeopim River (8.0 miles), is Not Rated on an evaluated basis in the aquatic life category due to significant noncompliance issues with permit limits at the Bethel Water Treatment Plant (WTP) (Permit NC0068861). By permit, the Bethel WTP is required to monitor whole effluent toxicity (WET) and is failing to meet its 90 percent acute toxicity target for effluent concentration. The facility discharges filter backwash or reverse osmosis (RO) reject water into Bethel Creek. The Bethel WTP is expanding, with the discharge being relocated to Albemarle Sound. The town has been advised to seek state funds to assist with renovation of the WTP.

#### **3.4.4 Mill Creek [AU# 30-6-5-(2)]**

Mill Creek, from the Perquimans County SR 1214 near Winfall to the Perquimans River (14.7 saltwater acres), is Not Rated on an evaluated basis in the aquatic life category due to significant noncompliance issues with permit limits at the Town of Winfall Water Treatment Plant (WTP) (Permit NC0081850). By permit, the Winfall WTP is required to monitor whole effluent toxicity (WET) and is failing to meet its 90 percent acute toxicity target for effluent concentration. The facility discharges filter backwash or reverse osmosis (RO) reject water into Mill Creek. During the last two years of the assessment period, the facility also experienced significant noncompliance issues with total suspended solids (TSS) and settleable solids.

The Town of Winfall's WTP recently was expanded and upgraded, and TSS are likely to meet compliance, but toxicity violations may remain an issue.

### **3.5 Additional Water Quality Issues within Subbasin 03-01-52**

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

According to the *Sanitary Survey of Albemarle and Currituck Sounds, Areas I-1, I-3 through I-16* (DEH Shellfish Sanitation & Recreational Water Quality Section, December 2005), there has been little change in water quality since the last survey. The only shellfish found in this area is *Rangia* clams. No commercial shellfish harvesting occurs. Freshwater runoff is the most significant factor affecting water quality in this region and can be associated with agricultural runoff or natural runoff from swampwaters following heavy rains.

Growing area I-6 consists of the Little River and Big Flatty Creek. The area is almost entirely rural and is comprised mainly of wooded areas and farmland. However, two new subdivisions are being developed along the Little River and an additional four subdivisions are being developed in the area. There was one chicken farm, two hog farm operations and approximately 150 goats observed during the survey.

Area I-7 consists of the entire watershed of the Perquimans River. The majority of the population lives in the Town of Hertford, which has an estimated population of 2,000. Hertford WTP discharges to the Perquimans River (See 3.3.2 above). Much of the land in area I-7 is used for agriculture.

A 65.5-acre sewage disposal field treats waste from a subdivision located in land draining to area I-8, but is not adjacent to any water. Area I-8 includes the watersheds of Yeopim River and Yeopim Creek. Most of this area is rural and is either forested or farmed. There is one major subdivision whose sewage is spray field applied on land in area I-8. Three other subdivisions are occupied with seasonal residents.

### **3.5.1 Wastewater Non-Discharge Runoff**

The Albemarle Plantation (WQ0001817) is a non-discharge facility using surface irrigation to dispose of its wastewater effluent. The disposal field for Albemarle Plantation, like several sites in northeastern NC, has limited hydraulic capacity due to poor soils. Therefore, proper operation of the site is critical to prevent ponding and run-off, while at the same time maintaining adequate freeboard. The Albemarle Plantation is in the Yeopin Creek watershed, which is currently not monitored by DWQ.

### **3.5.2 Dioxin Contamination Fish Consumption Advisory**

In 2001, the Department of Health and Human Services (DHHS) issued dioxin advisory for the consumption of catfish and carp in the Albemarle Sound from Bull Bay to Harvey Point; West to the mouth of the Roanoke River and to the mouth of the Chowan River to the U.S. Highway 17 Bridge (Perquimans, Chowan, Bertie, Washington, and Tyrrell Counties). For more information on this advisory, please visit the DHHS website <http://www.epi.state.nc.us/epi/fish/>.

# Chapter 4

## Pasquotank River Subbasin 03-01-53

Including: Scuppernon River, Kendrick Creek and Phelps Lake

### 4.1 Subbasin Overview

#### *Subbasin 03-01-53 at a Glance*

##### **Land and Water Area**

Total area:	475 mi <sup>2</sup>
Land area:	336 mi <sup>2</sup>
Water area:	139 mi <sup>2</sup>

##### **Land Cover (percent)**

Forest/Wetland:	41%
Cultivated Crop:	30%
Surface Water:	28%
Urban:	<1%
Pasture/ Managed Herbaceous:	<1%

##### **Counties**

Tyrrell and Washington

##### **Municipalities**

Columbia, Creswell and Roper

##### **Monitored Waterbody Statistics**

###### **Aquatic Life:**

Total:	18.0 mi/78,492.6 ac
Supporting:	62,474.2 ac
Impaired:	4.4 mi/80.1 ac
Not Rated:	13.6 mi/15,938.3 ac

###### **Recreation:**

Total:	13.6 mi/62,554.2 ac
Supporting:	13.6 mi/62,554.2 ac

This subbasin contains the Scuppernon River, Deep Creek, Kendrick Creek and several tributaries, many of which are channelized. Most streams are of low relief and often swampy. Ecologically, the subbasin contains characteristics of the Chesapeake-Pamlico lowlands and tidal marshes, as well as nonriverine swamps and peatlands. Land cover generally consists of evergreen forests, mixed forests, forested wetlands and marshes, and cultivated crop. This subbasin contains a diversity of public lands and Significant Natural Heritage Areas, including Lake Phelps State Park, Bull Neck Swamp, East Dismal and the Scuppernon River Swamp Forest.

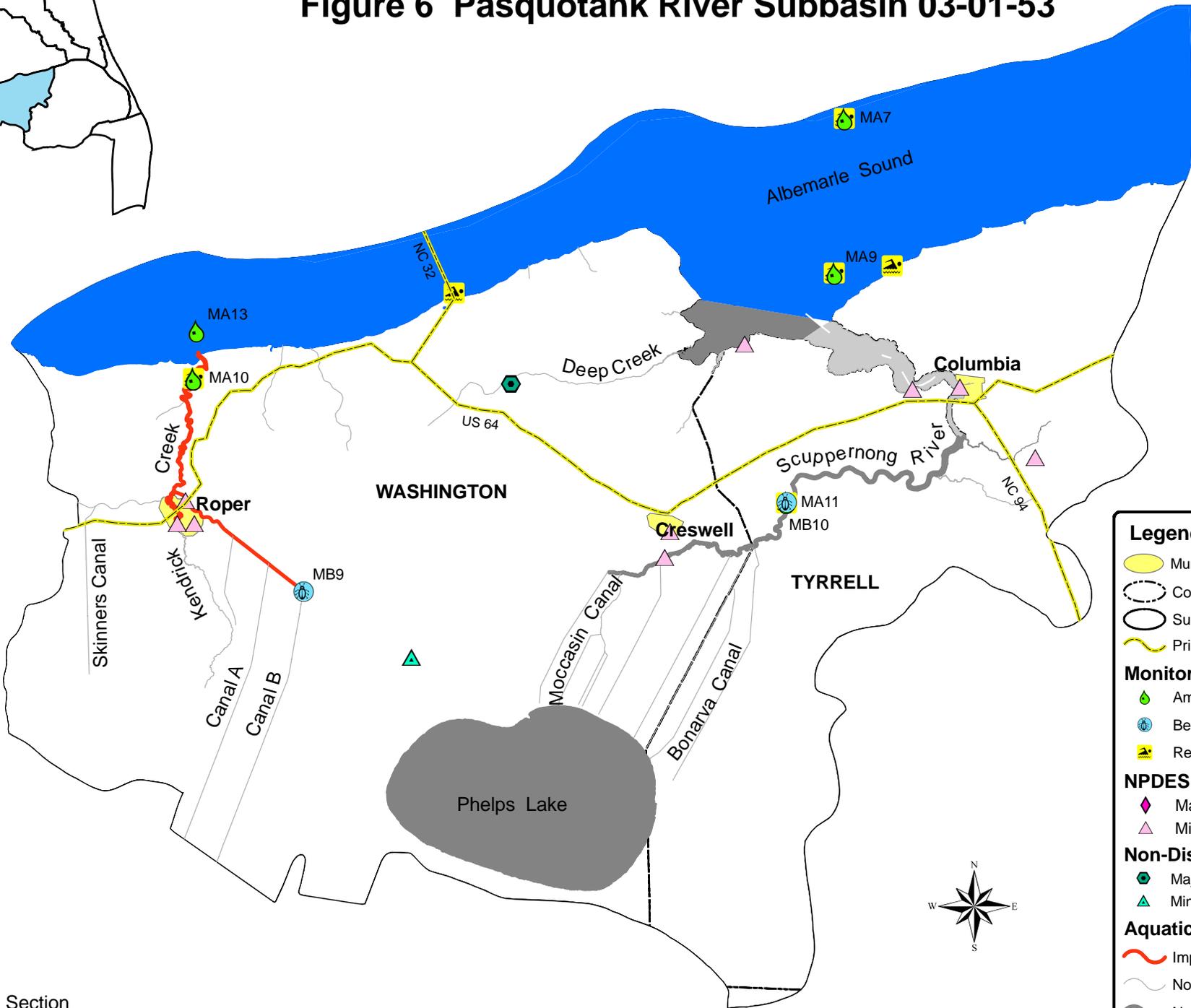
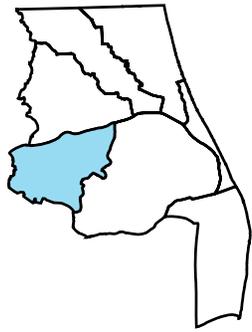
Western Tyrrell County and most of Washington County can be found in this subbasin with the highest concentration of urbanized areas around the small towns of Columbia, Creswell and Roper. All of these towns have experienced a net decrease in population since 1990 and Washington County's population is expected to decrease by 9.5 percent by 2020. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 11.

There are eleven minor National Pollutant Discharge Elimination System (NPDES) discharges in this subbasin with a total permitted flow of 0.75 MGD. Four of these facilities are water treatment plants (WTP) that are required by permit to monitor whole effluent toxicity (WET). No WET violations were reported for the Columbia WTP or the Creswell WTP. WET results submitted by the Tyrrell

County WTP and the Tyrrell County Bull Bay WTP, however, indicate that both facilities are consistently failing to meet their 90 percent acute toxicity target effluent concentration. More information about both of these facilities can be found in Section 4.4.2 and Section 4.4.1, respectively. A total of five NPDES facilities are permitted to discharge to the Scuppernon River; of which, Creswell Wastewater Treatment Plant has had significant noncompliance issues with biochemical oxygen demand. There are two surface irrigation non-discharge permits and three stormwater discharge permits for this subbasin. For the listing of NPDES permit holders, refer to Appendix III.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 6. Table 10 contains a summary of assessment unit numbers (AU#) and

Figure 6 Pasquotank River Subbasin 03-01-53



**Legend**

- Municipality
- County Boundary
- Subbasin Boundary
- Primary Roads

**Monitoring Stations**

- Ambient Monitoring Station
- Benthic Community
- Recreation Locations

**NPDES Dischargers**

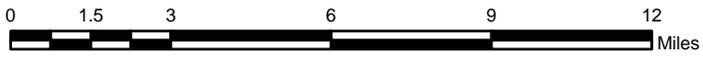
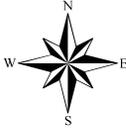
- Major
- Minor

**Non-Dischargers**

- Major
- Minor

**Aquatic Life Rating**

- Impaired
- No Data
- Not Rated
- Supporting



**Table 10 Pasquotank Subbasin 03-01-53**

AU Number	Classification	Length/Area		Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
Description														
<b>ALBEMARLE SOUND</b>														
30d	SB	62,474.2	S Acres	<b>S</b>	MA7	NCE	Low pH	8.2	<b>S</b>	MA7	NCE		Dioxin	Industrial Site
					MA9	NCE				MA9	NCE		Low pH	Unknown
										N61	NCE			
										N63	NCE			
										N65	NCE			
Portion of Albemarle Sound in subbasin 03-01-53. Waters of Albemarle Sound (All waters south and east of a line running in a southerly direction from Horniblow Point (North end of Norfolk-Southern Railroad Bridge) to a point of land on the east side of R														
<b>Canal B</b>														
30-9-4-1	C;Sw	7.4	FW Miles	ND										
From source to Main Canal														
<b>Kendrick Creek (Mackeys Creek)</b>														
30-9-(2)	SC	80.1	S Acres	<b>I</b>	MA10	CE	Low DO	43.9	<b>S</b>	MA10	NCE		Nutrient Impacts	Agriculture
					MA10	CE	Low pH	63.2					Nickel	Unknown
					MA10	NCE	Turbidity	8.6					Turbidity	Unknown
					MA10	CE	Nickel	45					Low pH	Unknown
From U.S. Hwy. 64 at Roper to Albemarle Sound														
													Low Dissolved Oxygen	Unknown
<b>Main Canal</b>														
30-9-4	C;Sw	4.4	FW Miles	<b>I</b>									Habitat Degradation	Agriculture
From source to Kendrick Creek														
					MB9	SS	2005							
<b>Phelps Lake</b>														
30-14-4-6-1	B;Sw,ORW	15,938.3	FW Acres	<b>NR</b>	ML2	ID								
					ML3	ID								
					ML1	ID								
Entire Lake														
<b>Scuppernong River</b>														
30-14-4-(1)	C;Sw	13.6	FW Miles	<b>NR+</b>	MA11	NCE							Low pH	WWTP NPDES
From source to mouth of Riders Creek (First Creek)														
					MB10	P	2005						Low Dissolved Oxygen	WWTP NPDES



lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Appendix V provides definitions of the terms used throughout this basin plan.

Two sites were sampled for benthic macroinvertebrates in 2005. Swamp and draft Coastal B criteria were used to evaluate the benthic communities resulting in Impaired and Not Rated stream segments. Data were also collected from four ambient monitoring stations (MA7, MA9, MA10 and MA11). Ambient monitoring on Kendrick Creek (MA10) showed frequent pH and dissolved oxygen levels below water quality standards. Frequent elevated levels of nickel were also recorded. Kendrick Creek drains several swamps in the area. Swamps are naturally low in pH, and therefore, low pH levels are not unexpected. More benthic data is needed to determine any significant water quality changes.

In this subbasin, one lake (Phelps Lake) was also sampled. Phelps Lake is the second largest natural lake in North Carolina. The lake was sampled a total of 12 times between October 2001 and September 2005 at three sampling locations. More information on Phelps Lake can be found in Section 4.3.4. Refer to the *2006 Pasquotank River Basinwide Assessment Report* <http://h2o.enr.state.nc.us/esb/Basinwide/PASQUOTANK2006Final.pdf> and Appendix I for more information on monitoring throughout the subbasin.

Waters in the following sections and in Table 10 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

## **4.2 Use Support Assessment Summary**

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Table 11 provides a summary of use support for waters in subbasin 03-01-53.

In subbasin 03-01-53, use support was assigned for aquatic life, recreation, and fish consumption. Waters are Supporting, Impaired, Not Rated, and 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).

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

Table 11 Summary of Use Support Ratings by Category in Subbasin 03-01-53

Use Support Rating	Aquatic Life		Recreation	
	Freshwater	Saltwater	Freshwater	Saltwater
<b>Monitored</b>				
Supporting	0	62,474.2 ac	13.6 mi	62,554.2 ac
Impaired*	4.4 mi (24.4%)	80.1 ac (0.1%)	0	0
Not Rated	13.6 mi 15,938.3 ac	0	0	0
<b>Total</b>	<b>18.0 mi 15,938.3 ac</b>	<b>62,554.2 ac</b>	<b>13.6 mi</b>	<b>62,554.2 ac</b>
<b>Unmonitored</b>				
Not Rated	3.6 mi	1,839.4 ac	0	0
No Data	91.5 mi	1,733.8 ac	99.6 mi 15,938.3 ac	3,573.2 ac
<b>Total</b>	<b>95.1 mi</b>	<b>3,573.2 ac</b>	<b>99.6 mi 15,938.3 ac</b>	<b>3,573.2 ac</b>
<b>Totals</b>				
<b>All Waters</b>	<b>113.1 mi 15,938.3 ac</b>	<b>66,127.4 ac</b>	<b>113.1 mi 15,938.3 ac</b>	<b>66,127.4 ac</b>

\* The noted percent Impaired is the percent of monitored miles/acres only.

### 4.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state’s 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Chapter 15.

#### 4.3.1 Kendrick Creek [AU# 30-9-(1) and 30-9-(2)]

##### 2002 Status

Kendrick Creek, from source to U.S. Hwy 64 in Roper, was first listed on the 1998 303(d) list of Impaired waters based on a 1998 historic listing for water quality standards violations for dissolved oxygen (DO) and pH. Potential sources were identified as nonirrigated crop production, off-farm animal holding and/or management areas and municipal point sources. Benthic sampling in 2000 resulted in a Not Rated bioclassification. Biologists also determined that the low pH and low DO levels in Kendrick Creek are likely due to natural conditions.

##### Current Status

Kendrick Creek, from U.S. Hwy 64 in Roper to the Albemarle Sound (80.1 saltwater acres), is Impaired in the aquatic life category due to standards violations at ambient monitoring station MA10. Site MA10 was sampled 57 times for dissolved oxygen and pH over the course of the five-year assessment period. Nearly 44 percent of the samples were below the water quality standard of 5.0 mg/l for DO and 63 percent were below the water quality standard of 6.8 s.u. for pH. Metals were sampled a total of 20 times over the course of the five year period. Nickel

exceeded the water quality standard of 8.3 µg/l in 45 percent of the samples collected. Turbidity was also elevated in 8.6 percent of the samples and is likely associated with road construction activities along US 64.

Fish tissue samples were also collected from Kendrick Creek in order to evaluate mercury levels in the Pasquotank River basin. Results are included in Section 4.5.1.

#### 2007 Recommendations

Kendrick Creek continues to be impacted from agricultural activity, primarily corn, bean and cotton crop production. Duckweed growth has become a noticeable problem in waterways. The expansion of US Hwy 64 during the 5-year data assessment period and/or the presence of an auto salvage yard could be contributing metals to the creek. Kendrick Creek will remain on the 2008 303(d) list. DWQ will further assess if low DO and pH are natural conditions. DWQ will work with local resource agencies to address agricultural impacts and further assess sources of metals.

### **4.3.2 Main Canal [AU# 30-9-4]**

#### 2002 Status

Main Canal was first listed on the 1998 303(d) list of Impaired waters for biological integrity. Potential sources were identified as off-farm animal holding and/or management areas, intensive animal feeding operations and nonirrigated crop production.

#### Current Status

Main Canal, from source to Kendrick Creek (4.4 miles), is Impaired in the aquatic life category due to a Severe swamp benthic bioclassification at site MB9. Substrate was composed entirely of silt and muck, consequently, making sampling very difficult. Sticks and aquatic macrophytes were present, but rare and provided the only habitat for macroinvertebrate colonization at the site. Water flow was slow, pools and riffles were absent. Erosion was observed on both streambanks with the left streambank riparian zone consisting of trees and the right streambank consisting of mostly grass. These minimal riparian vegetated areas make the streambanks susceptible to failure during high flow events. No permitted NPDES facilities are located above site MB9.

#### 2007 Recommendations

Main Canal [AU# 30-9-4] will remain on the 2008 303(d) list. DWQ will work with local resource agencies to address agricultural impacts.

### **4.3.3 Scuppernong River [AU# 30-14-4-(1)]**

Growing Area I-3 consists of all waters within the Scuppernong River watershed. According to the *Sanitary Survey of Albemarle and Currituck Sounds, Areas I-1, I-3 through I-16* (DEH Shellfish Sanitation & Recreational Water Quality Section, December 2005), there has been little change in water quality since the last survey. The only shellfish found in this area is *Rangia* clams and no commercial shellfish harvesting occurs. Freshwater runoff is the most significant factor affecting water quality in this region, and can be associated with agricultural runoff or natural runoff from swampwaters following heavy rains. The area is mainly rural with the exception of Columbia, which has 825 residents, although several new subdivisions were recently established. Columbia treats its waste with an oxidation ditch treatment system. A motel and restaurant rely on a package plant for sewage disposal with treated effluent discharged

into the Scuppernong River. Hog farming was an important industry in this area; ten hog farms and associated lagoons are located in this area, but most are currently not operational. Much of the area is covered with row crop farms including corn, potatoes and cotton.

### 2002 Status

The upper portion of the Scuppernong River was first listed on the 1998 303(d) list of Impaired waters for water quality standards violations for dissolved oxygen (DO) and pH. Potential sources were identified as nonirrigated crop production, off-farm animal holding and/or management areas, municipal point sources, and specialty crop production. Benthic sampling in 2000 resulted in a Not Rated bioclassification. Biologists also determined that the low pH and low DO levels in the Scuppernong River are likely due to natural conditions.

### Current Status

The upper portion of the Scuppernong River, from source to Riders Creek (First Creek) (13.6 miles), is Not Rated<sup>+</sup> in the aquatic life category. The Scuppernong River was sampled using draft criteria for Coastal B rivers and is labeled as NR<sup>+</sup>. Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. Other characteristics may include an open canopy, low pH and low DO. Boat sampling is required for these waters. Site MB10 received a Poor bioclassification using draft criteria for Coastal B rivers. Any bioclassifications derived from sampling data should be considered draft and not used for use support decisions; therefore this section of the Scuppernong River is Not Rated (BAU, March 2006). Samples taken in 2005, however, indicated a more pollution intolerant benthic community.

Data was also collected from one ambient monitoring station at site MA11. Site MA11 coincides with site MB10. No water quality standards were exceeded during this assessment period, and monthly measurements showed salinity concentrations to be less than 0.10 parts per thousand (ppt) for 2004 and early 2005. During drought conditions, however, the water often becomes brackish. The highest salinity concentration since 2000 was recorded in August 2002 with a measurement of 5.1 ppt. This concentration is higher than most freshwater invertebrates can survive. Three of the abundant taxa collected at the site were indicative of low DO. Ambient monitoring data for the past five years show DO levels typically fall below 1.0 mg/l each summer, limiting the benthic macroinvertebrate community at this site.

Hydrologically, the sampling site is located in a deep-water run with very little sinuosity. Duckweed and alligator weed were abundant. The riparian zones on both sides of the river were wide and intact, but undercut banks were abundant. Sticks, snags, logs, root mats and aquatic macrophytes (i.e., alligator weed) were also abundant.

A total of five NPDES facilities are permitted to discharge to the Scuppernong River. Two of these facilities are located approximately two miles upstream of the sampling site. The Creswell Water Treatment Plant (WTP) (Permit NC0027600) is required by permit to perform whole effluent toxicity (WET) testing. No WET violations were reported during the last two years of the assessment period. The Creswell Wastewater Treatment Plant (WWTP) (Permit NC0048861), however, reported significant noncompliance issues with biochemical oxygen demand (BOD), which can lead to lower than normal DO levels in the receiving stream. Significant noncompliance issues with pH were also identified. During the most recent inspection (January 2007), the facility received Civil Penalty assessments for BOD violations in February and March 2006 and a Notice of Violation (NOV) for BOD violations in April 2006.

In 2002, a Clean Water Management Trust Fund grant was awarded to Tyrrell Water and Sewer District for construction of a regional low-pressure sewer system to eliminate 191 septic systems and straight pipes.

Fish tissue samples were collected from the Scuppernong River in order to evaluate mercury levels in the Pasquotank River basin. Results are included in Section 4.5.1.

#### 2007 Recommendations

The Scuppernong River [AU# 30-14-4-(1)] will remain on the 2008 303(d) list to further assess natural conditions for low DO and pH. The Scuppernong River will be rated when Coastal B benthic criteria are finalized. DWQ will continue to work with local resource agencies to monitor water quality and work with the Town of Creswell to ensure that the WWTP is in compliance during the next review period.

#### **4.3.4 Phelps Lake [AU# 30-14-4-6-1]**

Phelps Lake is the second largest natural lake in North Carolina and is located within a vast peninsula between the Albemarle Sound to the north and the Pamlico River to the south. The peninsula contains numerous low-lying swampy areas underlain by thick organic muck and relatively well-drained areas with fertile mineral and organic soils. Much of the area has been cleared of vegetation, drained and put into large-scale agricultural use. Phelps Lake was reclassified from C Sw to B Sw ORW in August 2000.

Phelps Lake (15,938.3 freshwater acres) is Not Rated in the aquatic life category because sample size criteria (10 sample minimum) were not met. The lake was sampled four times from May 2005 to August 2005 at sites ML1, ML2 and ML3. Physical water quality values for chlorophyll a, pH, DO and temperature were similar to those collected in previous assessments. Nutrient concentrations, which were generally low to moderate, were also similar to previous assessments.

Phelps Lake was also sampled as part of the North Carolina Mercury Study Extension between 2004-2006. Samples were collected on a quarterly basis. No samples exceeded the state mercury standard. Fish tissue samples were also collected from Phelps Lake in order to evaluate mercury levels in the Pasquotank River basin. Results are included in Section 4.5.1.

### **4.4 Status and Recommendations for Waters with Noted Impacts**

The surface waters discussed in this section are not Impaired. Attention and resources should be focused on these issues to prevent water quality degradation. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix IV.

#### **4.4.1 Bull Bay [AU# 30-14]**

Bull Bay (1,839.4 saltwater acres) is Not Rated on an evaluated basis in the aquatic life category due to WET failures associated with the Tyrrell County (Bull Bay) Reverse Osmosis (RO) Water Treatment Plant (Permit NC0086924). Between October 2003 and December 2005, the facility failed to meet its 90 percent acute toxicity target effluent concentrations on three occasions. No other violations have been reported at this facility. DWQ will continue to work with Tyrrell County to assure permit limits are met.

#### 4.4.2 Riders Creek (First Creek) [AU# 30-14-4-10]

Riders Creek (First Creek), from source to the Scuppernong River (3.6 freshwater miles) is Not Rated on an evaluated basis in the aquatic life category due to WET failures associated with the Tyrrell County Ionic Exchange Water Treatment Plant (Permit NC0087092). Between July 2004 and December 2005, the facility failed to meet its 90 percent acute toxicity target effluent concentrations on five occasions. No other violations have been reported at this facility.

This WTP should be replaced with a new Reverse Osmosis WTP with discharge to the Albemarle Sound. Removing the WTP discharge to Riders Creek should reduce toxicity exceedances in the river.

### 4.5 Additional Water Quality Issues within Subbasin 03-01-53

#### 4.5.1 Mercury Contamination – Fish Tissue Assessment

Between 2003 and 2004, 89 fish tissue samples were collected from three stations in the Pasquotank River basin to determine the level of mercury contamination. The samples included largemouth bass, yellow perch, sunfish and catfish. Results from the period show 48 of the 89 samples collected contained mercury concentrations exceeding the state criteria of 0.4 ppm. Table 12 provides a list of the sampling locations, number of samples collected and mercury results for the Pasquotank River basin.

Currently, there are no site-specific consumption advisories for mercury-contaminated fish in the Pasquotank River basin. However, the Department of Health and Human Services (DHHS) issued statewide advice for the consumption of bowfin, catfish, warmouth and chain pickerel south and east of I-85 and statewide for largemouth bass.

Table 12 Fish Tissue Results for Mercury Contamination in Subbasin 03-01-53

Stream Name (Location)	Years Sampled	Species	Number of Samples	Samples Exceeding Mercury Standard
Kendrick Creek	2003	Bass, Sunfish, Catfish, Pickerel, Yellow Perch	23	7
Lake Phelps	2003 & 2004	Bass, Sunfish, Catfish, Yellow Perch	59	39
Scuppernong River	2004	Bass, Sunfish	7	2

#### 4.5.2 Dioxin Contamination- Fish Consumption Advisory

In 2001, the Department of Health and Human Services (DHHS) issued dioxin advisory for the consumption of catfish and carp in the Albemarle Sound from Bull Bay to Harvey Point; West to the mouth of the Roanoke River and to the mouth of the Chowan River to the U.S. Highway 17 Bridge (Perquimans, Chowan, Bertie, Washington, and Tyrrell Counties). For more information on this advisory, please visit DHHS website <http://www.epi.state.nc.us/epi/fish/>.

# Chapter 5

## Pasquotank River Subbasin 03-01-54

Including: Currituck Sound, Coinjock Bay, Dowdys Bay, Sanders Bay and the North River

### 5.1 Subbasin Overview

#### *Subbasin 03-01-54 at a Glance*

##### Land and Water Area

Total area:	503 mi <sup>2</sup>
Land area:	304 mi <sup>2</sup>
Water area:	199 mi <sup>2</sup>

##### Land Cover (percent)

Forest/Wetland:	39%
Surface Water:	39%
Cultivated Crop:	20%
Urban:	<1%
Pasture/ Managed Herbaceous:	<1%

##### Counties

Currituck and Camden

##### Municipalities

None

##### Monitored Waterbody Statistics

###### Aquatic Life:

Total:	1.6 mi
Supporting:	1.6 mi

###### Recreation:

Total:	75,988.1 ac
Supporting:	75,987.7 ac
Impaired:	0.4 ac

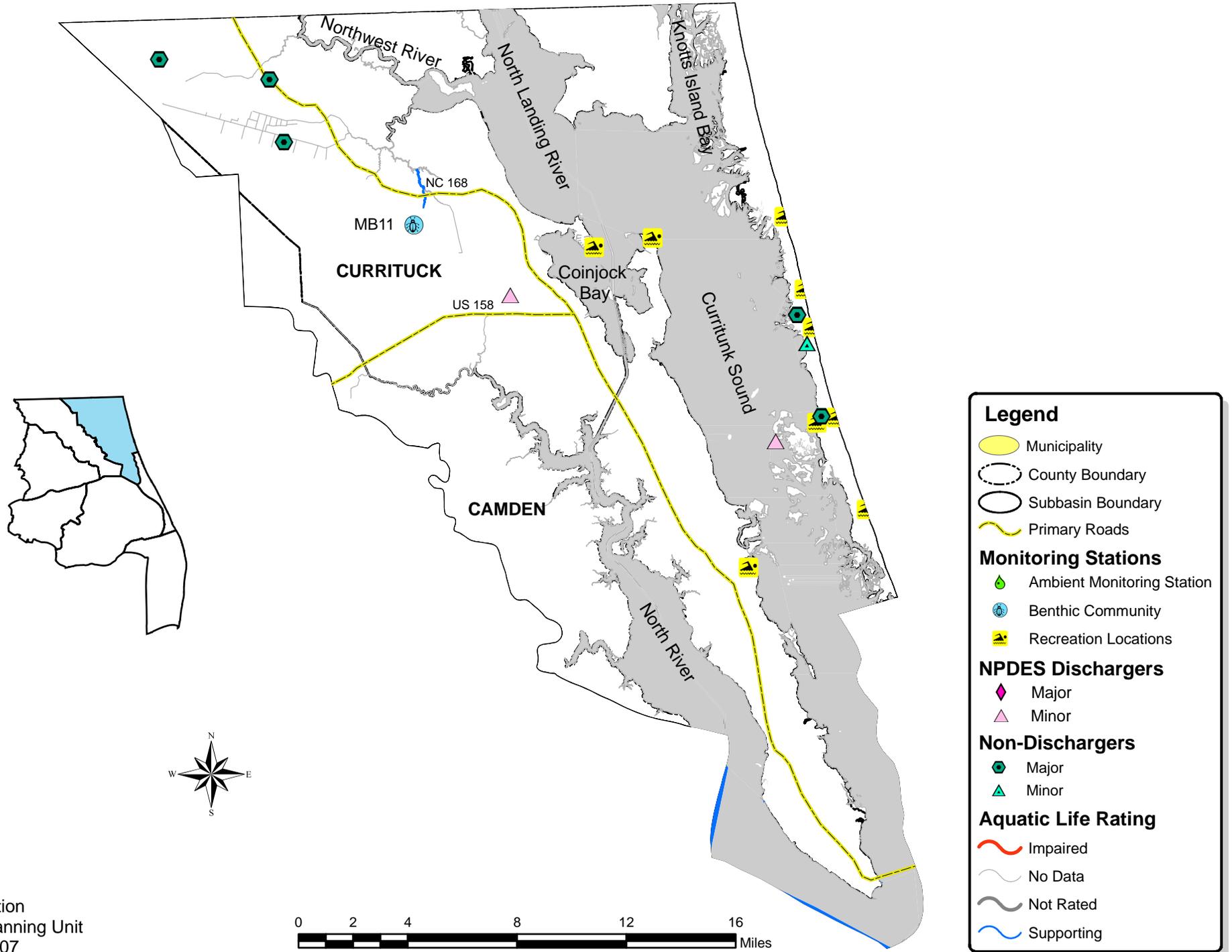
This subbasin contains portions of the Currituck Sound and several tributaries, many of which are channelized. Except for the barrier islands, most streams are of low relief and often swampy. Substrate is composed of silt and sand, and channelized ditches are common. Ecologically, the subbasin contains characteristics of the Chesapeake-Pamlico lowlands and tidal marshes, as well as nonriverine swamps and peatlands, the Virginian Barrier Islands and coastal marshes. Land cover generally consists of evergreen forests, mixed forests, forested wetlands, marshes and cultivated cropland. Land cover in the barrier islands includes marshes, forested wetlands and evergreen forests. This subbasin contains multiple public lands and Significant Natural Heritage Areas including several National Wildlife Refuges, the Currituck Banks National Estuarine Research Reserve, Northwest River Marsh Game Land, North River Game Land and portions of the Great Marsh.

A portion of this subbasin is located on the Outer Banks where there is the potential for high population growth and development. Most of Currituck County and the eastern portion of Camden County can be found in this subbasin. Both counties have a projected population growth of over 45 percent by 2020. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 11.

There are two minor National Pollutant Discharge Elimination System (NPDES) permitted facilities in this subbasin with a total permitted flow of 0.6 MGD. Both facilities are water treatment plants (WTP), one of which is required to monitor whole effluent toxicity (WET). Southern Outer Banks Water System WTP is a reverse osmosis (RO) facility that discharges filtered backwash or reject water into saline waters. No acute effluent toxicity violations were reported during the last two years of the assessment period. There are six non-discharge permits and two stormwater discharge permits for this subbasin. For the listing of NPDES permit holders, refer to Appendix III.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 7. Table 13 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Appendix V provides definitions of the terms used throughout this basin plan.

**Figure 7 Pasquotank River Subbasin 03-01-54**



**Table 15 Pasquotank Subbasin 03-01-54**

AU Number	Classification	Length/Area		Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating		
Description													
<b>Coinjock Bay</b>													
30-1-6	SC	4,670.6	S Acres	ND				<b>S</b>	N47	NCE			
Entire Bay													
<b>Cowells Creek</b>													
30-1-2-2-5-1-1	C;Sw	1.6	FW Miles	<b>S</b>				ND					
From source to Tull Creek													
					MB11	M	2005						
<b>Currituck Sound</b>													
30-1a	SC	69,301.2	S Acres	ND				<b>S</b>	N46	NCE			
From source to Wright Memorial Bridge at Albemarle Sound													
									N5B	NCE			
									N5C	NCE			
									N6A	NCE			
									N82A	NCE			
									N6	NCE			
									N82	NCE			
30-1b	SC	0.3	S Acres	ND				<b>I</b>	N5	CE	Enterrococcus	Unknown	
Currituck Sound off Ocean Bay Blvd.													
30-1c	SC	0.1	S Acres	ND				<b>I</b>	N89	CE	Enterrococcus	Unknown	
Southern Shores Private Soundside Access													
<b>Dowdys Bay (Poplar Branch Bay)</b>													
30-1-15	SC	1,532.3	S Acres	ND				<b>S</b>	N44A	NCE			
Entire Bay													
<b>Sanders Bay</b>													
30-1-11	SC	483.5	S Acres	ND				<b>S</b>	N84A	NCE			
Entire Bay													

**Table 15 Pasquotank Subbasin 03-01-54**

AU Number	Classification	Length/Area	Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
<b>Use Categories:</b>		<b>Monitoring data type:</b>		<b>Results:</b>			<b>Use Support Ratings 2006:</b>						
AL - Aquatic Life	MF - Fish Community Survey			E - Excellent			S - Supporting	I - Impaired					
REC - Recreation	MB - Benthic Community Survey			G - Good			NR - Not Rated						
SH - Shellfish Harvesting	MA - Ambient Monitoring Site			GF - Good-Fair			NR*- Not Rated for Recreation (screening criteria exceeded)						
	ML- Lake Monitoring			F - Fair			ND-No Data Collected to make assessment						
	N- DEH RECMON			P - Poor			NR+-Not rated because draft criteria used for rating						
				NI - Not Impaired			<b>Results</b>						
GA - DEH SS Classification and Growing Area				S- Severe Stress			CE-Criteria Exceeded > 10% and more than 10 samples						
APP- Approved				M-Moderate Stress			NCE-No Criteria Exceeded						
CAO- Conditionally Approved-Open				N- Natural			<b>Miles/Acres</b>						
CAC- Conditionally Approved-Closed							FW- Fresh Water						
PRO- Prohibited							S- Salt Water						

**Aquatic Life Rating Summary**

**Recreation Rating Summary**

**Fish Consumption Rating Summary**

S m 1.6 FW Miles  
 ND 123,984.8 S Acres  
 ND 1,026.4 FW Miles

S m 75,987.7 S Acres  
 I m 0.4 S Acres  
 ND 47,996.7 S Acres  
 ND 1,028.1 FW Miles

I e 123,984.8 S Acres  
 I e 1,028.1 FW Miles

One site was sampled for the first time for benthic macroinvertebrates in 2005. Two other creeks were investigated as potential sampling sites; however, both were too deep for freshwater sampling methodologies. There are several recreational monitoring stations (RECMON) located throughout the subbasin, but there are no ambient monitoring stations within this subbasin. The NC Division of Environmental Health (DEH) evaluates these stations. Refer to the *2006 Pasquotank River Basinwide Assessment Report* <http://h2o.enr.state.nc.us/esb/Basinwide/PASQUOTANK2006Final.pdf> and Appendix I for more information on monitoring.

Waters in the following sections and in Table 13 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

## 5.2 Use Support Assessment Summary

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Table 14 provides a summary of use support for waters in subbasin 03-01-54.

In subbasin 03-01-54, use support was assigned for aquatic life, recreation, and fish consumption. Waters are Supporting, Impaired, Not Rated, and 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).

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

Table 14 Summary of Use Support Ratings by Category in Subbasin 03-01-54

Use Support Rating	Aquatic Life		Recreation	
	Freshwater	Saltwater	Freshwater	Saltwater
<b>Monitored</b>				
Supporting	1.6 mi	0	0	75,987.7 ac
Impaired*	0	0	0	0.4 ac
<b>Total</b>	<b>1.6 mi</b>	<b>0</b>	<b>0</b>	<b>75,988.1 ac</b>
<b>Unmonitored</b>				
No Data	1,026.4 mi	123,984.8 ac	1,028.1 mi	47,996.7 ac
<b>Total</b>	<b>1,026.4 mi</b>	<b>123,984.8 ac</b>	<b>1,028.1 mi</b>	<b>47,996.7 ac</b>
<b>Totals</b>				
<b>All Waters</b>	<b>1,028.0 mi</b>	<b>123,984.8 ac</b>	<b>1,028.1 mi</b>	<b>123,984.8 ac</b>

\* The noted percent Impaired is the percent of monitored miles/acres only.

## **5.3 Status and Recommendations of Previously and Newly Impaired Waters**

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below. Information regarding 303(d) listing and reporting methodology is presented in Chapter 15.

### **5.3.1 Currituck Sound [AU# 30-1b and 30-1c]**

Currituck Sound (Ocean Bay Blvd.) (0.3 acres) at site N5 is Impaired in the recreation category because recreational monitoring (RECMON) bacteriological standards for safe bodily contact were exceeded. However, this sampling site has been relocated to more accurately reflect where primary recreation occurs and is now 750 yards off of Ocean Bay Blvd. The site is currently (July 2007) open for recreation.

Southern Shores Private Soundside Access Site N89 (AU# 30-1c) (0.1 acres) is Impaired in the recreation category based on recreational monitoring (RECMON) exceedances. This site is near the mouth of Jean Guite Creek. The site is known to have stagnant freshwater because of poor flushing and little tidal influences. Abundant wildlife populations are also found in this area and may be contributing to water quality conditions.

## **5.4 Status and Recommendations for Waters with Noted Impacts**

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix IV.

### **5.4.1 Unnamed Tributary to Cowells Creek [AU# 30-1-2-2-5-1-1]**

Because Cowells Creek was not suitable for basinwide sampling, an unnamed tributary was sampled for benthic macroinvertebrates. The unnamed tributary is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site MB11. The tributary was sampled for the first time in 2005 and will be added to the list of basinwide sites for the Pasquotank River basin. To date, it is the only accessible freshwater site found in the subbasin.

The substrate consisted of sand with a layer of detritus. Sticks, snags and logs were present along with root mats. Leaf packs were present, but rare. There was little evidence of stream modification; however, streambanks were undercut even though the riparian areas on both sides

of the stream were wide and intact. Two of the abundant taxa collected are indicators of organic enrichment and/or low DO. No permitted NPDES facilities are located above site MB11.

### 2007 Recommendations

Cowells and Tulls Creek receive drainage from 12,000 acres of cropland. Erosion and sedimentation control continue to be a priority need in this drainage. Agricultural BMPs, such as grassed swales, conservation tillage and cover crops are encouraged. DWQ will work with local resource agencies to promote installation of BMPs in the watershed.

## **5.5 Additional Water Quality Issues within Subbasin 03-01-54**

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

Subbasin 03-01-54 is experiencing rapid growth, where approximately 500 acres of farmland is being converted to residential development per year. This change in land use also changes the source of water quality stressors from primarily agriculture to increased impervious surface runoff and associated pollutants, ineffective sewage systems, and lawn runoff. Local government and agencies are encouraged to proactively plan, provide public education programs and implement conservation strategies to prevent water quality degradation.

According to the *Sanitary Survey of Albemarle and Currituck Sounds, Areas I-1, I-3 through I-16* (DEH Shellfish Sanitation & Recreational Water Quality Section, December 2005), there has been little change in water quality since the last survey. The only shellfish found in this area are *Rangia* clams and no commercial shellfish harvesting occurs. Runoff is the most significant factor affecting water quality in this region, and can be associated with agricultural runoff or natural runoff from swamp waters following heavy rains. Heavy development has occurred in the outer banks portion of growing area I-16 within Currituck Sound, while a significant amount of agriculture (e. g., turf grass farms, fruit orchards, horse farms, row crops and logging) occurs on the mainland portion.

Area I-1 consists of the North River shoreline, as well as a small portion of the Albemarle Sound. This area is predominantly rural, with scattered residential housing. Land use was historically agriculture and is being replaced with commercial and residential development. Remaining agriculture includes one hog farm near the head of the North River, turf grass farms, fruit orchards, row crops, and small horse farms. Four golf courses are located in area I-1. There are also four sewage application sites, all treated with lime.



# Chapter 6

## Pasquotank River Subbasin 03-01-55

Including: Northeastern Pamlico Sound

### 6.1 Subbasin Overview

#### *Subbasin 03-01-55 at a Glance*

##### **Land and Water Area**

Total area:	574 mi <sup>2</sup>
Land area:	96 mi <sup>2</sup>
Water area:	478 mi <sup>2</sup>

##### **Land Cover (percent)**

Surface Water:	89%
Forest/Wetland:	11%
Urban:	<1%
Cultivated Crop:	<1%
Pasture/ Managed Herbaceous:	<1%

##### **Counties**

Dare

##### **Communities**

Stumpy Point, Rodanthe, Avon,  
Waves

##### **Monitored Waterbody Statistics**

###### **Aquatic Life:**

Total: 0

###### **Recreation:**

Total: 315,259.3 ac

Supporting: 315,259.3 ac

###### **Shellfish Harvesting:**

Total: 319,557.8 ac

Supporting: 316,953.0 ac

Impaired: 2,604.8 ac

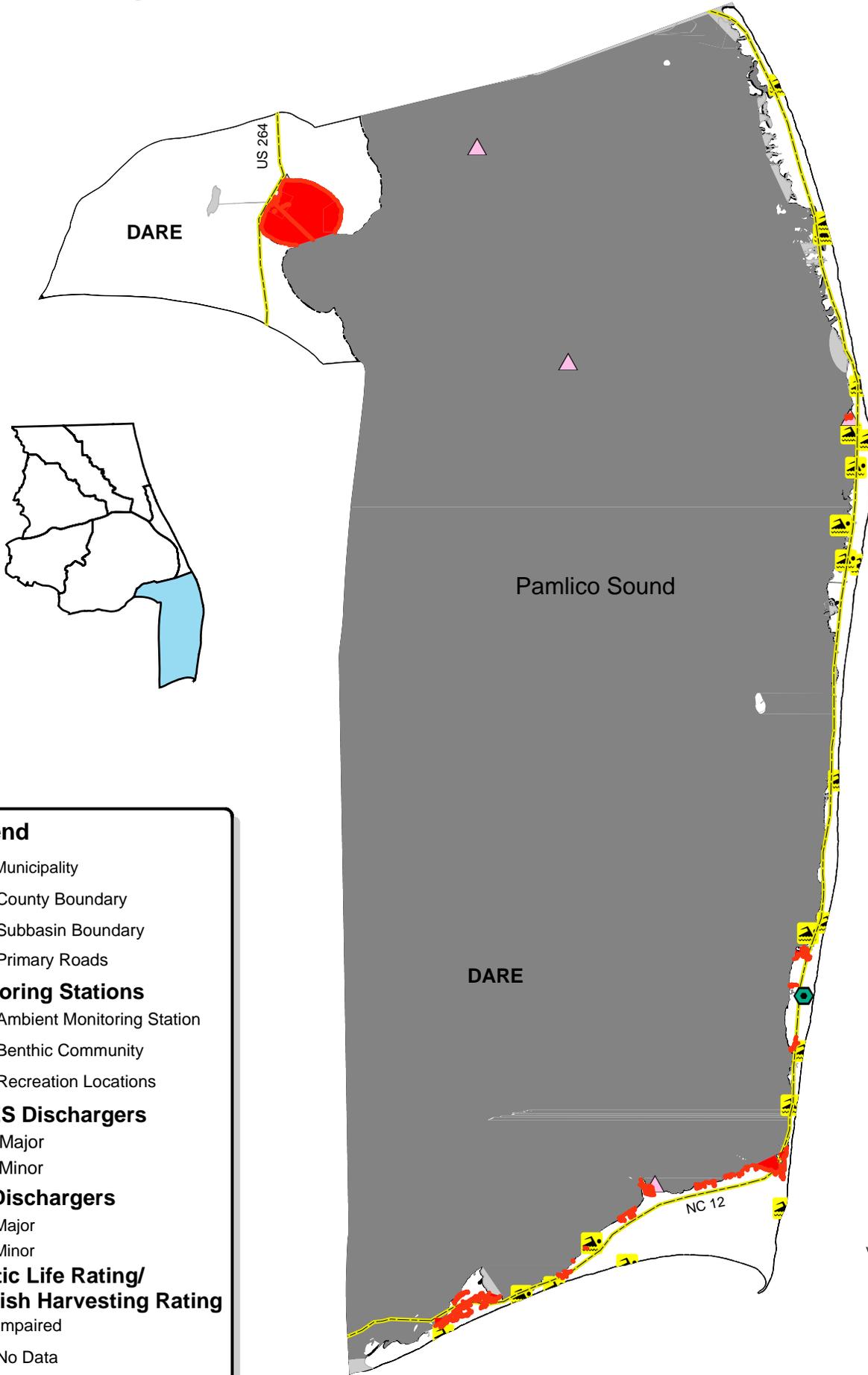
This subbasin consists of Pamlico Sound from Oregon Inlet to Hatteras Inlet and the Outer Banks in Dare County. Subbasin 03-01-55 contains Black Lake and Stumpy Point Bay on the mainland and the Pea Island National Wildlife Refuge and Cape Hatteras National Seashore on the Outer Banks. Ecologically, the subbasin consists primarily of Carolinian Barrier Islands and coastal marshes with portions of the mainland consisting of nonriverine swamps and peatlands. Streams on the mainland are few and low gradient with channelized ditches being common and all are either estuarine or oceanic. Land cover generally consists of surface water and forested wetlands.

Dare County, located in this subbasin, experiences a high seasonal population fluctuation with tourists visiting the Outer Banks. Dare County projected to experience a population increase of 35 percent by 2020. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 11.

There are three minor National Pollutant Discharge Elimination System (NPDES) permitted facilities in this subbasin with a total permitted flow of 2.1 MGD. All three facilities are reverse osmosis (RO) water treatment plants (WTP) that discharge filtered backwash or reject water into saline waters. All three are required to monitor whole effluent toxicity (WET). The permit for the Cape Hatteras RO WTP specifies chronic toxicity monitoring. WET results submitted by the facility indicate that it failed to meet its chronic toxicity target on one occasion between January 2000 and December 2005. The permits for the Stumpy Point RO WTP and the Rodanthe/Waves/Salvo RO WTP specify acute toxicity monitoring. No acute effluent toxicity violations were reported at the Stumpy Point RO

WTP; however, results from the Rodanthe/Waves/Salvo RO WTP show that the facility failed to meet its 90 percent acute toxicity target effluent concentration on four occasions between January 2000 and December 2005. There is one non-discharge permit and no stormwater discharge permits for this subbasin. For the listing of NPDES permit holders, refer to Appendix III.

**Figure 8 Pasquotank River Subbasin 03-01-55**



**Legend**

-  Municipality
-  County Boundary
-  Subbasin Boundary
-  Primary Roads
- Monitoring Stations**
-  Ambient Monitoring Station
-  Benthic Community
-  Recreation Locations
- NPDES Dischargers**
-  Major
-  Minor
- Non-Dischargers**
-  Major
-  Minor
- Aquatic Life Rating/  
Shellfish Harvesting Rating**
-  Impaired
-  No Data
-  Not Rated
-  Supporting

**Table 18 Pasquotank Subbasin 03-01-55**

AU Number	Classification	Length/Area		Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating		
Description													
<b>Askins Creek</b>													
30-22-24	SA;HQW	4.9	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
From source to Pamlico Sound													H-5
<b>Austin Creek (Clubhouse Creek)</b>													
30-22-31	SA;HQW	7.9	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
From source to Pamlico Sound													H-4
<b>Beach Slue</b>													
30-22-9	SA;HQW	76.9	S Acres	ND				ND			S	APP	
Entire area of Beach Slue													H-5
<b>Blackmar Gut</b>													
30-22-13	SA;HQW	4.6	S Acres	NR				ND			I	PRO	Toxic Impacts Fecal Coliform Bacteria
From source to Pamlico Sound													H-5
<b>Boat Creek</b>													
30-22-25	SA;HQW	1.9	S Acres	ND				ND			S	APP	
From source to Pamlico Sound													H-5
<b>Brooks Creek</b>													
30-22-28	SA;HQW	24.8	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
From source to Pamlico Sound													H-4
<b>Cape Creek</b>													
30-22-27	SA;HQW	15.8	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
From source to Pamlico Sound													H-5
<b>Clarks Bay</b>													
30-22-16	SA;HQW	19.8	S Acres	ND				S	N29	NCE	S	APP	
Entire Bay													H-5
<b>Duck Ponds and Isaac Pond</b>													
30-22-30-1-1	SA;HQW	10.3	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
Entire ponds and connecting streams to The Slash													H-4
<b>Eagle Nest Bay</b>													
30-22-2	SA;HQW	55.5	S Acres	ND				ND			S	APP	
Entire Bay													H-5

**Table 18 Pasquotank Subbasin 03-01-55**

AU Number	Classification	Length/Area		Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating		
Description													
<b>Goat Island Bay</b>													
30-22-3	SA;HQW	40.8	S Acres	ND			ND			S	APP		
Entire Bay												H-5	
<b>Goose Creek</b>													
30-22-32	SA;HQW	1.7	S Acres	ND			ND			S	APP		
From source to Pamlico Sound												H-4	
<b>Gull Island Bay</b>													
30-22-18	SA;HQW	16.5	S Acres	ND			ND			S	APP		
Entire Bay												H-5	
<b>Hatteras Inlet</b>													
30-22-33	SA;HQW	143.1	S Acres	ND			ND			S	APP		
Entire Inlet												H-4	
<b>Joe Saur Creek</b>													
30-22-29	SA;HQW	17.9	S Acres	ND			ND			I	PRO	Fecal Coliform Bacteria	
From source to Pamlico Sound												H-4	
<b>Long Point Creek</b>													
30-22-26	SA;HQW	6.3	S Acres	ND			ND			S	APP		
From source to Pamlico Sound												H-5	
<b>Midgett Cove</b>													
30-22-15	SA;HQW	36.4	S Acres	ND			ND			S	APP		
From source to Pamlico Sound												H-5	
<b>Mill Creek</b>													
30-22-22	SA;HQW	16.2	S Acres	ND			ND			I	PRO	Fecal Coliform Bacteria	
From source to Pamlico Sound												H-5	
<b>No Ache Bay</b>													
30-22-17	SA;HQW	38.1	S Acres	ND			ND			S	APP		
Entire Bay												H-5	
<b>North Drain</b>													
30-22-14	SA;HQW	2.0	S Acres	ND			ND			S	APP		
From source to Pamlico Sound												H-5	

**Table 18 Pasquotank Subbasin 03-01-55**

AU Number	Classification	Length/Area		Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources	
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating			GA
<b>Oregon Inlet</b>														
30-22-1	SA;HQW	571.2	S Acres	ND					ND					
	Entire Inlet													

**Table 18 Pasquotank Subbasin 03-01-55**

AU Number	Classification	Length/Area	Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources	
			AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA			
<b>Pamlico Sound</b>														
30-22a	SA;HQW	315,239.5	S Acres	NR				S	N26A N26C N28 N28A N29A N31 N33 N33A N38 N39	NCE NCE NCE NCE NCE NCE NCE NCE NCE	S	APP	Low Dissolved Oxygen	WWTP NPDES
	Portion of Pamlico Sound (from Croatan and Roanoke Sounds to a line running from Sandy Point south of Stumpy Point Bay to the northeast tip of Ocracoke Island) in subbasin 03-01-55 except DEH closure areas 30-22b through 30-22j.											H-6		
30-22b	SA;HQW	28.5	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria	H-4
	The waters of Pamlico Sound which include the DEH closed area of a boundary beginning at a point on land west of the Hatteras Ferry Landing at 35 degrees 12' 30" N- 75 degrees 42' 24" W, thence to a point in the ferry channel at 35 degrees 12' 37" N-75 deg													
30-22c	SA;HQW	15.2	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria	H-4
	The waters of the Pamlico Sound which include the DEH closed area with mouth 1.17 miles southwest of Durant Point.													
30-22d	SA;HQW	3.6	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria	H-4
	The waters of Pamlico Sound which include the DEH closed area with mouth 321 meters east of east mouth of Austin Creek													
30-22e	SA;HQW	18.7	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria	H-4
	The waters of Pamlico Sound which include the DEH closed area: all creeks, canals, and tributaries along Hatteras Island between Brooks Point to west mouth of Joe Saur Creek.													

**Table 18 Pasquotank Subbasin 03-01-55**

AU Number	Classification	Length/Area		Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
Description														
30-22f	SA;HQW	187.8	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria	
The waters of Pamlico Sound which include the DEH closed area: All waters south of a line beginning at a point on the shore north of Buxton at 35 degrees 16' 44" N- 75 degrees 31' 05" W, thence in a westerly direction through Bald Point to a point on the B														
30-22g	SA;HQW	1.3	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria	
The waters of Pamlico Sound which include the DEH closed area at the mouth of Askins Creek														
30-22h	SA;HQW	29.2	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria	
The waters of Pamlico Sound which include the DEH closed area at the mouth of Mill Creek. This includes all waters south of a line from Big Island to the Outer Banks and all waters east of line from Big Island to Gibbs Point.														
<b>Pauls Ditch</b>														
30-22-12	SA;HQW	6.9	S Acres	ND				ND			S	APP		
From source to Pamlico Sound														
<b>Pea Island Bay</b>														
30-22-6	SA;HQW	18.3	S Acres	ND				ND			S	APP		
Entire Bay														
<b>Pea Island Creek</b>														
30-22-5	SA;HQW	4.6	S Acres	ND				ND			S	APP		
Entire Creek														
<b>Peters Ditch</b>														
30-22-23	SA;HQW	2.7	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria	
From source to Pamlico Sound														
<b>Phipps Cove</b>														
30-22-19	SA;HQW	5.8	S Acres	ND				ND			S	APP		
From source to Pamlico Sound														
<b>Round Hammock Bay</b>														
30-22-11	SA;HQW	276.4	S Acres	ND				ND			S	APP		
Entire Bay														

**Table 18 Pasquotank Subbasin 03-01-55**

AU Number	Classification	Length/Area		Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating		
Description													
<b>Sandy Bay</b>													
30-22-30a	SA;HQW	37.6	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
	DEH Closure Area												H-4
30-22-30b	SA;HQW	123.7	S Acres	ND				ND			S	APP	
	Entire Bay excluding DEH closure Area												H-4
<b>Spencer Creek</b>													
30-22-21	SA;HQW	4.4	S Acres	ND				ND			S	APP	
	From source to Pamlico Sound												H-5
<b>Stumpy Point Bay</b>													
30-22-8a	SA;HQW	1,688.5	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
	Entire Bay except DEH area closures												H-3
30-22-8b	SA;HQW	198.2	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
	All those waters bounded by a line beginning at a point 35 degrees 41' 55" N-75 degrees 46' 09" W, thence in a southeasterly direction to a point 400 yards offshore at 35 degrees 41' 46" N- 75 degrees 45' 54" W, thence in a southwesterly direction in a st												H-3
30-22-8c	SA;HQW	260.3	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
	All those waters within an area bounded by a line beginning at a point on the east shore at 35 degrees 41' 44" N- 75 degrees 44' 18" W, thence to a point in the bay at 35 degrees 41' 28" N- 75 degrees 44' 45" W, thence to a point in the bay at 35 degrees												H-3
<b>Terrapin Creek</b>													
30-22-7-1	SA;HQW	2.8	S Acres	ND				ND			S	APP	
	From source to Terrapin Creek Bay												H-5
<b>Terrapin Creek Bay</b>													
30-22-7	SA;HQW	163.7	S Acres	ND				ND			S	APP	
	Entire Bay												H-5
<b>The Drain</b>													
30-22-20	SA;HQW	1.4	S Acres	ND				ND			S	APP	
	From source to Pamlico Sound												H-5

**Table 18 Pasquotank Subbasin 03-01-55**

AU Number	Classification	Length/Area		Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating		
Description													
<b>The Slash</b>													
30-22-30-1	SA;HQW	30.9	S Acres	ND				ND			I	PRO	Fecal Coliform Bacteria
From source to Sandy Bay												H-4	
<b>The Trench</b>													
30-22-4	SA;HQW	51.5	S Acres	ND				ND			S	APP	
From source to Pamlico Sound												H-5	
<b>Wreck Creek</b>													
30-22-10	SA;HQW	43.5	S Acres	ND				ND			S	APP	
Entire Creek												H-5	

<b>Use Categories:</b>	<b>Monitoring data type:</b>	<b>Results:</b>	<b>Use Support Ratings 2006:</b>
AL - Aquatic Life	MF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	MB - Benthic Community Survey	G - Good	NR - Not Rated
SH - Shellfish Harvesting	MA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	ML- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
	N- DEH RECMON	P - Poor	NR+-Not rated because draft criteria used for rating
		NI - Not Impaired	<b>Results</b>
GA - DEH SS Classification and Growing Area		S- Severe Stress	CE-Criteria Exceeded > 10% and more than 10 samples
APP- Approved		M-Moderate Stress	NCE-No Criteria Exceeded
CAO- Conditionally Approved-Open		N- Natural	<b>Miles/Acres</b>
CAC- Conditionally Approved-Closed			FW- Fresh Water
PRO- Prohibited			S- Salt Water

Aquatic Life Rating Summary			Recreation Rating Summary			Fish Consumption Rating Summary			Shellfish Harvesting Rating Summary		
NR	e	315,244.1 S Acres	S	m	315,259.3 S Acres	I	e	319,580.0 S Acres	S	m	316,953.0 S Acres
ND		4,335.9 S Acres	ND		4,320.6 S Acres	I	e	117.6 FW Miles	I	m	2,604.8 S Acres
ND		117.6 FW Miles	ND		117.6 FW Miles						

Flooding continues to be a concern along the Outer Banks. Groundwater levels are high, limiting the lands ability to infiltrate rainwater. Also, the increase in impervious surfaces contributes to higher stormwater runoff and flooding events.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 8. Table 15 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Appendix V provides definitions of the terms used throughout this basin plan.

Neither benthic samples nor ambient stations are located in this subbasin; however, there are several recreational monitoring stations (RECMON) located throughout the subbasin. These stations are evaluated by the NC Division of Environmental Health (DEH). Long-term trends in water quality cannot be assessed in this subbasin. Refer to the *2006 Pasquotank River Basinwide Assessment Report* <http://h2o.enr.state.nc.us/esb/Basinwide/PASQUOTANK2006Final.pdf> and Appendix I for more information on monitoring.

Many of the waters in subbasin 03-01-55 are classified for shellfish harvesting (Class SA). Many are also classified as High Quality Waters (HQW) or Outstanding Resource Waters (ORW). Several management strategies are in place to protect these waters.

Waters in the following sections and in Table 15 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

## **6.2 Use Support Assessment Summary**

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Table 16 provides a summary of use support for waters in subbasin 03-01-55.

In subbasin 03-01-55, use support was assigned for aquatic life, recreation, fish consumption and shellfish harvesting categories. Waters are Supporting, Impaired, Not Rated, and 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). There are no water supply watersheds designated in this subbasin.

Criteria for making use support determinations for the shellfish harvesting category were based on Division of Environmental Health (DEH) Sanitary Surveys (SS) growing area classifications. The problem parameter for all shellfish waters is the potential for fecal coliform standards exceedances. Differences in acreage estimates between basin cycles are not just related to changes in water quality. Changes in acreage are related to more refined methods of estimating acreages, changes in growing area classifications, extension of closure areas as a result of additional boat slips, and to changes in use support methodology.

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

Table 16 Summary of Use Support Ratings by Category in Subbasin 03-01-55

Use Support Rating	Aquatic Life		Recreation		Shellfish Harvesting	
	Freshwater	Saltwater	Freshwater	Saltwater	Freshwater	Saltwater
<b>Monitored Waters</b>						
Supporting	0	0	0	315,259.3 ac	0	316,953.0 ac
Impaired*	0	0	0	0	0	2,604.8 ac (0.8%)
<b>Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>315,259.3 ac</b>	<b>0</b>	<b>319,557.8 ac</b>
<b>Unmonitored Waters</b>						
Not Rated	0	315,244.1 ac	0	0	0	0
No Data	117.6 mi	4,335.9 ac	117.6 mi	4,320.6 ac	0	0
<b>Total</b>	<b>117.6 mi</b>	<b>319,580 ac</b>	<b>117.6 mi</b>	<b>4,320.6 ac</b>	<b>0</b>	<b>0</b>
<b>Totals</b>						
<b>All Waters</b>	<b>117.6 mi</b>	<b>319,580 ac</b>	<b>117.6 mi</b>	<b>319,579.9 ac</b>	<b>0</b>	<b>319,557.8 ac</b>

\* The noted percent Impaired is the percent of monitored miles/acres only.

### 6.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an assessment unit number (AU#). Information regarding 303(d) listing and reporting methodology is presented in Chapter 15.

For more information about use support determinations for the Impaired Class SA waters presented in Table 17 below, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>. Refer to Figure 8 for a map of subbasin 03-01-55.

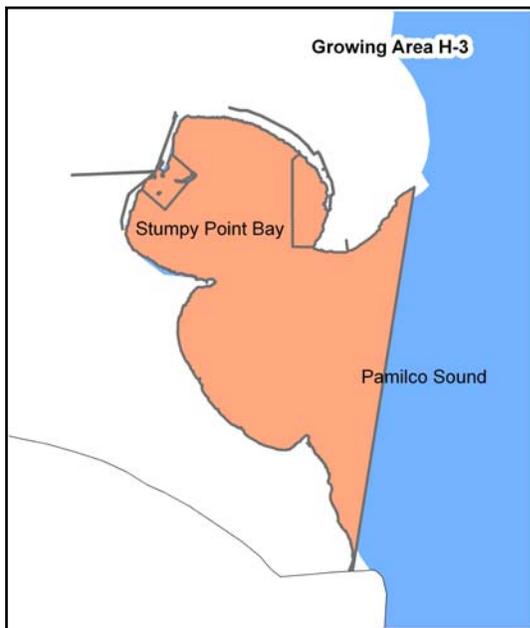
Table 17 Summary of DEH Growing Areas H-3, H-4, H-5, H-6 Classifications in Subbasin 03-01-55

Class SA Waters	Assessment Unit #	Growing Area Classification	DEH Growing Area
Stumpy Point Bay	30-22-8a	PRO	H-3
	30-22-8b	PRO	
	30-22-8c	PRO	
Austin Creek	30-22-31	PRO	H-4
Brooks Creek	30-22-28	PRO	H-4
Duck Ponds and Isaac Pond	30-22-30-1-1	PRO	H-4
Joe Saur Creek	30-22-29	PRO	H-4

Pamlico Sound	30-22a1	APP	H-4, H-5, H-6
	30-22a2	PRO	
	30-22b	PRO	
	30-22c	PRO	
	30-22d	PRO	
	30-22e	PRO	
	30-22f	PRO	
	30-22g	PRO	
30-22h	PRO		
Sandy Bay	30-22-30a	PRO	H-4
	30-22-30b	APP	
The Slash	30-22-30-1	PRO	H-4
Askins Creek	30-22-24	PRO	H-5
Blackmar Gut	30-22-13	PRO	H-5
Cape Creek	30-22-27	PRO	H-5
Mill Creek	30-22-22	PRO	H-5

PRO=Prohibited, CAC=Conditionally Approved Closed, CAO=Conditionally Approved Open

### 6.3.1 Stumpy Point Growing Area H-3



The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area H-3. If the entire Class SA water is located within more than one growing area it is noted in Table 17 or refer to the basinwide Growing Area map in the Executive Summary.

According to the *Sanitary Survey of Stumpy Point, Area H-3* (DEH Shellfish Sanitation & Recreational Water Quality Section, May 2006), oyster production is considered fair and there is no clam production. The entire area consists of marsh and forest of the Alligator River National Wildlife Refuge with the exception of the community of Stumpy Point. The area has a total population of 230 people with little seasonal variation. The population is not expected to grow unless a WWTP is constructed to facilitate

further development. There are two seafood businesses in area H-3.

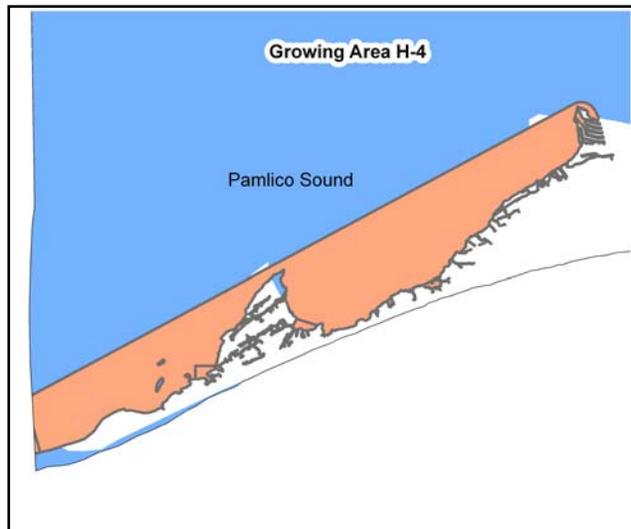
#### Stumpy Point Bay [AU# 30-22-8a, 30-22-8b and 30-22-8c]

Stumpy Point Bay (2,147.0 acres) is Impaired for shellfish harvesting. Stumpy Point Bay is classified by DEH SS as prohibited in growing area H-3 due to potential fecal coliform bacteria levels. Stumpy Point Bay [AU# 30-22-8a, AU# 30-22-8b and 30-22-8c] will be added to the state's 303(d) list of Impaired waters.

The Stumpy Point area does not have any central wastewater collection or treatment facilities. Unsuitable soils in this area leave homeowners with limited on-site wastewater treatment options. Currently, 63 of the 110 known septic systems are known to have straight pipe discharges that drain to a canal emptying directly into Stumpy Point Bay, or have failed. A new WWTP to serve the residents of Stumpy Point has been proposed. A Septic Tank Effluent Pump

system would collect the wastewater in Stumpy Point and deliver it to a membrane bioreactor wastewater treatment plant to provide advanced tertiary biological treatment and accomplish disinfection by an ultraviolet light system. This system would discharge into Bayview Drive Canal.

### 6.3.2 Hatteras Growing Area H-4



The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area H-4. If the entire Class SA water is located within more than one growing area it is noted in Table 17 or refer to the basinwide Growing Area map in the Executive Summary.

According to the *Sanitary Survey of Hatteras Area, Area H-4* (DEH Shellfish Sanitation & Recreational Water Quality Section, May 2002, March 2007), an overall decline in 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 to 5,000. There is no 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. Hatteras Landing uses a low-pressure pipe system for waste disposal. Additional multifamily residences are being built on fill in this area.

#### **Austin Creek (Clubhouse Creek) [AU# 30-22-31]**

Austin Creek (7.9 acres) is Impaired for shellfish harvesting. Austin Creek is classified by DEH SS as prohibited in growing area H-4 due to potential fecal coliform bacterial levels. Austin Creek will remain on the state's 303(d) list of Impaired waters.

#### **Brooks Creek [AU# 30-22-28]**

Brooks Creek (24.8 acres) is Impaired for shellfish harvesting. Brooks Creek is classified by DEH SS as prohibited in growing area H-4 due to potential fecal coliform bacterial levels. Brooks Creek will remain on the state's 303(d) list of Impaired waters.

### **Duck Ponds and Isaac Pond [AU# 30-22-30-1-1]**

Duck Ponds and Isaac Pond (10.3 acres) are Impaired for shellfish harvesting. Duck Ponds and Isaac Pond are classified by DEH SS as prohibited in growing area H-4 due to potential fecal coliform bacterial levels. Duck Ponds and Isaac Pond will be added to the state's 303(d) list of Impaired waters.

### **Joe Saur Creek [AU# 30-22-29]**

Joe Saur Creek (17.9 acres) is Impaired for shellfish harvesting. Joe Saur Creek is classified by DEH SS as prohibited in growing area H-4 due to potential fecal coliform bacterial levels. Joe Saur Creek will remain on the state's 303(d) list of Impaired waters.

### **Portions of the Pamlico Sound [AU# 30-22b, 30-22c, 30-22d and 30-22e]**

Portions of the Pamlico Sound (66.0 acres) is Impaired for shellfish harvesting. The Pamlico Sound is classified by DEH SS as prohibited in growing area H-4 due to potential fecal coliform bacterial levels. The Pamlico Sound will remain on the state's 303(d) list of Impaired waters.

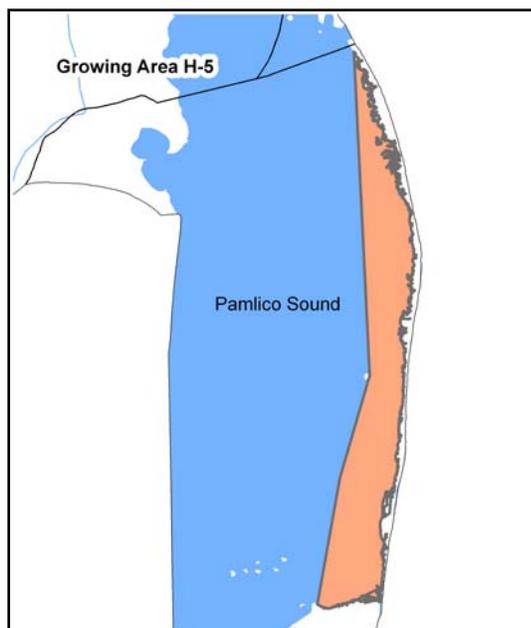
### **Sandy Bay [AU# 30-22-30a]**

Sandy Bay (37.6 acres) is Impaired for shellfish harvesting. Sandy Bay is classified by DEH SS as prohibited in growing area H-4 due to potential fecal coliform bacterial levels. Sandy Bay will remain on the state's 303(d) list of Impaired waters.

### **The Slash [AU# 30-22-30-1]**

The Slash (30.9 acres) is a tributary to Sandy Bay and Impaired for shellfish harvesting. The Slash is classified by DEH SS as prohibited in growing area H-4 due to potential fecal coliform bacterial levels. The Slash will remain on the state's 303(d) list of Impaired waters.

## **6.3.3 Outer Banks Growing Area H-5**



The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area H-5. If the entire Class SA water is located within more than one growing area it is noted in Table 17 or refer to the basinwide Growing Area map in the Executive Summary.

According to the *Sanitary Survey of Outer Banks, Area H-5 (DEH Shellfish Sanitation & Recreational Water Quality Section, October 2002, September 2006)*, water quality has declined in some areas. As a result of the 2006 survey approximately 15 acres will be closed to shellfish harvesting in Askins Creek and an additional 10 acres has been reclassified as prohibited near Salvo Marina. However, 120 acres in

the Cape Creek Area has been 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.

#### **Askins Creek [AU# 30-22-24]**

Askins Creek (4.9 acres) is Impaired for shellfish harvesting. Askins Creek is classified by DEH SS as prohibited in growing area H-5 due to potential fecal coliform bacterial levels. Askins Creek will remain on the state's 303(d) list of Impaired waters.

#### **Beach Slue [AU# 30-22-9]**

Beach Slue is listed on the 2004 303(d) list of Impaired waters for shellfish harvesting. Beach Slue (76.9 acres) is currently Supporting for shellfish harvesting. Beach Slue is now classified by DEH SS as approved for harvesting, therefore DWQ will recommend that Beach Slue be removed from the state's 303(d) list of Impaired waters.

#### **Blackmar Gut [AU# 30-22-13]**

Blackmar Gut (4.6 acres) is Impaired for shellfish harvesting. Blackmar Gut is classified by DEH SS as prohibited in growing area H-5 due to potential fecal coliform bacterial levels. Blackmar Gut will be added to the state's 303(d) list of Impaired waters.

Blackmar Gut is Not Rated on an evaluated basis in the aquatic life category due to WET failures associated with the Rodanthe/Waves/Salvo Reverse Osmosis (RO) Water Treatment Plant (WTP) (Permit NC0083909). Between January 2000 and December 2005, the facility failed to meet its 90 percent acute toxicity target effluent concentrations on four occasions.

#### **Cape Creek [AU# 30-22-27]**

Cape Creek (15.8 acres) is Impaired for shellfish harvesting. Cape Creek is classified by DEH SS as prohibited in growing area H-5 due to potential fecal coliform bacterial levels. Cape Creek will remain on the state's 303(d) list of Impaired waters.

#### **Eagle Nest Bay [AU# 30-22-2]**

Eagle Nest Bay was listed on the 2004 303(d) list of Impaired waters for shellfish harvesting. Eagle Nest Bay (55.5 acres) is currently Supporting for shellfish harvesting. Eagle Nest Bay is now classified by DEH SS as approved for harvesting, therefore DWQ will recommend that Eagle Nest Bay be removed from the state's 303(d) list of Impaired waters.

**Mill Creek [AU# 30-22-22]**

Mill Creek (16.2 acres) is Impaired for shellfish harvesting. Mill Creek is classified by DEH SS as prohibited in growing area H-5 due to potential fecal coliform bacterial levels. Mill Creek will remain on the state's 303(d) list of Impaired waters.

**Portions of the Pamlico Sound [AU# 30-22f, 30-22g and 30-22h]**

Portions of the Pamlico Sound (218.3 acres) are Impaired for shellfish harvesting. The Pamlico Sound is classified by DEH SS as prohibited in growing area H-5 due to potential fecal coliform bacterial levels. The Pamlico Sound will remain on the state's 303(d) list of Impaired waters.

**Peters Ditch [AU# 30-22-23]**

Peters Ditch (2.7 acres) is Impaired for shellfish harvesting. Peters Ditch is classified by DEH SS as prohibited in growing area H-5 due to potential fecal coliform bacterial levels. Peters Ditch will remain on the state's 303(d) list of Impaired waters.

### 7.1 Subbasin Overview

#### *Subbasin 03-01-56 at a Glance*

##### Land and Water Area

Total area:	109 mi <sup>2</sup>
Land area:	37 mi <sup>2</sup>
Water area:	72 mi <sup>2</sup>

##### Land Cover (percent)

Surface Water:	70%
Forest/Wetland:	22%
Urban:	7%
Cultivated Crop:	<1%
Pasture/ Managed Herbaceous:	2%

##### Counties

Dare

##### Municipalities

Kill Devil Hills, Nags Head,  
Kitty Hawk, Southern Shores

##### Monitored Waterbody Statistics

###### Recreation:

Total:	134.9 mi/22,216.2 ac
Supporting:	134.5 mi/22,211.5 ac
Impaired:	0.5 mi/4.7 ac

###### Shellfish Harvesting:

Total:	21,045.2 ac
Supporting:	19,258.3 ac
Impaired:	1,786.9 ac

This subbasin includes the Outer Banks from the northern portion of Dare County south to Oregon Inlet. It also includes portions of Currituck Sound, Albemarle Sound and Roanoke Sound. Ecologically, it is within the Carolinian Barrier Islands and Coastal Marshes ecoregions. Land cover generally consists of beaches, marshes, forested wetlands and evergreen forests with scattered urbanized areas, wildlife habitat and recreational areas. Several public lands and significant natural heritage areas can be found in this subbasin, including Jockey’s Ridge State Park, Nags Head Woods Preserve, Run Hill State Natural Area, Wright Brothers National Memorial and Kitty Hawk Woods Coastal Reserve.

Portions of Currituck and Dare Counties are in this subbasin. The Outer Banks have experienced rapid population growth and development with the Towns of Kill Devil Hills and Nags Head experiencing growth estimated at an increase of 39 and 47 percent by 2020, respectively. Refer to Chapter 11 for more information about population growth and trends.

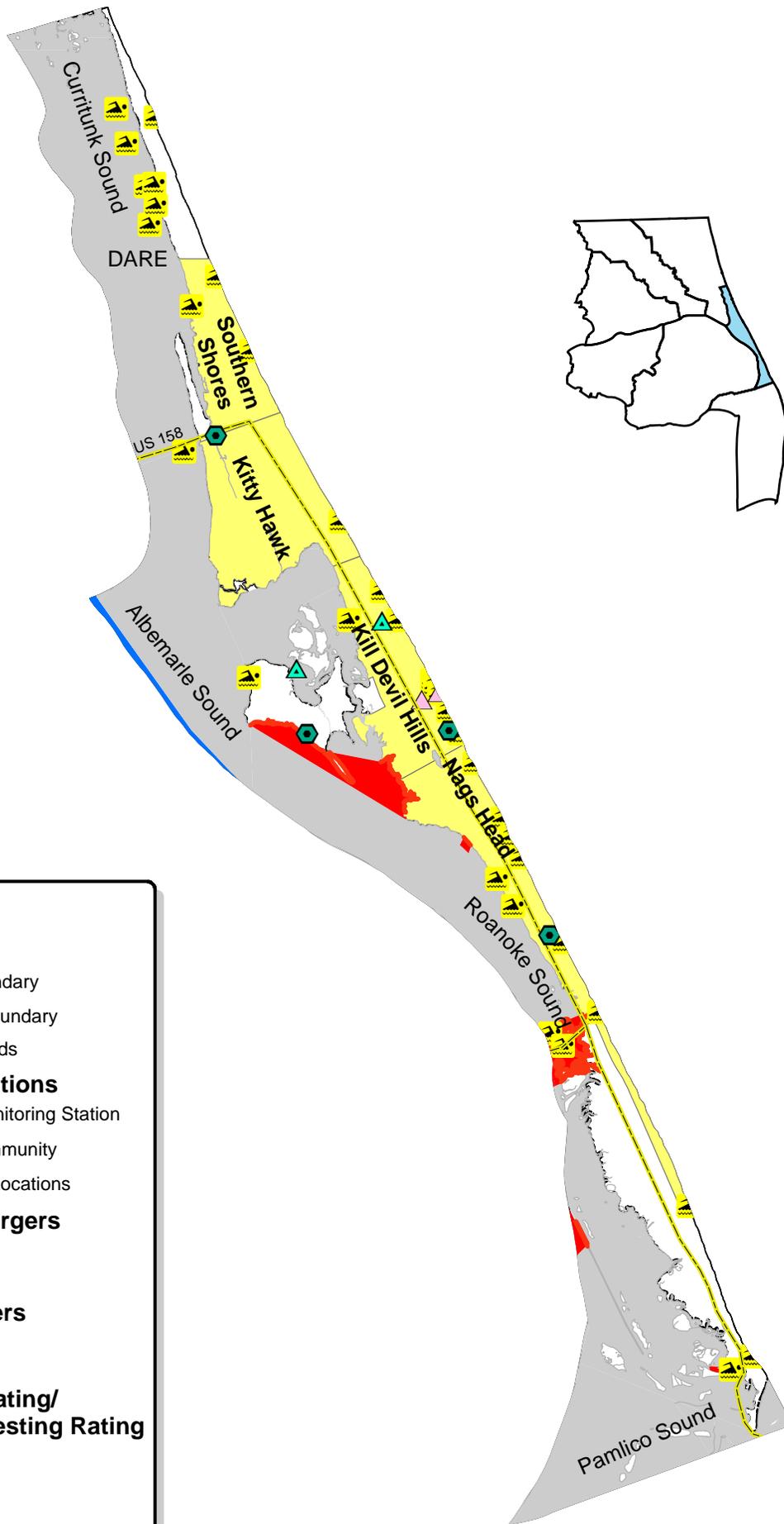
Water quality in areas with growing populations would benefit from individual or community implementation of backyard wetlands, rain gardens, bioretention areas, conversion of impervious surfaces, use of cisterns, streambank protection and restoration.

The Kill Devil Hills Reverse Osmosis (RO) Water Treatment Plant (WTP) holds the only National Pollutant Discharge Elimination System (NPDES) minor permit in

the subbasin with a permitted discharge of 0.03 MGD. The permit specifies that the facility monitor whole effluent toxicity (WET). During the last two years of the assessment period, WET tests show that the facility has failed to meet its 90 percent acute toxicity target effluent concentration on three occasions for both outfalls (outfall 001 and outfall 002). More information can be found in Section 7.4.1. There are six non-discharge permits and two stormwater discharge permits in this subbasin. For the listing of NPDES permit holders, refer to Appendix III.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 9. Table 18 contains a summary of assessment unit numbers (AU#) and

**Figure 9 Pasquotank River Subbasin 03-01-56**



**Legend**

- Municipality
- County Boundary
- Subbasin Boundary
- Primary Roads

**Monitoring Stations**

- Ambient Monitoring Station
- Benthic Community
- Recreation Locations

**NPDES Dischargers**

- Major
- Minor

**Non-Dischargers**

- Major
- Minor

**Aquatic Life Rating/  
Shellfish Harvesting Rating**

- Impaired
- No Data
- Not Rated
- Supporting

**Table 18 Pasquotank Subbasin 03-01-56**

AU Number	Classification	Length/Area		Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating		
<b>ALBEMARLE SOUND</b>													
30f1	SB	7,713.5	S Acres	ND				<b>S</b>	N9A	NCE		Fecal Coliform Bacteria	Marina
	Portion of Albemarle Sound in subbasin 03-01-56. Waters of Albemarle Sound (All waters south and east of a line running in a southerly direction from Horniblow Point (North end of Norfolk-Southern Railroad Bridge) to a point of land on the east side of R												
30f2	SB	0.1	S Acres	ND				<b>I</b>	N91	CE		Fecal Coliform Bacteria	Marina
	Colington Harbor swimming beach												
												Enterrococcus	Unknown

**Table 18 Pasquotank Subbasin 03-01-56**

AU Number	Classification	Length/Area	Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
<b>Atlantic Ocean</b>													
99-(7)a	SB	110.1 Coast Miles	ND				<b>S</b>		N1	NCE			
									N12	NCE			
									N12A	NCE			
									N12B	NCE			
									N14	NCE			
									N14A	NCE			
									N15	NCE			
									N16A	NCE			
									N17	NCE			
									N17A	NCE			
									N18	NCE			
									N1A	NCE			
									N2	NCE			
									N23	NCE			
									N25	NCE			
									N26	NCE			
									N26B	NCE			
									N27	NCE			
									N29B	NCE			
									N3	NCE			
									N30	NCE			
									N32	NCE			
									N34	NCE			
									N37	NCE			
									N4	NCE			
									N40	NCE			
									N5A	NCE			
									N7	NCE			
									N7A	NCE			
									N85A	NCE			
									N19	NCE			

The waters of the Atlantic Ocean contiguous to that portion of Pasquotank River Basin that extends from the North Carolina-Virginia State Line to the northeast tip of Ocracoke Island

**Table 18 Pasquotank Subbasin 03-01-56**

AU Number	Classification	Length/Area	Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
99-(7)b	SB	0.5 Coast Miles	ND					<b>I</b>	N22	CE		Enterococcus	Unknown
	Coastline 0.25 miles north and south of RECMON station N22 near Old Oregon Rd and NC12												
99-(7)c	SB	0.5 Coast Miles	<b>NR</b>					<b>S</b>	N85	NCE		Toxic Impacts	WWTP NPDES
	Coastline 0.25 miles north and south of NC0070157												
<b>Blossie Creek</b>													
30-21-12	SA;HQW	33.3 S Acres	ND					ND			<b>S</b>	APP	H-1
	Entire Creek												
<b>Colington Creek</b>													
30-19-1a	SC	758.1 S Acres	ND					<b>S</b>	N13A	NCE		Fecal Coliform Bacteria	Marina
	From Kill Devil Hills Bridge north to Kitty Hawk Bay												
30-19-1b	SC	0.4 S Acres	ND					<b>I</b>	N13	CE		Fecal Coliform Bacteria	Marina
	Wildlife Ramp on Bayview Dr.												
												Enterococcus	Unknown
												Enterococcus	Unknown
<b>Fresh Water Lake at Kill Devil Hills</b>													
30-23	WS-III;CA	23.8 FW Miles	ND					<b>S</b>	N16	NCE			
	Entire Lake												
<b>Georges Creek</b>													
30-21-10	SA;HQW	3.0 S Acres	ND					ND			<b>S</b>	APP	H-1
	From source to Roanoke Sound												
<b>Lighthouse Bay</b>													
30-21-11	SA;HQW	19.3 S Acres	ND					ND			<b>S</b>	APP	H-1
	Entire Bay												
<b>Pamlico Sound</b>													
30-22i	SA;HQW	5,150.1 S Acres	ND					ND			<b>S</b>	APP	H-6
	Portion of Pamlico Sound (from Croatan and Roanoke Sounds to a line running from Sandy Point south of Stumpy Point Bay to the northeast tip of Ocracoke Island) in subbasin 03-01-56												

**Table 18 Pasquotank Subbasin 03-01-56**

AU Number	Classification	Length/Area		Aquatic Life Assessment			Recreation Assessment			Shellfish Harvesting		Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating		
Description													
<b>Pond Island</b>													
30-21-4b	SA;HQW	40.3	S Acres	ND				<b>S</b>	N20A	NCE	<b>I</b>	PRO	Fecal Coliform Bacteria
The waters surrounding the Island within 1,000 feet from shore within subbasin 03-01-56													
<b>Roanoke Sound</b>													
30-21e1	SA;HQW	14,052.7	S Acres	ND				<b>S</b>	N24 N88A	NCE NCE	<b>S</b>	APP	
Those waters in 03-01-56 in the eastern portion of Roanoke Sound, from a line running from Northwest Point on Roanoke Island northward to Rhodoms Point on Colington Island, thence a line running eastward through Wright Memorial Monument, to a line running													
30-21e2	SA;HQW	4.2	S Acres	ND				<b>I</b>	N88	CE			Enterrococcus Stormwater Runoff
Jockey's Ridge Soundside Access													
30-21f	SA;HQW	1,177.4	S Acres	<b>NR</b>				ND			<b>I</b>	PRO	Total Suspended Solids Fecal Coliform Bacteria Fecal Coliform Bacteria Marina
DEH closed area northeast of a line from Rhodams Point to Mann Point including Buzzard bay													
30-21g	SA;HQW	26.3	S Acres	<b>NR</b>				ND			<b>I</b>	PRO	Low Dissolved Oxygen Fecal Coliform Bacteria
The waters of Roanoke sound which include those waters around the Villa Condominium STP Outfall beginning at a point 35 degrees 57' 54" N- 75 degrees 38' 46" W, thence 200 yards in a southwesterly direction to a point in the sound at 35 degrees 57' 48" N-													
30-21h	SA;HQW	405.0	S Acres	ND				<b>S</b>	N21B	NCE	<b>I</b>	PRO	Fecal Coliform Bacteria WWTP NPDES
DEH closed area east of Pond Island adjacent ot HWY 264 bridge													
30-21i	SA;HQW	100.7	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria
DEH closed area adjacent to Mill Landing in subbasin 03-01-56													
30-21j	SA;HQW	37.1	S Acres	ND				ND			<b>I</b>	PRO	Fecal Coliform Bacteria
DEH closed area in southern portion of Roanoke Sound adjacent to Big Tim Island													

**Table 18 Pasquotank Subbasin 03-01-56**

AU Number	Classification	Length/Area	Aquatic Life Assessment				Recreation Assessment			Shellfish Harvesting		Stressors	Sources
			AL Rating	Station	Result	Year/ Parameter % Exc	REC Rating	Station	Result	SH Rating	GA		
<b>Use Categories:</b>		<b>Monitoring data type:</b>		<b>Results:</b>			<b>Use Support Ratings 2006:</b>						
AL - Aquatic Life	MF - Fish Community Survey			E - Excellent			S - Supporting, I - Impaired						
REC - Recreation	MB - Benthic Community Survey			G - Good			NR - Not Rated						
SH - Shellfish Harvesting	MA - Ambient Monitoring Site			GF - Good-Fair			NR*- Not Rated for Recreation (screening criteria exceeded)						
	ML- Lake Monitoring			F - Fair			ND-No Data Collected to make assessment						
	N- DEH RECMON			P - Poor			NR+-Not rated because draft criteria used for rating						
				NI - Not Impaired			<b>Results</b>						
GA - DEH SS Classification and Growing Area				S- Severe Stress			CE-Criteria Exceeded > 10% and more than 10 samples						
APP- Approved				M-Moderate Stress			NCE-No Criteria Exceeded						
CAO- Conditionally Approved-Open				N- Natural			<b>Miles/Acres</b>						
CAC- Conditionally Approved-Closed							FW- Fresh Water						
PRO- Prohibited							S- Salt Water						

Aquatic Life Rating Summary			Recreation Rating Summary			Fish Consumption Rating Summary			Shellfish Harvesting Rating Summary		
NR	e	1,203.7 S Acres	S	m	22,969.7 S Acres	I	e	29,670.0 S Acres	S	m	19,258.3 S Acres
NR	e	0.5 Coast Mile	I	m	4.7 S Acres	I	e	23.8 FW Miles	I	m	1,786.9 S Acres
ND		28,466.3 S Acres	S	m	23.8 FW Miles	I	e	111.1 Coast Mile			
ND		23.8 FW Miles	S	m	110.6 Coast Mile						
ND		110.6 Coast Mile	I	m	0.5 Coast Mile						
			ND		6,695.6 S Acres						

lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin.

Many of the waters in subbasin 03-01-56 are classified for shellfish harvesting (Class SA). Many are also classified as High Quality Waters (HQW) or Outstanding Resource Waters (ORW). Several management strategies are in place to protect these waters.

Neither benthic samples nor ambient stations are located in this subbasin; however, there are several recreational monitoring stations (RECMON) located throughout the subbasin. These stations are evaluated by the NC Division of Environmental Health (DEH). Long-term trends in water quality cannot be assessed in this subbasin. Refer to the *2006 Pasquotank River Basinwide Assessment Report* <http://h2o.enr.state.nc.us/esb/Basinwide/PASQUOTANK2006Final.pdf> and Appendix I for more information on monitoring.

Waters in the following sections and in Table 18 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and is used to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

## 7.2 Use Support Assessment Summary

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Table 19 provides a summary of use support for waters in subbasin 03-01-56.

In subbasin 03-01-56, use support was assigned for aquatic life, recreation, fish consumption and shellfish harvesting. Waters are Supporting, Impaired, Not Rated and 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). There are no water supply watersheds designated in this subbasin.

Criteria for making use support determinations for the shellfish harvesting category were based on Division of Environmental Health (DEH) Sanitary Surveys (SS) growing area classifications. The problem parameter for all shellfish waters is the potential for fecal coliform standards exceedances. Differences in acreage estimates between basin cycles are not just related to changes in water quality. Changes in acreage are related to more refined methods of estimating acreages, changes in growing area classifications, extension of closure areas as a result of additional boat slips, and to changes in use support methodology.

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>. Appendix V provides definitions of the terms used throughout this basin plan.

Table 19 Summary of Use Support Ratings by Category in Subbasin 03-01-56

Use Support Rating	Aquatic Life		Recreation		Shellfish Harvesting	
	Freshwater	Saltwater	Freshwater	Saltwater	Freshwater	Saltwater
<b>Monitored Waters</b>						
Supporting	0	0	23.8 mi	110.6 mi 22,969.7 ac	0	19,258.3 ac
Impaired*	0	0	0	0.5 mi 4.7 ac (0.02%)	0	1,786.9 ac (8.5%)
<b>Total</b>	<b>0</b>	<b>0</b>	<b>23.8 mi</b>	<b>111.1 mi 22,974.4 ac</b>	<b>0</b>	<b>21,045.2 ac</b>
<b>Unmonitored Waters</b>						
Not Rated	0	0.5 mi 1,203.7 ac	0	0	0	0
No Data	23.8 mi	110.6 mi 28,466.3 ac	0	6,695.6 ac	0	0
<b>Total</b>	<b>23.8 mi</b>	<b>111.1 mi 28,771.4 ac</b>	<b>0</b>	<b>6,695.6 ac</b>	<b>0</b>	<b>0</b>
<b>Totals</b>						
<b>All Waters</b>	<b>23.8 mi</b>	<b>111.1 mi 28,771.8 ac</b>	<b>23.8 mi</b>	<b>111.1 mi 29,670 ac</b>	<b>0</b>	<b>21,045.2 ac</b>

\* The noted percent Impaired is the percent of monitored miles/acres only.

### 7.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state’s 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Chapter 15.

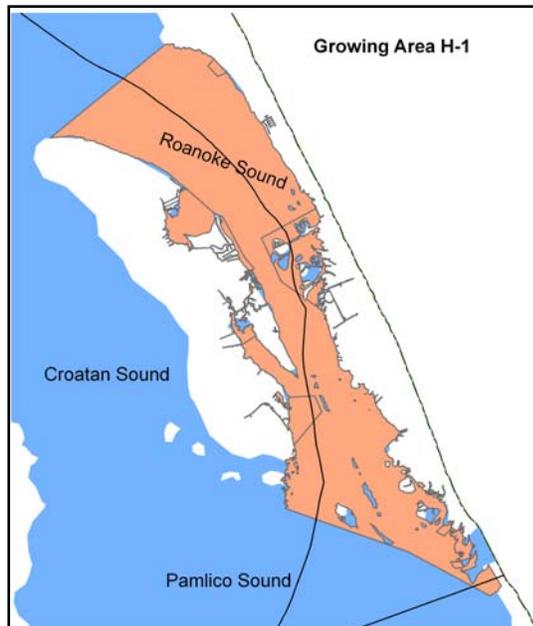
For more information about use support determinations for the Impaired Class SA waters presented in Table 20 below, refer to Appendix II or the *Supplemental Guide to North Carolina’s Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ’s website <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>. Refer to Figure 9 for a map of subbasin 03-01-56.

Table 20 Summary of DEH Growing Areas H-1, I-2 Classifications in Subbasin 03-01-56

Class SA Waters	Assessment Unit #	Growing Area Classification	DEH Growing Area
Pond Island	30-21-4b	PRO	H-1
Roanoke Sound	30-21e1	APP	H-1, I-2
	30-21e2	APP	
	30-21f	PRO	
	30-21g	PRO	
	30-21h	PRO	
	30-21i	PRO	
	30-21j	PRO	

PRO=Prohibited, CAC=Conditionally Approved Closed, CAO=Conditionally Approved Open

### 7.3.1 Eastern Shore of Roanoke Sound Growing Area H-1



The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area H-1. If the entire Class SA water is located within more than one growing area it is noted in Table 20 or refer to the basinwide Growing Area map in the Executive Summary.

According to the *Sanitary Survey of Roanoke Sound, Area H-1* (DEH Shellfish Sanitation & Recreational Water Quality Section, October 2002 and August 2006), little changes in water quality were detected. Roanoke Sound is bordered on the east by the Outer Banks and on the west by Roanoke Island. H-1 is located in Dare County, undergoing rapid population growth and large influxes in seasonal populations. Nags Head has an estimated permanent population of 3,200 with an increase to

over 60,000 during summer months.

Nags Head area continues to have significant construction of seasonal residences and retail businesses adding to impervious surface cover. Much of the construction ties into the municipal wastewater treatment system with land application disposal or package plants with low-pressure pipe drain fields for final effluent disposal. One of the two septic systems operated by the US National Park Service was found to be failing during the 2006 survey.

As a result of the 2002 survey an additional 10 acres of shellfishing waters were closed at the canals of Old Nags Head Cove.

#### **Pond Island [AU# 30-21-4b]**

Pond Island (40.3 acres) is Impaired for shellfish harvesting. Pond Island is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacteria levels. Pond Island will remain on the state's 303(d) list of Impaired waters.

#### **Roanoke Sound (Jockey's Ridge Soundside) [AU# 30-21e2]**

Roanoke Sound at Jockey's Ridge State Park (4.2 acres) is Impaired in the recreation category based on RECMON exceedences at site N88 for enterococci bacteria. The sampling location is near the storm drain just south of Jockey's Ridge. This section of the Roanoke Sound will be added to the state's 303(d) list of Impaired recreational waters.

#### **Roanoke Sound [AU# 30-21g]**

##### 2002 Status

DEH posted a swimming advisory for a portion of the Roanoke Sound centered around the discharge associated with the Villas Association, Inc. The Villas is a residential/resort

community in the Town of Nags Head. The advisory was posted in 1998. In 2002, the Villas Association received a non-discharge permit to eliminate the direct discharge to Roanoke Sound. The facility is now utilizing a land application method for its treated wastewater.

#### Current Status

Roanoke Sound (26.3 acres) is Impaired for shellfish harvesting. This section of the sound is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacteria levels. This section of the Roanoke Sound will remain on the state's 303(d) list of Impaired waters for shellfish harvesting.

This segment of the Roanoke Sound [AU# 30-21g] is Not Rated for recreation due to concerns with the previous WWTP discharges and will remain on the 303(d) list until further bacterial assessment is completed. No RECOM samples were collected in this section of the Roanoke Sound. The RECOMON sampling location closest to the Villas is near the storm drain just south of Jockey's Ridge. DEH has had 35 advisory days at this location since the 2004 swimming season.

### **Roanoke Sound [AU# 30-21h, 30-21i and 30-21j]**

#### Current Status

These segments of the Roanoke Sound (542.8 acres) are Impaired for shellfish harvesting. This portion of the Roanoke Sound is classified by DEH SS as prohibited in growing area H-1 due to potential fecal coliform bacteria levels. Roanoke Sound will remain on the state's 303(d) list of Impaired waters.

### **7.3.2 Eastern Shore of Roanoke Sound Growing Area I-2**



The following DWQ Class SA waters and the Impaired assessment units associated with these waters are located within Growing Area I-2. If the entire Class SA water is located within more than one growing area it is noted in Table 20 or refer to the basinwide Growing Area map in the Executive Summary.

According to the *Sanitary Survey of Eastern Albemarle Sound, Area I-2 (DEH Shellfish Sanitation & Recreational Water Quality Section, June 2005)*, water quality has improved with a few exceptions. The only shellfish present in this area is *Rangia* clams. The estimated population of this area is

11,000 people, which is a 50 percent increase since the last survey. With the influx of tourists the population in this area more than triples. There are 15 subdivisions, many of which are located along waters closed for shellfish harvesting.

### **Roanoke Sound (Buzzard Bay) [AU# 30-21f]**

Roanoke Sound (1,177.4 acres) is Impaired for shellfish harvesting. This impaired section runs from Rhodams Point to Mann Point and includes Buzzard Bay. It is classified by DEH SS as prohibited in growing area I-2 due to potential fecal coliform bacteria levels. This section of the Roanoke Sound will remain on the state's 303(d) list of Impaired waters.

### **7.3.3 Previously or Currently Impaired Freshwater and Non-Shellfish Harvesting Waters**

#### **Albemarle Sound [AU# 30f2]**

The Colington Harbor Swimming Beach in the Albemarle Sound (0.1 acres) is Impaired in the recreation category based on recreational monitoring (RECMON) exceedances at site N91. This section of Albemarle Sound will be added to the state's 303(d) list of Impaired recreational waters.

#### **Atlantic Ocean [AU# 99-(7)b]**

This 0.5 mile of coast line is Impaired in the recreation category based on RECMON exceedances at site N22. This section of the Atlantic coastline will be added to the state's 303(d) list of Impaired recreational waters.

#### **Colington Creek [AU# 30-19-1b]**

Colington Creek (0.4 acres) is Impaired in the recreation category based on recreational monitoring (RECMON) exceedances at site N13. During the assessment period extreme elevated bacteria counts were detected. Shore birds and other waterfowl are abundant in this area. The predominant southwest winds lead to limited flushing rates and often the waters become stagnant adjacent to the shoreline. Also, a dock was being built at the end of Dock Street, which was the location of the sampling site. During construction, sediments that include bacteria were being re-suspended in the water column by the pumping of pilings and the use of heavy equipment. This sampling station (N13) has now been dropped and replaced with a station (N13a) about 200 yards offshore.

## **7.4 Status and Recommendations for Waters with Noted Impacts**

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements.

### **7.4.1 Atlantic Ocean [AU# 99-(7)c]**

The Dare County Reverse Osmosis (RO) WTP (Permit NC0070157) for Kill Devil Hills discharges to an unnamed tributary that reaches this 0.5-mile section of the Atlantic coastline. The permit specifies that the facility monitor whole effluent toxicity (WET). During the last two years of the assessment period, WET tests show that the facility has failed to meet its 90 percent acute toxicity target effluent concentration on three occasions for both outfalls (outfall 001 and outfall 002). DWQ regional office staff report that outfall 001 is currently in compliance per the

permit; however, outfall 002 is showing high levels of chlorine. DWQ staff is working with the facility to ensure that both outfalls are in compliance per permit limits.

## **7.5 Additional Water Quality Issues within Subbasin 03-01-56**

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

Several pump stations contribute to the Kill Devil Hills WWTP non-discharge system (Permit WQ0002829), which have been non-compliant because of maintenance issues. Improved operational management and the possible consolidation of ownership of the pump stations would make inspections easier and maintenance issues could possibly be resolved. The facility is also expanding from 300,000 GPD to 500,000 GPD.

### *Town of Nags Head*

In the fall of 2000, the Town of Nags Head implemented the Septic Health Initiative to improve management of septic systems and to reduce a potential source of microbes. This initiative includes four major programs including a public education program, septic tank inspection and pumping, water quality monitoring and the development of a long term decentralized wastewater management plan. This voluntary program is designed to encourage homeowners to have their septic systems inspected and pumped on a regular basis by providing refunds for inspection costs and utility credits for septic pumping. A homeowner low interest loan program also promotes the replacement of failing systems. The development of a decentralized wastewater management plan is Nags Head's long-term strategy in protecting water quality while allowing the continued use of on-site wastewater systems. (<http://www.townofnagshead.net>)



# Chapter 8

## North Carolina Water Quality Classifications and Standards

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### 8.1 Description of Surface Water Classifications and Standards

North Carolina's Water Quality Standards Program adopted classifications and water quality standards for all the state's river basins in 1963. The program remains consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters (HQW), and unique and special pristine waters with outstanding resource values (ORW).

#### 8.1.1 Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table 21 briefly describes the best uses of each classification. A full description is available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). Information on this subject is also available at DWQ's website: <http://h2o.enr.state.nc.us/csu/>. Figure 10 presents Class SA, ORW and water supply classifications in the basin.

#### 8.1.2 Statewide Water Quality Standards

Each primary and supplemental classification is assigned a set of water quality *standards* that establish the level of water quality that must be maintained in the waterbody to support the uses associated with each classification. Some of the standards, particularly for HQW and ORW waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. These strategies are discussed briefly below. The standards for C and SC waters establish the basic protection level for all state surface waters. The other primary and supplemental classifications have more stringent standards than for C and SC, and therefore, require higher levels of protection.

Some of North Carolina's surface waters are relatively unaffected by pollution sources and have water quality higher than the standards that are applied to the majority of the waters of the state. In addition, some waters provide habitat for sensitive biota such as trout, juvenile fish, or rare and endangered aquatic species.

#### High Quality Waters (Class HQW)

All shellfish harvesting (Class SA) have the supplemental classification of HQW by rule. There are 395,269 acres of HQW waters in the Pasquotank River basin; all are SA waters except for 32.9 acres classified as SC waters. Special HQW protection management strategies are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new wastewater discharge facilities and facilities, which expand beyond their currently permitted loadings, address oxygen-consuming wastes, total suspended solids, disinfections, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances.

Table 21 Primary and Supplemental Surface Water Classifications

PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS	
<u>Class*</u>	<u>Best Uses</u>
<b>C and SC</b>	Aquatic life propagation/protection and secondary recreation.
<b>B and SB</b>	Primary recreation and Class C and SC uses.
<b>SA</b>	Suitable for commercial shellfish harvesting and SB and SC uses.
<b>WS</b>	<i>Water Supply (WS)</i> : Assigned to watersheds based on land use characteristics. The WS classifications have management strategies to protect the surface water supply. For WS-I through WS-IV, these include limits on point source discharges and local programs to control nonpoint source and stormwater runoff. A WS Critical Area (CA) has more stringent protection measures and is designated within one-half mile from a WS intake or WS reservoir. All WS classifications are suitable for Class C uses.
<b>WS-I</b>	Generally located in natural and undeveloped watersheds.
<b>WS-II</b>	Generally located in predominantly undeveloped watersheds.
<b>WS-III</b>	Generally located in low to moderately developed watersheds.
<b>WS-IV</b>	Generally located in moderately to highly developed watersheds.
<b>WS-V</b>	Generally upstream of and draining to Class WS-IV waters. No categorical restrictions on watershed development or treated wastewater discharges.
SUPPLEMENTAL CLASSIFICATIONS	
<u>Class</u>	<u>Best Uses</u>
<b>Sw</b>	<i>Swamp Waters</i> : Waters that have low velocities and other natural characteristics that are different from adjacent streams (i.e., lower pH, lower levels of dissolved oxygen).
<b>Tr</b>	<i>Trout Waters</i> : Provides protection to freshwaters for natural trout propagation and survival of stocked trout.
<b>HQW</b>	<i>High Quality Waters</i> : Waters that have excellent water quality, primary nursery areas and other functional nursery areas, WS-I and WS-II or SA waters.
<b>ORW</b>	<i>Outstanding Resource Waters</i> : Unique and special waters of exceptional state or national recreational or ecological significance which require special protection.
<b>NSW</b>	<i>Nutrient Sensitive Waters</i> : Waters subject to excessive plant growth and requiring limitations on nutrient inputs.

\* Primary classifications beginning with "S" are assigned to saltwaters.

For nonpoint source pollution, development activities which require a Sedimentation and Erosion Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program, and which drain to and are within one mile of HQWs, are required to control runoff from the development using either a low density or high density option. The low-density option requires a 30-foot vegetated buffer between development activities and the stream; whereas, the high-density option requires structural stormwater controls. In addition, the Division of Land Resources (DLR) requires more stringent erosion controls for land-disturbing projects within one mile of and draining to HQWs.

- Criteria for HQW Classification**
- Waters rated as Excellent based on DWQ's chemical and biological sampling.
  - Streams designated as native or special native trout waters by the Wildlife Resources Commission (WRC).
  - Waters designated as primary nursery areas or other functional nursery areas by the Division of Marine Fisheries.
  - Waters classified by DWQ as WS-I, WS-II or SA.

Outstanding Resource Waters (Class ORW)

There are 485 miles, 15,938 freshwater acres, and 43,154 saltwater acres of ORW waters in the basin (Figure 10). These waters have excellent water quality (rated based on biological and chemical sampling as with HQWs) and an associated outstanding resource.

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and a 30-foot vegetated buffer or stormwater controls for new developments are required. In some circumstances, the unique characteristics of the waters and resources that are to be protected require that a specialized (or customized) ORW management strategy be developed.

*The ORW rule defines outstanding resource values as including one or more of the following:*

- an outstanding fisheries resource;
- a high level of water-based recreation;
- a special designation such as National Wild and Scenic River or a National Wildlife Refuge;
- within a state or national park or forest; or
- a special ecological or scientific significance.

#### Class SA Waters

There are 395,236 acres of SA waters in the basin. The best uses of Class SA waters are for shellfishing for market purposes and any other usage specified by the "SB" or "SC" classification. SA waters also receive the supplemental classification of either HQW or ORW. Fecal coliform bacteria in class SA waters shall meet the current sanitary and bacteriological standards as adapted by the Commission for Health Services. Domestic wastewater discharges are not allowed, and there are provisions for stormwater controls. Refer to 15A NCAC 2B .0221 for specifics on water quality standards in Class SA waters. All Class SA waters are also carry a supplemental designation of HQW or ORW by rule (see above), depending on the resource value present at the time of classification.

#### Primary Recreation (Class B and SB)

There are 25 freshwater miles, 15,938 freshwater acres, 111 saltwater miles, and 312,119 saltwater acres classified for primary recreation in the Pasquotank River basin. Waters classified as Class B are protected for primary recreation, include frequent and/or organized swimming, and must meet water quality standards for fecal coliform bacteria. Sewage and all discharged wastes into Class B waters must be treated to avoid potential impacts to the existing water quality.

#### Aquatic Life Propagation and Secondary Recreation (Class C and SC)

There are 3,595 freshwater miles, 4,981 freshwater acres, 12 saltwater miles, and 374,818 saltwater acres classified for aquatic life propagation/protection and secondary recreation in the Pasquotank River basin.

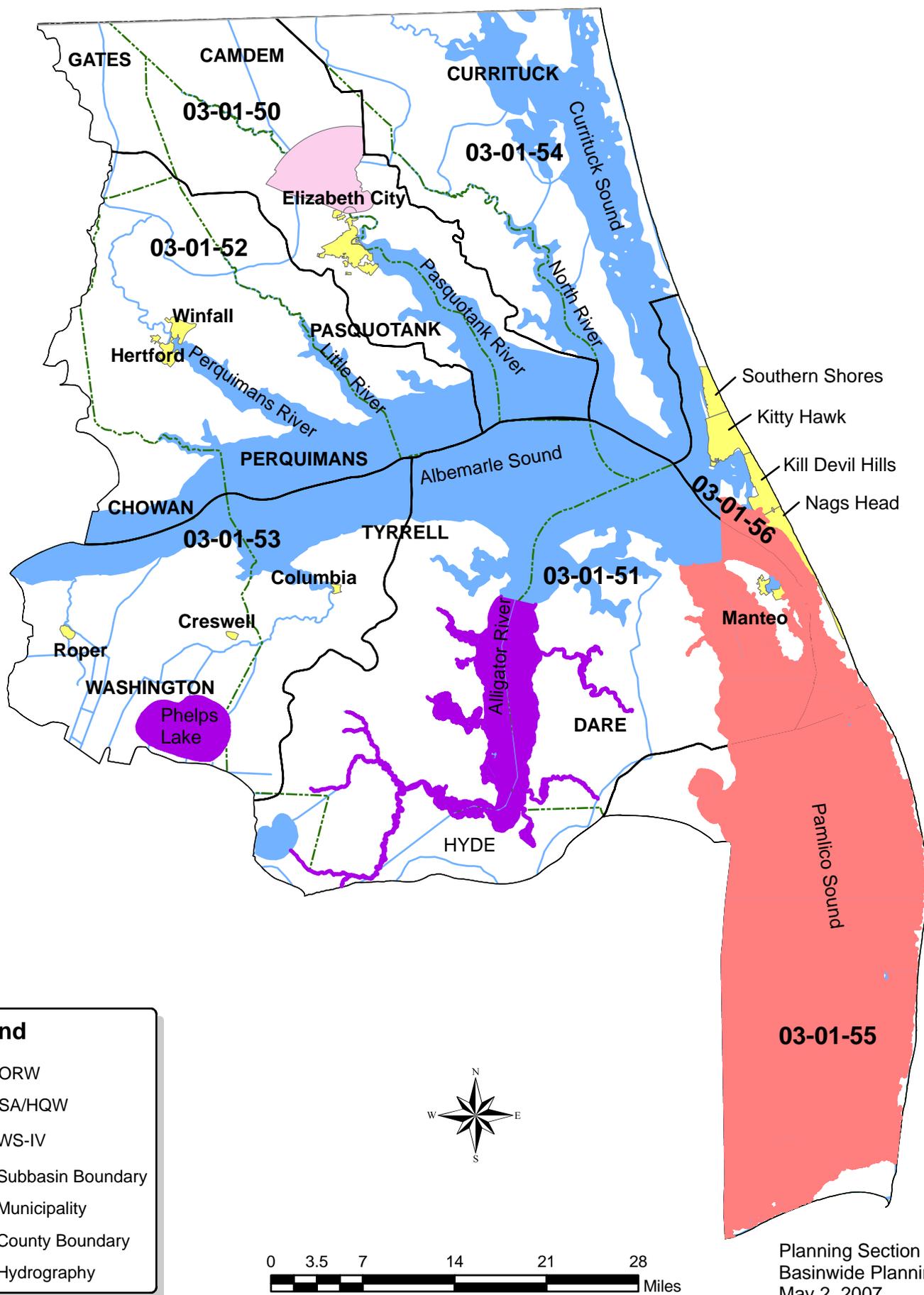
#### Swamp Waters (Class Sw)

There are 3,159 freshwater miles, 20,918.9 freshwater acres, 8.8 saltwater miles, and 66,519 saltwater acres with the supplemental classification of swamp waters in the basin. Waters with this supplemental classification will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen.

#### Water Supply watershed (Class WS)

There are 54 miles of waters classified as water supply waters. WS classifications are assigned to watersheds based on land use characteristics of the area. Each water supply classification has a set of management strategies to protect the surface water supply. There are five WS classes ranging from WS-I through WS-V; only levels III, IV and V occur in the Pasquotank basin. WS-I provides the highest level of protection and WS-IV provides the least protection. A Critical Area (CA) designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located.

**Figure 10 ORW, SA and WS waters in the Pasquotank River Basin**



# Chapter 9

## Water Quality Stressors and Sources of Impairment in the Pasquotank River Basin

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### 9.1 Stressor Identification

Human activities can negatively impact surface water quality, even when the activity is far removed from the waterbody. The many types of pollution generated by human activities may seem insignificant when viewed separately, but when taken as a whole can result in significant stress to the aquatic ecosystem. Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Stressors apply to one or more use support categories and may be identified for Impaired, as well as Supporting waters with noted impacts.

Identifying stressors is challenging because direct measurements of the stressor may be difficult or prohibitively expensive. DWQ staff use field observations from sample sites, special studies and data from ambient monitoring stations, as well as information from other agencies and the public to identify stressors and potential sources. The Division of Environmental Health Shellfish Sanitation Section collects data and information regarding potential sources of water quality stressors to shellfish growing areas. It is important to identify stressors and potential sources of stressors so that water quality programs can target limited resources to address the stressor.

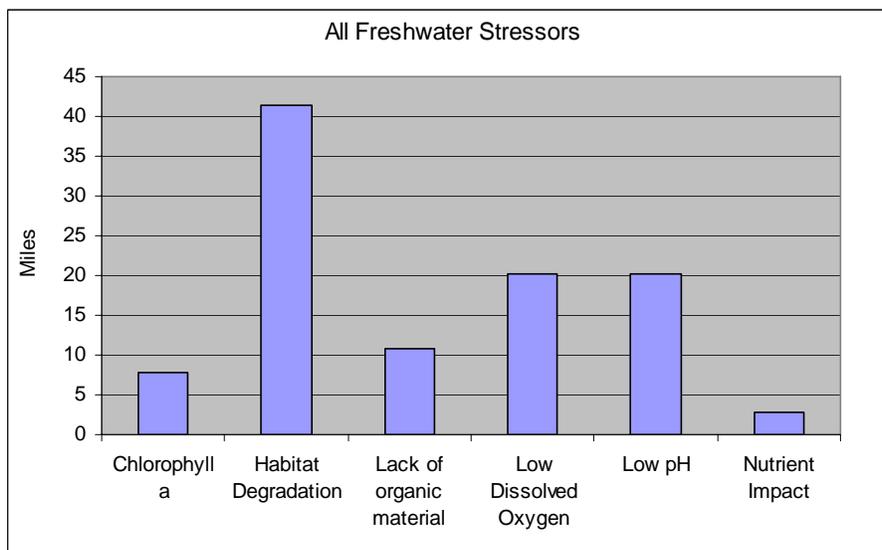
Stressors to recreational use include pathogenic indicators such as fecal coliform bacteria, *escheria coli* (*E. coli*), and *enterococci*. In the fish consumption category, mercury and dioxin are the noted stressors. Other substances may also result in the issuance of a fish consumption advisory or advice by the NC Department of Health and Human Services (NCDHHS).

Most stressors to the biological community are a complex grouping of many different stressors that individually may not degrade water quality or aquatic habitat, but together can severely impact aquatic life. Sources of stressors are most often associated with land use in a watershed, as well as the quality and quantity of any treated wastewater that may be entering a stream. During naturally severe conditions such as droughts or floods, any individual stressor, or group of stressors, may have more severe impacts to aquatic life than during normal climatic conditions. The most common source of stressors is from altered hydrology

#### 9.1.1 Overview of Stressors Identified in the Pasquotank River Basin

The stressors noted below are summarized for all waters and for all use support categories. Figure 11 identifies stressors noted for Impaired streams and streams with noted impacts for freshwater bodies. The stressors noted in the figure may not be the sole reason for the impairment or noted impacts. Fecal Coliform is the sole parameter that results in impairment in the shellfish harvesting category. DWQ relies heavily on Division of Environmental Health growing area classifications and Shellfish Sanitary Surveys for identification of sources of fecal coliform. For specific discussion of stressors to the impaired or noted waters, refer to the subbasin chapters. Stressor definitions and potential impacts are discussed in the remainder of this chapter.

Figure 11 Freshwater Stressors



### 9.1.2 Dioxin- Stressor

In the fish consumption category dioxin is a stressor resulting in the Impairment of waters in Albemarle Sound to the mouths of the Chowan and Roanoke Rivers. Dioxins are the byproducts of industrial processes and are formed during the chlorine bleaching process at pulp and paper mills. The current dioxin advisory was issued by the Department of Health and Human Services in 2001. The advisory is for the consumption of catfish and carp in the Albemarle Sound from Bull Bay to Harvey Point; West to the mouth of the Roanoke River and to the mouth of the Chowan River to the U.S. Highway 17 Bridge (Perquimans, Chowan, Bertie, Washington, and Tyrrell Counties). Women of childbearing age and children should not eat any catfish or carp from this area until further notice. All other persons should eat no more than one meal per month of catfish and carp from this area. For more information on this advisory please visit the DHHS website <http://www.epi.state.nc.us/epi/fish/>.

### 9.1.3 Copper- Stressor

Ambient water quality samples in the Pasquotank River basin found Copper as the most common problem parameter identified. Copper is naturally occurring in the ocean and estuaries; however, concentrations of copper typically range from 0.3 to 3.8  $\mu\text{g/L}$  in estuaries and 0.1 and 2.5  $\mu\text{g/L}$  in coastal waters in the United States. For all twelve of the ambient stations, at least 10 percent of the samples were above 3.8  $\mu\text{g/l}$ . For eight of the twelve ambient stations, samples were above 3.8  $\mu\text{g/l}$  at least 25 percent of the time. Higher than normal copper concentrations found in the basin may indicate anthropogenic sources of copper such as copper antifouling boat paints. These paints are designed to leach copper into the water to reduce barnacle and algal growth on boat bottoms. Boaters should use alternative nontoxic antifouling paints to protect their boats.

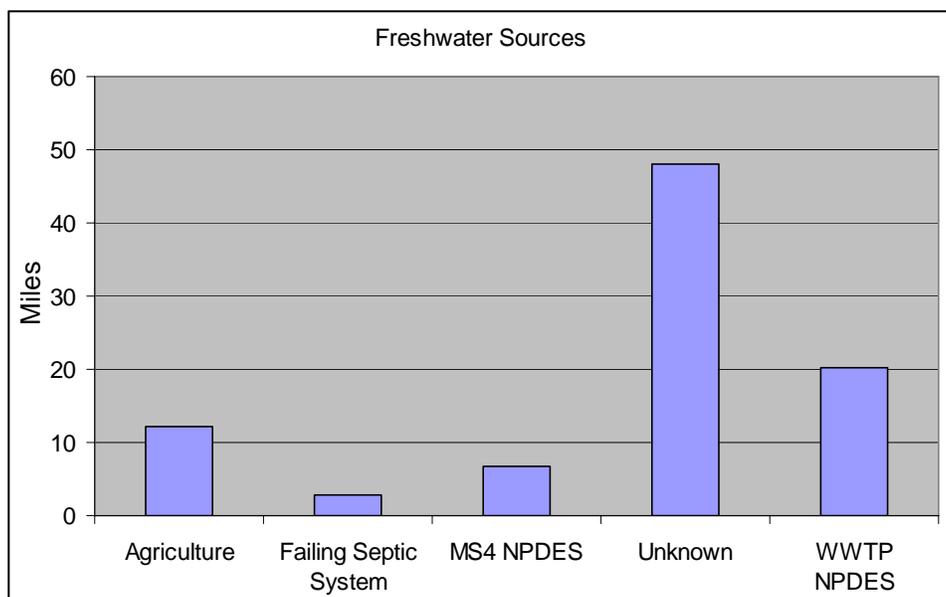
## 9.2 Source Identification

DWQ identifies the source of a stressor, point or nonpoint, as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the

predominant land use in a watershed. Stressors sources identified in the Pasquotank River basin during this assessment period include urban or impervious surface runoff, construction sites, road building, marinas and agriculture. Point source discharges are also considered a water quality stressor source. In addition to these sources, many impacts originate from unknown sources.

Stormwater runoff from a variety of land use practices is identified as the primary source of impairment to shellfish harvesting waters in the Pasquotank River basin. Runoff from rain events carries the fecal coliform bacteria stressor that results in impairment of the shellfish harvesting use support category. Established development, new construction, animal waste (e.g., domestic pets, agricultural animals, and wildlife), and human waste from sewer overflows and failing septic systems are all contributing factors to compounding problems in stormwater runoff. Figure 12 below shows stressor sources identified in the Pasquotank River basin.

Figure 12 Stressors Sources



**Reverse Osmosis Water Treatment- Source**

As development continues to expand along the NC coastline new drinking water treatment facilities have opened over the last several years to meet demands of population growth. There are 16 permitted water treatment plants in the Pasquotank River basin. With these new facilities, State and federal natural resource agencies are concerned with discharge of filter backwash and reverse osmosis reject water into estuarine and coastal receiving waters. Reverse Osmosis (RO) Water Treatment uses semipermeable membranes for water purification by forcing water through a membrane against the concentration gradient. This process allows water molecules to pass through the semipermeable membrane and excludes ions (e.g., Na<sup>+</sup>, Ca<sup>2+</sup>, Cl<sup>-</sup>) or larger molecules (e.g., bacteria, organic contaminants). Discharge from RO plants has the potential to create an ion-imbalance problem, depending on the salinity and mixing conditions of the receiving waters. Discharge can be highly ionic which can further stress estuarine and coastal environments.

Since 2000, DWQ permitting policy for monitoring whole effluent toxicity (WET) (i.e., tests to determine toxicity of discharges to sensitive aquatic species) of RO facilities has evolved. Permitting strategies were developed by an interagency workgroup to evaluate the impact RO discharge may have on the state's coastal waterways. As expected, data collected in coastal basins indicate that the briny (i.e., salty) discharge is less toxic to saltwater organisms than freshwater organisms. The interagency workgroup produced one major recommendation: the initial planning stage of RO facilities should incorporate the location of discharge outfalls such that the effluents produce minimal water quality impacts. WET data collected in the Pasquotank River basin strongly support this recommendation. (DWQ ESS, April 2006).

An ecological assessment of the proposed Currituck County and Pasquotank County Reverse Osmosis Water Treatment Plant discharge sites was conducted by Eastern Carolina University's Institute for Coastal and Marine Resources. In effort to identify potential effects on receiving waters from RO facility discharges this study used environmental conditions at the Camden County Reverse Osmosis WTP as a baseline. The following information is a summary of environmental condition data for the Camden WTP area collected from July 2005 to June 2006 as reported by Rulifson et al., 2006.

The Camden WTP discharges to the Pasquotank River across from Elizabeth City and the US Coast Guard facility. The facility draws water from two 600-foot wells from the Castle Hayne aquifer, and two 100-foot wells from the Yorktown aquifer. Discharge from the Camden RO-WTP was relatively constant at ~207,000 GPD, with the effluent plume shifting with prevailing winds and current conditions.

- The salinity of the in-plant discharge from the Camden Reverse Osmosis WTP ranged from 10.2-15.2 ppt and the groundwater feed to the plant varied from 8.1-8.3 ppt and 0.9-1.0 ppt for the Castle Hayne and Yorktown, respectively.
- Ion concentrations were much more variable at the bottom sites around the diffuser than at surface sites, and generally showed decreasing concentrations away from the diffuser in all directions. Surface waters were not noticeably affected and showed less variable chemistry than bottom waters.
- Ratios of major ions (except  $\text{HCO}_3^-$ ) to chloride were similar to surface water and groundwater samples. For,  $\text{HCO}_3^-$  in  $\text{Cl}^-$  the groundwater feed into the RO-WTP and the in-plant discharge were significantly higher than that of local water from the Pasquotank River and Albemarle Sound.
- Agronite is the only mineral to potentially reach saturation and precipitate out in the receiving waters, but will likely dissolve quickly as waters mix.
- Ammonium concentrations within 15 meters of the diffuser were significantly higher suggesting the possibility of increased photosynthetic activity and perhaps algal blooms. No algal blooms were observed during the study period, however, the naturally dark color of the river water results in visibilities of less than 0.5 meters suggesting that minimal light penetration may limit photosynthesis. (Rulifson et al., 2006).

More information regarding aquatic life, recreation, fish consumption and shellfish harvesting stressors and sources can be found in Chapter 3 of the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

# Chapter 10

## Stormwater and Wastewater Management for Improved Water Quality

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### 10.1 Introduction to Stormwater Runoff

Stormwater runoff is rainfall or snowmelt that runs off the ground or impervious surfaces (e.g., buildings, roads, parking lots, etc.). In some cases, it drains directly into streams, rivers, lakes, and oceans. In other cases, particularly in urbanized areas, stormwater drains into streets and manmade drainage systems consisting of inlets and underground pipes, commonly referred to as a storm sewer system. Storm sewer systems are designed simply to capture the stormwater and convey it to the nearest surface water without treatment. These sewers should not be confused with sanitary sewers, which transport human and industrial wastewaters to a treatment plant before discharging into surface waters.

Common stormwater pollutants include sediment, nutrients, organic matter, bacteria, oil and grease, and toxic substances (e.g., metals, pesticides, herbicides, hydrocarbons). Stormwater can also impact the temperature of a surface waterbody, which can affect the water's ability to support certain fish and aquatic communities.

Uncontrolled stormwater runoff has many impacts on both humans and the environment. Cumulative effects include flooding, undercut and eroding streambanks, widened stream channels, threats to public health and safety, impaired recreational use, and increased costs for drinking and wastewater treatment. For more information on stormwater runoff, visit the DWQ Stormwater Permitting Unit at <http://h2o.enr.state.nc.us/su/stormwater.html> or Chapter 5 of the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

### 10.2 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. These programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include National Pollutant Discharge Elimination System (NPDES) Phase I and II regulations, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Currently, there are 25 individual stormwater permits listed for the Pasquotank River basin and Phase I regulations are not applicable. However, there are a few local governments and/or counties that are affected by other water quality protection programs.

DWQ's Stormwater Permitting Unit webpage: <http://h2o.enr.state.nc.us/su/index.htm> provides links to the stormwater BMP manual, a map tool to identify where file a permit and guidance on North Carolina's evolving stormwater programs. A description of Federal and State stormwater regulations and programs are also described in detail in Chapter 5 of the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

## Stormwater Regulation Challenges

One challenge in meeting the goal of enhancing and protecting water quality is the state's inaccurate or lack of location data to identify permitted stormwater discharges. This permit data is important to DWQ for both tracking and renewing permits, assessing the program, and determining potential cumulative impacts. Discharge outfall locations are also important to compliment protection and restoration efforts by other organizations. In particular, the Division of Environmental Health needs to include the data in their extensive surveys of pollution sources for shellfish growing areas.

To correct this problem, updating discharge locations began in 2005 to include GPS coordinates of outfalls and digital photographs. A temporary administrative staff position has been requested to begin updating or correcting coastal stormwater permit data in DWQ's Basinwide Information Management System (BIMS) database. DWQ is working with regional offices to ensure data entry is consistent and a protocol exists for collecting GPS coordinates in a consistent manner at permitted sites.

As a result of the 2005-2006 municipal outfalls updates the number of untreated stormwater outfalls detected are listed in Table 22 below:

Table 22 Stormwater Outfalls (2005-06)

Municipality	Number of Outfalls Identified
Columbia	9
Creswell	5
Elizabeth City	10
Hertford	11
Kill Devil Hills	2
Manteo	5
Southern Shores	3

### 2007 Recommendations

DWQ recommends that local government and county officials in the basin develop stormwater management programs for new development and to retrofit existing development. In particular, Elizabeth City and Dare County would improve water quality in their jurisdiction if they were to voluntarily begin developing stormwater programs meeting Phase II standards. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government and county stormwater program development.

## **10.3 Wastewater Management Programs**

### **10.3.1 NPDES Wastewater Discharge Permit Summary**

Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities and stormwater discharges associated with certain industrial activities. Point

source dischargers in North Carolina must apply for and obtain a NPDES permit. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency (EPA).

Currently, there are 33 permitted wastewater dischargers in the Pasquotank River basin. Table 23 provides summary information (by type and subbasin) about the discharges. The types of dischargers listed in the table are described in the inset box. Facilities are mapped in each subbasin chapter, and a complete listing of permitted facilities is included in Appendix III.

Table 23 Summary of NPDES Dischargers and Permitted Flows for the Pasquotank River Basin (August 2006).

Facility Categories	03-01-50	03-01-51	03-01-52	03-01-53	03-01-54	03-01-55	03-01-56	TOTAL
<b>Total Facilities</b>	6	6	4	11	2	3	1	34
Total Permitted Flow (MGD)	4,984,000	1,490,000	700,000	753,000	600,000	2,143,200	1,420,000	12,090,200
<b>Facilities Grouped by Size</b>								
<b>Major Discharges</b>	1	1	0	0	0	0	0	2
Permitted Flow (MGD)	4,500,000	1,000,000	0	0	0	0	0	5,500,000
<b>Minor Discharges</b>	5	5	4	11	2	3	1	32
Permitted Flow (MGD)	484,000	490,000	700,000	753,000	600,000	2,143,200	1,420,000	6,590,200
<b>Facilities Grouped by Type</b>								
<b>100% Domestic Waste</b>	1	0	0	1	0	0	0	2
Permitted Flow (MGD)	7,000	0	0	6,000	0	0	0	13,000
<b>Municipal Facilities</b>	1	1	1	3	0	0	0	6
Permitted Flow (MGD)	4,500,000	1,000,000	700,000	449,000	0	0	0	6,649,000
<b>Nonmunicipal Facilities</b>	5	5	3	8	2	3	1	28
Permitted Flow (MGD)	484,000	490,000	---	304,000	600,000	2,143,200	1,420,000	5,441,200

### 10.3.2 NPDES Wastewater Non-Discharge Permit Summary

The Land Application Unit (LAU) in the Aquifer Protection Section of DWQ oversees non-discharge wastewater treatment and recycle systems including land application of wastewater and residuals. The program has operational and monitoring requirements similar to those of the NPDES wastewater program; however, the primary difference is that the treated effluent is not discharged to surface waters. Instead, it is usually discharged to a spray irrigation system for land application. Some other options for the land application of effluent include rapid infiltration basins and drip irrigation systems.

Systems that are reviewed and permitted by LAU include spray irrigation systems, animal waste management systems, rapid infiltration basins, drip irrigation systems, land application of residuals, wastewater collection systems, and beneficial reuse of wastewater systems. The non-discharge program and all associated permits, is regulated by North Carolina General Statutes 143.215.1 and Administrative Code Section 15A NCAC 2T .0100 - Waste Not Discharged to Surface Waters. These sections not only give DWQ the authority to issue permits, but they also provide details on the permitting process and information that must be submitted with a permit application.

Every wastewater treatment facility in the State of North Carolina, including large NPDES facilities, pretreatment systems and non-discharge systems, produce some form and amount of wastewater residuals. DWQ requires a permit for the land application of these residuals. The program was developed around the EPA rules 40 CFR Part 257 and 40 CFR Part 503.

Within the Pasquotank basin, it is important to note that there is a direct connection between groundwater and surface water in many places. Drainage ditches and canals are widespread in northeastern NC and function as a direct pathway for groundwater that may be impacted from nutrients and coliform bacteria, especially in rural areas where agriculture is widespread, to enter into the surface water system. In other cases, surface water bodies, themselves, directly border areas where groundwater quality may be impaired. In many areas, the time it takes for groundwater to move into the surface water system is brief. Although groundwater quality at non-discharge facilities may be compliant with 2L groundwater quality standards, groundwater flux moving into the surface water system has the ability to transport contaminants into surface water bodies and add to total mass loadings. It is recommended that research be conducted to better establish and understand the relationship between groundwater and surface water in eastern North Carolina. Such understanding would provide for more accurate assessment of surface water impairments resulting from groundwater discharges and enable the state to make sound permitting judgments and recommendations to better protect water quality in general.

Many non-discharge systems are constructed by the developer and turned over to a homeowners association (HOA) after completion. If there is a major problem, the HOA is responsible for the repair bill and funding the repair can be an issue. For systems that will be or are owned by a HOA, the statutes and rules require special accounts be set up by the HOA for the operation of the treatment system. In addition, the HOA must set up a reserve fund for major repairs.

Non-discharge systems create some challenges for the DWQ regional offices in terms of inspections and assuring permit and compliance conditions are met. DWQ may seek additional staffing resources to meet these challenges. One of DWQs goals is to better review covenants and bylaws upon permit review to make sure that HOAs are adhering to the financial assuredness requirements under the permit.

In the Pasquotank River basin, 20 non-discharge permits have been issued (See Table 24). More information about non-discharge permits can be found on the DWQ LAU Web site (<http://h2o.enr.state.nc.us/lau/main.html>) and in the *Supplemental Guide to North Carolina's Basinwide Planning* document (<http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>).

Table 24 Summary of NPDES Non-Discharge Permits for the Pasquotank River Basin (August 2006).

Facility Categories	03-01-50	03-01-51	03-01-52	03-01-53	03-01-54	03-01-55	03-01-56	TOTAL
<b>Total Facilities</b>	2	0	3	2	6	1	6	20
Total Permitted Flow (MGD)	260,000	0	487,667	29,000	1,089,000	350,000	584,000	2,799,667
<b>Facilities Grouped by Size</b>								
<b>Major Discharges</b>	1	0	2	1	5	1	4	14
Permitted Flow (MGD)	250,000	0	483,167	25,000	1,085,000	350,000	582,500	2,775,667
<b>Minor Discharges</b>	1	0	1	1	1	0	2	6
Permitted Flow (MGD)	10,000	0	4,500	4,000	4,000	0	1,500	24,000
<b>Facilities Grouped by Type</b>								
<b>Government-Municipal</b>	1	0	0	0	0	0	0	1
Permitted Flow (MGD)	10,000	0	0	0	0	0	0	10,000
<b>Government-County</b>	0	0	0	0	2	0	0	2
Permitted Flow (MGD)	0	0	0	0	540,000	0	0	540,000
<b>Government-State</b>	0	0	0	1	0	0	0	1
Permitted Flow (MGD)	0	0	0	25,000	0	0	0	25,000
<b>Non-Government</b>	1	0	3	1	4	1	6	16
Permitted Flow (MGD)	250,000	0	487,667	4,000	549,000	350,000	584,000	2,224,667

### 10.3.2.1 Coastal Wastewater Management Strategies

New development activities in coastal areas frequently rely on non-discharge systems for wastewater treatment and disposal. These treatment systems are designed to satisfy at least the minimum permitting requirements for protection of the surface and ground waters that they could potentially impact. Permitted non-discharge facilities can be a good alternative to permitted surface water discharges when appropriately permitted based on site conditions for disposal and treatment. The new rules for waste not discharged to surface waters can be found at: <http://h2o.enr.state.nc.us/admin/rules/documents/2Tbook.pdf> as 15A NCAC 02T. Numerous non-discharge systems and necessary treatment requirements are described at this website. These rules replaced the earlier 15A NCAC 02H .0200 rule version and are used in concert with 15A NCAC 02H .0400 rules (Coastal Waste Treatment Disposal Rules).

Reuse quality treatment may use infiltration ponds, but many systems use a sprayfield area with known soil types and crop designations along with hydraulic limits for disposal. Older, smaller package plants often have rotary distributor disposal systems, although these are becoming outdated and are being replaced by drip irrigation or small spray systems.

Setbacks are required for surface waters, drainage ditches and waterways for all irrigation sites. The land surface provides a final "treatment" phase in the disposal process, allowing for uptake and often vegetative removal of nutrients and/or fecal coliform bacteria that may be present in plant effluent depending on the level of treatment permitted for a given facility. However, the effectiveness of this treatment depends upon the ability of the cover crops to take up the

nutrients. In addition, the coarse grain sands do not always provide adequate adsorption and retention time before it enters groundwater. With the promulgation of the Subchapter 02T rules, high-rate systems must meet more stringent effluent limitations and/or increased setbacks.

If the water table is high in a disposal area, water level meters are installed to prevent irrigation until there is a certain vertical separation between the land surface and the water table. Runoff is a real concern at any irrigation site, but it can be prevented with proper hydraulic loading (water balance), buffering, and storage.

In the Pasquotank River basin there is documentation of some problems associated with these non-discharge systems. These problems are typically traced back to operator and operational system management issues or poor design. The Currituck Club, The Villages at Ocean Hill, Pine Island, The Village at Nags Head, and The Villas in Nags Head are communities with wastewater treated in package plants.

Another issue that can be associated with non-discharge systems is the installation of high rate infiltration systems in very densely developed areas. The high rate systems, combined with low-pressure systems and individual septic tank systems, can overload the upper groundwater aquifer in coastal areas. These conditions make it very difficult to conduct meaningful groundwater compliance monitoring because of the large number of neighboring influences from septic systems. Some solutions include effluent monitoring limits combined with more effective bacteriological treatment, increased denitrification, centralized waste treatment or limiting growth.

Non-discharge systems work well when the site is conducive to infiltration. However, problems can arise when the site is a low-lying area with a high groundwater table (thereby inhibiting infiltration), or with nearby wetlands or ditches that can act as a conduit for runoff. Most non-discharge spray irrigation sites have storage ponds that would allow the wastewater to be held until appropriate to spray.

Many non-discharge systems are constructed by developers and turned over to a homeowners association (HOA) after completion. If there is a major problem, the HOA is responsible for the repair bill and funding the repair can be an issue. For systems that will be or are owned by a HOA, the statutes and rules require special accounts be set up by the HOA for the operation of the treatment system. In addition, the HOA must set up a reserve fund for major repairs.

There are also "space" issues to consider. Although a designated green space area (in essence a repair area) is required for a coastal project, the repair solution can still be difficult to implement due to limited space to work in.

Non-discharge systems create some challenges for the DWQ regional offices in terms of inspections and assuring permit and compliance conditions are met. DWQ may seek additional staffing resources to meet these challenges. One of DWQs goals is to better review covenants and bylaws upon permit review to make sure that HOAs are adhering to the financial assuredness requirements under the permit.

## 10.4 On-Site Waste Management

North Carolina has enacted laws and adopted rules that mandate significant requirements for inspection and review of On-site Waste System (OSWS) performance. Siting, sizing, inspections, approvals, and permitting are the responsibilities of County Health Departments through their local authorized agents, but engineers and regional soil specialists are called upon for training, authorization, informal appeals, and consultation with environmental health specialists. Enforcement of onsite wastewater rules and laws is the responsibility of the local environmental health specialists. For more information on NC state rules pertaining to site evaluations and soil suitability for septic systems see [http://www.deh.enr.state.nc.us/osww\\_new/images/Rules/1900RulesJune2006.pdf](http://www.deh.enr.state.nc.us/osww_new/images/Rules/1900RulesJune2006.pdf).

### *Septic Systems and Straight Piping*

With increase in development there is an increase in demand for individual wastewater treatment systems requiring higher flows on smaller tracks of land. Wastewater from many households is not treated at wastewater treatment plants associated with NPDES discharge permits. Instead, it is treated on-site through the use of permitted septic systems. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from some of these homes illegally discharges directly to streams through what is known as a "straight pipe". In other cases, wastewater from failing septic systems makes its way to streams or contaminates groundwater. Straight piping and failing septic systems are illegal discharges of wastewater into waters of the State.

With on-site septic systems, the septic tank unit treats some wastes and the drainfield provides further treatment and filtration of the pollutants and pathogens found in wastewater. A septic system that is operating properly does not discharge untreated wastewater to streams and lakes or to the ground's surface where it can run into nearby surface waters. Septic systems are a safe and effective long-term method for treating wastewater if they are sited, sized and maintained properly. If the tank or drainfield are improperly located or constructed, or the systems are not maintained, nearby wells and surface waters may become contaminated, causing potential risks to human health. Septic tanks must be properly installed and maintained to ensure they function properly over the life of the system. Information about the proper installation and maintenance of septic tanks can be obtained by calling the environmental health sections of the local county health departments. See Appendix IV for contact information.

Discharge of untreated or partially treated sewage can be extremely harmful to humans and the aquatic environment. Pollutants from illegally discharged household wastewater contain chemicals, nutrients, disease pathogens and endocrine disrupting chemicals. Although DWQ's ambient monitoring of the waters in the Pasquotank River basin show a relatively small percentage of fecal coliform bacteria samples exceeding state standards for primary recreation, smaller streams may contain a higher concentration of bacteria and other pollutants. The economies of the counties in this basin are highly dependent upon river recreation, especially for tourists and seasonal residents.

### *2007 Recommendations*

In order to protect human health and maintain water quality failing septic systems should be repaired, older systems must be updated, and straight pipes must be eliminated. Additional monitoring of fecal coliform throughout tributary watersheds will aid in identifying where

straight pipes and failing septic systems are problems. Furthermore, precautions should be taken by local septic system permitting authorities to ensure that new systems are sited and constructed properly and an adequate repair area is also available. County, town and city planners need to understand the economic and human health ramifications caused by unsatisfactory septic systems and plan for long-term septic system sustainability. In areas where soils prevent individual septic systems a collective community septic system in appropriate soils may allow for sustainable development where a centralized sewer system is not available. Educational information should also be provided to new septic system owners regarding the maintenance of these systems over time. For more information please see Chapter 9 in the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans*. <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

On-going on-site waste management activities in the Pasquotank Basin are led by the Albemarle Regional Health Services (ARHS), a district Board of Health for Bertie, Gates, Pasquotank, Perquimans, Camden, Tyrrell, and Washington counties, which conducts annual inspections on all 3,500 innovative and alternative systems. In addition, Chowan, Currituck, Hertford, and Martin counties contract with ARHS for their services. They follow-up on all on-site waste system repairs and are responsible for conventional systems within the 7-county district.

#### *DENR On-Site Wastewater System Management*

DENR has several initiatives related to on-site wastewater education, including current literature and scientific evaluation of potential pollutants from On-site Wastewater Systems. The Division of Environmental Health (DEH) On-Site Wastewater Section has an active grant-seeking program. Current successful grants include those to the Wastewater Discharge Elimination (WaDE) program for eliminating straight pipes and failing systems, nonpoint source coordinator grants for fate and transport of microbes in the shellfish areas, endocrine disrupting chemicals and pharmaceuticals, and an on-site management grant. The DEH Shellfish Sanitation and Recreational Water Quality Section also have significant involvement with on-site wastewater inspections and protection of water quality in the CAMA counties. Sanitary Surveys are conducted for the shellfishing harvesting areas, which include inspecting on-site wastewater discharges. On-site wastewater systems are inspected once every year as a drive-by or shoreline observation, and every three years door-to-door inspections. The Division of Waste Management oversees the septage management firms and septage disposal in NC.

# Chapter 11

## Changes in Our Coastal Communities

### -Population Growth, Development and Water Quality

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#### 11.1 Our Changing Waterfronts and Loss of Public Access

Waterfronts in North Carolina are changing. Historic landmarks for those that have been born and raised on the waterfronts are disappearing; as are fish houses and fishing fleets. These historic uses of waterfronts are being replaced with “urban waterfronts”. Many waterfronts are redeveloping into waterfronts more like Wilmington’s waterfront – the state’s only designated “urban waterfront”. Redevelopment projects on historically working waterfronts include activities such as restaurants, condominiums and mixed-use buildings. Fishing fleets are being replaced by yachts, charter boats or sport fishing boats. Property values are soaring making it a challenge for historic waterfront business to stay in operation, when selling the business and property is more profitable. Reports of median selling prices for soundside lots on Hatteras Island jumping from \$82,000 in 1998 to \$412,000 in 2005 are not uncommon. Profits like these are hard to turn down, but with these selling prices comes a change of community structure and history. Even smaller coastal communities are feeling the brunt of coastal redevelopment for residences and businesses near the water. While land closest to the ocean has seen the first wave of development, the second and third waves of development on the sound and tidal creeks are already here.

##### *Loss of Access to Public Use of Coastal Waters*

North Carolina citizens and elected officials are concerned about the loss of working waterfronts, as fewer marinas and fishing piers are available for public access. The North Carolina Marine Fisheries Commission (MFC) recently passed a resolution asking that state leaders “recognize the vital importance of public access to State estuarine and marine fisheries and waters”. A resolution was also created and signed by scientists, authors and educators to preserve “the cultural integrity and economic significance” of the commercial fishing industry in the state. These resolutions were presented to the Joint Legislative Commission on Seafood and Aquaculture for further action in 2006.

The Coastal Resources Commission (CRC) attempts to not only protect Public Trust Waters as provided for by the Coastal Area Management Act (CAMA), but also attempts to encourage public access to these waters. Recognizing the demand for residences along coastal waters and seeing the threat of loss of public access to these waters, the CRC at its March 2006 meeting requested that a resolution be sent supporting the Joint Legislative Commission on Seafood and Aquaculture efforts to identify ways to ensure public access to coastal waters is preserved. The resolution calls for the creation of a Waterfront Access Study Committee to support efforts to preserve the cultural integrity and character of eastern North Carolina.

The Waterfront Access Study Committee was to study the degree of loss and potential loss of the diversity of uses along the North Carolina coastal shoreline, and how these losses impact access to the public trust waters of the state. The Committee asks for the cooperation of municipalities, public agencies, resource and facility-development granting entities, coastal developers, businesses, and other coastal resource users to recognize and integrate enhanced waterfront-use diversity and increased public access as beneficial factors and/or criteria in their decision making. The Committee supports the use of limited public funds to achieve enhanced water

quality, protection of natural and cultural/maritime heritage sites and resources, and maintaining or advancing waterfront-use diversity and public access. A final committee report is available online at: [www.ncseagrant.org/waterfronts](http://www.ncseagrant.org/waterfronts).

## 11.2 Population Growth and Development

North Carolina's coastal counties are some of the fastest growing areas in the state and the associated development is impacting water quality. Three of the ten counties in the basin are expected to experience growth rates in excess of thirty-five percent by 2020 (Table 25). As the counties in the Pasquotank River basin continue to grow there will likely be a loss of natural areas and an increase in the amount of impervious surface associated with new homes and businesses. Impacts are quickly felt with population increases resulting in an increase in runoff from roads and new developments, increase in wastewater treatment options, a change in the shoreline fronts from fish houses to condominiums, reduced public access to waterfronts, beach closures and a decline in our freshwater, estuarine and marine resources. Between 2003-2006, DEH Recreational Water Quality Monitoring Program in the Pasquotank Basin reported 1,259 postings of beach closure days.

County population data present projected county growth estimates based on Office of State Planning information (June and September 2004) (Table 25). Counties with the highest expected growth are associated with the largest municipal areas and the most densely populated subbasins in the basin.

Table 25 County Population and Growth Estimates

County	Percent of County in Basin <sup>♦</sup>	County Population 1990	County Population 2000	Estimated % Growth 1990-2000	Estimated Population 2020	Estimated % Growth 2000-2020
Camden	100	5,904	6,885	14.2	13,038	47.2
Chowan	33	13,506	14,150	4.6	15,154	6.6
Currituck	100	13,736	18,190	24.5	33,557	45.8
Dare	89	22,746	29,967	24.1	46,455	35.5
Gates	20	9305	10516	11.5	12962	18.9
Hyde	9	5,411	5,826	7.1	5,528	-5.4
Pasquotank	100	31,298	34,897	10.3	41,567	16.0
Perquimans	100	10,447	11,366	8.1	13,831	17.8
Tyrrell	100	3,856	4,149	7.1	4,492	7.6
Washington	68	13,997	13,723	-2.0	12,529	-9.5
<b>Subtotals</b>		<b>130,206</b>	<b>149,669</b>	<b>109.5</b>	<b>199,113</b>	<b>180.6</b>

♦ Source: North Carolina Center for Geographic Information and Analysis (CGIA), 1997.

Note: The numbers reported reflect county population; however, these counties may not entirely be within the basin. The intent is to demonstrate growth for counties located wholly or partially within the basin.

Urban growth poses one of the greatest threats to aquatic resources more than any other human activity. Greater numbers of homes, stores, and businesses require greater quantities of water. Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams and groundwater. Thus, just as demand and use increases, some of the potential water supply is lost (Orr and Stuart, 2000). The Pasquotank River basin municipal population and growth trends are reported in Table 26. Population fluctuations occur in developing coastal communities as seasonal changes bring time-

share and rental property residents creating an increased demand on municipality resources and natural resources. County, city and town planners need to account for these fluctuations and recognize that temporary residents may have less incentive to invest in sustainable community development efforts. Table 26 below presents population data from Office of State Planning for municipalities located wholly or partly within the basin. Data presented by municipality summarize information on past growth of urban areas in the basin.

Table 26 Municipal Population and Growth Trends

Municipality	County	April 1980	April 1990	April 2000	Percent Change (1980-1990)	Percent Change (1990-2000)
Columbia	Tyrell	758	836	819	10.3	-2.0
Creswell	Washington	426	361	278	-15.3	-23.0
Elizabeth City	Camden, Pasquotank	14,007	14,292	17,188	2.0	20.3
Hertford	Perquimans	1,941	2,244	2,070	15.6	-7.8
Kill Devil Hills	Dare	1,671	4,238	5,897	153.6	39.1
Kitty Hawk	Dare	849	1,937	2,991	128.2	54.4
Manteo	Dare	902	991	1,052	9.9	6.2
Nags Head	Dare	1,020	1,838	2,700	80.2	46.9
Roper	Washington	795	669	613	-15.8	-8.4
Southern Shores	Dare	520	1,447	2,201	178.3	52.1
Winfall	Perquimans	634	501	554	-21.0	10.6

As development in urbanizing areas consumes neighboring forests and fields, the impacts on rivers, lakes, and streams can be significant and permanent if stormwater runoff is not controlled (Orr and Stuart, 2000). As watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and driveways, the ability of the environment to absorb and diffuse the effects of natural rainfall is diminished. Urbanization results in increased surface runoff and correspondingly earlier and higher peak streamflows after rainfall. Flooding frequency also increases. These effects are compounded when small streams are channelized (straightened) or piped, and storm sewer systems are installed to increase transport of stormwater downstream. Bank scour from these frequent high flow events tends to enlarge urban streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams, leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

### 11.3 Changes in Land Cover

Land cover can be an important way to evaluate the effects of land use changes on water quality. Unfortunately, the tools and database to do this on a watershed scale are not yet available. Land cover information from the National Resources Inventory (NRI) published by the Natural Resource Conservation Service (NRCS) is presented only at an 8-digit hydrologic unit scale. This information is presented to provide a picture of the different land covers and developing land use trends in the Pasquotank River Basin, while noting that the data is outdated and does not reflect recent development along North Carolina's waterways.

Land cover information in this section is from the most current NRI, as developed by the NRCS (USDA-NRCS, June 2001). The NRI is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on

the Nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time -- 1982, 1987, 1992 and 1997. The USDA is working to provide updates to land cover data in the near future.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process is that the previously recorded data are carefully reviewed as determinations are made for the new inventory year. For those cases where a protocol or definition needs to be modified, all historical data must be edited and reviewed on a point-by-point basis to make sure that data for all years are consistent and properly calibrated. The following excerpt from the *Summary Report: 1997 National Resources Inventory* provides guidance for use and interpretation of current NRI data:

*The 1997 NRI database has been designed for use in detecting significant changes in resource conditions relative to the years 1982, 1987, 1992 and 1997. All comparisons for two points in time should be made using the new 1997 NRI database. Comparisons made using data previously published for the 1982, 1987 or 1992 NRI may provide erroneous results because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected.*

The following Table 27 summarizes acreage and percentage of land cover from the 1997 NRI for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units, and compares the coverages to 1982 land cover.

Table 27 Land Cover in the Pasquotank River Basin: 1982 vs. 1997

MAJOR WATERSHEED AREAS*							
Land Cover	Albemarle Sound Watershed		1997 TOTALS		1982 TOTALS		% Change Since 1982
	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	
Cultivated. Crop	437.1	21.3	437.1	21.3	493.2	24.0	-11.4
Uncultivated. Crop	0.1	0.0	0.1	0.0	0	0.0	10.0
Pasture	6.7	0.3	6.7	0.3	3.9	0.2	71.8
Forest	491.7	23.9	491.7	23.9	668.7	32.5	-26.5
Urban & Built-Up	68.7	3.3	68.7	3.3	36.9	1.8	86.2
Federal	271.8	13.2	271.8	13.2	69.1	3.4	293.3
Other	779.5	37.9	779.5	37.9	783.8	38.1	-0.5
Totals	2055.6	100	2055.6	100	2055.6	100.0	
% of Total Basin		100		100			
SUBBASINS	03-01-50 to 03-01-54						
8 – Digit Hydraulic Units	03010205						

\* = Watershed areas defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin titles used by DWQ.  
Source: USDA, Soil Conservation Service – 1982 and 1997 NRI.

## 11.4 Managing Growth, Development and Stormwater Runoff

### 11.4.1 Assessment of Current Conditions

The DWQ, in its goals to assure that all waters of the state meet or exceed their designated uses began an assessment of the adequacy of the current North Carolina rules intended to protect shellfish waters. DWQ further intended to determine if there was a way to enhance the level of

protection provided to these waters if the current rules were deemed to be inadequately protecting this vital resource in North Carolina. Critical to this review was an assessment of the adequacy of North Carolina's stormwater rules.

North Carolina's current stormwater regulatory programs for coastal areas were adopted in the late 1980's as three primary coastal programs, the Coastal (State) Stormwater Program, Shellfishing (Class SA) Waters Program, and the Outstanding Resource Waters (ORW) Program. Each of these programs require engineered stormwater control structures for high density areas, but no engineered stormwater controls were required for low density projects. High density is defined as more than 24 percent built-upon area or more than two dwelling units per acre. Recent reviews of scientific literature show that stream degradation and impairment occurs to varying degrees when 10-15 percent impervious cover is established without structural stormwater controls result in water quality degradation.

In North Carolina, over 1,255 acres of Class SA, ORW waters have been closed to commercial shellfishing due to elevated levels of bacteria since 1990. The Division of Environmental Health Shellfish Sanitation Program notes that stormwater runoff is the primary cause of bacterial contamination in more than 90 percent of the shellfish areas sampled. In light of the increased acreage of areas closed to shellfish harvesting, DWQ embarked on a study of the current conditions and impacts to the state's shellfish waters. DWQ found that between 1988 and 2005, 73 percent of new impervious surfaces in coastal areas were constructed under low density provisions (<24 percent impervious surfaces) that do not require engineered stormwater control measures, but instead rely on practices such as swales for water quality protection. The use of swales for low density areas indicate only a 25 percent effectiveness rate in reducing bacterial contaminants and may actually contribute to bacterial loading by providing a conduit to increase runoff volumes and rates. In contrast, engineered stormwater control structures for high density areas include wet ponds and wetlands with 70 and 78 percent bacteriological removal rates respectively.

Stormwater runoff carries sediment particles from drainage ditches, streambanks, parking lots, and construction sites. These sediments bind to other pollutants such as bacteria and viruses. Binding to soil particles protects the bacteria from ultraviolet rays that can kill the organisms. Bacteria coated sediment accumulates in coastal shallow water bottoms, which can be easily agitated, allowing the sediments to go in and out of suspension. Under favorable conditions, fecal coliform bacteria can survive in bottom sediments for an extended period (Howell et al., 1996; Sherer et al., 1992; Schillinger and Gannon, 1985). Therefore, concentrations of bacteria measured in the water column can reflect both recent inputs as well as the resuspension of older inputs. In addition to the bacteria and pollutants, the sediment itself threatens the oyster beds by smothering them.

DWQ assessed recent data and information on acres of shellfish closures in six tidal creeks in New Hanover County in the Neuse River basin (Mallin, 2006). This research focused on a county whose population grew 25 percent between 1990 and 2000, and is expected to increase an additional 31 percent by 2020. This research found a strong correlation between bacteria levels and impervious surfaces in the watershed; the greater the amount of impervious surfaces, the greater the bacteria levels. This correlation has also been documented by other research in South Carolina's coastal tidal creeks (Holland et al., 2004). In addition, there is a strong association between turbidity and fecal coliform bacteria levels in these estuarine waters.

Sewer overflows and poorly designed and maintained septic systems contribute to bacteria problems. The research further notes that areas in South Florida have found that septic tanks in porous soils can readily pass through the soil and can enter coastal waters near the shore within hours (Paul et al., 2000). Sandy soils and high water tables appear to be unsuitable for septic systems, yet these systems are relied on heavily in eastern North Carolina for waste management. Ditching and draining appear to facilitate the flow of septic waste to surface waters. Further noted is that some areas have demonstrated that fecal bacteria counts are higher upon outgoing tides and in wetter years due to subsurface movement through saturated soils and increased runoff due to rain.

DWQ's assessment of research results show that the acreages of shellfish waters closed (approximately 4, 446 acres) to shellfishing has increased significantly between 1988 and 2005, and there have been new closures after the implementation of the current stormwater programs. North Carolina waters permanently closed to shellfishing have increased by approximately 19 percent since 1984. The reliance on no engineered stormwater controls for low density projects is the major identifiable shortfall in the current programs. Without changes to these programs, there will be continued degradation of shellfishing waters.

#### **11.4.2 Assessment of Future Conditions**

With this knowledge, DWQ will proceed to determine how shellfishing waters can be better protected from stormwater runoff and its associated spectrum of pollutants. It will be critical to adopt programs that require control structures to be used for more development activities in an effort to better control and treat stormwater runoff. To this effect, DWQ will be assessing options for lowering or removing the low density option waiver from engineered stormwater controls. Two new programs may provide these options.

The Phase II stormwater rule is one of these options. These rules meet the federal Phase II requirements and are contained in Session Law 2006-246. These new rules will commence in July 2007 and are in part intended to redefine low density to 12 percent and areas within ½ mile of "shellfish resource waters". In addition, there are more stringent stormwater design controls defined for high density projects.

The second option is the Universal Stormwater Management Program (USMP) developed by DWQ. This is a voluntary program that may be adopted by local government discretion. It is hoped that the USMP will become effective in early 2007. This program does not allow for a low density waiver.

The goal of these and other stormwater control programs and mechanisms is to point to the fact that new construction activities do not have to degrade water resources if controls and treatment of stormwater are put into place.

Planning for sustainable growth in the Pasquotank Basin 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. The guides are available in print and on the web. <http://www.ncseagrant.org/>.

# Chapter 12

## Water Quality Management Strategies

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### 12.1 The Role of State Government

Several commissions, agencies and programs handle state policies governing actions and activities in coastal areas. The *Environmental Management Commission* (EMC) is a 19-member panel that is appointed by the governor and legislative officials and is responsible for adopting rules for the protection, preservation and enhancement of the state's water and air. Water related rules include stormwater management, basinwide planning, nutrient management strategies and discharge permits.

The North Carolina Coastal Area Management Act (CAMA) established a cooperative program of coastal area management between local and state governments. The Act states that local governments shall have the initiative for planning, while the state government establishes areas of environmental concern. With regard to planning, the state government is directed to act primarily in a supportive, standard-setting, and review capacity, except in situations where local governments do not elect to exercise their initiative. In addition, the CAMA established the *Coastal Resource Commission* (CRC) within the Department of Environment and Natural Resources, whose duties include approval of Coastal Habitat Protection Plans and designation of Areas of Environmental Concern (AEC). After designation of these areas, the Commission is responsible for issuing all permits and establishes regulations to control development. The CRC is a 15-member board appointed by the governor to adopt rules and policies for coastal development and certify local land use plans for the 20 coastal counties and their communities. These regulations are implemented and permitted by the Division of Coastal Management (DCM) (see website <http://dcm2.ehn.state.nc.us/>). An example of these rules is the establishment of a 30-foot buffer zone for building along estuarine waters.

The Division of Marine Fisheries is responsible for the stewardship of the state's marine and estuarine resources, which encompasses all coastal waters and extends to 3 miles offshore. Agency policies are established by the 9-member *Marine Fisheries Commission* and the Secretary of the Department of Environment and Natural Resources.

The N.C. Divisions of Water Quality, Coastal Management, Land Resources, Marine Fisheries, Soil and Water Conservation, Parks and Recreation and Environmental Health are responsible for many coastal activities and policies including stormwater management, development permits, erosion control programs, agriculture and land preservation, shellfish protection and recreation monitoring, just to name a few. Additional state programs include the Albemarle-Pamlico National Estuary Program (APNEP) and many inter-agency and group partnerships that work together to protect the resources found in coastal waters and communities.

The Coastal Zone Management Act requires NOAA to evaluate the performance of federally approved state coastal management programs. During the review of NC's CAMA specific recommendations call for the assessment of existing NC laws and regulations to minimize redundancy and avoid conflict with other regulations, prioritize emerging coastal issues and use adaptive management based on lessons learned.

## 12.2 Coastal Habitat Protection Plan

North Carolina has approximately 2.9 million acres of estuarine and marine waters, comprising the largest estuarine system of any state along the Atlantic coast. North Carolina has a billion-dollar commercial and recreational fishing industry and ranks among the nation's highest seafood-producing states. Fish and shellfish species important to these industries depend on the quality and quantity of habitats found along our rivers, sounds and ocean waters. Pressures from development, loss of habitat, pollution and degraded water quality threaten fish habitats. Shellfish beds, mud flats, marshes, sea grass beds, freshwater streams and swamps are in jeopardy. The loss of these vital fish habitats threatens fishing industry central to North Carolina's history and economic growth.

Recognizing these threats, the N.C. General Assembly passed the Fisheries Reform Act of 1997. Included within this law is a requirement for three of the state's regulatory commissions (Marine Fisheries, Environmental Management, and Coastal Resources commissions) to adopt a plan to manage and restore aquatic habitats critical to North Carolina's commercial and recreational fisheries resources. The DENR developed the Coastal Habitat Protection Plan (CHPP) through a cooperative, multi-agency effort with public input. The CHPP was adopted by the three commissions in December 2004 and sets the stage for unprecedented improvements in fish habitat protection and restoration in North Carolina.

The CHPP is a detailed document describing the six major fish habitats and providing scientific information on their ecological functions and importance to the species that inhabit them. It identifies threats and management needs for each habitat and recommends administrative, regulatory and non-regulatory steps necessary to protect, restore and enhance each habitat. These recommendations are a result of scientific studies, deliberations of the three commissions and input from citizens who attended 20 public meetings held during the development of the CHPP. The CHPP identifies six habitats that need protection or enhancement:

- Water Column
- Shell Bottom
- Submerged Aquatic Vegetation (SAV)
- Wetlands
- Soft Bottom
- Hard Bottom

DENR and the three commissions developed and adopted specific plans to implement the CHPP recommendations, with a focus on actions that could be taken based on existing resources and within the 2005-2007 budget cycle. The implementation actions are organized according to four habitat management goals:

### **GOAL 1. Improve effectiveness of existing rules and programs protecting coastal fish habitats**

North Carolina has a number of programs already in place to protect coastal fisheries and the natural resources that support them. The Marine Fisheries Commission (MFC) has adopted rules addressing the impacts of certain types of fishing gear and fishing practices that may damage fish habitats. The Coastal Resources Commission (CRC) regulates development impacts on certain types of critical coastal habitats, such as saltwater marshes and primary nursery areas. The Environmental Management Commission (EMC) has issued water quality standards that address

pollution of coastal waters from both direct discharges and runoff. The Coastal Habitat Protection Plan (CHPP) identifies a number of gaps in the protection provided for critical fish habitats under these programs, but also notes that these habitats would benefit from stronger enforcement of existing regulations and better coordination among agencies.

Recommendation 1.1 Enhance enforcement of, and compliance with, Coastal Resources Commission, Environmental Management Commission and Marine Fisheries Commission rules and permit conditions.

Recommendation 1.2 Coordinate and enhance water quality, physical habitat and fisheries resource monitoring (including data management) from headwaters to the nearshore ocean.

Recommendation 1.3 Enhance and expand educational outreach on the value of fish habitat, threats from human activities, effects of non-native species and reasons for management measures.

Recommendation 1.4 Coordinate rulemaking and enforcement among regulatory commissions and agencies.

## **GOAL 2. Identify, designate and protect strategic habitat areas**

Maintaining healthy coastal fisheries requires consideration of the entire ecosystem and the way different types of fish habitat work together. For example, coastal marshes help prevent erosion of soft bottom habitat. Unobstructed passage through the water column allows certain fish species to reach their spawning grounds in inland wetlands. Fragmenting these habitats, or damaging one of a series of interrelated habitats makes it more difficult for aquatic systems to support strong and healthy coastal fisheries. In 1998, the EMC, CRC, and MFC defined Strategic Habitat Areas. These areas are complexes of fisheries habitat that “provide exceptional functions that are particularly at risk due to imminent threats, vulnerability or rarity.” These areas merit special attention and should be given high priority for conservation.

Recommendation 2.1 Evaluate potential Strategic Habitat Areas (SHAs) by a) coordinating, completing and maintaining baseline habitat mapping (including sea grass, shell bottom and other bottom types) using the most appropriate technology; b) selective monitoring of the status of those habitats; and c) assessing effects of land use and human activities on those habitats.

Recommendation 2.2 Identify and designate SHAs using ecologically based criteria, analyze existing rules and enact measures needed to protect SHAs and improve programs for conservation (including voluntary actions) and acquisition of areas supporting SHAs.

## **GOAL 3. Enhance habitat and protect it from physical impacts**

The CHPP identifies a number of ways in which fish habitats can be damaged by direct physical impacts. Some examples include filling of wetlands, dredging of soft bottom habitat, destruction of shell bottom and hard bottom areas, damage to submerged aquatic vegetation by use of certain types of fishing gear, and physical obstructions that block fish movement to and from spawning areas. While large impacts can directly contribute to the loss of habitat functions, the accumulation of many small impacts can make a habitat more vulnerable to damage from which it might otherwise recover quickly. In some cases, historic damage to a habitat can be mitigated through the creation of sanctuaries where the resource can recover. One such program involves creation of protected oyster reefs. In other cases, the cumulative impacts of multiple projects can be more effectively managed through comprehensive planning and plan implementation.

Recommendation 3.1 Greatly expand habitat restoration.

Recommendation 3.2 Prepare and implement a comprehensive beach and inlet management plan that addresses ecologically based guidelines, socioeconomic concerns and fish habitat.

Recommendation 3.3 Protect submerged aquatic vegetation (SAV), shell bottom and hard bottom areas from fishing gear effects through improved enforcement, establishment of protective buffers around habitats and further restriction of mechanical shellfish harvesting.

Recommendation 3.4 Protect fish habitat by revising estuarine and public trust shoreline stabilization rules using best available information, considering estuarine erosion rates, and the development and promotion of incentives for use of alternatives to vertical shoreline stabilization measures.

Recommendation 3.5 Protect and enhance habitat for anadromous fishes by: a) incorporating the water quality and quantity needs of fish in surface water use planning and rule making and b) eliminating obstructions to fish movements, such as dams, locks and road fills.

#### **GOAL 4. Enhance and Protect Water Quality**

Good water quality is essential to coastal fisheries because water is the common element in all fish habitats. The water conditions necessary to support coastal fisheries include the right combination of temperature and salinity, as well as the absence of harmful pollutants. Achieving and maintaining good water quality for purposes of fisheries productivity requires management of both direct discharges of pollutants and stormwater runoff. The CHPP provides additional support for policies directed toward better management of point and non-point sources of water pollution. In doing so, the CHPP recognizes a need to go beyond relying on regulatory programs alone. Addressing water quality impacts will also require targeted use of land acquisition programs, incentives for conservation, development of effective BMPs, and assistance for local governments to upgrade wastewater and stormwater management infrastructure. Maintaining the water quality necessary to support vital coastal fisheries will not only benefit the commercial fishing industry – it will benefit a large sector of the entire coastal economy built around travel and tourism, and recreational fishing.

Recommendation 4.1 Reduce point source pollution from wastewater.

Recommendation 4.2 Adopt or modify rules or statutes to prohibit ocean wastewater discharges.

Recommendation 4.3 Prohibit new or expanded stormwater outfalls to coastal beaches and to coastal shellfishing waters (EMC surface water classifications SA and SB) except during times of emergency when public safety and health are threatened, and continue to phase out existing outfalls by implementing alternative stormwater management strategies.

Recommendation 4.4 Enhance coordination with, and financial/technical support for, local government actions to better manage stormwater and wastewater.

Recommendation 4.5 Improve land-based strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses to wetlands and streams through voluntary actions, assistance and incentives.

Recommendation 4.6 Improve land-based strategies throughout the river basins to reduce non-point pollution and minimize cumulative losses to wetlands and streams through rule making.

Recommendation 4.7 Develop and implement a comprehensive coastal marina and dock management plan and policy for the protection of shellfish harvest waters and fish habitat.

Recommendation 4.8 Reduce non-point source pollution from large-scale animal operations by the following actions: a) support early implementation of environmentally superior alternatives to the current lagoon and sprayfield systems as identified under the Smithfield Agreement and continue the moratorium on new/expanded swine operations until alternative waste treatment technology is implemented; b) seek additional funding to phase-out large-scale animal operations

in sensitive areas and relocate operations from sensitive areas; and c) use improved siting criteria to protect fish habitat.

Visit <http://www.ncdmf.net/habitat/index.html> to learn more about the CHPP or to download a copy of the plan. Questions and comments can be directed to [chpps@ncmail.net](mailto:chpps@ncmail.net) or by calling (252) 726-7021 or (800) 682-2632.

### 12.3 Oyster Action Plan

Over the past several years efforts to restore North Carolina's native oyster have increased significantly and annual oyster harvests have also increased. However, since the early 1900's, the oyster population has declined an estimated 90 percent due to a variety of factors – habitat loss, pollution, diseases, and harvest pressure. Recognizing the need for concerted action to reverse this trend and the value of a healthy oyster population, an Oyster Forum was sponsored by the North Carolina Coastal Federation in 2003 and is supported by the state's CHPP. The forum participants, including scientists, fishermen, policymakers and educators, drafted the *Oyster Restoration and Protection Plan for North Carolina: A Blueprint for Action*. Goals of this plan include:

- To restore and protect North Carolina's native oyster populations, and habitat so that estuaries are again robust, diverse, & resilient ecosystems,
- To build broad public awareness & support for the value of estuarine conservation & sustainable fisheries, and
- To work with a strong coalition to make significant, demonstrable & meaningful progress towards oyster restoration in the next 3-5 years.

Within the Pasquotank River Basin, the Oyster Action Plan has identified priority areas where restoration and protection efforts will start.

- Low Priority areas include: Stumpy Point (H3)
- Medium Priority areas include: Hatteras (H4), Outer Banks (H5), Roanoke Sound & Croatan Sound (H1/H2)

To achieve the goals of oyster protection and restoration there needs to be an increase in funding and resources allocated to oyster research, public education, regulation enforcement and land acquisition. The Blueprint identifies a need to increase resources available to the Division of Marine Fisheries' Shellfish Rehabilitation Program, planning oyster hatcheries at the NC Aquariums, and designating more oyster sanctuaries. Public education activities could focus on individual actions to include oyster shell recycling and oyster gardening. To promote a sustainable oyster industry opportunities for increasing mariculture are sought. Cleaning up existing sources of point and nonpoint source pollution in shellfish waters and watersheds is essential along with improving enforcement of discharge regulations. Communities not under stormwater regulations should voluntarily implement effective stormwater rules and include them in their CAMA Land Use Plans. DEH Shellfish Sanitation surveys are a valuable source for identifying water quality concerns and areas that threaten oyster health; supporting these surveys with resources and expanding their mapping capabilities is important for oyster restoration and protection.

## 12.4 NC Coastal Nonpoint Source Program

Section 6217 of the Federal 1990 Coastal Zone Act Reauthorization Amendments (CZARA) requires every state participating in the Coastal Zone Management Act Program to develop a Coastal Nonpoint Source Program (CNPSP). The purpose of this requirement, as stated in the Act, is to "strengthen the links between Federal and State coastal zone management and water quality management programs and to enhance State and local efforts to manage land use activities that degrade coastal waters and coastal habitats." To accomplish these goals, the federal agencies established 56 Management Measures that are to be used by each state to address the following nonpoint source pollution categories (first five items) and that provide tools to address the various sources of nonpoint pollution (last item):

- Agricultural Sources
- Forestry
- Urban Areas (*urban runoff; construction activities; existing development; on-site disposal systems; pollution prevention; and roads, highways and bridges*)
- Marinas and Recreational Boating (*siting and design; and marina and boat operation/maintenance*)
- Hydrologic Modification (*channelization and channel modification; dams; and streambank and shoreline erosion*)
- Wetlands, Riparian Areas and Vegetated Treatment Systems

Detailed descriptions of the management measures, where they are intended to be applied, their effectiveness, and their costs can be found in EPA's *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* at the following website:

<http://www.epa.gov/owow/nps/MMGI/>.

Within North Carolina, Coastal Nonpoint Source Program (CNPSP) is administered by the Division of Water Quality (DWQ) and the Division of Coastal Management (DCM).

The core of the state's CNPSP is increased communication and coordination between DWQ and key state agencies that have regulatory responsibilities for controlling nonpoint sources of pollution. This increased dialogue is facilitated in part by the state's CNPSP Coordinator and promotes identification of gaps, duplications, inadequacies and/or inefficiencies of existing programs and policies. Responsibilities of the state program coordinator also include developing the 15-year Strategy Plan, serving as a liaison between DWQ and DCM, and participating in the development of nonpoint source outreach and educational activities. For more information, contact the NC Coastal Nonpoint Source Program Coordinator at (919) 733-5083, ext. 567.

### CNPSP Evaluation

Since obtaining federal approval of its program in 2003, North Carolina made significant progress in implementing the management measures of the state's CNPSP. This finding is based on a review of a range of programs, actions and initiatives of state agencies, local governments, cooperating federal agencies and regulatory and non-regulatory programs between 2002 (the year the State's plan received preliminary federal approval) and 2006, which focus directly or indirectly on avoiding, reducing, and/or treating nonpoint source pollution in the coastal counties.

North Carolina met three of the four objectives of its CNPSP Five-Year Action Plan: 2004-2008, as a result of program improvements and initiatives listed below:

- Working with other agencies to improve data management capabilities and distribution to more effectively address nonpoint source impacts;
- Improving implementation and enforcement of existing regulations and programs and
- Developing effective and dynamic education and outreach programs.

Progress on the fourth objective, reducing fecal loading into impaired SA waters, continues to be challenging. North Carolina faces enormous environmental challenges as a consequence of population growth and development. With most of the state's oceanfront developed, large tracts along the estuarine shoreline and adjacent to the Intracoastal Waterway are being developed. The CNPSP's greatest challenges for the foreseeable future lie in strengthening the state's stormwater management programs to achieve real protection for unimpaired waters, while facilitating significant restoration of impaired waters coast-wide. The NC CNPSP will continue working to establish and strengthen programs and tools to offset the impacts associated with growth in this sensitive and vital region of the state.

Coastal population growth and development will continue to strain local and state government resources. Of great concern is the fact that current state and local land use planning and environmental management programs are not sufficient to address coastal nonpoint source pollution. Therefore, the NC CNPSP intends to pursue improvements in the following major program areas:

### **I. Developing Partnerships and NPS Implementation Tools with Local Governments**

In North Carolina, local governments have primary responsibility for planning and managing growth within the framework of state law and regulations. Most development activities are reviewed by, approved or denied by appointed and elected local government boards comprised of citizens. They are volunteers often with some or limited training on the technical issues of land use, transportation and stormwater management.

Neither state agencies nor local governments alone can address the complexities of development and environmental sustainability. An integrated approach that incorporates training and the development of implementation tools with more formalized technical assistance and grants, as incentives should be explored. Some excellent building blocks for an integrated local government assistance program include DCM's land use planning program and community planners; the University of North Carolina's School of Government training programs; the NC Chapter of the American Planning Association citizen planners training program, Sea Grant's Water Quality Planner; the NC National Estuarine Research Reserve's Coastal Training Program, the Cooperative Extension Service's Growth Readiness program, the county Cooperative Extension Service programs, the Clean Water Management Trust Fund, the Ecosystem Enhancement Program's local watershed plans and the Clean Water State Revolving Loan Fund.

### **II. Improving Stormwater Management**

While progress has been significant, major challenges to managing and eliminating stormwater impacts remain. Although North Carolina's coastal stormwater rules have been in effect for over 15 years, DWQ staff, other resource management agencies and many citizens believe the rules are ineffective. In January 2007, DWQ issued rules for a new stormwater program for local governments, the Universal Stormwater Management Program (USMP).

The USMP improves on the current rules by essentially eliminating the ability to avoid use of stormwater best management practices (BMPs) by staying below certain impervious thresholds. USMP strengthens other provisions as well, including treatment of a larger stormwater volume and providing attenuation of larger flows. While USMP would improve protections, it is only a voluntary option.

In recognition of the inability of existing rules to reduce the water quality impacts of stormwater and the need for stronger minimum mandatory measures, the DWQ is proposing changes to the coastal stormwater rules that are similar to the USMP but not quite as protective, requiring instead engineered stormwater treatment devices for all development adjacent to high quality coastal waters that have more than 12 percent built-upon area. The rules will also require the use of control measures that result in fecal coliform die off and control sources of fecal coliform.

Compliance with the stormwater rules is a significant issue. NC CNPSP funded inspections of a significant number of permit renewal sites in DWQ's Wilmington Regional Office region and found that approximately 35 percent were not in compliance. Approximately 8 percent of the sites had installation problems or design deficiencies and 2 percent exceeded the impervious area limits. Lack of routine maintenance was the main cause of non-compliance in the majority of inspected sites.

There is not enough DWQ field staff to inspect every site, and this situation is compounded by insufficient and incorrect information on these sites in DWQ's permit tracking system. A grant from the CNPSP is funding a DWQ effort to develop a field inspection form, inspect a subset of permitted sites that will be up for renewal in 2007 and 2008 and develop a consistent method for processing renewal permits and entering the data in DWQ's tracking system. This work should be completed by December 2007.

The increase in development in the coastal counties has resulted in the construction of hundreds of roads servicing subdivisions. Under current state law the state Department of Transportation (DOT) can be petitioned to designate roads as public and be maintained by DOT. DOT District Engineers review subdivision maps and/or plats for conformance with the state's minimum construction standards. They also review the stormwater facilities operations and maintenance plan required as part of this process. Coordination between the regional offices of DWQ and the appropriate DOT district offices on pending state stormwater permits could result in improvements in the proposed drainage plans and implementation of appropriate stormwater BMPs, including minimizing stormwater through site design.

Local governments have primary responsibility to plan for and manage growth in their jurisdictions. While many coastal counties and municipal governments are making progress on stormwater management, a 2006 UNC School of Government survey of local ordinances found that while 18 of the 20 coastal counties have subdivision ordinances, only eight have stormwater ordinances effective throughout their jurisdiction, two have partial coverage and only seven have erosion and sediment control ordinances. Without improvements to local government development ordinances, local stormwater management and enforcement, coastal water quality will continue to be compromised.

### **III. Improving Management of Marinas and Recreational Boating**

There are approximately 450 marinas in coastal North Carolina and over 100 shops where boats are built. There are thousands of private docks and piers as well. In the first seven months of 2006, DCM approved 53 major permit applications that added 340 private boat slips to coastal waters. Of these almost 90 were new residential multi-slip docking facilities. In addition, DCM issued approximately 1200 general permits in 2006 for small docks/piers of one or two slips (GP 07H .1200). At a minimum, these general permits added 1200 new residential boat slips in the state's coastal waters in one year.

The CNPSP funded a unified marina policy project, and the project Steering Committee concluded that the state should focus on improving management of facilities with 3-10 slips. These multi-slip docking facilities currently are not subject to the more comprehensive state regulatory review required of marinas; yet their locations and numbers are believed to have significant impact on water quality and fragile coastal habitat. The DCM and Marine Fisheries are cooperatively developing guidance on placement of structures in shallow waters and the DCM has made changes to its major permit application for marinas and multi-slip docking facilities to capture more detailed information.

The DWQ is conducting a marina and boatyard study to: 1) better understand the services and activities common to marinas, boatyards, and manufacturers, 2) determine if these facilities are properly covered by a NPDES stormwater permit (NCG190000), 3) understand types/frequency of process wastewater discharges that occur at these facilities and 4) sample process wastewater in order to understand and characterize waste streams.

The state law governing the designation of no-wake zones should be amended to allow designation to protect estuarine and river shorelines and shallow water habitats.

### **IV. Developing Best Management Practices Guidance for Hydromodification Projects**

Many ditches and canals in coastal North Carolina were first excavated for agriculture and forestry. Their management and maintenance continues to be exempt from state environmental review even though many are now managed for flood control purposes. Coastal counties and local governments have developed, or are in the process of developing stormwater management plans that include maintaining some existing drainage canals and ditches to avoid flooding of residential and commercial development. These maintenance activities can adversely impact water quality as well as riparian vegetation and fresh water and estuarine resources. Routine maintenance to remove debris from these canals and ditches, and cleanup in response to storm damage, is done in the absence of comprehensive guidance that could minimize the environmental impacts.

The DENR should establish an interagency working group to develop guidance on best management practices for routine and emergency maintenance activities. Adherence to this guidance should be required, at a minimum, for maintenance and management projects funded under the state's water resources development grants and the Clean Water Management Trust Fund. The working group could also consider developing a hands-on training program for contractors who conduct snagging and clearing activities, similar in intent to the Clear Water Contractor workshops conducted by the Division of Land Resources.

The working group should include representatives of the Divisions of Water Resources, DWQ, Forest Resources, Division of Soil and Water Conservation, Marine Fisheries, DCM, the Wildlife Resources Commission and the Ecosystem Enhancement Program, along with the U.S. Army Corps of Engineers, the Fish and Wildlife Service and the Natural Resources Conservation Service.

## **V. Updating Information for Decision Making**

The most recent land-cover information for North Carolina is based on 1997 imagery. Given the significant increases in population and development in the coastal counties, the use of ten-year old information does not allow for analysis of current conditions. North Carolina needs to update the state's land cover information and develop a funding and planning mechanism for continued updating on a 3-5 year basis.

### **12.5 Community Conservation Assistance Program**

The landscape of North Carolina is changing and Soil and Water Conservation Districts have voiced concern about a void in program areas to address the growing threat of nonpoint source pollution issues on non-agricultural lands. In the summer of 2005, a survey was distributed to all districts to inventory their level of interest and best management practices (BMP) needs on urban, suburban and rural lands. Many districts completed surveys about their needs for this program, and they requested over \$6.5 million for local projects. Division staff used the survey responses to develop two grant applications for program funding. In July 2006, while the grant applications were still under review, the legislature unanimously passed H2129, creating the Community Conservation Assistance Program (CCAP). Shortly after, both grants were approved at 100 percent funding. An additional survey was completed in fall 2006, and 40 districts responded with needs for CCAP BMPs. A grant was submitted on behalf of those districts during the March 2007 application cycle for the Clean Water Management Trust Fund. If awarded, this grant will impact several counties in this river basin.

#### **Current Status**

CCAP will support the installation of stormwater BMPs. This program is an innovative approach to controlling the amount and quality of stormwater runoff that enters our surface waters. Through locally led conservation, the Division of Soil and Water Conservation (DSWC) and Soil and Water Conservation Districts (SWCD) have been successful in implementing voluntary agricultural BMPs, which have addressed many different water quality parameters. The intent is for CCAP to operate under the same guidance and accountability as the NC Agriculture Cost Share Program and achieve the same successes.

CCAP will focus its efforts on stormwater retrofits to existing land uses. It will not be used to assist in new development sites to meet state and federal stormwater mandates. Districts have the technical expertise to install stormwater BMPs and a successful history of promoting voluntary conservation practices. The program will give the districts the structure and financial assistance to carry out this mission. CCAP will encourage local governments, individual landowners and businesses to incorporate stormwater BMPs within their landscape. The economic incentive, 75 percent of average installation costs, will encourage voluntary conservation.

Standards and specifications for 15 CCAP BMPs have been approved by the Soil and Water Conservation Commission. These practices include: impervious surface conversion, permeable

pavement, grassed swale, critical area planting, bioretention areas, backyard rain gardens, stormwater wetlands, backyard wetlands, diversion, riparian buffer, stream restoration, streambank and shoreline protection, cisterns, abandoned well closure and pet waste receptacles.

### **Funding**

The DSWC was recently awarded two grants that will fund CCAP implementation in 17 counties across the state. The DSWC received a grant from the Clean Water Management Trust Fund in the sum of \$557,000 and an award from the Section 319 Clean Water Act grant program for \$277,425. Since this is a grant funded program to date, only districts that participated in the surveys will receive an allocation. The maximum amount of assistance per practice is limited to \$50,000. It is the program's goal to seek additional funding sources, including recurring state appropriations, to offer this program statewide in the future. The DSWC and districts are excited about the possibilities that this program offers in addressing current stormwater pollution issues.

## **12.6 The Role of Local Government in Land Use Planning**

As residential and commercial development expands inward from the coast, many local governments are now faced with making land use decisions to limit the extent and areas of land development. Several coastal counties still have no zoning ordinances, or have large areas of the county that are not under zoning ordinances. In addition, property owners are being faced with the decision to continue historical uses of their land or sell their property for development. This is happening in both rural and coastal communities. According to a recent survey conducted by the Raleigh News and Observer, more than 34,000 houses and condominiums are planned or underway in the 20-county area of the coast from Currituck County to Brunswick County.

### **12.6.1 Land Use Plans**

The Coastal Area Management Act (CAMA) requires each of the 20 coastal counties to have a local Land Use Plan (LUP) 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. Each land use plan includes an inventory and assessment of existing environmental conditions along with local policies and a future land use map that address growth issues related to designated Management Topics: land use compatibility, infrastructure carrying capacity, natural hazards, public access, areas of local concern, and water quality.

Inventory and assessment specific to water quality include the identification of existing surface water quality, current situations and trends on permanent and temporary closures of shellfish waters, areas with chronic wastewater treatment system malfunctions, areas with water quality or public health problems related to nonpoint source pollution, and locations where land use and water quality conflicts exist. Policies to address water quality issues are prepared based on the management goal, CRC planning objective, and land use plan requirements specified for the water quality Management Topic. For water quality, the management goal is to maintain, protect, and where possible 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 the 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 (sewage and stormwater) 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.

The CRC's guidelines provide a common format for each plan and a set of issues that must be considered during the planning process; however, the policies included in the plan are those of the local government, not of the CRC. By law, the role of the CRC is limited to determining that plans have been prepared consistent with State Land Use Plan guidelines, do not conflict with State or federal rules, and are consistent with the State's Coastal Management program. Once a land use plan is certified by the CRC, the Division of Coastal Management uses the plan in making CAMA permit decisions and federal consistency determinations. Proposed projects and activities must be consistent with the policies of a local land use plan or DCM cannot permit a project to go forward.

At the local level, land use plans provide guidance for both individual projects and a broad range of policy issues, such as the development of regulatory ordinances and public investment programs. Although DCM monitors use of the land use plans through an implementation status report, strict adherence to land use plan policies and implementation actions is largely up to the local government. For this reason, community and local official support of the land use plan is critical to successfully achieving the goals for each management topic, including water quality.

### 12.6.2 Land Use Plans for Communities in the Pasquotank River Basin

More information and a list of CAMA LUPs are available from the Division of Coastal Management website: <http://www.nccoastalmanagement.net/Planning/planning.htm>. Table 28 presents counties and their municipalities within the Pasquotank River basin. The status of each CAMA Land Use Plan is also indicated.

Table 28 Local Planning Jurisdictions

Multi-County Planning Region R The Albemarle Commission		CAMA Land Use Plan CRC Certification Progress (as of March 2007)				
County	Municipalities	CRC Certified	Review & Revisions	Under State Review	In Process	Updates in 2008
Camden		2005				
Currituck			X			
Dare						X
Gates		2005				
Pasquotank	Elizabeth City		X			
Perquimans	Hertford, Winfall		X			
Tyrrell	Columbia				X	
Washington					X	
Dare	Town of Duck	2005				
	Town of Southern Shores				X	
	Town of Kitty Hawk	2005				
	Town of Kill Devil Hills					X
	Town of Nags Head				X	
	Town of Manteo	2007				

### Camden County

The LUP states the county will develop a shoreline access plan. The plan supports the reduction of soil erosion, sedimentation, runoff to protect water quality. It also takes into consideration countywide soil erosion and sedimentation control ordinance and a stormwater ordinance to include retention facilities and limits to impervious surface development. The county supports the use of BMPs for agriculture and forestry land uses. Vegetated buffers are encouraged between any right-of-ways. The county supports the use of package sewage treatment plants outside of proposed sewer service areas. These package plants must have a plan to assimilate into a public plan if private operation fails. The county opposes the installation of package sewage treatment plants and septic systems near areas classified as wetlands or natural heritage areas, with the exception of constructed wetlands. Strict enforcement of lot size requirements is needed for houses using septic systems.

Specific policies aimed to protect water quality include: establishing buffers along Joyce, Areneuse and Sawyer's Creeks and reducing nutrient runoff from developing areas along these waterways. The county supports state water quality and coastal management policies, including stormwater regulations. The county will rely on state and federal agencies to promote protection of aquatic nursery habitats and the Great Dismal Swamp. The county supports cluster development.

### Currituck County

The LUP separates the county into three areas to include: Knott's Island, the Outer Banks, and the mainland. Knott's Island is expected to have modest residential development and is development limited by the soil suitability for septic systems. Many of the new residential developments along the Outer Banks are large vacation rental units, which limit stormwater infiltration and pose concerns for the need to establish new wastewater treatment plants. Redevelopment includes replacing older beach cottages with large structures leading to intensification of land use and increased residential density. The coastline of the mainland is experiencing modest development as it is a less expensive alternative to development on the Outer Banks. Development is likely to move inland to agricultural tracts that are already cleared, leveled and well drained.

There are no large central sewer systems in Currituck County, but there are nine large surface sewage treatment plants and 64 on-site wastewater treatment systems. Septic systems are the predominate wastewater treatment option, however poor soil suitability leaves many of these systems failing. The LUP water and sewer policies include encouraging utility service extension to areas that are in existing developed areas and potential growth zones, where development densities make a public system more efficient, in new areas to support new industry and economic growth and away from environmentally sensitive areas and farmland. Package plants are supported to allow more efficient land use; these plants will be permanently managed on an organizational basis and may require assimilation into a central sewer system once established.

The LUP states its policy is to support actions to prevent soil erosion and sedimentation from entering the estuarine waters, controlling quality and quantity of stormwater runoff into the estuary, runoff from land use activities should be close to natural conditions and new developments are required to not exceed predevelopment runoff conditions. Stormwater management for new development requires engineering plans to include 10- year storm or 4.3 inches management. Natural vegetation, wetlands and open spaces are encouraged to maintain pervious surface areas and vegetated buffers are encouraged to help protect water quality. A

countywide drainage and flood management plan is to be developed to help resolve stormwater problems.

### Manteo LUP

Town of Manteo anticipates continued growth, with a higher percentage of people being retired. Goals included in the LUP as identified by citizens of Manteo include: maintaining a small town character, sense of community and history, protect wetlands and environmentally fragile areas while providing public green spaces, improve water quality in Shallowbag Bay, and limit or reduce growth to prevent exceeding the wastewater treatment plant's capacity. With the recognition that meeting many of the town's goals is dependent on improving and protecting water quality, the LUP identifies stormwater runoff, marinas, and discharge from their WWTP as threats to water quality. In 2000 Manteo developed a Stormwater Management Plan which identifies their stormwater conveyances as open ditches that lack capacity to convey during peak flows and they do not treat the polluted runoff before it is discharged into surface waters. They now have a stormwater management ordinance requiring new and redevelopment management plans that include onsite stormwater treatments. The town is also pursuing green spaces for use as stormwater treatment via bioretention and filtration. Shallowbag Bay was identified as one site where stormwater management improvements could improve water quality.

Water quality and conservation policies include, encouraging low water consumption to reduce the amount of wastewater needed to be treated, increase efficiency of the WWTP, limit impervious surfaces, limit additional WWTP intake to the current planned and permitted developments and encourage vegetated riparian buffers and wetlands. The LUP states one of the main constraints to development is the limited capacity of the WWTP. The town acknowledges that growth includes increased marina use and is encouraging marinas to become Clean Marina Certified. The town supports island-wide water quality planning to help address environmental protection issues that impact Manteo, but are outside the towns planning zone.

### Perquimans County

Growth in Perquimans County is anticipated to occur mainly in the subdivision areas of Hertford and Windfall. The county developed strategies to encourage residential development along internal access roads and to discourage strip development along state roads. Development, without the use of a centralized public sewer system, is limited because of poor soil conditions causing technical difficulties with septic tank drain fields. The unincorporated portions of Perquimans County rely on septic systems and Hertford currently operates a municipal wastewater treatment system that is being improved. Windfall's wastewater is collected and sent to Hertford for treatment. Wastewater treatment package plants will be considered in certain zones.

Specific water quality policies call for the enforcement of new ordinances regarding land use, development and redevelopment activities to protect the Perquimans River, Little River, Yeopin River and the Albemarle Sound. The LUP states the county will consider establishing criteria for cluster housing, vegetated buffers, impervious surface limits, stormwater management alternatives, erosion and sediment controls. The county may also amend zoning designations of permitted and condition use density and intensity criteria. The LUP identifies stormwater management and treatment is dependent on structures, swales and ditches associated with the transportation system and ponds and natural areas. The county suggests a stormwater study be completed to evaluate flood conditions and land use activities that contribute to intensified flooding.

## Land Use Plan Critique

After review of several CAMA Land Use Plan drafts, DWQ recommends that all communities adopt low impact development strategies and technologies for both new development and as options in retrofitting existing infrastructure. It is important for communities to undertake stronger stormwater controls and to update old or failing wastewater systems (e.g., on-site and treatment plants) to prevent future deterioration in water quality. Communities need to address development issues in regards to water quality by implementing the best available control options and by implementing enforcement. DWQ views LUPs as a tool to improve and protect the water quality that these communities' economies depend on. Unfortunately, many of the reviewed LUPs do not adequately reflect proactive planning above and beyond state minimum criteria. DWQ also recognizes and supports the importance of low impact development and appropriate technologies trainings for developers and local leaders. Overall, LUP policy framework is too general. A large number of policies address adoption of ordinances and procedures by the local government, or defer to the State and Federal agencies' rules to meet the LUP requirements. The policies should provide specific guidance to aid in the development of local ordinances and procedures, not merely state that they will be adopted.

An evaluation of 40 CAMA LUPs written during the mid 1990's concluded, "local planning efforts are procedurally strong, addressing the ranges of issues they are required to cover, but analytically and substantively weak, providing little meaningful attention to regional environmental protection concerns" (Norton, 2005). This evaluation found that many LUPs completed the various required analyses in regards to identifying hazards, flood zones, soil limitations and environmentally sensitive areas, but later in the plan made future land classifications for development with no reference to these analyses (e.g., high density development on oceanfront property zoned as high hazard) (Norton, 2005). The plans did not adequately explain how land was determined suitable for future growth and development and did not adequately address potential adverse environmental impacts, beyond state compliance standards (Norton, 2005). Almost all the communities addressed the environmental impacts and thus need for improved wastewater systems, but "they uniformly failed to discuss the potential growth-inducing effects and resulting environmental impacts that come with infrastructure expansions" (Norton, 2005). In addition, stormwater management was addressed for controlling runoff and associated flooding, but did not address the water quality related issues associated with stormwater management (Norton, 2005). In conclusion, regional environmental concerns and cumulative and secondary impacts of development were not addressed with specific management strategies in the LUPs.

## **12.7 Management Recommendations for Local Governments**

Below is a summary of management actions recommended for local authorities, followed by discussions on large, watershed management issues. These actions are necessary to address current sources of impairment and to prevent future degradation in all streams. The intent of these recommendations is to describe the types of actions necessary to improve stream conditions, not to specify particular administrative or institutional mechanisms for implementing remedial practices. Those types of decisions must be made at the local level.

Because of uncertainties regarding how individual remedial actions cumulatively impact stream conditions and in how aquatic organisms will respond to improvements, the intensity of management effort necessary to bring about a particular degree of biological improvement cannot be established in advance. The types of actions needed to improve biological conditions

can be identified, but the mix of activities that will be necessary – and the extent of improvement that will be attainable – will only become apparent over time as an adaptive management approach is implemented. Management actions are suggested below to address individual problems, but many of these actions are interrelated (NCDENR-DWQ, 2003).

- (1) Feasible and cost-effective stormwater retrofit projects should be implemented throughout the watershed to mitigate the hydrologic effects of development (e.g., increased stormwater volumes and increased frequency and duration). This should be viewed as a long-term process.
  - (a) Over the short term, currently feasible retrofit projects should be identified and implemented.
  - (b) In the long term, additional retrofit opportunities should be implemented in conjunction with infrastructure improvements and redevelopment of existing developed areas.
  - (c) Grant funds for these retrofit projects may be available from EPA initiatives, such as EPA Section 319 funds, or the North Carolina Clean Water Management Trust Fund.
- (2) A watershed scale strategy to address inputs should be developed and implemented, including a variety of source reduction and stormwater treatment methods. As an initial framework for planning input reduction efforts, the following general approach is proposed:
  - (a) Implementation of available best management practice (BMP) opportunities for control of stormwater volume and velocities. As recommended above to improve aquatic habitat potential, these BMPs will also remove pollutants from stormwater.
  - (b) Development of a stormwater and dry weather sampling strategy in order to facilitate the targeting of pollutant removal and source reduction practices.
  - (c) Implementation of stormwater treatment BMPs, aimed primarily at pollutant removal, at appropriate locations.
  - (d) Development and implementation of a broad set of source reduction activities focused on: reducing nonstorm inputs of toxics; reducing pollutants available for runoff during storms; and managing water to reduce storm runoff.
- (3) Actions recommended above (e.g., stormwater quantity and quality retrofit BMPs) are likely to reduce nutrient/organic/bacterial loading, and to some extent, its impacts. Activities recommended to address this loading include the identification and elimination of illicit discharges; education of homeowners, commercial applicators, and others regarding proper fertilizer use, street sweeping, catch basin clean-out practices, animal and human waste management, and the installation of additional BMPs targeting biological oxygen demand (BOD) and nutrient removal at appropriate sites.
- (4) Prevention of further degradation will require effective post-construction stormwater management for all new development in the study area.
- (5) Effective enforcement of sediment and erosion control regulations will be essential to the prevention of additional sediment inputs from construction activities. Development of improved erosion and sediment control practices may also be beneficial.

- (6) Watershed education programs should be implemented and continued by local governments with the goal of reducing current stream damage and preventing future degradation. At a minimum, the program should include elements to address the following issues:
- (a) Redirecting downspouts to pervious areas rather than routing these flows to driveways or gutters;
  - (b) Protecting existing woody riparian areas on all streams;
  - (c) Replanting native riparian vegetation on stream channels where such vegetation is absent;
  - (d) Reducing and properly managing pesticide and fertilizer use;
  - (e) Reducing and properly managing animal waste; and
  - (f) Reducing and properly managing septic systems.

## 12.8 Planning for Sea Level Changes

Sea level rise will adversely impact North Carolina's coastline and 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 should be used as a resource for coastal town and municipality 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 the website: <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/welcome.html>.

## 12.9 Using Land Use Planning as a Tool to Reduce Impacts of Future Development

Many communities are looking at the challenges and opportunities that development offers to their communities seriously. Camden County extended a moratorium on new subdivisions until a new school can be completed to hold the additional students resulting from the developments. Outside of the Pasquotank River basin, the town of Bath approved a 6-month moratorium on new subdivisions to allow them time to assess how the town wanted to develop its remaining waterfronts lots and where the town needed to protect its resources. In addition, Pamlico County approved an ordinance to limit density and height of developments along the water. The neighborhood of Woodsong in Shallotte drains to Lockwoods Folly, which is Impaired for shellfish harvesting. The development will use pervious concrete to collect stormwater and a man-made wetland to help treat it, as well as courtyard gardens to treat runoff before it goes to a collection system. The developer notes that degradation of the environment does not have to

follow development, but believes a quality lifestyle is being sold by clustering home sites and creating large common areas. These types of development activities point to a growing market for developments like these; socially, financially and environmentally viable.

Proactive planning efforts at the local level are needed to assure that development is done in a manner that maintains water quality. These planning efforts can find a balance between water quality protection, natural resource management, and economic growth. Growth management requires planning for the needs of future population increases, as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin. DWQ's review of draft CAMA Land Use Plans finds that the planning efforts do not adequately protect water quality. Many plans do not consider the cumulative impact from development on water quality. Land Use Plans need to incorporate proactive measures to meet future growth demands to prevent water quality deterioration.

To prevent further impairment in urbanizing watersheds local governments should:

- (1) Identify waters that are threatened by development.
- (2) Protect existing riparian habitat along streams.
- (3) Implement stormwater BMPs during and after development.
- (4) Develop land use plans that minimize disturbance in sensitive areas of watersheds.
- (5) Minimize impervious surfaces including roads and parking lots.
- (6) Develop public outreach programs to educate citizens about stormwater runoff.

***Planning Recommendations  
for New Development***

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking & narrower slots).
- Place sidewalks on only one side of residential streets.
- Minimize culvert pipe and hardened stormwater conveyances.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.

Action needs be taken at the local level to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box (above), refer to EPA's website at [www.epa.gov/owow/watershed/wacademy/acad2000/protection](http://www.epa.gov/owow/watershed/wacademy/acad2000/protection), the Center for Watershed Protection website at [www.cwp.org](http://www.cwp.org), and the Low Impact Development Center website at [www.lowimpactdevelopment.org](http://www.lowimpactdevelopment.org). Additional information regarding environmental stewardship for coastal homeowners is available at <http://www.soil.ncsu.edu/assist/coastindex.html>. Further public education is also needed in the Pasquotank River basin in order for citizens to understand the value of urban planning and stormwater management. For an example of local community planning effort to reduce stormwater runoff, visit <http://www.charneck.org/Home.htm>.

## **12.10 The Importance of Local Initiatives**

As the Basinwide Planning Program completes its third cycle of plan development, there are many efforts being undertaken at the local level to improve water quality. DWQ encourages local agencies and organizations to learn about and become active in their watersheds.

An important benefit of local initiatives is that local people make decisions that affect change in their own communities. There are a variety of limitations local initiatives can overcome

including: state government budgets, staff resources, lack of regulations for nonpoint sources, the rulemaking process, and many others.

These local organizations and agencies are able to combine professional expertise in a watershed. This allows groups to holistically understand the challenges and opportunities of different water quality efforts. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests, and encourages others to become involved and invested in these projects. By working in coordination across jurisdictions and agency lines, more funding opportunities are available, and it is easier to generate necessary matching or leveraging funds. This will potentially allow local entities to do more work and be involved in more activities because their funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success. Federal and State government agencies are interested in assisting local governments and citizen groups in developing their water quality management programs.

The collaboration of these local efforts are key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the state. The following local organizations and agencies are highlighted to share their efforts towards water quality improvement.

### 12.10.1 Federal Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects (Table 29). Through annual base funding, there is approximately \$1 million available for demonstration and education projects across the state. An additional \$2 million is available annually through incremental funds for restoration projects. All projects must provide nonfederal matching funds of at least 40 percent of the project’s total costs. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution (NPS). Information on the North Carolina Section 319 Grant Program application process is available online at [http://h2o.enr.state.nc.us/nps/application\\_process.htm](http://h2o.enr.state.nc.us/nps/application_process.htm). Descriptions of projects and general Section 319 Program information are available at [http://h2o.enr.state.nc.us/nps/Section\\_319\\_Grant\\_Program.htm](http://h2o.enr.state.nc.us/nps/Section_319_Grant_Program.htm).

Many Section 319 projects are demonstration projects and educational programs that allow for the dissemination of information to the public through established programs at NC State University (NCSU) and the NC Cooperative Extension. Other projects fund stream restoration activities that improve water quality.

Table 29 Section 319 Grant Funded Projects in the Pasquotank River Basin

Fiscal Year	Name	Description	Agency	Amount
2002	Effects of Drainage Ditches and Roads on Watershed Ecology Hydrology and Water Quality within the Emily and Richardson Pryer-Buckridge Coastal Reserve	Wetlands & Hydrologic Modification	NC DENR, DCM & NCSU	\$200,000
2000	Promote Responsible nutrient management by developing a procedure to document forage crop realistic yield expectations (RYE)		NCSU	

2003 - 2004	Manteo Stormwater Retrofit (not a 319 Project)	Urban Stormwater, Planning	CWMTF	\$247,500
2004	Adapt a Site Evaluation Tool (SET) for use by local governments in Upper Neuse Basin in determining w/stormwater performance standards for new development		Upper Neuse River Basin Association	
2005	Phytoremediation to Prevent NPS Discharge of Gasoline Contaminated Groundwater to the Pasquotank River	Groundwater Protection, Stream Restoration	NCSU	\$145,054
2005	Kitty Hawk Stormwater Education	Urban Stormwater, Education	DCM-NERR Manteo	\$11,590
2005 - 2006	OBX LID Project	Urban Stormwater, Planning, Education	Coastal Studies Institute	\$58,300
<b>Total Funding</b>				<b>\$662,444</b>

### 12.10.2 Pasquotank River Watershed Project

In 2005, Congress approved a multi-year Pasquotank River Watershed Project led by the Albemarle Regional Health Services Agency, NCSU's College of Agriculture and Life Sciences and Cooperative Extension. The Project will demonstrate the application of Integrated Water Designs (IWD), which addresses all aspects of water management such as: septic systems, stormwater, water table management, flood control and erosion and sedimentation control. IWD concepts will be developed; appropriate technologies selected and designed, and a demonstration community will be selected. Existing baseline water quality conditions and water quantity impacts (e.g. storm water removal, flooding, etc.) will be monitored, including assessment and tracking of key water quality pollutants as they move through the ground water. Bacterial source tracking (BST) techniques will be investigated to determine if they can help identify key microbial pollutant sources. More advanced types of septic systems than are currently in use will be evaluated to determine their potential use as IWDs for repair of failing septic systems. NC State University team, working in partnership with the Pasquotank County Cooperative Extension office and the local Albemarle Agency staff will coordinate technology transfer training in the county. Water management professionals throughout the state will also be trained at the NCSU's training centers located throughout the state. New hands-on demonstrations and training materials will be developed to describe the IWD approach to practicing professionals such as soil scientists, planners, technology designers, installers and service providers. Cooperative Extension will lead public educational programming efforts for community decision makers and field practitioners.

### 12.10.3 Clean Water Management Trust Fund

The Clean Water Management Trust Fund (CWMTF) offers approximately \$40 million annually in grants for projects within the broadly focused areas of restoring and protecting state surface waters and establishing a network of riparian buffers and greenways. In the Pasquotank River basin, 34 projects have been funded for a total of \$34,157,005 (Table 30). For more information on the CWMTF or these grants, call (252) 830-3222 or visit the website at [www.cwmtf.net](http://www.cwmtf.net).

Table 30 Clean Water Management Trust Fund Projects in the Pasquotank River Basin

Project Number	Application Name	Proposed Project Description	Amount Funded
1997B-006	NC Div Coastal Management - Buckridge Tract Acq&Restor/Alligator R	Restore and enhance 10,000 acres of wetlands at Buckridge Tract. Monitor results.	\$3,858,500
1998A-008	NC Wildlife Resources Commission - Hassell Tract Acq/ Whitehurst's Ck	Acquire through fee simple purchase 491 acres along Whitehurst Creek.	\$169,000
1998A-010	NC Wildlife Resources Commission - Tice Tract Acq/ NW River & Tulls Bay	Acquire through fee simple purchase 473 acres along the Northwest River, Tulls Bay, and Crosses Creek.	\$250,000
1998A-011	NC Wildlife Resources Commission -Midgett Marsh Tract Acq/ Roanoke S.	Acquire through fee simple purchase 574 acres along Roanoke Sound.	\$620,000
1998A-403	Roper- Roper Site Acq and Env Cleanup/ Kendrick Ck	Purchase, clean up and preserve a waterfront greenway property of 4.8 acres and 10,000 linear feet along Kendricks Creek.	\$60,000
1998A-413	Pasquotank Co-Constructed Wetlands/CE/Ag BMPs/Newland	Construct a series of "in-stream" wetlands along the 7 mile canal, modify and stabilize canal (6,000 acre drainage). Restore riparian wetlands, and secure easements on 278 acres buffers. Install water control structures and ag BMPs.	\$413,600
1998A-414	Currituck County- Constructed Wetlands/CE/Ag BMPs/Guinea Mill	Construct a series of instream wetlands, restore 35 acres of hardwood swamp, acquire 50 foot easements on both sides of the canal. Implement ag BMPs in 6,000 acre watershed.	\$352,610
1998B-507	Roanoke Villas Clean Water Found. -Land Ap/WWTP upgrade	Design, construct and operate infiltration pond alternative to surface water discharge. Remove 60,000 GPD permitted discharge into SA waters.	\$245,568
2000A-010	NC Wildlife Resources Commission - Harrison Tract Acq/North R	Acquire through fee simple purchase 3,915 acres along the North River. CWMTF funds to acquire the 720 acres of riparian buffers.	\$534,360
2000A-018	NC Wildlife Resources Commission - Roanoke Island Greenway I	Acquire through fee simple purchase 38 acres on Roanoke Island. Tract to become part of a greenway system.	\$1,207,000
2000B-006	Nags Head & Nature Conservancy- Nags Head Woods Acq	Acquire through fee simple purchase 49 acres along Roanoke Sound in the Nags Head Wood-Jockeys Ridge conservation complex.	\$693,000
2000B-010	NC Div Coastal Management - Roper Island Acq	Acquire through permanent conservation easements 8,274 acres on Roper Island along the Alligator River. CWMTF funds to be combined with other funds to acquire the CE.	\$285,220
2000B-013	NC Wildlife Resources Commission - Circle Tract/Alligator River Acq	Acquire through fee simple purchase 5,401 acres along the Alligator River and Second Creek.	\$1,715,000
2000B-015	NC Wildlife Resources Commission - Roanoke Island II Acq & Greenway	Acquire through fee simple purchase 46 riparian and wetland acres along Roanoke Sound. Tract represents Phase II of the Roanoke Island Greenway project.	\$2,707,000
2001B-023	NC Aquarium Society- Acquisition & Stormwater/ Whalebone Junction	Acquire 5 acres along Atlantic Ocean and treat stormwater runoff from 30 acres to Roanoke Sound.	\$4,600,000
2001B-042	Perquimans Co. Restoration Assc.-Acquisition/ Perquimans River	Acquire through fee simple purchase 38 acres on the Perquimans River. Includes riparian buffer installation, created wetland demonstration, nature trail construction, and environmental education.	\$345,000

2001B-502	Camden County/Currituck County -Sawyer's Creek	Provide funds to design and obtain permits for a regional wastewater collection and land application systems to address failing and straight-piped septic systems draining to Sawyers Creek.	\$3,564,000
2002A-014	Nags Head - Acq/ Catfish Farm Open Space	Acquire 11.4 acres through fee simple purchase along the Roanoke Sound and tributary creeks. CWMTF would fund purchase of 46% of the tract.	\$300,000
2002B-017	NC Wildlife Resources Commission - Acq./Risky Business, Roanoke Sound	Acquire through fee simple purchase 250 acres along the Roanoke Sound, Johns Sand Beach and Broad Creeks.	\$375,000
2002B-608	Tyrrell County Water & Sewer District 1 - Septic Systems/Scuppernong II	Eliminate failing septic tanks in Districts 1&2 of the County by constructing a collection system and pumping waste to the Town of Creswell's WWTP. The Town of Creswell's WWTP would be expanded. Would reduce pollutant delivery to the Scuppernong River.	\$1,203,647
2003A-029	NC Div Parks & Recreation - Acq./ Pettigrew State Park, Scuppernong River	Acquire through fee simple purchase 1,864 acres along the Scuppernong River and add the property to Pettigrew State Park.	\$890,000
2003A-031	NC Wildlife Resources Commission- Acq./ Davis Tract, Alligator River	Acquire through fee simple purchase 340 acres draining to the Little Alligator River. The tract contains areas of ditched cropland which will be restored when the tract becomes part of the adjoining Alligator River Game Lands.	\$374,000
2003A-032	NC Wildlife Resources Commission- Acq./ GMS Tract, Alligator River	Acquire through fee simple purchase 8,476 acres, including 4,860 riparian and wetland acres, along Second Creek and Alligator River (both ORWs) and Little Alligator River. The tract will be managed as part of WRC's Game Lands Program.	\$1,700,000
2004A-702	Manteo, Town of - Storm./ Shallowbag Bay	Design, permit, & acquire stormwater easements for pocket stormwater infiltration areas and/or construction of pocket infiltration areas to treat runoff from 147 ac in the Shallowbag Bay drainage area.	\$379,500
2004B-046	NC Wildlife Resources Commission-Acq/ Pipkin Tract, Broad Creek	Protect through fee simple purchase 120.5 acres along Broad Creek and Roanoke Sound. The tract is adjacent to open shellfish waters and would become part of the Roanoke Marshes Game Lands.	\$200,000
2004B-604	Stumpy Point Water & Sewer District - Septic/ Stumpy Point and Lake Worth Septic Tanks	Construct 8 miles of a septic tank effluent pump sewer collection system to connect 110 failing septic systems to a tertiary WWTP with UV disinfection. Project will reduce fecal coliform and nutrient delivery to Stumpy Bay and Pamlico Sound.	\$1,728,000
2004B-802	Creswell, Town of - Plan/ Stormwater Management, Scuppernong River	Develop a plan to address stormwater management needs for the Scuppernong River and a tributary canal. Plan to consider wetland pond modification, wetland construction, pump station modification, and canal widening.	\$25,000
2005A-024	NC Wildlife Resources Commission - Acq/ Roanoke Island Greenway, Amended Project	Provide additional funds to finalize the purchase of 39 acres along Croatan Sound that were previously approved by CWMTF (2000B-015). The tract has increased in value since the original award. Tract will be managed as part of the Game Lands program.	\$1,746,000
2005A-804	Manteo, Town of - Plan/WW/ Wastewater Treatment Feasibility Plan, Shallowbag Bay	Develop a feasibility study of nutrient removal options for wastewater discharged to Shallowbag Bay.	\$65,000
2005A-806	NC Coastal Federation - Plan/Acq/ Currituck Sound Protection Plan	Develop a plan to prioritize acquisition and restoration efforts in Currituck Sound. Project to include landowner outreach and development of funding proposals for top two priority sites identified by the study.	\$40,000

2005B-504	Elizabeth City, City of - WW/ Hughes Boulevard Force Main, Knobs Creek	Address infiltration & inflow problems by constructing 16,200 lf of force main to serve 2,200 residences. Would reduce fecal coliform bacteria and nutrient contamination to the Pasquotank River. Includes pump station upgrade and standby power generation.	\$2,000,000
2006A-024	NC Coastal Land Trust - Ac/ Indian Creek Tracts	Protect a total of 1,027 acres along the Indiantown Creek through purchase of 702 acres in fee and of a 325-acre fee simple donation.	\$528,000
2006A-406	Perquimans County- Rest/ Newbold- White House and Greenway, Perquimans River	Design, permit and construct natural channel design shoreline stabilization project along 2,000 linear feet of the Perquimans River. Construct 3 stormwater wetlands and link to county greenway system.	\$340,000
2006B-706	Kitty Hawk, Town of - Storm/Rest/ Stormwater BMPs, Kitty Hawk Bay	Design and permit BMPs to improve water quality along 4,100 linear feet of shoreline in Kitty Hawk Bay. Potential BMPs include a breakwater system, reestablishment of the fringe marsh, and infiltration and bioretention areas.	\$543,000
2006B-816	Washington County - Plan/Acq/ Sustainable Development Planning, Albermarle Sound	Fund the development of a long-term sustainable development plan for the southern Albemarle Sound shoreline between Mackey's Ferry and Leonard's Point. Includes inventory of existing conditions, vision statement, implementation strategies.	\$100,000
<b>Total Funded</b>			<b>\$34,157,005</b>

This list does not include:

- all projects are in the CWMTF's Northern Coastal Plain region
- regional or statewide projects that were in multiple river basins, or
- projects that were funded and subsequently withdrawn.

#### 12.10.4 North Carolina Ecosystem Enhancement Program (NCEEP)

The NC Ecosystem Enhancement Program (NCEEP) combines an existing wetlands-restoration initiative by the NC DENR with ongoing efforts by the NC Department of Transportation (DOT) to offset unavoidable environmental impacts from transportation-infrastructure improvements. The U.S. Army Corps of Engineers joined as a sponsor in the historic agreement, which is committed to restoring, enhancing and protecting the wetlands and waterways across the State of North Carolina. NCEEP can provide:

- High-quality, cost-effective projects for watershed improvement and protection;
- Compensation for unavoidable environmental impacts associated with transportation-infrastructure and economic development; and
- Detailed watershed-planning and project-implementation efforts within North Carolina's threatened or degraded watersheds.

NCEEP can perform restoration projects cooperatively with other state or federal programs or environmental groups. For example NCEEP efforts can complement projects funded through the Section 319 Program. Integrating wetlands or riparian area restoration components with Section 319 funded or proposed projects will often improve the overall water quality and habitat benefits of the project. The NCEEP actively seeks landowners throughout the state that have restorable wetland, riparian, and stream restoration sites. For more information about NCEEP, visit <http://www.nceep.net/> or call (919) 715-7452.

#### 12.10.5 Coastal and Estuarine Land Conservation Program

The Coastal and Estuarine Land Conservation Program (CELCP) was established by Congress “for the purpose of protecting important coastal and estuarine areas that have significant

conservation, recreation, ecological, historical, or aesthetic values, or that are threatened by conversion from their natural or recreational state to other uses.” The program provides funding for projects that ensure conservation of these areas for the benefit of future generations, giving priority lands which can be effectively managed and protected, and that have significant ecological value. The Division of Coastal Management administers the CELCP program in North Carolina. For more information on funding opportunities and guidelines see <http://www.nccoastalmanagement.net/Facts/CELCP.htm>.

### **12.10.6 Oyster Shell Recycling**

The North Carolina Oyster Shell Recycling Partnership is encouraging restaurants, seafood dealers, community organizations and individuals to participate in the effort to collect oyster shells and use them to build oyster reefs in protected oyster sanctuaries. More information about this recycling effort can be found at <http://www.ncfisheries.net/shellfish/recycle1.htm>. Oyster recycling sites within the Pasquotank River Basin include:

- Nags Head: Jockey’s Ridge State Park (Hwy 158)
- Kill Devil Hills: Nature Conservancy, Nags Head Woods (701 West Ocean Acres Dr.)
- Wanchese: NCDMF office, Wanchese Seafood Industrial Park (604 Harbor Rd.)
- Avon: Village Grocery (40618 Hwy. 12)
- Hatteras Village: Burrus Red & White (57196 Kanlar Rd.)
- Rodanthe/Waves/Salvo: Recycling Center, Rodanthe Harbor (Myrna Peters Rd.)

### **12.10.7 Clean Marina Program**

The Clean Marina Program is a voluntary program that began in the summer of 2000. The program is designed to show that marina operators can help safeguard the environment by using management and operations techniques that go above and beyond regulatory requirements. This is a nationwide program developed by the National Marine Environmental Education Foundation, a nonprofit organization that works to clean up waterways for better recreational boating. The foundation encourages states to adapt Clean Marina principles to fit their own needs. North Carolina joins South Carolina, Florida and Maryland as states with Clean Marina programs in place.

Marina operators who choose to participate must complete an evaluation form about their use of specific best management practices. If a marina meets criteria developed by N.C. Marine Trades Services and the Division of Coastal Management, it will be designated as a Clean Marina. Such marinas will be eligible to fly the Clean Marina flag and use the logo in their advertising. The flags will signal to boaters that a marina cares about the cleanliness of area waterways. Marinas that do not meet the standards will be able to learn about improvements needed for Clean Marina designation. Marina owners can reapply after making the necessary changes.

The International Yachting Center in Columbia, NC is the only Clean Marina in the Pasquotank River basin, while there are 14 other marinas with pump-out facilities in the basin. For more information about the program, please see <http://dcm2.enr.state.nc.us/Marinas/clean.htm> or <http://www.nccoastalmanagement.net/Marinas/marinas.htm>

Or contact N.C. Coastal Reserve Education Office at 252-728-2170 or Coastal Management at 919-733-2293.

### **12.10.8 Currituck Sound Restoration Feasibility Study**

The Army Corps of Engineers and the State of North Carolina are partnering to conduct a Feasibility Study on the Currituck Sound to identify ways to improve water quality and restore the Sound. The ongoing study is being cost shared between the US Army Corps of Engineers (USACE) and the NC Department of Environment and Natural Resources (DENR). Each cost share partner pays 50 percent of the feasibility phase costs.

The Currituck Sound Restoration Coordination Team is collecting data and formulating recommendations necessary to meet the established restoration goals and objectives. Data collection efforts are being conducted as part of multiple individual studies within the Currituck Sound as well as in the surrounding watersheds that impact the Sound, including Back Bay. A Feasibility Report and NEPA document recommending viable restoration projects and management measures will be the products of the study.

The Currituck Sound Restoration Coordination Team is composed of multiple agencies and organizations including, but not limited to: USACE, Wilmington District, DENR, Division of Water Resources (DWR), Elizabeth City State University (ECSU), USACE Coastal and Hydraulics Laboratory (CHL), NC National Estuarine Research Reserve (NERR), US Fish and Wildlife Service (USFWS), US Geological Survey (USGS), USACE Engineer Research and Development Center (ERDC), Hampton Roads Planning District Commission, Division of Coastal Management (DCM), NC Coastal Federation (NCCF), Virginia Department of Conservation and Recreation (VADCR), Currituck County, The Nature Conservancy (TNC), Wildlife Resources Commission (WRC), Division of Water Quality (DWQ), Pasquotank River Basin Regional Council, Virginia Department of Environmental Quality (VADEQ), Virginia Marine Resources Commission (VAMRC), and Albemarle Pamlico National Estuary Program (APNEP). The entities composing the restoration team participate in one or more of three Workgroups, which are: Hydrologic, Hydrodynamics, and Water Quality Modeling Workgroup; the Living Resources Workgroup; and the Planning and Public Involvement Workgroup.

The Hydrologic, Hydrodynamics, and Water Quality Modeling Workgroup is using a model to characterize existing hydrologic and water quality conditions in Currituck Sound, develop a baseline, and produce a model for use in determining the condition in which to restore the Sound. This Workgroup is developing and using a modeling package based on modeling requirements of the USGS in cooperation with USACE ERDC, DWR, and ECSU to develop a comprehensive and cost effective data collection and monitoring plan for Currituck Sound, including site locations, data type, frequency, and purpose of the data to be collected. The model will characterize the effects of internal and external factors such as freshwater flow, tides, wind, suspended and bottom sediments, nutrient inputs, land use, etc., on water quality and the health of the biological communities in Currituck Sound.

The Living Resources Workgroup consists of four subgroups, which have individual data collection efforts underway. The four subgroups and subject matter areas are as follows: the Vegetation Subgroup (Submerged Aquatic Vegetation (SAV), forests, wetlands, marshes, invasive species); the Survey/GIS Subgroup (land and hydrologic surveys, aerial photography, mapping, and geographic analysis); the Fisheries Subgroup (freshwater and saltwater fisheries and crabs); and the Waterfowl Subgroup (nesting water birds and waterfowl).

The Vegetation and Survey/GIS Subgroups have completed data collection efforts for historic and existing SAV within the Currituck Sound and surrounding watershed. This is a critical component of the Currituck Sound Feasibility Study because the abundance of SAV has undergone several long-term downward trends since early 1900's and has not fully recovered to former abundant conditions of the past century. The SAV Habitat Cooperative Mapping Project at ECSU has completed and will continue with field surveys, as well as recording data on water clarity, temperature, salinity, DO, pH Distribution, density and species composition of SAV. Also collaborative efforts to digitize the findings reported in the Sincock Master Surveys were completed by USACE, ECSU, and others. The result of this effort is an interactive site, "The Sincock Master Survey Internet Mapping Service & Website," and is available at: [http://155.82.232.43/website/Currituck\\_Sincock\\_MS/viewer.htm](http://155.82.232.43/website/Currituck_Sincock_MS/viewer.htm).

The Planning and Public Involvement Workgroup serves to gather information from the public for incorporation into the study and to disseminate information from ongoing study findings out to the public. This Workgroup is requesting historical information and records, fishing and hunting logbooks, and old photographs and maps of the Sound and Shoreline. This Workgroup will hold future Public Meetings; the public will be informed in advance. The planning function of this Workgroup serves to balance the interests of all involved entities as well as produce the Currituck Sound Restoration Feasibility Report. This report will capture and document the Currituck Sound Restoration Coordination Team's findings and make recommendations for alternatives and management measures to improve water quality and restore the Sound.

For further information or inquiries regarding the Currituck Sound Restoration Feasibility Study, you may visit [http://www.saw.usace.army.mil/Currituck\\_Sound/main.htm](http://www.saw.usace.army.mil/Currituck_Sound/main.htm) or contact Tara Anderson, Lead Planner, at 910-251-4694 or 1-800-626-8449, ext 4694.

#### **12.10.9 Albemarle-Pamlico National Estuary Program (APNEP)**

In February 1987, Congress established the National Estuary Program (NEP) through amendments to the Clean Water Act. A unique approach to resource management, its hallmark of using science to inform and engage broad-based community involvement, collaborative decision-making, outreach and education, distinguishes the NEP from other programs.

As the first NEP to be designated "an estuary of national significance" in November of 1987, the Albemarle-Pamlico National Estuary Program (APNEP) was known then as the Albemarle-Pamlico Estuarine Study (APES). The APNEP has since been joined by 27 other NEPs located in 18 coastal states and Puerto Rico spanning the United States' three coastlines. It is estimated 15 percent of all Americans reside in a NEP designated watershed.

Each NEP is mandated to develop a Comprehensive Conservation and Management Plan (CCMP) that details deteriorating/threatened environmental conditions in their estuarine region and the strategies required for rectifying them. In November 1994, the Administrator of the EPA accepted APNEP's CCMP on behalf of the citizens of the United States, and Governor James B. Hunt, Jr., accepted it on behalf of the citizens of North Carolina.

Estuaries are of significant economic value to the states under whose governance they fall, as well as to the entire nation. It is estimated that estuaries provide habitat for approximately 75 percent of commercial fish catches in the United States and 80-90 percent of the recreational fishery, totaling more than \$1.9 billion annually. Recreation and tourism in coastal areas

generate an additional \$8 to \$12 billion. Clearly, it behooves us to protect these fragile, beautiful, and valuable places.

In the Pasquotank River basin APNEP has supported a number of research, restoration, and demonstration projects. Several demonstration projects are designed to mitigate the effects of stormwater runoff and pollution. Recently, in the Pasquotank River basin, the APNEP funded projects in three locations intended to improve water quality and to aid in environmental education: Manteo, Winfall and Hertford.

The Perquimans County High School constructed wetland and environmental education project in Hertford is a collaborative effort led by Perquimans County Schools, and the Perquimans County Soil and Water Conservation District. The project reshaped and restored natural wetlands located on the grounds of the school and included the construction of an access boardwalk, pedestrian bridges and an observation deck. The now accessible wetlands are used as the basis for an outdoor education program for 570 high school science students and their teachers. This phase of the project builds on the successful first stage of the Jennie's Gut constructed wetlands project, also funded in part with an APNEP grant.

The goal of the Manteo Middle School demonstration project, to create two attractive stormwater gardens (with signage) in a highly visible schoolyard site, included the labor of students, teachers, and community volunteers. The gardens serve as a point of collections for stormwater coming off the school's parking lots and roof. The project also includes curriculum development utilizing information on stormwater pollution.

The Town of Winfall's drinking water treatment plant was exceeding water quality standards in its backwash waters for some time. Regular monitoring showed high levels of iron, manganese, magnesium, calcium, chlorides and sand. To remove the offending elements and treat the discharge, a constructed wetland system with salt and iron tolerant plants was installed adjacent to the plant. Two wetland cells were built using rock check dams and a third cell was built using logs for the check dam. A boardwalk, with an observation platform at its center, allows the wetland to be used as an outdoor environmental education classroom for the Perquimans County Middle School adjacently located to the wetland. It should also be noted that an added benefit of the wetland system is the diversion of runoff (showing high levels of nitrogen and phosphorus) from an abandoned fertilizer plant across the road, and from school grounds, roads and parking lots adjacent to it.

For information on the APNEP, visit [www.apnep.org](http://www.apnep.org).

#### **12.10.10 Albemarle-Pamlico Regional Water Quality Study**

The study will identify regional water quality, water management, and recreational concerns resulting from land-use changes associated with unprecedented development in Chowan, Perquimans, Pasquotank, Camden, Gates, Currituck, Dare, Hyde, Tyrrell, and Washington counties. This work will build on county-wide drainage studies and water quality projects that the Albemarle Resource Conservation and Development Council (RC&D) and its partners have implemented, or are implementing, in the Albemarle-Pamlico region. Projects identified and implemented as a result of the study will help create a region-wide infrastructure for maintaining the integrity of water resources and improving drainage. Components of the regional study will include:

- Identify and prioritize streams and canals for a 5-year recurrence interval for clearing and snagging in major watersheds.
- Identify opportunities to develop or upgrade stormwater ordinances in each county to address water quality and drainage concerns associated with rapid commercial and residential development. Ordinances would include standards for 1) evaluating upstream and downstream drainage at the watershed level, 2) determining flooding consequences for existing and new developments, and 3) reconstructing drainage systems on commercial, residential and public/ agricultural properties using innovative techniques including constructed wetlands, buffers, and water table management.
- Identify a commercial, residential and public/agricultural property in each county to reconstruct drainage systems for demonstrating innovative stormwater management.
- Identify opportunities for establishing a water quality/water management advisory committee in each county to provide technical information, public education, and research support.
- Identify opportunities for establishing Special Use Water Management Districts (SUWMD) in each county to provide a mechanism for public input to prioritize and implement drainage and water quality improvement projects.
- Identify opportunities for establishing a regional Stewardship Development Program similar to the Lower Cape Fear Stewardship Development Program. The program would recognize innovative residential and commercial development projects that protect the environment.
- Identify key issues and costs associated with monitoring and evaluating water quality and reconstructed drainage projects at the local and regional level.

Each of the 10 counties in the region is at a different stage of developing the study components listed above. For example, with assistance from NCRS and the Albemarle RC&D, Pasquotank County is developing a stormwater ordinance that includes specifications for evaluating upstream and downstream drainage at the watershed level, and reconstructing drainage systems using innovative techniques such as constructed wetlands instead of detention and retention ponds. Perquimans County is beginning the process of developing a stormwater ordinance, and may be able to save time and money by using Pasquotank County's ordinance as a model. The same scenario may apply to other counties in the region that will have to develop ordinances to help manage stormwater runoff from residential and commercial development.

The regional study will help identify specific project opportunities in each county, and progress toward maintaining the integrity of regional water quality and improving drainage. Conducting the study and coordinating projects on a regional level will also allow the sharing of experiences and information, and thus help avoid costly mistakes and duplication of effort.

# Chapter 13

## Agriculture and Water Quality

### 13.1 Animal Operations

Over the years, key legislative bills were introduced and approved to regulate concentrated animal feeding operations (CAFOs) in the State of North Carolina. In May 2006, the Environmental Management Commission (EMC) adopted Title 15A Subchapter 02T. The rules reflect current policy and provide routine consideration of an applicant's compliance status. Section .1300 of Subchapter 02T applies to all persons proposing to construct, modify, expand or operate an animal waste management system. Animal waste is defined as livestock or poultry excreta or mixture of excreta with feed, litter, bedding or other material generated at a feedlot. Animal waste management systems are defined as a combination of structural and nonstructural practices that collect, treat, store or apply animal waste to the land. An animal waste management plan is defined as a plan to properly collect, store, treat or apply animal waste to the land in an environmentally safe manner developed in accordance with the General Statute §143-215.10C ([www.ncleg.net/EnactedLegislation/Statutes/HTML/BySection/Chapter\\_143/GS\\_143-215.10C.html](http://www.ncleg.net/EnactedLegislation/Statutes/HTML/BySection/Chapter_143/GS_143-215.10C.html)).

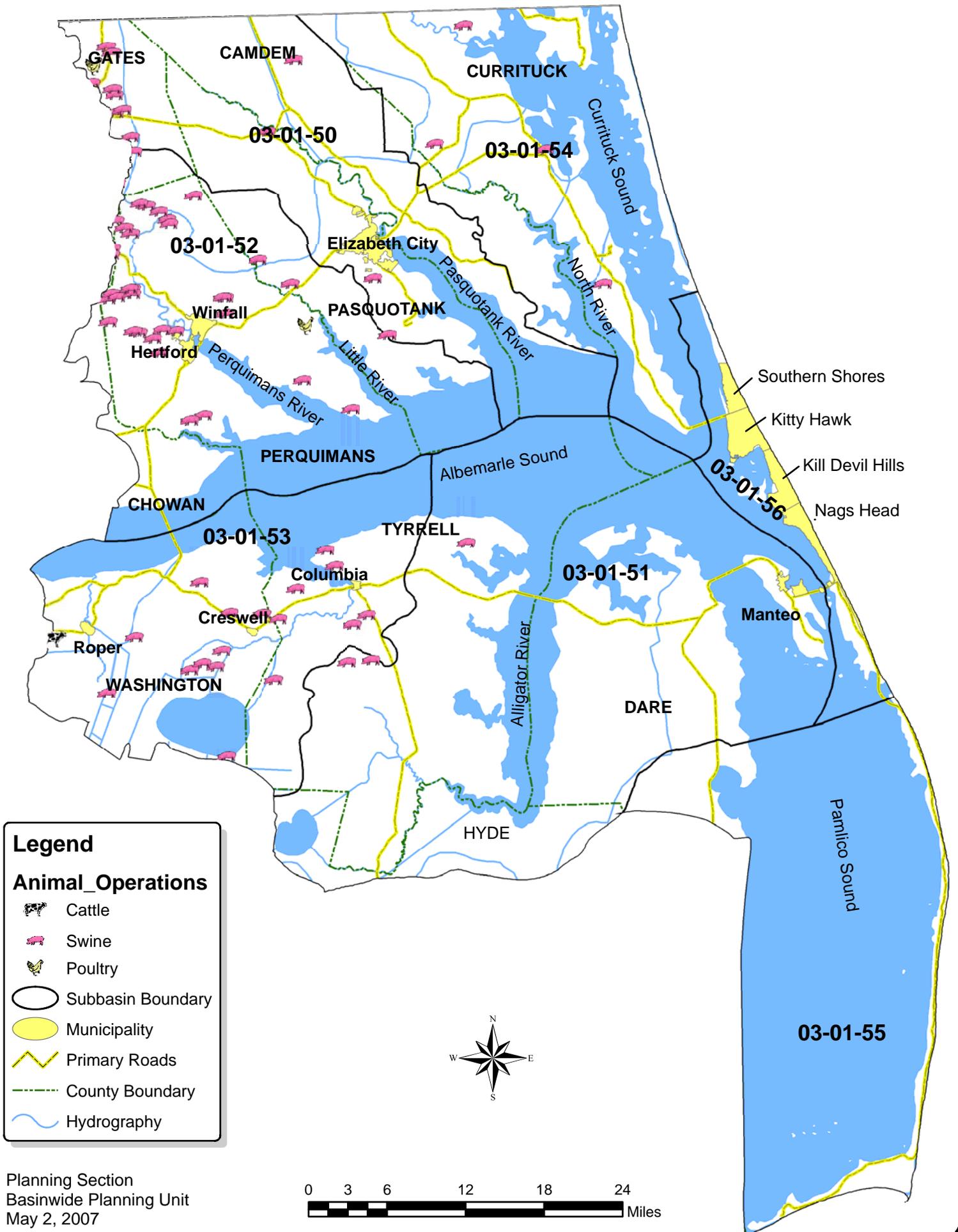
Table 31 summarizes the number of permitted livestock operations, total number of animals, number of facilities, and total steady state live weight. These numbers reflect only operations required by law to be permitted, and therefore, do not represent the total number of animals in each subbasin. The Pasquotank River basin contains approximately 74 animal operations, including both permitted and nonpermitted cattle, poultry and hog farms, as shown in Figure 13.

Table 31 Permitted Animal Operations.

Subbasin	Cattle			Swine		
	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	Total Steady State Live Weight
03-01-50	-	-	-	1	500	216,500
03-01-51	-	-	-	1	1,350	182,250
03-01-52	-	-	-	8	7,590	1,105,750
03-01-53	1	120	96,000	7	65,960	11,096,962
03-01-54	-	-	-	-	-	-
03-01-55	-	-	-	-	-	-
03-01-56	-	-	-	-	-	-
<b>Totals</b>	<b>1</b>	<b>120</b>	<b>96,000</b>	<b>17</b>	<b>75,400</b>	<b>12,601,462</b>

\* 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.

**Figure 15 Animal Operations in the Pasquotank River Basin**



**Legend**

**Animal\_Operations**

-  Cattle
-  Swine
-  Poultry
-  Subbasin Boundary
-  Municipality
-  Primary Roads
-  County Boundary
-  Hydrography

## 13.2 Agricultural Best Management Practices and Funding Opportunities

### 13.2.1 NC Agriculture Cost Share Program

The NC Agricultural Cost Share Program (NCACSP) was established in 1984 to help reduce agricultural nonpoint runoff into the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using best management practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. The NCACSP is implemented by the Division of Soil and Water (DSWC), which divide the approved BMPs into five main purposes or categories.

- *Sediment/Nutrient Delivery Reduction from Fields*  
Sediment/nutrient management measures include planned systems that prevent sediment and nutrient runoff from fields into streams. Practices include: field borders, filter strips, grassed waterways, nutrient management strategies, riparian buffers, water control structures, streambank stabilization, and road repair/stabilization.
- *Erosion Reduction/Nutrient Loss Reduction in Fields*  
Erosion/nutrient management measures include planned systems for reducing soil erosion and nutrient runoff from cropland into streams. Practices include: critical area planting, cropland conversion, water diversion, long-term no-till, pastureland conversion, sod-based rotation, stripcropping, terraces, and Christmas tree conservation cover.
- *Stream Protection from Animals*  
Stream protection management measures are planned systems for protecting streams and streambanks. Such measures eliminate livestock access to streams by providing an alternate watering source away from the stream itself. Other benefits include reduced soil erosion, sedimentation, pathogen contamination and pollution from dissolved, particulate, and sediment-attached substances. Practices include: heavy use area protection, livestock exclusion (i.e., fencing), spring development, stream crossings, trough or watering tanks, wells, and livestock feeding areas.
- *Proper Animal Waste Management*  
A waste management system is a planned system in which all necessary components are installed for managed liquid and solid waste to prevent or minimize degradation of soil and water resources. Practices include: animal waste lagoon closures, constructed wetlands, controlled livestock lounging area, dry manure stacks, heavy use area protection, insect and odor control, stormwater management, waste storage ponds/lagoons, compost, and waste application system.
- *Agricultural Chemical (agrchemical) Pollution Prevention*  
Agrichemical pollution prevention measures involve a planned system to prevent chemical runoff to streams for water quality improvement. Practices include: agrichemical handling facilities and fertigation/chemigation back flow prevention systems.

The NCACSP is a voluntary program that reimburses farmers up to 75 percent of the cost of installing an approved BMP. The cost share funds are paid to the farmer once the planned BMP

is completed, inspected and certified to be installed according to NRCS standards and specifications and SWCC policies. The annual statewide budget for BMP cost sharing is approximately \$8 million. [Note: the annual statewide budget for ACSP cost sharing is \$5.6 million; the additional \$2.4 million is the annual statewide budget for technical assistance.] During the period from 2000 to 2005, \$1,280,878 was provided for projects in the Pasquotank River basin. Table 32 summarizes the cost and total BMPs implemented (i.e., acres, units, linear feet) throughout the Pasquotank River basin.

Table 32 Summary of NCACSP Projects in the Pasquotank River Basin (2000-2005)

Purpose of BMP									
	Erosion Reduction <sup>1</sup>		Sediment Reduction <sup>2</sup>		Stream Protection <sup>3</sup>		Animal Waste <sup>4</sup>		Total Cost (\$)
	Total	Cost (\$)	Total	Cost (\$)	Total	Cost (\$)	Total	Cost (\$)	
<b>Subbasin 03-01-50</b>	2,962.5 ac 400 ft	238,760	2,088.5 ac 3 units	43,267	0	0	4 units	18,123	300,150
<b>Subbasin 03-01-51</b>	535 ac	51,000	1,907 ac 4 units	46,904	0	0	2 units	44,510	142,414
<b>Subbasin 03-01-52</b>	3,698.6 ac	410,746	2,573.3 ac 3 units	43,219	0	0	8 units 62 tons	54,114	508,079
<b>Subbasin 03-01-53</b>	1,349.4 ac	131,749	373 ac 24 units	74,551	0	0	3 units	27,500	233,800
<b>Subbasin 03-01-54</b>	416.6 ac	66,548	104.3 ac 26 units	22,405	0	0	0	0	88,953
<b>Subbasin 03-01-55</b>	121.1 ac	7,266	7.2 ac	216	0	0	0	0	7,482
<b>Subbasin 03-01-56</b>	0	0	0	0	0	0	0	0	0

<sup>1</sup> Erosion Reduction/Nutrient Loss Reduction in Field

<sup>2</sup> Sediment/Nutrient Delivery Reduction from Field

<sup>3</sup> Stream Protection from Animals

<sup>4</sup> Proper Animal Waste Management

Total Benefits					
	Soil Saved (tons)	(N)itrogen Saved (lb.)	(P)hosphorous Saved (lb.)	Waste-N Saved (lb.)	Waste-P Saved (lb.)
<b>Subbasin 03-01-50</b>	3,736	98,799	10,595	17,030	18,674
<b>Subbasin 03-01-51</b>	130	6,008	8,026	0	0
<b>Subbasin 03-01-52</b>	6,446	10,954	6,787	85,736	35,146
<b>Subbasin 03-01-53</b>	1,718	29,329	1,367	13,785	13,803
<b>Subbasin 03-01-54</b>	1,179	36,564	4,575	0	0
<b>Subbasin 03-01-55</b>	0	571	0	0	0
<b>Subbasin 03-01-56</b>	0	0	0	0	0

\* The North Carolina Agricultural Nutrient Assessment Tool (NCANAT) contains two field-scale assessment tools: the Nitrogen Loss Estimation Worksheet (NLEW) and the Phosphorus Loss Assessment Tool (PLAT). NCANAT is a product of the cooperative effort between the NC State University, NC Department of Agriculture & Consumer Services, USDA-NRCS and the DENR. The tool consists of a function that allows comparisons to be made before and after BMPs are installed. Gains and losses of nitrogen, phosphorus and sediment due to BMP implementation can be computed. The DSWC has adopted this program to calculate these losses for the NCACSP reporting requirements.

County Soil and Water Conservation District (SWCD) contacts for the Pasquotank River basin are included in Appendix IV. BMP definitions and SWCD contact information can be found online at [www.enr.state.nc.us/DSWC/pages/agcostshareprogram.html](http://www.enr.state.nc.us/DSWC/pages/agcostshareprogram.html).

### **13.2.2 USDA – NRCS Environmental Quality Improvement Program (EQIP)**

The USDA – Environmental Quality Improvement Program (EQIP) provides technical, educational and financial assistance to eligible farmers to address soil, water and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. NRCS district contacts for the Pasquotank River basin are provided in Appendix IV, or information can also be found on NRCS website at <http://www.nc.nrcs.usda.gov/programs/EQIP/index.html>.

## **13.3 SWCD Water Quality Strategy Plan**

Agricultural land use and a growing development continue to alter natural hydrology with the need to improve drainage. Currently, most of the swamps and wetlands have been circumvented, routing stormwater through these areas in man-made channels. The water that once flowed through the floodplain is now channeled through man-made ditches directly to the creeks and rivers and is no longer filtered by swamps. In the Pasquotank River basin, redesigning and reconstructing drainage systems may improve water quality. Drainage redesign involves evaluating the entire watershed to determine where instream improvements can compliment farm fields and subdivision improvements such as no-till, land grading to reduce nitrogen, water control, riparian buffers and establishing wetlands.

Better tools to predict water flow are now available and research at NC State University provides examples that demonstrate how drainage systems can be redesigned. Reestablishing degraded swamps can be achieved by improving drainage, while forcing stormwater flow to reassociate with the floodplain. Old floodplains can be restored by establishing in-stream wetlands and building new wetlands where needed directly in the drainage system to reduce the total volume of water flow from these drainage systems.

SWCDs are encouraging the counties to develop Special Use Water Management Districts. Each district is to develop a list of priorities to address stormwater issues and drainage. Plans for each watershed will address the following:

- Volume of stormwater retained and discharged during stormwater events,
- Channel modification to reassociate storm flow with the biology of the flood plain to remove sediment and nutrients,
- Establishment of instream wetlands where needed,
- Drainage improvements required to sustain conservation enhancement and to provide drainage for urban and agricultural areas,
- Clearing and snagging required on five-year intervals to maintain the integrity of the drainage system and
- Demonstration projects illustrating innovative techniques for addressing the water quality issues associated with drainage.



# Chapter 14

## Natural Resources in the Pasquotank River Basin

### 14.1 River Basin Hydrologic Units

Under the federal system, the Pasquotank River basin is made up of hydrologic areas referred to as cataloging units (USGS 8-digit hydrologic units). Cataloging units are further divided into smaller watershed units (14-digit hydrologic units) that are used for smaller scale (Table 33).

Table 33 Hydrologic Subdivisions in the Pasquotank River Basin

Watershed Name and Major Tributaries	DWQ Subbasin 6-digit Codes	USGS 8-digit Hydrologic Units	USGS 14-digit Hydrologic Units Local Watersheds*
Albemarle Sound	03-01-50 03-01-51 03-01-52 03-01-53	03010205	010010, 010020, 020010, 020020, 030010, 040010, 050010, 060010, 060020, 070010, 080010, 080020, 085020, 090010, 090020, 090030, 100010, 110010, 130010, 130040, 140010, 150010, 170010, 180010, 190010, 210010, 210020, 210030, 220010
Pasquotank River	03-01-50	03010205	240050
Alligator River and Croatan Sound	03-01-51	03010205	240060
Perquimans, Little and Yeopim River	03-01-52	03010205	240030
Scuppernong River	03-01-53	03010205	240040
Phelps Lake	03-01-53	03010205	160010
Currituck Sound	03-01-54	03010205	230010, 240100
North River	03-01-54	03010205	240090
Roanoke Sound and surrounding area	03-01-56	03010205	230020
Pamlico Sound	03-01-55	03020105	090020, 090016, 090014

\*Numbers from the 8-digit and 14-digit column make the full 14-digit HU.

### 14.2 Water Resources and Water Supply Planning

NC DENR Division of Water Resources administers programs for river basin management, water supply assistance, water conservation, and water resources development. The Division conducts special studies on instream flow needs and serves as the State liaison with federal agencies on major water resources related projects. The Division also administers two environmental education outreach programs, Stream Watch and Project WET. For more information about the Pasquotank basin visit <http://www.ncwater.org/basins/Pasquotank/>.

### 14.3 Water Quality Issues Related to Drought

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows may carry increased loadings of substances like metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) or may result in oxygen depletion or sedimentation. During drought conditions, these pollutants become more concentrated in streams due to reduced flow. Summer months are generally the most critical months for water quality. Dissolved

oxygen is naturally lower due to higher temperatures, algae grow more due to longer periods of sunlight, and streamflows are reduced. In a long-term drought, these problems can be greatly exacerbated and the potential for water quality problems to become catastrophic is increased. This section discusses water quality problems that can be expected during low flow conditions.

The frequency of acute impacts due to nonpoint source pollution (runoff) is actually minimized during drought conditions. However, when rain events do occur, pollutants that have been collecting on the land surface are quickly delivered to streams. When streamflows are well below normal, this polluted runoff becomes a larger percentage of the water flowing in the stream. Point sources may also have water quality impacts during drought conditions even though permit limits are being met. Facilities that discharge wastewater have permit limits that are based on the historic low flow conditions. During droughts these wastewater discharges make up a larger percentage of the water flowing in streams than normal and might contribute to lowered dissolved oxygen concentrations and increased levels of other pollutants.

As streamflows decrease, there is less habitat available for aquatic insects and fish, particularly around lake shorelines. There is also less water available for irrigation and for water supplies. The dry conditions and increased removal of water for these uses further increases strain on the resource. With less habitat, naturally lower dissolved oxygen levels and higher water temperatures, the potential for large kills of fish and aquatic insects is very high. These conditions may stress the fish to the point where they become more susceptible to disease and where stresses that normally would not harm them result in mortality.

These are also areas where longer retention times due to decreased flows allow algae to take full advantage of the nutrients present resulting in algal blooms. During the daylight hours, algae greatly increase the amount of dissolved oxygen in the water, but at night, algal respiration and die off can cause dissolved oxygen levels to drop low enough to cause fish kills. Besides increasing the frequency of fish kills, algae blooms can also cause difficulty in water treatment resulting in taste and odor problems in finished drinking water.

## **14.4 Source Water Assessment of Public Water Supplies**

### **14.4.1 Introduction**

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://www.deh.enr.state.nc.us/pws/index.htm>.

#### **14.4.2 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://www.deh.enr.state.nc.us/pws/swap>.

##### *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 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://h2o.enr.state.nc.us/wswp/index.html>.

#### **14.4.3 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 (i.e., turbidity and total coliform) and watershed characteristics (i.e., 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.

### **14.4.4 Source Water Protection**

The PWS Section believes that the information from the source water assessments will become 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 programs

To encourage and support local SWP, the state offers PWS system owners assistance with local SWP 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://www.deh.enr.state.nc.us/pws/swap>.

### **14.4.5 Public Water Supply Susceptibility in the Pasquotank River Basin**

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. A second round of assessments were completed in April 2005. 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 PWS web page (<http://www.deh.enr.state.nc.us/pws/swap>). To view a report, select the PWS System of interest by clicking on the “SWAP Reports” icon.

In the Pasquotank River Basin, 355 public water supply sources were identified. One is a surface water source and 354 are groundwater sources. Of the 354 groundwater sources, 17 of them have a Higher, 312 have a Moderate and 25 have a Lower susceptibility rating. Table 34 identifies the surface water source and its overall susceptibility rating. 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 by the identified PCSs within the assessment area.

Table 34 SWAP Results for Surface Water Source in the Pasquotank River Basin

PWS ID Number	Inherent Vulnerability Rating	Contaminant Rating	Overall Susceptibility Rating	Name of Surface Water Source	PWS Name
0428010	L	L	L	Fresh Pond	Town of Nags Head

## 14.5 Forestry

### 14.5.1 Forest Management

Approximately 44 percent of forestland in the Pasquotank basin is privately owned; 10 percent is owned by forest industry, and the remaining 46 percent is publicly owned. These ownership estimates comes from the most recent Forestry Inventory and Analysis data published by the USDA Forest Service (*Forest Statistics for North Carolina, 2002*. Brown, Mark J. Southern Research Station Resource Bulletin SRS-88. January 2004).

At least 22,362 acres of land were planted or regenerated with forest trees across the basin from September 1, 2000 through August 31, 2005. During this same time period, the North Carolina Division of Forest Resources (DFR) provided individual forest plans for landowners that encompassed over 68,252 acres in the basin. This includes 1,384 plans, such as preharvest, rehabilitation and forest stewardship plans, that provide site specific guidance for water quality protection.

The DFR also operates a 700 + acre tree nursery in Goldsboro. The nursery grows 9 species of conifers and 51 species of hardwoods that are available for forest management and stream / wetland restoration projects. There is a distribution center located in Edenton where these seedlings can be picked up once they are purchased. Call 1-888-NC TREES (628-7337) for more information, or visit the Web site noted above.

Uncontrolled high intensity fires can combust excessive amounts of ground cover and vegetation and have potential to negatively impact water quality. The DFR performs hazard reduction burns to reduce fuel load and therefore wild fire hazard. During the period covered by this Plan, approximately 3,055 acres were either prepared or burned for the reduction of hazardous fuels.

### **14.5.2 Forest Practices Guidelines Related to Water Quality (FPGs)**

The DFR is delegated the authority to monitor and evaluate forestry operations for compliance with laws and/or rules. Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973. However, forestry operations are exempt from the permit and plan requirements of the SPCA, if the operations meet the compliance standards outlined in the Forest Practices Guidelines Related to Water Quality (FPG) and General Statutes regarding stream obstruction. For more information regarding forest practices guidelines related to water quality please visit Chapter 7 in the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* <http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm>.

The DFR has personnel in all 100 counties who perform FPG inspections and handle other basic water quality related tasks on a daily basis. In addition, ten of its thirteen Districts across the State also have specialists known as Water Quality Foresters. The portion of the Pasquotank basin north of Albemarle Sound has coverage by a Water Quality Forester, thanks to a new position that was established in 2005, which is assigned from the Elizabeth City District Office. Field foresters based in the Fairfield District Office work the southern portion of the basin. Water Quality Foresters conduct FPG inspections, survey BMP implementation, check for compliance with forest harvest requirements of state buffer rules, develop preharvest plans, provide training opportunities for landowners, loggers, and the public regarding water quality issues related to forestry, and assist other DFR staff with more technical water quality issues.

During the period September 1, 2000 through August 31, 2005 the Division of Forest Resources inspected 916 forestry sites for FPG compliance the basin; 97 percent of the sites inspected were in compliance. In addition, 181 re-inspections were performed to ensure that sites continued to be or were brought into compliance with the FPGs.

### **14.5.3 Forestry Best Management Practices**

Implementing Forestry Best Management Practices is strongly encouraged by the Division of Forest Resources in order to efficiently and effectively protect the water resources of North Carolina and maintain compliance with the FPGs. During this reporting period, DFR provided 467 written or verbal BMP recommendations on tracts totaling 18,910 acres in the Pasquotank River Basin. To further assess BMPs, the DFR conducted a detailed, statewide BMP Implementation Survey from March 2000 through March 2003 to evaluate Forestry BMPs on *active* harvest operations. During that time period, 17 of those surveys were performed in the Pasquotank River Basin. On those sites, implementation of North Carolina's recommended BMPs was 83 percent. Two percent (2 percent) of the conditions on those sites had potential to be a risk to water quality. Forestry BMP implementation in the Pasquotank River Basin was close to the statewide survey average of 82 percent. The problems most often cited in this survey relate to stream crossings, skid trails, and site rehabilitation. This survey, and additional surveys to be conducted, will serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP implementation and training.

#### **14.5.4 Bridgemats**

To help prevent water quality problems associated with stream crossings, the DFR has been loaning bridgemats to loggers for establishing temporary stream crossings during harvest activities. Temporary bridges are usually the best solution for stream crossings, instead of culverts or hard-surfaced ‘ford’ crossings. Bridgemats are available upon request from any District Office. In 2005, the Albemarle-Pamlico National Estuary Program provided grant funding for the purchase of two steel sets of 30-foot bridgemats for use in northeastern North Carolina. There may be situations whereby the bridgemats are used in neighboring river basin areas, if the customer demand warrants. More information about using bridgemats, and the above noted BMP survey, is available on the ‘Water Quality’ section of the DFR’s Web site <http://www.dfr.state.nc.us/>.

#### **14.5.5 Forest Products Industry**

The forest industry is a vital economic driver throughout the Pasquotank River basin, with significant forest industry operations located in the basin. In the Pasquotank basin, 7 different businesses are considered “Primary Processors” of forest products raw material, which represents 3 percent of the total number of primary processors in the state. Examples of primary processors in this basin include several sawmills that produce products such as rough and dressed lumber, chips, bark and sawdust. All primary processors pay an assessment to the state, which is then combined with annual legislative appropriations, to fund the “Forest Development Program - FDP”, which provides cost-shared reforestation assistance for forest landowners.

### **14.6 Public Lands**

The Embayed Region has large acreages in public ownership. Pocosin Lakes, Alligator River, Great Dismal Swamp, and Mackay Island National Wildlife Refuges; Dare Bombing Range; Dismal Swamp State Natural Area; Pettigrew State Park; and Northwest River and North River Game Lands protect large acreages of pocosin, nonriverine swamp, and marsh from development. Yet there are large, highly significant sites in this region that are in need of acquisition or other protection action. The series of sites along the Northwest River, the North River, the Scuppernong River, and a number of smaller sites have little or none of their area protected. Protection is particularly urgent for Nonriverine Wet Hardwood Forests and Peatland Atlantic White Cedar Forests. No examples of Nonriverine Wet Hardwood Forest are protected in the region, and only one small example is protected anywhere in the state.

### **14.7 Ecological Significance of the Pasquotank River Basin**

The Pasquotank River basin has a large number of significant natural areas, including aquatic habitats. Coastal influence is prevalent in the basin. For instance, four of the five federally listed threatened and endangered aquatic species are predominantly marine species -- the American Alligator being the exception -- although the Shortnose Sturgeon is anadromous, spending some stages of its life in freshwater rivers. The Pasquotank River basin, which includes waterways that do not drain to the Pasquotank River, contains some extensive conservation lands, which correspond to a number of expansive natural features (swamps, marshes, pocosins, etc). Rare animal species and plants found in the Pasquotank River basin are listed in Table 35.

For more information on rare plant and animal species, visit the NC Natural Heritage Program (NHP) website at [www.ncnhp.org](http://www.ncnhp.org).

### 14.7.1 Significant Natural Heritage Areas in the Pasquotank River Basin

The North Carolina Natural Heritage Program (NHP) compiles the list of Significant Natural Heritage Areas. The list is based on the program's inventory of natural diversity in the state. Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high-quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determines a site's significance rating. The sites included on this list are the best representatives of the natural diversity of the state, and therefore have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Certain sites that contribute to the maintenance of water quality in the Pasquotank River Basin are highlighted below. They are grouped by region, and the names of individual Significant Natural Heritage Areas that constitute the grouping are bulleted. More complete information on Significant Natural Heritage Areas may be obtained from the Natural Heritage Program.

#### Currituck Sound Significant Natural Heritage Areas

- \* Buckskin Creek/Great Swamp
- \* Church Island Marsh
- \* Currituck Banks Corolla Natural Area
- \* Currituck Banks/Swan Island Natural Area
- \* Gibbs Woods/Tull Bay Marshes
- \* Great Marsh
- \* Nellie Bell Ponds, Marsh, and Cedar Swamp
- \* Northwest Backwoods
- \* Northwest River Marsh Game Land
- \* Maple Swamp Gordonia Forest
- \* Monkey Island Heronry
- \* Pine Island/Currituck Club Natural Area
- \* Troublesome Point/Gibbs Point Marshes
- \* Upper Northwest River Marsh

The Currituck Sound region includes the Northwest River, North Landing River, and Currituck Banks. Many of the Significant Natural Heritage Areas in Currituck Sound are Tidal Freshwater Marsh and Nonriverine Swamp Forest/Nonriverine Wet Hardwood Forest communities surrounding the estuarine shoreline and drowned river mouths. Several of the sites in this region are extensive, such as Great Marsh (6,037 acres), Pine Island/Currituck Club Natural Area (11,709 acres), and Buckskin Creek/Great Swamp (5,044 acres). These high-quality natural areas provide water quality benefits as well as outstanding wildlife habitat. The Upper Northwest River Marsh contains the only example of the Estuarine Fringe Pine Forest in the state and one of only two known in the nation.

#### North River Significant Natural Heritage Areas

- \* Broad Creek Marshes
- \* Hunting Creek Pocosin & Marsh
- \* Indiantown Creek/North River Cypress Forest
- \* North River/Deep Creek Marshes & Forest
- \* North River/Crooked Creek Wetlands

Significant Natural Heritage Areas in the North River are characterized by vast, high-quality Tidal Freshwater Marshes and Cypress--Gum Swamps, as well as nonriverine wetland communities of Swamp Forest and Atlantic White Cedar. However, only a small fraction of the area is protected.

### Great Dismal Swamp Significant Natural Heritage Areas

- \* Dismal Swamp State Natural Area
- \* The Green Sea
- \* Great Dismal Swamp National Wildlife Refuge

The combined acreage of the Dismal Swamp State Natural Area and the Great Dismal Swamp National Wildlife Refuge is over 41,000 acres. This vast area extends into Virginia and consists mostly of Nonriverine Swamp Forest, High Pocosin, Atlantic White Cedar, and other associated nonriverine wetland communities. Together with the Green Sea, a 9,592-acre natural area to the east, the Great Dismal Swamp provides habitat for rare plant and animal species and is home to wildlife such as black bear that require large undeveloped areas for survival. Sizeable portions of the Dismal Swamp State Natural Area and the National Wildlife Refuge are Registered Natural Heritage Areas, yet drainage of adjacent lands has significantly affected the hydrology of these areas.

### Albemarle Sound Significant Natural Heritage Areas

- \* Albemarle Sound Low Shoreline
- \* Harbinger Marshes
- \* Big Flatty Creek Forests & Marshes
- \* Little Flatty Creek Forests & Marsh
- \* Bull Neck Swamp
- \* Mamie Marshes & Ponds
- \* Durant Island
- \* Menzies Pond

The Significant Natural Heritage Areas that border Albemarle Sound are areas of high-quality Tidal Freshwater Marsh, Nonriverine Swamp Forest, Maritime Forests, and important Nonriverine Wet Hardwood Forests. These areas, though scattered, serve important roles as natural vegetated buffers for Albemarle Sound, in addition to providing habitat for wildlife. Completing protection of river buffers could improve water quality in Albemarle Sound.

### East Dismal Swamp Significant Natural Heritage Areas

East Dismal Swamp is a 3,868-acre remnant of a Nonriverine Swamp Forest that once stretched over 100,000-acres in Washington and Beaufort counties. Certain old-growth forests characteristics of the East Dismal Swamp make it an attractive stop over for neotropical migrant birds. When protected, the East Dismal Swamp will contribute to the overall ecosystem function of natural areas in the region.

### Scuppernong River/Lake Phelps Significant Natural Heritage Areas

- \* Lake Phelps Aquatic Habitat
- \* Pungo Lake Natural Areas
- \* Palmetto-Peartree Swamp Forest
- \* Scuppernong River Swamp Forest
- \* Pettigrew State Park

Emptying into Albemarle Sound, the Scuppernong River drains northern Washington and Tyrrell counties. The high-quality communities bordering the river comprise over 14,000 acres and include Coastal Plain Small Stream Swamp (Blackwater Subtype), Cypress--Gum Swamp (Blackwater Subtype), Atlantic White Cedar, and Nonriverine Swamp Forest. Lake Phelps, one of the Coastal Plain's few natural lakes, drains into the Scuppernong River via canals. Lake Phelps is noteworthy for its unique shoreline community. Another natural lake, Pungo Lake, is one of the largest and most intact natural lakes in North Carolina, and it is a major concentration area for wintering waterfowl.

### Alligator River, Dare/Tyrrell/northern Hyde counties Significant Natural Heritage Areas

- \* Alligator River/South Lake Swamp Forest
- \* Alligator River/Swan Creek Swamp Forest
- \* Alligator Creek/Second Creek Forest
- \* Alligator River Swamp Forest
- \* Alligator River Refuge/Central Section
- \* Alligator River Refuge/Southeast Marshes
- \* Upper Alligator River Marshes & Forests
- \* Upper Alligator River Pocosin
- \* US 264 Low Pocosin
- \* Taylor Road Natural Area
- \* Dare County Pocosin
- \* Buck Island Bay Forest
- \* Harvester Road Tall Pocosin
- \* Faircloth Road Pond Pine Pocosin
- \* Mashoes Marshes
- \* New Lake Fork Pocosin
- \* Pine Road Swamp
- \* Roper Island
- \* Roanoke/Stumpy Point Marshes & Pocosin

This large area is made up of extensive peatlands on either side of Alligator River. This region has the greatest extent of peatland communities in North Carolina, and probably in the whole eastern United States. Specifically, the Dare County Pocosin is one of the best Low Pocosin communities globally, one of the most extensive and one of the best Pond Pine Woodland occurrences globally, as well as one of the most outstanding peatland complexes. Nonriverine communities -- Swamp Forests, Pocosins, Pond Pine Woodland, Atlantic White Cedar Forests -- dominate the landscape here, although they are quite rare outside the Pasquotank basin. Some areas along the shores of the Albemarle Sound and the Alligator River support marshes and Tidal Cypress--Gum Swamps. Much of the land in this region is publicly-owned. Protection of Roper Island, Buck Island Bay Forest, and Alligator River/Swan Creek Swamp Forest in southern Tyrrell and northern Hyde counties could add significantly to the ecological integrity of the area by acting as a link between protected natural areas on either side of Alligator River.

### Coastal Region Significant Natural Heritage Areas

- \* Cape Hatteras Point
- \* Colington Woods
- \* Bodie Island Lighthouse Pond
- \* Buxton Woods
- \* Fort Raleigh Maritime Forest
- \* Hatteras Island Middle Section
- \* Hatteras Inlet Bird Nesting Islands
- \* Hatteras Sand Flats
- \* Jockey's Ridge State Park
- \* Kitty Hawk Woods
- \* Nags Head
- \* Oregon Inlet/Roanoke Sound Bird Nesting Islands
- \* Pea Island National Wildlife Refuge
- \* Roanoke Island Juncus Marsh
- \* Southern Shores Cypress Swamp

The Coastal Region includes the barrier islands and peninsulas, along with their associated marshes. These narrow ridges of unconsolidated sediment are among the most dynamic environments in the state, subject to reworking by erosion and overwash by storms as well as the more regular effects of tides, surf, salt spray, and wind. Significant Natural Heritage Areas in the coastal region of the Pasquotank basin include communities of Maritime Grassland, Maritime Forest, Sand Flats, and Salt Marshes. Protection exists for portions of several of these sites, such as Buxton Woods, Jockey's Ridge State Park, Pea Island National Wildlife Refuge, Nags Head Woods, and part of Kitty Hawk Woods. Because of the extreme rarity of these barrier island communities, protection should be a priority for the unprotected Significant Natural Heritage Areas.

### **14.7.2 Wetland Communities in the Pasquotank River Basin**

The Pasquotank River basin constitutes a significant portion of the North Carolina Coastal Plain known as the Embayed Region. The name Embayed Region refers to the prominence of drowned river valleys, which form the large sounds and many bays. The land in the Embayed Region is universally low and flat, and most is poorly drained. This region contains the largest acreage and proportion of wetlands in the state. The extensive reach of the Pasquotank River basin -- from the coastal environment of the outer banks, across estuaries, to embayed rivers and natural lakes -- captures many types of wetland communities. Vast peatlands occupy the centers of peninsulas between the drowned rivers. On the fringes of the peatlands are flat mineral soil wetlands which are kept saturated primarily by rainfall and sheet flow. Additional large areas of organic and mineral soil swamps and marshes lie adjacent to the sounds and tidally-influenced rivers.

Freshwater tidal wetlands are an important component of the landscape in the Pasquotank River basin, especially along Currituck Sound and the North and Northwest Rivers. Along the Albemarle Sound, the land-water interface is characterized by Tidal Cypress-Gum Swamp communities. Nonriverine wetland communities in the Pasquotank River basin include Nonriverine Swamp Forest, Nonriverine Wet Hardwood Forest, High Pocosin, Low Pocosin, Pond Pine Woodland, Peatland Atlantic White Cedar Forest, and Bay Forest. Both the Dismal Swamp and the Dare mainland contain extensive Nonriverine Swamp Forest, and they also support patches of Atlantic White Cedar, Pocosin, and Pond Pine Woodland. The extent of the natural areas in both the Dismal Swamp and the Dare mainland allows for the natural 'shifting mosaic' pattern of these wet peatland communities. The Nonriverine Wet Hardwood Forest community, which is dominated by oaks, is not part of the 'shifting mosaic' pattern, being associated more with mineral soils than organic soils and peatlands. The high productivity of the Nonriverine Wet Hardwood wetland community soils when cleared for agriculture has led to a drastic decline in the acreage of this community type across the state.

Natural Lake Shoreline is a wetland community type composed of the vegetated shoreline zone of large natural lakes. The vegetation may include emergent graminoids and other herbs, shrub thickets, Cypress--Gum Swamps, or various bottomland species. The Natural Lake Shoreline of Phelps Lake in Washington County is a high-quality example of this wetland community type which is protected within Pettigrew State Park.

Nontidal coastal fringe wetlands occur primarily on the outer banks. Wetland communities on the outer banks include Maritime Swamp Forest and Maritime Shrub Swamp, examples of which are protected at Nag's Head Woods; Maritime Wet Grassland, an example of which is found in the Pine Island Audobon Sanctuary in Currituck County; and Interdune Pond, a protected example of which is found at Cape Hatteras National Seashore.

### **14.7.3 Rare Aquatic and Wetland-Dwelling Species**

The influence of the coastal location of the Pasquotank River basin is reflected in the rare aquatic species. Most of the species found on this basin's list are associated with marine and estuarine environments, such as the Manatee, the sea turtles (Loggerhead, Hawksbill, and Northern Diamondback Terrapin), and the fishes Lyre Goby and Shortnose Sturgeon. Even the American Alligator lives in fresh to slightly brackish lakes, ponds, rivers and marshes.

While there are other rare mammals in the Pasquotank basin, the Manatee (*Trichechus manatus*) is the only rare aquatic mammal. A migratory animal that typically lives in the warmer waters of Florida and other Gulf states, manatees occasionally inhabit North Carolina's inlets, estuaries and rivers from June to October. Manatees rest near the surface of the water, which makes them vulnerable to motorboat propellers and discarded trash.

Table 35 List of Rare Aquatic Species in Pasquotank River Basin

Scientific Name	Common Name	State Status	Federal Status
<b>Animals</b>			
<i>Acipenser brevirostrum</i>	Shortnose Sturgeon	E	LE
<i>Alligator mississippiensis</i>	American Alligator	T	T(S/A)
<i>Caretta caretta</i>	Loggerhead	T	LT
<i>Chelonia mydas</i>	Green Turtle	T	LT
<i>Eretmochelys imbricata</i>	Hawksbill	E	LE
<i>Evorthodus lyricus</i>	Lyre Goby	SR	
<i>Fundulus confluentus</i>	Marsh Killifish	SR	
<i>Fundulus cf. diaphanus</i>	Lake Phelps Killifish	SR	FSC
<i>Malaclemys terrapin terrapin</i>	Northern Diamondback Terrapin	SC	FSC
<i>Trichechus manatus</i>	Manatee	E	LE
<b>Plants</b>			
<i>Amaranthus pumilus</i>	Seabeach Amaranth	T	LT
<i>Ceratophyllum australe</i>	Southern Hornwort	SR	
<i>Didiplis diandra</i>	Water Purslane	SR	
<i>Eriocaulon perkeri</i>	Estuary Pipewort	SR	
<i>Heteranthera multiflora</i>	Multiflowered Mud-plantain	SR	
<i>Lilaeopsis carolinensis</i>	Carolina Grasswort	T	
<i>Myriophyllum tenellum</i>	Leafless Watermilfoil	SR	
<i>Ranunculus ambigens</i>	Water-plantain Spearwort	SR	
<i>Sphagnum torreyanum</i>	Giant Peatmoss	SR	
<i>Torreyochloa pallida</i>	Pale Mannagrass	SR	
<i>Utricularia macrorhiza</i>	Greater Bladderwort	SR	
<i>Utricularia resupinata</i>	Northeastern Bladderwort	SR	
SR = Significantly Rare; T = Threatened; SC = Special Concern; FSC = Federal Species of Concern; E = Endangered			

Three rare fishes currently occur in the Pasquotank basin. The Shortnose Sturgeon (*Acipenser brevirostrum*) is a large, anadromous fish that once was common in North Carolina waterways. A distinctive fish with five rows of bony plates running the length of the body (giving it a rather prehistoric look), the shortnose sturgeon may live for up to 30 years, and inhabits the lower sections of larger rivers and estuaries along the Atlantic coast. The fish moves from the ocean and estuaries into freshwater rivers to spawn between February and May. Juveniles may remain upriver for up to five years after birth before migrating to the ocean. The species has suffered from excessive harvesting and habitat degradation, and is now in danger of extinction. Current distribution is not well known, and the shortnose sturgeon has not been reported from the Pasquotank basin for more than 20 years. The Lyre Goby (*Evorthodus lyricus*), so named for the lyre-shaped marking on its caudal fin, is a small fish limited to coastal areas in North Carolina. It is found in the Cape Fear River estuary, tidepools at Wrightsville Beach, and Bogue and Pamlico sounds. It prefers shallow, muddy tidepools dominated by smooth cordgrass. Human impacts to smooth cordgrass marshes place constant pressures on the natural habitat of the lyre goby. The third rare fish found in the Pasquotank basin is the Lake Phelps Killifish (*Fundulus cf. diaphanus*), and is endemic to North Carolina.

Several rare reptiles are found in the Pasquotank basin. Three species of sea turtles have been identified in the basin: the Loggerhead Turtle (*Caretta caretta*), the Green Turtle (*Chelonia mydas*), and the Hawksbill Turtle (*Eretmochelys imbricata*). A fourth turtle, the Northern Diamondback Terrapin (*Malaclemys terrapin terrapin*), is basically restricted to estuarine situations, and lives in coastal marshes, tidal flats, coves, estuaries, and lagoons behind barrier beaches. It is intolerant of long-term exposure to freshwater or 100 percent seawater. The American Alligator (*Alligator mississippiensis*), lives in slow moving coastal rivers, canals, lakes, marshes and estuaries and is a state and federally threatened species. The American Alligator has recovered from the low populations of the past century, and is no longer biologically threatened or endangered under the Endangered Species Act. However, it retains the federally threatened status due to its similarity of appearance to other rare crocodilians, and commercial hunting and trade are regulated.

## **14.8 Fisheries**

### **14.8.1 River Herring Fisheries Management Plan**

Within the Pasquotank River basin exists critical habitat for the anadromous fish species. Good water quality is an essential habitat element and has been identified as a limiting factor in fish stock recovery if water quality does not improve. The draft 2007 River Herring Fisheries Management Plan (FMP) provides an assessment of habitat conditions, recent studies, and recommendations to improve stock conditions. The FMP for the river herring advocates for multi-agency natural resource conservation and preservation. The FMP recommends that agencies collaboratively work to 1) develop stricter nutrient discharge limits to reduce eutrophication, 2) develop sediment discharge limits to protect spawning habitats, 3) reevaluate the oxygen budget in coastal waters to account for low DO waters draining from swamps and 4) require dischargers meet compliance with BOD limitations. The FMP supports the need for improved stormwater management plans and developing requirements for establishing and protecting riparian buffers and wetlands. The FMP discourages interbasin water transfers to prevent exacerbation of existing water quality conditions. The FMP also calls for an assessment of potential contaminants and by-products of reverse osmosis plants. More information on fish habitat requirements, water quality needs and specific recommendations can be found in the draft river herring FMP on the Division of Marine Fisheries website: <http://www.ncfisheries.net/fmps/index.html>.

### **14.8.2 Fish Kill Summary**

DWQ has systematically monitored and reported fish kill events across the state since 1996. From 2000 to 2005, field investigators reported eleven fish kill events in the Pasquotank River basin. Low dissolved oxygen, high water temperatures and possible chemical contamination may have contributed to these fish kill events. Annual fish kill reports can be found at DWQ's Environmental Sciences website <http://h2o.enr.state.nc.us/esb/Fishkill/fishkillmain.htm>.

## **14.9 Submerged Aquatic Vegetation**

Submerged Aquatic Vegetation (SAV) is a fish habitat dominated by one or more species of underwater vascular plant. These vegetation beds occur in both subtidal and intertidal zones and may occur in isolated patches or cover extensive areas. Fresh water vegetation may also grow in SAV beds. In North Carolina, SAV usually occurs in water less than 6 ft deep because of light

limitations. SAV is valued as a Critical Habitat Area under Marine Fisheries Commission rules. Over 150 fish and invertebrate species are known to use SAV as adults or juveniles, of which about 30 are important commercial fishery species. SAV beds provide an excellent nursery area for many species, including blue crabs, red drum, pink shrimp, spotted seatrout, and gag. SAV blades provide a surface for post-larval shellfish attachment, especially bay scallops, and refuge for small fish like mummichogs, pipefish, and grass shrimp. Large predators like flounders, rays, and red drum forage around SAV. SAV produces oxygen and detritus that is exported to other habitats, and reduces moderate turbidity and turbulence.

SAV coverage has declined and currently there are about 200,000 acres of SAV in coastal North Carolina. Aerial and ground surveys of SAV condition and growth provide baseline maps for future management actions are being coordinated through Albemarle Pamlico National Estuary Program, National Oceanic Atmospheric Association and local universities. SAV areas in Currituck Sound have been mapped. SAV is an environmental indicator and responds to water quality conditions. SAV is extremely dependent on clarity of the water column for its existence. Reduced light availability from nutrient and sediment loading is thought to be the primary cause of losses. Efforts need to continue to support SAV research to promote restoration and to identify water quality conditions that are limiting growth.

# Chapter 15

## North Carolina's Impaired Waters List

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### 15.1 Introduction to North Carolina's Impaired Waters List

The *North Carolina Water Quality Assessment and Impaired Waters List* is an integrated report that includes both the 305(b) and 303(d) reports. The *305(b) Report* is compiled to meet the Section 305(b) reporting requirement of the federal Clean Water Act (CWA). The 305(b) portion of the integrated report presents how well waters support designated uses (e.g., swimming, aquatic life support, water supply), as well as likely stressors (e.g., sediment, nutrients) and potential sources of impairment. The *303(d) List* is a comprehensive accounting of all Impaired waters and is derived from the 305(b) Report. North Carolina refers to the Impaired Waters List as the *Integrated Report* because it fulfills both the 305(b) and 303(d) requirements.

Section 303(d) of the CWA enacted in 1972 required States, Territories and authorized Tribes to 1) identify and establish a priority ranking for waters for which technology-based effluent limitations are not stringent enough to attain and maintain water quality standards, 2) establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waters, and 3) develop and submit the list of Impaired waters and TMDLs biennially by April 1<sup>st</sup> of every even numbered year to the US Environmental Protection Agency (EPA). EPA is required to approve or disapprove the state-developed 303(d) list within 30 days. For each segment Impaired by a pollutant and identified in the 303(d) list, a TMDL must be developed. TMDLs are not required for waters Impaired by pollution. Here, pollution is defined by the EPA as, “man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of the water,” and is related to water control structures.

### 15.2 Introduction to TMDLs

A 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 amount to the pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can still attain its designated uses. The calculation must also account for seasonal variation and critical conditions in water quality.

For more information on TMDLs and the 303(d) listing process, visit the TMDL website at <http://h2o.enr.state.nc.us/tmdl/>.

### 15.3 Contents of the Integrated Report

The Integrated Report includes descriptions of monitoring programs, the use support methodology, and the Impaired waters list. New guidance from EPA places all waterbody assessment units into one unique assessment category (EPA, 2001b). Although EPA specifies five unique assessment categories, North Carolina elects to use seven categories. Each category is described in detail below:

**Category 1: Attaining the water quality standard and no use is threatened.** This category consists of those waterbody assessment units where all applicable use support categories are rated "Supporting". Data and information are available to support a determination that the water quality standards are attained and no use is threatened. Future monitoring data will be used to determine if the water quality standard continues to be attained.

**Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened.** This category consists of those waterbody assessment units where at least one of the applicable use support categories are rated "Supporting" and the other use support categories are rated "Not Rated" or "No Data". Also included in this category are waters where at least one of the applicable use support categories, except Fish Consumption, are rated "Supporting"; the remaining applicable use support categories, except Fish Consumption, are rated "Not Rated"; and the Fish Consumption category is rated "Impaired-Evaluated". Data and information are available to support a determination that some, but not all, uses are attained. Attainment status of the remaining uses is unknown because there are insufficient or no data or information. Future monitoring data will be used to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information were previously insufficient to make a determination.

**Category 3: Insufficient or no data and information to determine if any designated use is attained.** This category consists of those waterbody assessment units where all applicable use support categories, except Fish Consumption, are rated "Not Rated", and the Fish Consumption category is rated "Impaired-Evaluated". Measured data or information to support an attainment determination for any use are not available. Supplementary data and information, or future monitoring, will be required to assess the attainment status.

**Category 4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL.** This category contains three distinct sub-categories:

**Category 4a: TMDL has been completed.** This category consists of those waterbody assessment units for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered before moving an assessment unit from Category 4a to Categories 1 or 2.

**Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future.** This category consists of those waterbody assessment units for which TMDLs will not be attempted because other required regulatory controls (e.g., NPDES permit limits, Stormwater Program rules, etc.) are expected to attain water quality standards within a reasonable amount of time. Future monitoring will be used to verify that the water quality standard is attained as expected.

**Category 4c: Impairment is not caused by a pollutant.** This category consists of assessment units that are Impaired by pollution, not by a pollutant. EPA defines pollution as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPA staff have verbally stated that this category is intended to be used for impairments related to water control structures (i.e., dams). Future monitoring will be used to confirm that there continues to be an absence of pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

**Category 5: Impaired for one or more designated uses by a pollutant(s) and requires a TMDL.** This category consists of those waterbody assessment units that are Impaired by a pollutant and the proper technical conditions exist to develop TMDLs. As defined by the EPA, the term pollutant means "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water". When more than one pollutant is associated with the impairment of a single waterbody assessment unit in this category, the assessment unit will remain in Category 5 until TMDLs for all listed pollutants have been completed and approved by the EPA.

**Category 6: Impaired based on biological data.** This category consists of waterbody assessment units historically referred to as "Biologically Impaired" waterbodies; these assessment units have no identified cause(s) of impairment although aquatic life impacts have been documented. The waterbody assessment unit will remain in Category 6 until TMDLs have been completed and approved by the EPA.

**Category 7: Impaired, but the proper technical conditions do not yet exist to develop a TMDL.** As described in the Federal Register, "proper technical conditions" refer to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662, December 28, 1978). These are assessment units that would otherwise be in Category 5 of the integrated list. As previously noted, EPA has recognized that in some specific situations the data, analyses or models are not available to establish a TMDL. North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. Open water and ocean hydrology fecal coliform Impaired shellfishing waters are included in this category.

Categories 5, 6 and 7 constitute the 2004 North Carolina 303(d) List for the State of North Carolina. A table of waters on Categories 1 through 3 is available for downloading on the DWQ website ([http://h2o.enr.state.nc.us/tmdl/General\\_303d.htm](http://h2o.enr.state.nc.us/tmdl/General_303d.htm)).

## 15.4 How North Carolina Proposes Delisting Waters

Waters appearing on the previously approved Impaired waters list will be moved to Categories 1, 2, 3 or 4 under the following circumstances:

- An updated 305(b) use support rating of Supporting, as described in the basinwide management plans.

- Applicable water quality standards are being met (i.e., no longer Impaired for a given pollutant) as described in either basinwide management plans or in technical memoranda.
- The basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as Impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing Decisions. Robert Wayland, III, Director. Office of Wetlands, Oceans and Watersheds. Aug 27, 1997).
- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories or modification of fish eating advice.
- Typographic listing mistakes (i.e., the wrong water was identified).
- EPA has approved a TMDL.

## 15.5 Scheduling TMDLs

Category 5 waters, those for which TMDLs are required, are at many different stages on the path to an approved TMDL. Some require additional data. Some require more outreach to increase stakeholder involvement. Others need to have a technical strategy budgeted, funded and scheduled. Some are ready for EPA submittal.

According to EPA guidance (EPA 2004), prioritization of waterbody assessment units for TMDLs need not be reflected in a “high, medium or low” manner. Instead, prioritization can be reflected in the TMDL development schedule. Generally, North Carolina attempts to develop TMDLs within 8-13 years of the original pollutant listing. Other information for each assessment unit is also utilized to determine the priority in the TMDL development schedule. This information includes the following:

- Year listed. Assessment units that have been on the 303(d) list for the longest period of time will receive priority for TMDL development and/or stressor studies.
- Reason for listing. (Applicable to Category 5 AUs only) AUs with an impairment due to a standard violation will be prioritized based on which standard was violated. Standard violations due to bacteria or turbidity currently receive priority for TMDL development.
- Classification. AUs classified for primary recreation (Class B), water supply (Class WS-I through WS-V), trout (Tr), high quality waters (HQW), and outstanding resource waters (ORW) will continue to receive a higher priority for TMDL development and/or stressor studies.
- Basinwide Planning Schedule. (Applicable to Category 6 AUs only). The basinwide schedule is utilized to establish priority for stressor studies.

## 15.6 Revising TMDLs

Current federal regulations do not specify when TMDLs should be revised. However, there are several circumstances under which it would seem prudent to revisit existing TMDLs. The TMDL analysis of targets and allocations is based upon the existing water quality standards, hydrology, water quality data (chemical and biological), and existing, active NPDES wastewater discharges. Conditions related to any of these factors could be used to justify a TMDL revision. Specific conditions that the Division will consider prior to revising an existing, approved TMDL include the following:

- A TMDL has been fully implemented and the water quality standards continue to be violated. If a TMDL has been implemented and water quality data indicate no improvement or a decline in overall water quality, the basis for the TMDL reduction or the allocation may need to be revised;
- A change of a water quality standard (e.g., fecal coliform to *E. coli*). The Division will prioritize review of existing TMDLs and data to determine if a revision to TMDLs will be required;
- The addition or removal of hydraulic structures to a waterbody (e.g., dams). Substantial changes to waterbody hydrology and hydraulics have the potential to change many aspects of target setting, including the water quality standard upon which the TMDL was developed, the water quality data, and the water quality modeling;
- Incorrect assumptions were used to derive the TMDL allocations. This would include errors in calculations and omission of a permitted discharge.

Should a TMDL be revised due to needed changes in TMDL targets, the entire TMDL would be revised. This includes the TMDL target, source assessment, and load and wasteload allocations. However, the Division may elect to revise only specific portions of the TMDL. For example, changes may be justifiable to the load and wasteload allocation portions of a TMDL due to incorrect calculations or inequities. In these cases, revisions to the TMDL allocations would not necessarily include a revision of TMDL targets.



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# **Appendix I**

## **DWQ Water Quality Monitoring Programs in the Pasquotank River Basin**



## DWQ Water Quality Monitoring Programs in the Pasquotank River Basin

Staff in the Environmental Sciences Section (ESS) and Regional Offices of DWQ collect a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the Pasquotank River basin for that program. For more detailed information on sampling and assessment of streams in this basin, refer to the *Basinwide Assessment Report* for the Pasquotank River basin, available from the Environmental Sciences Section website at <http://www.esb.enr.state.nc.us/bar.html> or by calling (919) 733-9960.

### DWQ monitoring programs for the Pasquotank River Basin include:

- Benthic Macroinvertebrates
- Fish Assessments
- Lakes and Reservoirs
- Aquatic Toxicity Monitoring
- Ambient Monitoring System

### Overview of Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since macroinvertebrates have life cycles of six months to over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies), commonly referred to as EPTs. A Biotic Index (BI) value gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont, coastal plain and swamp) within North Carolina and bioclassifications fall into five categories: Excellent, Good, Good-Fair, Fair and Poor. Swamp stream bioclassifications fall into three categories: Natural Moderate and Severe.

There were 11 benthic samples collected during this assessment period. The following table lists the total bioclassifications (by subbasin) for all benthos sites in the Pasquotank River basin. For detailed information regarding the samples collected during this assessment period, refer to the table that follows the next section.

Summary of Bioclassifications for All Freshwater Benthic Macroinvertebrate Sites (using the most recent rating for each site) in the Pasquotank River Basin

Subbasin	Bioclassifications						Swamp Streams Bioclass.			Total
	Excellent	Good	Good-Fair	Fair	Poor	Not Rated	Natural	Moderate	Severe Stress	
03-01-50				1				3		4
03-01-52				1				3		4
03-01-53					1				1	2
03-01-54								1		1

Assessing Benthic Macroinvertebrate Communities in the Northeastern Coastal Plain

There are three types of streams in the Pasquotank River basin, in which biological criteria can be assessed and bioclassifications are assigned. Streams referred to as Coastal A have continuous flow throughout the year, Coastal B streams are deep non-wadeable rivers with minimal flow throughout the year and swamp streams typically only have flow between February to March.

The Biological Assessment Unit defines swamp streams, as those streams that are within the coastal plain ecoregion and that normally have no visible flow during a part of the year. This low flow period usually occurs during the summer, but flowing water should be present in swamp streams during the winter. Sampling during winter, high flow periods provides the best opportunity for detecting differences in communities from what is natural, and only winter (February to early March) benthos data can be used when evaluating swamp streams. The swamp stream must have visible flow in this winter period, with flow comparable to a coastal plain stream that would have acceptable flow for sampling in summer.

The Biological Assessment Unit has limited data on Coastal B, thus, draft criteria have been developed based only on EPT taxa richness. However, biotic index values and total taxa richness values were also evaluated for between year and among site comparisons. These criteria will continue to be evaluated and any bioclassifications derived from them should be considered tentative and not used for use support decisions. Three Coastal B waterbody segments were Not Rated during this assessment period because of the draft Coastal B criteria.

The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for flowing freshwater streams. The benthic macroinvertebrate database is being evaluated and a study to systematically look at reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in specific stream types. DWQ will continue to develop criteria to better assess water quality.

Benthic macroinvertebrate basinwide monitoring data collected in the Pasquotank River basin, 2000-2005.

Subbasin/ Waterbody	Map ID	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	BioClass
<b>03-01-50</b>										
<b>Pasquotank R</b>	MB4	SR 1361	Pasquotank	30-3-(1)	2/22/2005	30	2	7.56	6.40	Moderate
					3/6/2002	29	1	7.19	---	Not Rated
					8/3/2000	27	0	8.28	---	Not Rated
<b>Newland Drainage Canal</b>	MB2	SR 1363	Pasquotank	30-3-1.5	2/22/2005	44	2	7.77	6.73	Moderate
					3/6/2002	26	2	7.13	7.10	Moderate
<b>Pasquotank R</b>	MB3	Goat Island	Pasquotank	30-3-(3)	8/24/2005	52	4	7.79	7.20	Fair
					8/2/2000	31	4	8.09	6.83	Not Rated
<b>Sawyers Cr</b>	MB5	SR 1200	Camden	30-3-6	3/7/2002	29	0	6.89	---	Not Rated
					2/18/2000	27	0	7.55	---	Natural
<b>Areneuse Cr</b>	MB1	NC 343	Camden	30-3-13-(1)	2/23/2005	36	1	7.98	9.80	Moderate

					3/6/2002	16	0	7.88	---	Not Rated
					2/18/2000	22	0	7.82	---	Moderate
Newbegun Cr		SR 1132	Camden	30-3-16-(1)	2/23/2000	20	0	8.59	---	Moderate
<b>03-01-51</b>										
NW Fk Alligator R		Canoe Trail Mile 4	Tyrrell	30-16-8	3/1/2000	13	0	8.19	---	Not Rated
SW Fk Alligator R		Canoe Trail Mile 2	Tyrrell	30-16-8-2	3/1/2000	14	0	7.19	---	Not Rated
UT Billys Ditch		off US-64 E of FWS ofc	Dare		10/10/2000	33	2	8.42	6.67	Not Rated
UT Billys Ditch		off US 64 nr landfill	Dare		10/10/2000	43	2	8.05	7.98	Not Rated
UT Callaghan Cr		ditch off Cub Rd	Dare		10/10/2000	37	2	8.87	5.46	Not Rated
UT Callaghan Cr		ditch off Long Curve Rd	Dare		10/10/2000	31	0	8.78	---	Not Rated
<b>03-01-52</b>										
<b>Little R</b>	MB7	SR 1221	Perquimans	30-5-(1)	2/23/2005	40	1	8.35	6.40	Moderate
					2/11/2000	24	0	7.95	---	Moderate
Perquimans R		SR 1204	Perquimans	30-6-(1)	2/22/2000	26	0	7.54	---	Moderate
<b>Perquimans R</b>	MB8	NC 37	Perquimans	30-6-(1)	2/22/2005	25	0	7.53	---	Moderate
<b>Perquimans R</b>	MB12	above Hertford	Perquimans	30-6-(1)	8/23/2005	41	4	7.91	6.80	Fair
					8/2/2000	45	4	8.04	6.91	Not Rated
<b>Burnt Mill Cr</b>	MB6	NC 37	Chowan	30-8-1	2/21/2005	54	0	7.91	---	Moderate
					2/22/2000	37	0	7.92	---	Moderate
<b>03-01-53</b>										
Kendrick Cr		US 64	Washington	30-9-(1)	10/26/2000	35	0	7.60	---	Not Rated
<b>Main Canal</b>	MB9	SR 1180	Washington	30-9-4	2/21/2005	33	1	8.34	6.20	Severe
					2/23/2000	31	1	8.62	9.80	Severe
Deep Cr		SR 1302	Washington	30-14-2	2/23/2000	28	1	7.06	6.40	Natural
Scuppernong R		SR 1155	Washington	30-14-4-(1)	8/3/2000	49	2	8.14	6.06	Poor
<b>Scuppernong R</b>	MB10	SR 1105	Tyrrell	30-14-4-(1)	8/25/2005	59	2	8.27	7.62	Poor
<b>03-01-54</b>										
<b>UT Cowells Cr</b>	MB11	NC 34	Currituck		2/24/2005	36	1	8.02	9.80	Moderate

## Overview of Fish Tissue Assessment

Because fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Contamination of aquatic resources have been documented for heavy metals, pesticides, and other complex organic compounds. Once these contaminants reach surface waters, they may be available for bioaccumulation, either directly or through aquatic food webs, and may accumulate in fish and shellfish tissues. Results from fish tissue monitoring can serve as an important indicator of further contamination of sediments and surface water.

Since 1991, fish tissue surveys have been conducted as part of the Basinwide Assessment Program. Fish tissues were sampled for metals and organic contaminants throughout the year's scheduled basins with the intent of assessing as many waterbodies as possible. While this included efforts to assess suspected "trouble spots" in a basin, significant time and resources were spent in gathering data from areas where few fish tissue contaminants were historically detected. Review of data after the first round of basin assessments were completed revealed that,

except for mercury, there were no widespread fish contaminant issues in the state that warranted basinwide-style investigations.

In 1999, the scope of fish tissue surveys were revised and shifted from basinwide assessments to areas where contaminants exist or are suspected. This shift has resulted in less basinwide coverage, but has focused resources on known contaminant issues within a basin.

All fish samples were collected according to standard operating procedures (NCDENR 2001). Analysis results are used as indicators for human health concerns, fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem. The Division conducted fish tissue surveys at three stations within the Pasquotank Basin during 2003 and 2004. These surveys were conducted as part of statewide fish tissue mercury assessments. All fish samples were analyzed for concentrations of total mercury (wet weight, ppm).

Eighty-nine fish tissue samples were collected from three stations in the Pasquotank basin during 2003 and 2004 and analyzed for mercury contamination. The samples included largemouth bass, yellow perch, sunfish and catfish. Results from the period show 48 of 89 samples collected contained mercury concentrations exceeding the state criteria of 0.4 ppm.

Fish samples and results exceeding NC criteria in Subbasin 53 in the Pasquotank River basin.				
Description	Years Sampled	Species	Number Samples	Samples exceeding NC Hg criteria (0.4 ppm)
Kendricks Creek	2003	Bass, Sunfish, Catfish, Pickerel, Yellow Perch	23	7
Lake Phelps	2003, 2004	Bass, Sunfish, Catfish, Yellow Perch	59	39
Scuppernong River	2004	Bass, Sunfish	7	2

### **Fish Kill Assessment**

DWQ has systematically monitored and reported fish kill events across the state since 1996. From 2000 to 2005, field investigators reported eleven kill events in the Pasquotank River basin. Low dissolved oxygen, high water temperatures and possible chemical contamination may have contributed to these fish kill events. Annual fish kill reports can be found at DWQ's Environmental Sciences website <http://h2o.enr.state.nc.us/esb/Fishkill/fishkillmain.htm>.

### **Overview of Lakes Assessment**

Phelps Lake was the only lake sampled between October 1, 2001 and September 30, 2005. The lake was sampled four times in 2005 for chlorophyll a, pH, dissolved oxygen, water temperature, turbidity and metals and eight times as part of a low-level mercury study from November 2002 through September 2006. Except for one sample with mercury exceeding state standards, all water quality standards were met.

## Overview of Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity (WET) by their NPDES permit or by administrative letter. Other facilities may also be tested by DWQ's Aquatic Toxicology Unit (ATU). Per Section 106 of the Clean Water Act, the ATU is required to test at least 10 percent of the major discharging facilities over the course of the federal fiscal year (FFY). However, it is ATU's target to test 20 percent of the major dischargers in the FFY. This means that each major facility would get evaluated over the course of their five-year permit. There are no requirements or targets for minor dischargers.

The ATU maintains a compliance summary for all facilities required to perform tests and provides monthly updates of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

Sixteen NPDES permits in the Pasquotank River basin currently require WET testing. Two of these facilities have a WET limit, while fourteen require monitoring without a limit; all of these facilities are drinking water treatment plants discharging filter backwash or reverse osmosis reject water. Across the state, the number of facilities required to perform WET has increased steadily since 1987, the first year that WET limits were written into permits in North Carolina. Consequently, compliance rates have also risen. Since 1996, the compliance rate has stabilized at approximately 90 percent.

## Overview of Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collections of physical and chemical water quality data. North Carolina has more than 378 water chemistry monitoring stations statewide, including 12 stations in the Pasquotank River basin. Between 23 and 32 parameters are collected monthly at each station. In the Pasquotank River basin, five ambient parameters exceeded state water quality parameters including: copper, iron, nickel, pH, and dissolved oxygen. The locations of these stations are shown on individual subbasin maps. Notable ambient water quality parameters are discussed in the subbasin chapters. Refer to *2006 Pasquotank River Basinwide Assessment Report* at <http://www.esb.enr.state.nc.us/bar.html> for more detailed analysis of ambient water quality monitoring data.

Specific information on water quality standards and action levels can be found in 15A NCAC 2B.0200 (August 1, 2004) available at <http://h2o.enr.state.nc.us/csu/swstdsfaq.html>.

### Water Quality Parameters

#### Dissolved Oxygen

Dissolved oxygen (DO) is one of the most important of all the chemical measurements. Dissolved oxygen provides valuable information about the ability of the water to support aquatic life and the capacity of water to assimilate point and nonpoint discharges. Water quality

standards for dissolved oxygen vary depending on the classification of the body of water but generally results less than 4.0 mg/L can be problematic. Consistent patterns of low concentrations of dissolved oxygen can be subject to intense management review and corrective actions, although patterns of low dissolved oxygen can occur naturally in and near swamp waters, in estuarine waters under salt wedge conditions, or during droughts.

### pH

The pH of natural waters can vary throughout the state. Low values ( $\ll 7.0$  s.u.) can be found in waters rich in dissolved organic matter, such as swamp lands, whereas high values ( $\gg 7.0$  s.u.) may be found during algal blooms. Point source dischargers can also influence the pH of a stream. The water quality standards for pH in freshwaters consider values less than 6.0 s.u. or greater than 9.0 s.u. to warrant attention; whereas in salt waters pH values less than 6.8 or greater than 8.5 warrant attention.

### Turbidity

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

### Nutrients

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as “nutrients.” Nitrogen compounds include ammonia-nitrogen ( $\text{NH}_3\text{-N}$ ), total Kjeldahl nitrogen (TKN) and nitrite+nitrate nitrogen ( $\text{NO}_2+\text{NO}_3\text{-N}$ ). Phosphorus is measured as total phosphorus. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes, or runoff from urban or agricultural land, the excessive growth of algae (algal blooms) 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  $\text{NH}_4\text{OH}$ , a form toxic to fish and other aquatic organisms.

### Bacteria

Concentrations of fecal coliform bacteria can vary greatly. The descriptive statistics used to evaluate fecal coliform bacteria data include the geometric mean and the median depending on the classification of the waterbody. For all sites in the Pasquotank River Basin, the standard specified in Administrative Code 15A NCAC 02B.0211 (3)(e) (August 1, 2005) is applicable:

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

### Metals

A number of metals are essential micronutrients for the support of aquatic life. However, there are threshold concentrations over which metals can be toxic. DWQ monitors total (not dissolved) concentrations for aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, manganese (Water Supply waters only), nickel, and zinc. Aluminum and iron are commonly found in North Carolina soils, therefore high aluminum and iron concentrations are typically correlated with high turbidity.

### Conductivity

Conductivity is a measure of the ability of water to conduct an electric current. The presence of ions and temperature are major factors in the ability of water to conduct a current. Clean freshwater has a low conductivity, whereas high conductivities may indicate polluted water or saline conditions. Measurements reported are corrected for temperature, thus the range of values reported over a period of time indicate the relative presence of ions in water. North Carolina freshwater streams have a natural conductance range of 17-65  $\mu\text{mhos/cm}$ , however (USGS 1992).

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

### Locations of DWQ Monitoring stations in the Pasquotank River Basin, 2000 - 2005.

Subbasin/ Station ID	Map ID	Location	Class
<b>50</b>		<b>Pasquotank River and Northeast Albemarle Sound</b>	
M2750000	MA1	Pasquotank River at Elizabeth City	SB
M390000N	MA4	Albemarle Sound near Frog Island North Shore	SB
<b>51</b>		<b>Alligator River and Southeast Albemarle Sound</b>	
M7175000	MA12	Alligator River at US 64 near Alligator	SC Sw ORW
M390000S	MA5	Albemarle Sound near Frog Island South Shore	SB
M390000C	MA3	Albemarle Sound near Frog Island Mid Channel	SB
<b>52</b>		<b>Little River, Perquimans River, and Central Albemarle Sound</b>	
M3500000	MA2	Little River at SR 1367 at Woodville	C Sw
M5000000	MA6	Perquimans River at SR 1336 at Hertford	SC
M610000N	MA8	Albemarle Sound btwn Harvey Point and Mill Point N Shore	SB
<b>53</b>		<b>Scuppernong River, Kendrick Creek, and Southwest Albemarle Sound</b>	
M6920000	MA10	Kendrick Creek at SR 1300 at Mackeys	SC
M6980000	MA11	Scuppernong River at SR 1105 near Columbia	C Sw
M610000S	MA9	Albemarle Sound btwn Harvey Point and Mill Point S Shore	SB
M610000C	MA7	Albemarle Sound btwn Harvey Point and Mill Point Mid Channel	SB



# **Appendix II**

## **Use Support Methodology**



## Introduction to Use Support

All surface waters of the state are assigned a classification appropriate to the best-intended uses of that water. Waters are assessed to determine how well they are meeting the classified or best-intended uses. The assessment results in a use support rating for the use categories that apply to that water.

### Use Support Categories

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the use of five use support categories: aquatic life, recreation, fish consumption, water supply, and shellfish harvesting. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. Waters are Supporting if data and information used to assign a use support rating meet the criteria for that use category. If these criteria are not met, then the waters are Impaired. Waters with inconclusive data and information are Not Rated. Waters where no data or information are available to make an assessment are No Data. The table below specifies which use support categories apply to which primary classifications.

A single body of water may have more than one use support rating corresponding to one or more of the use support categories, as shown in the following table. For many waters, a use support category will not be applicable (N/A) to the classification of that water (e.g., shellfish harvesting is only applied to Class SA waters). A full description of the classifications is available in the DWQ document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (15A NCAC 2b .0100 and .0200). Information can also be found within each basin plan and at <http://h2o.enr.state.nc.us/csu/>.

### Use Support Categories

Primary Classification	Ecosystem Approach	Human Health Approach			
		Fish Consumption	Recreation	Water Supply	Shellfish Harvesting
C	X	X	X	N/A	N/A
SC	X	X	X	N/A	N/A
B	X	X	X	N/A	N/A
SB	X	X	X	N/A	N/A
SA	X	X	X	N/A	X
WS I – WS IV	X	X	X	X	N/A

### Assessment Period

Data and information are used to assess water quality and assign use support ratings using a five-year data window that ends on August 31 of the year of basinwide biological sampling. For example, if biological data are collected in a basin in 2004, then the five-year data window for

use support assessments would be September 1, 1999 to August 31, 2004. There are occasionally some exceptions to this data window, especially when follow up monitoring is needed to make decisions on samples collected in the last year of the assessment period.

Data and information for assessing water quality and assigning use support ratings for lakes uses a data window of October 1 to September 30. Any data collected by DWQ during the five-year data window that ends on September 30 of the year of biological sampling will be used to develop a Weight-of-Evidence approach to lakes assessment. Refer to page 16 of this appendix for more information.

### **Assessment Units**

DWQ identifies waters by index numbers and assessment unit numbers (AU). The AU is used to track defined stream segments or waterbodies in the water quality assessment database, for the 303(d) Impaired waters list, and in the various tables in basin plans and other water quality documents. The AU is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU indicates that the AU is smaller than the DWQ index segment. No letter indicates that the AU and the DWQ index segment are the same.

### **Interpretation of Data and Information**

It is important to understand the associated limitations and degree of uncertainty when interpreting use support ratings. Although these use support methods are based on data analysis and other information, some best professional judgment is applied during these assessments. Use support ratings are intended to provide an assessment of water quality using a five-year data window, to describe how well surface waters support their classified uses, and to document the potential stressors contributing to water quality degradation and the sources of these contributions.

Use support methods continue to improve over time, and the information and technology used to make use support determinations also continue to become more accurate and comprehensive. These improvements sometimes make it difficult to make generalizations comparing water quality between basin plans. However, technology and methods improvements result in more scientifically sound use support assessments.

## **Assessment Methodology**

### **Introduction**

Many types of data and information are used to determine use support ratings and to identify stressors and sources of water quality degradation. All existing data pertaining to a stream segment for each applicable use support category are entered into a use support database. Assessments and data entries may include use support ratings for each of the five use support categories, basis of assessment, stressors and potential sources, biological, chemical/physical (ambient monitoring), and lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, swimming advisories and shellfish sanitation growing area classifications from the NC Division of Environmental Health, and available land

cover and land use information. The following describes the data and methodologies used to conduct use support assessments. These methods will continue to be refined as additional information and technology become available.

**Basis of Assessment**

Assessments are made on an overall basis of either monitored (M) or evaluated (E), depending on the level of information available. A monitored rating is based on the most recent five-year data window and site-specific data and is therefore treated with more confidence than an evaluated rating. Evaluated ratings are used when there are no site-specific data.

<b>Rating Basis</b>	<b>Use Support Category</b>	<b>Assessment Applicability*</b>
S/M	AL	Biological community data or ambient water quality parameters do not exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
S/M	REC	Ambient fecal coliform bacteria levels do not exceed criteria in AU or AU with DEH sites is posted with advisories for 61 days or less during assessment period.
S/M	SH	AU is a DEH Approved shellfish growing area.
I/M	AL	Biological community data or ambient water quality parameters exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
I/M	REC	Ambient fecal coliform bacteria levels exceeds criteria in AU or AU with DEH sites is posted with advisories for more than 61 days during assessment period.
I/M	FC	DHHS has established a site-specific advisory for fish consumption and fish tissue data are available.
I/M	SH	AU is a DEH Conditionally-Approved, Prohibited or Restricted shellfish growing area.
NR/M	AL	Biological community is Not Rated or inconclusive, or ambient water quality parameters are inconclusive or there are less than 10 samples in AU during assessment period. Biological and ambient data are independently applied.
NR/M	REC	Ambient fecal bacteria parameter exceeds annual screening criteria, but does not exceed assessment criteria of five samples in 30 days in AU during assessment period.
NR/M	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice; fish tissue data available.
S/E	AL	AU is a tributary to a S/M AU and land use is similar between AUs.
S/E	WS	AU is classified as WS, and DEH report notes no significant closures at time of assessment.
I/E	FC	AU is in basin under a mercury advice or drains to areas within a mercury advice. AU has a site-specific advisory and there is no fish tissue data available.
NR/E	AL	AU is tributary to I/M AU, or AU is in watershed with intensive and changing land use, or other information suggests negative water quality impacts to AU. Discharger in AU has noncompliance permit violations or has failed three or more WET tests during the last two years of the assessment period.
NR/E	REC	Discharger has noncompliance permit violations of fecal bacteria parameter during last two years of assessment period.
NR/E	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice, or has no fish tissue data.
ND	AL, REC, SH	No data available in AU during assessment period.

Note: S/M = Supporting/Monitored                      I/M = Impaired/Monitored                      NR/M = Not Rated/Monitored  
 S/E = Supporting/Evaluated                      I/E = Impaired/Evaluated                      NR/E = Not Rated/Evaluated  
 ND = No Data  
 AL = Aquatic Life                      REC = Recreation                      FC = Fish Consumption  
 SH = Shellfish Harvesting                      WS = Water Supply  
 AU = Assessment Unit                      WET = Whole Effluent Toxicity  
 DEH = Division of Environmental Health  
 DHHS = Department of Health and Human Services  
 \* = for lakes assessments, see page 16

Supporting ratings are extrapolated up tributaries from monitored streams when there are no problematic dischargers with permit violations or changes in land use/cover. Supporting ratings may also be applied to unmonitored tributaries where there is little land disturbance (e.g., national forests and wildlife refuges, wilderness areas or state natural areas). Problem stressors or sources are not generally applied to unmonitored tributaries. Impaired ratings are not extrapolated to unmonitored tributaries.

### **Stressors**

Biological and ambient samplings are useful tools to assess water quality. However, biological sampling does not typically identify the causes of impairment, and ambient sampling does not always link water quality standards to a biological response. Linking the causes of impairment and the biological response are a complex process (USEPA, 2000) that begins with an evaluation of physical, chemical or biological entities that can induce an adverse biological response. These entities are referred to as stressors. A stressor may have a measurable impact to aquatic health. Not all streams will have a primary stressor or cause of impairment. A single stressor may not be sufficient to cause impairment, but the accumulation of several stressors may result in impairment. In either case, impairment is likely to continue if the stressor or the various cumulative stressors are not addressed. Use support assessments evaluate the available information related to potential stressors impacting water quality.

A stressor identification process may be initiated after a stream appears on the 303(d) list in order to address streams that are Impaired based on biological data. Intensive studies are required to summarize and evaluate potential stressors to determine if there is evidence that a particular stressor plays a substantial role in causing the biological impacts. Intensive studies consider lines of evidence that include benthic macroinvertebrate and fish community data, habitat and riparian area assessment, chemistry and toxicity data, and information on watershed history, current watershed activities and land uses, and pollutant sources. These studies result in decisions regarding the probable stressors contributing to or causing impairment. The intensity of a stressor study may be limited due to a lack of resources. In these cases, it may still be appropriate to include stressors in use support assessments, but to also note where additional information is needed in order to evaluate other stressors.

Where an ambient parameter is identified as a potential concern, the parameter is noted in the DWQ database and use support summary table. Where habitat degradation is identified as a stressor, DWQ and others attempt to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools or riffles, channelization, lack of riparian vegetation, streambed scour and bank erosion).

## **Aquatic Life Category**

The aquatic life category is an ecosystem approach to assessing the biological integrity of all surface waters of the state. The biological community data and ambient water quality data are used in making assessments in this category. These represent the most important monitoring data for making water quality assessments in the aquatic life category. Evaluation information such as compliance and whole effluent toxicity information from NPDES dischargers, land cover, and other more anecdotal information are also used to identify potential problems and to refine assessments based on the monitoring data. The following is a description of each monitoring data type and the criteria used in assigning use support ratings. Criteria used to evaluate the other information and assign use support ratings are also described. Refer to page 14 for lakes and reservoir assessment methods as applied in the aquatic life category.

### ***Biological Data***

Benthic macroinvertebrate (aquatic insects) community and fish community samples are the best way to assess the biological integrity of most waterbodies. Unfortunately, these community measures cannot be applied to every stream size and are further limited by geographic region. These community measures are designed to detect current water quality and water quality changes that may be occurring in the watershed. However, they are only directly applied to the assessment unit where the sample was collected.

Where recent data for both benthic macroinvertebrates and fish communities are available, both are assessed for use support ratings. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit.

### ***Benthic Macroinvertebrate Criteria***

Criteria have been developed to assign bioclassifications to most benthic macroinvertebrate samples based on the number of taxa present in the pollution intolerant aquatic insect groups of *Ephemeroptera* (Mayflies), *Plecoptera* (Stoneflies) and *Trichoptera* (Caddisflies) commonly referred to as EPTs ; and the Biotic Index (BI), which summarizes tolerance data for all taxa in each sample. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored.

If a Fair macroinvertebrate bioclassification is obtained under conditions (such as drought or flood conditions, recent spills, etc.) that may not represent normal conditions or is borderline Fair (almost Good-Fair), a second sample should be taken within 12-24 months to validate the Fair bioclassification. Such sites will be Not Rated until the second sample is obtained.

Use support ratings are assigned to assessment units using benthic macroinvertebrate bioclassifications as follows.

<b>Waterbody Sample Type or Criteria</b>	<b>Benthic Bioclassification</b>	<b>Use Support Rating</b>
Mountain, piedmont, coastal A <sup>3</sup>	Excellent	Supporting
Mountain, piedmont, coastal A <sup>3</sup>	Good	Supporting
Swamp <sup>1</sup>	Natural	Supporting
Mountain, piedmont, coastal A	Good-Fair	Supporting
Smaller than criteria but Good-Fair <sup>1</sup>	Not Impaired	Supporting
Swamp <sup>1</sup>	Moderate Stress	Supporting
Mountain, piedmont, coastal A <sup>3</sup>	Fair	Impaired
Swamp <sup>1</sup>	Severe Stress	Impaired
Mountain, piedmont, coastal A <sup>3</sup>	Poor	Impaired
Criteria not appropriate to assign bioclassification	Not Rated	Not Rated

<sup>1</sup> Swamp streams for benthos sampling are defined as streams in the coastal plain that have no visible flow for a part of the year, but do have flow during the February to early March benthic index period.

<sup>2</sup> This designation may be used for flowing waters that are too small to be assigned a bioclassification (less than three square miles drainage area), but have a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria.

<sup>3</sup> Coastal A streams are those located in the coastal plain that have flow year round and are wadeable.

### Fish Community Criteria

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The NCIBI incorporates information about species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored. Use support ratings are assigned to assessment units using the NCIBI bioclassifications as follows:

<u>NCIBI</u>	<u>Use Support Rating</u>
Excellent	Supporting
Good	Supporting
Good-Fair	Supporting
Fair	Impaired
Poor	Impaired

The NCIBI was recently revised (NCDENR, 2001), and the bioclassifications and criteria have also been recalibrated against regional reference site data (NCDENR, 2000a, 2000b and 2001a). NCIBI criteria are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamlico, French Broad, Hiwassee, Little Tennessee, New and Watauga. Additionally, the NCIBI criteria are only applicable to streams in the piedmont portion of the Cape Fear, Neuse, Roanoke and Tar-Pamlico River basins. The definition of "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

- In the Cape Fear River basin -- all waters except for those draining the Sandhills in Moore, Lee and Harnett counties, and the entire basin upstream of Lillington, NC.
- In the Neuse River basin -- the entire basin above Smithfield and Wilson, except for the south and southwest portions of Johnston County and eastern two-thirds of Wilson County.
- In the Roanoke River basin -- the entire basin in North Carolina upstream of Roanoke Rapids, NC and a small area between Roanoke Rapids and Halifax, NC.
- In the Tar-Pamlico River basin -- the entire basin above Rocky Mount, except for the lower southeastern one-half of Halifax County and the extreme eastern portion of Nash County.

NCIBI criteria have not been developed for:

- Streams in the Broad, Catawba, Yadkin-Pee Dee, Savannah, French Broad, Hiwassee, Little Tennessee, New and Watauga River basins which are characterized as wadeable first to third order streams with small watersheds, naturally low fish species diversity, coldwater temperatures, and high gradient plunge-pool flows. Such streams are typically thought of as "Southern Appalachian Trout Streams".
- Wadeable streams in the Sandhills ecoregion of the Cape Fear, Lumber and Yadkin-Pee Dee River basins.
- Wadeable streams and swamps in the coastal plain region of the Cape Fear, Chowan, Lumber, Neuse, Pasquotank, Roanoke, Tar-Pamlico and White Oak River basins.
- All nonwadeable and large streams and rivers throughout the state.

### ***Ambient Water Quality Monitoring Criteria***

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring Program statewide and NPDES discharger coalitions in some basins. All samples collected (usually monthly) during the five-year assessment period are used to assign a use support rating. Ambient water quality data are not direct measures of biological integrity, but the chemical/physical parameters collected can provide an indication of conditions that may be impacting aquatic life. Because these data represent water quality conditions with a high degree of confidence, use support ratings assigned using these data are considered monitored. Where both ambient data and biological data are available, each data type is assessed independently.

The parameters used to assess water quality in the aquatic life category include dissolved oxygen, pH, chlorophyll *a* and turbidity. Criteria for assigning use support ratings to assessment units with ambient water quality data of a minimum of ten samples are as follows:

<u>Ratings Criteria</u>	<u>Rating</u>
Numerical standard exceeded in ≤10% of samples	Supporting
Numerical standard exceeded in >10% of samples	Impaired
Less than 10 samples collected	Not Rated
DO and pH standard exceeded in swamp streams	Not Rated

Some standards are written with more specific criteria than others and these specific criteria are used to assess use support. For example, the DO standard for Class C waters is a daily average

of 5 mg/l and an instantaneous value of 4 mg/l. Because DWQ does not collect daily DO levels at the ambient stations, the instantaneous value is used for assessment criteria. Instantaneous concentrations of 4.0 mg/L or less (5.0 mg/L in salt water) are in violation of the standard unless caused by natural (e.g. swampy) conditions. In areas with continuous monitoring, the daily average of 5 mg/l will also be assessed. In addition, pH has a standard of not less than 6 and not greater than 9; each level is assessed. To assess the fecal coliform bacteria standard, five samples must be collected within a 30 day period (see Recreation Category for more information).

### ***Multiple Monitoring Sites***

There are assessment units with more than one type of monitoring data. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit. Monitoring data are always used over the evaluation information; however, evaluation information can be used to lengthen or shorten monitored assessment units and to assign use support ratings on an evaluated basis to non-monitored assessment units.

### ***NPDES Wastewater Whole Effluent Toxicity (WET) Information***

Whole Effluent Toxicity (WET) tests are required for all major NPDES discharge permit holders, as well as those minor NPDES dischargers with complex effluent (defined as not being of 100 percent domestic waste). WET tests are evaluated to determine if the discharge could be having negative water quality impacts. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data or has no ambient water quality data, and that facility has failed three or more WET tests in the last two years of the assessment period, the assessment unit is Not Rated. Because this information is not a direct measure of water quality and the confidence is not as high as for monitoring data, this use support rating is considered evaluated rather than monitored. Problems associated with WET test failures are addressed through NPDES permits.

### ***NPDES Discharger Daily Monitoring Report (DMR) Information***

NPDES effluent data monthly averages of water quality parameters are screened for the last two years of the assessment period. If facilities exceed the effluent limits by 20 percent for two or more months during two consecutive quarters, or have chronic exceedances of permit limits for four or more months during two consecutive quarters, then the assessment unit is Not Rated if no biological or ambient monitoring data are available. Because discharger effluent data is not a direct measure of water quality and data confidence is not as high as for stream monitoring data, the assessment units are considered evaluated rather than monitored. If biological or ambient data are available, that data will be used to develop a use support rating for appropriate stream segments.

### **Fish Consumption Category**

The fish consumption category is a human health approach to assess whether humans can safely consume fish from a waterbody. This category is applied to all waters of the state. The use

support rating is assigned using fish consumption advisories or advice as issued by the NC Department of Health and Human Services (DHHS). The fish consumption category is different from other categories in that assessments are based on the existence of a DHHS fish consumption advice or advisory at the time of use support assessment. The advice and advisories are based on DHHS epidemiological studies and on DWQ fish tissue data. DWQ fish tissue data are used to inform DHHS of potential fish tissue toxicity. DHHS is responsible for proclaiming a fish tissue advisory or advice for any waterbody. Fish tissue monitoring data are not used directly for assigning a use support rating in this category.

If a site-specific fish consumption advisory is posted at the time of assessment, the water is Impaired on either a monitored or evaluated basis dependent upon the availability of monitoring data. The DHHS has developed statewide fish consumption advice for certain fish species shown to have elevated levels of mercury in their tissue. All waters of the state are therefore Impaired/Evaluated in the fish consumption category.

### **Recreation Category**

This human health related category evaluates waters for the support of primary recreation activities such as swimming, water-skiing, skin diving, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Waters of the state designated for these uses are classified as Class B, SB and SA. This category also evaluates waters used for secondary recreation activities such as wading, boating, and other uses not involving human body contact with water, and activities involving human body contact with water where such activities take place on an infrequent, unorganized or incidental basis. These waters are classified as Class C, SC and WS.

The use support ratings applied to this category are currently based on the state's fecal coliform bacteria water quality standard where ambient monitoring data are available or on the duration of local or state health agencies posted swimming advisories. Use support ratings for the recreation category may be based on other bacteriological indicators and standards in the future.

DWQ conducts monthly ambient water quality monitoring that includes fecal coliform bacteria testing. The Division of Environmental Health (DEH) tests coastal recreation waters (beaches) for bacteria levels to assess the relative safety of these waters for swimming. If an area has elevated bacteria levels, health officials will advise that people not swim in the area by posting a swimming advisory and by notifying the local media and county health department.

The North Carolina fecal coliform bacteria standard for freshwater is: 1) not to exceed the geometric mean of 200 colonies per 100 ml of at least five samples over a 30-day period; and 2) not to exceed 400 colonies per 100 ml in more than 20 percent of the samples during the same period. The AU being assessed for the five-year data window is Supporting in the recreation category if neither number (1) nor (2) of the standard are exceeded. The AU being assessed is Impaired in the recreation category if either number (1) or (2) is exceeded. Waters without sufficient fecal coliform bacteria data (five samples within 30 days) are Not Rated, and waters with no data are noted as having No Data.

Assessing the water quality standard requires significant sampling efforts beyond the monthly ambient monitoring sampling and must include at least five samples over a 30-day period.

Decades of monitoring have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, multiple samples over a 30-day period are needed to evaluate waters against the North Carolina water quality standard for recreational use support. Waters classified as Class SA, SB and B are targeted for this intensive sampling effort due to the greater potential for human body contact.

Waters with beach monitoring sites will be Impaired if the area is posted with an advisory for greater than 61 days of the assessment period. Waters with beach monitoring sites with advisories posted less than 61 days will be Supporting. Other information can be used to Not Rate unmonitored waters.

#### *DWQ Ambient Monitoring Fecal Coliform Bacteria Screening Criteria*

As with other information sources, all available information and data are evaluated for the recreation category using the assessment period. However, DWQ conducts an annual screening of DWQ ambient fecal coliform bacteria data to assess the need for additional monitoring or immediate action by local or state health agencies to protect public health.

Each March, DWQ staff will review bacteria data collections from ambient monitoring stations statewide for the previous sampling year. Locations with annual geometric means greater than 200 colonies per 100 ml, or when more than 20 percent of the samples are greater than 400 colonies per 100 ml, are identified for potential follow-up monitoring conducted five times within 30 days as specified by the state fecal coliform bacteria standard. If bacteria concentrations exceed either portion of the state standard, the data are sent to DEH and the local county health director to determine the need for posting swimming advisories. DWQ regional offices will also be notified.

Due to limited resources and the higher risk to human health, Class B, SB and SA waters will be given monitoring priority for an additional five times within 30 days sampling. Follow-up water quality sampling for Class C waters will be performed as resources permit. Any waters on the 303(d) list of Impaired waters for fecal coliform will receive a low priority for additional monitoring because these waters will be further assessed for TMDL development.

DWQ attempts to determine if there are any swimming areas monitored by state, county or local health departments or by DEH. Each January, DEH, county or local health departments are asked to list those waters which were posted with swimming advisories in the previous year.

#### **Shellfish Harvesting Use Support**

The shellfish harvesting use support category is a human health approach to assess whether shellfish can be commercially harvested and is therefore applied only to Class SA waters. The following data sources are used to assign use support ratings for shellfish waters.

#### *Division of Environmental Health (DEH) Shellfish Sanitation Surveys*

DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Estuarine waters are delineated according to DEH shellfish management areas (e.g., Outer Banks, Area H-5) which include Class SA, SB and SC waters. DEH samples growing

areas regularly and reevaluates the areas by conducting shellfish sanitation shoreline surveys every three years to determine if their classification is still applicable. DEH classifications may be changed after the most recent sanitary survey. Classifications are based on DEH bacteria sampling, locations of pollution sources, and the availability of the shellfish resource. Growing waters are classified as follows.

DEH Classification	DEH Criteria
Approved (APP)	<p><b>Fecal Coliform Standard for Systematic Random Sampling:</b> The median fecal coliform Most Probable Number (MPN) or the geometric mean MPN of the water shall not exceed 14 per 100 milliliters (ml), and the estimated 90<sup>th</sup> percentile shall not exceed an MPN of 43 MPN per 100 ml for a 5-tube decimal dilution test.</p> <p><b>Fecal Coliform Standard for Adverse Pollution Conditions Sampling:</b> The median fecal coliform or geometric mean MPN of the water shall not exceed 14 per 100 ml, and not more than 10 percent of the samples shall exceed 43 MPN per 100 ml for a 5-tube decimal dilution test.</p>
Conditionally Approved-Open (CAO)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be open more frequently than closed.
Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be closed more frequently than open.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data do not meet criteria for Approved, Conditionally Approved or Restricted Classification.

Assigning Use Support Ratings to Shellfish Harvesting Waters (Class SA)

DWQ use support ratings may be assigned to separate segments within DEH management areas. In assessing use support, the DEH classifications and management strategies are only applicable to DWQ Class SA (shellfish harvesting) waters. It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) for their suitability for shellfish harvesting. This will result in a difference of acreage between DEH areas classified as CAC, PRO and RES, and DWQ waters rated as Impaired. For example, if DEH classifies a 20-acre area CAC, but only 10 acres are Class SA, only those 10 acres of Class SA waters are rated as Impaired.

The DEH "Closed" polygon coverage includes CAC, RES and PRO classifications, and it is not currently possible to separate out the PRO from the RES areas. Therefore, these areas are a combined polygon coverage, and DWQ rates these waters as Impaired.

Sources of fecal coliform bacteria are more difficult to separate out for Class SA areas. DEH describes the potential sources in the sanitary surveys, but they do not describe specific areas affected by these sources. Therefore, in the past, DEH identified the same sources for all Class SA sections of an entire management area (e.g., urban runoff and septic systems). Until a better way to pinpoint sources is developed, this information will continue to be used. A point source discharge is only listed as a potential source when NPDES permit limits are exceeded.

DWQ and DEH are developing the database and expertise necessary to assess shellfish harvesting frequency of closures. In the interim, DWQ has been identifying the frequency of closures in Class SA waters using an interim methodology (see below) based on existing databases and GIS shapefiles. There will be changes in reported acreages in future assessments using the permanent methods and tools that result from this project.

**Past Interim Frequency of Closure-Based Assessment Methodology**

The interim method was used for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin use support assessments. Shellfish harvesting use support ratings for Class SA waters using the interim methodology are summarized below.

<b>Percent of Time Closed within Basin Data Window</b>	<b>DEH Growing Area Classification</b>	<b>DWQ Use Support Rating</b>
N/A	Approved*	Supporting
Closed ≤10% of data window	Portion of CAO closed ≤10% of data window	Supporting
Closed >10% of the data window	Portion of CAO closed >10% of data window	Impaired
N/A	CAC and PRO/RES**	Impaired

\* Approved waters are closed only during extreme meteorological events (hurricanes).

\*\* CAC and P/R waters are rarely opened to shellfish harvesting.

For CAO areas, DWQ worked with DEH to determine the number of days and acreages that CAO Class SA waters were closed to shellfish harvesting during the assessment period. For each growing area with CAO Class SA waters, DEH and DWQ defined subareas within the CAO area that were opened and closed at the same time. The number of days these CAO areas were closed was determined using DEH proclamation summary sheets and the original proclamations.

The number of days that APP areas in the growing area were closed due to preemptive closures because of named storms was not counted. For example, all waters in growing area E-9 were preemptively closed for Hurricane Fran on September 5, 1996. APP waters were reopened September 20, 1996. Nelson Bay (CAO) was reopened September 30, 1996. This area was considered closed for ten days after the APP waters were reopened.

**Current Assessment Methodology**

Use support assessment is now conducted such that only the DEH classification will be used to assign a use support rating. By definition, CAO areas are areas that DEH has determined do not, or likely do not, meet water quality standards and these areas will be rated Impaired, along with CAC and PRO/RES areas. Only APP areas will be rated Supporting.

Growing areas that have been reclassified by DEH during the assessment period from a lower classification to APP will be rated Supporting. Areas that are reclassified from APP to any other classification during the assessment period will be rated Impaired.

Over the next few years, DWQ, DEH, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a database with georeferenced (GIS)

shellfish harvesting areas. The new database and GIS tools will be valuable for the above agencies to continue to work together to better serve the public. Using the new database with georeferenced areas and monitoring sites, DEH will be able to report the number of days each area was closed excluding closures related to large or named storms.

### **Water Supply Use Support**

This human health related use support category is used to assess all Class WS waters for the ability of water suppliers to provide potable drinking water. Water quality standards established for drinking water apply to water delivered to consumers after it has been treated to remove potential contaminants that may pose risks to human health. Ambient standards established by states under the Clean Water Act are not intended to ensure that water is drinkable without treatment. Modern water treatment technologies are required to purify raw water to meet drinking water standards as established by the North Carolina Division of Environmental Health.

Water supply use support is assessed by DWQ using information from the seven DEH regional water treatment plant consultant staff. Each January, the DEH staff consultants are asked to submit a spreadsheet listing closures and water intake switch-overs for all water treatment plants in their region. This spreadsheet describes the length and time of the event, contact information, and the reason for the closure or switch.

The spreadsheets are reviewed by DWQ staff to determine if any closures/switches were due to water quality concerns. Those closures/switches due to water quantity problems and reservoir turnovers are not considered for use support. The frequency and duration of closures/switches due to water quality concerns are considered when assessing use support. Using these criteria, North Carolina's surface water supplies are currently rated Supporting on an Evaluated basis. Specific criteria for rating waters Impaired are to be determined on a case-by-case basis.

### **Use of Outside Data**

DWQ actively solicits outside data and information in the year before biological sampling in a particular basin. The solicitation allows approximately 90 days for data to be submitted. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments.

The way the solicited data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the 303(d) report and shown in the table below. Level 1 data can be use with the same confidence as DWQ data to determine use support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and stressors. They may also be used to limit the extrapolation of use support ratings up or down a stream segment from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

<b>Criteria Levels for Use of Outside Data in Use Support Assessments</b>			
<b>Criteria</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>
Monitoring frequency of at least 10 samples for more than a one-year period	Yes	Yes/No	No
Monitoring locations appropriately sited and mapped	Yes	Yes	No
State certified laboratory used for analysis according to 15A NCAC 2B .0103	Yes	Yes/No	No
Quality assurance plan available describing sample collection and handling	Yes, rigorous scrutiny	Yes/No	No

## **Lakes and Reservoir Use Assessment**

Like streams, lakes are classified for a variety of uses. All lakes monitored as part of North Carolina’s Ambient Lakes Monitoring Program carry the Class C (aquatic life) classification, and most are classified Class B and SB (recreation) and WS-I through WS-V (water supply). The surface water quality numeric standard specifically associated with recreation is fecal coliform. For water supplies, there are 29 numeric standards based on consumption of water and fish. Narrative standards for Class B and Class WS waters include aesthetics such as no odors and no untreated wastes. There are other numeric standards that also apply to lakes for the protection of aquatic life and human health. These standards also apply to all other waters of the state and are listed under the Class C rules. One of the major problems associated with lakes and reservoirs is increasing eutrophication related to nutrient inputs. Several water quality parameters help to describe the level of eutrophication.

For nutrient enrichment, one of the main causes of impacts to lakes and reservoirs, a more holistic or weight of evidence approach is necessary since nutrient impacts are not always reflected by the parameters sampled. For instance, some lakes have taste and odor problems associated with particular algal species, yet these lakes do not have chlorophyll *a* concentrations above 40 µg/l frequently enough to impair them based on the standard. In addition, each reservoir possesses unique traits (watershed area, volume, depth, retention time, etc.) that dramatically influence its water quality, but that cannot be evaluated through standards comparisons. In such waterbodies, aquatic life may be Impaired even though a particular indicator is below the standard. Where exceedances of surface water quality standards are not sufficient to evaluate a lake or reservoir, the weight of evidence approach can take into consideration indicators and parameters not in the standards to allow a more sound and robust determination of water quality.

The weight of evidence approach uses the following sources of information to determine the eutrophication (nutrient enrichment) level as a means of assessing lake use support in the aquatic life category:

- Quantitative water quality parameters - dissolved oxygen, chlorophyll *a*, pH, etc.
- Algal bloom reports
- Fish kill reports

- Hydrologic and hydraulic characteristics – watershed size, lake volume, retention time, volume loss, etc.
- Third party reports – citizens, water treatment plant operators, state agencies, etc.
  - Taste and odor
  - Sheens
  - Odd colors
  - Other aesthetic and safety considerations

In implementing the weight of evidence approach for eutrophication, more consideration is given to parameters that have water quality standards (see table). Each parameter is assessed for percent exceedance of the state standard. Parameters with sufficient (ten or more observations), quality-assured observations are compared to surface water quality standards. When standards are exceeded in more than 10 percent of the assessment period, portions or all of the waterbody are rated Impaired.

However, in many cases, the standards based approach is incapable of characterizing the overall health of a reservoir. The eutrophication-related parameters and water quality indicators without numeric standards are reviewed based on interpretation of the narrative standards in 15A NCAC 2B .0211(2) and (3).

A modification to lake use assessment is the evaluation and rating of a lake or reservoir by assessment units (AUs). Each lake or reservoir may have one or more AU based on the classification segments (DWQ index numbers). Each sampling date is considered one sample. Multiple sampling locations within one AU are considered one sample. A minimum of ten samples is needed to assess use support for any AU. Each AU with documented problems (sufficient data, ambient data above standards, and supporting public data) will be rated as Impaired while the other portions are rated as Supporting or Not Rated. The following table lists the information considered during a lake/reservoir use assessment, as well as the criteria used to evaluate that information.

<b>Lake/Reservoir Weight of Evidence Use Assessment for Aquatic Life Category</b>	
<b>Assessment Type</b>	<b>Criteria</b>
<b><i>EUTROPHICATION</i></b>	
<b><i>Water Quality Standards (a minimum of 10 samples is required for use support assessment)</i></b>	
Chl <i>a</i>	Above standard in >10% of samples.
DO	Below or above standard in >10% of samples.
pH	Below or above standard in >10% of samples.
Turbidity	Above standard in >10% of samples.
% Total Dissolved Gases	Above standard in >10% of samples.
Temperature	Minor and infrequent excursions of temperature standards due to anthropogenic activity. No impairment of species evident.
Metals (excluding copper, iron and zinc)	Above standard in >10% of samples.
<b><i>Other Data</i></b>	
% Saturation DO	>10% of samples above >120%
Algae	Blooms during 2 or more sampling events in 1 year with historic blooms.
Fish	Kills related to eutrophication.
Chemically/ Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.
Aesthetics Complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state agency.
Trophic Status Index (TSI)	Increase of 2 trophic levels from one 5-year period to next.
Historic DWQ Data	Conclusions from other reports and previous use support assessments.
AGPT	Algal Growth Potential Test $\geq 5$ mg/L
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat; clogging intakes.
Taste and Odor	Public complaints; Potential based on algal spp
Sediments	Clogging intakes - dredging program necessary.

## **References**

- Fels, J. 1997. *North Carolina Watersheds Map*. North Carolina State University Cooperative Extension Service. Raleigh, NC.
- North Carolina Department of Environment and Natural Resources (NCDENR). 2000a. *Fish Community Metric Re-Calibration and Biocriteria Development for the Inner Piedmont, Foothills, and Eastern Mountains (Broad, Catawba, Savannah, and Yadkin River Basins)*. September 22, 2000. Biological Assessment Unit. Environmental Sciences Branch. Water Quality Section. Division of Water Quality. Raleigh, NC.
- \_\_\_\_\_. 2000b. *Fish Community Metric Re-Calibration and Biocriteria Development for the Outer Piedmont (Cape Fear, Neuse, Roanoke and Tar River Basins)*. October 17, 2000. *Ibid*.
- \_\_\_\_\_. 2001a. *Standard Operating Procedure. Biological Monitoring. Stream Fish Community Assessment and Fish Tissue*. Biological Assessment Unit. Environmental Sciences Branch. Water Quality Section. Division of Water Quality. Raleigh, NC.
- \_\_\_\_\_. 2001b. *Fish Community Metric Re-Calibration and Biocriteria Development for the Western and Northern Mountains (French Broad, Hiwassee, Little Tennessee, New and Watauga River Basins)*. January 05, 2001. *Ibid*.
- USEPA. 2000. *Stressor Identification Guidance Document*. EPA/822/B-00/025. Office of Water. Washington, DC.



## **Appendix III**

# **NPDES Discharge, Non-Discharge and Stormwater Permits**



*NPDES Dischargers in the Pasquotank River Basin (2007)*

NPDES Dischargers									
Permit	Owner	Facility	County	Region	Type	Class	Flow	Subbasin	Receiving Stream
NC0007978	South Mills Water Association Inc	South Mills Water Association WTP	Camden	Washington	Water Treatment Plant	Minor	45000	30150	Dismal Swamp Canal
NC0025011	City of Elizabeth City	Elizabeth City WWTP	Pasquotank	Washington	Municipal, Large	Major	4500000	30150	Pasquotank River
NC0036447	City of Elizabeth City	Elizabeth City WTP	Pasquotank	Washington	Water Treatment Plant	Minor	not limited	30150	Knobbs Creek
NC0037214	Camden County Board of Education	Grandy Primary School	Camden	Washington	100% Domestic < 1MGD	Minor	7000	30150	Sawyers Creek
NC0043583	Pasquotank County	Pasquotank County WTP	Pasquotank	Washington	Water Treatment Plant	Minor	not limited	30150	New Begun Creek
NC0086681	Camden County	Camden County Reverse Osmosis WTP	Camden	Washington	Water Treatment Plant	Minor	432000	30150	Pasquotank River
NC0001732	Daniels Seafood Company	Daniels Seafood / Nags Head	Dare	Washington	Industrial Process & Commercial	Minor	not limited	30151	Roanoke Sound
NC0035670	Dare County	Skyco Regional WTP	Dare	Washington	Water Treatment Plant	Minor	192000	30151	Croatan Sound
NC0041386	NC Department of Commerce	Wanchese Harbor Project	Dare	Washington	Industrial Process & Commercial	Minor	270000	30151	Mill Landing Creek (Mill Creek)
NC0048151	Etheridge Seafood Company	Etheridge Seafood Company	Dare	Washington	Industrial Process & Commercial	Minor	25000	30151	Mill Landing Creek (Mill Creek)
NC0056065	State of North Carolina Department of Transportation	Marine Maintenance facility	Dare	Washington	Industrial Process & Commercial	Minor	3000	30151	Spencer Creek
NC0079057	Town of Manteo	Manteo WWTP	Dare	Washington	Municipal, Large	Major	1000000	30151	Shallowbag Bay
NC0021849	Town of Hertford	Hertford WWTP	Perquimans	Washington	Municipal, < 1MGD	Minor	700000	30152	Perquimans River
NC0051373	Perquimans County	Winfall WTP	Perquimans	Washington	Water Treatment Plant	Minor	not limited	30152	Mill Creek
NC0068861	Perquimans County	Bethel WTP	Perquimans	Washington	Water Treatment Plant	Minor	not limited	30152	Bethel Creek
NC0081850	Town of Winfall	Winfall WTP	Perquimans	Washington	Water Treatment Plant	Minor	not limited	30152	Mill Creek
NC0007510	Town of Columbia	Columbia WTP	Tyrrell	Washington	Water Treatment Plant	Minor	20000	30153	Scuppernong River
NC0020443	Town of Columbia	Columbia WWTP	Tyrrell	Washington	Municipal, < 1MGD	Minor	300000	30153	Scuppernong River
NC0027600	Town of Creswell	Creswell WTP	Washington	Washington	Water Treatment Plant	Minor	not limited	30153	Scuppernong River
NC0031925	Town of Roper	Roper WTP	Washington	Washington	Water Treatment Plant	Minor	9000	30153	Main Canal
NC0036315	Town of Roper	Roper WWTP	Washington	Washington	Municipal, < 1MGD	Minor	85000	30153	Main Canal
NC0048861	Town of Creswell	Creswell WWTP	Washington	Washington	Municipal, < 1MGD	Minor	64000	30153	Scuppernong River
NC0085081	Charlson S. Boucher	Dalton House Motel/Restaurant	Tyrrell	Washington	100% Domestic < 1MGD	Minor	6000	30153	Scuppernong River
NC0086924	Tyrrell County	Reverse Osmosis WTP	Tyrrell	Washington	Water Treatment Plant	Minor	216000	30153	Bull Bay
NC0087009	Washington County	Washington County WTP	Washington	Washington	Water Treatment Plant	Minor	not limited	30153	ALBEMARLE SOUND
NC0087092	Tyrrell County	Tyrrell County WTP	Tyrrell	Washington	Water Treatment Plant	Minor	53000	30153	Riders Creek (First Creek) and connecting canals

**NPDES Dischargers in the Pasquotank River Basin (2007)**

Permit	Owner	Facility	County	Region	Type	Class	Flow	Subbasin	Receiving Stream
NC0088234	Philip Carawan	Capt. Neill's Seafood, Inc.	Tyrrell	Washington	Industrial Process & Commercial	Minor	not limited	30153	ALBEMARLE SOUND
NC0072150	Currituck County	Currituck County WTP	Currituck	Washington	Water Treatment Plant	Minor	not limited	30154	East Creek
NC0087670	Currituck County	Southern Outer Banks Water System WTP	Currituck	Washington	Water Treatment Plant	Minor	600000	30154	Atlantic Ocean
NC0083909	Dare County	Rodanthe/Waves/Salvo Reverse Osmosis WTP	Dare	Washington	Water Treatment Plant	Minor	300000	30155	Blackmar Gut
NC0085707	Dare County/Cape Hatteras Water Assoc	Cape Hatteras Reverse Osmosis WTP	Dare	Washington	Water Treatment Plant	Minor	1800000	30155	Pamlico Sound
NC0086932	Dare County	Stumpy Point Reverse Osmosis WTP	Dare	Washington	Water Treatment Plant	Minor	43200	30155	Stumpy Point Bay
NC0070157	Dare County	Kill Devil Hills Reverse Osmosis WTP	Dare	Washington	Water Treatment Plant	Minor	1420000	30156	Atlantic Ocean

*General Stormwater Permits in the Pasquotank River Basin (2007)*

<b>General Stormwater Permits</b>				
<b>COC Number</b>	<b>Facility Name</b>	<b>Receiving Stream</b>	<b>Subbasin</b>	<b>County</b>
NCG020566	Superior Sand Company Incorporated	Pasquotank River	# 03-01-50	Pasquotank
NCG020587	Camden Yard Materials	Dismal Swamp Canal	# 03-01-50	Camden
NCG020617	Route 17 Mine	Dismal Swamp Canal	# 03-01-50	Camden
NCG020642	Stevenson Sand Mine	New Begun Creek	# 03-01-50	Pasquotank
NCG020644	Stevenson Sand Mine	Pasquotank River	# 03-01-50	Pasquotank
NCG020649	Winslow Pit	Knobbs Creek	# 03-01-50	Pasquotank
NCG080759	Chesapeake & Albermarle Railroad	Knobbs Creek	# 03-01-50	Pasquotank
NCG160076	Barnhill Contracting Co-Pasquo	Knobbs Creek	# 03-01-50	Pasquotank
NCG210017	J W Jones Lumber Company Inc	Pasquotank River	# 03-01-50	Pasquotank
NCS000336	Universal Forest Products - Eastern Div Inc Elizabeth City	Knobbs Creek	# 03-01-50	Pasquotank
NCG020596	Dare Co - C & D Landfill Borrow Pit	Sandy Ridge Gut (Sawyer Lake)	# 03-01-51	Dare
NCG020625	Roberson's Contracting Tyrell County Pit	ALBEMARLE SOUND	# 03-01-51	Tyrrell
NCG020650	J Tildon Whitehurst, Jr. Mine	Little River	# 03-01-52	Perquimans
NCG020675	Whitehurst Sand Company Mine	Little River	# 03-01-52	Perquimans
NCG030213	Mitek Edenton	ALBEMARLE SOUND	# 03-01-52	Chowan
NCG190056	Shore Flyte Marina	Perquimans River	# 03-01-52	Perquimans
NCG190063	Albemarle Sportfishing Boats Inc	ALBEMARLE SOUND	# 03-01-52	Chowan
NCS000008	Fortress Wood Products	Little River	# 03-01-52	Pasquotank
NCG020447	Tyrrell Ready Mix-Dolly Mine	Scuppernong River	# 03-01-53	Tyrrell
NCG020662	Davenport Sand Company	Kendrick Creek (Mackeys Creek)	# 03-01-53	Washington
NCG210303	Mackeys Ferry Sawmill - Roper	Kendrick Creek (Mackeys Creek)	# 03-01-53	Washington
NCG020641	Green Acres Land Development, Inc.	Currituck Sound	# 03-01-54	Currituck
NCG140226	Coastal Ready Mix Concrete	Roland Creek	# 03-01-54	Currituck
NCG080464	NC Power-Kitty Hawk Combustion	Kitty Hawk Bay	# 03-01-56	Dare
NCG140324	TNT Services Inc	Kitty Hawk Bay	# 03-01-56	Dare

General Stormwater Permits in the Pasquotank River Basin (2007)

**Non-Discharge NPDES Permits**

Permit	Owner	Facility	County	Region	Owner Type	Perm Type	Class	Perm_Statu	Flow
WQ0029868	Sandy Point Water & Sewer LLC	Sandy Point WWTF	Chowan	Washington	Non-Government	Reuse	Major	ACTIVE	300000
WQ0000185	Currituck County	Ocean Sands	Currituck	Washington	Government - County	High-Rate Infiltration	Major	ACTIVE	500000
WQ0004696	Carolina Village L L C	Carolina Village	Currituck	Washington	Non-Government	Surface Irrigation	Major	ACTIVE	60000
WQ0011284	Carolina Water Service Inc Of NC	Corolla Light Water Trmt. Plant - Infiltration Pond	Currituck	Washington	Non-Government	High-Rate Infiltration	Minor	ACTIVE	4000
WQ0014306	Sandler Utilities at Mill Run LLC	Eagle Creek	Currituck	Washington	Non-Government	Reuse	Major	ACTIVE	321000
WQ0015052	Enviro-Tech of North Carolina Inc	Village at Ocean Hill	Currituck	Washington	Non-Government	Reuse	Major	ACTIVE	164000
WQ0015053	Currituck County	Moyock Commons	Currituck	Washington	Government - County	Surface Irrigation	Major	ACTIVE	40000
WQ0000910	Carolina Water Service Inc Of NC	The Village at Nags Head	Dare	Washington	Non-Government	High-Rate Infiltration	Major	ACTIVE	500000
WQ0002042	J R S Partners LLC	Holiday Inn-Nags Head	Dare	Washington	Non-Government	High-Rate Infiltration	Major	ACTIVE	30000
WQ0002284	Outer Banks/Kinnakeet Associates L L C	Kinnakeet Shores	Dare	Washington	Non-Government	Reuse	Major	ACTIVE	350000
WQ0007256	Baycliff Homeowners' Association Inc	Baycliff	Dare	Washington	Non-Government	High-Rate Infiltration	Major	ACTIVE	20000
WQ0014757	Hatchell Concrete Inc	Hatchell Concrete Inc-Carwas	Dare	Washington	Non-Government	Wastewater Recycling	Minor	EXPIRED	0
WQ0017224	Ginguite Woods Wtr Reclamation Assoc Inc	Ginguite Woods	Dare	Washington	Non-Government	Reuse	Major	ACTIVE	32500
WQ0001189	Rollingview Marina Inc	Rollingview Marina	Durham	Raleigh	Non-Government	Surface Irrigation	Minor	ACTIVE	1500
WQ0006932	Professional Laboratories & R	Professional Laboratories & R	Gates	Washington	Non-Government	Surface Irrigation	Minor	ACTIVE	4500
WQ0014808	City of Elizabeth City	City of Elizabeth City WTP Residuals Storage Facility	Pasquotank	Washington	Government - Municipal	Surface Disposal of Residual Solids(503 Exempt)	Minor	ACTIVE	10000

*General Stormwater Permits in the Pasquotank River Basin (2007)*

WQ0024740	Tanglewood Utilities, LLC	Tanglewood Wastewater Treatment Plant	Pasquotank	Washington	Non-Government	Lagoons, Infiltration/Evaporative	Major	ACTIVE	250000
WQ0001817	Albemarle Utilities Inc	Albemarle Plantation	Perquimans	Washington	Non-Government	Surface Irrigation	Major	ACTIVE	183167
WQ0000265	NC Department Of Corrections	Washington Correctional Center	Washington	Washington	Government - State	Surface Irrigation	Major	ACTIVE	25000
WQ0012892	New Colony Farms LLC	New Colony Farms LLC	Washington	Washington	Non-Government	Surface Irrigation	Minor	ACTIVE	4000

*General Stormwater Permits in the Pasquotank River Basin (2007)*

## **Appendix IV**

# **Pasquotank River Basin Nonpoint Source Program Description and Contacts**



## Agriculture

### USDA Natural Resources Conservation Service:

Part of the U.S. Department of Agriculture (USDA), formerly the Soil Conservation Service. Technical specialists certify waste management plans for animal operations; provide certification training for swine waste applicators; work with landowners on private lands to conserve natural resources, helping farmers and ranchers develop conservation systems unique to their land and needs; administer several federal agricultural cost share and incentive programs; provide assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conduct soil surveys; offer planning assistance for local landowners to install best management practices; and offer farmers technical assistance on wetlands identification. [www.nc.nrcs.usda.gov/](http://www.nc.nrcs.usda.gov/)

County	Contact Person	Phone	Address
Area 3 Conservationist	William J. Harrell	919-751-0976	Cashwell Office Park, Suite C, 208 Malloy St., Goldsboro, NC 27534
Camden County	R. Dwane Hinson	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Chowan County	R. Dwane Hinson	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Currituck County	R. Dwane Hinson	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Dare County	Todd Waters	252-926-4195	PO Box 264, Swanquaters, NC 27885-0264
Gates County	William P. Boone	252-358-7846	PO Box 265, Winton, NC 27986-0265
Hyde County	Todd Waters	252-926-4195	PO Box 264, Swanquaters, NC 27885-0264
Pasquotank County	R. Dwane Hinson	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Perquimans County	R. Dwane Hinson	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Tyrrell County	Rufus W. Croom	252-793-4561	128 East Water Street, Suite 202, Plymouth, NC 27962-1330
Washington County	Rufus W. Croom	252-793-4561	128 East Water Street, Suite 202, Plymouth, NC 27962-1330

### Soil and Water Conservation Districts:

Boards and staff under the administration of the NC Soil and Water Conservation Commission (SWCC). Districts are responsible for: administering the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* at the county level; identifying areas needing soil and/or water conservation treatment; allocating cost share resources; signing cost share contracts with landowners; providing technical assistance for the planning and implementation of BMPs; and encouraging the use of appropriate BMPs to protect water quality.

Camden County	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Chowan County	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Currituck County	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Dare County	252-926-4195	PO Box 264, Swanquaters, NC 27885-0264
Gates County	252-358-7846	PO Box 265, Winton, NC 27986-0265
Hyde County	252-926-4195	PO Box 264, Swanquaters, NC 27885-0264
Pasquotank County	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Perquimans County	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932-1735
Tyrrell County	252-793-4561	128 East Water Street, Suite 202, Plymouth, NC 27962-1330
Washington County	252-793-4561	128 East Water Street, Suite 202, Plymouth, NC 27962-1330

**Division of Soil and Water Conservation:**

State agency that administers the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* (ACSP). Allocates ACSP funds to the Soil and Water Conservation Districts, provides administrative and technical assistance related to soil science and engineering. Distributes Wetlands Inventory maps for a small fee. [www.enr.state.nc.us/DSWC/](http://www.enr.state.nc.us/DSWC/)

Washington Region	David Cash (Area 5 Coordinator)	252-946-6481	943 Washington Square, Washington, NC 27889
Central Office	David B. Williams	919-715-6103	512 N Salisbury Street, Raleigh NC 27604
Central Office	Jill A. Slankas (Nonpoint Source Planning Coordinator)	919-715-6110	1614 Mail Service Center, Raleigh, NC 27699-1614

**NCDA&CS Regional Agronomists:**

The NC Department of Agriculture & Consumer Services (NCDA&CS) technical specialists: certify waste management plans for animal operations; provide certification training for swine waste applicators; track, monitor, and account for use of nutrients on agricultural lands; operate the state *Pesticide Disposal Program*, and enforce the state pesticide handling and application laws with farmers. [www.ncagr.com/](http://www.ncagr.com/)

Central Office	J. Kent Messick	919-733-2655	4300 Reedy Creek Road, Raleigh NC 27607
Region 1	Wayne Nixon	252-426-7210	Rt. 2 Box 161-E, Hertford, NC 27944
Region 2	Kent Yarborough	252-793-4118	Tidewater Research Station, Plymouth, NC 27962

**NRCS Resource Conservation & Development (RC&D):**

Albemarle	Mark Powell (Project Coordinator)	252-482-7437	730 N. Granville Street, Suite B Edenton, NC 27932-1735
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**Education****NC Cooperative Extension Service:**

Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities. [www.ces.ncsu.edu](http://www.ces.ncsu.edu)

Camden County	252-338-1919	120 NC Highway 343 N, Camden, NC 27921-0129
Chowan County	252-482-6585	730 North Granville St., Chowan County Agricultural Center, Suite A, Edenton, NC 27932-1434
Currituck County	252-232-2261	153 Courthouse Rd, Room 211, Currituck, NC 27929
Dare County	252-473-4290	517 Budleigh St., Manteo, NC 27954
Gates County	252-357-1400	112 Court Street, Gatesville, NC 27938
Hyde County	252-926-4486	1372 Main Street, NC Cooperative Extension at O.A Peay School, Swan Quarter, NC 27885
Pasquotank County	252-338-3954	1209 Mcpherson St., Elizabeth City, NC 27909
Perquimans County	252-426-5428	601-A South Edenton Road Street, Hertford, NC 27944
Tyrrell County	252-796-1581	407 Martha Street, Columbia, NC 27925-0209
Washington County	252-793-2163	128 E Water St., Plymouth, NC 27962

**Forestry****DENR Division of Forest Resources:**

Develop, protect, and manage the multiple resources of North Carolina's forests through professional stewardship, enhancing the quality of our citizens while ensuring the continuity of these vital resources. [www.dfr.state.nc.us](http://www.dfr.state.nc.us)

Elizabeth City District Office (District 7)	Water Quality Forester DFR's Bertie County	252-794-3725	113 Wakelon Road, Windsor, NC 27983
Fairfield District Office (District 13)	Field Forester	252-926-3041	P.O. Box 127 9291 Piney Woods Road Fairfield, NC 27826-0127
Griffiths Forestry Center (Statewide)	Water Quality & Wetlands Staff Forester	919-553-6178 ext. 230	2411 Old US Hwy 70-West Clayton, NC 27520
Central Office (Statewide)	Forest Hydrologist	919-733-2162 ext. 206	1616 Mail Service Center Raleigh, NC 27699-1616

### Construction/Mining

#### DENR Division of Land Resources:

Administers the NC Erosion and Sedimentation Control Program and the Mining Program. Conducts land surveys and studies, produces maps, and protects the state's land and mineral resources. [www.dlr.enr.state.nc.us](http://www.dlr.enr.state.nc.us)

Central Office (Mining)	Floyd Williams	919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Central Office (Sediment)	Gray Hauser	919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Washington Region	Pat McClain	252-946-6481	943 Washington Square Mall, Washington, NC 27889

#### Local Erosion and Sedimentation Control Ordinances:

Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances. For a listing of the most recently approved local programs visit [www.dlr.enr.state.nc.us/pages/sedimentlocalprograms.html](http://www.dlr.enr.state.nc.us/pages/sedimentlocalprograms.html)

Town of Kill Devil Hills	Matt Lowcher	252-449-5318	PO Box 1719, Kill Devil Hills, NC 27948
Town of Kitty Hawk	Holly White	252-261-3552	PO Box 549, Kitty Hawk, NC 27949
Town of Nags Head	Kim Allen	252-441-5508	PO Box 99, Nags Head, NC 27959

### General Water Quality

#### DENR DWQ Planning Section:

Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the Nutrient Sensitive Waters Strategies; administer the Section 319 grants program statewide; conduct stormwater permitting; model water quality; conduct water quality monitoring; perform wetlands permitting; conduct animal operation permitting and enforcement; and conduct water quality classifications and standards activities. <http://h2o.enr.state.nc.us/pb/index.html>

Planning Section Chief	Alan Clark	919-733-5083 x 570	1617 Mail Service Center, Raleigh NC 27699
NPS Planning	Rich Gannon	919-733-5083 x 356	1617 Mail Service Center, Raleigh NC 27699
Modeling/TMDL Classifications and Standards	Kathy Stecker	919-733-5083 x 505	1617 Mail Service Center, Raleigh NC 27699
Basinwide Planning	Jeff Manning	919-733-5083 x 579	1617 Mail Service Center, Raleigh NC 27699
Groundwater Planning		919-733-5083 x 354	1617 Mail Service Center, Raleigh NC 27699
		919-733-5083 x 522	1617 Mail Service Center, Raleigh NC 27699

#### DWQ Regional Offices:

Conduct permitting and enforcement field work on point sources, stormwater, wetlands and animal operations; conduct enforcement on water quality violations of any kind; and perform ambient water quality monitoring.

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

Washington Region *	Al Hodge	252-946-6481	943 Washington Square, Washington, NC 27889
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<b>NC Wildlife Resources Commission:</b>			
To manage, restore, develop, cultivate, conserve, protect and regulate the wildlife resources of the state, and to administer the laws enacted by the General Assembly relating to game, game and non-game freshwater fishes, and other wildlife resources in a sound, constructive, comprehensive, continuing and economical manner. <a href="http://www.ncwildlife.org">www.ncwildlife.org</a>			
Central Office	Wildlife Management	919-707-0050	1722 Mail Service Center, Raleigh NC 27699
<b>U.S. Army Corps of Engineers:</b>			
Responsible for: investigating, developing and maintaining the nation's water and related environmental resources; constructing and operating projects for navigation, flood control, major drainage, shore and beach restoration and protection; hydropower development; water supply; water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; responding to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection. Responsible for wetlands and 404 Federal Permits. <a href="http://www.usace.army.mil">www.usace.army.mil</a>			
Wilmington Field Office		910-251-4501	69 Darlington Ave., Wilmington, NC 28402-1890
<b>Solid Waste</b>			
<b>DENR Division of Waste Management:</b>			
Management of solid waste in a way that protects public health and the environment. The Division includes three sections and one program -- Hazardous Waste, Solid Waste, Superfund, and the Resident Inspectors Program. <a href="http://wastenot.enr.state.nc.us">http://wastenot.enr.state.nc.us</a>			
Central Office	Brad Atkinson	919-508-8409	401 Oberlin Road, Suite 150, Raleigh NC 27605
Washington Region *		252-946-6481	943 Washington Square, Washington, NC 27889
<b>On-Site Wastewater Treatment</b>			
<b>Division of Environmental Health and County Health Departments:</b>			
Safeguard life, promote human health, and protect the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust. Services include: training of and delegation of authority to local environmental health specialists concerning on-site wastewater; engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface; and technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems. <a href="http://www.deh.enr.state.nc.us">www.deh.enr.state.nc.us</a>			
Central Office	Andy Adams	919-715-3274	2728 Capital Boulevard, Raleigh NC 27604
Washington Region *	Bob Uebler	252-946-6481	943 Washington Square, Washington, NC 27889
Camden County	Jerry Parks	252-338-4460	PO Box 189, Elizabeth City, NC 27907-0189
Chowan County	Jerry Parks	252-482-6023	PO Box 189, Elizabeth City, NC 27907-0189
Currituck County	Jerry Parks	252-232-6603	PO Box 189, Elizabeth City, NC 27907-0189
Dare County	Anne Thomas	252-475-5555	PO Box 1000, Manteo, NC 27954
Gates County	Jerry Parks	252-357-1380	PO Box 189, Elizabeth City, NC 27907-0189
Hyde County	Linda Mayo	252-926-4200	PO Box 100, Swan Quarter, NC 27885
Pasquotank County	Jerry Parks	252-338-4490	PO Box 189, Elizabeth City, NC 27907-0189
Perquimans County	Jerry Parks	252-338-4400	PO Box 189, Elizabeth City, NC 27907-0189
Tyrrell County	Keith Patton	888-388-9208	408 Bridge St., Columbia, NC 27925
Washington County	Keith Patton	888-388-9208	408 Bridge St., Columbia, NC 27925

\* DENR Washington Regional Office covers the following counties: Beaufort, Bertie, Camden, Chowan, Craven, Currituck, Dare, Gates, Greene, Hertford, Hyde, Jones, Lenoir, Martin, Pamlico, Pasquotank, Perquimans, Pitt, Tyrrell, Washington and Wayne

**Appendix V**

**Glossary**  
**of**  
**Terms and Acronyms**



## Glossary

§	Section.
30Q2	The minimum average flow for a period of 30 days that has an average recurrence of one in two years.
7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
balds	Balds are high elevation areas where soils can support a diverse tree population; however, there are no trees present. Grassy balds are dominated by herbaceous plant species. Heath balds are dominated by dense shrub communities. Definition provided by the NC Natural Heritage Program ( <a href="http://www.ncnhp.org">www.ncnhp.org</a> ).
basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information.
benthos	A term for bottom-dwelling aquatic organisms.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
BMPs	See <i>best management practices</i> .
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.
C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.
CAMA	Coastal Area Management Act
channelization	The physical alteration of streams and rivers by widening, deepening or straightening of the channel, large-scale removal of natural obstructions, and/or lining the bed or banks with rock or other resistant materials.
chlorophyll <i>a</i>	A chemical constituent in plants that gives them their green color. High levels of chlorophyll <i>a</i> in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication.
coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the <i>fall line</i> (approximated by Interstate I-95).

conductivity	A measure of the ability of water to conduct an electrical current. It is dependent on the concentration of dissolved ions such as sodium, chloride, nitrates, phosphates and metals in solution.
degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
DENR	Department of Environment and Natural Resources.
DO	Dissolved oxygen.
drainage area	An alternate name for a watershed.
DWQ	North Carolina Division of Water Quality, an agency of DENR.
dystrophic	Naturally acidic (low pH), "black-water" lakes which are rich in organic matter. Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not appropriate for evaluating dystrophic lakes.
EEP	Ecosystem Enhancement Program
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.
EPT Index	This index is used to judge water quality based on the abundance and variety of three orders of pollution sensitive aquatic insect larvae: <u>E</u> phemeroptera (mayflies), <u>P</u> lecoptera (stoneflies) and <u>T</u> richoptera (caddisflies).
eutrophic	Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur.
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.
FS	Fully supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.
habitat degradation	Identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour.
headwaters	Small streams that converge to form a larger stream in a watershed.
HQW	High Quality Waters. A supplemental surface water classification.
HU	Hydrologic unit. See definition below.
<i>Hydrilla</i>	The genus name of an aquatic plant - often considered an aquatic weed.
hydrologic unit	A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.

hypereutrophic	Extremely elevated biological productivity related to excessive nutrient availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish kills and excessive aquatic plant growth.
impaired	Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses.
impervious	Incapable of being penetrated by water; non-porous.
kg	Kilograms. To change kilograms to pounds multiply by 2.2046.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.
loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
mesotrophic	Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life.
MGD	Million gallons per day.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
NCIBI	North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody.
NH <sub>3</sub> -N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
oligotrophic	Low biological productivity related to very low concentrations of available nutrients. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds and have very good water quality.
ORW	Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ.

pH	A measure of the concentration of free hydrogen ions on a scale ranging from 0 to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas values above 7 and approaching 14 indicate a more basic solution.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.
Piedmont	One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region.
PS	Partially supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired.
riparian zone	Vegetated corridor immediately adjacent to a stream or river. See also SMZ.
river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins: Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins.
river system	The main body of a river, its tributary streams and surface water impoundments.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
SA	Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting.
SB	Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact.
SC	Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival.
sedimentation	The sinking and deposition of waterborne particles (e.g., eroded soil, algae and dead organisms).
seeps	Seeps are areas that remain wet due to groundwater seepage. The plant community generally consists of a dense bed of wetland herbs.
silviculture	Care and cultivation of forest trees; forestry.
SOC	Special Order by Consent. An agreement between the Environmental Management Commission and a permitted discharger found responsible for causing or contributing to surface water pollution. The SOC stipulates actions to be taken to alleviate the pollution within a defined time. The SOC typically includes relaxation of permit limits for particular parameters, while the facility completes the prescribed actions. SOC's are only issued to facilities where the cause of pollution is not operational in nature (i.e., physical changes to the wastewater treatment plant are necessary to achieve compliance).
streamside management zone (SMZ)	The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms.
subbasin	A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see <i>hydrologic unit</i> ).
Sw	Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored giving rise to their nickname of "blackwater" streams.
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses and water quality standards.

TN	Total nitrogen.
TP	Total phosphorus.
tributary	A stream that flows into a larger stream, river or other waterbody.
trophic classification	Trophic classification is a relative description of a lake's biological productivity, which is the ability of the lake to support algal growth, fish populations and aquatic plants. The productivity of a lake is determined by a number of chemical and physical characteristics, including the availability of essential plant nutrients (nitrogen and phosphorus), algal growth and the depth of light penetration. Lakes are classified according to productivity: unproductive lakes are termed "oligotrophic"; moderately productive lakes are termed "mesotrophic"; and very productive lakes are termed "eutrophic".
TSS	Total Suspended Solids.
turbidity	An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity.
UT	Unnamed tributary.
watershed	The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin.
WET	Whole effluent toxicity. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.
WS	Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV.
WWTP	Wastewater treatment plant