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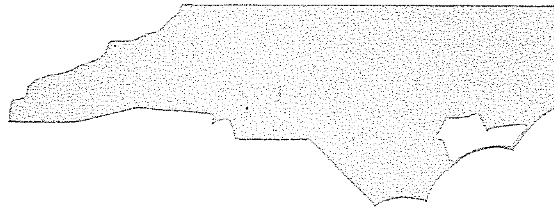
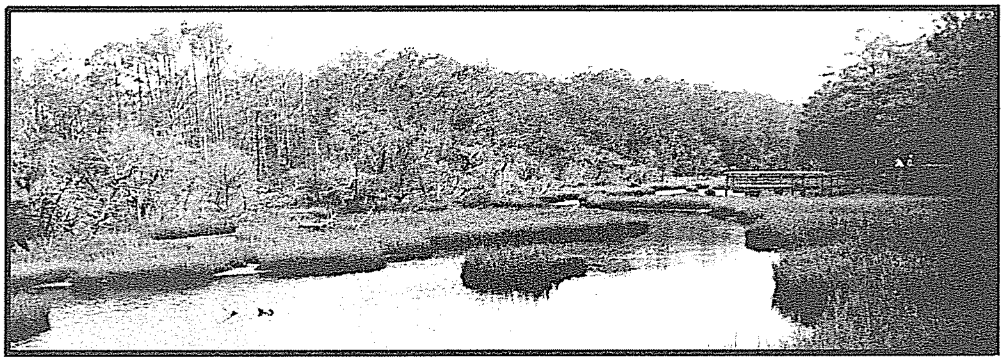
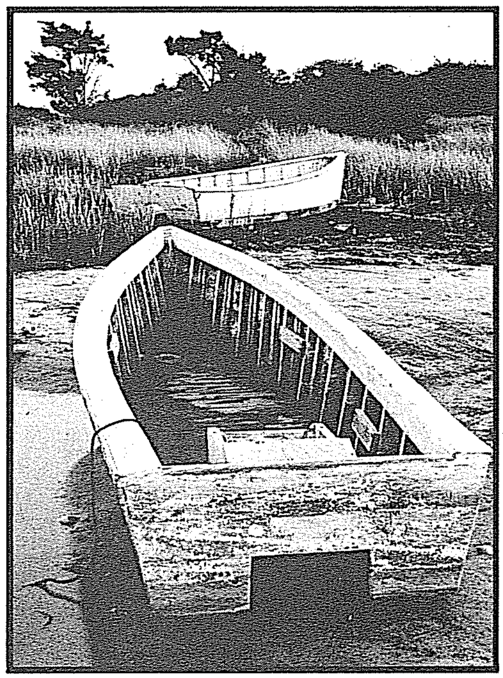
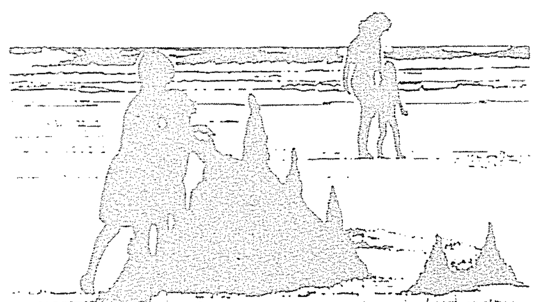
WHITE OAK RIVER BASINWIDE WATER QUALITY MANAGEMENT PLAN









North Carolina Department of Environment, Health, and Natural Resources
Division of Water Quality • Water Quality Section • February, 1997

Michael F. Easley, Governor
William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

April 22, 2003

Thank you for your interest in North Carolina's water quality issues. Enclosed is the basinwide water quality plan that you recently requested from the Division of Water Quality (DWQ).

The basinwide planning program aims to identify and restore full use to impaired waters, identify and protect highly valued resource waters, and protect the quality and intended uses of North Carolina's surface waters while allowing for sound economic planning and reasonable growth. North Carolina relies on the input and experience of its public to ensure that the water quality plans are effective. DWQ coordinates plan development; however, plan implementation and effectiveness entails the coordinated efforts and endorsement of many agencies, groups, local governments, and the general public. Your participation is essential for us to achieve our goals.

Our website (http://h2o.enr.state.nc.us/wqs/) provides detailed information on our program, other basin plans, current events, publications, and rules and regulations. Please visit us at this site.

DWQ appreciates your interest in water quality issues, and we hope to continue working with you into the future. Please contact me if you have any further questions or ideas on specific basins at (919) 733-5083, ext. 354.

Sincerely,

Darlene Kucken
Basinwide Planning Program Coordinator

Enclosure

ADDENDUM: Use Support Changes for the White Oak River Basin
January 2000

The fully supporting but threatened (support-threatened, ST) category is no longer used as a use support rating. In the past, ST was used to identify a water that was fully supporting but had some notable water quality problems. ST could represent constant, degrading, or improving conditions. North Carolina's use of ST was very different from that of the US Environmental Protection Agency (EPA), which uses it to identify waters that are characterized by declining water quality. In addition, the US EPA requires the inclusion of ST waters on the 303(d) list in its proposed revision (August, 1999) to the 303(d) list rules (Appendix VI). Due to the difference between US EPA's and North Carolina's definitions of ST, North Carolina no longer uses this term. Because North Carolina has used fully supporting but threatened as a subset of fully supporting (FS) waters, those waters formerly called ST are now rated FS. This change is reflected in the 305(b) report for 2000. Based on this change, use support ratings for all basins have been altered. Revised use support ratings for the White Oak River basin are presented below.

Table 4.13 Use Support Status for Freshwater Streams (miles) in the White Oak River Basin (1990 to 1994) (*Found on p. 4-48 of this plan.*)

Subbasin	Fully Supporting	Partially Supporting	Not Supporting	Not Evaluated	Total Miles
03-05-01	102.8	0.0	0	0.0	102.8
03-05-02	94.0	10.9	0	14.5	119.4
03-05-03	68.2	0.0	0	0.0	68.2
Total	265.0	10.9	0	14.5	290.4
Percent	91	4	0	5	

Table 4.14 Use Support Status for Estuarine Waters in the White Oak River Basin

(Found on p. 4-52 of this plan.)

Area Name	DEH Area	Total Acres	Overall Use Support			Major Causes (Acres)				Major Sources		Source Description
			FS	PS	NS	Fecal	DO	Chl *a*	Metals	Point	Nonpoint	
Chadwick Bay	C1	1,700	1,477	223	0	223					NP	urban runoff, septic tanks, marinas
Sneads Ferry	C2	3,100	2,911	189	0	189				p	NP	WWTP, septic tanks, marinas,urban runoff
Stones Bay	C3	15,025	11,269	3,756	0	751		3,005		**P**	NP	WWTP, urban runoff, marinas
Hurst Beach	C4	500	340	160	0	160				p	NP	WWTP, urban runoff,forestry
Bear Creek	D1	700	630	70	0	70					NP	ag, marinas,wildlife,forestry
Queen Creek	D2	2,100	1,355	745	0	745				p	NP	WWTP, ag, urban runoff, septic tanks
White Oak River	D3	8,500	7,083	1,417	0	1,417				p	NP	WWTP, ag, urban runoff, septic tanks, marina,wildlife
Deer Creek	D4	2,300	2,078	222	0	222					NP	urban runoff, marinas, septic tanks, urban runoff
Broad Creek	E1	4,700	4,567	133	0	133					NP	urban runoff, septic tanks, marinas
Bogue Sound	E2	7,100	7,006	94	0	94					NP	urban runoff, septic tanks, marinas
Morehead City	E3	4,900	3,616	1,284	0	1,284					NP	urban runoff, septic tank, marina, state port
Newport River	E4	8,600	6,737	1,863	0	1,863				p	NP	WWTP, ag, forestry, urban runoff, septic tanks, marina
Taylor Creek	E5	6,250	5,800	450	0	450				p	NP	WWTP, urban runoff, septic tanks
North River	E6	10,000	9,353	647	0	647				p	NP	WWTP, ag, forestry, urban runoff, marina,septic tanks
Back Sound	E7	8,100	8,068	32	0	32					NP	septic tanks, marinas
Core Sound	E8	21,000	20,800	200	0	200					NP	ag, forestry, marinas
Nelson Bay	E9	17,300	16,844	456	0	456				p	NP	WWTP, ag, septic tanks
Total Acres		121,875	109,934	11,941	0	8,936		3,005				
Percent			90.2	9.80	0	74.83		25.17				

MAJOR SOURCES:

- p (lower case) Indicates that point sources discharge, but are operating efficiently, or it is noted that they are not affecting the shellfish waters.
- **P** (bold upper case) Indicates that point sources are experiencing problems and are a major source affecting water quality.
- NP Indicates that surveys note NP sources are the major factor influencing the water quality or there are no major point sources of pollution.

WHITE OAK RIVER BASINWIDE WATER QUALITY MANAGEMENT PLAN

February, 1997

Prepared by:

North Carolina
Division of Water Quality
Water Quality Section
P.O. Box 29535
Raleigh, NC 27626-0535

(919) 733-5083

This document was approved and endorsed by the NC Environmental Management Commission on February 13, 1997 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 White Oak River Basin.

Cover Photo Credits
Top: Salt Marsh at the NC Aquarium at Pine Knoll Shores, Alan Clark
Bottom left: Beaufort Waterfront, NC Wildlife Resources Commission
Bottom right: Boats on a Salt Marsh in Carteret County, NC Wildlife Resources Commission

FOREWORD

The White Oak Basin has seen a significant increase in population over the past twenty years, most of it concentrated immediately along the coast and sounds. Pressure for continued growth is expected to be strong during the coming decades. As coastal areas grow, more development takes place causing the generation of more stormwater runoff, the addition of new septic tanks, the need for more wastewater treatment capacity, a need for new and expanded water supply sources and the location of new marinas. Yet options for wastewater disposal and water supply are extremely limited. And the region's economically important wetland and estuarine resources are sensitive to the effects of increased development.

Protection of surface waters in the White Oak River Basin represents a tremendous challenge. Although it is relatively small in size, (encompassing approximately 1,233 square miles which makes it the thirteenth largest basin out of a total of seventeen basins in the state), it contains many environmental resources and water quality issues. Although it is labeled the 'White Oak basin', the basin contains Bogue and Core Sounds and four distinct drainage areas including the New, White Oak, Newport and North Rivers.

The majority of the surface waters in the basin are saltwaters, but there are some freshwaters in the upper parts of the New, White Oak and Newport drainages. Of the 290 miles of freshwater streams in the basin only 4% are considered impaired. Of the 121,875 acres of saltwater, 10% are considered impaired. Fecal coliform bacteria was the most widespread cause of impairment. Elevated levels of fecal coliform bacteria are an indicator of water quality degradation that results in the closure of shellfishing areas. Nonpoint source pollution (stormwater runoff) is estimated to be the primary pollution source in the saltwater areas. Waters are impacted primarily by multiple nonpoint sources including agriculture, forestry, urban runoff, septic tanks and marinas. Point sources also contribute to water quality problems in the basin, but to a lesser extent.

Preserving and enhancing the quality of water in the basin is beyond the capabilities of any one agency or group. State and federal government regulatory programs will play an important part, but much of the responsibility will be at the local level. Those who live, work and recreate in the basin have the most at stake.

This document provides a summary of the causes and sources of water pollution in the basin, the status of the basin's water quality, a summary of water quality rules and statutes that apply to water quality protection in the basin, and recommended measures to protect and enhance the quality of the surface waters and aquatic resources in the White Oak River Basin. The White Oak Basinwide Water Quality Management Plan will be used as a guide by the NC Division of Water Quality in carrying out its water quality program responsibilities in the basin. Beyond that, it is hoped that the plan will provide a framework for cooperative efforts between the various stakeholders in the basin toward a common goal of protecting the basin's water resources while accommodating reasonable economic growth.

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EXECUTIVE SUMMARY

NORTH CAROLINA'S BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT - PURPOSE OF WHITE OAK RIVER BASIN PLAN

Basinwide management is a watershed-based planning approach to water quality improvement and protection. The plan has been prepared by the North Carolina Division of Water Quality (DWQ), however, implementation of the plan and protection of water quality involve the efforts of all stakeholders in the basin. The *White Oak Basinwide Water Quality Management Plan* (White Oak Plan) is the ninth in a series of basinwide water quality management plans that will be prepared by DWQ for all seventeen of the state's major river basins by the year 1998. The plan will be used as a guide by DWQ in carrying out its water quality program duties and responsibilities in the White Oak River Basin. It is not a new regulatory document.

A basinwide management plan report is prepared for each basin in order to communicate to policy makers, the regulated community and the general public the state's rationale, approaches and recommended long-term water quality management strategies for each basin. The draft plans are circulated for public review and comment and are presented at public meetings in each basin. The plan for a given basin is completed and approved prior to the scheduled date for basinwide discharge permit renewals in that basin. The plans are then to be evaluated, based on follow-up water quality monitoring, and updated at five-year intervals.

The White Oak Plan was completed in February of 1997 and will be updated in the year 2002. Basinwide NPDES permitting is scheduled to commence in June of 1997.

BASINWIDE GOALS

The primary goals of DWQ's basinwide program are to 1) identify and restore full use to impaired waters, 2) identify and protect highly valued resource waters, and 3) manage problem pollutants throughout the basin to protect water quality standards while accommodating reasonable economic growth. In addition, DWQ is applying this approach to each of the major river basins in the state as a means of better identifying water quality problems; developing appropriate management strategies; maintaining and protecting water quality and aquatic habitat; assuring equitable distribution of waste assimilative capacity for dischargers; and improving public awareness and involvement in management of the state's surface waters.

PUBLIC WORKSHOPS

Three public workshops were held in October of 1995 in Jacksonville, Cedar Point and Morehead City to familiarize stakeholders in the basin with DWQ's basinwide approach and to solicit their comments for the basin plan. The workshops in October, which had a combined total of 81 participants, were co-sponsored by the North Carolina Cooperative Extension Service (CES), the North Carolina Coastal Federation, the North Carolina Division of Coastal Management, the North Carolina Division of Soil and Water Conservation, the North Carolina Sea Grant College Program Marine Advisory Service and DWQ. A summary of these workshops is provided in Appendix IV of the plan. Priority issues and recommended actions identified by two or more discussion groups included:

- Need for land use planning and growth management
- Concerns with closed shellfish waters
- Need for increased public education and involvement of local stakeholders
- Better control of stormwater runoff and other nonpoint sources of pollution
- Protection of existing high water quality and resources (submerged rooted vegetation, wetlands, nursery areas)
- Better management of livestock operations

These issues have been addressed in Chapter 6 of the plan.

WHITE OAK BASIN OVERVIEW

The White Oak River Basin lies entirely within the southern coastal plain. The name of the basin is a bit of a misnomer in that it includes four separate river systems: the New River and its tributaries in the southwestern section; the White Oak River and its tributaries; the Newport River and its tributaries; and the North River in the eastern section. The basin also includes Bogue and Core Sounds.

The basin encompasses a total 1,233 square mile watershed area which includes the drainages of the New, White Oak, Newport and North Rivers. The basin contains 267 miles of freshwater streams and rivers, extensive estuarine areas in the Bogue and Core Sounds, and 192 square miles (122,875 acres) of saltwater. Figure 1 provides a general view of the entire basin.

There are 4 counties and 14 municipalities located in whole or in part in the basin. Based on 1990 census data, the population of the basin was 194,802 people. The most populated areas are located in Jacksonville and Camp Lejeune on the New River, and Morehead City and Beaufort on Bogue Sound and Newport River. The overall population density is 187 persons per square mile versus a statewide average of 123 persons per square mile. The percent population growth over the ten year period from 1980 to 1990 was 35.2%. This is almost 3 times the statewide population increase of 12.7% over the same period. Statistics provided by the state Department of Administration project that the population in the basin will grow by nearly 50% by the year 2020.

Large portions of the basin are publicly owned areas, such as the Croatan National Forest on the White Oak River and the Hoffman State Forest and Camp Lejeune on the New River. Statistics provided by the US Department of Agriculture, Natural Resources Conservation Service indicate that there had been an increase in the amount of developed land and a decrease in the amount of cultivated cropland and forest between 1982 and 1992 (USDA, NRCS, 1994)

The New River watershed is the westernmost of the four major river systems in the basin. It is also the largest and most populated and includes the City of Jacksonville. The New River is a coastal blackwater river with a watershed entirely within Onslow County. The watershed above Jacksonville is characterized by gum-cypress swamps with upland areas used primarily for forestry and agriculture. The New River upstream of the US 17 Bridge is a narrow, free-flowing freshwater stream. At Jacksonville, the river widens into a broad, slow-moving tidal embayment. It eventually discharges into the Atlantic Ocean through a narrow opening called New River Inlet. The city of Jacksonville and the US Marine Corps, with the operation of Camp Lejeune, cover the most amount of land in the lower watershed.

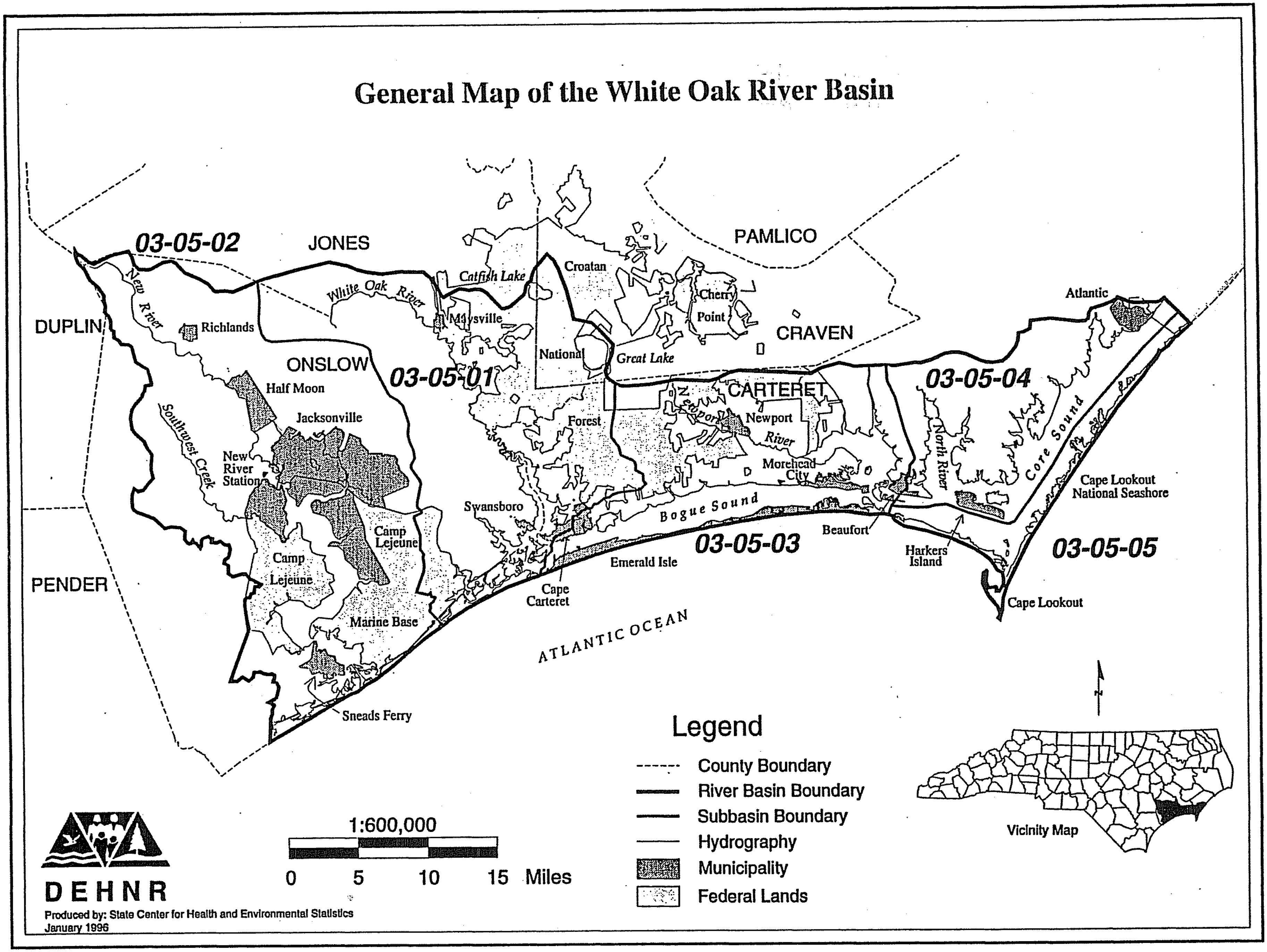


Figure 1. General Map of the White Oak River Basin

The White Oak River watershed, the basin's namesake, is located immediately east of the New River. It is the second largest watershed in the basin. A large portion of the watershed's land area is in public lands held in the Croatan National Forest and Hoffman State Forest. The White Oak River is approximately 48.4 miles long with a watershed of approximately 320.5 square miles (Hosier and Cleary 1982). The River flows past the western end of Bogue Sound and into the Atlantic Ocean at Bogue Inlet.

The Newport River is located just east of the White Oak River. It flows into the eastern end of Bogue Sound before entering the Atlantic Ocean near Morehead City. The Newport River watershed begins in Craven County and flows through Newport. The headwaters of the North River originate in Carteret County and flow directly into Back Sound near Harkers Island.

The waters of the White Oak River Basin have a variety of surface water quality classifications applied to them. The majority of the waters are saltwater and have primary classifications of either SA (shellfishing waters) or SC (water classified for the protection of aquatic life). The basin contains both High Quality Waters (HQWs) and Outstanding Resource Waters (ORWs) but there are no water supply watersheds. HQWs and ORWs are protective classifications applied to waters with significant resources (such as primary nursery areas) or exceptional water quality. The upper portion of the New River drainage area of the White Oak Basin has been supplementally classified as Nutrient Sensitive Waters (NSW). This designation is applied in areas where problems with nutrient enrichment (such as algal blooms) have been identified. Management of nutrient inputs from wastewater discharges is applied along with the classification.

The basin contains many important natural resources including commercially important fisheries and shellfisheries, fishery nursery areas (primary and secondary), seagrass beds, endangered and threatened aquatic species and wetlands. The basin's estuaries and rivers are also valuable recreational waters to many people within North Carolina as well as visitors from other states.

In the White Oak River Basin, there are 121 permitted wastewater dischargers. Of this total, 7 are municipalities and 24 are industries. Forty (40) of the permitted discharges are stormwater facilities. Seven (7) of the total number are major facilities having a permitted flow of > 1 million gallons per day (MGD) and 33 of the total have 100% domestic wastewater. The total permitted flow for all facilities is 27 MGD.

There are a total of 74 registered livestock operations in the White Oak Basin. Twenty-one (21) of these are certified, meaning they have approved waste management plans. The vast majority of the operations are concentrated in subbasins 01 and 02 (the White Oak and New River drainage areas, respectively) and all of them are swine operations. The White Oak drainage contains 11 registered operations with a total of approximately 14,600 swine and the New River drainage contains 61 operations with approximately 82,900 swine.

ASSESSMENT OF WATER QUALITY IN THE WHITE OAK RIVER BASIN

An assessment of water quality data collected by DWQ and others reveals that the White Oak River Basin has generally good water quality but there are some problem areas. Below is a summary of some key monitoring data that reflect water quality in the basin. A more detailed presentation of this information can be found in Chapter 4.

Summary of Biological Indicators

Benthic Macroinvertebrates - In freshwaters, macrobenthic invertebrates (or benthos) are primarily bottom-dwelling aquatic insect larvae such as species of stoneflies, mayflies and caddisflies. In estuarine waters, which are predominant in the White Oak Basin, they are made up of shellfish, worms and crabs. Measurements of the number, types and diversity of these organisms at strategic sampling sites is an important means of assessing water quality. Twenty-five estuarine locations were sampled for macroinvertebrates in the White Oak River Basin during the summer of 1994. All sites located in waters classified as Outstanding Resource Waters (ORW) contained a diverse array of pollution-intolerant species suggesting the water quality is excellent. In contrast, Calico Creek which is stressed by both point (Morehead City wastewater treatment plant) and nonpoint sources of pollution had a very low variety of organisms and a low biotic index reflecting poor water quality conditions. In the individual subbasin sections of Chapter 4, results of samples taken at all sites are discussed.

Fish Community Evaluations - Fish community structure (IBI) analyses were performed on data from 6 sites in the White Oak River Basin collected by DWQ. On average these data indicated good water quality for all of the sites sampled.

Fish Tissue Analyses - Fish tissue samples were collected at 8 sites from 1983 to 1994 within the White Oak River basin consisting of 79 observations. Samples were collected as part of the DWQ's ambient fish tissue monitoring program or as part of special mercury studies.

Fish or shellfish samples collected within the White Oak basin were analyzed for metals contaminants only. Metals in samples from all but one station were non-detectable or present at levels below FDA action level and EPA screening criteria. Great Lake (Craven Co.) contained elevated mercury in 6 of 26 samples (23%). Two contained mercury exceeding both FDA and EPA criteria and four others contained mercury exceeding just the EPA criteria. Significant mercury contamination was associated with older, top predator fish species. Elevations in contaminants suggest a need for further sampling in the lake, but may not indicate human health or ecological concerns.

Lakes Studies - There were two lakes in the White Oak River Basin sampled as part of the Lakes Assessment Program. These lakes are Catfish Lake and Great Lake, both of which are in subbasin 030501 (White Oak River Drainage). Both lakes are Carolina Bay lakes located in the Croatan National Forest. They have naturally low pH levels (in other words they are acidic) and have low clarity because of their blackwater character. For these reasons, the lakes are classified as dystrophic. They are both used for recreation and are not considered impaired.

Use-Support Ratings

Another important method for assessing surface water quality is to determine whether the quality is sufficient to support the uses for which the waterbody has been classified by the state. All surface waters in the state have been assigned a classification. These classifications are discussed in Section 2.7 of Chapter 2. The word *uses* refers to activities such as swimming, fishing and water supply. DWQ has collected extensive chemical and biological water quality monitoring data throughout the basin, some of which is summarized above. All data for a particular stream segment have been assessed to determine the overall *use support* rating; that is, whether the waters are *fully supporting*, *partially supporting* or *not supporting* their uses. A fourth rating, support-*threatened*, applies where all uses are currently being supported but water quality conditions are marginal. Streams referred to as *impaired* are those rated as either partially supporting or not supporting their uses. Use support ratings in the White Oak River basin, described more fully in Chapter 4, are summarized below for freshwater streams and lakes and saltwater estuaries.

Freshwater Streams and Rivers - Of the 290 miles of freshwater streams and rivers in the White Oak basin, use support ratings were determined for 95% or 276 miles with the following breakdown: 70% were rated fully supporting, 21% support-threatened, 4% partially supporting, and 5% not evaluated. Only the White Oak River, New River and Newport River drainages (subbasins 30501 through 30503) contain freshwater streams. In the White Oak and Newport drainages the total of the miles rated fully supporting accounted for more than 91% of the stream mileage for each basin. In the New River subbasin, 35% of the stream miles were rated fully supporting, 44% were rated support threatened, 9% were rated partially supporting, and 12% were not evaluated.

SUPPORTING........................91%
  Fully supporting (70%)
  Support-threatened (21%)
IMPAIRED..............................4%
  Partially supporting (4%)
  Not supporting (0%)
NOT EVALUATED:...................5%

Salt (Estuarine) Waters - Use support determinations were made for all of the 121,875 acres of saltwater in the White Oak Basin. Approximately 65% of the saltwaters were rated as fully supporting, 25% were rated support threatened and the remaining 10 percent were rated partially supporting, or impaired. Fecal coliform bacteria was the most widespread cause of impairment followed by nutrient-related chlorophyll *a* water quality violations. Elevated levels of fecal coliform bacteria are an indicator of water quality degradation that requires the closure of shellfishing areas.

SUPPORTING........................90%
  Fully supporting (65%)
  Support-threatened (25%)
IMPAIRED............................10%
  Partially supporting (10%)
  Not supporting (0%)
NOT EVALUATED:...................0%

Lakes - Two lakes in the White Oak basin totaling 3,910 acres were monitored and assigned use support ratings. Great Lake and Catfish Lake are both dystrophic lakes rated C-Swamp waters, and both are used for recreation. These lakes were most recently sampled August 1994 and found to be fully supporting their designated uses.

MAJOR WATER QUALITY ISSUES AND RECOMMENDATIONS

Several water quality issues emerge as being of particular importance in light of factors such as the degree of water quality degradation, the value of the resources being impacted and the number of users potentially affected. Those issues considered most significant on a basinwide scale are presented below along with recommended corrective or research actions.

A. RESTORATION AND PROTECTION OF THE BASIN'S SHELLFISH RESOURCES

Approximately 8,900 acres of shellfish waters are essentially closed to harvesting and an additional 30,000 acres of shellfish (SA) waters are considered threatened. The acreage of shellfish waters that are threatened or closed to harvesting has been steadily increasing since 1984 as growth occurs and nonpoint sources of pollution increase.

The goal of the state is to protect all areas currently meeting their uses and to develop and implement plans to restore priority areas to a condition which will allow reopening them to harvesting. The quality of the shellfish resource in a particular area will be an important consideration in setting priorities. Areas that are closed to harvesting that have a resource will receive the highest priority for restoration efforts.

There are many various activities and conditions that contribute to elevated fecal coliform levels and therefore shellfish closures. These include, but are not limited to, construction, urban stormwater runoff, failing septic systems, forestry and agricultural activities. Control of all of these activities is the responsibility of many different state agencies including DWQ, DEH, the Division of Coastal Management (DCM), the Division of Land Resources (DLR), the Division of Forest Resources (DFR) and the Division of Soil and Water Conservation (DSWC). In addition, there are local health departments, county and municipal governments and other entities, including private property owners, that impact local land use practices and other activities. Therefore there is no single prescriptive remedy to solve the problem of closed shellfish waters. Rather, it will require a great deal of collaboration and coordination to achieve the common goal of protecting and restoring shellfish waters in the basin.

<u>Recommendations for the Restoration of Impaired Shellfish Waters</u>

1. Remove wastewater discharges, where feasible, from closed shellfish waters.
2. Develop and apply Use Restoration Waters as a water classification or a management tool to restore high priority shellfish waters.
3. Development and implementation of Nonpoint Source Team Action Plans.
4. Prioritize closed shellfish waters for implementation of voluntary best management practices by land owners and local governments for shellfish water restoration.
5. Work with the NC Department of Transportation to study and correct, as necessary, to mitigate impacts from flow restrictions caused by road construction.

<u>Recommendations for the Protection of Unimpaired Waters</u>

1. Continue to ban new sewage discharges to shellfish (SA) waters.
2. Evaluate effectiveness of stormwater and sedimentation/erosion control regulations and improve as necessary.
3. Evaluate effectiveness of on-site wastewater regulations, inspections and enforcement and improve as necessary.
4. Local governments need to develop long-range growth and wastewater management to be implemented at the local level that include provisions to protect shellfish resources. This should include establishing protective buffers or greenbelts around shellfish waters.
5. Improve management of animal waste operations located in watersheds that flow to shellfish (SA) waters.
6. Continue to improve and implement nonpoint source best management practices for reducing fecal coliform bacteria.
7. Develop guidelines for protecting conditionally approved shellfish waters.

B. IDENTIFICATION AND RECLASSIFICATION OF BIOLOGICALLY SENSITIVE OR HIGH VALUE RESOURCE WATERS

There are two areas in the basin, listed below, that have been designated as inland primary nursery areas (PNA's) by the NC Wildlife Resources Commission. This designation makes these areas eligible for consideration for designation as HQW. These reclassifications are currently pending internal review.

1) French's Creek
2) New River upstream of US 17 bridge

One of North Carolina's most important resources is its commercial and recreational fisheries. The Final Recommendations of the Moratorium Steering Committee (established by the NC General Assembly to investigate and make recommendations pertaining to declines in the state's fisheries) have recently been released. Its recommendations cover a variety of subjects, including water quality. DWQ recognizes that protection of water quality is an important component of protecting North Carolina's fishery resources and will continue to work toward the maintenance and improvement of coastal water quality to protect these resources.

Where waters are known to support state or federally listed endangered or threatened species or species of concern, but where water quality is less than excellent and where no critical habitat has been designated, consideration will be given during NPDES permitting to minimize impacts to these habitat areas consistent with the requirements of the federal Endangered Species Act and North Carolina's endangered species statutes. Possible protection measures may include dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, backup power provisions to minimize accidental plant spills, and others. The need for special provisions will be determined on a case by case basis during review of individual permit applications and will take into account the degree of impact and the costs of protection.

C. PROTECTING, ENHANCING AND RESTORING NPS POLLUTION ABATEMENT FUNCTIONS OF WETLANDS

Wetlands perform a wide variety of functions. Those functions that are perceived as essential or important for protection by laws and regulations are referred to as values. Wetland values include water quality improvement, flood control, wildlife habitat, nursery areas for fisheries, and recreation. Water quality values are of special interest for basinwide planning purposes. Coastal wetlands are currently protected under Section 404 of the federal Clean Water Act and under the NC Coastal Area Management Act. DWQ should utilize the 401 certification program to protect these values as much as is feasible especially along riparian corridors.

D. REGIONAL WASTEWATER TREATMENT OPTIONS

Waste disposal options are limited in the White Oak basin, which is dominated by SA waters and sensitive aquatic habitats. The development of effective long-term wastewater management strategies is one of the most critical issues facing the basin, from the perspective of both environmental protection and economic development.

Two local groups have been working to address these issues. The Regional Wastewater Task Force has been evaluating long term options for the Carteret, Craven, Onslow and Pamlico County area (see Malcolm Pirnie Inc, 1995). The Carteret County Interlocal Agency, consisting of nine Carteret County towns, has been meeting to assess alternatives on a more local level (see Camp Dresser and McKee, 1995). The Interlocal Agency has determined that land application alone can not meet the needs of municipalities in Carteret County. This group has suspended further action on its part pending the outcome of a feasibility study being conducted through the Regional Wastewater Task Force. The Task Force conducted public meetings on several regional waste treatment alternatives in May of 1996.

North Carolina has recognized that an effluent discharge to the Atlantic Ocean may be necessary in the future in order to meet wastewater demands in coastal areas, including the area of the White Oak basin. In 1993 the NC Department of Environment, Health and Natural Resources and the Neuse River Council of Governments sponsored the NC Ocean Outfall Forum to gather experts and stakeholders together to provide federal, state, and local management agencies with educated and diverse perspectives on the possible impacts of choosing ocean outfalls for wastewater disposal in North Carolina. The Forum revealed that several important issues must be addressed before this option could be pursued, including, but not limited to:

- need to address secondary impacts (growth, nonpoint source pollution);
- lengthy review process (10 or more years); and
- human health concerns for people swimming at the beach.

Recommendation:

- DWQ will continue to work with the groups described above, as well as individual local governments, on the development of viable long-term options for wastewater disposal.

E. RECOMMENDED MANAGEMENT ACTIONS FOR CONTROLLING NUTRIENTS IN THE NEW RIVER, CALICO CREEK AND NORTH RIVER

New River (Subbasin 02)

Nutrients and algal growth are a significant concern primarily in the New River drainage, much of which was designated as nutrient sensitive waters (NSW) in 1991. Point sources account for 59% of the phosphorus load to the NSW area and 44% of the nitrogen load. Over 94% of point source inputs of both nutrients originates from the Jacksonville WWTP and four Camp Lejeune facilities.

The City of Jacksonville is in the process of removing its discharge from Wilson Bay and land applying the wastewater. In addition, Camp Lejeune is in the process of consolidating its 7 discharges into 1 and upgrading the treatment of the wastewater. Both of these actions will greatly reduce loading of a variety of pollutants (including nutrients) to the New River.

Since point sources contribute such a significant proportion of the New River's nutrient load and the largest dischargers are still implementing projects which will decrease those loadings substantially, it is still too early to fully evaluate the New River Nutrient Sensitive Waters (NSW) strategy. Water quality improvements in Wilson Bay and Northeast Creek are anticipated after these projects are completed.

Recommendations:

1. As specified by the current NSW strategy, existing facilities with a permitted capacity of .05 MGD or greater should continue to receive TP limits of 2.0 mg/l. New or expanding facilities should continue to receive 0.5 mg/l, with the requirement that prospective permittees first establish that nondischarge options or connection to an existing facility are not feasible.
2. In light of research indicating the importance of nitrogen to estuarine algal growth, it is also recommended that total nitrogen (TN) limits be required for new and expanding facilities with a capacity of 1 MGD or greater. While specific levels should be determined on a case by case basis, limits similar to those given to Camp Lejeune (5.0 mg/l summer, 10.0 mg/l winter) should be anticipated. All facilities without nutrient limits will be required to monitor TN and TP.

Calico Creek (Subbasin 03)

Calico Creek at Morehead City in the Newport River watershed has experienced excessive algal growth, elevated nutrient levels and low dissolved oxygen concentrations for many years. DWQ has indicated to the city that the eventual removal of the discharge is desirable. Morehead City, as a member of the Carteret County Interlocal Agency, has been evaluating alternatives to the present arrangement.

Recommendations:

1. While alternative plans are under development, the city should be encouraged to evaluate and optimize the operation of its facility to ensure that all reasonable efforts at nutrient and BOD removal are being made.
2. If removal of the plant is determined not to be an option after the efforts of the Regional Wastewater Task Force and the Carteret County Interlocal Agency, advanced tertiary limits with nutrient removal would likely be recommended for the facility.

North River (Subbasin 04)
On a unit area basis, nitrogen and phosphorus inputs from nonpoint source runoff from land surfaces are generally low to moderate. The North River drainage, which contains substantial agricultural acreage (including part of Open Grounds Farm), has the highest nonpoint source inputs among these watersheds (approximately 440 kg per square km of land area).

Recommendation:

- While this level of nutrient input is not elevated compared with highly impacted areas in basins such as the Neuse, the North River merits continued monitoring as well as consideration by the Nonpoint Source Team for voluntary implementation of agricultural BMPs.

Wetlands Protection and Nutrient Reductions
The White Oak River basin contains expanses of headwater forests, bottomland hardwood forests, and swamp forests along its coastal streams and rivers. Protection of these significant forested wetlands will protect important nutrient and sediment removal values. Nonpoint source reduction measures should capitalize on and protect the nutrient removal and transformation functions of these important floodplain wetlands. This can be accomplished through the following initiatives.

Recommendations:

1. Continue acquisition and restoration efforts to protect riparian forested wetlands in the coastal plain of the basin. Section 319(h) funds can be used to acquire and restore riparian wetlands that are important to preventing and controlling NPS pollution in the White Oak River Basin.
2. Encourage the use of riparian buffers in agricultural and urban areas. Riparian buffers can be restored and established along cropland, pasture, hayland, or rangeland or along the rear lot lines of subdivisions to remove nutrients, sediments, organic matter and pesticides.
3. Encourage riparian wetland restoration, enhancement, protection, or some combination of them for compensatory mitigation.
4. Utilize forestry incentives programs to reduce sediment and nutrient inputs from forestry practices in the White Oak River Basin. The Forest Stewardship Incentives Program administered by the Division of Forest Resources and the U.S. Forest Service provides cost-share funds for implementing Forest Stewardship Plans.
5. Continue emphasis of the 401 Water Quality Certification Program on protecting wetlands with water quality values and preventing downstream impacts.

F. RECOMMENDED MANAGEMENT ACTIONS FOR CONTROLLING OXYGEN-CONSUMING WASTES

Maintenance of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of North Carolina's surface waters. Below is a summary of major issues and recommendations for oxygen-consuming wastes in the White Oak River Basin.

Discharges to Low Flow Streams
Due to the preponderance of low flow streams across the state and their susceptibility to low dissolved oxygen conditions in summer months, studies were done in 1980 to develop regulations for evaluating and permitting discharges to low flow streams.

Recommendations:

1. Based on the studies in 1980, the Division will continue to prohibit new or expanded discharges of oxygen-consuming wastes to zero flow streams.
2. Existing facilities discharging to zero flow streams will be evaluated for alternatives to discharging to surface waters.

Swamp Waters
Swamp waters have naturally low dissolved oxygen levels which require a modified management approach for oxygen-consuming wastes.

Recommendations:

1. It is recommended that new discharges will not be permitted at limits less stringent than 15 mg/l BOD5 and 4 mg/l NH3-N. More stringent limits may be needed on a case-by-case basis if data or conditions suggest that adverse impacts will occur.
2. Existing facilities will receive current permit limits unless they expand or site specific information is available which indicates more stringent limits are needed. Upon expansion, they will receive existing loading (mass basis).

Little Northeast Creek
Frequent violations of the instantaneous DO standard (4.0 mg/L) have been recorded at the ambient station on Little Northeast Creek which is characterized by low flow, swamp-like conditions. Four wastewater treatment facilities discharge treated domestic effluent into the creek.

Recommendation:

- Removal of the dischargers on Little Northeast Creek is recommended as soon as a non-discharge alternative, such as connection to Jacksonville's land application system, becomes available.

Wallace Creek
Although data from the ambient monitoring station located near the mouth of Wallace Creek indicates no severe DO violations at that point, upstream conditions have been in violation of the DO standard during the summertime. Three dischargers are located in the Wallace Creek drainage area.

Recommendation:

- It is recommended that all of these discharges be removed when an alternative to discharge becomes available.

<u>Upper New River</u>
Instream monitoring data indicates that there is little to no assimilative capacity in the upper New River basin.

Recommendations:

1. It is recommended that no additional loading of oxygen consuming wastes be allowed in the upper New River basin. Specifically, it is recommended that no new discharges be allowed and that expansions only be allowed with no increase in permitted loading. This area includes the tributaries and mainstems of Northeast Creek, Southwest Creek, and the New River above the confluence with Northeast and Southwest Creeks.
2. New or expanding discharges to the lower New River basin will be considered on a case-by-case basis. Before any additional loading is allowed in the lower New River basin, emphasis should be placed on closely examining the engineering alternatives analysis to ensure that an alternative to a surface water discharge does not exist.
3. All dischargers in subbasin 02 are encouraged to cease discharging at the earliest possible date and connect to Jacksonville's land application system.

<u>Calico Creek</u>
Low DO concentrations along with high chlorophyll-a concentrations have been measured in Calico Creek. The eutrophic conditions in Calico Creek can be attributed to impacts from the Morehead City discharge and urban stormwater runoff. Since the waters surrounding Morehead City are classified as SA, the City has few options for an alternative discharge location.

Recommendations:

1. Removal of the Morehead City discharge to Calico Creek is recommended as soon as a practical alternative is available.
2. As an interim measure Morehead City is encouraged to evaluate and optimize its treatment units to ensure the maximum removal of oxygen consuming wastes from its effluent.
3. If removal is not a future option, advanced tertiary limits with nutrient removal are recommended for the facility.

G. MANAGEMENT STRATEGIES FOR URBAN STORMWATER CONTROL

There are no local governments in the White Oak Basin that are required to develop NPDESstormwater programs. However, since urban stormwater impacts have been identified in the basin, particularly in shellfish waters, there are several basic steps, listed below, that could be undertaken at relatively low cost to help control urban stormwater pollution. Local governments are encouraged to consider implementing the steps for controlling urban stormwater described above.

<u>Recommendations:</u>

1. Mapping of municipal storm sewer systems and outfall points, and developing procedures to update this information.
2. Evaluating existing land uses in the local government's jurisdictional area to determine where sources of stormwater pollution may exist. In addition, local government activities and programs could be evaluated to determine where existing activities address stormwater management in some way, or could be modified to do so.
3. Developing educational programs to inform citizens of activities that may contribute pollutants to stormwater runoff (dumping oil, paint or chemicals down storm drains)

and offering ways of carrying out such activities in an environmentally sound manner. Storm drain stenciling is a good example of a low cost educational tool.

4. Developing programs to locate and remove illicit connections (illegal discharge of non-stormwater materials) to the storm sewer system. These often occur in the form of floor drains and similar connections. In practice, stormwater management programs represent an area where local governments can develop their own ideas and activities for controlling sources of pollution.
5. Reviewing local ordinances pertaining to parking, curb and gutter and open space requirements. Many of these local ordinances could be modified to enhance water quality protection from urban stormwater runoff impacts by minimizing impervious area, encouraging use of natural drainage patterns, grassed swales and landscaped areas for stormwater control. Maintaining riparian buffer strips along streams is an example.
6. Wetlands can be created or protected along streams in urbanized areas of the watershed to receive stormwater runoff. In many cases, natural wetlands already serve as water treatment systems for agricultural and urban runoff. Water quality parameters including nutrients, heavy metals, pesticides, organics, and other chemical constituents can be affected by passage through a wetland (Bastion and Benforado 1988). When transported into a wetland, pollutants can be removed by burial, chemical breakdown, and/or assimilation into plant tissue. Careful design of these systems is needed in order to adequately handle the altered hydraulics of urban areas.

H. MANAGEMENT STRATEGIES FOR WASTE FROM ANIMAL OPERATIONS

DWQ is currently pursuing a number of efforts to improve the management of waste generated from animal production operations. These efforts include the implementation and enforcement of the animal waste regulations adopted in 1992 and the training and certification of operators of animal waste systems. These actions are both new and ongoing and will work toward the goal of eliminating the contribution of animal waste into North Carolina's surface waters.

Recommendations:

1. Continue the implementation of 15A NCAC 2H .0217 requiring the development of animal waste management plans for animal waste management systems designed to serve more than or equal to 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds with a liquid waste system facilities. These plans must be certified by a technical specialist designated by the Soil and Water Conservation Commission and based on the standards and specifications of the USDA Natural Resources Conservation Service.
2. Continue to administer a training and certification program for operators of swine facilities with more than 250 swine that land apply animal waste.
3. Continue efforts to increase compliance inspections for animal waste management operations.

I. TOXIC SUBSTANCES

While toxicants have not been identified as a major cause of water quality impairment in the White Oak basin, there are a number of programs underway that need to be continued that are intended to prevent significant problems from occurring.

Recommendations:

1. Point source discharges will continue to be allocated chemical specific toxics limits and monitoring requirements based on a mass balance technique discussed in the Instream Assessment Unit's Standard Operating Procedures manual and in Appendix III of this report. Any available data are used at permit renewal to determine which toxic parameters need to be limited in the NPDES permit.
2. Whole effluent toxicity limits will be assigned to all major discharges and any discharger of complex wastewater.
3. Stormwater control strategies will continue to be implemented through the industrial NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters.

J. MANAGEMENT STRATEGIES FOR CONTROLLING SEDIMENT

No streams have been identified as being impaired in the White Oak River Basin due to sedimentation. However, sedimentation is a potential nonpoint source-related water quality problem resulting from land-disturbing activities that can have significant localized effects in this basin. The most significant of these activities include agriculture and land development (e.g., highways, shopping centers, and residential subdivisions). For each of these major types of land-disturbing activities, there are programs being implemented by various government agencies at the state, federal and/or local level to minimize soil loss and protect water quality.

FUTURE INITIATIVES IN THE WHITE OAK RIVER BASIN

USE RESTORATION WATERS

The Use Restoration Waters approach to water quality management will be an appropriate avenue to address problems in areas where there is a shellfish resource but the waters are closed to harvesting due to fecal coliform contamination.

The Use Restoration Waters (URW) strategy, currently being developed by DWQ staff, is a new approach to restore waters which do not currently meet their uses. As now envisioned, the strategy would be used only where data have demonstrated that the impairment is persistent and not transitory, that the causes and sources of impairment are known, and that these can be adequately controlled using strategies implemented under existing EMC authority. A site specific study would be required, with strategies developed in coordination with a team of stakeholders. Both point sources and nonpoint sources could be targeted, using a site specific mixture of voluntary and regulatory methods, as appropriate to the situation. The concept could be implemented either as a new supplemental classification or as a focused, coordinated non-regulatory effort for particular waterbodies. If the regulatory pathway is followed, formal rule-making procedures, including public hearings, would be undertaken for the establishment of the rules and subsequently for each waterbody to which the strategy is applied.

REGIONALIZATION OF WASTEWATER TREATMENT

Four counties in the White Oak River Basin area (Carteret, Craven, Onslow and Pamlico) have formed the Regional Wastewater Task Force to investigate long term wastewater treatment management alternatives at a regional level. This group has recently decided on 6 possible alternatives to present to the local public for their input. Meetings on these alternatives were held in May of 1996. The alternatives being considered range from upgrading existing treatment facilities to consolidating all discharges into an ocean outfall. DWQ supports the upgrade and consolidation of waste treatment systems, especially in areas such as the White Oak River Basin where failing septic systems and package plants contribute to water quality degradation. DWQ will continue to work with the Task Force to support them in identifying the most feasible long term treatment alternatives for the four-county area.

WETLANDS RESTORATION
The 1996 NC General Assembly established a wetland restoration program in this state (G.S. 143-214.8 through 214.13). As this program is implemented, North Carolina will begin a concentrated effort to inventory and digitally map wetlands throughout the state. As the program progresses, it is envisioned that a wetland conservation and restoration plan will be developed for each river basin and incorporated into the basinwide planning process. Through this, the water quality protection function of wetlands can be used more effectively in areas prioritized during basinwide planning.

NONPOINT SOURCE TEAMS
DWQ has begun setting up nonpoint source teams in each of the state's 17 major river basins. One has been set up for the White Oak Basin and began meetings in August 1996. These teams will emphasize local participation and will have representatives from agencies covering agriculture, urban stormwater, construction, mining, on-site wastewater disposal, forestry, solid waste, wetlands, wildlife and groundwater, as well as local governments, the League of Municipalities and trade and environmental organizations. These teams will provide descriptions of NPS activities within a basin, conduct assessments of NPS controls in targeted watersheds, identify future monitoring sites, develop five-year action plans for NPS pollutants, and develop Section 319 grant proposals for projects in targeted watersheds.

IMPROVED MONITORING AND INTERAGENCY COORDINATION
DWQ is undertaking a couple of efforts to improve the amount of information that is generated about the quality of waters in the state. Currently, a citizen monitoring program is being developed for areas in the Neuse River Basin. This will serve as a pilot for future citizen monitoring programs in other river basins throughout the state. People will be trained in sampling methods and appropriate analytical techniques so that they can help DWQ get a wider picture of water quality conditions in particular basins. Workshops for future monitors will be conducted for the Neuse River Basin in June of 1996.

In addition to this, DWQ has been discussing with other environmental agencies the potential for coordination of field resources. If individuals from another environmental agency are visiting certain streams or rivers or lakes to investigate fish populations or wetland areas, they could also collect water quality data from that area.

FURTHER EVALUATION OF SWAMP SYSTEMS
Many of the waterbodies in the eastern third of the State are classified as swamp waters. It is difficult to evaluate monitoring data in these systems to determine if a waterbody is impaired. For example, a swamp may have low dissolved oxygen concentrations, but these may be due to natural background concentrations rather than from impacts from point and nonpoint sources. DWQ will continue its efforts to evaluate these systems using chemical and biological data.

GENERAL NPDES PROGRAM INITIATIVES
In the next five years, efforts will be continued to:

- improve compliance with permitted limits;
- improve pretreatment of industrial wastes to municipal wastewater treatment plants so as to reduce the toxicity in effluent wastes;
- encourage pollution prevention at industrial facilities in order to reduce the need for pollution control;
- require dechlorination of chlorinated effluents or use of alternative disinfectants;

- require multiple treatment trains at wastewater facilities; and
- require plants to begin plans for expansion well before they reach capacity.

Longer-term objectives will include refining overall management strategies after obtaining feedback on current management efforts during the next round of water quality monitoring. Long-term point source control efforts will stress reduction of wastes entering wastewater treatment plants, seeking more efficient and creative ways of recycling byproducts of the treatment process (including nonpotable reuse of treated wastewater), and keeping abreast of and recommending the most advanced wastewater treatment technologies.

CHAPTER 1

INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose this Basinwide Water Quality Management Plan is to report to citizens, policy makers and the regulated community on

- the current status of surface water quality in the basin,
- major water quality concerns and issues,
- projected trends in development and water quality,
- the long-range water quality goals for the basin, and
- recommended point and nonpoint source management options.

This Plan presents strategies for management of point sources and nonpoint sources of pollution. Section 1.2 provides an overview of the plan format to assist in the use and understanding of the document. It is one of a series of basinwide water quality management plans that are being prepared by the North Carolina Division of Water Quality (DWQ). Plans will be prepared for all seventeen of the state's major river basins over the next five years as shown in Figure 1.1. An introduction to the basinwide management approach and a statewide basinwide permitting schedule are presented in Section 1.3.

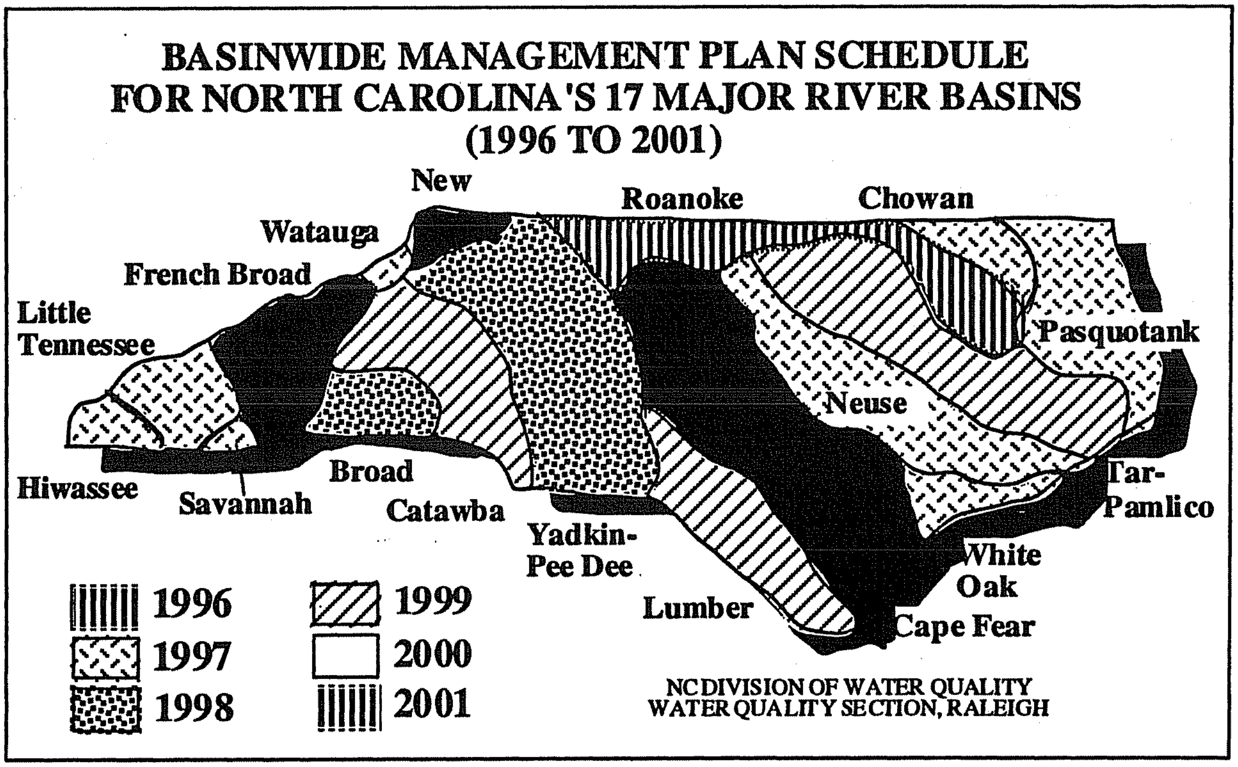


Figure 1.1 Basinwide Management Plan Schedule (1996 to 2001)

1.2 GUIDE TO USE OF THIS DOCUMENT

CHAPTER 1: Introduction - This chapter provides a non-technical description of the purpose of this plan, the basinwide water quality management approach and how this approach will be administered. The description of the basinwide management approach is based primarily on a 54-page document entitled *North Carolina's Basinwide Approach to Water Quality Management: Program Description - Final Report/August 1991* (Creager and Baker, 1991).

CHAPTER 2: General Basin Description - This chapter provides a general description of the basin. Some of the specific topics covered include:

- an overview of the major features such as location, rainfall, population, physiography, etc.
- hydrology of the basin and its subbasins
- a summary of land cover within the basin based on results of a 1982 and 1992 Nationwide Resources Inventory (NRI) conducted by the US Department of Agriculture Natural Resources Conservation Service.
- population growth trends and densities by subbasin using 1970, '80 and '90 census data.
- major water uses in the basin and DWQ's program of water quality classifications and standards.

CHAPTER 3: Causes and Sources of Water Pollution in the Basin - Chapter 3 discusses the probable causes and sources of surface water degradation in the basin. It describes both point and nonpoint sources of pollution as well as a number of important causes of water quality impacts including sediment, biochemical oxygen demand (BOD), toxic substances, nutrients, color, fecal coliform bacteria and others. It also discusses pollutant loading in the basin and generally discusses water quality problem areas.

CHAPTER 4: Water Quality Status in the Basin - Data generated by DWQ on water quality and biological communities are reviewed and interpreted in this chapter in order to assess current conditions and the status of surface waters within the basin. The chapter describes the various types of water quality monitoring conducted by DWQ, summarizes water quality in each of the subbasins in the basin and presents a summary of use support ratings for those surface waters that have been monitored or evaluated.

CHAPTER 5: Existing Point and Nonpoint Source Pollution Control Programs - Chapter 5 summarizes the existing point and nonpoint source control programs available to address water quality problems. These programs represent the management tools available for addressing the priority water quality concerns and issues that are identified in Chapter 6. Chapter 5 also describes the concept of Total Maximum Daily Loads (TMDLs). TMDLs represent management strategies aimed at controlling point and nonpoint source pollutants on various water bodies within the basin.

CHAPTER 6: Basinwide Goals, Major Water Quality Concerns and Recommended Management Strategies - Water quality issues identified in Chapters 2, 3 and 4 are evaluated and prioritized based on use-support ratings, degree of impairment, and the sensitivity of the aquatic resources being affected. Recommended management strategies, or TMDLs, are then presented that describe how the available water quality management tools and strategies described in Chapter 5 will be applied in the basin. This includes generalized wasteload allocations for dischargers (for nutrients, biochemical oxygen demand (BOD) and toxicity) and recommended programs and best management practices for controlling nonpoint sources.

CHAPTER 7: Future Initiatives - This chapter presents future initiatives necessary to evaluate and manage human impacts on the natural resources of the basin. Management strategies need to be developed for a number of areas identified within the basin. Future programmatic initiatives will consider further evaluation of swamp waters, use of discharger self-monitoring data, promotion of non-discharge alternatives, and improved data management and expanded use of geographic information (GIS) computer capabilities.

1.3 NORTH CAROLINA'S BASINWIDE MANAGEMENT APPROACH

Introduction - Basinwide water quality management is a watershed-based management approach being implemented by DWQ which features basinwide permitting, integrating existing point and nonpoint source control programs, and preparing basinwide management plan reports.

DWQ is applying this approach to each of the seventeen major river basins in the state as a means of better identifying water quality problems, developing appropriate management strategies, maintaining and protecting water quality and aquatic habitat, and assuring equitable distribution of waste assimilative capacity for dischargers. Other important benefits of the basinwide approach include improved efficiency, increased cost-effectiveness, better consistency and equitability, and improved public awareness and involvement in management of the state's surface waters.

After conducting public workshops to identify areas of concern and major issues, a basinwide management plan document is prepared for each basin. The plans are circulated for public review and are presented at public meetings in each river basin. The management plan for a given basin is completed and approved preceding the scheduled date for basinwide permit renewals in that basin. The plans are then to be evaluated, based on followup water quality monitoring, and updated at five year intervals thereafter.

DWQ began formulating the idea of basinwide management in the late 1980s, established a basin permitting schedule in 1990, began basinwide monitoring activities in 1990, and published a basinwide program description in August 1991. Basinwide management entails coordinating and integrating, by major river basin, DWQ's water quality program activities. These activities, which are discussed further in Section 1.4, include permitting, monitoring, modeling, nonpoint source assessments, and planning.

Water Quality Program Benefits - Several benefits of basinwide planning and management to North Carolina's Water quality program include: (1) *improved program efficiency,* (2) *increased effectiveness*, (3) better *consistency and equitability* and (4) *increased public awareness of the state's water quality protection programs*. First, by reducing the area of the state covered each year, monitoring, modeling, and permitting efforts can be focused. As a result, *efficiency increases* and more can be achieved for a given level of funding and resource allocation. Second, the basinwide approach is in consonance with basic ecological principles of watershed management, leading to *more effective* water quality assessment and management. Linkages between aquatic and terrestrial systems are addressed (e.g., contributions from nonpoint sources) and all inputs to aquatic systems, and potential interactive, synergistic and cumulative effects, are considered. Third, the basinwide plans will provide a focus for management decisions. By clearly defining the program's long-term goals and approaches, these plans will encourage *consistent* decision-making on permits and water quality improvement strategies. Consistency, together with greater attention to long-range planning, will promote a *more equitable* distribution of assimilative capacity, explicitly addressing the trade-offs among pollutant sources (point and nonpoint) and allowances for economic growth.

Basinwide management will also promote integrating point and nonpoint source pollution assessment and controls. Once waste loadings from both point and nonpoint sources are established, management strategies can be developed to prevent overloading of the receiving waters and to allow for a reasonable margin of safety to ensure compliance with water quality standards.

Basinwide Planning Schedule - The following table presents the overall basin schedule for all 17 major river basins in the state. Included are the dates for permit reissuance and the dates by which management plans are to be completed for each basin.

Table 1.1 Basinwide Permitting and Planning Schedule for North Carolina's 17 Major River Basins (1993 through 1998).

Basin	Target Date for Basin Plan Approval	Discharge Permits to be Issued	Basin	Target Date for Basin Plan Approval	Discharge Permits to be Issued
Neuse	2/93(approved)	4/93	Roanoke	9/96 (approved)	1/97
			White Oak	2/97 (approved)	6/97
Lumber	5/94(approved)	11/94	Savannah	4/97	8/97
			Watauga	4/97	9/97
Tar-Pamlico	12/94(approved)	1/95	Little Tennessee	5/97	10/97
Catawba	2/95(approved)	4/95	Hiwassee	5/97	12/97
French Broad	5/95(approved)	8/95			
New	7/95(approved)	11/95	Chowan	8/97	1/98
			Pasquotank	8/97	1/98
Cape Fear	9/95(approved)	1/96	Neuse (2nd cycle)	11/97	4/98
			Yadkin-Pee Dee	1/98	7/98
			Broad	6/98	11/98

The number of plans to be developed each year varies from one to six and is based on the total number of permits to be issued each year. For example, the Cape Fear basin, the state's largest, has about as many dischargers as all six of the small basins in 1997. This has been done in order to balance the permit processing workload from year to year. In years where more than one basin is scheduled to be evaluated, an effort has been made to group at least some of the basins geographically in order to minimize travel time and cost for field studies and public meetings.

Plans to be updated every five years - The earliest basin plans will likely not achieve all of the long-term objectives for basinwide management outlined above. However, subsequent updates of the plans, every 5 years, will incorporate additional data and new assessment tools (e.g., basinwide water quality modeling) and management strategies (e.g., for reducing nonpoint source contributions) as they become available.

Basinwide Plan Preparation, Review and Public Involvement - Preparation of an individual basinwide management plan is a five year process which is broken down into four phases described below.

Year	Activity
1 to 3	Water Quality Data Collection/Identification of Goals and Issues: Year 1 entails identifying sampling needs and canvassing for information. It also entails coordinating with other agencies, the academic community and local interest groups to begin establishing goals and objectives and identifying and prioritizing problems and issues. Biomonitoring, fish community and tissue analyses, special studies and other water quality sampling activities are conducted in Years 2 and 3 by DWQ's Environmental Sciences Branch (ESB). These studies provide

information for assessing water quality status and trends throughout the basin and provide data for computer modeling.

3 to 4 Data Assessment and Model Preparation: Modeling priorities are identified early in this phase and are refined through assessment of water quality data from the ESB. Data from special studies are then used by DWQ's Technical Support Branch (TSB) to prepare models for estimating potential impacts of waste loading from point and nonpoint sources using the TMDL approach. Preliminary water quality control strategies are developed, based on modeling, with input from local governments, the regulated community and citizens groups during this period.

4 Preparation of Draft Basinwide Plan: The draft plan, which is prepared by DWQ's Planning Branch, is due for completion by the end of year 4. It is based on support documents prepared by ESB (water quality data) and TSB (modeling data and recommended pollution control strategies). Preliminary findings are presented at informal meetings through the year with local governments and interested groups, and comments are incorporated into the draft.

5 Public Review and Approval of Plan: At the beginning of year 5, the draft plan, after approval of the Environmental Management Commission (EMC), is circulated for review, and public meetings are held. Revisions are made to the document, based on public comments, and the final document is submitted to the EMC for approval midway through year 5. Basinwide permitting begins at the end of year 5.

Each basinwide management plan includes a minimum of six chapters as presented on page 2. A seventh chapter has also been added to the plans that discusses future initiatives needed to address water quality concerns.

Implementation - The implementation of basinwide planning and management will occur in phases. Permitting activities and associated routine support activities (field sampling, modeling, wasteload allocation calculations, etc.) have already been rescheduled by major river basin. All National Pollutant Discharge Elimination System (NPDES) permit renewals within a basin occur within a prescribed time period after completion of the final basin plan, and will be repeated at five year intervals (Table 1.2).

Table 1.2 Subbasin NPDES Permit Schedule for the White Oak River Basin

Subbasin No.	Month/Year
030501	June, 1997
030502	June, 1997
030503	July, 1997
030504	July, 1997
030505	August, 1997

Basinwide NPDES permitting in the White Oak River basin will occur during time intervals between June, 1997 and August, 1997. Table 1.2 lists each subbasin and the month in which permitting will occur for that subbasin.

1.4 BASINWIDE RESPONSIBILITIES WITHIN THE WATER QUALITY SECTION OF THE DIVISION OF WATER QUALITY

The Water Quality Section within Division of Water Quality is the lead state agency for the regulation and protection of the state's surface waters. It is within the Department of Environment, Health and Natural Resources.

The primary responsibilities of the Water Quality Section are to maintain or restore an aquatic environment of sufficient quality to protect the existing and best intended uses of North Carolina's surface waters and to ensure compliance with state and federal water quality standards. The Section receives both state and federal allocations and also receives funding through the collection of permit fees. Policy guidance is provided by the Environmental Management Commission. The Division of Water Quality is comprised of over 200 staff members in the central and seven regional offices (Figure 1.2). The major areas of responsibility are water quality monitoring, permitting, planning, modeling (wasteload allocations) and compliance oversight.

The Central office is divided into four branches, with each branch being subdivided into two units. The Planning Branch is responsible for developing water quality standards and classifications, program planning and evaluation, and implementation of new water quality protection programs. The *Water Quality Planning and Assessment Unit* handles surface water reclassifications, development of water quality standards, and the coordination of the state's nonpoint source program. The *Basinwide Assessment Unit* administers implementation of the basinwide management program and includes technical staff to assist in modeling nonpoint pollution sources, developing use support ratings and improving the section's GIS capabilities. It also coordinates EPA water quality planning grants, state environmental policy act responsibilities and the implementation of the Comprehensive Conservation and Management Plan (CCMP) that resulted from the Albemarle-Pamlico Estuarine Study (APES).

The Operations Branch is responsible for permit compliance tracking, the pretreatment program, water supply watershed protection/local government technical support, and the operator training and certification program. The *Facility Assessment Unit* includes both the permit compliance and pretreatment programs. The *Water Quality and Technical Assistance Unit* includes the water supply watershed protection program and the operator certification and training program. The former program assists local governments in meeting the requirements of the water supply watershed protection program. The latter program rates the complexity of operation of wastewater treatment plants and provides formal training for operators commensurate with the plant operating needs.

The Technical Support Branch is responsible for processing of discharge and nondischarge permits as well for preparing TMDLs and wasteload allocations for dischargers. The *Instream Assessment Unit* provides primary computer modeling support and is responsible for coordinating development of TMDLs and individual NPDES wasteload allocations. The *Permits and Engineering Unit* handles reviews and processing of permit applications for both discharging and nondischarging wastewater treatment systems.

The Environmental Sciences Branch is responsible for water quality monitoring, toxicity testing, biological laboratory certifications and the wetlands 401 Water Quality Certification program. The branch is divided into the Ecosystems Analysis Unit and the Aquatic Survey and Toxicology Unit. Some of the major functions of the *Ecosystems Analysis Unit* include biological and chemical

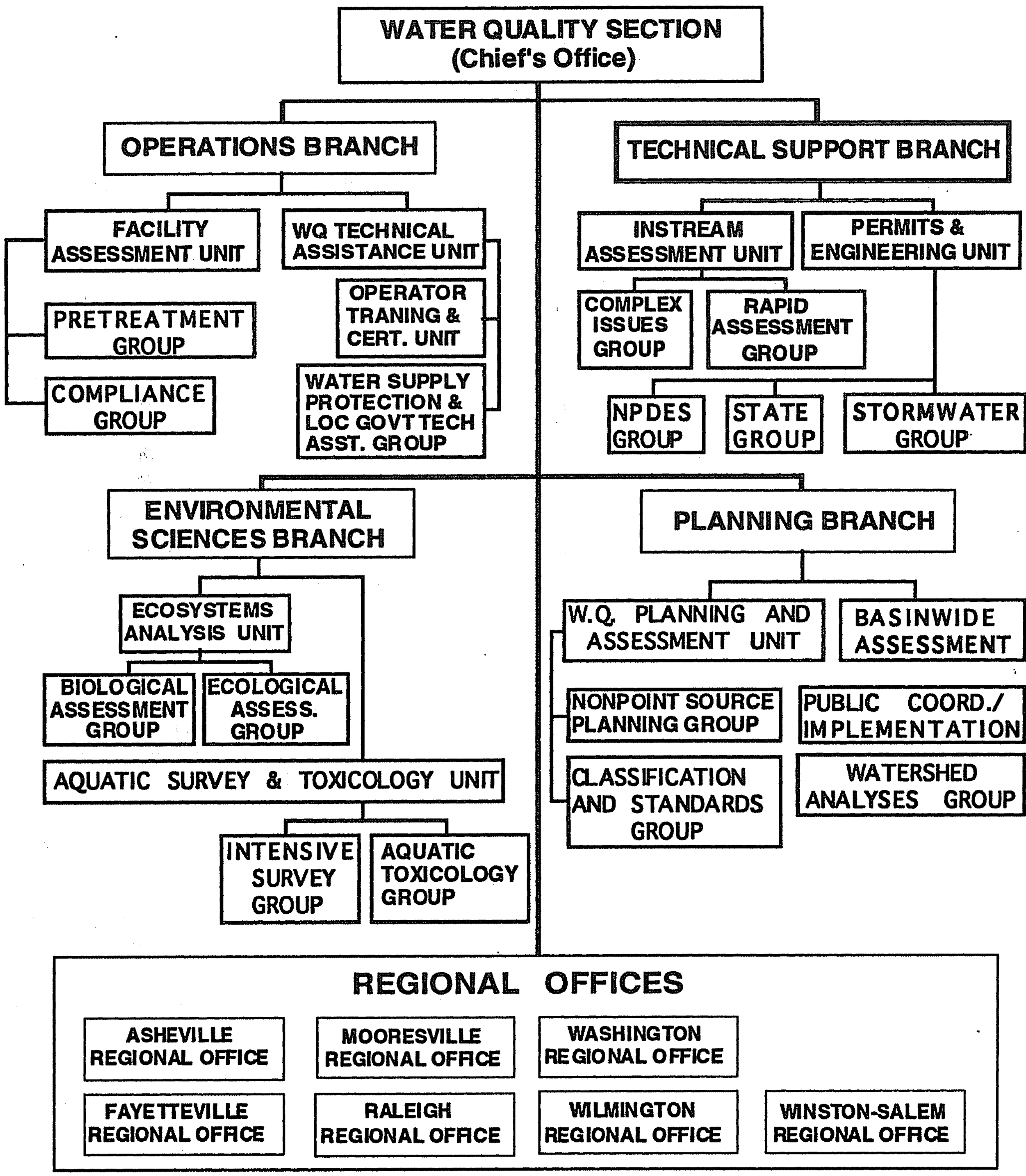


Figure 1.2 Organizational Structure of the Water Quality Section of DWQ

water quality monitoring and evaluation, evaluating reclassification requests, algal analyses, benthic macroinvertebrate monitoring (biomonitoring), fish tissue and fish communities studies and wetlands assessment and certification. Major functions of the *Aquatic Survey and Toxicology Unit* include effluent toxicity testing, chemical toxicity evaluations, toxicity reduction evaluations (TRE), biological lab certification, biocide evaluations and related special studies, intensive surveys, special studies, dye studies, time-of-travel studies, long term biochemical and sediment oxygen demand, chemical water quality monitoring and lakes assessments.

The seven Regional Offices carry out activities such as wetland reviews, compliance evaluations, permit reviews and facility inspections for both discharging and nondischarging systems, ambient water quality monitoring, state environmental policy act reviews, stream reclassification reviews, pretreatment program support and operator training and certification assistance. In addition, they respond to water quality emergencies such as oil spills and fish kills, investigate complaints and provide information to the public. Figure 1.3 shows the location of the regional offices and the counties that they serve.

Although the basic structure and major responsibilities within the Division of Water Quality will remain unchanged, implementation of a basinwide approach to water quality management will require some modification of and additions to the tasks currently conducted by each branch and the regional offices. The goal of basinwide planning is to broaden the scope of management activities from a stream reach to the entire basin. Accomplishing this goal will require more complex water quality modeling, data interpretation, and database management within the water quality program. For example, more sophisticated methods of quantitatively estimating nonpoint source pollutant loads will need to be developed and applied. In addition, these quantitative estimates of nonpoint source loads will have to be integrated with information on point sources to determine the total loading to the system.

Planning for future growth and the possibility of incorporating "agency banking" (see Section 5.3) into the Division of Water Quality's management objectives will require model projections of various potential scenarios to allocate the remaining assimilative capacity and fairly distribute control requirements. Finally, the link between water quality data and model projections for the multiple stream reaches within a basin, and the overlay of other relevant types of information, such as land use, will require expanded use of geographic information systems (GIS) with coordination and support from this state's Center for Geographic Information Analysis (CGIA).

1.5 STATE AND FEDERAL LEGISLATIVE AUTHORITIES FOR NORTH CAROLINA'S WATER QUALITY PROGRAM

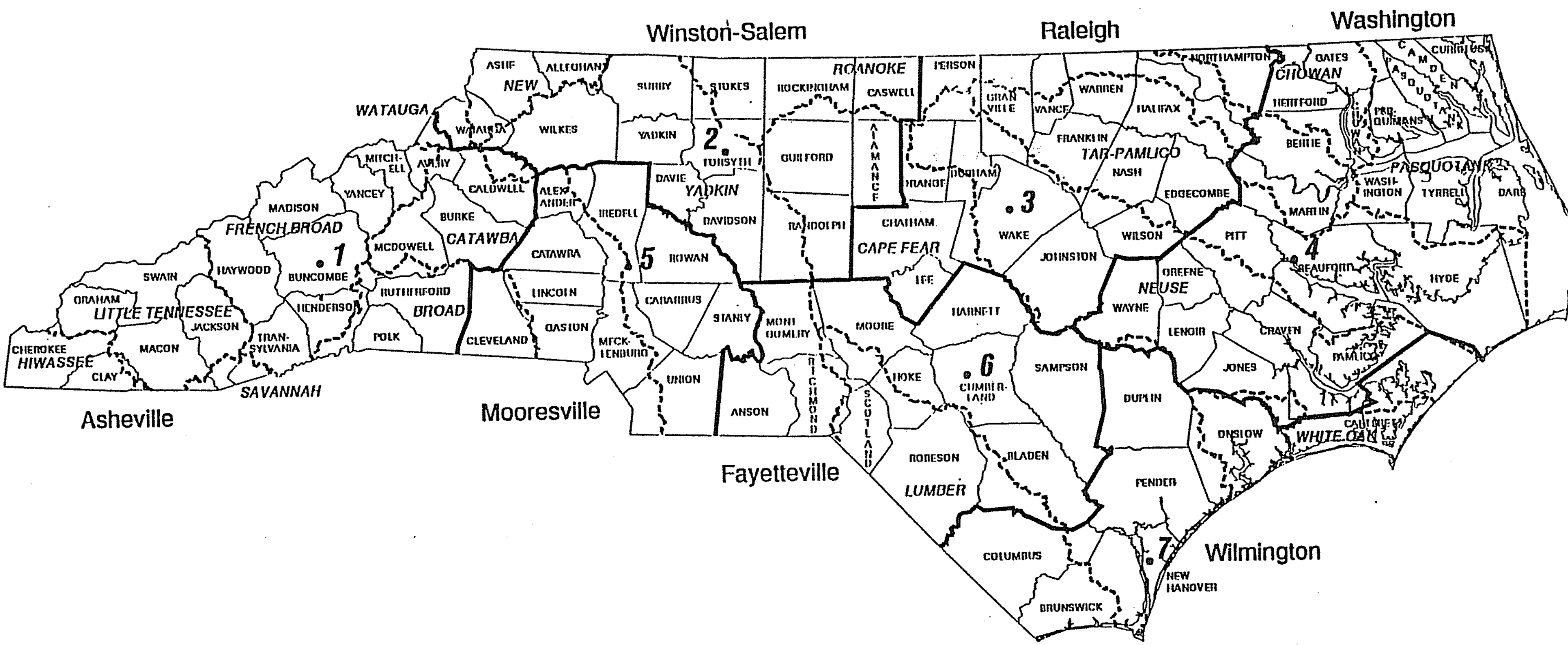
Authorities for some of the programs and responsibilities carried out by the Division of Water Quality are derived from a number of federal and state legislative mandates outlined below. The major federal authorities (Section 1.5.1) for the state's water quality program are found in sections of the Clean Water Act (CWA). State authorities listed in Section 1.5.2 are from state statutes.

1.5.1 Federal Authorities for NC's Water Quality Program

- **Section 301** - Prohibits the discharge of pollutants into surface waters unless permitted by EPA (see Section 402, below).
- **Section 303(c)** - States are responsible for reviewing, establishing and revising water quality standards for all surface waters.
- **Section 303(d)** - Each state shall identify those waters within its boundaries for which the effluent limits required by section 301(b)(1) A and B are not stringent enough to protect any water quality standards applicable to such waters.
- **Section 305(b)** - Each state is required to submit a biennial report to the EPA describing the status of surface waters in that state.

DEM CENTRAL AND REGIONAL OFFICES (WITH RIVER BASINS)

N.C. Department of Environment, Health, and Natural Resources



1 - ARO Mr. Roy Davis Regional Supervisor 59 Woodfin Place Asheville, NC 28801 (704)251-6208 Fax (704)251-6098	**2 - WSRO** Mr. Larry Coble Regional Supervisor 585 Waughtown Street Winston-Salem, NC 27107 (919)771-4600 Fax (919)771-4631	**3 - CENTRAL OFFICE** DEHNR, DEM Water Quality Section P.O. Box 29535 Raleigh, NC 27626-0535 (919)733-5083 Fax (919)733-9919	**3 - RRO** Mr. Ken Schuster Regional Supervisor 3800 Barrett Drive Raleigh, NC 27609 (919)571-4700 Fax (919)571-4718
4 - WaRO Mr. Jim Mulligan Regional Supervisor 1424 Carolina Avenue Washington, NC 27889 (919)946-6481 Fax (919)975-3716	**5 - MRO** Mr. Keith Overcash Regional Supervisor 919 North Main Street Mooresville, NC 28115 (704)663-1699 Fax (704)663-6040	**6 - FRO** Mr. Tommy Stevens Regional Supervisor Wachovia Bldg., Suite 714 Fayetteville, NC 28301 (910)486-1541 Fax (910)486-0707	**7 - WIRO** Mr. Rick Shiver Regional Supervisor 127 Cardinal Drive Extension Wilmington, NC 28405-3845 (910)395-3900 Fax (910)350-2004

Figure 1.3 Location and Jurisdictions of DEM Regional Offices

- **Section 319** - Each state is required to develop and implement a nonpoint source pollution management program.
- **Section 402** - Establishes the National Pollutant Discharge Elimination System (NPDES) permitting program. Allows for delegation of permitting authority to qualifying states (includes North Carolina).
- **Section 404/401** - Section 404 regulates the discharge of fill materials into navigable waters and adjoining wetlands unless permitted by the US Army Corps of Engineers. Section 401 requires the Corps to receive a state Water Quality Certification prior to issuance of a 404 permit.

1.5.2 State Authorities for NC's Water Quality Program

- **G.S. 143-15.3B, 113-145.1 through 145.7** - Establishes a Clean Water Management Trust Fund.
- **G.S. 143-214.1** - Directs and empowers the NC Environmental Management Commission (EMC) to develop a water quality standards and classifications program.
  G.S. 143-214.2 - Prohibits the discharge of certain wastes to surface waters of the state without a permit.
- **G.S. 143-214.5** - Provides for establishment of the state Water Supply Watershed Protection Program.
- **G.S. 143-214.7** - Directs the EMC to establish a Stormwater Runoff Program.
- **G.S. 143-214.8 through 214.13** - Establishes a wetland restoration program.
- **G.S. 143-215** - Authorizes and directs the EMC to establish effluent standards and limitations.
- **G.S. 143-215.1** - Outlines methods for control of sources of water pollution (NPDES and nondischarge permits, statutory notice requirements, public hearing requirements, appeals, etc.).
- **G.S. 143-215.2** - Empowers the EMC to issue *special orders* to any person whom it finds responsible for causing or contributing to any pollution of the waters of the state within the area for which standards have been established.
- **G.S. 143-215.3** - Outlines additional powers of the EMC including provisions for adopting rules, charging permit fees, delegating authority, investigating fish kills and investigating violations of rules, standards or limitations adopted by the EMC.
- **G.S. 143-215.6A, 143-215.6B and 143-215.6C** - Includes enforcement provisions for violations of various rules, classifications, standards, limitations, provisions or management practices established pursuant to G.S. 143-214.1, 143-214.2, 143-214.5, 143-215, 143-215.1, 143-215.2. Section 6A describes enforcement procedures for civil penalties. Section 6B outlines enforcement procedures for criminal penalties. Section 6C outlines provisions for injunctive relief.
- **G.S. 143-215.10A through 215.10G** - Requires permits and controls for animal waste systems.
- **G.S. 143-215.74, 74A, 74B, 74C, 74D, and 74E** - Deal with animal waste management and agricultural cost share.
- **G.S. 143-215.75** - Outlines the state's Oil Pollution and Hazardous Substances Control Program.

REFERENCES CITED: CHAPTER 1

Creager, C.S., and J. P. Baker, 1991, North Carolina's Basinwide Approach to Water Quality Management: Program Description, DEM Water Quality Section, Raleigh, NC.

CHAPTER 2

GENERAL BASIN DESCRIPTION

2.1 WHITE OAK BASIN OVERVIEW

The White Oak River basin lies entirely within the southern coastal plain. The name of the basin is a bit of a misnomer in that it includes four separate river systems: the New River and its tributaries in the southwestern section; the White Oak River and its tributaries; the Newport River and its tributaries; and the North River in the eastern section. The basin also includes Bogue and Core Sounds.

The basin encompasses a total 1,233 square mile watershed area which includes the drainages of the New, White Oak, Newport and North Rivers. The basin contains 267 miles of freshwater streams and rivers, extensive estuarine areas in the Bogue and Core Sounds, and 192 square miles (122,875 acres) of saltwater. Figure 2.1 provides a general view of the entire basin.

There are 4 counties and 14 municipalities located in whole or in part in the basin . Based on 1990 census data, the population of the basin was 194,802 people. The most populated areas are located in Jacksonville and Camp Lejeune on the New River, and Morehead City and Beaufort on Bogue Sound and Newport River. The overall population density is 187 persons per square mile versus a statewide average of 123 persons per square mile. The percent population growth over the ten year period from 1980 to 1990 was 35.2% versus a statewide average of 12.7%. Statistics provided by the state Department of Administration project that the population in the basin will grow by nearly 50% by the year 2020.

Large portions of the basin are publicly owned areas, such as the Croatan National Forest on the White Oak River and the Hoffman State Forest and Camp Lejeune on the New River. Statistics provided by the US Department of Agriculture, Natural Resources Conservation Service indicate that there had been an increase in the amount of developed land and a decrease in the amount of cultivated cropland and forest between 1982 and 1992 (USDA, NRCS, 1994)

The New River watershed is the westernmost of the four major river systems in the basin. It is also the largest and most populated and includes the City of Jacksonville. The New River is a coastal blackwater river with a watershed entirely within Onslow County. The watershed above Jacksonville is characterized by gum-cypress swamps with upland areas used primarily for forestry and agriculture. At Jacksonville, the river widens into a broad, slow-moving tidal embayment. It eventually discharges into the Atlantic Ocean through a narrow opening called New River Inlet. The city of Jacksonville and the US Marine Corps, with the operation of Camp Lejeune, comprise the majority of land cover in the lower watershed (that area below ithe US 17 bridge). The New River has a narrow and flowing freshwater section and a slow-moving, poorly-circulating and wide estuarine section. The US 17 bridge is the approximate location of the boundary between these sections.

The White Oak River watershed, the basin's namesake, is located immediately east of the New River. It is the second largest watershed in the basin. A large portion of the watershed's land area is in public lands held in the Croatan National Forest and Hoffman State Forest. The White Oak River is approximately 48.4 miles long with a watershed of approximately 320.5 square miles (Hosier and Cleary 1982). The River flows past the western end of Bogue Sound and into the Atlantic Ocean at Bogue Inlet.

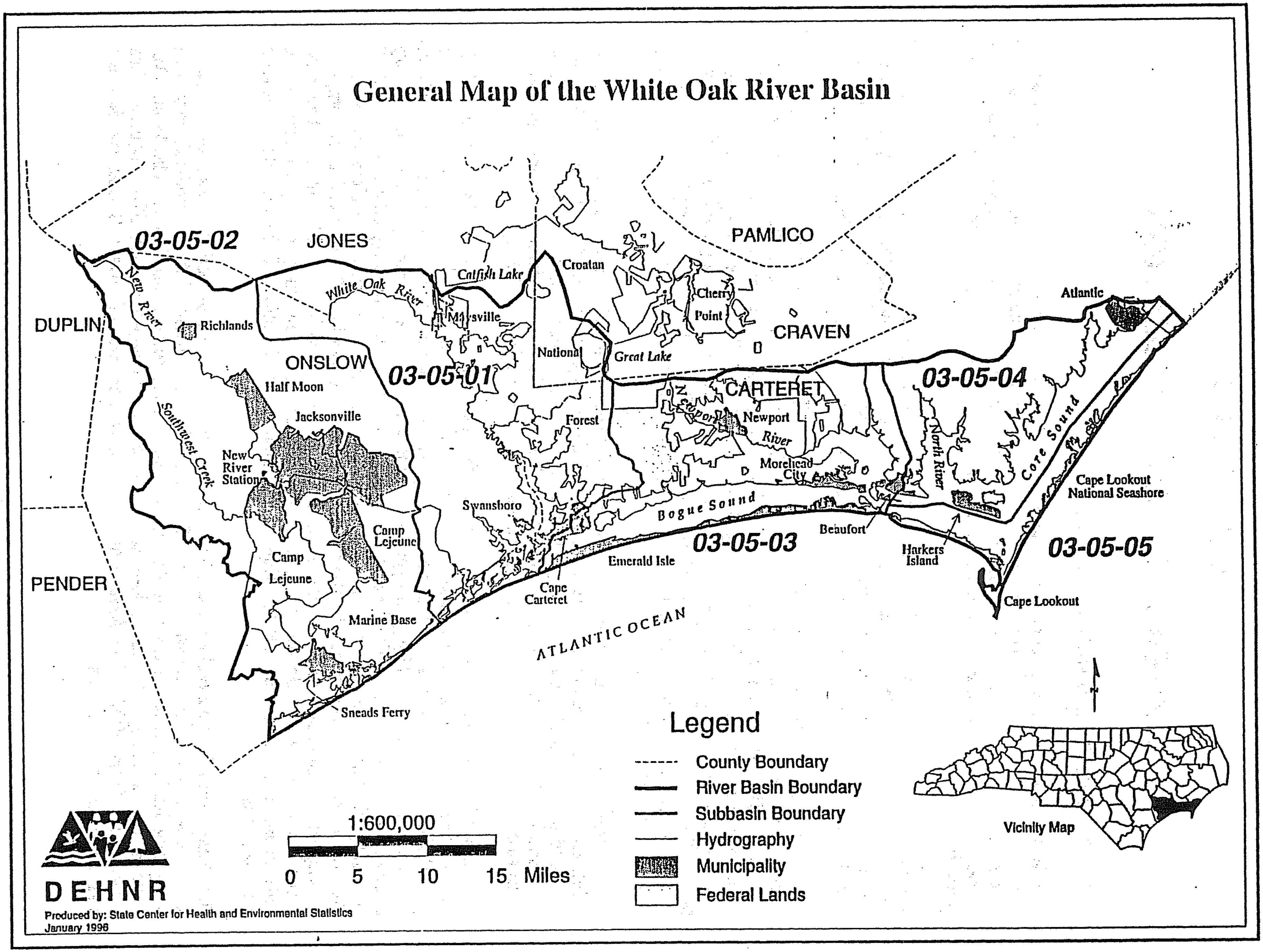


Figure 2.1 General Map of the White Oak River Basin in North Carolina

The Newport River is located just east of the White Oak River. It flows into the eastern end of Bogue Sound before entering the Atlantic Ocean near Morehead City. The Newport River watershed begins in Craven County, flows through Newport . The headwaters of the North River originate in Carteret County and flow directly into Back Sound near Harkers Island.

2.2 COMPARISON OF STATE AND FEDERAL HYDROLOGIC AREAS IN THE WHITE OAK BASIN

Most federal government agencies, including the US Geological Survey and the US Natural Resources Conservation Service (NRCS) use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. DWQ has a two-tiered system in which the state is subdivided into 17 river basins, and each basin is subdivided into subbasins. As noted earlier, the White Oak River basin is subdivided by DWQ into 5 subbasins. By contrast, a nationally uniform hydrologic unit system was developed in 1974 by the US Geological Survey's Office of Water Data Coordination (USDA, NRCS, Nov 1995). This system divides the country into 21 regions, 222 sub-regions, 352 accounting units and 2,149 cataloging units based on surface hydrologic features. Under the federal system, the White Oak basin is divided into two hydrologic areas referred to as cataloging units. Each cataloging unit is defined by an 8-digit number. One of these units includes all of the White Oak basin, except the New River watershed area, and is assigned the number 03020106. This area is equivalent to four subbasins defined by the state including subbasins 03-05-01, 03-05-03, 03-05-04 and 03-05-05. The other cataloging unit includes just the New River watershed and is assigned the number 03030001. It is the same as the state's subbasin 03-05-02. Table 2.1, below, compares the two systems.

Table 2.1. Hydrologic Divisions in the White Oak River Basin

Watershed Name and Major Tributaries	Federal Cataloging Unit. 8-digit Hydrologic Units	DWQ Subbasin 6-digit codes Figure 2.3
New River	03030001	030502
White Oak River	03020106	030501
Newport River	"	030503
North River, Jarrett Bay, Nelson Bay	"	030504
Core Sound, Back Sound	"	030505

These comparisons are presented to aid in the interpretation of land cover data summaries in Section 2.4. That section presents land cover information developed by the US NRCS which is summarized for each of the two cataloging units in the basin.

2.3 LOCAL GOVERNMENT AND PLANNING JURISDICTIONS

The basin encompasses parts of Onslow, Jones, Craven and Carteret counties and 14 municipalities as presented in Table 2.2. Also included in the table are abbreviations for the Lead Regional Organizations (Council of Governments) and Districts of the North Carolina League of Municipalities.

Table 2.2. Local Governments and Local Planning Units within the White Oak River Basin

County	*% of county in basin	Lead Regional Organization	NC League of Munic. Dist.	Municipality
Carteret	70%	Region P (Neuse River Council of Governments)	II	Morehead City Emerald Isle Newport Atlantic Beach Cape Carteret Pine Knoll Shores Cedar Point Indian Beach Harkers Island Beaufort
Craven	1%	"	II	None
Jones	20%	"	II	Maysville
Onslow	90%	"	II	Jacksonville Richlands Swansboro

* percentages are approximate

2.4 LAND COVER, POPULATION AND GROWTH TRENDS

2.4.1 General Land Cover

Land cover information in this section is derived from two sources. The first is the US Department of Agriculture (USDA), Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) of 1992 and 1982 (USDA, 1994). The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. According to the NRCS 1992 NRI Instructions booklet, the 1982 NRI was the most comprehensive study of our nation's natural resources ever conducted. The inventory is considered accurate to the 8-digit cataloging unit scale established by the US Geological Survey (NRCS, 1993). A 1992 update of these data were recently released.

Table 2.3 summarizes acreages and percentage of land cover from the 1992 and 1982 NRI for the basin as a whole and for the two major watershed areas within the basin. Land cover types identified in Table 2.4 by the NRI as occurring in the White Oak River basin include cultivated cropland, uncultivated cropland, pastureland, forest land, urban and built-up lands, rural transportation, open water (small water areas and census waters), federal lands and other.

Land cover in the basin, as presented in Table 2.3, is dominated by water area (such as estuaries) (33%), and forest land (29%). Twenty-one (21%) of the area is under federal ownership. This category, which comprises 58% of the basin, includes estuarine waters. Forest lands cover approximately 28% of the basin's area. The most significant change in land use between 1982 and 1992 was the addition of 33,000 acres of developed land (urban/built-up category) which translates to a 52% percent increase during that decade. Cultivated cropland and forest land saw a 9% and 8% decrease during the decade, respectively.

Table 2.3. Estimated Acreage by Broad Land Use for the White Oak River Basin in 1992 and 1982. (Source: USDA, NRCS, 1994)

1992 NRI

LAND COVER	New River 03030001 Acres (1000s)	New River %	Bogue-Core Sounds 03020106 Acres (1000s)	Bogue-Core Sounds %	TOTAL ACRES (1000s)	% of TOTAL	% Change from 1982 to 1992
Cult. Crop	17.9	5.1	37.0	5.0	54.9	5.0	- 9%
Uncult. Crop	0.0	0.0	0.0	0.0	0.0	0.0	0
Pasture	2.5	0.7	1.7	0.2	4.2	0.4	+ 147%
Forest	154.8	43.9	150.3	20.2	305.1	27.8	- 8%
Urban/Built-up	44.3	12.6	52.4	7.0	96.7	8.8	+ 52%
Rural Trans.	7.0	2.0	3.8	0.5	10.8	1.0	+ 13%
Water	29.8	8.4	335.1	44.9	364.9	33.2	0
Federal	86.8	24.6	141.4	19.0	228.2	20.8	+2%
Other	9.7	2.7	23.8	3.2	33.5	3.1	- 22%
Totals	352.8	100.0	745.5	100.0	1098.3	100.0	
% of Basin		32.1		67.9	1098.3	100.0	
DWQ Subbasins	03-05-02		03-05-01, 03, 04 & 05				

1982 NRI

LAND COVER	New River 03030001 Acres (1000s)	New River %	Bogue-Core Sounds 03020106 Acres (1000s)	Bogue-Core Sounds %	TOTAL ACRES (1000s)	% of TOTAL
Cult. Crop	20.6	5.8	39.9	5.4	60.5	5.5
Uncult. Crop	0.0	0.0	0.0	0.0	0.0	0.0
Pasture	0.0	0.0	1.7	0.2	1.7	0.2
Forest	165.1	46.8	165.6	22.2	330.7	30.1
Urban/Built-up	33.6	9.5	30.0	4.0	63.6	5.8
Rural Trans.	6.7	1.9	2.9	0.4	9.6	0.9
Water	29.8	8.4	335.1	44.9	364.9	33.2
Federal	86.7	24.6	137.6	18.5	224.3	20.4
Other	10.3	2.9	32.7	4.4	43.0	3.9
Totals	352.8	100.0	745.5	100.0	1098.3	100.0
% of Basin		32.1		67.9		100.0
DWQ Subbasins	03-05-02		03-05-01, 03, 04 & 05			

Table 2.4 Description of Land Cover Types (1992 NRI - USDA NRCS)

Land Cover Type (No.)	Land Cover Description
1) Cultivated Cropland	Land used for the production of adapted crops for harvest, including row crops, small-grain crops, hay crops, nursery crops, orchard crops, and other specialty crops. The land may be used continuously for these crops or they may be grown in rotation with grasses and legumes.
2) Uncultivated Cropland	Summer fallow, aquaculture in crop rotation, or other cropland not planted (may include cropland in USDA set-aside or similar short-term program).
3) Pastureland	Land used primarily for production of introduced or native forage plants for livestock grazing. This category includes land that has a vegetative cover of grasses, legumes, and /or forbs, regardless of whether or not it is being grazed by livestock.
4) Forest Land	Land at least 10 percent stocked by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover and not currently developed for non-forest use. Ten percent stocked, when viewed from a vertical direction, is a canopy cover of leaves and branches of 25 percent or greater. The minimum area for classification of forest land is 1 acre, and the area must be at least 1,000 feet wide.
5) Urban and Built-up Land	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Highways, railroads, and other transportation facilities are considered part of this category if surrounded by other urban and built-up areas. Tracts of less than 10 acres that do not meet this category's definitions (e.g., small parks or water bodies) but are completely surrounded by urban and built-up lands are placed in this category.
6) Rural Transportation:	Consists of all highways, roads, railroads, and associated rights-of-way outside Urban and Built-up areas; private roads to farmsteads, logging roads; and other private roads (but not field lanes).
7) Water	Includes the following three categories: <u>Small Water Areas:</u> Water bodies less than 40 acres in size and streams less than one-half mile wide. <u>Census Water</u>: Large water bodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width.
8) Federal	Lands owned by the Federal government such as Camp Lejeune and Croatan National Forest.
9) Other	Lands not in one of the other categories.

The second land cover source is derived from interpretation of 1988 LANDSAT satellite data that were made available in a report by the Water Resources Research Institute (Holman, 1993). The report was funded through the Albemarle-Pamlico Estuarine Study (APES) and the North Carolina Striped Bass Study Management Board. This coverage is available for the part of the basin located east of the New River Drainage Area. The land cover data for this portion of the basin are summarized in Table 2.5.

Seven land cover categories are included. Each is briefly described in the chart accompanying Table 2.5 . The subbasins listed in the table are for those subbasins in the White Oak River basin that are within the APES region (see Figure 2.1 for locations of subbasins). The only one excluded is the subbasin that covers the New River Drainage Area (subbasin 02).

The estimated acreages for the various land use categories do not compare well between the NRI and LANDSAT data. This may be attributable to: 1) differences in categorizing land uses (for example, the NRI data does not include a 'wetland' category); and 2) to differences in time frame (the LANDSAT data is from 1987 whereas the NRI data is from 1982 and 1992). The 200,000 acre difference between the total acres of the NRI data versus the LANDSAT data is attributable to the fact that the NRI data measures acreage for their hydrologic which includes some water area outside of the boundary that DWQ defines as the White Oak basin. However, some differences are not easily justifiable. For example, for subbasins 01, 03, 04 and 05, the NRI data shows a total acreage of 745,500 acres and the LANDSAT data shows it as 512,730. The LANDSAT data indicates that the majority of the coverage is wetland area, while, according to the NRI data, it is forest. This may be due to wetland forests such as bottomland hardwood forests and pine-covered pocosins being included as forest in the NRI data and as wetland in the LANDSAT data.

2.4.2 Population and Growth Trends in the Basin

The White Oak River basin has an estimated population of 194,802 people based on 1990 census data. Table 2.6 presents census data for 1970, 1980, and 1990 for each of the subbasins. It also includes land and water areas and population densities (persons/square mile of land area) by subbasin. Figure 2.2 shows the percent population growth by subbasin. (Note: The density information in this figure is incorrect for subbasin 030505 which has had no growth. The State Center for Health and Environmental Statistics is currently updating the map and an accurate version will be included in the Final plan.) The subbasin containing Newport, Morehead City and Beaufort (03-05-03) has seen a dramatic increase in population growing by 81% over the 20-year period. Overall, the population in the basin has grown by 50% between 1970 and 1990.

Table 2.7 shows those cities within the White Oak basin that have experienced the greatest increase in population. It should be noted that while the cities of Jacksonville and Richlands have both had significant population increases, the majority of this increase is due to annexation of other areas. In contrast, Atlantic Beach and Cape Carteret have experienced population increases above the state average and they have not annexed populated areas.

Future population growth is expected to be strong as evidenced by Table 2.8 below. This table shows population data for the four counties which encompass the White Oak basin. The projected percent change in growth between 1990 and 2020 is presented for that portion of the county estimated to be within each subbasin. The most significant changes in the basin are expected to be seen in Onslow and Carteret counties.

Table 2.5. Land Cover in Four of the Five Subbasins in the White Oak River Basin based on Interpretation of 1987 Landsat Satellite Coverage (WRRI: Holman, 1993)

Subbasin	Urban	Agriculture	Forest	Water	Wetland	Shrub Land	Barren Land	TOTAL	% of Total
30501: acres	5,117	25,951	55,118	22,371	126,613	10,311	233	245,715	48
percent	2	11	22	9	52	4	<1	100	
30503: acres	16,439	8,408	9,296	27,893	56,645	5,275	656	124,612	24
percent	13	7	8	22	45	4	1	100	
30504: acres	8,793	11,664	0	43,507	38,460	6,798	82	109,304	21
percent	8	11	0	40	35	6	<1	100	
30505: acres	0	1,364	700	24,663	3,634	372	2,365	33,099	7
percent	0	4	2	75	11	1	7	100	
TOTALS: acres	30,349	47;387	65,114	118,434	225,352	22,757	3,337	512,730	100

LAND COVER DESCRIPTIONS:

Land Cover Type	Description
Urban	Residential, commercial and industrial development
Agriculture	Cropland and pasture (including bare and grassed soil
Forest	Stands of conifers, deciduous and mixed
Water	Lakes, reservoirs, ponds, estuaries, sounds and large rivers
Wetland	Bottomland hardwoods, riverine swamp, Atlantic White Cedar, low pocosin, high marsh, low marsh
Shrub Land	Low density vegetation
Barren Land	Bare, dry sandy soil (i.e. sand dunes)

Table 2.6. White Oak Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

SUBBASIN	POPULATION (Number of Persons)			POPULATION CHANGE (%)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
										Total Land and Water Area		Water Area	Land Area
	1970	1980	1990	1970-80	1980-90	1970-90	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-05-01	12,958	11,934	17,215	-8	44	33	39	36	52	224,923	351	22	329
03-05-02	89,068	69,146	130,191	-22	88	46	209	162	306	295,882	462	36	426
03-05-03	20,646	27,755	37,421	34	35	81	119	160	216	146,026	228	55	173
03-05-04	7,185	8,145	8,986	13	10	25	73	83	92	108,875	170	56	98
03-05-05	0	0	0	0	0	0	0	0	0	33,063	52	38	14
Totals	129,857	116,980	193,813	-10	66	49	125	112	186	808,769	1263	207	1,040

Note: Population, land area and water area were derived from 1970, 1980 and 1990 census data.

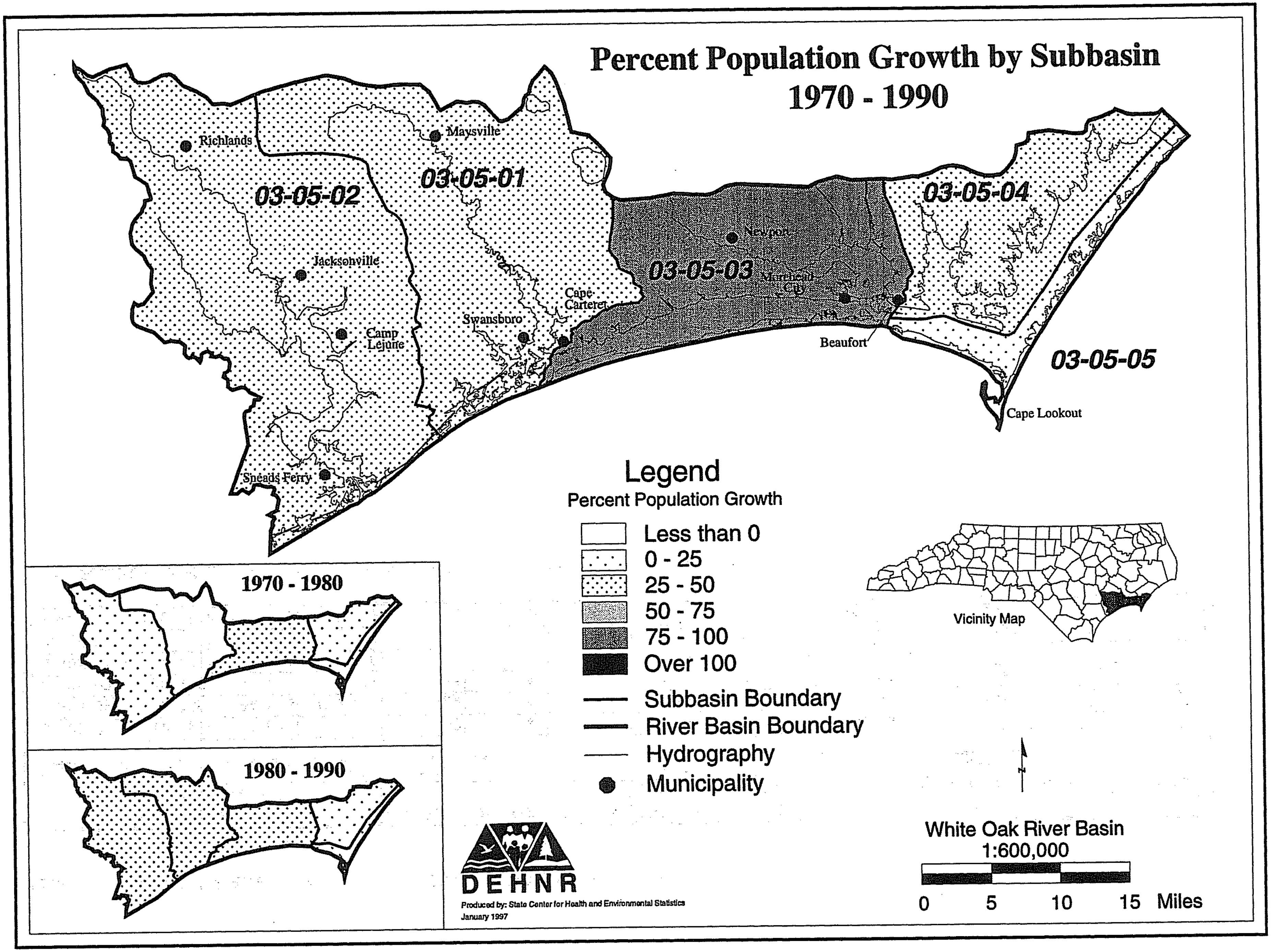


Figure 2.2 Percent Population Growth by Subbasin

Table 2.7. Cities within the White Oak River Basin with the Greatest Increase in Population between 1990 and 1994 (Office of State Planning, 1995).

City	County	% Increase	Growth (in Numbers)	Annexed Population
Jacksonville	Onslow	147.5 %	44,832	43,265
Richlands	Onslow	25.7 %	256	191
Atlantic Beach	Carteret	17.0 %	329	0
Cape Carteret	Carteret	16.4 %	166	0

Table 2.8. Projected Population Changes by Estimated Percentage of County in Subbasin (Source: NC Department of Administration)

County	Population 1990	Projected Pop. 2020	% County in subbasin	Projected % Change
Carteret	36,787	55,020	70 %	49.6 %
Jones	1,883	1,790	20 %	-4.9 %
Onslow	134,854	222,051	90 %	48.2 %
Craven	8,161	11,101	1 %	36.0 %

Figure 2.3 demonstrates population density by census block group for the White Oak basin. While the majority of the basin is rural, there are heavily populated areas centered in Jacksonville, Morehead City and Beaufort. The majority of the barrier islands are considered densely populated. Although total numbers of people may be low, land area on the islands is also low which translates into higher densities. The subbasin encompassing Jacksonville is the most dense with 305 persons/square mile. In general, the population density in the White Oak basin is low when compared to other basins such as the Cape Fear, which in some places has more than 600 people/square mile.

In using these data, it should be noted that the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, an estimate has to be made on the percentage of the population that is located in the subbasin. This is done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it the subbasin. Use of this method necessitates assuming that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups may change for each census so comparisons between years must be considered approximate.

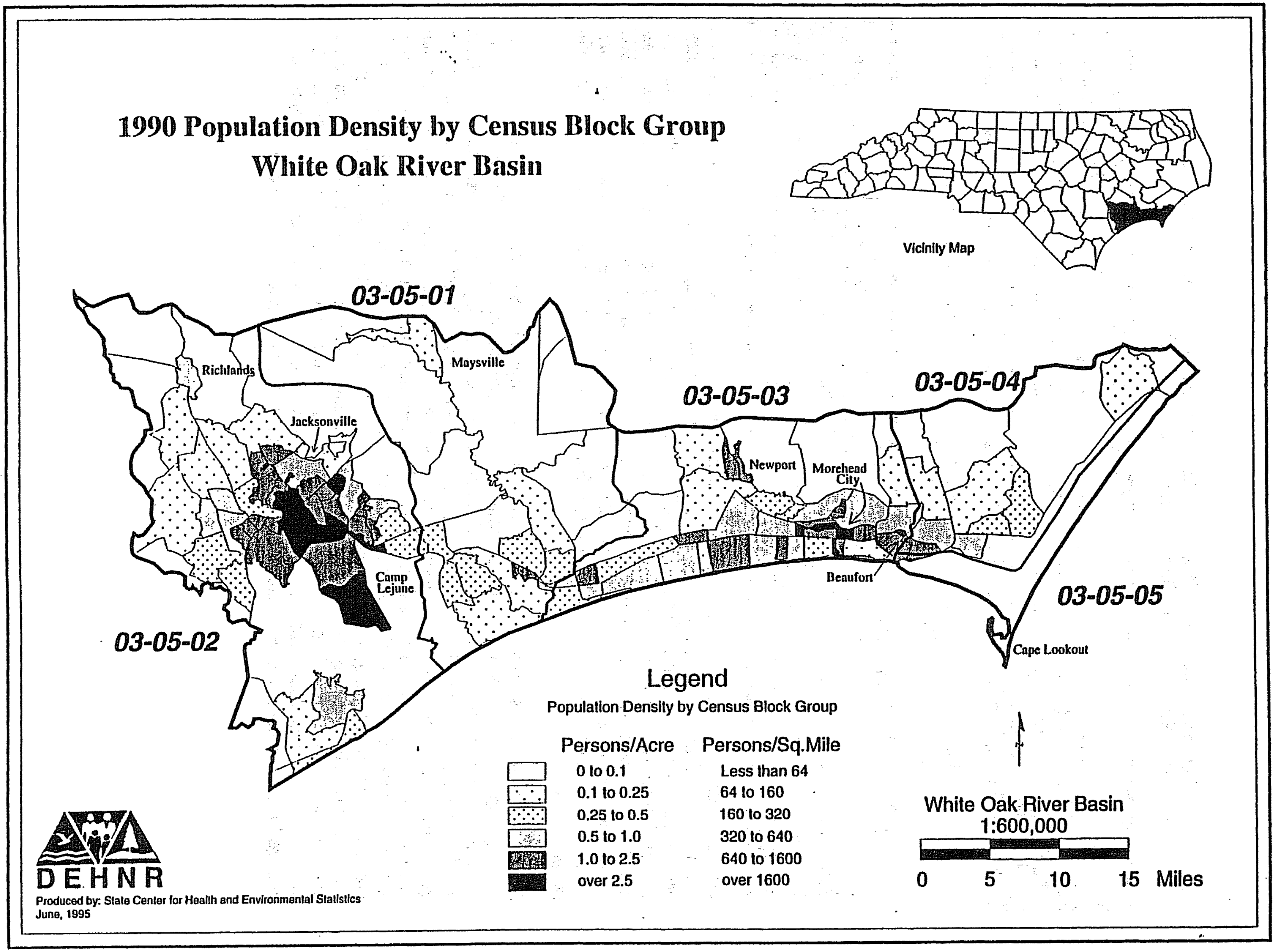


Figure 2.3. 1990 Population Density by Census Block Group for the White Oak River Basin

2.5 AGRICULTURAL ACTIVITIES IN THE WHITE OAK RIVER BASIN

Agriculture is an important industry in the White Oak River basin. Based on a 1995 report from the North Carolina Department of Agriculture, there are a total of 538 farms in Carteret and Onslow counties combined (these counties make up the vast majority of the basin). These farms comprise a total of 128,023 acres with the average farm size being 151 acres in Onslow County and 567 acres in Carteret County. In 1993, cash receipts for agricultural products in these counties totaled $80,628,000. Of this total, $33,322,000 was generated through crop production and $47,306,000 was associated with livestock production. The following section focuses more specifically on these two types of agricultural operations in the basin.

2.5.1 Livestock Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for managing and reusing animal wastes from intensive livestock operations (See section 5.3.1 for additional information on rule requirements). The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. The deadline for submittal of registrations to DWQ for existing facilities was December 31, 1993.

In the White Oak River basin, there are a total of 74 registered livestock operations. Twenty-one (21) of these are certified, meaning they have approved waste management plans (the remainder must have approved plans in place before the end of 1997). The majority of the operations are concentrated in subbasins 01and 02 (the White Oak and New River drainage areas, respectively) and all of them are swine operations. The White Oak drainage contains 11 registered operations with a total of approximately 14,600 swine and the New River drainage contains 61 operations with approximately 82,900 swine. Locations of registered animal operations in the White Oak basin are illustrated in Figure 2.4.

The increase in swine numbers from 1990 to 1994 has been dramatic in subbasins 01 an 02 (NCDA Veterinary Division, 1995). In the White Oak drainage area (subbasin 01), there was a 163% increase in the number of swine during this time period. And in the New River drainage (subbasin 02) there was a 147% increase. Although there are no registered operations in subbasin 03 (Newport River drainage), this area experienced the highest rate of growth in the number of swine between 1990 and 1994 with an increase of 230%. Since no operations in this subbasin have registered with DWQ, the total number of swine (2,432) must be made up of a number of small (<250 animals) operations. Additional information on potential water quality impacts associated with these increases is discussed in Chapter 3.

Smaller numbers of other animals are also raised in the basin (NC Department of Agriculture, 1995). In Carteret County there are some cattle, beef cows and chickens. Onslow County has a large number of turkeys (3,000,000) and some cattle, beef cows and chickens.

2.5.2 Crop Production

According to the NC Department of Agriculture (1995), there are a variety of crops grown in the White Oak River basin (based on data from Carteret and Onslow Counties). Corn and soybeans are the most prevalent crops with 31,300 acres harvested in 1994. Other crops grown include tobacco, wheat, hay, cotton and potatoes (irish and sweet).

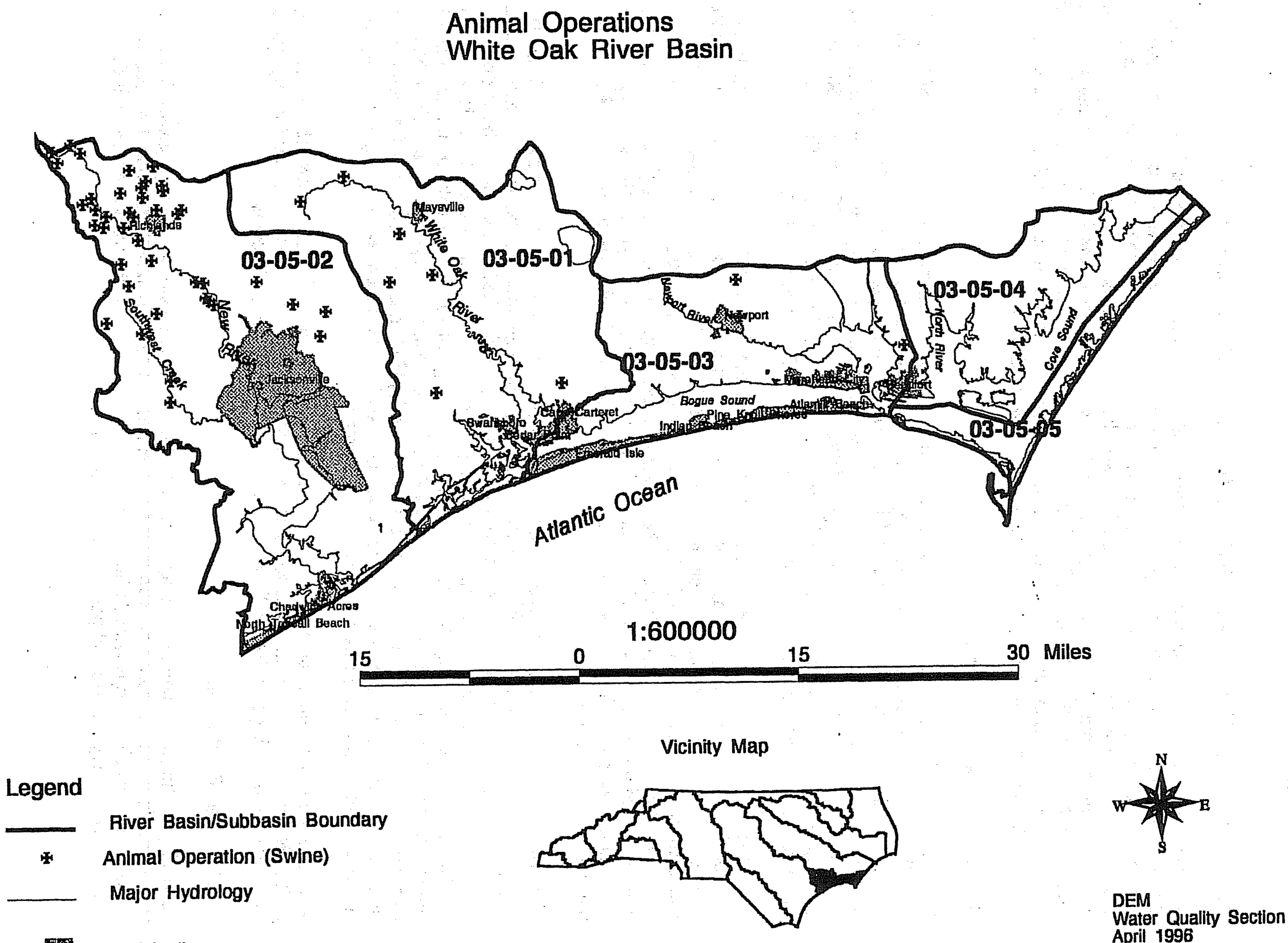


Figure 2.4. Location of Registered Livestock Operations in the White Oak River Basin

2.6 NATURAL RESOURCES IN THE WHITE OAK RIVER BASIN

2.6.1 Fish and Shellfish Resources

North Carolina's commercial and recreational fishery resources are both nationally and regionally significant. Commercial harvest of fish and shellfish in North Carolina produces an average of 180.6 million pounds of marketable resource each year (based on figures from 1987 - 1991) (Division of Marine Fisheries, 1993). The annual economic value of this resource is $1 billion and is a critical component of North Carolina's coastal economy. Management of these fisheries resources has recently become a critical issue in the state as fisheries are threatened by overfishing, habitat loss, and water quality decline.

In the White Oak River basin, a downward trend in overall commercial landings of fish and shellfish is apparent between the years of 1972 and 1994. Figure 2.5 illustrates this trend. Trends from commercial landings data, such as these, should be considered only a general indicator of productivity because the numbers are subject to a variety of influences including market demand, price, fishing effort, weather, availability of alternate species, regulations, and data collection procedures (DMF, 1993).

In the White Oak basin, the Core Sound area produces the most catch with total landings of over 10 million pounds with a value in excess of $7,700,000 (1994 data from DMF). The other areas of the White Oak River basin are much less productive, probably due to much smaller water areas. The most productive areas after Core Sound are Bogue Sound and the Newport River area with commercial landings in 1994 of 672,419 and 685,223 pounds, respectively. These areas are also showing declining trends in productivity as evidenced in Figure 2.6.

Another benchmark that is used to determine the health of North Carolina's commercial fisheries is the Juvenile Abundance Index. The Division of Marine Fisheries (DMF) samples waters in the state for abundance of juvenile fish. These data are used to designate primary nursery areas (PNAs) in the state. PNA's are those areas in estuarine waters where initial post-larval development takes place. These areas are considered important to the subsistence of the species. Figure 2.7 (a - d) shows trends over time in juvenile abundance for four of the primary commercial species (brown shrimp, croaker, spot and blue crab) in the White Oak River basin. Juvenile abundance is expressed in terms of catch per unit effort (CPUE). This means that a trawl is done in a specific area for a specific amount of time (such as one minute). From this 'effort' a given number of individuals for each species is 'caught'. These numbers (CPUE) can be compared over time. As seen in figure 2.7, generally, numbers of juveniles have been consistent over time. Except for blue crab, there are no obvious trends upward or downward. The numbers being seen for these species are consistent with numbers that would support designating an area as a PNA (Francesconi, DMF, personal communication). The graph for blue crab appears to show a decline in juvenile abundance although the reason for this is unclear. Statewide the numbers for this species are not declining (DMF - North Carolina Estuarine Trawl Survey Juvenile Abundance Indices, 1979 - 1994).

Figures 2.8 and 2.9 show the location of Primary and Secondary Nursery Areas in the White Oak River basin as designated by DMF. PNAs have been described above. Secondary Nursery Areas are those areas in estuarine waters where later juvenile development takes place. Although both areas are important to the subsistence of coastal fisheries, populations in Secondary Nursery Areas are not as vulnerable as the younger, less-developed larval population in the PNAs. As can be seen in Figures 2.8 and 2.9, many of the headwaters of tributaries to the larger rivers and estuaries serve as Primary or Secondary Nursery Areas in the White Oak River basin.

Some fish species such as river herring, shad, striped bass and sturgeon spend the majority of their life in saltwater but migrate to freshwater areas to spawn. In the White Oak River basin, the New,

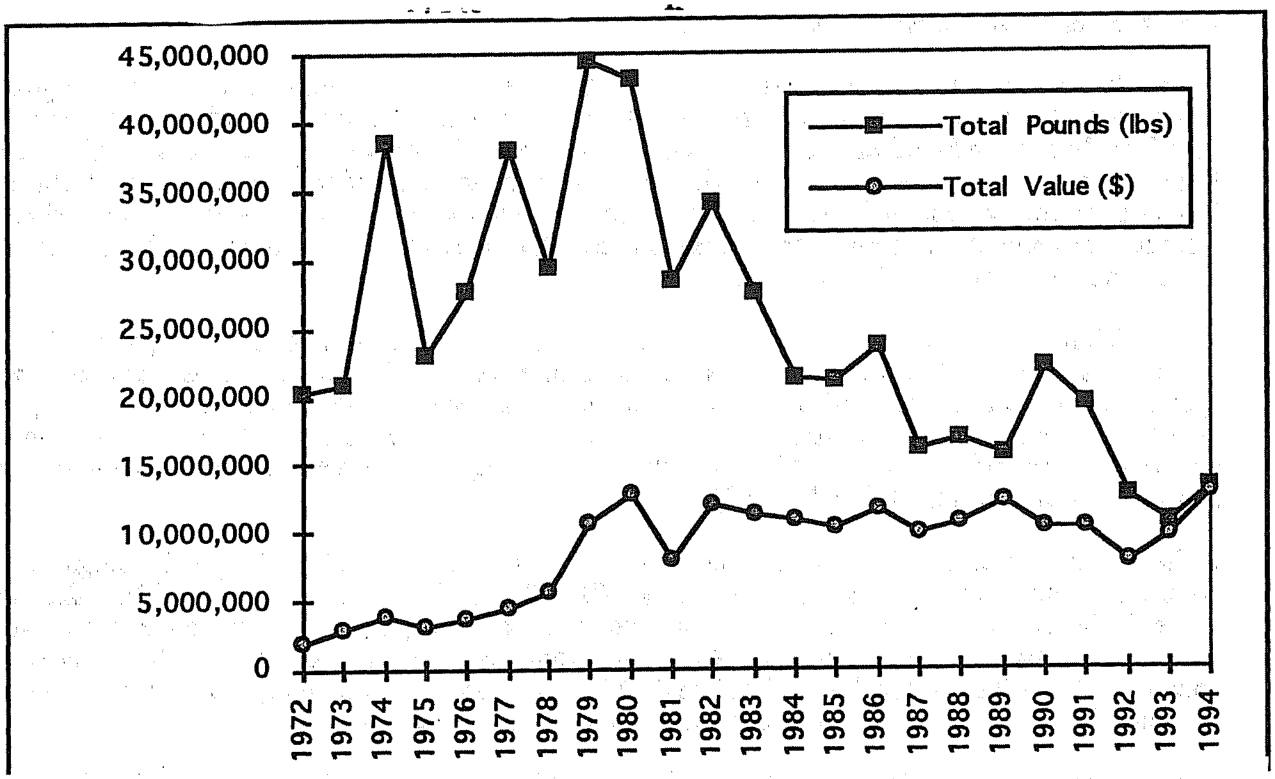


Figure 2.5. Overall Trends in Commercial Landings in the White Oak Basin by Total Pounds and Total Value - 1972 to 1994 (NC DMF data)

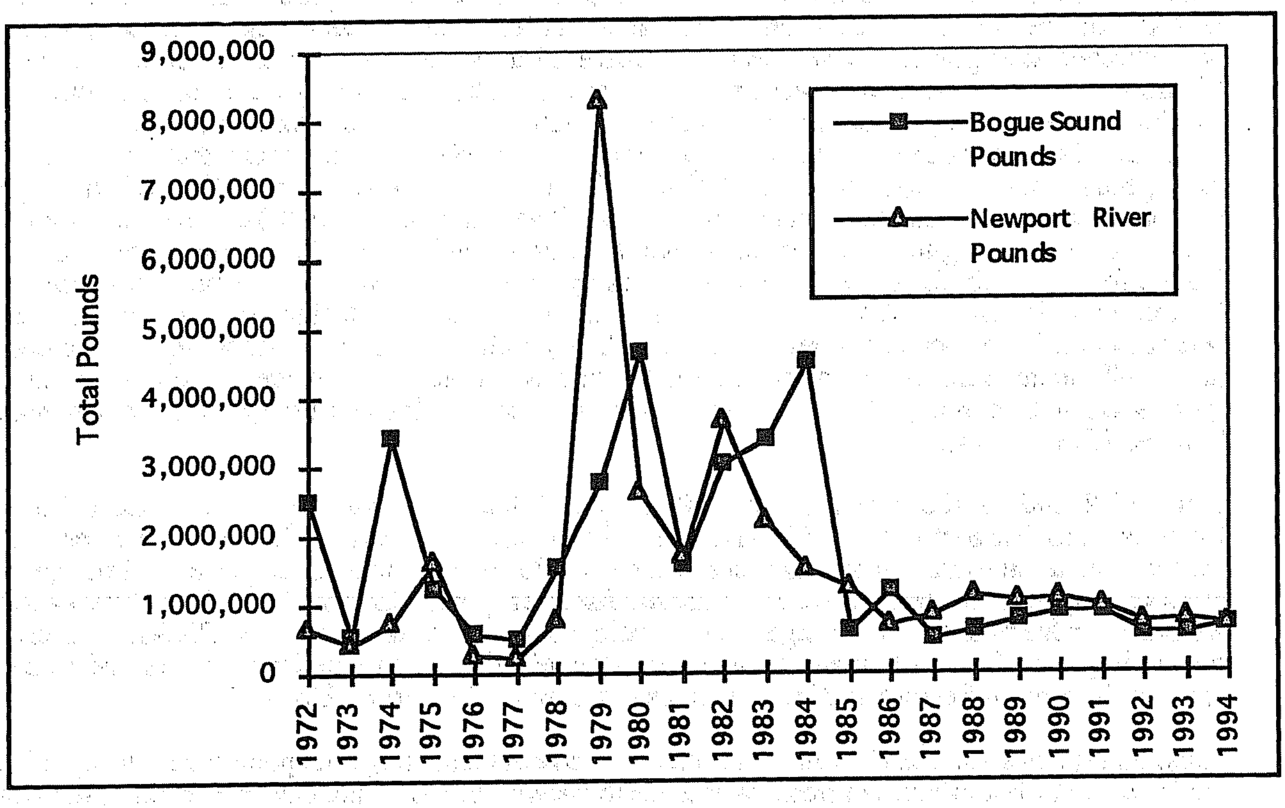


Figure 2.6. Overall Trends in Commercial Landing for Bogue Sound and Newport River - 1972 to 1994 (NC DMF data)

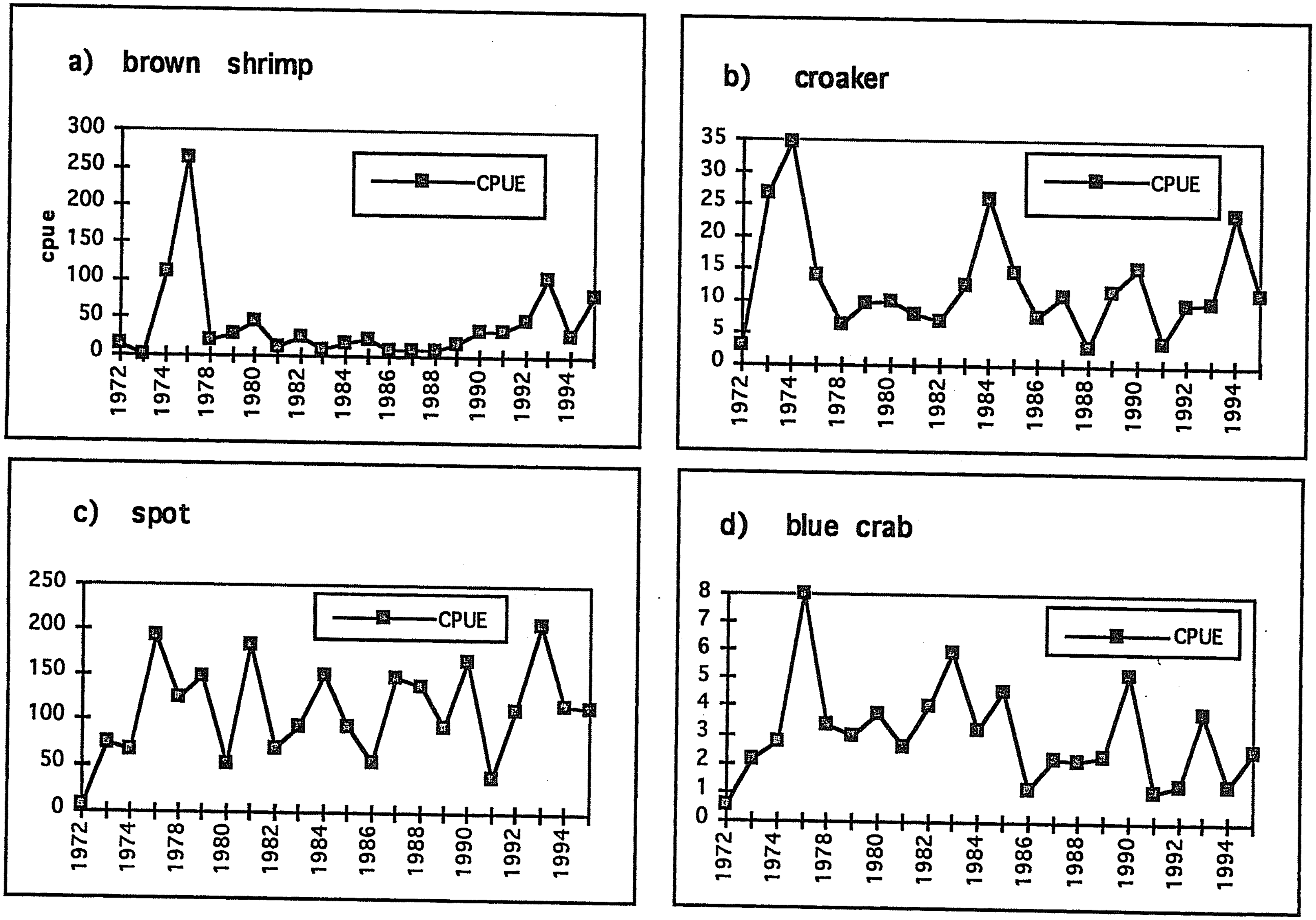


Figure 2.7 Juvenile Abundance Index (based on Catch per Unit Effort or CPUE) for: a) Brown shrimp, b) Croaker, c) Spot and d) Blue Crab in the White Oak Basin - 1972 to 1995 (NC DMF data)

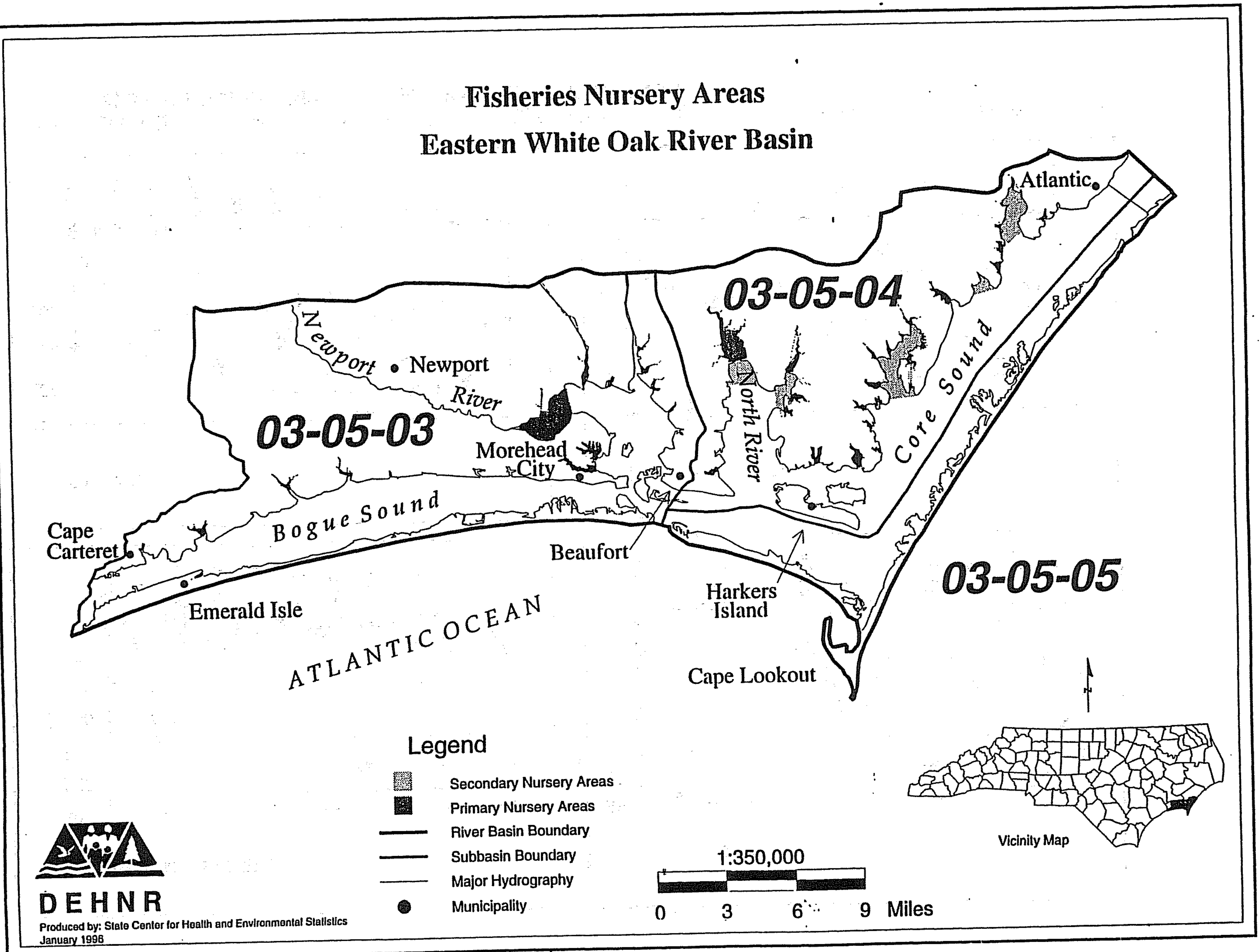


Figure 2.8. Fishery Nursery Areas in the Eastern White Oak River Basin (Bogue Sound,

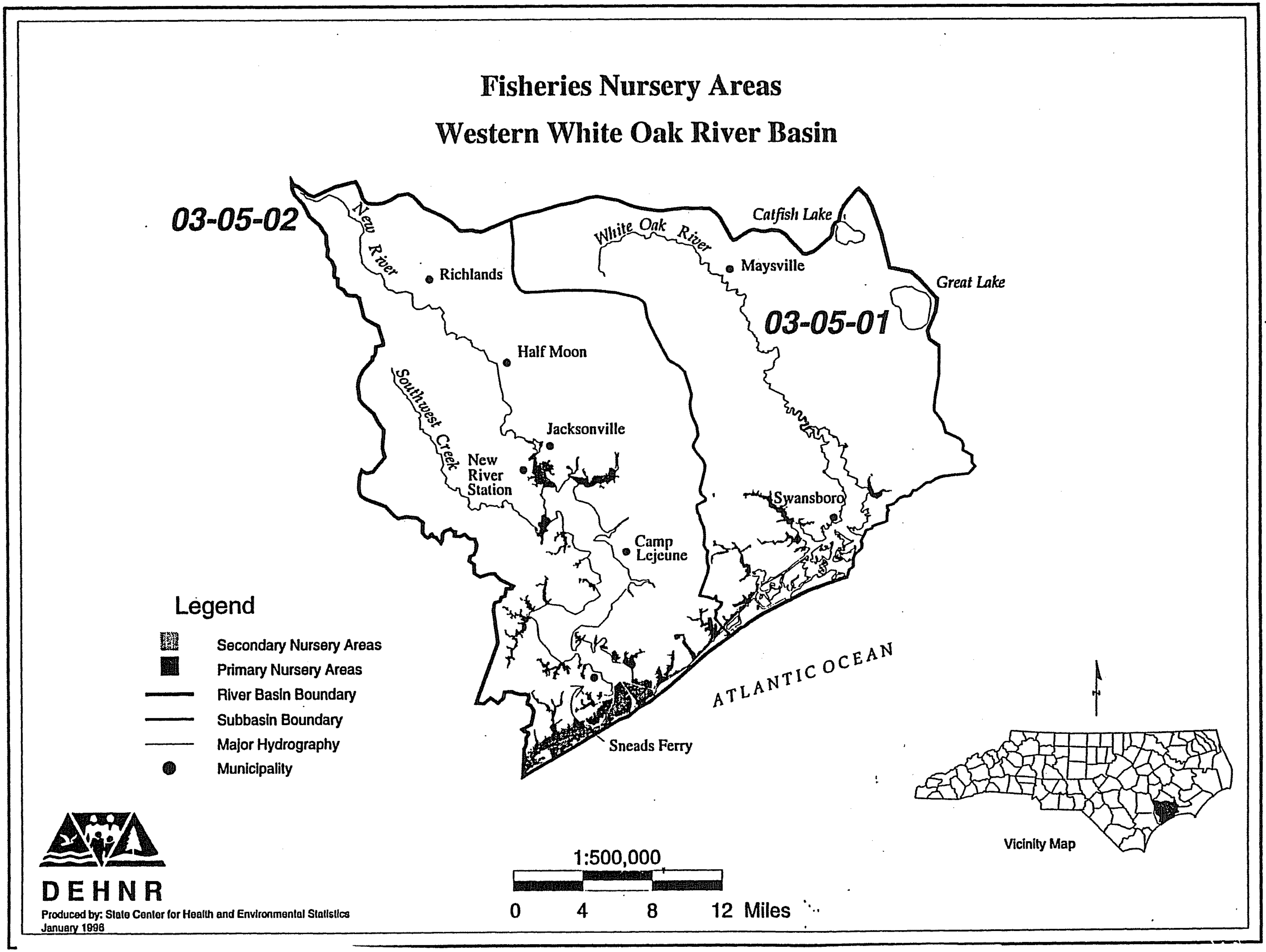


Figure 2.9. Fishery Nursery Areas in the Western White Oak River Basin (White Oak River

White Oak and Newport Rivers are channels that are used by these anadromous fish species. Figure 2.10 illustrates the locations of anadromous fish spawning areas in the White Oak River basin.

Portions of the White Oak River basin are among the most productive areas of North Carolina for hard clams and bay scallops (DMF data, 1985-1994). Between the years of 1985 and 1994, 4,124,975 and 1,076,018 pounds of hard clam meat were harvested from Core Sound and the New River, respectively. These two areas were among the top three most productive areas in the state for hard clams, with Core Sound being the most productive area for this shellfish statewide. The two most productive areas for bay scallops in North Carolina are in the White Oak River basin. Core Sound and Bogue Sound generated 800,895 and 370,685 pounds of bay scallop meat during the years of 1985 -1994. Harvest in these areas far exceeded other areas of the NC coast, with the next highest harvest being 107,405 pounds of scallop meat harvested during the same time frame from Pamlico Sound. Although it is not the most productive in the state, oyster production throughout the White Oak River basin is consistently high with a range of harvest from 76,493 pounds of oyster meat harvested from Bogue Sound and 198,576 pounds of meat harvested from the New River area, all during the years of 1985 - 1994.

North Carolina has seen a decline in its shellfish resources over the last several years, and these trends are evident in the White Oak basin. Two species in particular have received specific attention: these are oysters and bay scallops. In response to widespread public concern about the status of oyster resources in the state, the NC General Assembly established the Blue Ribbon Advisory Council on Oysters to serve in an advisory capacity to the Marine Fisheries Commission and the Joint Legislative Commission of Seafood and Aquaculture. This Advisory Council found that oyster populations in the state have been declining for almost 100 years (NC Blue Ribbon Advisory Council on Oysters, 1995). This trend has been attributed to a combination of factors including outbreaks of oyster diseases, degradation of oyster habitat, overharvesting and substantial deterioration of coastal water quality. The Advisory Council has submitted recommendations for addressing these issues. Those related to water quality are discussed in Chapter 6 of this document. In the meantime, favorable natural conditions may be giving the state's oyster population a boost. According to a recent article in the Raleigh News and Observer (March 17, 1996), good weather and a low disease rate last year have resulted in the highest oyster harvest in eight years. Based on data from the Division of Marine Fisheries, commercial landings statewide increased 24 percent between 1994 and 1995.

In late 1987 and early 1988, coastal North Carolina was affected by an outbreak of a red tide Gymnodinium breve) transplanted to our waters from Florida via an eddy from the Gulf Stream. The bloom of this toxic dinoflagellate dramatically reduced the population of bay scallops in North Carolina. This reduction is illustrated in Figure 2.11 which shows the pounds of scallops harvested between 1972 and 1994 from Bogue Sound in the White Oak River basin (based on data from the DMF). The graph also shows that scallop populations have not yet recovered from the effects of the red tide. Bogue Sound has low recruitment of scallop populations compared to other areas in the basin (Core and Back Sounds), which may contribute to the slow recovery rate of scallops in this area (Peterson and Summerson, 1992). Efforts to restore scallop populations in Bogue Sound through the transplantation of pre-spawning adult scallops have been successful. Peterson et. al. (1994) have shown that recruitment levels in western Bogue Sound following transplants in 1992 and 1993 were 654% greater than the years of 1988 and 1989 when no transplantation occurred. This recruitment rate was significantly higher than two control sites in Back and Core Sounds where the average increase in recruitment was 54%. Therefore, the results of these and any continued efforts to transplant pre-spawning adult scallops to this area should result in an accelerated restoration of bay scallop populations.

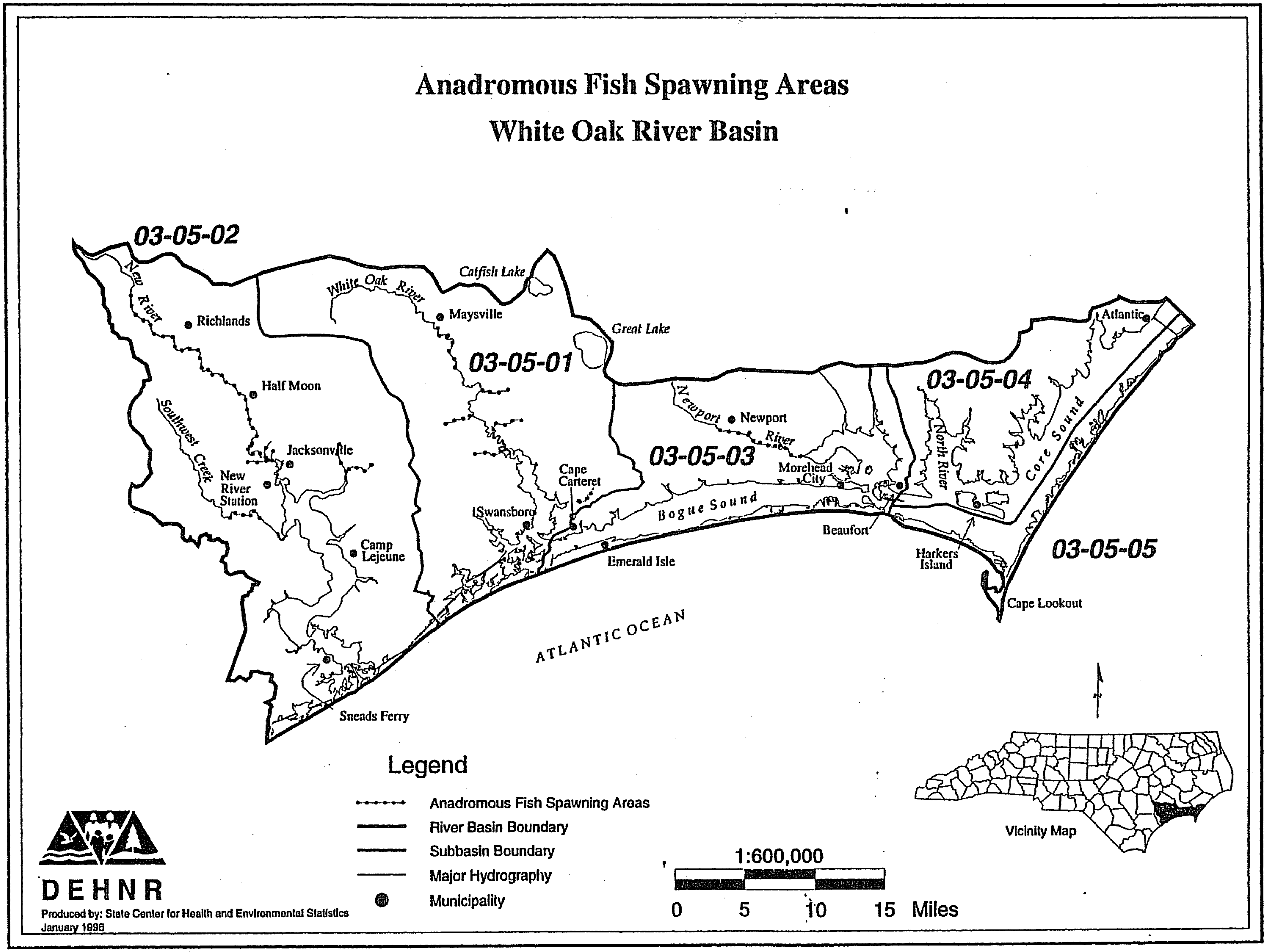


Figure 2.10 Anadromous Fish Spawning Areas in the White Oak River Basin

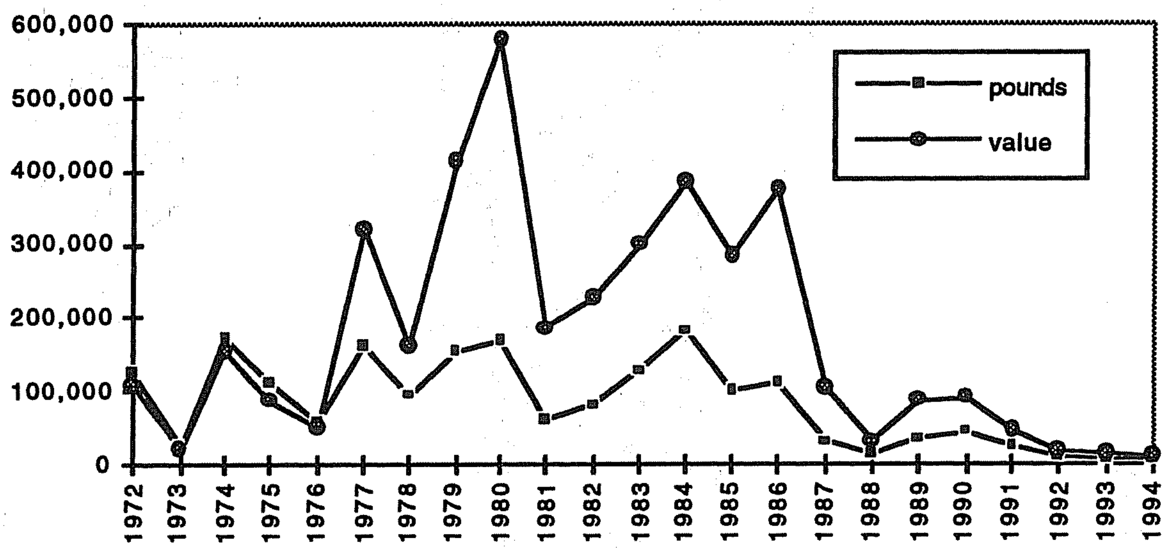


Figure 2.11 Scallop Harvest Trend (Pounds per Year) in Bogue Sound from 1972 to 1994 (NC DMF data)

2.6.2 Submerged Rooted Vascular Beds

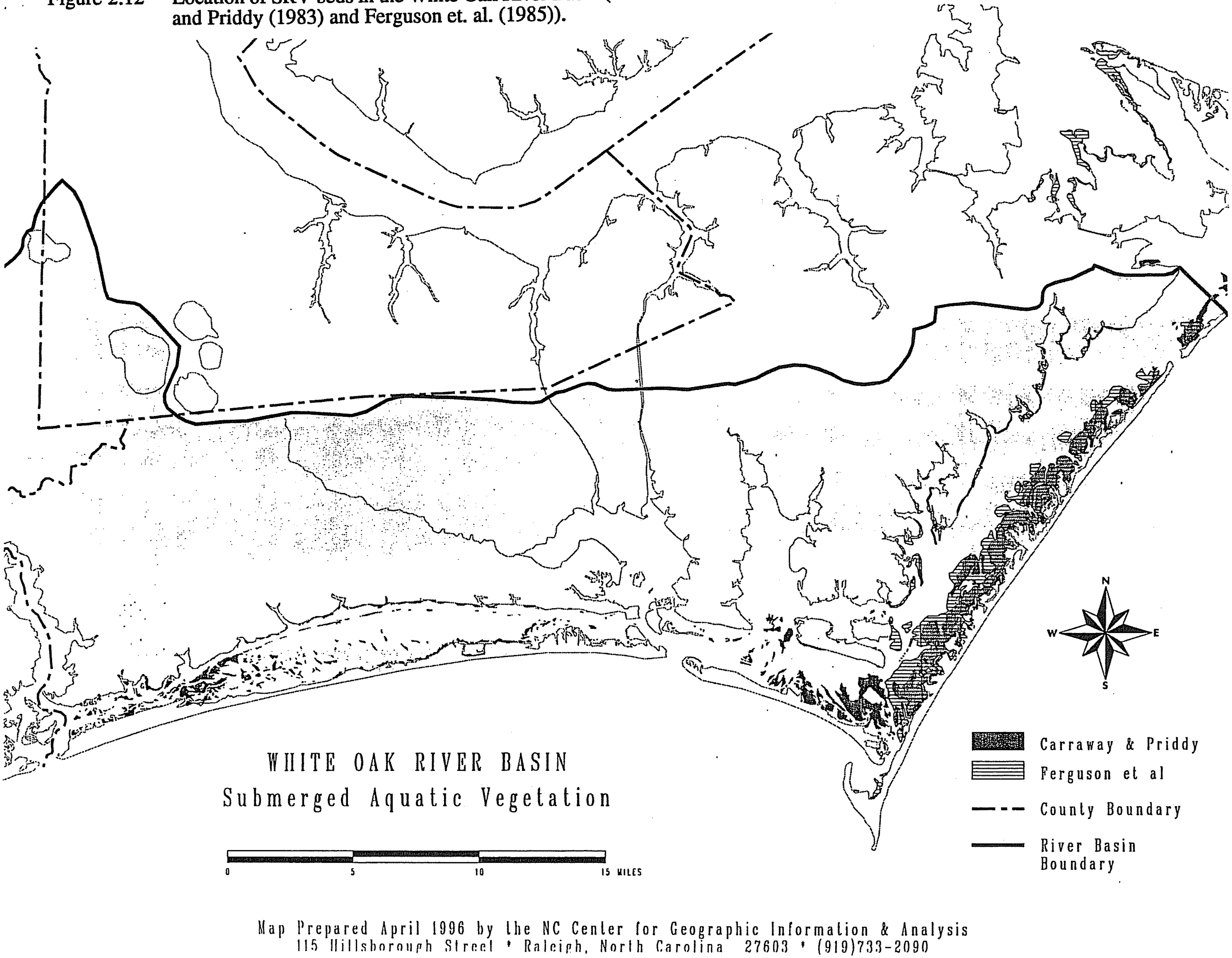
Submerged aquatic plants (also known as submerged rooted vascular beds or SRV) are critical components of estuarine ecosystems. In North Carolina, they grow in waters that have a depth of 6 feet or less and provide habitat for many commercially and recreationally important finfish and shellfish (Ferguson and Wood, 1994). Many fish species (including red drum, mullet, spotted sea trout and spot) use SRV as nursery areas. SRV beds are also home to shellfish and are the primary habitat for bay scallops.

Several species of SRV occur in North Carolina and their distribution is largely a function of salinity levels. Some species, such as eelgrass and shoal grass, tolerate higher salinity levels than others such as eurasion water milfoil, pondweed and alligator weed. Core, Back and Bogue Sounds in the White Oak River basin are characterized by high salinities and are dominated by eelgrass, shoal grass and widgeon grass (Ferguson and Wood, 1994).

A study by Ferguson et. al. (1989) concluded that there are approximately 200,000 acres of SRV beds in an area of coastal North Carolina that includes eastern and southern Pamlico Sound, Core Sound, Back Sound and Bogue Sound. Of this total number of acres, roughly 20% is located in Bogue, Back and Core Sounds which are within the White Oak River basin.

Figure 2.12 illustrates the location of SRV in the White Oak River basin. Southwest of Bogue Sound there is minimal occurrence of this vegetation so the map focuses in on those areas of the basin where SRV is found. The data for this map comes from two sources that overlap somewhat but that also complement each other. The first set of data comes from Ferguson et. al. (1989) which is based on aerial photographs taken in 1985. This was an investigation funded by an Albemarle-Pamlico Estuarine Study (APES) grant and therefore did not include Bogue Sound which is outside of that geographic region. To supplement this database, another source of data that does cover Bogue Sound has been tapped. The Carraway and Priddy (1983) database is based

Figure 2.12 Location of SRV beds in the White Oak River Basin (based on data from Carraway and Priddy (1983) and Ferguson et. al. (1985)).



on aerial photography taken in 1981. Estimates of the extent of SRV from this database are more conservative than those from Ferguson's study. This is probably attributable to a higher quality photographic product from the 1985 (Ferguson et. al.) photographs compared to the 1981 (Carraway and Priddy) photographs (Ferguson et. al., 1989). However, the Caraway and Priddy data can be used to get a general idea of the location of SRV in the area.

Because SRV beds are important habitat for many species of fish and shellfish, their protection is an important component in managing coastal waters for ecological health. Water quality degradation can contribute to losses of these beds and, therefore, maintenance of high water quality is important to their preservation. Ferguson and Wood (1994) have stated that "change in SRV may be a sensitive indicator of change in water quality and potential for precipitous change in fisheries productivity". Other threats to SRV health include boat traffic, dredging and large, mechanized shellfish harvesting efforts.

2.6.3 Wetlands

Wetlands are abundant in the White Oak River basin with wet flats and pocosins covering extensive areas in interstream divides. Headwater forests grade into extensive swamp forests and bottomland forests along most rivers (DEM, 1994). Salt marshes and brackish marshes are also abundant in the basin along the tidal estuaries and streams.

Although a complete inventory of wetlands in the White Oak River basin is not yet available, the Division of Coastal Management has completed the mapping of wetland resources in the Carteret County and nearby portion of the basin. The distribution of wetland types in this portion of the basin is summarized in acres by type in Table 2.9 (on next page). Large portions of the basin are publicly owned and include natural areas of national, state, and regional significance (DPR, 1995). Croatan National Forest, which is located in the northwest corner of Carteret County, contains extensive pocosins. Hoffman Forest, located in Onslow County, contains pocosins and cypress natural areas. Camp Lejeune, also located in Onslow County, contains numerous large expanses of wetlands including pocosins, wet flats, and swamp forests.

Wetlands can be very important in watershed planning because they perform a variety of services beneficial to society. Because of characteristics unique to wetlands, these systems are able to process sediments, nutrients, and other pollutants, provide wildlife habitat, store organic matter and provide other means to protect habitat as well as downstream and on-site water quality. Each of the actions that a wetland performs, regardless of human recognition of that action, is called a function. When these actions are declared important to society as a whole, they are called values. The following discussion primarily concerns wetland values. Some wetland values are ubiquitous to most wetland types, such as wildlife habitat. However, wetland values are ultimately tied to specific wetlands because they depend on site specific factors such as landscape position, size, soil type, and land use. Table 2.10 lists those wetland types that are most common in the White Oak basin and a brief description of their typical values.

Table 2.9 Summary of Wetland Types and Acreage in Carteret County and Vicinity of the White Oak River Basin (Source: NC DCM).

WETLAND TYPE	ACREAGE	PERCENTAGE
salt/brackish marsh	24,843	14
freshwater marsh	1,580	1
estuarine shrub-scrub	4,038	2
estuarine forest	51	<1
maritime forest	193	<1
pocosin	48,578	28
bottomland hardwood/swamp forest	10,285	6
hardwood flat	3,753	2
pine flat	27,952	16
managed pineland	31,051	18
headwater swamp	5,612	3
human impacted wetland	266	<1
drained salt/brackish marsh	4,984	3
drained freshwater marsh	1,199	1
drained estuarine shrub-scrub	323	<1
drained pocosin	3,780	2
drained bottomland hardwood/swamp forest	280	<1
drained hardwood flat	251	<1
drained pine flat	2,523	1
drained headwater swamp	136	<1
Total Drained	**13,476**	**8**
cleared salt/brackish marsh	1,186	1
cleared freshwater marsh	266	<1
cleared estuarine shrub-scrub	627	<1
cleared estuarine forest	1	<1
cleared maritime forest	2	<1
cleared pocosin	139	<1
cleared bottomland hardwood/swamp forest	488	<1
cleared hardwood flat	261	<1
cleared pine flat	1,160	1
cleared headwater swamp	209	<1
Total Cleared	**4,339**	**2**
TOTAL ACRES	**176,017**	100

Table 2.10 Wetland types common in the White Oak Basin.

Wetland Type	Values
Headwater Forests	overland pollutant removal, wildlife habitat, timber production
Bottomland Hardwood Forests	water storage, shoreline stabilization, pollutant removal, wildlife habitat, aquatic habitat, outdoor recreation/ education, timber production, hunting leases
Swamp Forests	water storage, overland and overbank pollutant removal, wildlife habitat, aquatic habitat, outdoor recreation/ education, timber production, hunting leases
Wet Flats	special ecological attributes, wildlife habitat, outdoor recreation/education, timber production, hunting leases
Pocosins	wildlife habitat, hunting leases, water storage
Brackish Marshes	water storage, wildlife habitat, aquatic habitat, outdoor recreation/ education, hunting leases
Saltwater Marshes	water storage, shoreline stabilization, wildlife habitat, aquatic habitat, outdoor recreation/ education, estuarine nutrient cycling

Bottomland hardwood and headwater wetlands perform valuable water quality functions including flood water storage, nutrient and sediment retention and nutrient transformation. However, their effectiveness is diminished if the stream waters can no longer inundate adjacent floodplains or if nutrient loads exceed the assimilative capacity of the wetland. As these wetlands are lost upstream, the potential for erosion, flooding, sedimentation, algal blooms, and fish kills increase downstream. Those wetlands adjacent to intermittent streams are especially important in filtering nonpoint pollution from agricultural and urban runoff.

Wet flats and pocosins in the coastal plain also may have a considerable influence on the water quality of the region. In general, on a per-acre basis, wet flats and pocosins do not store as much water or retain as many pollutants as wetlands directly associated with streams, such as bottomland hardwood forests. However, wet flats and pocosins occupy extensive areas of interstream divides, and, based on sheer magnitude of coverage in the coastal plain, the cumulative effects of these wetlands may be vital to water quality of coastal plain streams. Consequently, the conversion of these wetlands may significantly affect the hydrology or water quality of the region. In 1995, wet flats and pocosins recEived the greatest impacts from permitted wetland fill activities in the White Oak basin (Table 2.11). The Division of Water Quality is currently assessing the cumulative impacts on water quality of incremental fill of wet flats and pocosins.

Table 2.11 Fill activities in the White Oak Basin by wetland type (1995).

Wetland Type	Acres Wetland Fill Permitted
Bottomland Hardwood Forest	3.97
Salt Marsh	0.08
Wet Flat	112.87
Pocosin	37.49
Other	2.36

The Division of Coastal Management with the cooperation of various federal and state agencies and Carteret County officials has developed a functional assessment procedure to determine the relative significance of wetlands on the landscape. This system is based on remotely sensed data (aerial photographs and satellite imagery) and automated on a geographic information system. This method considers both landscape and site-specific factors which are important to each hydrologic unit's water quality, hydrology and habitat to identify wetlands which are highly significant on the landscape. Those that are highly significant provide important and cost-effective values and should not be disturbed if possible. An example of the results of this procedure is shown in Figure 2.13. This is a black and white photocopy of a color map. Coastal counties developing land use plans pursuant to the Coastal Area Management Act are provided with color copies of such maps for their individual county. Color versions of this map for counties in the White Oak River basin can be viewed by contacting the Division of Coastal Management.

2.6.4 Threatened and Endangered Aquatic Faunal Species

In the White Oak River basin, there are twelve species that are listed by North Carolina as either Threatened, Endangered, Special Concern, or Significantly Rare. Threatened species are considered likely to become endangered within the foreseeable future. Endangered species are those species that are in danger of becoming extinct. Species of Special Concern have limited numbers and vulnerable populations and are in need of monitoring. Significantly Rare species are those whose numbers are small and whose populations need monitoring. The federal status of 'Candidate 2' are those species that may be appropriate for listing as endangered or threatened, but which lack conclusive data on the status of the species. The American Alligator has received the classification of 'Threatened Due to Similarity of Appearance' due to the similarity between the alligator and the endangered crocodile. Table 2.12 lists the species in the White Oak River basin that have received a State or Federal listing because of limited or vulnerable populations.

Table 2.12 Threatened and Endangered Species in the White Oak River Basin (Source: NC Natural Heritage Program)

Common Name	Scientific Name	Subbasins where found	Listing Status: State	Federal
American Alligator	(Alligator mississippiensis)	01-02-03-04-05	T	T(S/A)
Loggerhead Turtle	(Caretta caretta)	01-02-03-04-05	T	T
Green Turtle	(Chelonia mydas)	01-02-03-04-05	T	T
Leatherback Turtle	(Dermochelys coriacea)	01-02-03-04-05	E	E
Spinycheek Sleeper	(Eleotris pisonis)	03-05	SR	
Lyre Goby	(Evorthodus lyricus)	03-04	SR	
Atlantic Ridley	(Lepidochelys kempii)	03-05	E	E
Carolina Diamondback Terrapin	(Malaclemys terrapin centrata)	01-02-03-04-05	SC	
Carolina Salt Marsh Snake	(Nerodia sipedon williamengelsi)	04	SC	
Manatee	(Trichecus manatus)	03-04-05	E	E
Croatan Crayfish	(Procambarus plumimanus)	01-02-03	SR	C2
Freckled Blenny	(Hypsoblennius ionthas)	02	SR	

Abbreviations: E = Endangered, T = Threatened, SR = Significantly Rare, SC = Species of Concern, C2 = Candidate 2, T(S/A) = Threatened Due to Similarity of Appearance.

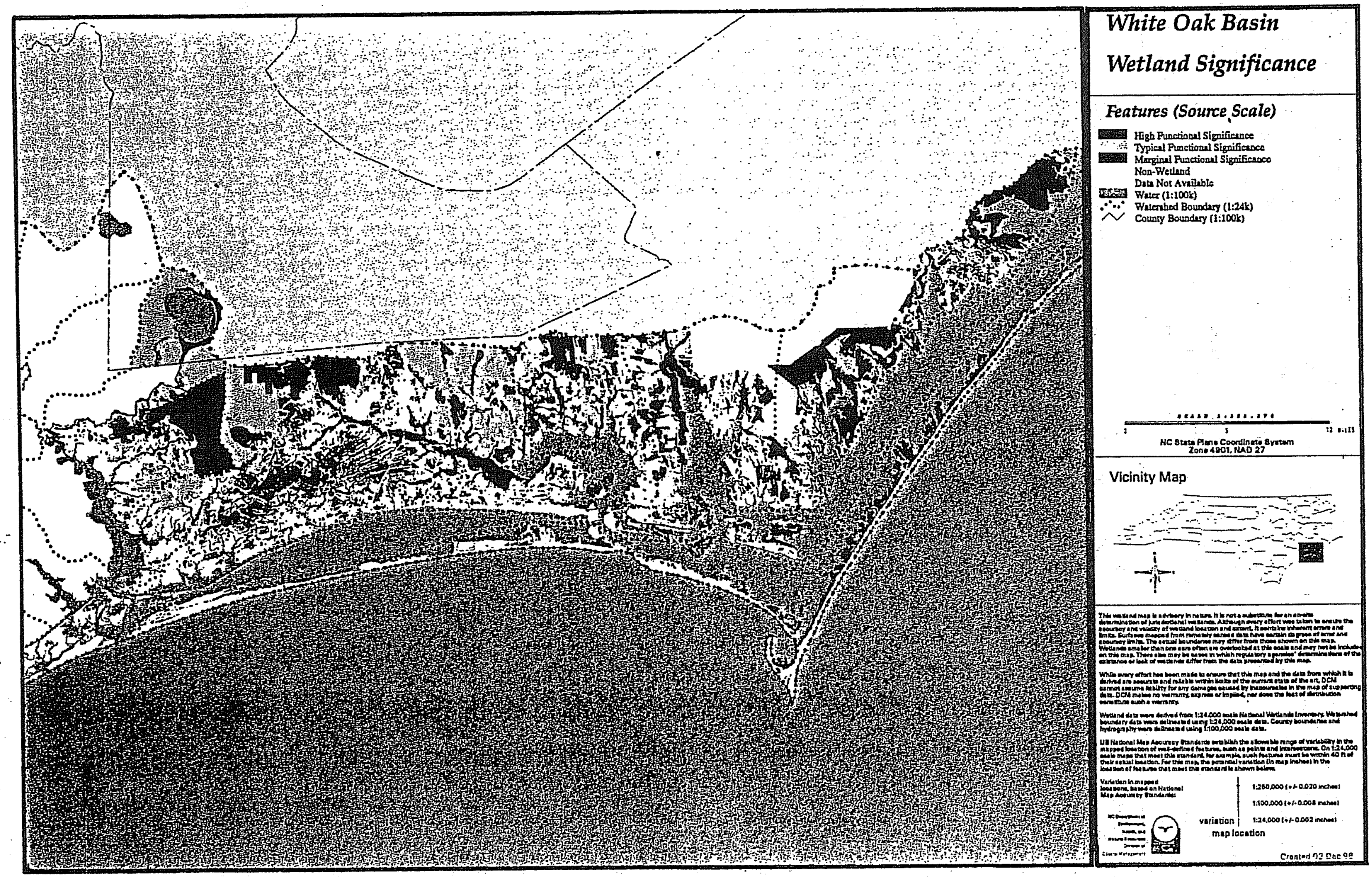


Figure 2.13. Copy of color map of Functional Significance Ratings of wetlands in the White Oak River Basin - Produced by the Division of Coastal Management (Note: The purpose of presenting this map is to provide the reader with a general idea of DCM's spacial database for wetlands.)

As indicated in Table 2.12, manatees are considered endangered at both the state and federal level. Between, 1919 and 1994, there have been numerous manatee sightings along the North Carolina coast (Shwartz, 1995). Several of these occurred within the White Oak River basin at areas near Cape Lookout, Fort Macon, Back Sound and Core Sound. Pelletier Creek was the location of six sightings making it one of the areas of North Carolina's coast most frequented by manatees.

2.7 SURFACE WATER CLASSIFICATIONS AND STANDARDS

2.7.1 Program Overview

North Carolina has established a water quality classification and standards program pursuant to G.S. 143-214.1. Classifications and standards are developed pursuant to 15A NCAC 2B.0100 - Procedures for Assignment of Water Quality Standards. Waters were classified for their "best usage" in North Carolina beginning in the early 1950's, with classification and water quality standards for all the state's river basins adopted by 1963. The effort to accomplish this included identification of water bodies (which included all named water bodies on USGS 7.5 minute topographic maps), studies of river basins to document sources of pollution and appropriate best uses, and formal adoption of standards/classifications following public hearings.

The Water Quality Standards program in North Carolina has evolved over time and has been modified to be 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 and the protection of unique and special pristine waters with outstanding resource values. Classifications and standards have been broadly interpreted to provide protection of uses from both point and nonpoint source pollution.

2.7.2 Statewide Classifications and Water Quality Standards

All surface waters in the state are assigned a primary water classification, and they may also be assigned one or more supplemental classifications (Table 2.13).

Table 2.13. Primary and Supplemental Classifications Applicable to the White Oak River Basin

PRIMARY CLASSIFICATIONS

Class	Best Uses
C/SC	Aquatic life propagation/protection and secondary recreation
SB	Primary recreation and class C/SC uses
SA	Commercial shellfishing and all other tidal saltwater uses

SUPPLEMENTAL CLASSIFICATIONS

Class	Best Uses
Sw	Swamp Waters: recognizes waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen
HQW	High Quality Waters: Waters which are rated as excellent based on biological and physical/chemical characteristics or waters which have received some other special designation from another agency (such as wild trout waters or primary nursery areas (PNAs)). HQWs in the White Oak River basin have been so classified because they have been designated as PNAs by the Division of Marine Fisheries. Waters classified as SA are considered to be HQW by definition.
ORW	Outstanding Resource Waters: Unique and special waters that are of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses. These waters have been identified as having excellent water quality in conjunction with at least one important resource value.
NSW	Nutrient Sensitive Waters: Waters that are subject to growths of microscopic or macroscopic vegetation that require the control of nutrient inputs.

As noted above, classifications are assigned to protect uses of the waters such as swimming, aquatic life propagation or water supplies. For each classification, there is a set of water quality standards that must be met in order to protect the uses. Appendix I provides a more detailed summary of the state's primary and supplemental classifications including, for each classification, the best usage, water quality standards, stormwater controls and other protection requirements as appropriate. This information is derived from 15A NCAC 2B .0200 - Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina.

2.7.3 Surface Water Classifications in the White Oak River Basin

The waters of the White Oak River basin have a variety of surface water quality classifications applied to them. The majority of the waters are saltwater and have primary classifications of either SA or SC. The basin contains both HQWs and ORWs but there are no water supply watersheds. The upper portion of the New River drainage area of the White Oak basin has been supplementally classified as NSW. The coverage of waters classified as HQW, ORW and NSW is illustrated in Figure 2.14 and waters classified for shellfishing (SA waters) are illustrated in Figure 2.15. Table 2.14 below numerically summarizes the extent of the assigned classifications. This table focuses on the saltwaters contained in the basin. There are some freshwaters in the headwaters of the major drainage areas, but the overwhelming majority of the waters are saltwaters.

Table 2.14 Acres of saltwaters by primary and supplemental classifications in the White Oak River Basin*

	Primary Classifications			Supplemental Classifications		
Classification	SA	SB	SC	HQW	ORW	NSW
Acres	118,937	461	11,584	1,435	63,329	10,882
% of Total Water Area	91%	<1%	9%	1%	48%	8%

*Note: Only the primary classification categories are mutually exclusive of each other. Primary and supplemental classification are often combined for individual waters (for example, Core Sound is classified SA ORW; so the acreage for Core Sound is included in the figures for SA and for ORW).

A complete listing of classifications for all surface waters in the basin can be found in a DWQ publication entitled "Classifications and Water Quality Standards Assigned to the Waters of the White Oak River Basin". This has been reprinted in Appendix 1. Pending reclassifications are discussed in Chapter 6.

2.8 WATER USE IN THE WHITE OAK RIVER BASIN

The Division of Water Resources (DWR) is compiling a State Water Supply Plan (SWSP) Database that incorporates information from Local Water Supply Plans pursuant to GS 143-355 (l) and (m), the legislation that started this program. There are fifteen water systems in the White Oak River basin that are subject to GS 143-355 (l). Systems subject to this law are units of local government that operate or plan to operate a local water supply system. They were required to submit a water supply plan by 1/1/95. The purpose of these plans is to examine the quantity of current and projected uses of water to help local governments assess their water systems and plan efficient and economical water supply improvements to meet future needs. Nine of the 15 systems in the White Oak basin have submitted approved plans that have been entered into the SWSP database. The following summary of current and future water use is based on information submitted by these nine water systems which include: Atlantic Beach, Beaufort, Harkers Island, Jacksonville, Maysville, Morehead City, Newport, North River Community and Richlands.

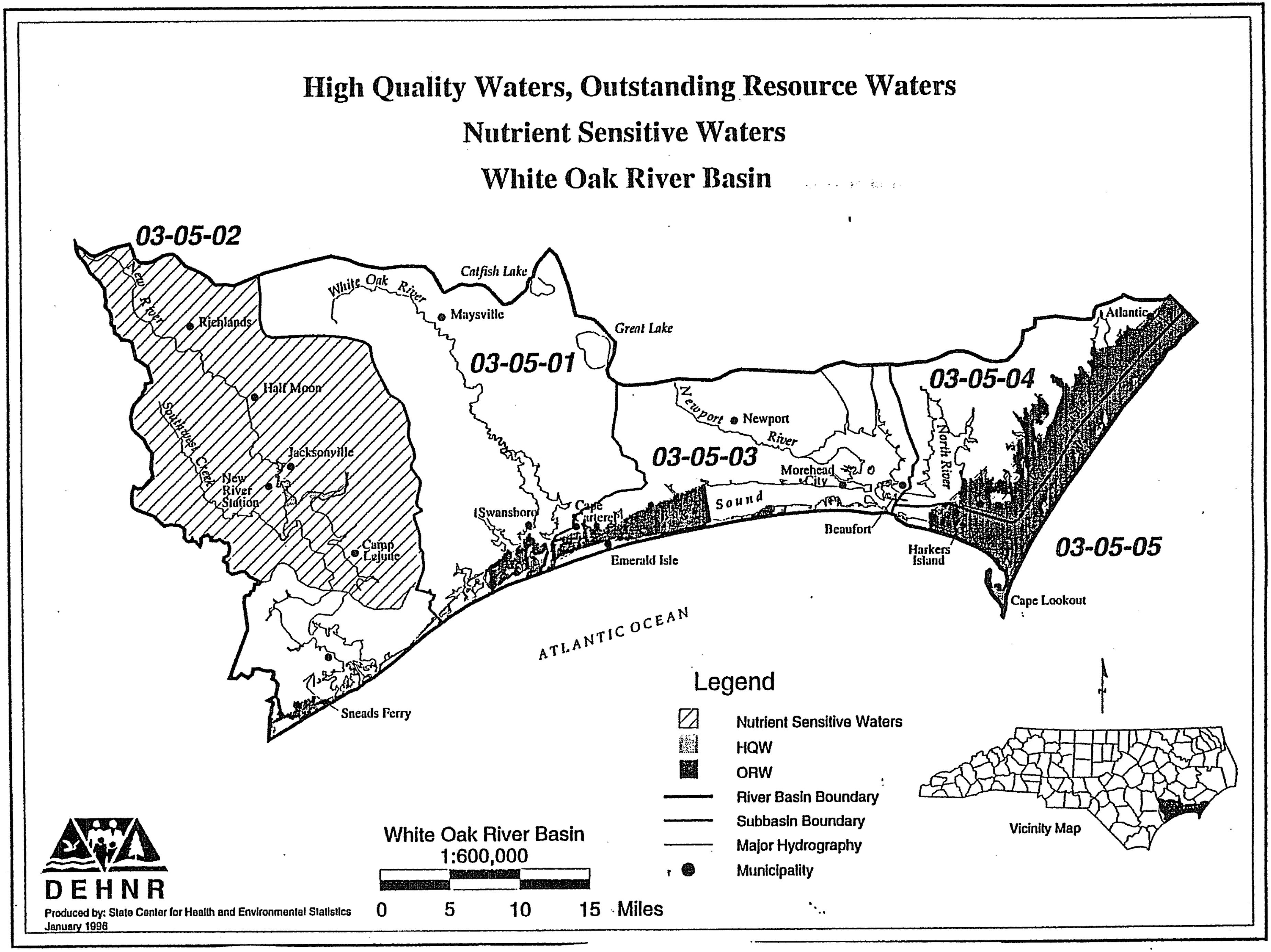


Figure 2.14. High Quality Waters, Outstanding Resource Waters and Nutrient Sensitive Waters in the White Oak River Basin

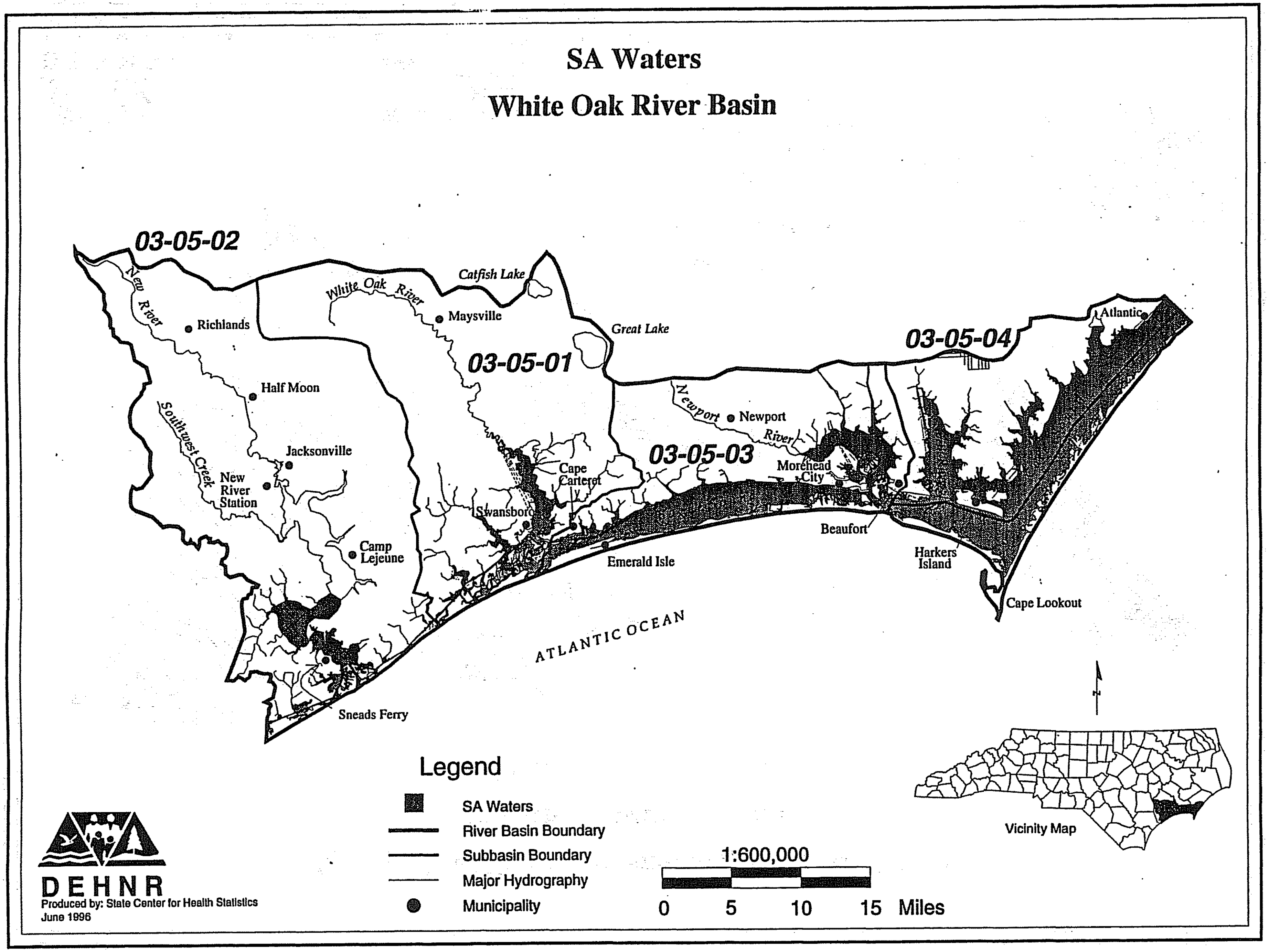


Figure 2.15 Class SA waters in the White Oak River Basin

Present Water Use

The current (1992) water use profile for these systems indicates an average daily use of 6.3 MGD and a maximum daily use of 10.0 MGD. It is important to note that these systems reported that their water supply came from ground water sources (wells). Although these systems did not report any surface water withdrawals, they did report waste water discharges that would contribute to surface flow. That average daily discharge for these systems was 6.9 MGD with a high monthly discharge of 9.2 MGD occurring in August and a low monthly discharge of 5.7 occurring in November. Table 2.15 presents water use profiles for each of the nine water systems that have submitted information to DWR.

Table 2.15 1992 Water Use Profiles for Water Systems in the White Oak River Basin. (Source: SWSP Database; DWR)

System Name	Average Use (MGD)	Maximum Use (MGD)	Residential Use (MGD)	Non-Residential Use (MGD)
Atlantic Beach	0.565	1.815	0.511	0.013
Beaufort	0.486	0.834	0.283	0.125
Harkers Island	0.137	0.205	0.102	0.028
Jacksonville	3.570	4.487	3.100	0.000
Maysville	0.102	0.126	0.059	0.033
Morehead City	0.977	1.673	0.268	0.623
Newport	0.282	0.501	0.160	0.075
North River Community	0.016	0.018	0.016	0.000
Richlands	0.168	0.348	0.122	0.046

MGD = Million Gallons Per Day

Projected Water Use

Current (1992) versus future water use in the White Oak River basin is presented in Figure 2.16. A 67 percent increase in water use is forecasted for the year 2020. The forecasted use exceeds the current supply of groundwater. Accordingly, additional water supplies are expected to be needed to augment the current supply (either through new groundwater wells or surface intakes).

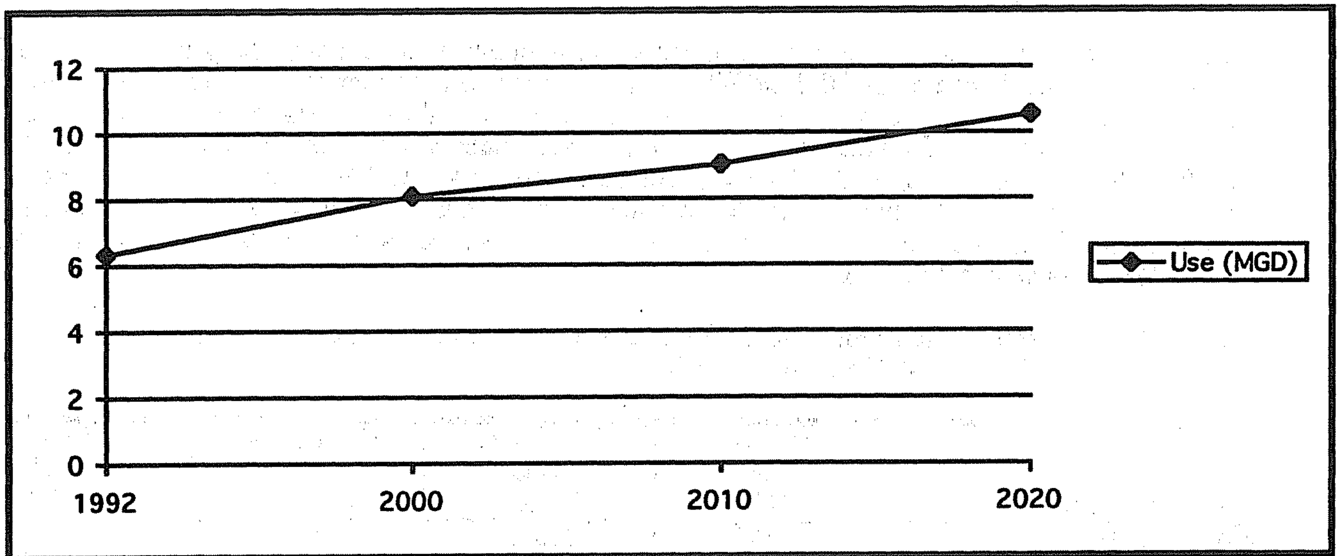


Figure 2.16. Overall Projected Water Use for Nine Systems in the White Oak River Basin. (Source: SWSP Database; DWR)

Of the individual systems that have reported to DWR, Jacksonville and Atlantic Beach are projecting a water supply deficit in the year 2020 based on their current water supply sources. Since water supply systems in this area generally get their water from the ground, consideration will have to be given to impacts to groundwater resources when these municipal systems seek to augment their water supplies.

Jacksonville is currently getting its water from the Black Creek Aquifer. This deep Cretaceous-period aquifer has experienced a dramatic and continuous drawdown since the mid-1900's as groundwater use has increased dramatically (DWR, personal communication). Potential impacts from further drawdowns that will need be considered as communities such as Jacksonville need to augment their water supplies include: the increasing potential for saltwater intrusion as groundwater levels fall; the increasing cost of pumping groundwater from greater depths; and the increasing cost of maintaining the water supply systems as the quality of the groundwater changes from exposure to air.

Atlantic Beach gets its water from the Castle Hayne Aquifer. This aquifer is more shallow than the Black Creek Aquifer and recharges more quickly. As groundwater use from this aquifer has risen, some drawdown has been experienced. However, this decline in groundwater level has leveled off and there does not appear to be a significant downward trend such as that being seen in the deeper aquifers of the region.

<u>Water Withdrawal and Transfer Registration and Transfer Database</u>

DWR's Water Withdrawal and Transfer Registration Database for 1991 contains one surface water withdrawal from Taylors Creek in the Beaufort area. This is an industrial use withdrawal of 2.88 MGD. The 1993 Water Withdrawal and Transfer Registrations (pursuant to G.S. 143- 215.22H) include three ground water withdrawals in the New River basin (2-6). These public water supply withdrawals have a combined average daily withdrawal of 5.9 MGD. No other significant withdrawals have been registered in the study area.

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CHAPTER 3

CAUSES AND SOURCES OF WATER POLLUTION IN THE WHITE OAK RIVER BASIN

3.1 INTRODUCTION

Water pollution is caused by a number of substances including sediment, nutrients, bacteria, oxygen-demanding wastes and toxic substances such as heavy metals, chlorine and pesticides. *Sources* of these pollution-causing substances are divided into two broad categories called *point* sources and *nonpoint* sources. Point sources are typically piped discharges from wastewater treatment plants and large urban and industrial stormwater systems. Nonpoint sources can include stormwater runoff from small urban areas (population less than 100,000), forestry, mining, agricultural lands and others. **Section 3.2** identifies and describes the major causes of pollution in the White Oak basin. **Section 3.3** describes point and nonpoint source pollution in the basin.

3.2 CAUSES OF POLLUTION

The term *causes* of pollution refers to the substances which may cause water quality degradation. The major causes of pollution in the White Oak are discussed below. They include biochemical oxygen demand (BOD), fecal coliform bacteria, sediment, nutrients, and toxicants (such as heavy metals, chlorine, pH and ammonia). Each of the following descriptions indicates whether the cause is derived primarily from point sources, nonpoint sources, or both.

3.2.1 Oxygen-Consuming Wastes

Maintaining a sufficient level of dissolved oxygen in the water is critical to most forms of aquatic life. Oxygen-consuming wastes are substances such as decomposing organic matter or chemicals which reduce dissolved oxygen in the water column through chemical reactions or biological activity. Raw domestic wastewater and some industrial wastes contain high concentrations of oxygen-consuming wastes that need to be removed from wastewater before it can be safely discharged into a waterway. Most dissolved oxygen problems are a result of point source discharges, but low dissolved oxygen can also be a natural occurrence in swamp waters.

The United States Environmental Protection Agency (EPA) states that 3.0 milligrams per liter (mg/l) is the threshold dissolved oxygen concentration needed for many species' survival (EPA, 1986). North Carolina has adopted a dissolved oxygen standard of 5.0 mg/l (daily average with minimum instantaneous measurements not permissible below 4.0 mg/l) in order to protect the majority of its waters. An exception to this standard in the White Oak Basin exists for waters supplementally classified as *swamp* waters or waters that exhibit swamp-like conditions. Swamp waters often have naturally low levels of dissolved oxygen, and aquatic organisms typically found in these waters are adapted to the lower dissolved oxygen levels. Sluggish swamp waters in the Coastal Plain portion of the state may have natural dissolved oxygen levels of 3.0 to 4.0 mg/l or less at times. Therefore, an acceptable concentration of dissolved oxygen may be less than 5.0 mg/l if that lower level is judged to be the result of natural conditions.

Dissolved oxygen concentrations are affected by natural conditions. Turbulent actions which mix air and water such as waves, rapids and water falls help aerate water, and cool waters are able to retain dissolved oxygen better than warm waters. Water depth is also a factor. In deep slow-moving waters, such as reservoirs or estuaries, dissolved oxygen concentrations may be very high near the surface due to wind action and plant (algae) photosynthesis, but may be entirely depleted (anoxic) at the bottom. In general, the lowest dissolved oxygen concentrations occur during the warmest summer months and particularly during low flow periods.

Causes of dissolved oxygen depletion can include wastewater treatment plant effluent and the decomposition of organic matter such as leaves, dead plants and animals, and organic waste matter that may be washed or discharged into the water. Sewage from human and household wastes is high in organic waste matter, and bacterial decomposition can rapidly deplete dissolved oxygen levels unless these wastes are adequately treated at a wastewater treatment plant to remove much of the organic component. In addition, some chemicals may react with and bind up dissolved oxygen.

Biochemical oxygen demand, or BOD, is a technical term that describes the overall demand on dissolved oxygen. A commonly used measure of BOD is called BOD_5 where the "5" stands for the amount of oxygen demand exerted over five days. BOD_5 is a standard waste limit in most discharge permits. A limit of 30 mg/l of BOD_5 is the highest concentration allowed by federal and state regulations for municipal and domestic wastewater treatment plants. Limits less than 30 mg/l and sometimes as low as 5 mg/l are becoming more common in order to protect dissolved oxygen standards in the receiving waters.

<u>**Oxygen-Consuming Wastes in the White Oak River Basin**</u>

In the White Oak River Basin, Little Northeast Creek (a tributary to the New River in Onslow County) exhibits episodes where dissolved oxygen standards are violated. Also, the New River has been the subject of algal blooms which tend to deplete oxygen from the water column and cause fish kills. Monitoring of these conditions in conjunction with the management of contributions of BOD are both important in maintaining appropriate dissolved oxygen levels for the protection of aquatic life. Recommended strategies for addressing BOD are presented in Chapter 6.

3.2.2 Nutrients

The term *nutrients* refers to the substances phosphorus and nitrogen. While a certain level of these nutrients are needed to support aquatic life, an overabundance can stimulate the occurrence of nuisance algal blooms. Algae blooms deplete the water column of dissolved oxygen and can contribute to serious water quality problems such as fish kills. The blooms can also be aesthetically undesirable, impair recreational use and enjoyment of the affected waters, impede commercial fishing and pose difficulties in water treatment at water supply reservoirs. Nutrient overenrichment and the resultant problems is called *eutrophication.*

Excessive nutrient enrichment has also been implicated in the occurrence of the toxic dinoflagellate, *Pfisteria piscicida.* The extent to which this growth is the result of direct stimulation versus preying on algal flagellates whose populations may be increased by nutrient availability will be the subject of further study (Burkholder, 1994).

DO depletion from nutrient overenrichment and algal blooms fluctuates seasonally and with the time of day. Oxygen is produced by algae and other plants in the presence of sunlight through a process called *photosynthesis.* At nighttime, however, photosynthesis and DO production slow, and DO is consumed by plants through the process of *respiration.* During the summer months, this daily cycle of daytime oxygen production and nighttime depletion often results in supersaturation of the surface water by oxygen during the afternoon hours on bright, sunny days, and low DO concentrations during the late night and early morning hours. In addition, decaying algae may settle to the bottom of the water body and contribute to *sediment oxygen demand* (SOD) which may lower DO concentrations in the bottom waters of lakes, reservoirs, and estuaries.

Discharges from wastewater treatment plants and runoff from agricultural lands, urban areas and forests are the main sources of nutrients in the basin. Nutrients in nonpoint source runoff come mostly from fertilizer and animal wastes. Nutrients in point source discharges are from human wastes, food residues and some cleaning agents. A statewide phosphorus detergent ban implemented in 1988 significantly reduced the amount of phosphorus reaching and being discharged into surface waters from wastewater treatment plants. A strong emphasis is now being placed on nitrogen removal.

At this time, North Carolina has no instream standards for total phosphorus (TP) and total nitrogen (TN). Limits on the amount of phosphorus that may be discharged into surface waters are presented in Chapter 6. In addition, the State has a standard of 40 ug/l (micrograms per liter or parts per billion) for chlorophyll *a*. Chlorophyll *a* is a chemical constituent of algae (it gives it its green color). A chlorophyll *a* reading above the 40 ug/l standard is indicative of excessive algal growth and portends bloom conditions.

Nutrients in the White Oak Basin

Nutrients are a significant concern in the New River estuary and, to a lesser extent, in Calico Creek in Morehead City. Moderately elevated phosphorus concentrations are also common in the upper White Oak estuary which is poorly flushed and receives substantial freshwater input. The New River has been designated Nutrient Sensitive Waters (NSW) because of chronic problems with algal blooms. Below is a brief history of the NSW classification followed by present information on estimated nutrient loads from point and nonpoint source activities to the waters of the basin.

New River: Background and Development of the New River NSW Strategy

In the mid 1980s, the Divisions of Environmental Management (DEM) and Marine Fisheries recognized persistent water quality problems in the upper New River estuary. The frequency of algal blooms, fish kills and low dissolved oxygen levels led the Wilmington Regional Office of the Department of Environment, Health and Natural Resources (EHNR) to request a special water quality investigation of the area in 1986. In January of 1987, the director of DEM, utilizing authority granted under the coastal waste treatment disposal regulations [NCAC 15A 2H.0404 (c)], required a total phosphorus (TP) limit of 2.0 mg/l on new and expanding discharges in the upper New River watershed. Existing discharges with a permitted flow greater than 50,000 gallons per day (.05 MGD) were to receive the 2.0 mg/l limit upon permit renewal.

In 1990 DEM released the results of an intensive investigation of the New River conducted during the period from 1986 to 1989 (NCDEM, 1990). This study documented high levels of total nitrogen (TN), TP, and chlorophyll *a* in the upper New estuary, especially in the Jacksonville area. High phytoplankton biovolume and density levels were also documented. The study concluded that the estuary above Hadnot Point was highly eutrophic, primarily due to substantial point source nutrient inputs. It recommended the NSW classification and a specific set of control strategies.

On April 11, 1991, the Environmental Management Commission designated the upper New estuary as NSW. The designated area included all waters upstream of a line connecting Grey Point to a point of land approximately 2,200 yards downstream from the mouth of Duck Creek (see figure 2.15 in Chapter 2 for a map illustrating this area). The major elements of the adopted strategy are presented in Table 3.1, below (EMC, 1991):

Table 3.1 Major Elements of New River Nutrient Sensitive Waters Strategy

- A Total Phosphorus (TP) limit of 2.0 mg/l was applied to existing facilities with a permitted capacity of .05 MGD or greater.
- More stringent TP limits or limits on nitrogen could be applied to large existing facilities which make a significant contribution of nutrients to the system.
- A TP limit of 0.5 mg/l was applied to new or expanded discharges, regardless of design capacity.
- Individuals considering a new discharge must demonstrate that nondischarge options or connection to an existing facility are not feasible.
- In order to reduce nonpoint source inputs of phosphorus and nitrogen, the area should be targeted for the implementation of agricultural BMPs under the Agricultural Cost Share Program.

Calico Creek
Calico Creek is a poorly flushed tidal channel feeding the Newport River at Morehead City which has experienced excessive algal growth and elevated nutrient levels for many years. Calico Creek receives effluent from the town's wastewater treatment plant and is also affected by nonpoint source runoff from developed areas. The eutrophication of Calico Creek is a localized problem that does not appear to significantly effect water quality in the Newport River.

Estimated Nutrient Loadings to the New, White Oak, Newport and North Rivers

Although the subbasins other than the New River subbasin are not threatened by elevated nutrient levels, nutrient loading estimates can still serve as a useful tool for evaluating the condition of these areas. Annual nutrient loads were calculated for the New, White Oak, the Newport River and the North River subbasins. Table 3.2 presents the nitrogen and phosphorus loads to these drainage areas for different contributing categories. Point source loads represent the average loading from permitted dischargers in the watershed under current conditions (1994-1995). Nonpoint source loads represent the net export of nutrients from areas of varying land use within each watershed. Nonpoint source loads were calculated using an export coefficient model utilizing land cover information derived from LANDSAT data and nutrient export estimates derived from the literature. Atmospheric loadings were also calculated using export coefficients. The specific methodology used is discussed in Appendix VIII.

New River Loadings
Nutrient contributions in the New River estuary are dominated by point source contributors. Figures 3.1 and 3.2 illustrate the relative contributions of nitrogen and phosphorus from point sources, atmospheric deposition, urban runoff, agriculture and forest land. In the late 1980's, the phosphorus loading from Jacksonville's Wilson Bay facility declined by an estimated 29% as a result of the phosphate detergent ban (NCDEM, 1991). Point sources nonetheless continue to dominate nutrient inputs, accounting for 59% of the P load to the NSW area and 44% of the N load

TABLE 3.2
NUTRIENT LOADS FOR FOUR WATERSHEDS IN THE WHITE OAK BASIN

	PHOSPHORUS		NITROGEN		AREA
	KG/YR	% of Load	KG/YR	% of Load	%
WHITE OAK RIVER (738 km2)					
DEVELOPED LAND	1100	7%	8253	3%	1%
AGRICULTURE	5985	35%	59851	24%	11%
FOREST/WETLAND	7193	43%	133773	54%	82%
POINT SOURCE	177	1%	391	0%	
ATMOSPHERIC DEPOSITION	2424	14%	46242	19%	5%*
Total	16879	100%	248510	100%	99%
NEW RIVER NSW AREA (849 km2)					
DEVELOPED LAND	6587	9%	49403	8%	6%
AGRICULTURE	11199	16%	111986	19%	18%
FOREST/WETLAND	10117	14%	134222	23%	72%
POINT SOURCE	42173	59%	254358	44%	
ATMOSPHERIC DEPOSITION	1754	2%	33455	6%	3%*
Total	71830	100%	583424	100%	99%
NEWPORT RIVER (393 km2)					
DEVELOPED LAND	807	5%	6049	3%	2%
AGRICULTURE	3487	23%	34870	18%	12%
FOREST/WETLAND	3619	24%	60352	31%	70%
POINT SOURCE	3108	20%	9235	5%	
ATMOSPHERIC DEPOSITION	4315	28%	82319	43%	17%*
Total	15336	100%	192825	100%	101%
NORTH RIVER (171 km2)					
DEVELOPED LAND	203	2%	1526	1%	1%
AGRICULTURE	3269	37%	32695	27%	24%
FOREST/WETLAND	1452	17%	15235	12%	40%
POINT SOURCE	0	0%	0	0%	
ATMOSPHERIC DEPOSITION	3811	44%	72698	60%	34%*
Total	8735	100%	122154	100%	99%

* Percent of watershed area represented by open water, salt marsh and sand.
Percentages may not add to 100% due to rounding.

(Figures 3.1 and 3.2). Over 94% of point source inputs of both nutrients originates from the Jacksonville WWTP and four Camp Lejeune facilities. Runoff from agricultural land, as well as managed and natural forests, is also a contributor, especially for nitrogen. However, nutrient loading to the New River due to runoff from land surfaces does not appear to differ substantially from nonpoint source loads to other watersheds in the basin that are not threatened by eutrophication (Figures 3.3 and 3.4).

Nutrient Loadings to other subbasins
As shown in Table 3.2, none of the other three watersheds experience the high point source loads characteristic of the New River. The only waterbody with substantial wastewater input is the Newport River, but this predominately reflects the discharge from the Morehead City WWTP, which does not mix well with the main body of the river. The current policy prohibiting new or expanded discharges to SA waters should continue to protect these areas from significant point source nutrient impacts.

On a unit area basis, nitrogen and phosphorus inputs from nonpoint source runoff from land surfaces are generally low to moderate. The North River drainage, which contains substantial agricultural acreage (including part of Open Grounds Farm), has the highest nonpoint source inputs among these watersheds (approximately 440 kg of N per square km of land area) as shown in Figures 3.3 and 3.4.

Nitrogen loads to the North and Newport River drainages are dominated by atmospheric deposition onto open water. Atmospheric deposition of phosphorus is also important in these areas. As noted above, however, these waterbodies are not considered to be at risk from eutrophication. The high proportion of the nutrient load accounted for by atmospheric deposition reflects the fact that loading from other sources is relatively modest. There is no evidence that atmospheric deposition is causing water quality problems in these areas. Although nutrient loads were not calculated for Core and Bogue Sounds, it is clear that these waterbodies have significant inputs of atmospheric nitrogen. Water quality remains excellent in the sounds which are relatively well flushed and receive little input from wastewater or runoff.

3.2.3 Toxic Substances

Regulation 15A NCAC 2B. 0202(36) defines a toxicant as "any substance or combination of substances ... which after discharge and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, has the potential to cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions or suppression in reproduction or growth) or physical deformities in such organisms or their offspring or other adverse health effects". Toxic substances frequently encountered in water quality management include *chlorine*, *ammonia*, *organics* (hydrocarbons, pesticides, herbicides), and *heavy metals*. These materials are toxic to different organisms in varying amounts, and the effects may be evident immediately or may only be manifested after long-term exposure or accumulation in living tissue.

Toxic Substances in the White Oak River Basin

Sporadic copper values above the state action level have been observed in various estuarine waters (see Chapter 4). Marine paints and wood preservatives used in marine construction are potential sources (NCDEM, 1991). There is no evidence that this poses a water quality problem at the present time.

As discussed in Chapter 4, toxicants are not a major concern in the White Oak basin. The Jacksonville WWTP and the Camp Lejeune facilities had some toxicity problems in the early 1990's (associated with dechlorination) but these have been resolved. The seven Camp Lejeune

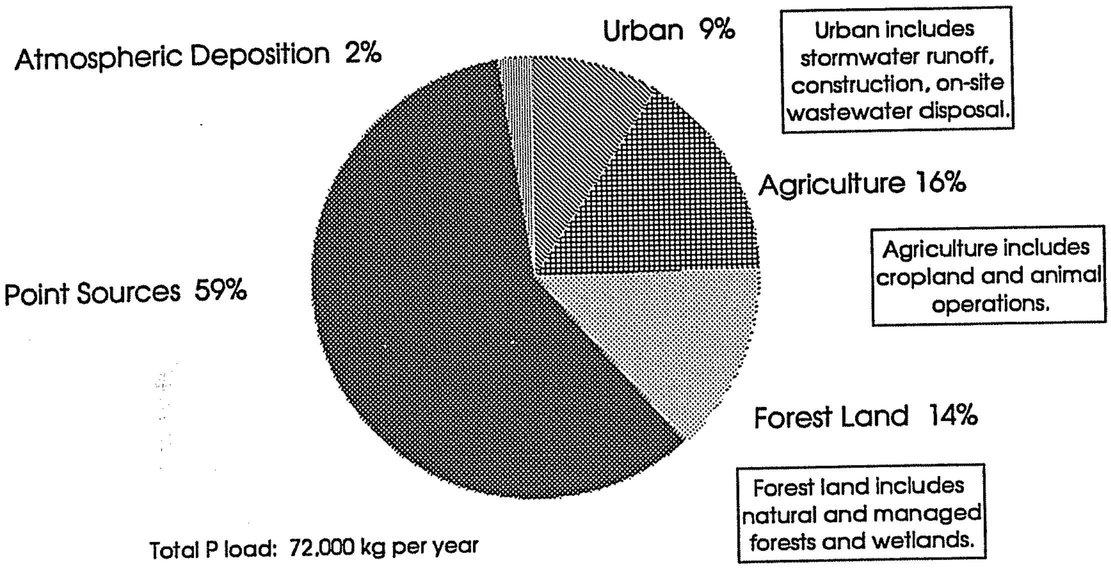

Figure 3.1. Estimated annual phosphorus load to New River NSW Area.

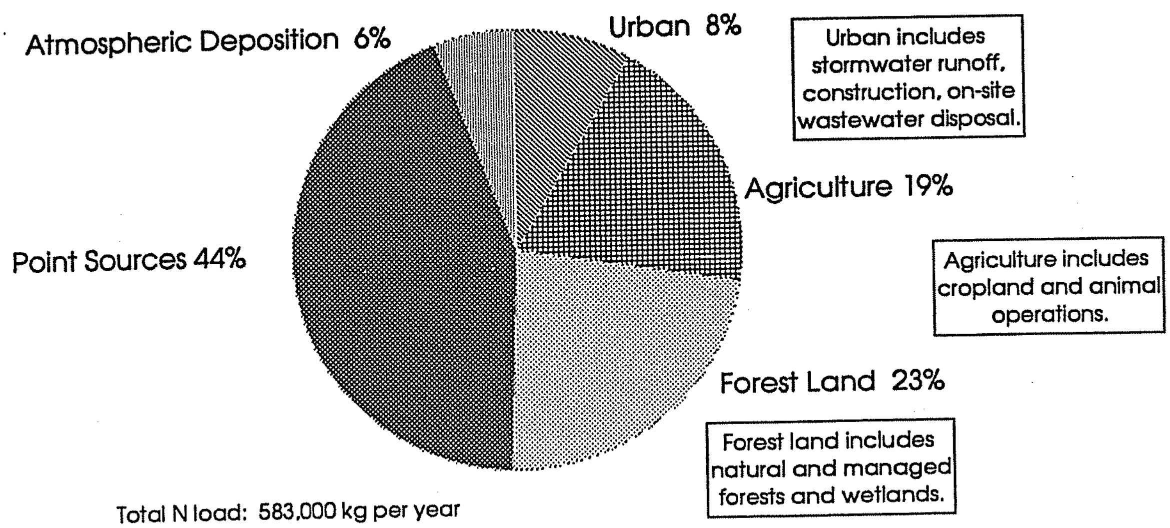

Figure 3.2. Estimated annual nitrogen load to New River NSW Area.

Source:
Point source estimates based on average loads, 1994-95. Nonpoint source estimates developed from 1988 LANDSAT data. See Appendix VIII for documentation.

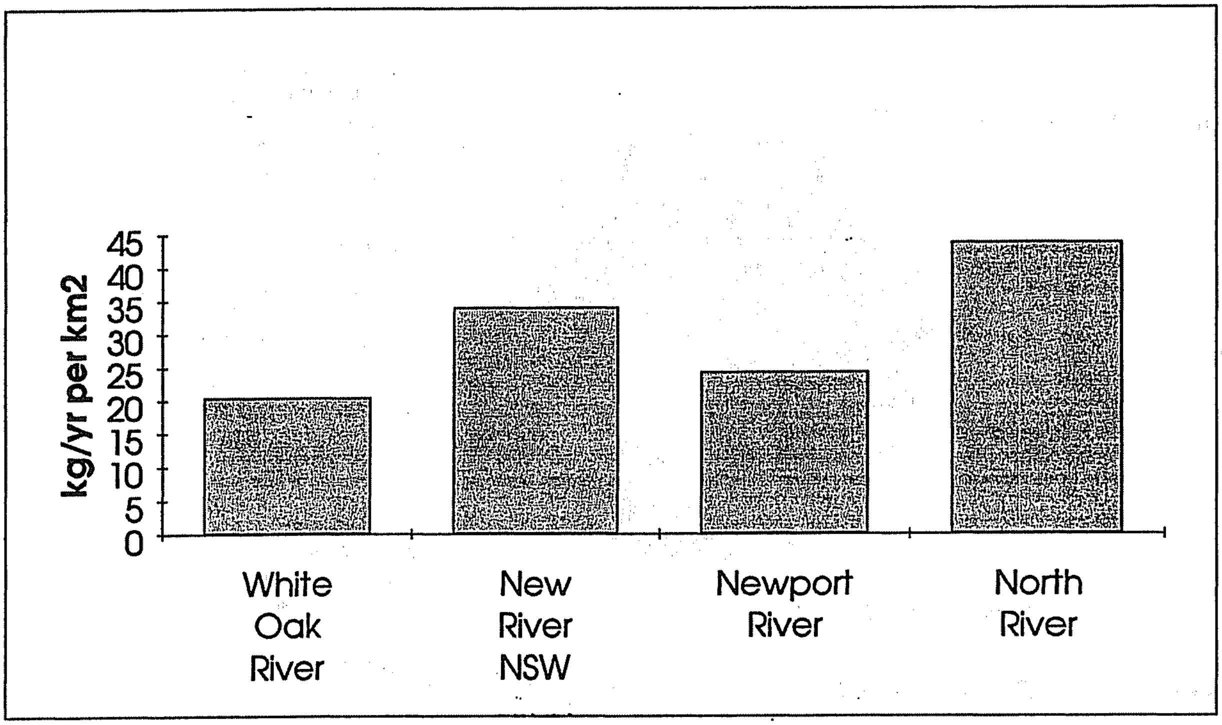

Figure 3.3. **Total nonpoint source phosphorus loads per square kilometer for White Oak Basin watersheds.**

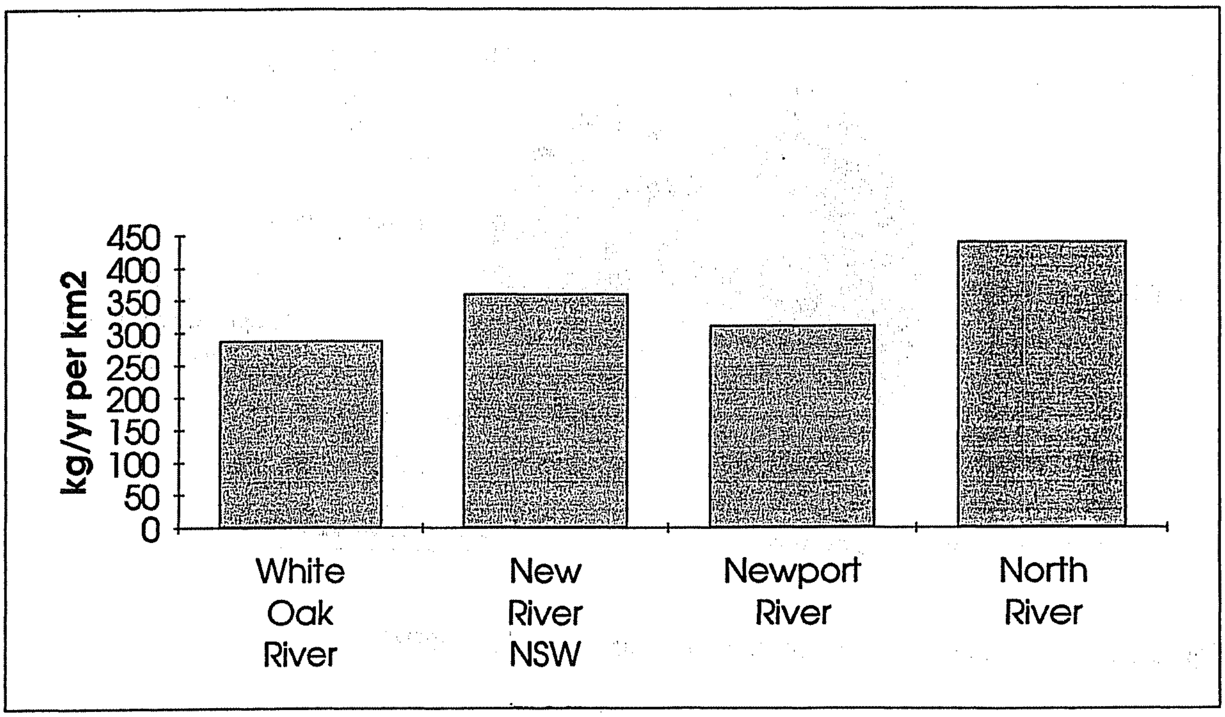

Figure 3.4. **Total nonpoint source nitrogen loads per square kilometer for White Oak Basin watersheds.**

facilities have collectively had only two toxicity test failures in the past three years, Camp Geiger in 1993 and Courthouse Bay in 1994. The Jacksonville discharge will be removed when the city completes its land application system in 1997, and Camp Lejeune is in the process of consolidating its discharges into a single advanced treatment facility at Hadnot Point. The Morehead City WWTP had one test failure in 1994.

Although there is no indication that there is any related water quality impairment, it is interesting to note that numerous areas of Camp Lejeune contain toxic substances. In October 1989, Camp Lejeune was placed on the National Priorities List (NPL), a list of facilities or sites proposed for the Superfund list. In February 1991, the U.S. Department of the Navy, the U.S. Environmental Protection Agency Region IV, and the State of N.C. signed a Federal Facilities Agreement (FFA). The FFA ensures that environmental impacts at Camp Lejeune are thoroughly investigated and corrective actions taken where necessary. The FFA identified 34 sites at Camp Lejeune that need investigation and potentially need cleanup in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Operable Units were formed for those sites with similarities or in close proximity to each other. To date, a total of seventeen Operable Units have been formed. A Site Management Plan was developed to outline a five year action plan for investigating and remediating identified Operable Units.

3.2.4 Sedimentation

Sedimentation and erosion is the most widespread cause of nonpoint source pollution in the state. It impacts streams in several ways. Eroded sediment may gradually fill lakes and navigable waters and may increase drinking water treatment cost. Sediment may clog the gills of fish, eliminate the available habitat of organisms which serve as food for fish, or even completely cover shellfish beds. Sediment also serves as a carrier for other pollutants including nutrients (especially phosphorus), toxic metals and pesticides. Most sediment-related impacts are associated with nonpoint source pollution generated by ground-disturbing activities such as building and road construction and farming.

While North Carolina does not have a numeric water quality standard for suspended solids, however all discharges must meet federal effluent guideline values at a minimum (e.g. 30 mg/l for domestic discharges). Also, most point source BOD limitations usually require treatment to a degree that removes sediments to a level below federal guidelines requirements. Discharges to high quality waters (HQW) must meet a total suspended solids (TSS) limit of 10 mg/l for trout waters and primary nursery areas and 20 mg/l for all other HQWs. In addition, the state has adopted a numerical instream turbidity standard for point and nonpoint source pollution. Nonpoint sources are considered to be in compliance with the standard if approved best management practices (BMPs) have been implemented.

Statistics compiled by the US Department of Agriculture, Natural Resources Conservation Service indicate a statewide decline in erosion from 1982 to 1992 (USDA, NRCS, 1992) as shown in Table 3.3.

Table 3.3. Overall Erosion Trends in North Carolina

	1982	1987	1992
Area (1,000 acres)	33,708.2	33,708.2	33,708.2
Gross Erosion (1,000 tons/yr)	46,039.5	43,264.6	36,512.9
Erosion Rate (Tons/Yr/Ac)	1.4	1.3	1.1

The NRCS statistics also indicate a statewide reduction per acre on cropland erosion using the Universal Soil Loss Equation (Table 3.4).

Table 3.4. USLE Erosion on Cultivated Cropland in North Carolina

	1982	1987	1992
Cropland Area (1,000 acres)	6,318.7	5,956.8	5,538
Gross Erosion (1,000 tons/yr)	40,921.4	37,475.3	30,908.3
Erosion Rate (Tons/Yr/Ac)	6.5	6.3	5.6

While there is an overall 10-year downtrend statewide in the erosion rate on agricultural lands, the erosion rate/acre and the 10-year trends vary by region as shown in Table 3.5. The greatest improvement in erosion control is seen in the Southern Piedmont and Sand Hills with a small uptrend in the tidewater area and a significant increase in the mountains.

Table 3.5. North Carolina Erosion on Major Land Resource Areas (MLRA) in Tons/acre/yr

	1982	1987	1992
Blue Ridge Mountains	12.7	20.8	18.3
Southern Piedmont	12.3	12.0	10.5
Carolina and Georgia Sand Hills	6.0	5.6	5.1
Southern Coastal Plain	3.9	3.9	4.0
Atlantic Coast Flatwoods	3.2	3.1	3.2
Tidewater Area	1.4	1.5	1.6

Sedimentation in the White Oak River Basin

There are no waters in the White Oak River Basin that have been identified as impaired due to sedimentation. As noted above, sedimentation rates are less than 2.0 tons/acres/year in the Tidewater portion of the state which encompasses most of the White Oak River Basin.

3.2.5 Fecal Coliform Bacteria

Fecal coliform bacteria are typically associated with the intestinal tract of warm-blooded animals. They are widely used as an indicator of the potential presence of waterborne pathogenic, or disease-causing, bacteria and viruses (e.g. those which cause such diseases as typhoid fever, dysentery, and cholera) because they are easier and less costly to detect than the actual pathogens. The coliform standard, which has been used to indicate the microbiological quality of drinking water, swimming waters, and shellfish harvesting waters for more than 50 years, has often been questioned. Increasing evidence collected during the past several decades suggest that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water. Yet, the detection and identification of specific bacteria, viruses and parasites, such as *Giardia* , *Cryptosporidium* , and *Shigella* require large volumes of sample and very sophisticated laboratory techniques which are not commonly available.

Fecal coliform water quality standards have been established in order to ensure safe use of waters for water supplies, recreation and shellfish harvesting. The current State (DWQ) standard for fecal coliform bacteria is 200 MF/100 ml for all waters except SA waters where the standard is 14

MF/100 ml. (MF is an abbreviation for the Membrane Filter procedure for determining fecal coliform concentrations.) The 200 MF/100 ml standard is intended to ensure that waters are safe enough for water contact recreation. The standard of 14 MF/100 ml in SA waters is intended to ensure that shellfish (oysters) harvested from these waters are safe to eat. The Division of Environmental Health (DEH) applies the same numerical standard to shellfish growing areas (14), but they are required to use a different method of analysis. DEH's standard is a median or geometric mean fecal coliform Most Probable Number (MPN) not greater than 14/100 ml, and not more than 10% of the samples in excess of 43 MPN/100 ml. The MPN is derived from using the multilpe-tube method of sample analysis.

Fecal colform bacteria enter surface waters from nonpoint source runoff, but they also come from improperly treated discharges of domestic wastewater. Common nonpoint sources of fecal coliform bacteria include leaking or failing septic systems, leaking sewer lines or pump station overflows, runoff from livestock operations, urban stormwater and wildlife. Fecal coliform bacteria in treatment plant effluent are controlled through disinfection methods including chlorination (often followed by dechlorination), ozonation or ultraviolet light radiation.

Fecal Coliform Bacteria in the White Oak River Basin

Fecal coliform bacteria are a significant concern in both the freshwater and saltwater portions of the White Oak River basin. In the freshwater portion of the basin, fecal coliform levels exceeding the criterion of 200/100 ml have occurred at three ambient stations: Little Northeast Creek near Jacksonville, New River near Gum Branch and Newport River at Newport. Contamination at these sites is primarily of nonpoint source origin, although the Richlands WWTP has had occasional fecal coliform violations. During the summer of 1995, the failure of a large swine waste lagoon caused widespread but temporary fecal coliform contamination in much of the upper New River.

In the saltwater portion of the basin, large areas of water are temporarily or permanently closed to shellfish harvesting because of fecal coliform bacteria. DEH's Shellfish Sanitation Branch monitors fecal coliform levels in coastal waters and, using the results of these data and other information, determine whether or not shellfish can be harvested from actual or potential shellfish growing areas.

The early 1980's saw increasing concern regarding the potential role of stormwater runoff and septic tank failures as a source of fecal coliform contamination to shellfish waters. DEM released a report documenting high fecal coliform levels in water draining developed areas of coastal North Carolina and discussing various management options (NCDEM, 1985). The initial coastal stormwater regulations were adopted by the EMC in 1986. Over the past half dozen years DWQ has conducted two intensive investigations of closed shellfish waters: the Lockwoods Folly River (Lumber River basin) in 1989 (NCDEM, 1989), and the South River (Neuse River basin) in 1994 (NCDEM, 1994). Much was learned from these two studies with regard to the site-specific nature of the problem and the difficulty of pinpointing specific sources of contamination. The South River investigation documented contamination in sub-drainages dominated by all types of land uses and practices--residential, agricultural and recently logged forest, as well as undisturbed forest. The Lockwoods Folly River study noted that unacceptable fecal coliform levels were found despite the fact that there were no violations of rules or procedures.

DEH's Shellfish Sanitation Program (Fowler, 1994)

DEH has subdivided all coastal waters in the state into shellfish growing areas. For each growing area, DEH must conduct a sanitary survey once every three years. A sanitary survey is comprised of a shoreline survey, a hydrographic survey, and a bacteriological survey. The shoreline survey is used to identify potential pollution sources. The hydrographic survey evaluates meteorological and hydrographic features of the area that may affect the distribution of pollutants and the bacteriological survey assesses water quality using fecal coliform sampling. Based on the results of the survey, the waters are classified by DEH into one of the following categories:

- ***Approved Area*** - an area determined suitable for the harvesting of shellfish for direct market purposes.
- ***Conditionally Approved Open*** - waters that are normally open to shellfish harvesting but are closed on a temporary basis in accordance with management plan criteria.
- ***Conditionally Approved Closed*** - waters that are normally closed to shellfish harvesting but are open on a temporary basis in accordance with management plan criteria.
- ***Restricted Area*** - an area from which shellfish may be harvested only by permit and subjected to an approved depuration process or relayed to an approved area.
- ***Prohibited Area*** - an area unsuitable for the harvesting of shellfish for direct market purposes.

An area is considered approved for shellfish harvesting only if the median fecal coliform MPN or the geometric mean MPN does not exceed 14/100 ml and if no more than 10 percent of the samples exceed a MPN of 43/100 ml. Numerous closed areas have median levels below 14 but fail to meet the second criteria due to periodic contamination usually occurring after moderate to heavy rainfall.

Closed Shellfish Waters in the White Oak Basin

All coastal waters, regardless of their surface water classification or shellfish abundance, are assigned a shellfish harvesting designation (i.e. approved, prohibited). Figure 3.5 is a map of the entire White Oak River Basin that depicts all areas closed to shellfish harvesting that fall into any one of the following DEH harvesting designations: 'Prohibited', 'Restricted' and 'Conditionally Approved' but closed most of the time. This map is provided to give the reader a general idea of where closed shellfishing waters occur in the basin. DEH continually updates closure areas and should be consulted for more specific and current data related to shellfish closures.

However, those closures of most concern are those that occur in waters classified by DWQ as shellfishing waters (SA). These are areas where the commercial harvest of shellfish is or has been an actual or attainable use. Therefore, their closure represents a loss of that use. Figure 3.6 depicts those waters closed by DEH that occur in waters classified as SA by DWQ for shellfish harvesting purposes.

In the saltwater portion of the White Oak basin, 8,936 acres (or approximately 7% of the saltwater area) are considered impaired because of fecal coliform contamination. The majority of this contamination is believed to be attributable to nonpoint sources of pollution such as urban runoff, septic tank failures, marinas and agriculture. Table 4.14 in Chapter 4 presents more specific figures for impairment in particular areas defined by DEH.

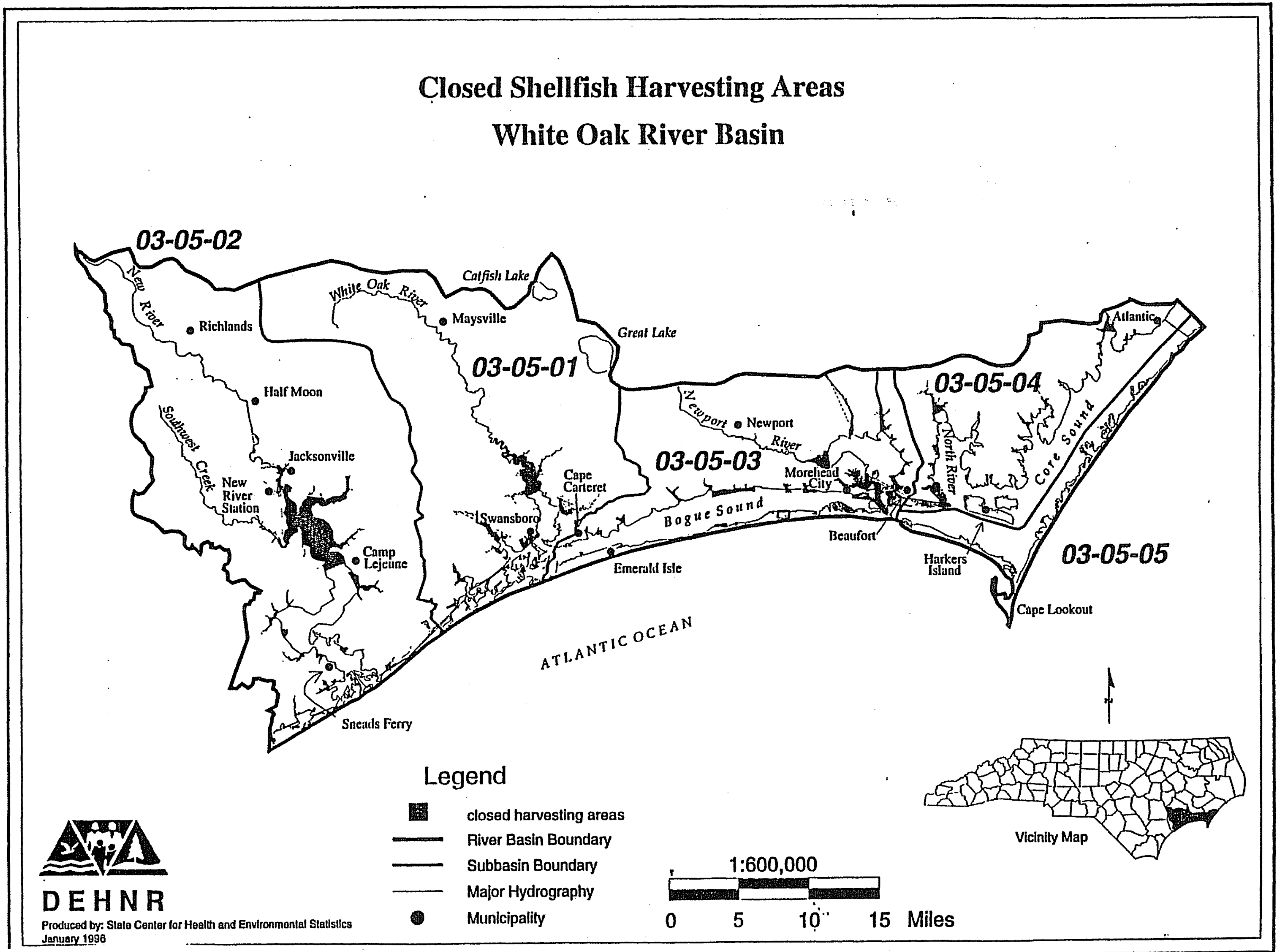

Figure 3.5. Closed Shellfish Harvesting Areas in the White Oak River Basin

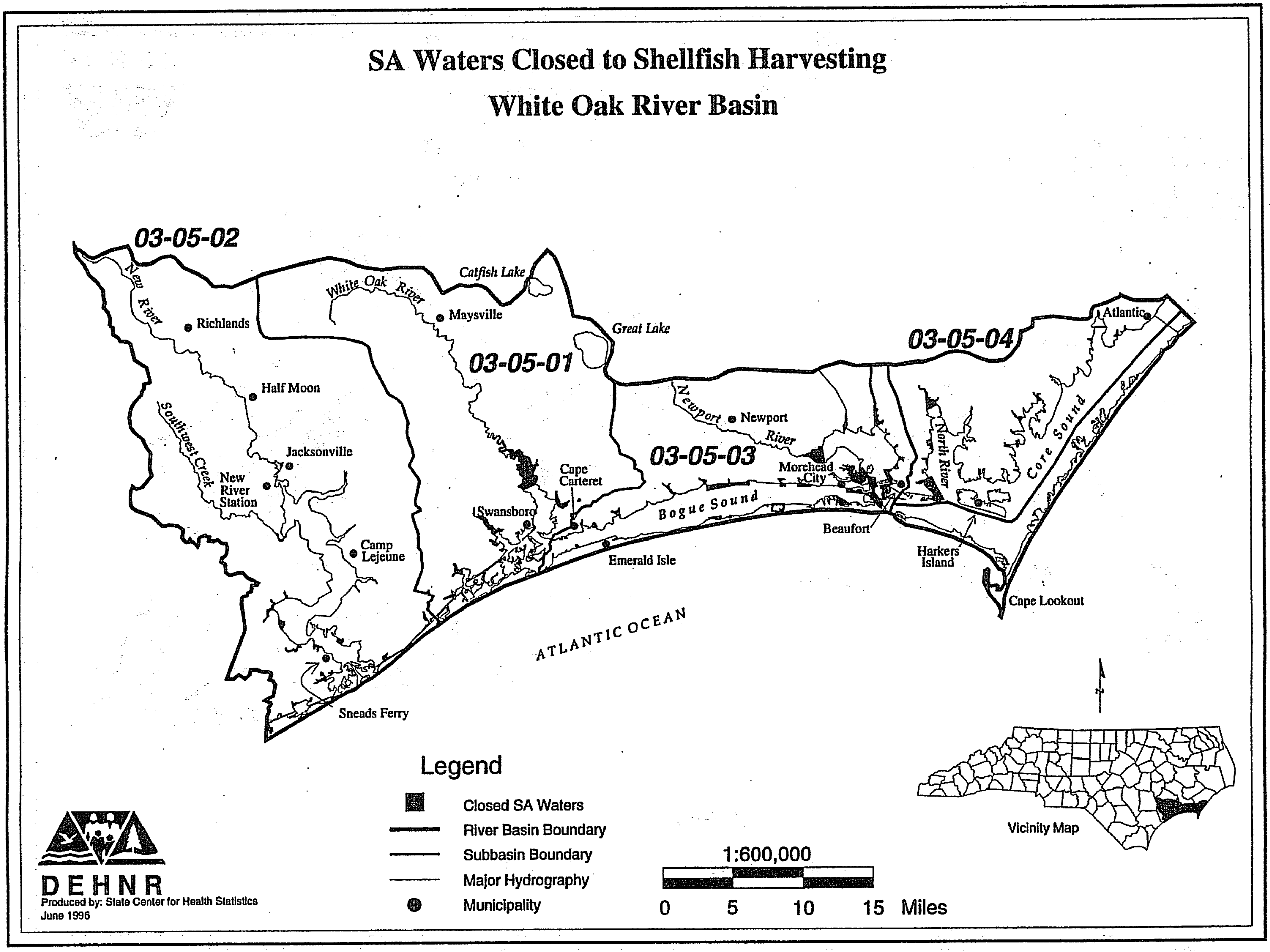

Figure 3.6. Closed Shellfish Harvesting Areas in the White Oak River Basin that Occur in SA

Since 1983, 13 of the 17 shellfish management areas in the White Oak basin have experienced an increase in the acreage closed to shellfish harvesting. This trend is primarily the cumulative result of numerous small, widely dispersed increases in prohibited area. Figure 3.7 illustrates this trend.

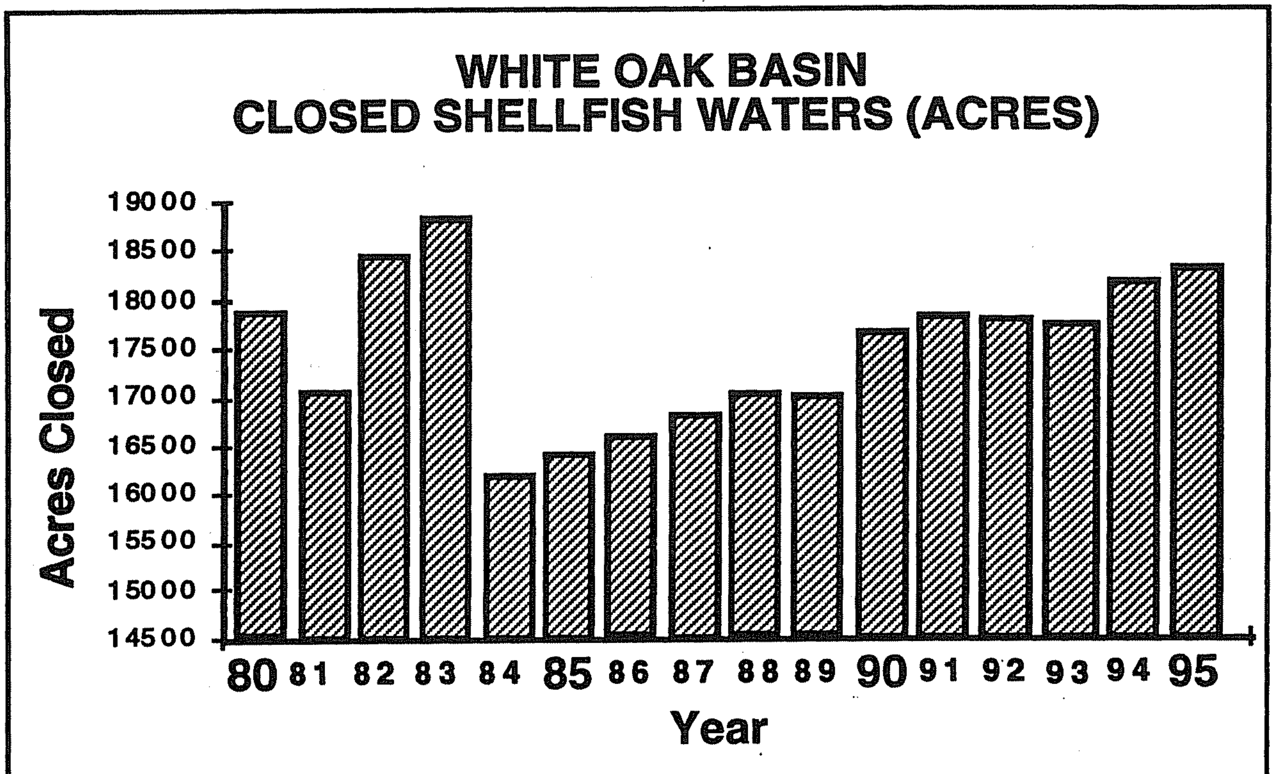

Figure 3.7 Acres of Shellfish Waters Closed to Harvesting in the White Oak Basin by Year (1980 to 1995)

As has been the case in other parts of the country with important shellfish resources, recent closings have been due primarily to contamination from nonpoint sources (see Puget Sound Water Quality Authority, 1994). Few of the closed areas in the White Oak basin are near any point of discharge.

Shoreline surveys conducted in the White Oak basin by the Shellfish Sanitation Branch of DEH generally conclude that development and other land disturbing activities, especially in the immediate area of estuarine shorelines, are the primary and most widespread cause of fecal coliform contamination in the White Oak basin (Fowler, 1994; Barber et al, 1994; Fowler, 1995 personal communication). This conclusion is the result of numerous years of observation, although it is not based upon rigorously designed studies. Data from the most recent shoreline survey in the White Oak River area (DEH management area D-3, see figure 4.25), for example, illustrate the increases in shoreline development documented by DEH. The number of houses in shoreline subdivisions in area D-3 increased from approximately 230 in 1991 to about 450 in 1994 (NCDEH, 1995). Approximately 1200 houses are planned for these subdivisions.

The DEH shoreline surveys have found some contamination from septic systems, but do not document widespread failures in most areas. Observations by regional DWQ staff indicate that problems with on-site systems may be more prevalent. Contamination via groundwater seepage is not readily assessed by visual inspection. Based on site investigations, surface failures usually occur after heavy rains.

Although the over all contribution of septic tank failure in the White Oak basin is unclear, there is no doubt that the potential for contamination is great given the nature of local soils, the high level of population growth along the coastline, and the reliance on on-site waste disposal in most of the basin. There are currently 18,700 septic systems in Onslow County, serving 38% of county residents, while Carteret County's 7,000 systems provide waste treatment for 56% of the population (Malcolm Pirnie, Inc. 1995). The proportion of these systems which are at least 15 years old is 50% and 40% in Onslow and Carteret Counties respectively. It is well known that many areas of these counties have either poorly drained or excessively drained soils which are not suitable for the construction of septic fields.

North Carolina regulations require a vertical separation of one foot between the bottom of an infiltration trench and the top of the seasonal high water table. Experimental evidence and field observations suggest that microorganisms can move substantial distances in saturated sandy soils and that one foot of vertical separation may not be adequate to prevent surface water contamination under such conditions (NCDEM, 1989; Cogger et al, 1988). Additionally, it has been a common practice in some areas to install drainage tile networks to lower the water table and allow the construction of drainfields in areas where they would otherwise not be permitted (Duda and Cromartie, 1982; NCDEM, 1989). Current state regulations require a 25 foot separation between septic fields and such drainage networks, but prior to 1982 the required separation was only 15 feet. There is some concern about the possible transport of fecal bacteria through the subsurface drainage network to ditches and streams during rainfall events but the extent to which this occurs is not well documented. Few local governments in the White Oak basin, or elsewhere in North Carolina, have adopted requirements for vertical separation or horizontal setbacks from surface waters that are greater than the state standards (McGuire, 1996).

Management strategies for addressing fecal coliform bacteria are presented in Chapter 6.

3.2.6 Color

Color is sometimes a water quality problem associated with wastewater discharges from textile manufacturers that use dyes to color their fabrics and from pulp and paper mills. No waters in the basin have been identified as use-impaired due to color.

3.3 SOURCES OF POLLUTION

3.3.1 *Point* Sources

Point sources refers to discharges that enter surface waters through a pipe, ditch or other well-defined points of discharge. The term most commonly refers to discharges associated with wastewater treatment plant facilities. These include *municipal* (city and county) and *industrial* wastewater treatment plants as well as small *domestic* discharging treatment systems that may serve schools, commercial offices, residential subdivisions and individual homes. In addition, discharges from *stormwater systems* at industrial sites are now considered point source discharges and are being regulated under new urban stormwater runoff regulations being required by the U.S. Environmental Protection Agency (EPA). The urban stormwater runoff program is discussed in more detail in Chapter 5 and Section 6.8 in Chapter 6. The primary water quality pollutants associated with point source pollution are oxygen-demanding wastes, nutrients, color and toxic substances including chlorine, ammonia and metals.

Point source discharges are not allowed in North Carolina without a permit from the state. Discharge permits are issued under the National Pollutant Discharge Elimination System (NPDES) program delegated to North Carolina from EPA. The amount or loading of specific pollutants that may be allowed to be discharged into surface waters are defined in the NPDES permit and are called *effluent limits*. Under the NPDES permitting program, each NPDES discharger is assigned either *major* or *minor* status. Major facilities are large with greater flows. For municipalities, all dischargers with a flow of greater than 1 million gallons per day (MGD) are classified as major. Most point source discharges, other than urban and industrial stormwater discharges, are continuous and do not occur only during storm events as do nonpoint sources. They generally have the most impact on a stream during low flow conditions when the percentage of stream flow composed of treated effluent is greatest. Permit limits are generally set to protect the stream during low flow conditions. The standard low flow used for determining point source impacts is called the *7Q10*. This is the lowest flow which occurs over seven consecutive days and which has an average recurrence of once in ten years.

Information is collected on NPDES permitted discharges in several ways. The major method of collection is facility self-monitoring data which are submitted monthly to the DWQ by each individual permittee. NPDES facilities are required to monitor for all pollutants for which they have limits as well as other pollutants which may be present in their wastewater. All domestic wastewater dischargers are required to monitor flow, dissolved oxygen, temperature, fecal coliform, BOD, ammonia, and chlorine (if they use it as a disinfectant). In addition, facilities with industrial sources may have to monitor for chemical specific toxicants and/or whole effluent toxicity (see Section 3.2.3); and all dischargers with design flows greater than 50,000 gallons per day (GPD) monitor for total phosphorus and total nitrogen. Minimum NPDES monitoring requirements are provided in 15A NCAC 2B .0500.

Other methods of collecting point source information include effluent sampling by DWQ during inspections and special studies. The regional offices may collect data at a given facility if they believe there may be an operational problem or as a routine compliance check. In addition, DWQ may collect effluent data during intensive surveys of segments of streams, and extensive discharger data have been collected during on-site toxicity tests.

Point Source Discharges in the White Oak River Basin

In the White Oak River Basin, there are 121 permitted NPDES dischargers. Table 3.6 (next page) summarizes the number of dischargers and their total permitted and actual flows for each subbasin and by broad categories of dischargers including majors, minors, domestic, municipal, industrial (process and nonprocess) and stormwater. A distribution map of the discharge facilities is shown in Figure 3.8. The numbered facilities are the major discharges in the basin, and the numbers correspond to the list in Table 3.7.

Table 3.7. Major NPDES Discharges in the White Oak River Basin.

Map No.	Facility Name	NPDES No.	Subbasin	Type	Design Flow (MGD)
1	USMC/Camp Geiger WWTP	NC0062995	030502	Non-M	1.60
2	Jacksonville /Wilson Bay WWTP	NC0024121	030502	Munic.	4.46
3	USMC/Camp Johnson WWTP	NC0063011	030502	Non-M	1.00
4	USMC/Tarawa Terrace WWTP	NC0063002	030502	Non-M	1.25
5	USMC Hadnot Point WWTP	NC0063029	030502	Non-M	8.00
6	Morehead City WWTP	NC0026611	030503	Munic.	1.70
7	Beaufort WWTP	NC0021831	030503	Munic.	1.50

Of the total 121 dischargers, 7 are municipalities and 24 are industries. Seven (7) of the total number are major facilities and 33 of the total have 100% domestic wastewater. The total permitted flow for all facilities is 27 million gallons per day (MGD) with the actual measured flows being 17

Table 3.6. Summary of Major/Minor Dischargers and Permitted and Actual Flows by Subbasin in the White Oak River Basin

	SUBBASIN					
FACILITY CATEGORIES	**01**	**02**	**03**	**04**	**05**	**TOTALS**
Total Facilities	17	52	34	18	0	121
Facils. w/o Stmwtr & Gen. Permits	9	38	9	6	0	62
Total Permitted Flow (MGD)	0.58	19.98	3.72	3.04	0.00	27.32
# of Facilities Reporting	7	32	5	3	0	47
Total Avg. Flow (MGD)	0.43	13.52	2.26	0.93	0.00	17.14
***Major Discharges**	0	5	2	0	0	7
Total Permitted Flow (MGD)	0	16.31	3.2	0	0	19.51
# of Facilities Reporting	0	5	2	0	0	7
Total Avg. Flow (MGD)	0.00	11.10	2.06	0.00	0.00	13.16
***Minor Discharges**	9	33	7	6	0	55
Total Permitted Flow (MGD)	0.58	3.67	0.52	3.04	0.00	7.81
# of Facilities Reporting	6	27	3	3	0	39
Total Avg. Flow (MGD)	0.27	1.84	0.46	0.85	0.00	3.42
100% Domestic Wastewater	3	27	0	3	0	33
Total Permitted Flow (MGD)	0.05	13.73	0.00	0.02	0.00	13.80
# of Facilities Reporting	3	25	0	1	0	29
Total Avg. Flow (MGD)	0.01	8.52	0.00	0.01	0.00	8.53
Municipal Facilities	2	2	3	0	0	7
Total Permitted Flow (MGD)	0.48	4.70	3.70	0.00	0.00	8.88
# of Facilities Reporting	2	2	3	0	0	7
Total Avg. Flow (MGD)	0.24	4.50	2.30	0.00	0.00	7.04
Major Process Industrial	0	1	0	0	0	1
Total Permitted Flow (MGD)	0	1	0	0	0	1
# of Facilities Reporting	0	0	0	0	0	0
Total Avg. Flow (MGD)	0.00	0.36	0.00	0.00	0.00	0.36
Minor Process Industrial	0	3	1	2	0	6
Total Permitted Flow (MGD)	0.00	0.30	0.00	3.01	0.00	3.31
# of Facilities Reporting	0	3	1	2	0	6
Total Avg. Flow (MGD)	0.00	0.07	0.16	0.92	0.00	1.15
Nonprocess Industrial	4	4	6	3	0	17
Total Permitted Flow (MGD)	0.06	0.28	0.02	0.00	0.00	0.36
# of Facilities Reporting	2	1	1	0	0	4
Total Avg. Flow (MGD)	0.21	0.24	0.01	0.00	0.00	0.46
Stormwater Facilities	8	12	18	1	1	40
Total Avg. Flow (MGD)	0	0	0	0	0	0

*** Number of facilities without stormwater and general permits**

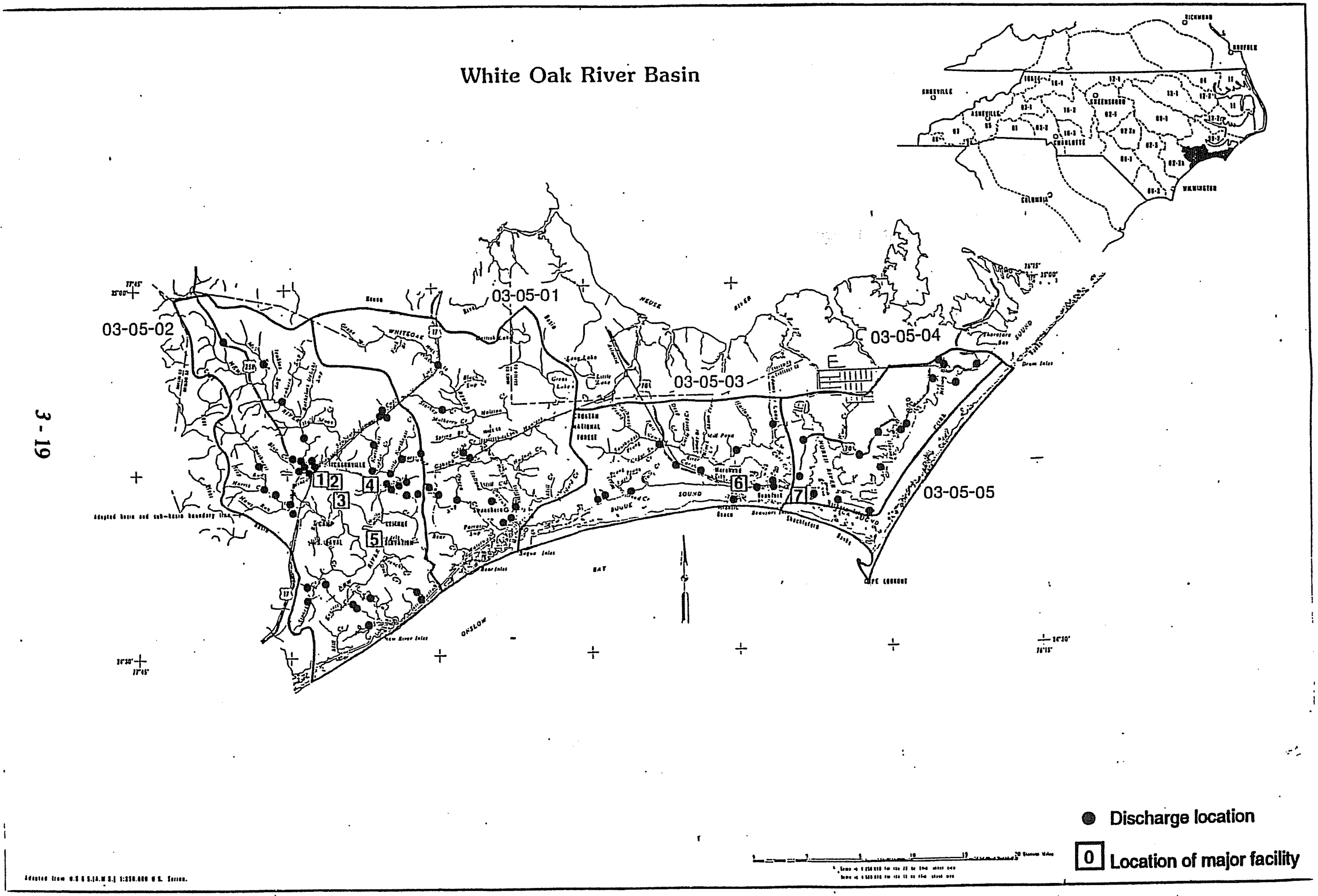

Figure 3.8 Map of NPDES Dischargers in the White Oak River Basin

MGD. Average actual flow is lower than the permitted flow because most facilities do not operate at full capacity.

Many of the municipalities in the White Oak River Basin are currently facing problems associated with wastewater treatment and disposal. Wastewater treatment capacities have been or will be exceeded in the near future. There are a couple of efforts that have been undertaken to help determine the most feasible solutions to addressing wastewater management needs in North Carolina's central coast. In 1994, the Carteret County Interlocal Agency was formed to determine whether land application methods for wastewater treatment are viable alternatives for municipalities in Carteret County. The municipalities participating in the organization were Atlantic Beach, Beaufort, Cape Carteret, Cedar Point, Emerald Isle, Indian Beach, Morehead City, Newport and Pine Knoll Shores. The Interlocal Agency, which suspended its endeavor in February of 1996, generally concluded that land application alone can not feasibly meet the wastewater needs of all of the municipalities in the county. The Agency also postponed further action on their findings pending the outcome of another group charged with addressing regional wastewater needs.

The Regional Wastewater Task Force is composed of four central coast counties facing similar problems in wastewater management. The counties involved in this effort are Carteret, Craven, Onslow and Pamlico. In July of 1995, the Task Force hired Malcolm Pirnie (an engineering consulting firm) to develop a Feasibility Study for Regional Wastewater Management (Malcolm Pirnie, 1996). Malcolm Pirnie has defined several alternatives for consideration. These alternatives will be discussed further in Chapter 7 of this document. Public meetings on the different scenarios were held in May of 1996.

3.3.2 Nonpoint Sources of Pollution

Nonpoint source (NPS) pollution refers to runoff that enters surface waters through stormwater or snow melt. There are many types of land use activities that can serve as sources of nonpoint source pollution including land development, construction, crop production, animal feeding lots, failing septic systems, landfills, roads and parking lots. As noted above, stormwater from large urban areas (>100,000 people) and from certain industrial sites is technically considered a point source since NPDES permits are required for piped discharges of stormwater from these areas. However, a discussion of urban runoff will be included in this section.

Fecal coliform bacteria and nutrients are major pollutants associated with nonpoint source pollution. Others include sediment, heavy metals, oil and grease, and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters. Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur at random intervals depending on rainfall events. Below is a brief description of major areas of nonpoint sources of concern in the White Oak Basin.

Agriculture

A number of agricultural activities can impact water quality if not done properly. Land clearing and plowing render soils susceptible to erosion which in turn can cause stream sedimentation. Contour plowing, terracing and grassed waterways are several common methods used by most farmers to minimize soil loss. Maintaining a vegetated buffer between fields and streams is another excellent means of minimizing soil loss to streams although this practice is not always utilized because it may necessitate taking some land out of production. While sedimentation is the most widespread cause of stream impairment resulting from agricultural activities, it should be noted that statewide agricultural soil loss rates had dropped from 1982 to 1992 based on statistics compiled by the USDA Natural Resources Conservation Service (Section 3.2.4).

Improper application of pesticides and fertilizers (including chemical fertilizers, manure and spray application of lagoon wastewater) can result in these substances being washed from fields. Field buffers would again minimize this potential problem. Improperly designed storage or disposal sites can also be a problem. Construction of drainage ditches on poorly drained soils enhances the movement of stormwater into surface waters, and channelization of natural streams destroys habitat values. In addition, use of small streams for irrigation can dewater the streams and cause localized impacts.

Concentrated animal operations can be a significant source of nutrients, biochemical oxygen demand and fecal coliform bacteria if wastes are not properly managed (see Section 5.3.1 of Chapter 5 for discussion of animal waste rules). Impacts can result from over-application of wastes to fields, from leaking lagoons and from unpermitted flows of lagoon liquids to surface waters from improper waste lagoon management. Also there are potential concerns associated with nitrate-nitrogen movement through the soil from poorly constructed lagoons and from wastes applied to the soil surface.

The bar chart in Figure 3.9 presents a comparison between the amount of nutrients generated through manure and the amount of nutrients needed for crop and forage production for the counties in the White Oak River basin. A percentage greater than 100 means that there are more nutrients generated in the manure than can be used by the crops and forage grown in that county. Plant recoverable manure nutrients are those that remain from the time the animal voids the manure till the time it is transported to the field for spreading (in other words, the nutrients can be recovered or taken up and used by the plants). During this period, much of the nutrients can be lost through drying or dilution, surface runoff, volatilization or microbial digestion. Since different manure management systems either conserve or sacrifice varying amounts of nutrients, an estimate was made of the percentage of farms using specific systems. These percentages were applied to the manure characteristics appropriate to the specific method which gave the remaining nutrients after storage and treatment losses.

As indicated in Figure 3.9, Carteret County manure production does not come close to exceeding the nutrient requirements of crops in that county. At the other extreme is Onslow County where values for phosphate, zinc and copper are all in excess of 100% of plant needs. It should be noted that these figures do not take into account commercial fertilizer applications in the counties.

These data were calculated by Dr. James Barker and Dr. Joseph Zublena of NCSU for a draft report entitled "Livestock Manure Nutrient Assessment in North Carolina" (Barker and Zublena, 1995). The report was initiated to: 1) geographically depict where the livestock are located and identify "clustering effects", i.e., high densities of livestock production around support facilities such as feed mills, hatcheries, processing plants, etc.; 2) assess current generation of manure by county; 3) determine the amount of nutrients from manure which can be recovered and made available to agronomic crops; 4) determine the quantity of nutrients required for non-legume agronomic crops and forages in each county; and 5) calculate the percent of agronomic crop and forage nutrients which can be supplied by animal manure.

In the estuarine (saltwater) portion of the White Oak River Basin, it is estimated that 5,398 acres of impaired waters are experiencing water quality problems that can be at least partly attributed to agricultural activities. This figure represents 45% of the total impaired saltwater acreage. This information is derived from the table in Chapter 4 which presents use support data for estuarine waters in the basin. In the freshwater portion of the basin, there are approximately 11 miles of streams that are impaired due to nonpoint source activities. It is unclear whether or not the nonpoint source is agricultural in nature.

While, as noted above, the most widespread cause of freshwater stream impairment associated with agriculture is sedimentation, nutrients, fecal coliform bacteria, biochemical oxygen demand

and pesticides are all potential concerns. Nutrient-related problems, primarily seen as excessive algal or aquatic weed growth, are not always evident in the receiving stream adjoining a farm. Rather, they may be seen in a downstream impoundment, sluggish creek or estuary many miles away. In the White Oak River basin, this is evident in the New River estuary which has been designated as Nutrient Sensitive Waters. Chapter 5 discusses programs aimed at minimizing agricultural nonpoint source pollution. Recommended management strategies for reducing nutrients and sediment runoff can be found in Chapter 6. A list of agricultural BMPs is included in Appendix V.

Urban

Runoff from urbanized areas, as a rule, is more localized but generally more severe than agricultural runoff. The rate and volume of runoff in urban areas is much greater due to the high concentration of impervious surface areas and to storm drainage systems that rapidly transport stormwater to nearby surface waters. These drainage systems, including curb and guttered roadways, allow urban pollutants to reach surface waters quickly and with little or no filtering by vegetated areas. These affects are further exacerbated by replacement of small streams and riparian vegetation with pipes. Urban pollutants include lawn care products such as pesticides and fertilizers; automobile-related pollutants such as fuel, lubricants, abraded tire and brake linings; lawn and household wastes (often dumped in storm sewers); and fecal coliform bacteria (from animals and failing septic systems).

Many urban streams are rated as biologically poor. As presented in the Use Support section of Chapter 4, it is estimated that there are approximately 8 miles of freshwaters in the White Oak Basin that are thought to be impaired due to urban runoff. More importantly, urban runoff is identified as a partial contributor to the impairment of an estimated 11,183 acres of saltwaters. This represents 94% of the total impaired acreage. Urban runoff is a major issue in coastal areas where closed shellfish waters are increasing in response to coastal development (Barber et. al., 1994).

Construction

Construction activities that entail excavation, grading or filling, such as road construction or land clearing for development, can produce large amounts of sediment if not properly controlled. As a pollution source, construction-related activities are temporary in nature; however, as discussed under the section on sediment, above, the results can be severe and long-lasting. In areas where the growth rate is high, such activities should be monitored to ensure that stream impairment does not occur. A list of BMPs to address construction-related water quality impacts is presented in Appendix V.

Forestry

Forestry, a major industry in North Carolina, can impact water quality in a number of ways. Ditching and draining of naturally forested low-lying lands in order to create pine or hardwood plantations can change the hydrology of an area and significantly increase the rate and flow of stormwater runoff. Clearing of trees through timber harvesting and construction of logging roads can produce sedimentation. Removing riparian vegetation along stream banks can cause water temperature to rise substantially, and improperly applied pesticides can result in toxicity problems. Timber harvesting occurs throughout much of the upper basin and is often done at the onset of clearing for site development. As summarized in Chapter 4, it is estimated that in the estuarine portion of the basin, forestry contributes to 25% (2,940) of the total impaired acreage. A list of forestry BMPs is presented in Appendix V.

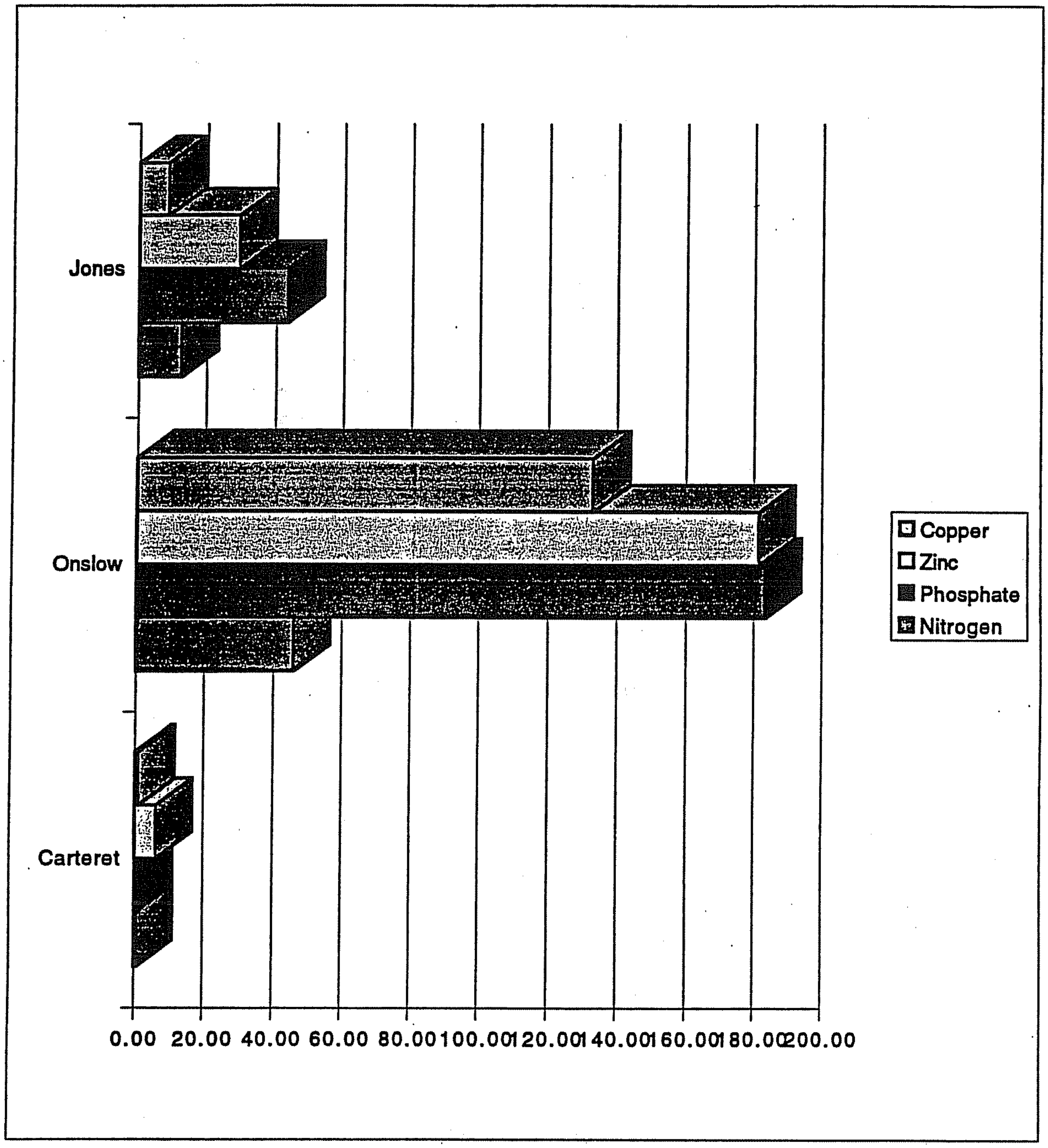

Figure 3.9 Percent of Non-legume Agronomic Crop and Forage Nitrogen and Phosphorus Needs Supplied by Recoverable Plant Available Manure Nutrients (NCSU 1995)

Mining

Mining is a common activity in the Piedmont and Coastal Plain regions and can produce high localized levels of stream sedimentation. Sediment may be washed from mining sites or it may enter streams from the wash water used to rinse some mined products. In addition, abandoned gold mined lands are suspected of being the sources of mercury in stream waters because of its historic use for the amalgamation of gold. Mining has not been identified as a source of pollution in the White Oak basin. A list of BMPs to address mining is presented in Appendix V.

On-site Wastewater Disposal

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. These systems can provide safe and adequate treatment of wastewater; however, improperly placed, constructed or maintained septic systems can serve as a significant source of pathogenic bacteria and nutrients. These pollutants may enter surface waters both through or over the soil. They may also be discharged directly to surface waters through *straight pipes* (i.e., direct pipe connections between the septic system and surface waters). These types of discharges, if unable to be eliminated, must be permitted under the NPDES program and be capable of meeting effluent limitations specified to protect the receiving stream water quality which includes a requirement for disinfection.

On-site wastewater disposal is widely used in the White Oak River Basin. It is estimated that septic tanks contribute to 65% (7,755 acres) of the impairment of saltwaters in the basin. As mentioned earlier in this chapter, there are currently 18,700 septic systems in Onslow County, serving 38% of county residents, while Carteret County's 7,000 systems provide waste treatment for 56% of the population (Malcolm Pirnie, Inc. 1995). It is well known that many areas of these counties have either poorly drained or excessively drained soils which are not suitable for the construction of septic fields. A list of BMPs for on-site wastewater disposal is presented in Appendix V.

Solid Waste Disposal

Solid wastes may include household wastes, commercial or industrial wastes, refuse or demolition waste, infectious wastes or hazardous wastes. Improper disposal of these types of wastes can serve as a source of a wide array of pollutants. The major water quality concern associated with modern solid waste facilities is controlling the leachate and stabilizing the soils used for covering many disposal facilities. Properly designed, constructed and operated facilities should not significantly effect water quality.

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CHAPTER 4

WATER QUALITY AND USE SUPPORT RATINGS IN THE WHITE OAK RIVER BASIN

4.1 INTRODUCTION

This chapter provides a detailed overview of water quality and use support ratings in the White Oak River Basin. It is divided into two major parts and five sections.

Water Quality Monitoring and Assessment

- **Section 4.2** describes seven water quality monitoring programs conducted by the Environmental Sciences Branch of the Division of Water Quality's (DWQ's) Water Quality Section. Consideration of information reported by researchers and other agencies within the White Oak River Basin is also included. Basinwide data summaries are presented for several of the programs.
- **Section 4.3** presents a narrative summary of water quality findings for each of the five subbasins in the basin. This summary is based on the monitoring programs described in Section 4.2 Also included are watershed maps which show the locations of monitoring sites.

Use-Support Ratings

- **Section 4.4** introduces the concept of use-support ratings and describes how they are derived. Using this approach, water quality for specific surface waters in the basin is assigned one of the following four use-support ratings: fully supporting uses, fully supporting but threatened, partially supporting or not supporting uses.
- **Section 4.5** presents the use support ratings for many streams and estuaries in the White Oak basin through a series of tables and figures. Included is a color-coded 2-page use support map of the basin (Figure 4.23).

4.2 WATER QUALITY MONITORING PROGRAMS

Division of Water Quality

DWQ's monitoring program integrates biological, chemical, and physical data assessment to provide information for basinwide planning. Below is a list of the seven major monitoring programs, each of which is briefly described in the following text.

- Benthic macroinvertebrate monitoring (Section 4.2.1 and Appendix II),
- Fish population and tissue monitoring(Section 4.2.2 and Appendix II),
- Lakes assessment (including phytoplankton monitoring) (Section 4.2.3 and Appendix II),
- Aquatic toxicity monitoring (Section 4.2.4),
- Special studies and chemical/physical water quality investigations (Section 4.2.5),
- Sediment oxygen demand monitoring (Section 4.2.6), and
- Ambient water quality monitoring (covering the period 1990-1994) (Section 4.2.7).

US Marine Corps

The US Marine Corps also collects physical and chemical water quality data in the basin. This is briefly described in Section 4.2.8.

4.2.1 Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom of rivers, streams and estuaries. The benthic organisms collected most often in freshwater monitoring are aquatic insect larvae. In estuarine (saltwater) systems the benthic organisms most often collected include molluscs (such as clams and snails), crustaceans (such as crabs and shrimp) and polychaetes (worms). The use of benthos data has proven to be a reliable water quality assessment tool, as these organisms are relatively immobile and sensitive to subtle changes in water quality. Since many organisms in a community have life cycles of six months to one year, the effects of short term pollution (such as an oil or chemical spill) will generally not be overcome until the following generation appears. The benthic community also responds to, and shows the effects of, a wide array of potential pollutant mixtures.

For *freshwater* streams and rivers, criteria have been developed to assign five bioclassifications ranging from Poor to Excellent to each benthic sample. The bioclassifications include Excellent, Good, Good- Fair, Fair and Poor. The bioclassifications are based on the number of different kinds of species (taxa) present in three groups of pollution-intolerant insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). These three groups are used to develop EPT ratings. Likewise, ratings can be assigned with a Biotic Index (Appendix II). This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification. Higher taxa richness values (i.e. a greater number of different kinds of species) are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is inadequately assessed by a taxa richness analysis alone. Different classification criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina.

For *estuarine* waters the effort to develop a method to assess water quality based on macroinvertebrates started in North Carolina in late 1990. An Estuarine Biotic Index designed for Florida was modified to create the North Carolina Estuarine Biotic Index (EBI) which more closely reflects taxa and tolerances in North Carolina and can accurately rank sites of different water quality. Biocriteria based on these metrics are still being developed, so at the present time estuarine samples cannot be given a water quality rating.

<u>Benthic Macroinvertebrate Sampling in the White Oak Basin</u>

The White Oak River Basin contains both freshwater and estuarine benthic sampling sites. Freshwater samples have been analyzed and assigned a water quality rating as briefly described above. As noted, criteria for assigning water quality ratings in estuarine waters have not been fully developed at this time. However, twenty-five estuarine locations were sampled for macroinvertebrates in the White Oak River Basin during the summer of 1994. These samples have been used to provide a descriptive assessment of water quality. Results of all benthic sample analyses will be discussed in the upcoming subbasin descriptions in section 4.4 of this chapter.

4.2.2 Fisheries Monitoring

To the public, the condition of the fishery is one of the most meaningful indicators of ecological integrity. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web will affect the abundance, species composition, and condition of the fish population. Two types of fisheries monitoring are conducted by DWQ and described briefly below. The first, called Fish Community Structure, involves assessing the overall health of the fish community. The second, called Fish Tissue

Analysis, involves analyzing fish tissues to determine whether they are accumulating metals or organic chemicals. This information is useful as an indicator of water quality and is also used to determine whether human consumption of these fish poses a potential health risk.

Fish Community Structure

As noted above, fish community structure involves assessing the overall health of the fish community as a means of assessing the quality of the ecosystem in which the fish reside. Fish community structure is assessed using a method called the North Carolina Index of Biotic Integrity (NCIBI). This method, which is a modification of Karr's IBI (1981), was developed as a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The index, (which is described in more detail in Appendix II), incorporates information about species richness and composition, trophic composition, fish abundance and fish condition. At this time there is no Index of Biotic Integrity calculated for fish populations in lakes.

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

Fish Community Structure in the White Oak Basin

Fish community structure (IBI) analyses were performed on data from 6 sites in the White Oak River Basin collected by DWQ. On average, these data indicated good water quality for all sites sampled. A limited number of samples were taken in this basin since IBI analyses are only performed in wadable freshwaters. The majority of the waters in the White Oak Basin do not meet this criteria.

Fish Tissue Analysis

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Therefore, by analyzing fish tissue, determinations about what chemicals are in the water can be made. Contamination of aquatic resources, including freshwater, estuarine, and marine fish and shellfish species has 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. Therefore, results from fish tissue monitoring can serve as an important indicator of contamination of sediments and surface water. Fish tissue analysis results are also used as indicators for human health concerns, fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem.

In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with federal Food and Drug Administration (FDA) *action levels* and U.S. Environmental Protection Agency (EPA) recommended *screening values* for contaminants.

The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue parameters accompanied by their FDA criteria are presented in Appendix II. At present, the FDA has only developed metals action level criteria for mercury (1.0 ppm). Individual parameters which appear to be of potential human health concern are evaluated by the N.C. Division of Epidemiology by request of DWQ.

Fish Tissue Analyses in the White Oak Basin
Fish tissue samples were collected at 8 sites from 1983 to 1994 within the White Oak River basin consisting of 79 observations. Samples were collected as part of the DWQ's ambient fish tissue monitoring program or as part of special mercury studies.

Fish or shellfish samples collected within the White Oak basin were analyzed for metals contaminants only. Metals in samples from all but one station were non-detectable or present at levels below FDA action level and EPA screening criteria. Great Lake (Craven Co.) contained elevated mercury in 6 of 26 samples (23%). Two contained mercury exceeding both FDA and EPA criteria and four others contained mercury exceeding just the EPA criteria. Significant mercury contamination was associated with older, top predator fish species. Elevations in contaminants suggest a need for further sampling in the lake, but may not indicate human health or ecological concerns.

4.2.3 Lakes Assessment Program (including Phytoplankton)

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lakes Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed.

One way to evaluate the health of a lake is to examine the growth of phytoplankton. Phytoplankton are microscopic algae found in the water column of lakes, rivers, streams, and estuaries. Phytoplankton populations respond to the availability of nutrients (phosphorus and nitrogen) and other environmental factors such as light, temperature, pH, salinity, water velocity, and grazing by organisms in higher trophic levels. Phytoplankton may be useful as indicators of nutrient overenrichment (see following paragraph on trophic status) and are often collected with water quality samples from lakes. Prolific growths of phytoplankton sometimes result in "blooms" in which one or more species of algae may discolor the water or form visible mats on top of the water. These blooms, which are often due to high concentrations of nutrients, may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An Algal Bloom Program was initiated in 1984 to document suspected algal blooms with species identification, quantitative biovolume, and density estimates. Usually, an algal sample with a biovolume larger than 5000 mm^3/m^3, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 µg/l (the North Carolina state standard) constitutes a bloom. Bloom samples may be collected as a result of complaint investigations, fish kills, or during routine monitoring if a bloom is suspected.

Another measure of water quality in lakes is the North Carolina Trophic State Index (NCTSI). This is a numerical index that is used to evaluate the trophic status of lakes, and it can be used to determine whether the designated uses of a lake have been threatened or impaired by pollution. Trophic status is a relative measure of nutrient enrichment and productivity. The NCTSI index is based on total phosphorus, total organic nitrogen, secchi depth (water clarity indicator) and chlorophyll-a. Basin on this index, a lake is assigned one of five trophic status classifications: Oligotrophic, Mesotrophic, Eutrophic, Hypereutrophic and Dystrophic. Oligotrophic lakes are those that have the lowest levels of enrichment and generally have good clarity and no problems with algal blooms. At the other end of the spectrum are eutrophic and hypereutrophic lakes which have a lot of plant productivity which can cause nuisance problems and have little clarity in the water column. Dystrophic lakes are acidic blackwater lakes scattered throughout the coastal plain. Their NCTSI scores are highly skewed because of their natural discoloration. Further details of the NCTSI can be found in Appendix II.

Lakes Studies in the White Oak

There were two lakes in the White Oak River Basin sampled as part of the Lakes Assessment Program. These lakes are Catfish Lake and Great Lake, both of which are in subbasin 030501. Each lake is individually discussed in the appropriate subbasin section with a focus on the most recent available data. These lakes, which were sampled most recently in 1994, fully support their designated uses.

4.2.4 Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of wastewater treatment 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. The Aquatic Survey and Toxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update 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.

Aquatic Toxicity Monitoring in the White Oak

There are 11 facilities in the basin that are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. A list of these facilities is included in Appendix II. Other facilities may be tested by DWQ's Aquatic Toxicology Laboratory.

4.2.5 Special Studies and Chemical/Physical Characterizations

Water quality simulation models are often used for the purpose of determining wasteload allocations. These models must accurately predict water body responses to different waste loads so that appropriate effluent limits can be included as requirements in National Pollutant Discharge Elimination System (NPDES) permits. Where large financial expenditures or the protection of water quality is at risk, models should be calibrated and verified with actual in-stream data. Because sufficient historical data are often lacking, intensive water quality surveys are required to provide the field data necessary to accomplish model calibration and verification. Intensive water quality surveys are performed on water bodies below existing or proposed wastewater dischargers and usually consist of a time-of-travel dye study, flow measurements, physical and chemical samples, long-term biochemical oxygen demand (BOD_{lt}) analysis, water body channel geometry, and effluent characterization analysis.

Special Studies and Chemical/Physical Characterizations in the White Oak River Basin

There have been a number of studies in the White Oak River Basin to calibrate water quality models or to investigate specific issues such as the animal waste spill that occurred in the summer of 1995 or the impact of marinas on water quality. Some of these studies are discussed in detail in the sections on specific subbasins in this chapter. The White Oak River Basin Assessment Document summarizes all of them (DEM, 1996).

4.2.6 Sediment Oxygen Demand

The concentration of dissolved oxygen in surface waters can be affected by bacterial action and chemical processes in bottom sediments. If oxygen depletion in surface waters is suspected due to the characteristics of bottom sediments, then sediment oxygen demand (SOD) studies may be performed. Each stream reach is divided into a series of segments. The number of stream segments that must be evaluated with an intensive survey depends on the individual study and the spatial resolution desired. Intensive surveys and SOD evaluations are reported as a series of field data tables and summaries of laboratory analysis reports.

<u>SOD Studies in the White Oak Basin</u>

In July 1992, a Sediment Oxygen Demand (SOD) study was conducted in the White Oak River Basin on the New River. The purpose of test was to provide water quality data for assimilative capacity modeling of the New River near Jacksonville. The data indicated minimal SOD resulting from the presence of oxygen consuming sediments in that area of the New River. In addition, EPA Region IV conducted seven SOD tests in subbasins 03-05-02 and 03-05-03 during 1987 and 1988.

4.2.7 Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine (saltwater) water quality monitoring stations (about 380 statewide) strategically located for the collection of physical and chemical water quality data. The type of water quality data, or parameters, that are collected is determined by the waterbody's freshwater or saltwater classification and corresponding water quality standards. Table 4.1 summarizes the types of water quality data collected at ambient stations.

Table 4.1 Ambient Monitoring System Parameters

<u>C and SC WATERS</u> (minimum monthly coverage for all stream stations)
- dissolved oxygen,
- pH, <u>WATER SUPPLY</u>
- conductivity,
- temperature,
- salinity (SC),
- secchi disk (where appropriate),
- nutrients: total phosphorus, ammonia, total Kjeldahl nitrogen, nitrate+nitrite,
- total suspended solids,
- turbidity,
- hardness,
- chlorides (SC),
- fecal coliforms,
- metals: aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, zinc

<u>NUTRIENT-SENSITIVE WATERS:</u>
- Chlorophyll *a* (where appropriate)

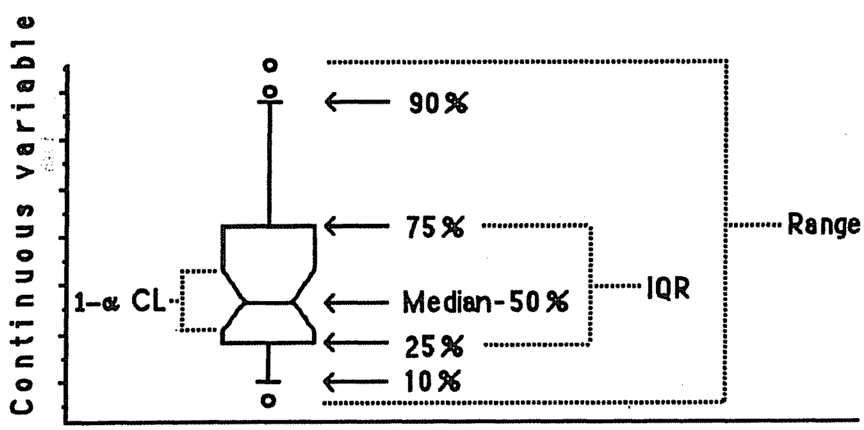
- chlorides,
- total coliforms,
- manganese,
- total dissolved solids

<u>SA WATERS</u>:
- Fecal coliforms

Ambient water quality data are often summarized using box and whisker plots (for example see Figure 4.11). Figure 4.1 provides an explanation of how to interpret the plots.

Figure 4.1 Box and Whisker Plots

Box and whisker plot are useful for the visual comparison of single variable data sets. After the data have been ordered from low to high, the 10th, 25th, 50th, 75th, and 90th percentiles are calculated for plot construction. Box and whisker plots display the following important information: 1) the interquartile range (IQR) which measures the distribution and variability of the bulk of the data (located between the 25th and 75th percentiles), 2) the desired confidence interval (1- CL) for measuring the statistical significance of the median (50th percentile), 3) indication of skew from comparing the symmetry of the box above and below the median, 4) the range of the data from the lowest to highest values, and 5) the extreme values below the 10th percentile and above the 90th percentile (depicted as dots).



Visual comparison of confidence level notches about the medians of two or more box plots can be used to roughly perform hypothesis testing. If the box plots represent data from samples assumed to be independent, then overlapping notches indicate no significant difference in the samples at a prescribed level of confidence. Formal tests should subsequently be performed to verify preliminary conclusions based on visual inspection of the plots.

AMS data for the White Oak Basin are briefly summarized in the tables below. Discussion of the data are presented in Section 4.3.1 through 4.3.4 for each major drainage area.

Table summaries of ambient water chemistry data for all Ambient Monitoring System (AMS) stations within the White Oak River Basin are located in the Basinwide Assessment Report Support Document (DEM, 1996). These tables summarize data from 1990 through 1994 for common selected chemical parameters. They include station summary information, descriptive statistics for parametric data, water quality criteria information for the station's classification, a yearly breakdown of selected parametric data and descriptive statistics for parametric data from summer months. The April-October months are used in summer modeling applications, June-September months are used in worst-case, low-flow analyses.

There are 20 AMS stations in the White Oak River Basin. These stations are presented in figure 4.2 and listed in Table 4.2

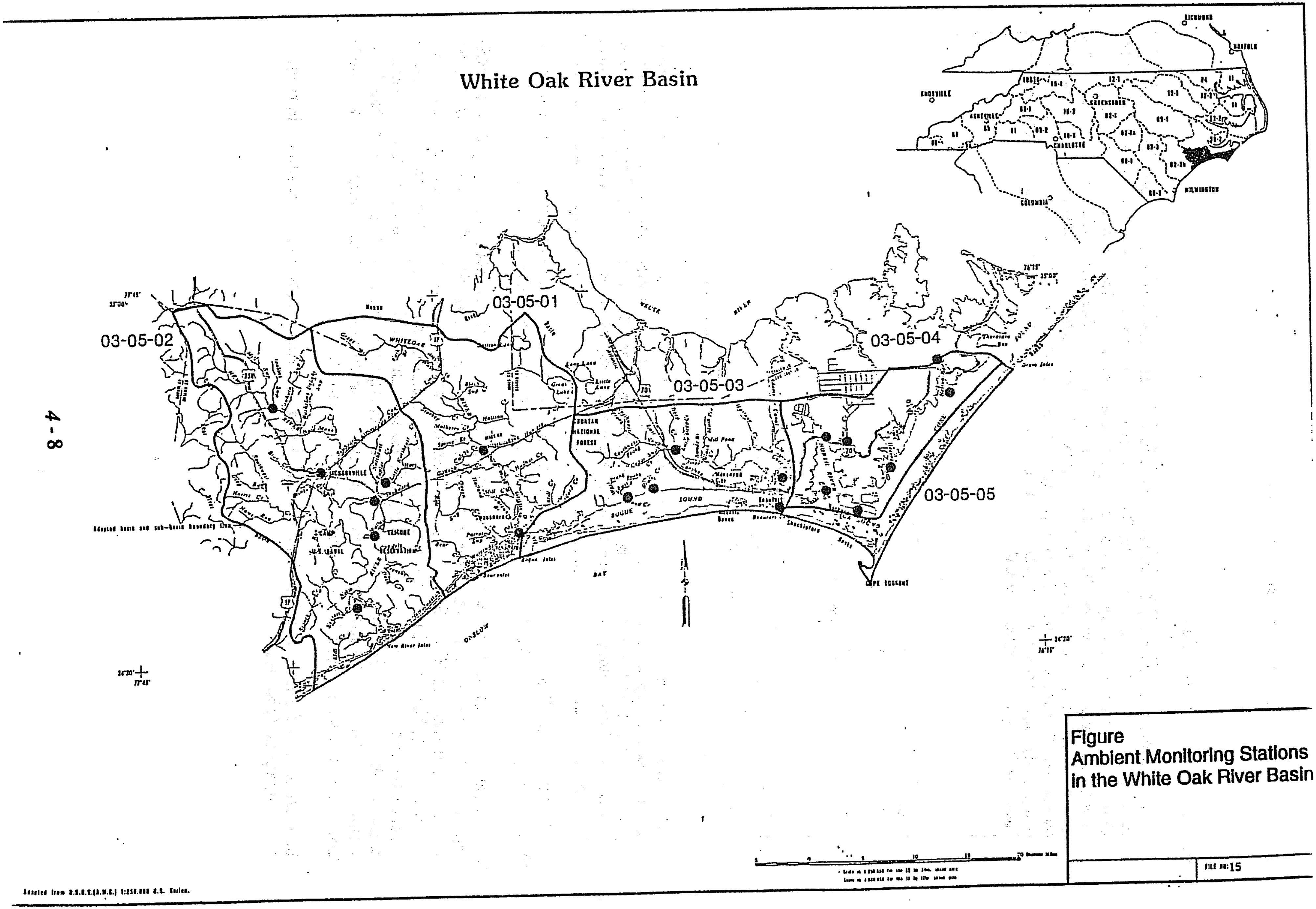


Figure 4.2 Ambient Monitoring System Stations in the White Oak River Basin

Table 4.2. Ambient Monitoring System Stations Within the White Oak Basin.

Primary No	STORET No.	Station Name	Subbasin
White Oak River Drainage			
02092744	P6400000	WHITE OAK RIVER NR STELLA NC	030501
02092760	P6850000	WHITE OAK R AT SWANSBORO NC	030501
New River Drainage			
02093000	P0600000	NEW RIVER AT SR 1314 NEAR GUM BRANCH NC	030502
02093032	P1200000	NEW RIVER AT US HWY 17 AT JACKSONVILLE NC	030502
0209317585	P3100000	LITTLE NORTHEAST CK @ SR1406 NR JACKSONVILLE NC	030502
02093186	P3700000	NORTHEAST CK AT NC HWY 24 @ JACKSONVILLE NC	030502
0209319360	P4400000	WALLACE CK @ RIVER DR @ CAMP LEJEUNE NC	030502
02093197	P4750000	NEW RIVER NR SNEEDS FERRY NC	030502
Newport River Drainage			
02092702	P7300000	NEWPORT RIVER AT SR 1247 AT NEWPORT NC	030503
WOK037C	P8700000	NEWPORT RIVER @ CM G 1 @ NEWPORT MARSHES	030503
WOK039C4	P8965500	MOREHEAD CITY HARBOR @ CM G15 NR MOREHEAD CITY	030503
0209270870	P9580000	BOGUE SOUND @ CM G 15 NR SALTER PATH NC	030503
0209270940	P9600000	BOGUE SOUND AT EMERALD ISLE NC	030503
North River Drainage			
0209270760	P8975000	NORTH RIVER @ US HWY 70 NEAR BETTIE NC OPGF-Q	030504
0209270780	P8976000	WARD CREEK @ US HWY 70 NEAR OTWAY NC OPGF-Q	030504
0209268982	P8978000	BROAD CREEK @ US HWY 70 NR MASONTOWN NC OPGF-Q	030504
0209270790	P8990000	NORTH RIVER AT CM R 56 NEAR BEAUFORT NC	030504
Coastal Drainage			
WOK045	P9720000	BACK SOUND AT CM G 3 AT HARKERS ISLAND NC	030504
WOK046	P9730000	CORE SOUND @ CM R36 NR JARRETT BAY	030504
WOK047	P9740000	CORE SOUND @ CM G 1 @ ENTRANCE TO NELSON BAY CA	030504

Table 4.3. lists those ambient stations in the White Oak Basin for those stations where any sampling results exceeded the water quality criterion for specific water quality parameters. Each station is listed with the following information: parameter that was exceeded, the total number of samples, the number of samples with less than detection level recorded, and the number of samples for that parameter that represented an excursion from a water quality criterion. Thirteen of the total 20 ambient stations in the basin are included in this table. Five stations have two parameters that exceed the criteria and one has exceedences of three criteria.

It should be noted that the criteria are numeric criteria (not narrative) and represent instantaneous measurements. The actual water quality standard for each parameter may include a narrative description, such as for turbidity. Also, as in some metals criteria, standards may be based on extended exposure at or above the criteria to expect chronic toxicity of the most sensitive species of organism. Therefore the table is useful for relative comparisons between locations and screening areas where frequent excursions of individual or multiple parameters suggest waters that might be targeted for more detailed evaluations and/or specific management strategies. A more thorough evaluation can include review of temporal and spatial trends in the water quality data, association of concentrations to flow, degree of excursion from the criterion, or use of other analytical methods.

Later in this chapter, where individual subbasins are discussed, ambient monitoring data are compared to water quality standards to help indicate the health of a stream. *Action levels* are a special subgroup of water quality standards that apply to substances that are not generally bioaccumulative and have variable toxicity to aquatic life depending upon their chemical form, solubility or the characteristics of the receiving stream. Parameters for which action levels are applied include copper, iron, silver, zinc, chloride and residual chlorine. Given the variable toxicity of action level parameters, a water quality sample which exceeds an action level does not necessarily indicate water quality impairment. Biological monitoring is often used as a complementary measure to indicate the overall health of the stream.

Table 4.3. Summary of Ambient Monitoring System Station Data Excursions from the NC Water Quality Criteria by Parameter (other than fecal coliforms (see Table 4.4) and chlorophyll a). January 1990 to December 1994.

Station Number	Station Name	Parameter/Criterion	Samples All	Samples <Det	Excur
White Oak River Drainage					
02092744	WHITE OAK RIVER NR STELLA NC	pH (SU) [6.8]	30	0	3
New River Drainage					
02093000	NEW RIVER AT SR 1314 NEAR GUM BRANCH NC	Dissolved Oxygen (mg/l) [4]	56	0	3
02093032	NEW RIVER AT US HWY 17 AT JACKSONVILLE NC	Dissolved Oxygen (mg/l) [4]	55	0	1
0209317585	LITTLE NORTHEAST CK @ SR1406 NR JACKSONVILLE NC	Dissolved Oxygen (mg/l) [4]	55	0	13
0209319360	WALLACE CK @ RIVER DR @ CAMP LEJEUNE NC	Dissolved Oxygen (mg/l) [4]	55	0	1
02093032	NEW RIVER AT US HWY 17 AT JACKSONVILLE NC	pH (SU) [6.8]	56	0	6
02093186	NORTHEAST CK AT NC HWY 24 @ JACKSONVILLE NC	pH (SU) [6.8]	52	0	10
0209319360	WALLACE CK @ RIVER DR @ CAMP LEJEUNE NC	pH (SU) [6.8]	55	0	4
0209317585	LITTLE NORTHEAST CK @ SR1406 NR JACKSONVILLE NC	pH (SU) [6]	54	0	1
02093186	NORTHEAST CK AT NC HWY 24 @ JACKSONVILLE NC	Turbidity (NTU) [25]	52	0	2
0209319360	WALLACE CK @ RIVER DR @ CAMP LEJEUNE NC	Turbidity (NTU) [25]	55	0	1
Newport River Drainage					
02092702	NEWPORT RIVER AT SR 1247 AT NEWPORT NC	Dissolved Oxygen (mg/l) [4]	28	0	4
WOK037C	NEWPORT RIVER @ CM G 1 @ NEWPORT MARSHES	Nickel (µg/l) [8.3]	16	15	1
02092702	NEWPORT RIVER AT SR 1247 AT NEWPORT NC	pH (SU) [6]	28	0	4
North River Drainage					
0209268982	BROAD CREEK @ US HWY 70 NR MASONTOWN NC OPGF-Q	Dissolved Oxygen (mg/l) [4]	30	0	3
0209270780	WARD CREEK @ US HWY 70 NEAR OTWAY NC OPGF-Q	Nickel (µg/l) [8.3]	29	28	1
0209268982	BROAD CREEK @ US HWY 70 NR MASONTOWN NC OPGF-Q	pH (SU) [6.8]	28	0	6
0209270760	NORTH RIVER @ US HWY 70 NEAR BETTIE NC OPGF-Q	Turbidity (NTU) [25]	30	0	3
0209270780	WARD CREEK @ US HWY 70 NEAR OTWAY NC OPGF-Q	Turbidity (NTU) [25]	29	0	2
Coastal Drainage					
WOK047	CORE SOUND @ CM G 1 @ ENTRANCE TO NELSON BAY CA	Cadmium (µg/l) [5]	14	13	1

Fecal Coliform Bacteria

Fecal coliform bacteria behave differently than most other water quality parameters, and these differences must be considered when using them to evaluate water quality. (See Chapter 3 for further discussion of fecal coliform bacteria). Available information was reviewed to identify potentially impaired waters and locate potential sources of pollutants in order that targeting efforts and appropriate management strategies can be developed. As sampled in the ambient monitoring system, fecal coliform bacteria are most useful as a screening tool to estimate the cumulative inputs from multiple sources, but in some instances can be used to locate a single large source of bacteria. In coastal waters, fecal coliform bacteria are sampled by other agencies in addition to DWQ. Other portions of this plan incorporate data and information from other agencies, whereas this discussion presents data gathered from DWQ's ambient monitoring network.

A geometric mean of two hundred (200) colonies/100 milliliters (based on the membrane filter method (MF)) using five samples collected within 30 days is the fecal coliform standard for Class SC, SB, C and B waters. In addition, no more than 20% of the samples can exceed 400/100 ml. A median of fourteen (14) per 100 milliliters is the standard for SA, or shellfishing waters, and no more than 10% of the samples can exceed 43/100 ml. The primary screening tool used to look at fecal coliform data is the geometric mean. Sites with 10 or more fecal coliform samples within the last 5 years that have a geometric mean higher than 200 or 14 (depending upon the classification) are considered to be a priority for regional office investigation. Table 4.4 presents a summary of the fecal coliform data collected in the White Oak River Basin.

There were no sites with a geometric mean greater than 200/100 ml in the basin. The highest geometric mean was recorded at Little Northeast Creek (189.4/100ml). This station also had the most samples exceeding 400/100ml (28.6%). Four sites also exceeded 400/100ml in more than 10% of the total samples. These were Little Northeast Creek (28.6%), Broad Creek (13.3%), New River at Gum Branch (11.8%), and Wallace Creek (11.8%).

Table 4.4 Fecal Coliform Data Summary for the White Oak River Basin: 1990-1994

Station Name	Geo-metric Mean	Total Samples	Samples >14/100 ml	%> 14/100 ml	Samples >200/ 100ml	%>200/ 100ml	Samples >400/ 100ml	%> 400/100 ml
NEW RIVER DRAINAGE								
New River @ SR 1314 near Gum Branch	59.5	17	NA	NA	3	17.6	2	11.8
New River @ US Hwy 17 at Jacksonville	41.7	44	NA	NA	6	13.6	1	2.3
Little NE Creek @ SR 1406 near Jacksonville	189.4	14	NA	NA	8	57.1	4	28.6
Northeast Creek @ Hwy 24 @ Jacksonville	63.1	16	NA	NA	3	18.8	1	6.3
Wallace Creek @ River Dr. @ Camp Lejeune	24.8	17	NA	NA	2	11.8	2	11.8
New River near Sneads Ferry	*11*	*46*	*3*	*6.5*	*0*	*0*	*0*	*0*
WHITE OAK R. DRAINAGE								
White Oak River near Stella	*37.6*	*30*	*20*	*66.7*	*4*	*13.3*	*1*	*3.3*
White Oak River @ Swansboro	10	16	NA	NA	0	0	0	0
NEWPORT R. DRAINAGE								
Newport River @ SR 1247 @ Newport	103.8	16	NA	NA	5	31.3	1	6.3
Newport River @ CM G1 @ Newport Marshes	*10.4*	*16*	*1*	*6.3*	*0*	*0*	*0*	*0*
Morehead City Harbor @ CM G15 near Morehead City	*11.3*	*16*	*1*	*6.3*	*0*	*0*	*0*	*0*
Bogue Sound @ CM G15 near Salter Path	*10*	*16*	*0*	*0*	*0*	*0*	*0*	*0*
Bogue Sound @ Emerald Isle	*10*	*16*	*0*	*0*	*0*	*0*	*0*	*0*
NORTH RIVER DRAINAGE								
North River @ Hwy 70 Near Bettie OPGF-Q	*13.2*	*30*	*4*	*13.3*	*1*	*3.3*	*1*	*3.3*
Ward Creek @ Hwy 70 near Otway - OGPF-Q	*18.2*	*29*	*7*	*24.1*	*3*	*10.3*	*0*	*0*
Broad Creek @Hwy 70 near Masontown - OPGF-Q	*91.5*	*30*	*26*	*86.7*	*6*	*20*	*4*	*13.3*
North River @ CM R 56 near Beaufort	*10*	*16*	*0*	*0*	*0*	*0*	*0*	*0*
COASTAL DRAINAGE								
Back Sound n@ CM G 3 @ Harkers Island	*10*	*16*	*0*	*0*	*0*	*0*	*0*	*0*
Core Sound @ CM R36 near Jarrett Bay	*10*	*14*	*0*	*0*	*0*	*0*	*0*	*0*
Core Sound @ CM G 1 @ entrance to Nelson Bay	*11*	*14*	*1*	*7.1*	*0*	*0*	*0*	*0*

NOTE: Stations in *italics* have fecal coliform standard of 14/100 ml (Class SA or shellfishing waters). All other stations have a standard of 200/100 ml. NA = Application of standard Not Applicable.

There are thirteen sites in SA waters in the White Oak Basin. Three sites' geometric mean exceeded the 14/100ml criterion. They were White Oak River at Stella (37.6), Ward Creek (18.2), and Broad Creek (91.5). There was an additional site in SA waters that had more than 10% samples above the 14/100ml criterion. It was North River at Bettie with 13.3% samples greater than 14/100ml. The area of the White Oak River at Stella has been closed to shellfishing since 1967. The cause appears to be runoff from farmland and residential communities. The North River and Ward Creek sites are both currently conditionally approved for shellfishing. Both sites are "impacted" by rainfall. Land development in this area is increasing and the disturbance appears to be causing the runoff problems. Shellfishing is prohibited in Broad Creek area. Drainage from surrounding farms and forestry practices seem to be the major contributing factors in the closure. A canal from Open Grounds Farms directly discharges into Broad Creek; however, there is no direct evidence of contribution of this discharge.

4.2.8 US Marine Corps - Camp Lejeune Monitoring Data

The Marine Corps (USMC) operates seven wastewater treatment plants as part of its training facility at Camp Lejeune. Compliance with NPDES effluent limitations has been difficult to achieve at these existing treatment facilities. As a result the USMC has been required to monitor physical and chemical parameters at 13 sites in the New River as part of its effort to consolidate and improve its wastewater treatment process at Camp Lejeune (see Table 4.5). The USMC has initiated sampling every other week during the warm season (April-October). Monitoring stations are located from Wilson Bay to Channel Marker (CM) 33. Three transects, each with three stations were also established. Sampling began in 1992 and will continue until 1998. Data collected during this period will reflect water quality characteristics before and after the improvements in wastewater treatment are implemented. These improvements will include stringent controls for nutrients.

Table 4.5 USMC water quality monitoring station locations

Station Number	Station Location
1	Wilson Bay
2	Midway between channel markers 50 and 52
3	Channel marker 47
4	Farnell Bay transect - west
5	Farnell Bay transect - middle
6	Farnell Bay transect - east
7	Spring Point transect - west
8	Spring Point transect - middle
9	Spring Point transect - east
10	Grey Point transect - west
11	Grey Point transect - middle
12	Grey Point transect - east
13	Channel marker 33

4.3 NARRATIVE WATER QUALITY SUMMARIES BY SUBBASIN

4.3.1 Subbasin 01 - White Oak River and Tributaries

Description

This subbasin consists of the White Oak River and its tributaries in Onslow, Jones, Craven, and Carteret counties. Most of this area, including its two lakes (Catfish Lake and Great Lake), lies within the Croatan National Forest and Hoffman State Forest and is relatively undisturbed. A significant portion of waters in this subbasin are estuarine, including the waters around Hammocks Beach State Park, the intracoastal waterway, Bogue Sound, much of the White Oak River, and most of Queens Creek and Bear Creek. With the exception of Maysville, most development is on the coast near the towns of Swansboro and Cape Carteret. There are no major dischargers in this subbasin. The largest discharger, Swansboro WWTP, discharges 0.3 MGD into Fosters Creek. Water quality sampling locations are presented in Figure 4.3.

Overview of Water Quality

Ambient Monitoring System Data

There are two ambient chemistry sites in the White Oak River. The most upstream site is at Stella and the most downstream site is near the mouth of the White Oak at Swansboro. The water quality is generally good in the high salinity water at Swansboro with only sporadic measurements of copper greater than the action level (3ug/l) (see page 4-9 for discussion of action levels). White Oak River near Stella is a much more variable site with wide swings in salinity (0 - 17 ppt). Frequent values above the fecal coliform standard and elevated residue during periods of freshwater input suggest some effects from land disturbing activities (logging, construction, etc.) in the area.

The Stella site had 26 total excursions from water quality criteria, the second highest percentage of excursions (4.77%) in the entire basin. There were three (10%) excursions from the pH criterion (low pH) and 19 (63.3%) from the fecal coliform criterion. (Note that for fecal coliform results, an "excursion" indicates an individual sample exceedence of the numeric criterion of 14 cfu/100ml used in the fecal coliform standard. For the full fecal coliform standard to be violated, the *mean of all samples* taken within the specified time period must exceed the numeric criterion. Thus, while these individual excursions are not violations of the fecal coliform standard, they serve as a useful screening tool for further investigation.) The minimum pH value recorded was 6.3 and indicates the low pH excursions were not very much below the 6.8 criterion for salt waters. Both stations in the White Oak drainage have several (17.4% at Stella and 25% at Swansboro) samples recorded above the action level for copper (see page 4-9 for a discussion of action levels). Considering the whole basin for copper samples, 16 of 20 stations recorded samples above the copper action level. This indicates that the presence of copper is probably not due to any point source but due to runoff of natural soil constituents throughout the basin.

The dissolved oxygen data from the White Oak drainage (Figure 4.4) show the typical low summer/high winter readings with some of the summer data from the Stella site dropping below 5.0 mg/l. However, there are no recorded excursions below the criterion of 4.0 mg/l at either site. There is no apparent trend in the data over the past five years. However, the turbidity data appear to indicate a downward trend from 1990 to 1994. This is visually indicated by the data in graph from (Figure 4.5). There is a very high turbidity reading taken in December 1994, the last data point for this basin analysis period, but generally the trend appears to be decreasing over the five-year period.

White Oak River Basin
030501

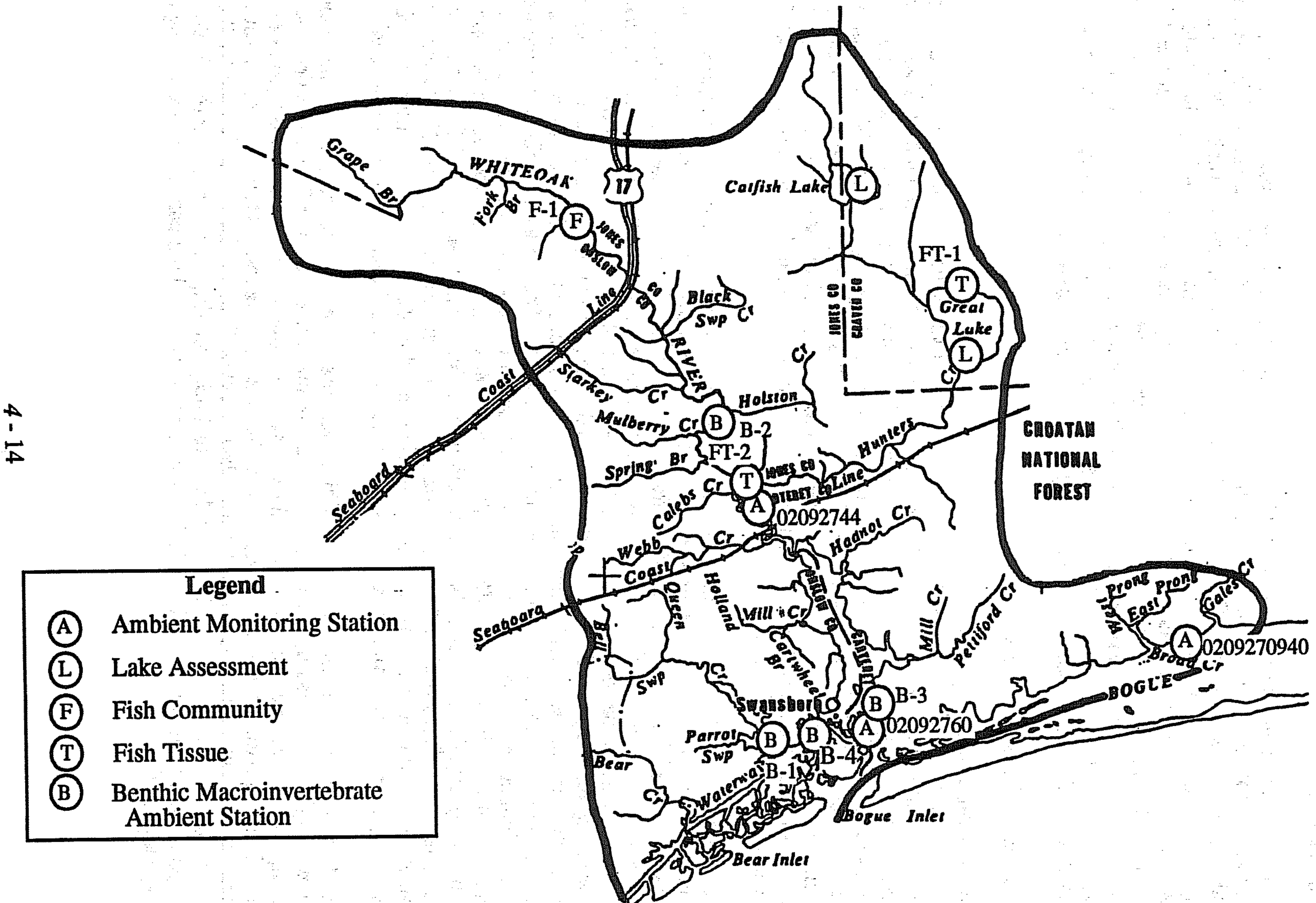


Figure 4.3 Locations of Sampling Locations for Subbasin 01 (White Oak River and portion of Bogue Sound)

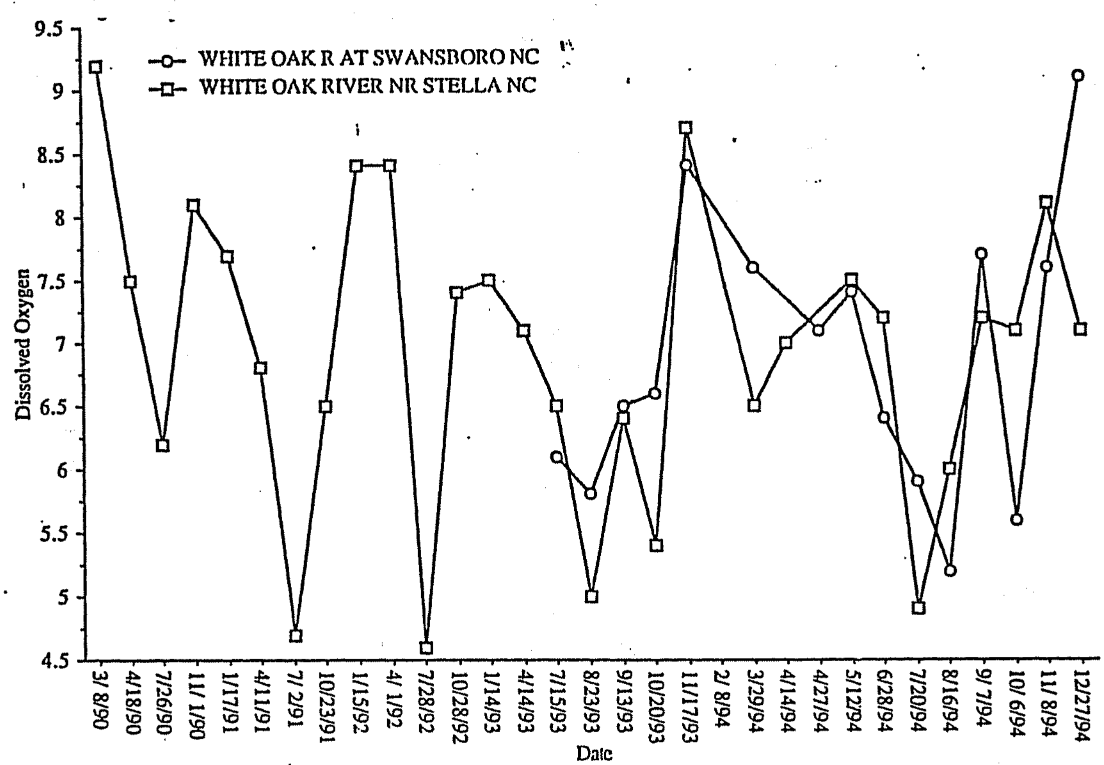


Figure 4.4. Dissolved oxygen (mg/l) from the White Oak drainage, 1990 - 1994.

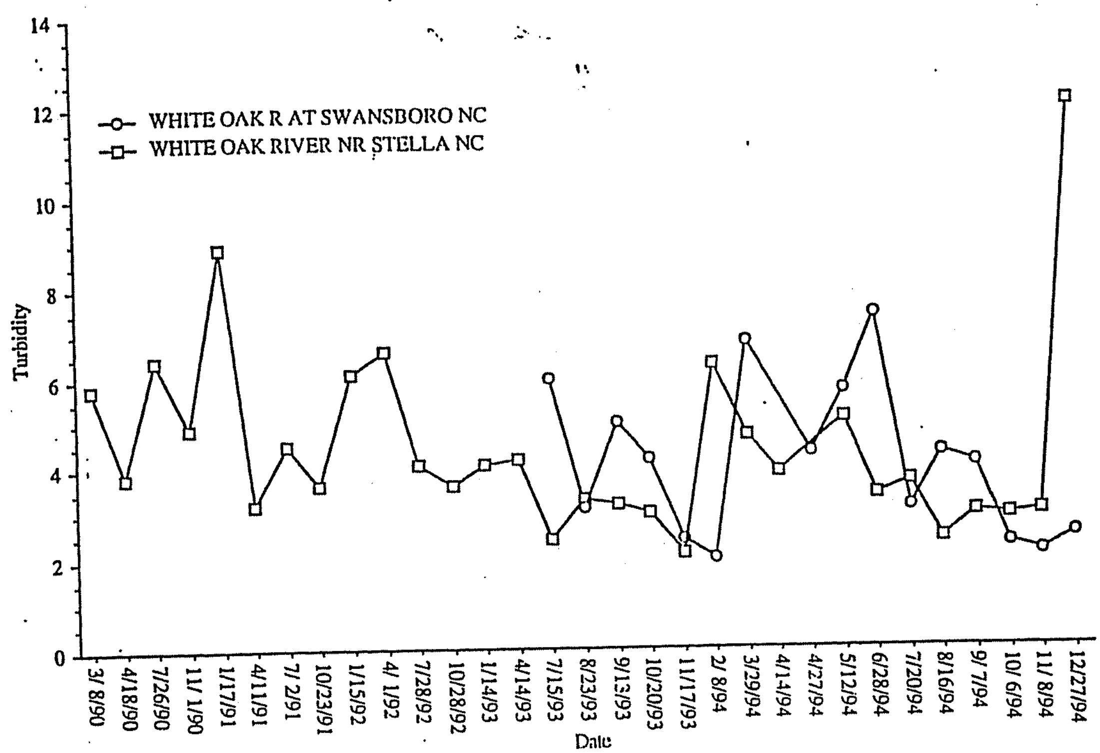


Figure 4.5. Turbidity (NTU) from the White Oak drainage, 1990 - 1994.

An approximately two mile stretch of the White Oak River between Spring Branch and Hunters Creek has been classified as High Quality Waters because it is a primary nursery area (PNA) designated by the Division of Marine Fisheries. Two other areas have been classified as Outstanding Resource Waters (ORW) based on the existence of excellent water quality and significant aquatic resources. The first are the waters between Bear Island (Hammocks Beach State Park) and the Intracoastal Waterway (ICW). The second, and largest area extends from Bogue Inlet eastward including all of Bogue Sound within this subbasin. This area includes Taylor Bay, but excludes all other creeks and bays. Because of the large number of ORW areas in this subbasin, water quality in the sounds is considered to be generally excellent due largely to good tidal flushing.

Water quality concerns have arisen since a bridge was built across the White Oak River in the mid-1930's. It has been suggested that bridge development has decreased tidal flushing in the river (Hosier and Cleary, 1982) which has resulted in elevated coliform and decreased salinity levels. During recent planning of road improvement in the area the NC Department of Transportation has been looking at potential ways to improve hydraulic exchange above and below the bridge. Several resource agencies such as the NC Divisions of Coastal Management, Marine Fisheries and Water Resources were consulted during this process. Final recommendations on the project have not yet been made.

Benthic Macroinvertebrate Data

All but one benthic macroinvertebrate samples collected in this subbasin were estuarine (Table 4.6). The one that was freshwater actually shifted to estuarine with the advance of a saltwater wedge. As mentioned earlier, for estuarine sites, water quality ratings cannot yet be assigned but general characterizations can be made from the data.

Table 4.6. Benthic Macroinvertebrate Data Collected from 1983 through 1994 in the White Oak River Basin - Subbasin 01

Site	Old/New DWQ #	Index #	Date	S/EPT S	(E)BI/BIEPT	Bioclass
Queen Cr, at mouth, Onslow	-/B-1	19-41-16	8/94	103/-	2.3/-	Est
White Oak R, Haywoods Landing, Jones	A/B-2	20-(1)	8/94	36/4	8.77/4.31	Est
			6/86	49/5	7.87/5.83	Est
			7/84	58/8	7.80/7.04	G-F
White Oak R, at Swansboro, Carteret	-/B-3	20-(18)	9/94	65/-	2.0/-	Est
Fosters Cr, off outfall, Onslow	-/B-4	20-35	8/94	64/-	2.7/-	Est

Swansboro WWTP did not appear to have a significant effect on the water quality of Fosters Creek, however the heavy deposits of fine mud at Fosters Creek are probably due, at least in part, to settled particulates from the outfall. While two of the three metrics (S and A+) are higher at Queen Creek, this is due primarily to the presence of oysters and shell hash absent from Fosters Creek. The Biotic Index, a measure of the sensitivity to pollution of the taxa at a site, was higher at Fosters Creek. This suggests that the intolerant shrimp that were found here, but not at Queen Creek, are feeding in the muddy deposits and do not find these muds noxious.

The White Oak River above Swansboro appears to have approximately equivalent water quality with Fosters Creek. The Biotic Index was slightly depressed at this site, however this may be due to the selection of the site. If this area is resampled in the future, the site should be moved closer to the channel for a more favorable flow regime.

Fish Tissue and Community Assessment

Fish have been collected for tissue analysis from Great Lake. Mercury was found to be above FDA levels in the single bowfin collected and one of 15 large mouth bass tested. DWQ conducted one fish community analysis in 1995 on the upper White Oak River, which received an ecological health rating of Good.

Shellfish Water Closures
Problems in this subbasin appear to be related to land disturbing activities, agriculture, and large marinas. Closed shellfish areas (those areas designated as prohibited or restricted by the Division of Environmental Health) include the upper reaches of Bear Creek and Queens Creek, Parrot Creek, Dick Creek, Pettiford Bay, Broad Creek and Gales Creek. Further information concerning shellfish closures can be found in Chapter 3. DMF considers the commercial value of shellfish in this area to be Good; the oyster resource is rated Good-Fair and primarily consumed locally, while the clam resource is rated Good and able to support a commercial fishery.

Lakes Assessment
Water and sediment chemistry samples have been collected in Great Lake and Catfish Lake. No water quality problems were found. The lakes were found to be dystrophic and to have very low pH values (< 4.0).

4.3.2 Subbasin 02 - New River and Tributaries

Description

This subbasin is on the western end of the White Oak River basin, and lies entirely within Onslow County. It contains the New River and its tributaries plus several small coastal streams. Nearly half of this subbasin is estuarine, with estuarine waters in the New River reaching upstream to Jacksonville. Nutrient enrichment is a significant problem in the New River and periodic elevated fecal coliforms also appear to be a recurring problem in this subbasin. Most of the development in this subbasin is on the New River: Richlands near the headwaters, the City of Jacksonville and Camp Lejeune Military Reservation in the middle reaches, and Sneads Ferry near the mouth. There are several significant dischargers in this subbasin: Jacksonville WWTP, five discharges from the Camp Lejeune US Marine Corps Base, and two package plants. Figure 4.6 illustrates the locations of the different sampling stations in this subbasin.

Overview of Water Quality

Ambient Monitoring System Data
The New River drainage has six AMS sites, three on the New River at Gum Branch, Jacksonville, and Sneads Ferry, and three on tributaries (Little Northeast Creek, Northeast Creek, and Wallace Creek). Little Northeast had 13 (23.6%) excursions below the dissolved oxygen criterion, eight (57.1%) above the fecal coliform criterion and one below the pH criterion. (Note that for fecal coliform results, an "excursion" indicates an individual sample exceedence of the numeric criterion of 14 cfu/100ml used in the fecal coliform standard. For the full fecal coliform standard to be violated, the *mean of all samples* taken within the specified time period must exceed the numeric criterion. Thus, while these individual excursions are not violations of the fecal coliform standard, they serve as a useful screening tool for further investigation.) Little Northeast and Northeast Creek do appear to have swamp-like areas along stretches and this could account for chronic low pH and dissolved oxygen; however, these swamp-like conditions would not account for a trend in either parameter up or down.

White Oak River Basin
030502

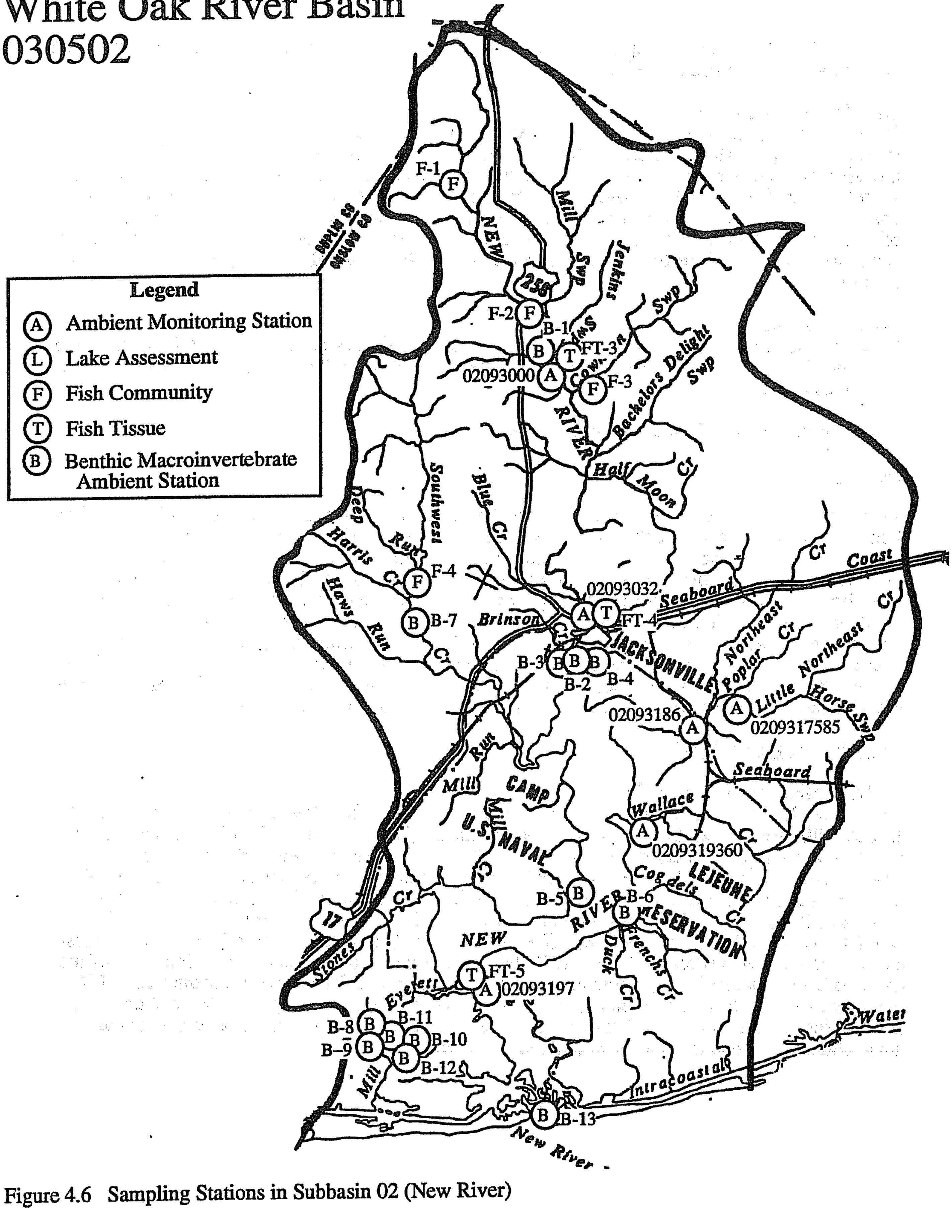


Figure 4.6 Sampling Stations in Subbasin 02 (New River)

Northeast Creek has three (18.8%) excursions above the fecal coliform criterion, 10 (19.2%) above and below the pH criteria, and two (3.8%) above the turbidity criterion. The data from a number of parameters from Northeast Creek (Turbidity (NTU), pH (SU), total residue (mg/l), total suspended residue (mg/l), and chlorophyll a (Corr)(µg/l)) appear to be trending downward from 1990 to 1994. Total residue sampling was discontinued in May 1993, and statements about current conditions cannot be made. The significance of the trend for total suspended residue and turbidity seems to be an effect of the absence of very high samples in the past two years (Figures 4.7 and 4.8). Chlorophyll a and pH do seem to have a downward trend compared to the initial high readings in the first year (1990) of the basin planning period (Figures 4.9 and 4.10). Data from 1995 are not included, but it was a very wet year.

Dissolved oxygen distributions (Figure 4.11) are fairly uniform throughout the drainage with the exception of Little Northeast Creek. The distribution is notably lower than other stations, and the site had 13 samples (23.6%) below the dissolved oxygen criterion. These excursions may be due to the effect of the swamp-like conditions along the shore of the creek.

The distributions of chlorophyll a from the entire drainage (Figure 4.12) show a general skewing higher in the first two years, 1990 and 1991, of the planning period. Two of the three New River mainstem sites (Gum Branch and Jacksonville), appear to have a downward trend in turbidity from 1990 to 1994. The distributions of turbidity from the two New River sites (Figure 4.13) over the five-year planning period do show a higher distribution in the first two years (1990 and 1991). At Little Northeast Creek, the median coliform value of 190/100ml is nearly as high as the state water quality standard of 200/100ml. Hypoxia (DO < 1 mg/l) is also a sporadic problem for the swamp-like, slow flowing Little Northeast Creek. There also have been sporadic high metal observations along the Intracoastal Waterway.

Long-term trend data are not available for the NSW area. However, an analysis of trends at three ambient monitoring stations on the New River (Gum Branch 02093000, Jacksonville 02093032, Sneads Ferry 02093197) indicates that water quality at these locations has improved somewhat since the mid 1980s, although the upper estuary remains highly eutrophic. While total nitrogen levels have not changed significantly during this time period, total phosphorus (TP) has been declining at two of the three stations. Near Gum Branch, on the freshwater portion of the river, total phosphorus loads declined by 913 lbs/year over the period from 1987 to 1994. While loads could not be calculated at the estuarine stations due to the unavailability of flow data, TP concentration declined slightly at Jacksonville (by 0.004 mg/l per year from 1985 to 1994). No change in TP could be documented at Sneads Ferry. Algal levels at all three stations, as measured by chlorophyll *a* concentrations, have been lower over the past several years than in the mid to late 1980s. The details of this analysis may be found in Appendix IX.

While there is no information to assess whether water quality in the most eutrophic portions of the estuary has followed these same trends, the results do provide evidence of modest improvements in three distinct parts of the watershed. The reason for these improvement is not clear. The phosphate detergent ban, effective in January 1988, is one likely factor. Most of the TP decline appears to have occurred in the late 80s, while algal levels declined in the early 1990s. In any case, nutrient levels and chlorophyll concentrations are still excessive in the upper estuary. Continued implementation of the nutrient reduction strategies is needed to insure that water quality in this river reaches an acceptable level.

US Marine Corps - Camp Lejeune Monitoring Data

The data collected during 1992-1994 clearly show elevated nutrient concentrations in Wilson Bay. Relative to Wilson Bay, all the remaining stations have similar concentrations with the exception of the monitoring sites on the Spring Point Transect south of the Hadnot Point treatment facility. At this site there are slight, but significant increases for NO2+NO3-N and TP. Overall, the USMC data are comparable to the data collected through the AMS and the 1986-

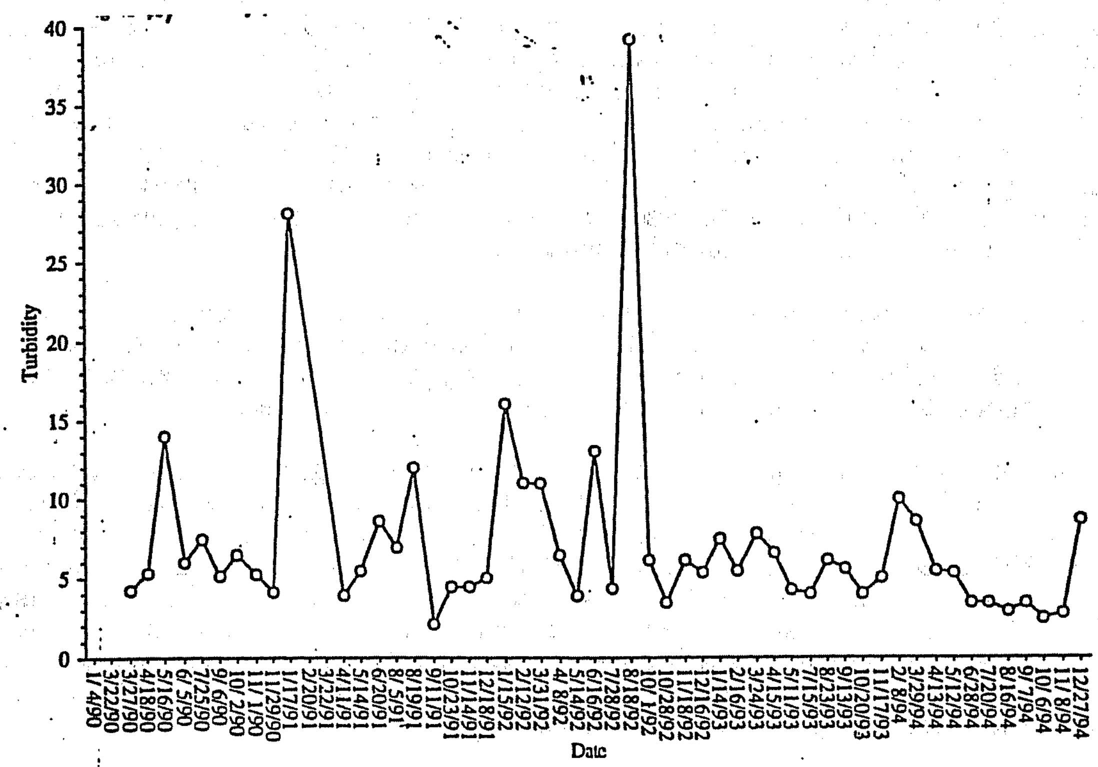


Figure 4.7. Turbidity (NTU) from Northeast Creek at Jacksonville, 1990 - 1994.

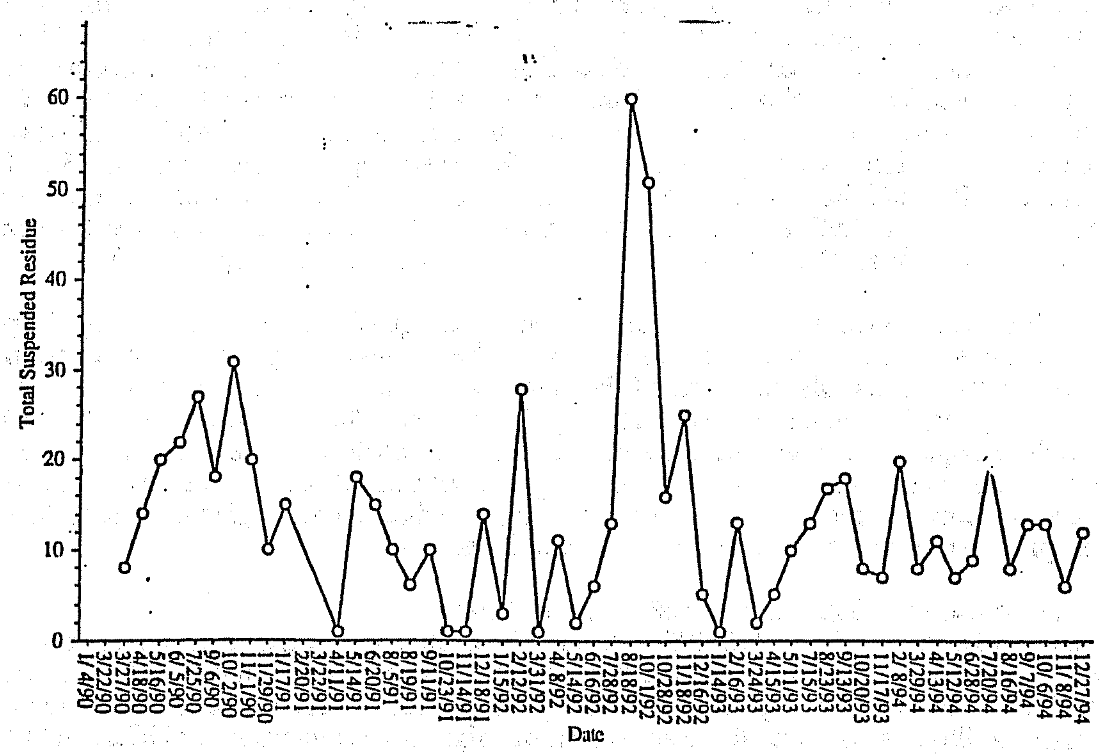


Figure 4.8. Total Suspended Residue (mg/l) from Northeast Creek at Jacksonville, 1990 - 1994.

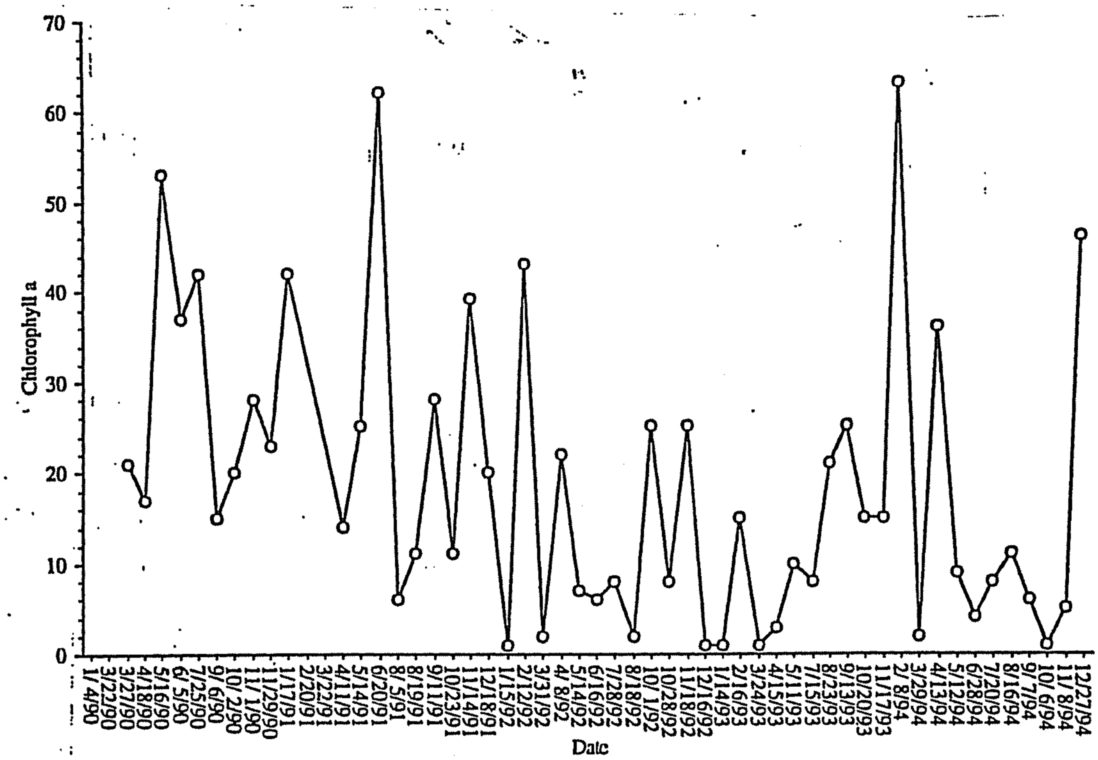


Figure 4.9. Chlorophyll a (ug/l) from Northeast Creek at Jacksonville, 1990 - 1994.

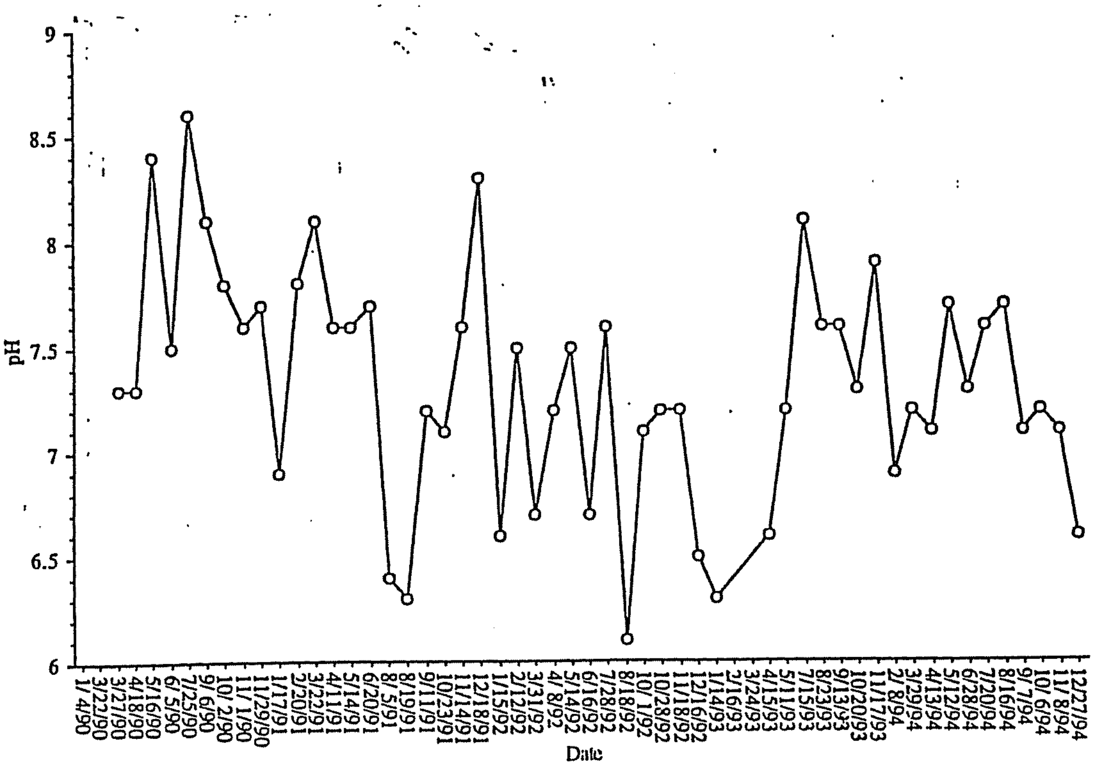


Figure 4.10. pH (SU) from Northeast Creek at Jacksonville, 1990 - 1994.

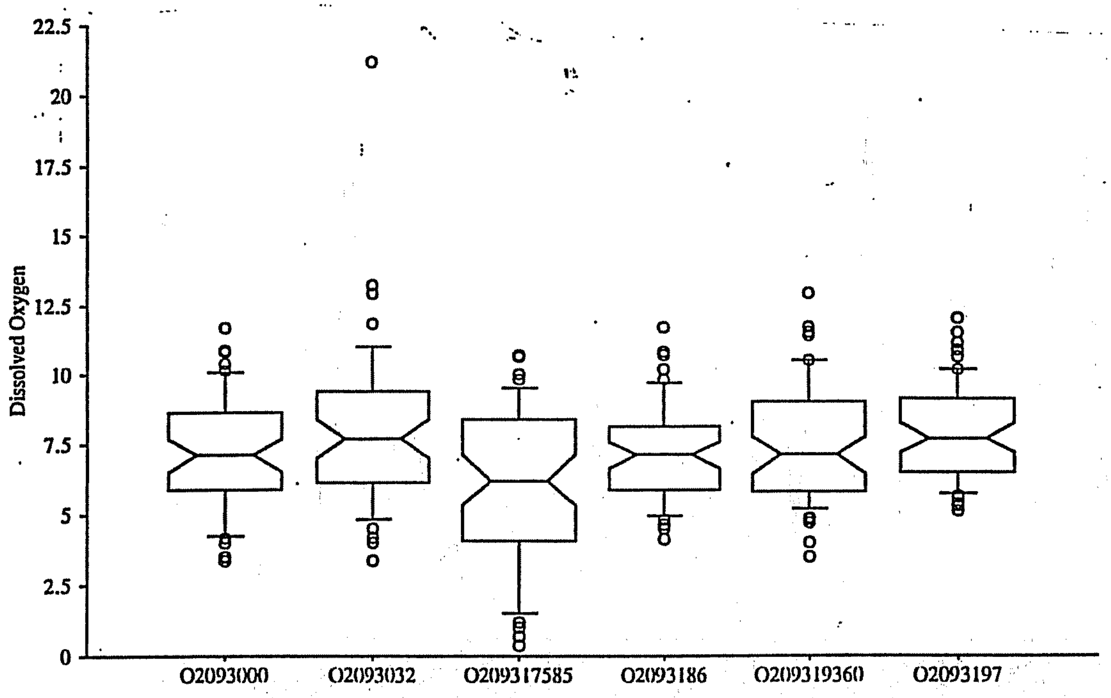


Figure 4.11. Box plots showing the dissolved oxygen distribution at 6 ambient stations in the New River drainage, 1990 - 1994.

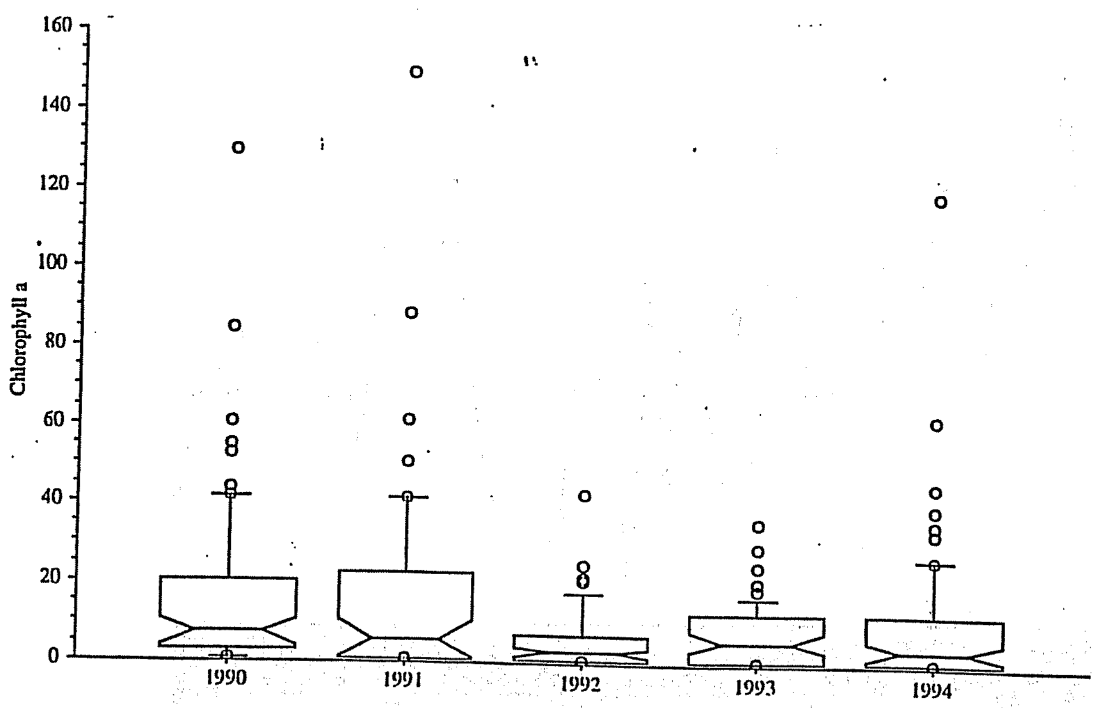


Figure 4.12. Box plots showing the chlororphyll a distribution by year for all stations in the New River drainage, 1990 - 1994.

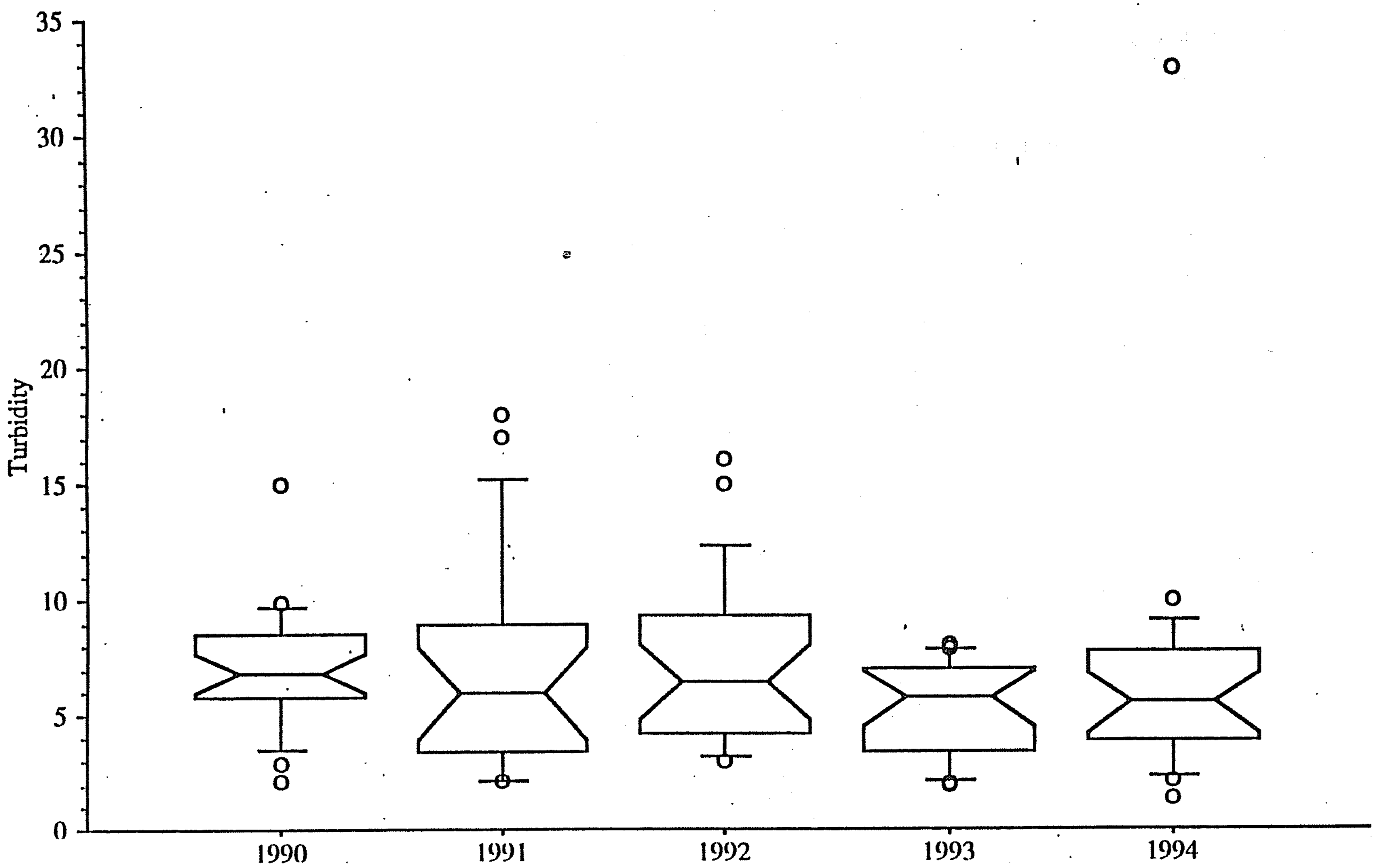


Figure 4.13. Box plots showing the turbidity distribution by year for the New River at Jacksonville and Gum Branch, 1990 - 1994.

1989 special study. The spatial coverage provided by the 13 monitoring stations and frequent summer sampling should enhance the capability to discern changes in water quality with concomitant improvements in wastewater treatment. Distributions of the concentrations of total phosphorus (TP) and total Kjeldahl nitrogen are depicted in Figure 4.14.

Supplemental Water Quality Classifications
The New River has been classified Nutrient Sensitive Waters from its headwaters to Grey Point (half way between Jacksonville and the Atlantic Ocean). The areas designated Outstanding Resource Waters in this subbasin are Goose Bay, Alligator Bay, and the portion of the Intracoastal Waterway connecting them to the Cape Fear Basin. Several High Quality Waters areas also have been designated in this subbasin based on their use as primary nursery areas: New River from US 17 to Mumford Point (including Edwards Creek, Wilson Bay and Stick Creek), middle Northeast Creek and Scales Creek, lower Southwest Creek, Lewis Creek, Town Creek, and Whitehurst Creek.

Benthic Macroinvertebrate Data
There have been numerous benthic macroinvertebrate samples taken in this subbasin since 1983 (Table 4.7). These include both freshwater and estuarine areas. Two sampling sites were freshwater and one of these is a long-term benthos site. Southwest Creek was sampled for the first time in 1994. While few EPT taxa were found, this was apparently due to the slow-flowing, swamp-like nature of the stream rather than any serious degradation of water quality. The long-term benthos site is on the New River at Gum Branch and has been sampled seven times since 1983. Bioclassifications were Good from 1984 to 1988. Sampling in 1990 showed a significant decline in water quality, though it was unclear whether this was from increasing agricultural inputs in the watershed or DOT widening NC 24/258 and channelizing the New River approximately three miles upstream. Sampling in 1994 was not conducted at the usual site, rather near the bridge pool which is normally not flowing, and so the criteria are not applicable to that sample. Sampling in 1995, following a 25 million gallon spill of hog waste (see below for further discussion), also resulted in a Good-Fair bioclassification with slightly fewer EPT taxa and a slightly higher Biotic Index value.

The remainder of the sampling sites are located in estuarine waters. One of these, on the New River at Sneads Ferry, is a long-term estuarine benthos site. The New River at Spring Point was sampled as a reference to the New River sample near the USMC Hadnot Point discharge above Frenchs Creek. The BI was only slightly higher at the reference site, however total taxa was slightly higher near the outfall. There does not appear to be a measurable impact on the New River from the USMC discharge.

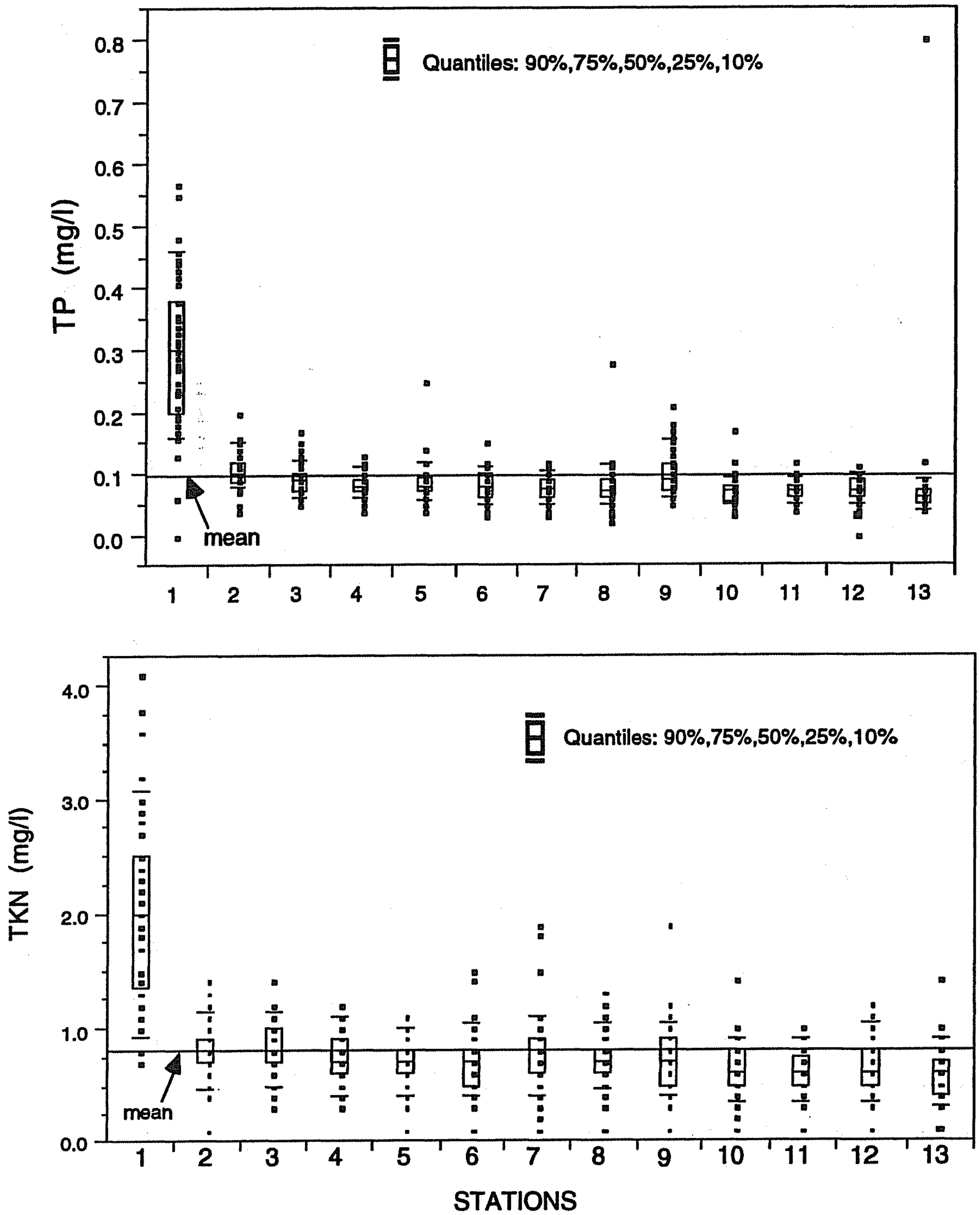


Figure 4.14. Total phosphorus (TP) and total Kjeldahl nitrogen (TKN) concentrations for stations in the US Marine Corps (Camp Lejeune) study. Values here represent measurements taken between 1992-1994. Station locations are provided in Table 4.5.

Table 4.7. Benthic Macroinvertebrate Data Collected from 1983 through 1994 in the White Oak River Basin - Subbasin 02

Site	Old/New DWQ #	Index #	Date	S/EPT S	(E)BI/BIEPT	Bioclass
New R , SR 1314, Gum Branch, Onslow	B/B-1	19-(1)	8/94	52/3	7.18/5.27	NR
			6/90	70/15	6.43/5.13	G-F
			7/88	88/24	6.04/4.19	Good
			6/86	84/24	6.16/4.97	Good
			7/85	96/24	6.19/4.61	Good
			7/84	92/25	6.19/4.76	Good
			7/83	83/20	6.32/5.28	G-F
New R, nr Ethridge Pt, Onslow	-/B-2	19-(11)	8/94	11/-	1.0*	Est
Brinson Cr, at mouth, Onslow	-/B-3	19-(12)	8/94	7/-	1.0*	Est
Wilson Bay, off point, Onslow	-/B-4	19-(14)	8/94	2/-	1.0*	Est
New R, off Spring Pt, Onslow	-/B-5	19-(15.5)	8/94	19/-	2.5/-	Est
New R, ab Frenchs Cr, Onslow	-/B-6	19-(15.5)	8/94	21/-	2.3/-	Est
Southwest Cr, SR 1105, Onslow	-/B-7	19-17-(6.5)	8/94	59/5	7.04/6.57	NR
NW Mill Cr, upstr NC 210, Onslow	-/B-8	19-39-3-1	8/85	58/5	7.49/5.18	NR
			2/84	43/5	7.11/5.98	NR
NW Mill Cr, downst NC 210, Onslow	-/B-9	19-39-3-1	8/85	44/2	7.57/3.22	NR
			2/84	22/3	6.35/5.93	NR
NE Mill Cr, nr confluence, Onslow	-/B-10	19-39-3-1	8/85	49/1	7.81/6.37	NR
N Mill Cr, nr confluence, Onslow	-/B-11	19-39-3-1	8/85	26/2	7.40/5.84	NR
E Mill Cr, be confluence, Onslow	-/B-12	19-39-3-1	8/85	34/0	7/83/-	NR
			2/84	36/2	7.50/3.53	NR
New R (ICWW), nr Sneads Ferry, Onslow	11/B-13	19-41-(0.5)	8/94	152/-	2.5/-	Est
			6/93	92/-	2.5/-	Est
			6/90	81/-	2.6/-	Est
			6/89	71/-	2.2/-	Est
			7/88	66/-	2.6/-	Est
			6/87	67/-	2.6/-	Est
			6/86	65/-	2.6/-	Est
			7/85	69/-	2.4/-	Est
			7/83	37/-	2.4/-	Est

* These samples were collected using a petite ponar dredge and thus should not be compared with samples collected by sweep.
NR = Not Rated because there is currently no established criteria for biologically rating swamp systems, although efforts are being made in that direction.

Three sites in the upper estuary of the New River, New River near Ethridge Point, Brinson Creek and Wilson Bay, received a BI score of 1.0. This is the lowest score possible with the EBI and indicative of very stressed areas, in part due to the low and fluctuating salinity. Values for the two supplementary metrics (% Crustacean taxa and % Spionid and Capitellid taxa) were: New River - 9% and 27%, Brinson Creek - 0% and 43% and Wilson Bay - 0% and 50% respectively. These data suggest that Brinson Creek, which receives large amounts of nonpoint source runoff, and Wilson Bay, which receives the effluent from Jacksonville WWTP, are approximately equivalently stressed and both are degraded compared to the New River near Ethridge Point.

The New River near Sneads Ferry has been sampled nine times since 1983. Salinity is generally high at this site with moderate fluctuations and a slight trend of increasing salinity since 1984. Taxa richness has generally climbed over time, probably as a result of improved sampling techniques, until in 1994 a record number of taxa were collected. Compared with reference sites in other subbasins, the Biotic Index at the New River indicates slightly depressed water quality.

Fish Tissue and Community Assessment

There have been three collections for tissue analysis in the New River since 1983. In 1984 clams and croaker were sampled at Sneads Ferry, in 1986 mussels were collected at Gum Branch and in 1994 largemouth bass, brown bullhead, white catfish, and redear sunfish were collected near Jacksonville. No tissues showed elevated levels of any metal. Fish community sampling in 1995 resulted in a Good ecological health rating for an upstream site, and a Fair-Good rating at a site below Richlands. Two tributary streams indicated very high water quality: Cowhorn Swamp was Good, and Southwest Creek was Good-Excellent.

Shellfish Closures
The four main reasons for closures (areas designated as prohibited or restricted by DEH) in this subbasin are development, freshwater sources, WWTP's, and marinas. Development has caused the closure of Galleon Bay and the ICW from Onslow Beach west to Salliers Bay. Mill Creek (Alligator Bay), Wheeler Creek, Fannie Creek, Everett Creek, Stones Creek, Muddy Creek and Mill Creek (New River) are all closed due to freshwater sources. A number of marinas near the mouth of the New River have caused closure of small areas. Further discussion of closed shellfish areas can be found in Chapter 3. DMF has rated oyster and clam harvesting in this subbasin as Fair-Good with the best shellfishing in the New River from Ellis Cove to Farnell Bay. Overall the commercial value of the shellfish in this subbasin was rated Fair-Good.

Aquatic Toxicity Monitoring
Two major dischargers, Jacksonville and USMC are under SOC and conduct toxicity tests. Jacksonville regularly has an LC50 < 50%, while all of the USMC discharges have usually passed their tests since 1992. USMC is currently working to consolidate all of their discharges at Hadnot Point and significantly improve treatment.

Phytoplankton Studies in Subbasin 02

Phytoplankton are microscopic algae found in the water column of lakes, rivers, streams, and estuaries. These organisms respond to the availability of nutrients, and other environmental factors such a light, temperature, pH, salinity, water velocity, and grazing by organisms in higher trophic levels. Phytoplankton are especially useful as indicators of eutrophication and have been monitored in the New River by DWQ since 1984.

A total of 71 phytoplankton samples have been collected in the New River since January 1990. These samples include those collected by the DWQ (n=28) and the USMC (n=43). The samples collected by DWQ include those collected in conjunction with ambient water quality sampling and others collected when an algal bloom is thought to be in progress. The USMC collects samples from 13 locations twice monthly during the summer and forwards results to the Environmental Sciences Branch of DWQ. Phytoplankton samples are usually analyzed if chlorophyll a concentrations exceed 40 ug/L. A total of 565 samples were collected from 1992-1994 and 43 were analyzed for phytoplankton (Table 4.8). Some caution is warranted in comparing prior DWQ chlorophyll results to the more recent USMC data due to differences in methodology. The method used by the USMC (spectrophotometric) may produce results slightly lower than the DWQ (fluorometric) method. The DWQ will increase split sampling for comparative purposes.

Ambient Phytoplankton
Phytoplankton are often collected in conjunction with ambient water quality samples. Although the frequency of sampling is greater for physical and chemical parameters, phytoplankton samples are taken more often during critical periods such as the summer when algal populations are stimulated by high temperatures and nutrients. These data may provide information on temporal and spatial patterns in phytoplankton densities, biovolumes, and community composition. In addition they recently have been used to assess the presence of a toxic dinoflagellate (Pfisteria piscida).

A total of 16 ambient samples were collected during 1990-1994 from the US 17 bridge in Jacksonville (Station no. 02093000; n= 11) and near the NC 172 bridge near Sneads Ferry (Station no. 02093197; n=5). The station in Jacksonville had high concentrations of nutrients and this is reflected in the high median biovolume (23,800 mm3/m3) and density (28, 100 units/ml) of phytoplankton. The median biovolume (300 mm3/m3) and density (2,400) of phytoplankton were considerably lower near Sneads Ferry. Biovolume measurements greater that 5000 mm3/m3 and density measurements greater than 10,000 units/ml indicate bloom conditions.

USMC Study - Phytoplankton Response
The USMC collected phytoplankton samples as part of its monitoring efforts. These samples clearly show the response of phytoplankton to nutrients. All samples collected from Wilson Bay had elevated biovolumes and densities (Table 4.8). These data were examined closely for the 1992-1993 calendar years. Frequent and massive algal blooms are generally limited to the Wilson Bay area. The larger blooms extended down as far as the mouth of Northeast Creek. Total Nitrogen generally decreases steadily downstream during summer low flow conditions, with the exception of a pulse that is often present in the general area of the Hadnot Point facility. Data suggest there is an early spring response (May) to nutrients present in the system, and late summer blooms tend to follow significant rainfall. As in other estuarine systems, the spring blooms may occur simultaneously with vertical stratification of dissolved oxygen and salinity.

There were few major algal blooms in 1992. There was strong stratification in shallow waters (1.5-2 m), bottom water hypoxia, and a bloom of cryptophytes and dinoflagellates in May that was limited to the area from just above US 17 Bridge to just below Wilson Bay. Although a fish kill was not reported, fish were seen in distress by field crews present. High chlorophyll *a* measurements in August were in response to unusually heavy rain and increased nitrogen concentrations as far downstream as Gray Point.

A very large algal bloom occurred in early February 1993. Due to the cold temperatures, dissolved oxygen levels were sufficient. The concentrations of the dominant phytoplankton, *Eutreptia viridis* (a euglenophyte), suggest a strong pulse of organic nutrients entered the system. Heavy rainfall and a 50,000 gallon spill of partially treated sewage from a backed up pipe both occurred prior to the bloom. High concentrations of phytoplankton and chlorophyll *a* were measured as far down as Stone's Bay. A fish kill was reported in the Wilson Bay area.

In May of 1993 a bloom occurred from upstream of US17 down to and including Wilson Bay. Algal densities were very high (67000-214,000 units/ml) even though chlorophyll *a* concentrations were more moderate (57-100 ug/l) due to dominance by a small centric diatom (*Cyclotella* sp.) As in the previous May, stratification was entrenched and bottom water hypoxia evident in very shallow water. There was no fish kill reported with the bloom. Elevated chlorophyll a concentrations were measured at various locations in the estuary, but the algal bloom was limited to the Wilson Bay area.

Table 4.8 Biovolume and density estimates of phytoplankton collected by the USMC, 1992-1994.

		Biovolume (mm^3/m^3)			Density (units/ml)		
Station	N	Median	Min	Max	Median	Min	Max
Wilson Bay	10	11,200	5,500	136,800	59,100	16,800	650,400
All other stations	33	3,100	3	91,500	2,621	46	33,700

Algal bloom program
Prolific growths of phytoplankton, called algal blooms, may occur as the result of high concentrations of nitrogen or phosphorus. Algal blooms may be unsightly and deleterious to water quality causing fish kills, anoxia, and taste and odor problems. Information about algal populations is obtained through the ambient water quality sampling or algal bloom programs. Bloom samples are collected often as a result of complaint investigations, fish kills, or routine

monitoring if a bloom is detected. Diatoms, euglenophytes, and dinoflagellates are the most common types of algae that have been observed in high densities in the New River.

Toxic Dinoflagellate

The recently discovered toxic dinoflagellate, Pfiesteria piscicida is found in phytoplankton samples from the New River. Although this alga occurs more frequently in other estuaries, its presence in the New River warrants concern. It is known to attack and kill fish and has been reported to be responsible for a significant portion of the fish kills in the Pamlico River since 1991, and the fall 1995 fish kill in the Neuse River. This alga is stimulated by substances excreted by fish and feeds on fish flesh. It encysts in the sediments once the fish have died.

Special Studies in Subbasin 02

1995 Special Study-Hog Lagoon Spill

In June of 1995, a hog waste spill occurred on the Oceanview Farm near the Town of Richlands. Twenty-five million gallons of hog waste was inadvertently discharged into a tributary to the New River. Following a period of heavy rainfall, the farm's waste lagoon dike collapsed, causing the hog waste to be released.

In response to this spill, a special study of water quality in the New River was conducted during the summer of 1995. This study was implemented cooperatively among the NC Division of Environmental Management, the NC Division of Epidemiology, and the Onslow County Health Department. Primary concerns were the risk to public health from the elevated levels of fecal coliform bacteria and the impacts to water quality and wildlife. Monitoring for this study involved the collection of fecal coliform bacteria, chlorophyll a, nutrients, and physical measurements at 15 stations. Data were collected five times within a 30 day period beginning July 17. All stations were downstream of the spill.

The Wilmington Regional Office conducted an intensive investigation between June 21 and July 12, 1995. These surveys indicated that the spill killed about 2600 fish in the stretches of the New River north of the Highway 17 bridge near Jacksonville. The concentrated waste slug was measurable at least as far downstream as Wilson's Bay. Fecal coliform bacteria levels in Donahoe Branch on June 22, 1995 were 120,000/100ml, while total coliform levels were 2,400,000/100ml. In response to the spill, a health advisory was issued by the Onslow County Health Department and the State Health Director calling for people to avoid using the New River for recreational purposes. The Division of Environmental Management (now the Division of Water Quality (DWQ) conducted weekly monitoring activities to help assess the risk to public health from the elevated levels of fecal coliform bacteria and to evaluate impacts to water quality and wildlife. Water quality of the New River was monitored at locations downstream from the spill for fecal coliform, chlorophyll *a*, and nutrients (NH_3, NO_2NO_3, TKN and TP). Depth integrated physical readings (dissolved oxygen, pH, conductivity, and temperature) were also collected. As a result of declining fecal coliform bacteria levels, the State Health Director recommended that the public health advisory be lifted on September 7, 1995. Excessive concentrations of chlorophyll *a* and nutrients have been documented in the New River for years. New wastewater treatment plant management strategies have been developed to reduce the excess nutrient loading of this system.

4.3.3 Subbasin 03 - Newport River and Tributaries including Bogue Sound

Description

This subbasin lies in the center of Carteret County, extending from the Croatan National Forest to Beaufort and Beaufort inlet. Most of this subbasin is estuarine with the Newport River as the only major source of freshwater. With the exception of Newport, most of the development in this subbasin is along the coast; Morehead City, Beaufort, Atlantic Beach, and Bogue Banks. There are four significant dischargers in this subbasin. The Newport WWTP (0.5 MGD) discharges to the Newport River, Morehead City WWTP (3.4 MGD) discharges into Calico Creek and Beaufort Fisheries (3 MGD), and Beaufort WWTP (1.5 MGD) both discharge into Taylors Creek. Figure 4.15 illustrates the locations of all of the sampling sites in this subbasin.

Overview of Water Quality

Ambient Monitoring System Data

It appears that water quality is generally high in the estuarine portions of this subbasin although sporadic excursions of dissolved oxygen, pH, fecal coliform bacteria, and some metals have been recorded. The Newport River drainage has five AMS sites, three on the Newport River (Newport, Newport Marshes, and Morehead City Harbor) and two in Bogue Sound (Salter Path and Emerald Isle). Four of these sites are on the Intracoastal Waterway. The Newport site had four (14.3%) excursions below the dissolved oxygen criterion, five (31.3%) excursions above the fecal criterion, four (23.5%) excursions above the iron action level (see page 4-9 for discussion of action levels), four (14.3%) excursions below the pH criterion, and one (3.4%) excursion above the zinc action level. (Note that for fecal coliform results, an "excursion" indicates an individual sample exceedence of the numeric criterion of 14 cfu/100ml used in the fecal coliform standard. For the full fecal coliform standard to be violated, the *mean of all samples* taken within the specified time period must exceed the numeric criterion. Thus, while these individual excursions are not violations of the fecal coliform standard, they serve as a useful screening tool for further investigation.) This site is downstream from the Newport WWTP and some of the excursions recorded may be from the effects from this plant.

The Newport Marshes site had five (31.3%) excursions above the copper action level, one (6.3%) excursion above the fecal coliform criterion, and one (6.3%) excursion above the nickel criterion. The Morehead City Harbor, Bogue Sound at Salter Path, and Bogue Sound at Emerald Isle had excursions above the copper action level of three (18.8%), one (6.3%), and one (6.3%) respectively. Morehead City Harbor also had one (6.3%) excursion above the fecal criterion. There were no apparent trends in any parameter noted in this drainage. The box plots for dissolved oxygen (Figure 4.16) show the Newport site with the lowest distribution of any of the sites in the drainage. This could be, as noted above, an effect of the upstream discharge from the Newport WWTP.

The Newport River at Newport has intermittent low dissolved oxygen and pH values. These low values were probably the result of high concentrations of organic matter being drawn out of flooded swamps following periods of high water. This also may or may not be the source of periodic elevated fecal coliform counts.

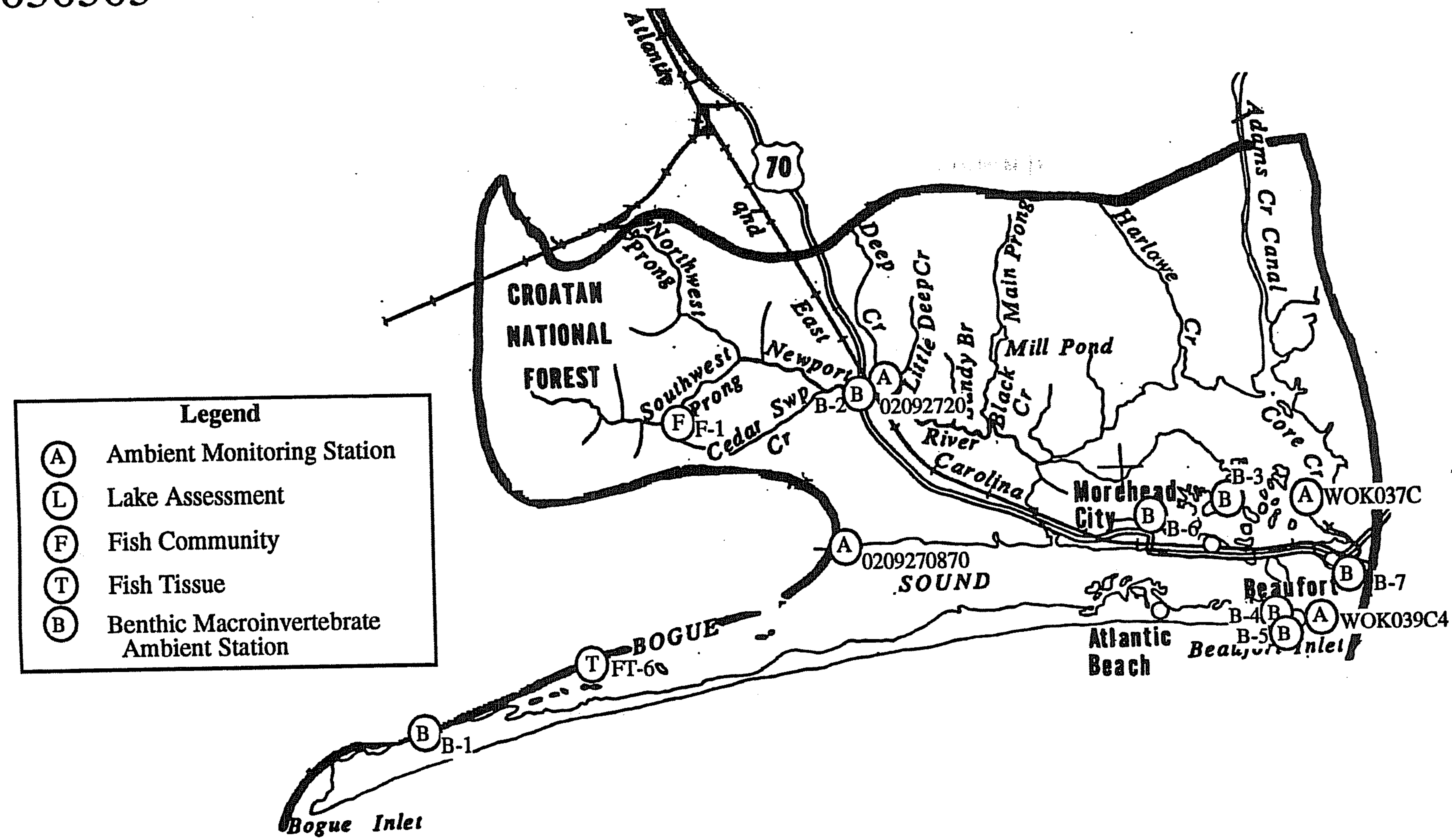


Figure 4.15 Sampling Stations in Subbasin 03 (Newport River and Tributaries to Bogue Sound)

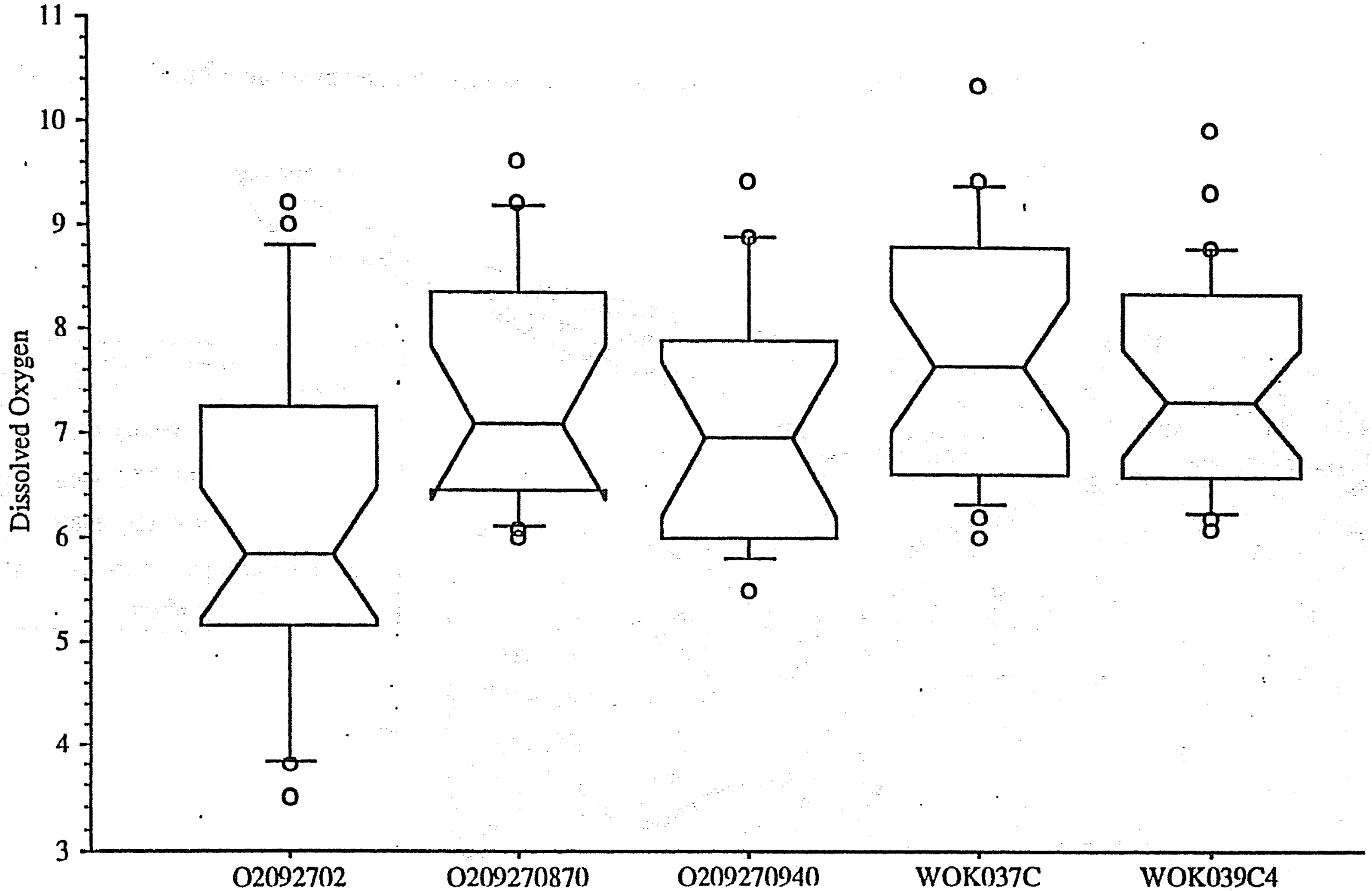


Figure 4.16. Box plots showing the dissolved oxygen distribution in the Newport drainage, 1990 - 1994.

Surface Water Quality Classifications
There are two Outstanding Resource Waters in this subbasin. The larger area is the western half of Bogue Sound, and the smaller is the swamp and salt waters of the Theodore Roosevelt State Natural Area.

Benthic Macroinvertebrate Monitoring
All of the benthic macroinvertebrate stations in this subbasin are estuarine, except for one on the Newport River that cannot be rated (NR) due to its swampy nature. As mentioned earlier, DWQ is currently working to establish a biological water quality rating system for estuarine waters. Since it has not yet been finalized, actual ratings cannot be given. However, the information gathered can be used descriptively to discuss water quality in the basin. In this subbasin there are some areas with notable sampling results and there are three long-term benthos sites. Table 4.9 presents the results of all benthic samples collected in this subbasin.

Table 4.9 Benthic Macroinvertebrate Data Collected from 1983 through 1994 in the White Oak River Basin - Subbasin 03

Site	Old/New DWQ #	Index #	Date	S/EPT S	(E)BI/BIEPT	Bioclass
Bogue Sound , nr Emerald Isle,Carteret	10/B-1	20-36-(0.5)	9/94	131/-	2.8/-	Est
			6/94	125/-	2.7/-	Est
			6/91	121/-	2.6/-	Est
			6/90	95/-	2.6/-	Est
			6/89	97/-	2.6/-	Est
			6/88	80/-	2.6/-	Est
			6/87	67/-	2.8/-	Est
			6/86	81/-	2.7/-	Est
			7/85	82/-	2.7/-	Est
			7/84	67/-	2.6/-	Est
			7/83	59/-	2.7/-	Est
Newport R, US 70, Carteret	6/B-2	21-(1)	7/83	24/2	7.82/5.70	NR
Newport R, nr Crab Pt, Carteret	8/B-3	21-(17)	8/94	102/-	2.4/-	Est
			6/91	94/-	2.1/-	Est
			6/90	48/-	2.2/-	Est
			6/88	77/-	2.5/-	Est
			7/87	67/-	2.3/-	Est
			6/86	52/-	2.2/-	Est
			7/85	44/-	2.2/-	Est
Morehead Hrbr, SW of Radio Is, Carteret	9/B-4	21-(17)	8/94	105/-	2.6/-	Est
			6/94	132/-	3.0/-	Est
			6/91	116/-	2.7/-	Est
			6/90	77/-	2.4/-	Est
			6/88	111/-	2.5/-	Est
			6/86	72/-	2.7/-	Est
			7/85	73/-	2.7/-	Est
Beaufort Inlet, Ft Macon Jetty, Carteret	-/B-5	21-(17)	6/94	32/-	3.5/-	Est
Calico Cr, Piggotts Br, Carteret	-/B-6	21-32	8/94	22/-	1.8/-	Est
Taylors Cr, Rachel Carson Res., Carteret	-/B-7	21-34	6/88	65/-	2.2/-	Est

Calico Creek is a tidal creek in suburban Morehead City that receives the effluent from the Morehead City WWTP as well as runoff from lawns throughout its watershed. The low taxa richness, Biotic Index and number of amphipods, indicates a severely stressed creek. To date this is the only site where no amphipods were collected using the timed sweep method. It is impossible to separate the impacts of the WWTP with degradation from nonpoint runoff.

Beaufort Inlet was sampled as a benchmark to monitor potential changes in the benthic community if Atlantic Beach would be given a permit to discharge its waste in this area. While the taxa richness is low, this is probably due to the harsh physical conditions. The high Biotic

Index suggests that water quality is high as does the presence of several rare crustacean taxa: Paradella sp., Atylis urocarinatus, Amphiporeia virginiana, and Bowmaniella portoricensis.

The Bogue Sound near Emerald Isle site (B-1) is a long-term benthos site that has been sampled eleven times since 1983. Salinity within this ORW area is high and stable. This has led to high numbers of both total and pollution intolerant taxa and a very stable, very high, biotic index. Taxa richness has generally climbed over time, probably as a result of improved sampling techniques. The single exception was in 1987. Despite the depressed number of taxa collected that year, the fact that the biotic index did not decline indicates that this was not due to a decline in water quality.

The Newport River near Crab Point site (B-3) is another long-term benthos site and has been sampled seven times since 1983. While salinity is usually high at this site, it fluctuates more than the nearby reference site at Morehead Harbor. With the exception of a single metric (BI in 1988), this site has demonstrated depressed water quality metrics compared to Morehead Harbor in every year the two have been sampled. This would indicate that this site is being consistently stressed. It is not clear how much of this stress is due to salinity fluctuations, how much is due to habitat differences, and what portion is differences in water quality. Taxa richness has generally climbed over time, probably as a result of improved sampling techniques. The one exception was 1990, when sampling was not done at low tide, so the usual variety of habitats were unavailable.

The Morehead Harbor near Radio Island site is also a long-term benthos site which has been sampled seven times since 1983. This site has been characterized by high, stable salinity and a variety of habitat. Taxa richness has generally climbed over time, probably as a result of improved sampling techniques. There are two exceptions to this observation, however. In 1990, sampling was not done at low tide, so the usual variety of habitats, especially the rocks, were unavailable. The decline in all categories in August 1994 compared to June 1994, suggests that the spring abundance peak extends into June and thus June samples should be compared with care to other summer samples.

Fish Tissue Analyses

Fish have been collected for tissue analysis. In 1980, clams and scallops were tested, while in 1984, summer flounder and pinfish were tested. There were no outstanding metal levels in either of these tests.

Shellfish Closures

The main reasons for closures in shellfish waters in this subbasin (based on DEH Shellfish Sanitation reports) are development and marinas. Salter Path, Pine Knoll Shores, Morehead City Area, and Bogue Sound are areas closed due to development. Spooners Creek, Russell Creek, upper Harlowe Creek, and upper Newport River are areas closed due to coliforms from freshwater runoff. Also, shellfishing is prohibited around a number of marinas scattered throughout the subbasin. Further information on closed shellfish areas can be found in Chapter 3.

Special Studies in Subbasin 03

Intensive Surveys

Three intensive surveys have been performed in this subbasin by DWQ. Dye tracer studies have been conducted in Gull Harbor and Beacons Reach Marinas, and a dye and long-term BOD study was conducted in Calico Creek. Gull Harbor was found to have flushed 91% of the dye from the marina within 12 hours, while at Beacons Reach only 65% of the dye was flushed in 24 hours. Calico Creek flushed 93% of dye at the discharge within 24 hours. BOD5 was found to be 21.7

mg/l at a site 1/2 mile downstream of Morehead City WWTP in 1981, whereas by 1988, BOD5 was measured at 6.5 mg/l.

Marina Study
In 1990, the Division of Environmental Management issued a report from a study of North Carolina Coastal Marinas (DEM 1990). The objectives of the study were to assess the water quality of selected coastal marinas and to develop methodologies for evaluating water quality impacts of marina proposals. Eleven (11) marinas were the subject of the survey and 5 of these were located in Bogue Sound. Water quality parameters covered in the study included, but were not limited to, fecal coliforms, BOD, nitrogen, phosphorus, chlorophyll-a and metals.

One of the primary objectives of the study was to characterize the water quality of marinas relative to ambient waters. There was no evidence that the marinas in the study were a source of pollutants to ambient monitoring stations. But dye tracer studies suggested that the transport of pollutants from marinas might be concentrated near shore instead of in open waterways where the ambient stations were located. The report recommended that marina siting and design use features which promote flushing such as locating marinas near inlets, minimizing the restriction of entrance channels and minimizing stagnant corners by using rounded corners, level bottoms sloping towards the entrance and avoiding bends.

4.3.4 Subbasin 04 - North River and tributaries; Jarrett Bay, Nelson Bay and Thorofare Bay (tributaries to Core Sound)

Description
This subbasin lies to the east and north of Beaufort in Carteret County. Major waterbodies in this subbasin include North River, Jarrett Bay and Nelson Bay, plus the landward halves of Back Sound and Core Sound. Most of this subbasin is estuarine with freshwater drainage from adjacent land including Open Grounds Farm. Atlantic, at the northern end of the subbasin, and Harkers Island at the south, are the two most densely developed areas within the subbasin. The one large discharger in this subbasin is Beaufort Fisheries #2, which is permitted to discharge up to 3 MGD of treated effluent into Taylors Creek. Figure 4.17 shows the various DWQ sampling sites in this subbasin.

Overview of Water Quality

Ambient Monitoring System Data
Seven ambient monitoring sites are in this subbasin; one on a small creek draining agricultural areas, three at the mouths of the major rivers and bays, and one off of the Town of Atlantic. This monitoring appears to indicate high water quality; results show low nutrients and dissolved oxygen levels well above standards. Sporadic high copper observations in higher traffic areas, one as high as 280 ug/l, have been observed. Broad Creek, which drains Open Grounds Farm, shows chronic fecal coliform violations, high, but declining levels of total phosphorus, and sporadic episodes of low dissolved oxygen.

Of the seven AMS sites in the North River Drainage, two sites are on the North River (Bettie and Beaufort), two sites are on tributaries (Broad Creek and Ward Creek), and three sites are on the sounds (Back Sound, Core Sound at Jarrett Bay, and Core Sound at Nelson Bay). The Broad Creek site had the highest percent excursions from water quality standards of any site in the basin. As noted by DEH Shellfish Sanitation Branch reports, this area is being developed and is susceptible to runoff. There is also a runoff effect from the Open Ground Farm operations in the drainage of these three streams. Many of the parameters exceeding standards noted below can be accounted for due to rainfall runoff from residential development and agricultural operations.

White Oak River Basin
030504

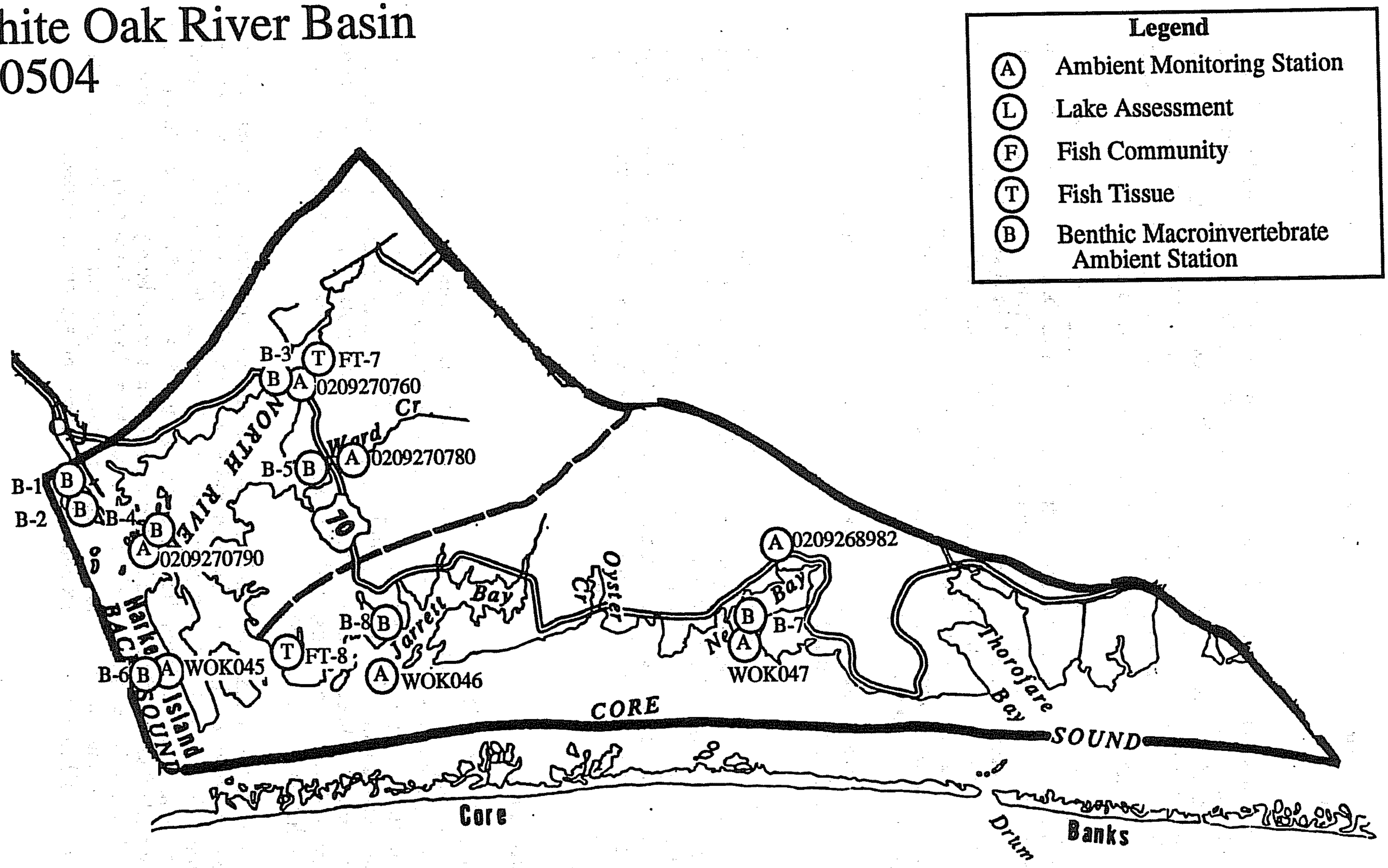


Figure 4.17 Sampling Sites in Subbasin 04 (North River and Tributaries to Core Sound)

Broad Creek had three (10%) excursions below the dissolved oxygen criterion, 26 (86.7%) excursions above the fecal criterion, and six (21.4%) excursions below the pH criterion. (Note that for fecal coliform results, an "excursion" indicates an individual sample exceedence of the numeric criterion of 14 cfu/100ml used in the fecal coliform standard. For the full fecal coliform standard to be violated, the *mean of all samples* taken within the specified time period must exceed the numeric criterion. Thus, while these individual excursions are not violations of the fecal coliform standard, they serve as a useful screening tool for further investigation.) Ward Creek had five (17.2%) excursion above the copper action level (see page 4-9 for discussion of action levels), seven (24.1%) excursions above the fecal criterion, one (3.4%) excursion above the nickel criterion, and two (6.9%) excursions above the turbidity criterion. North River at Bettie had four (13.3%) excursions above the copper action level, four (13.3%) excursions above the fecal criterion, and three (10%) excursions above the turbidity criterion. The North River at Beaufort, Back Sound, and Core Sound at Jarrett Bay had excursions above the copper action level of one (6.3%), two (12.6%), and three (21.4%) respectively. Core Sound at Nelson Bay had one (7.1%) cadmium excursion, two (14.3%) copper action level excursions, and one (7.1%) fecal coliform excursion.

The Broad Creek site recorded significant trends in data from three parameters: dissolved oxygen, turbidity, and total phosphorus. Figure 4.18 shows the dissolved oxygen data. The data appears to show a drop in the general dissolved oxygen level after mid-1992. Before this time the dissolved oxygen seem to fluctuate around six to eight mg/l. Recent data is relatively stable around four to six mg/l indicating a definite change from the 1990, 1991, and 1992 data. Figure 4.19 shows turbidity data with a very definite trend downward over the five-year period. The same downward trend is evident in Figure 4.20 showing the total phosphorus data for the same period.

The North River site at Bettie has two significant trends in pH and copper. The copper trend appears to be an artifact of two very high readings in 1990 and many subsequent below-detection readings after that. Figure 4.21, on the other hand, does appear to show a very definite downward trend in pH at this site.

Large portions of this subbasin have been classified as Outstanding Resource Waters. In addition to Core Sound and most of Back Sound, Styron Bay, Brett Bay, Oyster Creek, and Jarrett Bay also are classified ORW. Several creeks and tributaries to these bays are also included: Willis Creek, Fulchers Creek, Maria Creek, Fork Creek, Ditch Creek, Broad Creek, Great Creek, Howland Creek, Jump Run, Tush Creek, and Great Marsh Creek.

Benthic Macroinvertebrate Monitoring

All of the benthic macroinvertebrate sampling stations in this subbasin are estuarine, although they can not be given a specific water quality rating, the data collected can be used to draw some general conclusions about water quality. One site, Ward Creek (discussed in this section), is considered a long-term benthos site although only two samples have been collected since 1993. Table 4.10 presents the data collected in this subbasin.

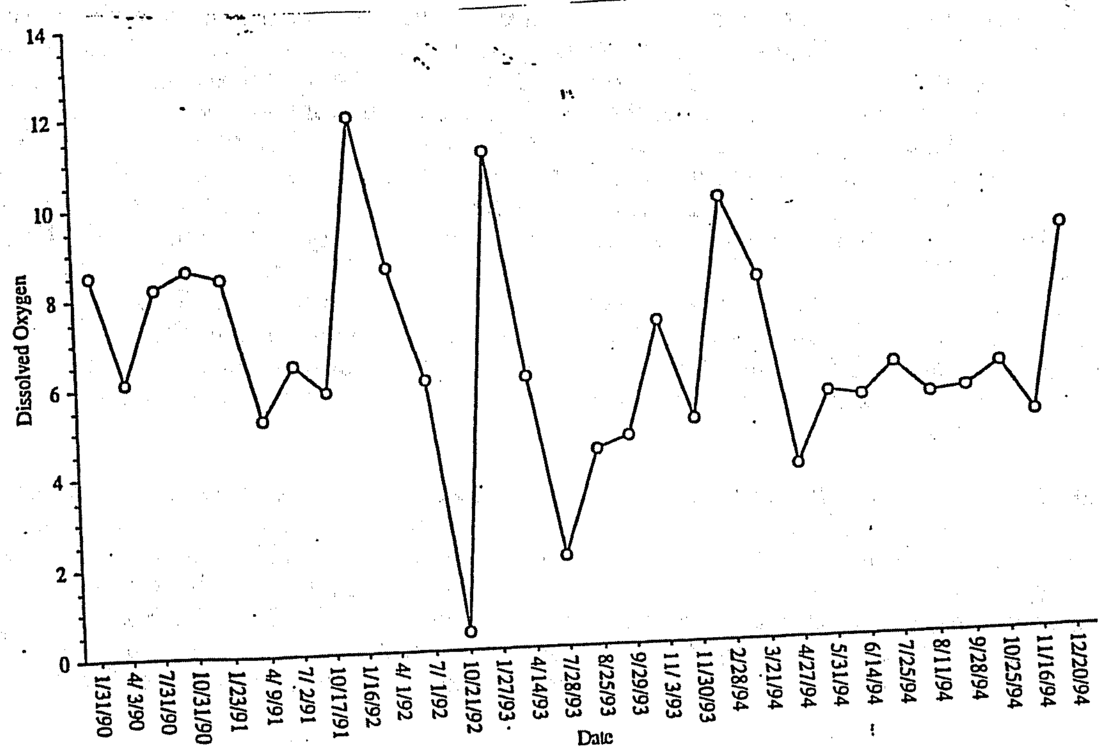


Figure 4.18. Dissolved oxygen (mg/l) data from Broad Creek near Masontown, 1990 - 1994.

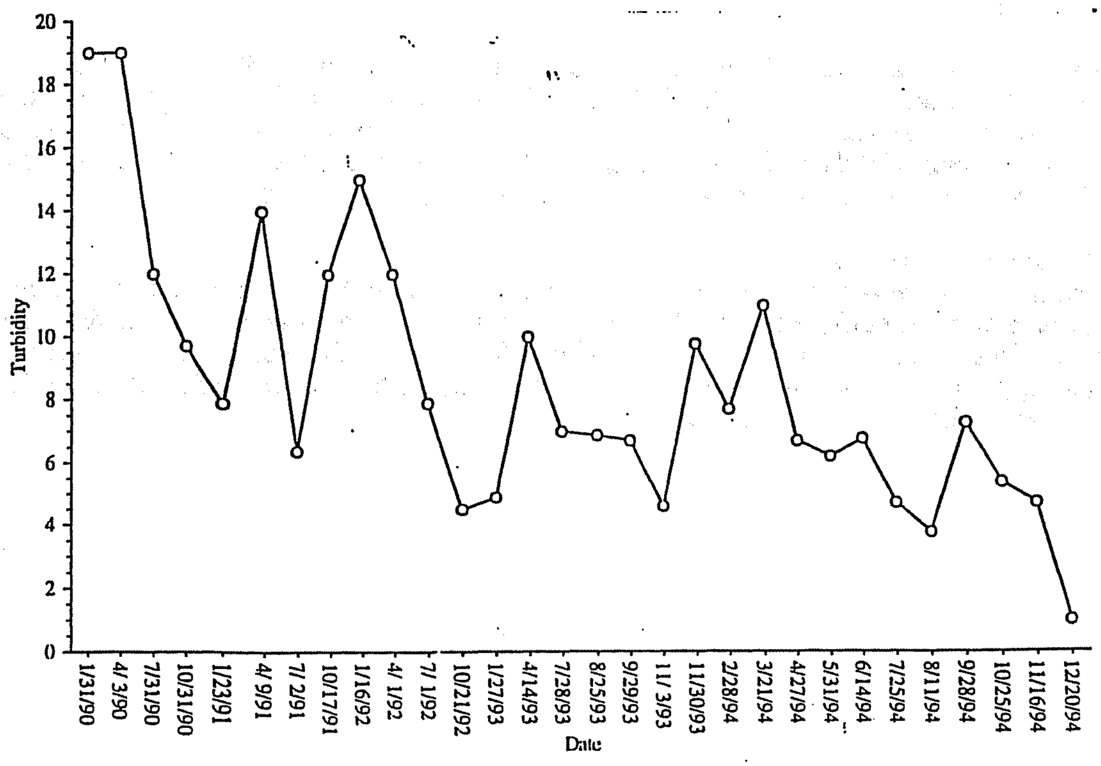


Figure 4.19. Turbidity (NTU) data from Broad Creek near Masontown, 1990 - 1994.

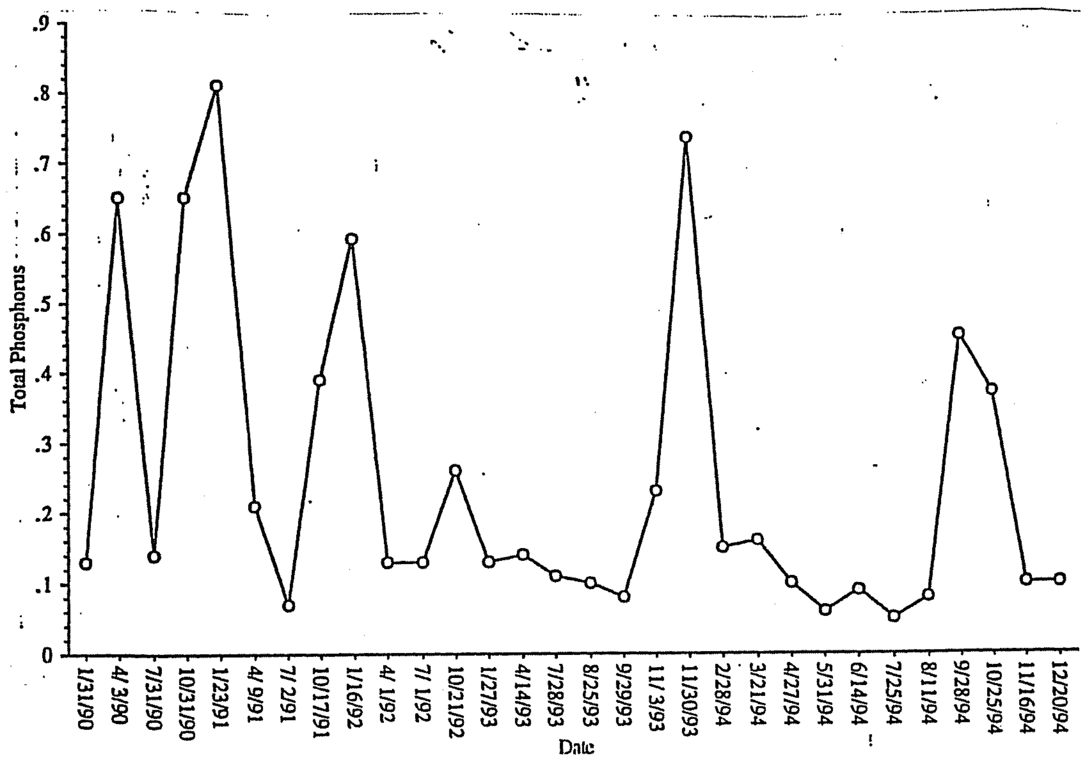


Figure 4.20. Total Phosphorus (mg/l) data from Broad Creek near Masontown, 1990 - 1994.

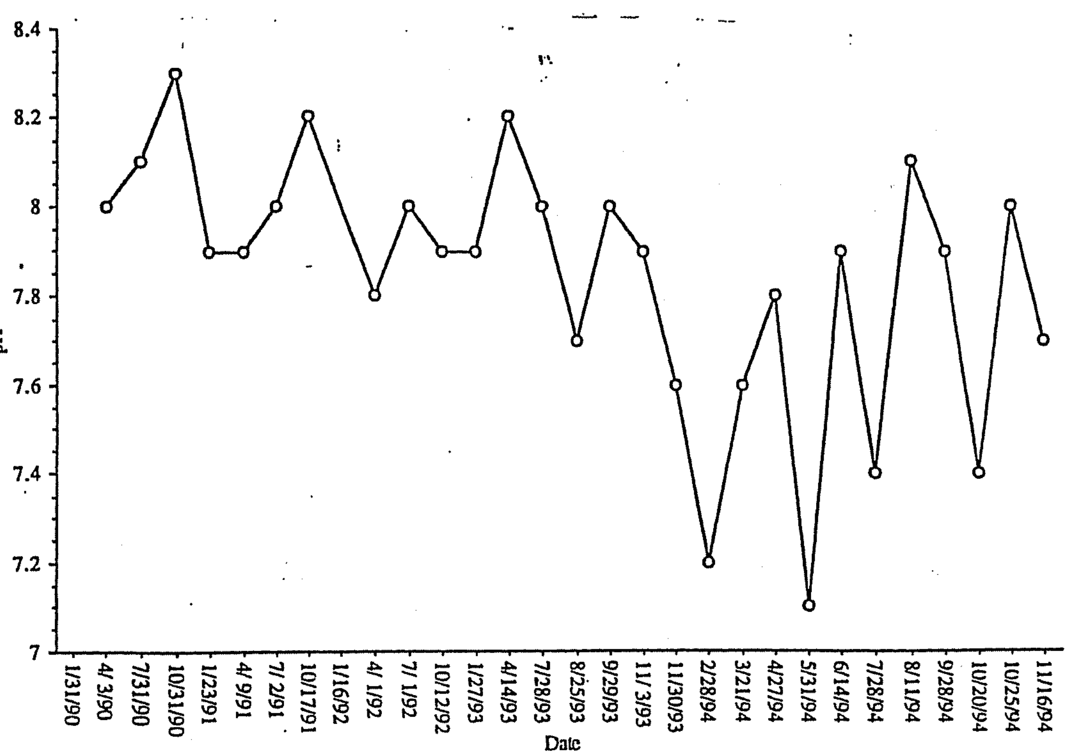


Figure 4.21. pH (SU) data from North River at Bettie, 1990 - 1994.

Table 4.10. Benthic Macroinvertebrate Data Collected from 1983 through 1994 in the White Oak River Basin - Subbasin 04

Site	Old/New DWQ #	Index #	Date	S/EPT S	(E)BI/BIEPT	Bioclass
Taylors Cr, W of Beaufort WWTP, Carteret	-/B-1	21-34	9/94	19/-	2.5*	Est
Taylors Cr, E of Beaufort WWTP, Carteret	-/B-2	21-34	9/94	11/-	3.4*	Est
North R, US 70, Carteret	-/B-3	21-35-1	8/94	55/-	2.3/-	Est
North R, at Mouth, Carteret	-/B-4	21-35-1	8/94	99/-	2.8/-	Est
Ward Cr, US 70, Carteret	7/B-5	21-35-1-7	8/94	35/-	2.1/-	Est
			7/85	40/-	2.3/-	Est
Back Sound, Marker 3, Carteret	-/B-6	21-35-(1.5)	8/94	118/-	2.6/-	Est
Nelson Bay, Marker 1, Carteret	-/B-7	21-35-7-10-(5)	8/94	77/-	2.8/-	Est
Jarrett Bay, Midden Pt, Carteret	-/B-8	21-35-7-22	8/94	87/-	2.9/-	Est

Two sites were collected on Taylors Creek to see if the Beaufort WWTP was having an impact on the creek. The near-outfall site was approximately 200 m west of the Beaufort WWTP outfall, while the far-outfall site was approximately 800 m east of the outfall. The near-outfall site had a BI of 2.9 and % Crustacea of 16%, while the far-outfall site had a BI of 3.4 and % Crustacea of 36% (neither site had spionid nor capitellid taxa). Based on this, it would appear that the Beaufort WWTP is providing some organic loading to Taylors Creek.

North River at US 70 is a much more variable, and hence naturally stressed site, than the site at the river's mouth. While North River at the mouth only had a salinity fluctuation of 6 ppt in the 12 months prior to sampling, the site at US 70 had a salinity range of 27 ppt (9 - 36 ppt). Historical records indicate that these large swings are normal for this site. Lacking information from a known unimpacted site with similar natural fluctuations, it is impossible to estimate how much of the stress at this site is natural and how much, if any, is from runoff from Open Grounds farm.

Ward Creek at US 70 has been sampled twice since 1983. In both years, salinity fluctuations six months before sampling were large (14 ppt in 1994 and 16 ppt in 1985). When compared with a similarly fluctuating waterbody, North River at US 70, Ward Creek had a slightly lower Biotic Index and 20 fewer taxa in 1994. This would indicate that Ward Creek is somewhat more impacted from nonpoint runoff than is the North River. The differences in metrics between the 1994 and 1985 collections is not clear. Three shrimp: Hippolyte zostericola, H. pleuracanthus, and Tozeuma carolinense, and two gastropods: Bittium varium and Mitrella lunata, which are usually associated with grass beds, were collected in 1985, but not 1994. This would seem to indicate the presence of seagrasses and their additional associated taxa at this site in 1985 but not in 1994. Collection notes made at the site, however, indicated no grass could be found in either year.

Fish Tissue Analyses
Shellfish and fish have been collected for tissue analysis in the North River and Sleepy Creek. All values were low with the exception of one oyster sample in 1984 from the North River where 300 ppm of zinc was detected.

Shellfish Closures
The reasons for closed shellfish areas (those areas designated as prohibited or restricted by DEH) in this subbasin fall into three categories: marinas, WWTP effluent and freshwater inputs. In increasing order of importance they are: marinas, especially around Atlantic; WWTP effluent from Taylors Creek discharges in subbasin 03; and headwater areas of creeks and rivers including the North River, Middens Creek, Wade Creek, Williston Creek and Smyrna Creek. For further information on shellfish closures see Chapter 3. DMF list oyster production in this subbasin as Good to Fair and clam production as Good with an overall commercial value of Good.

Special Studies
DWQ has conducted one intensive survey, a dye study of Taylors Creek, in this subbasin. Taylors Creek was found to have a large assimilative capacity due to high tidal flushing, however incomplete lateral mixing kept dye, and presumably effluent, near the north shore.

4.3.5 Subbasin 05 - Eastern side of Core Sound and Southern side of Back Sound

Description

This subbasin includes the eastern side of Core Sound and the southern side of Back Sound in Carteret County. All of this subbasin is estuarine. The land within this subbasin, Shackleford Banks, Cape Lookout, and Core Banks, is part of the Cape Lookout National Seashore and is nearly undeveloped. There are no major dischargers in this subbasin. Figure 4.22 illustrates the sampling locations in the subbasin.

Overview of Water Quality

The entire subbasin has been classified as Outstanding Resource Waters. Of the nearly 4000 acres of Back Sound in this subbasin, there are no areas closed to shellfishing and only one fecal coliform sample out of 126 that has been above 7 colonies/100 ml. There are no DEH shellfish sanitation monitoring sites in the nearly 14,000 acres of Core Sound in this subbasin, and all waters are open. DEH has several monitoring locations in Back Sound and, as already mentioned, all waters in this area are open to shellfish harvesting.

Table 4.11 Benthic Macroinvertebrate Data Collected from 1983 through 1994 in the White Oak River Basin - Subbasin 05

Site	Old/New DWQ #	Index #	Date	S/EPTs	(E)BI/BIEPT	Bioclass
Core Sound, nr Marker 30, Carteret	-/B-1	21-35-7	8/94	98/-	2.9/-	Est
Core Sound, Goose Isl, Carteret	-/B-2	21-35-7	8/94	105/-	2.8/-	Est
Core Sound, Marker 25, Carteret	-/B-3	21-35-7	8/94	101/-	2.9/-	Est

White Oak River Basin
030505

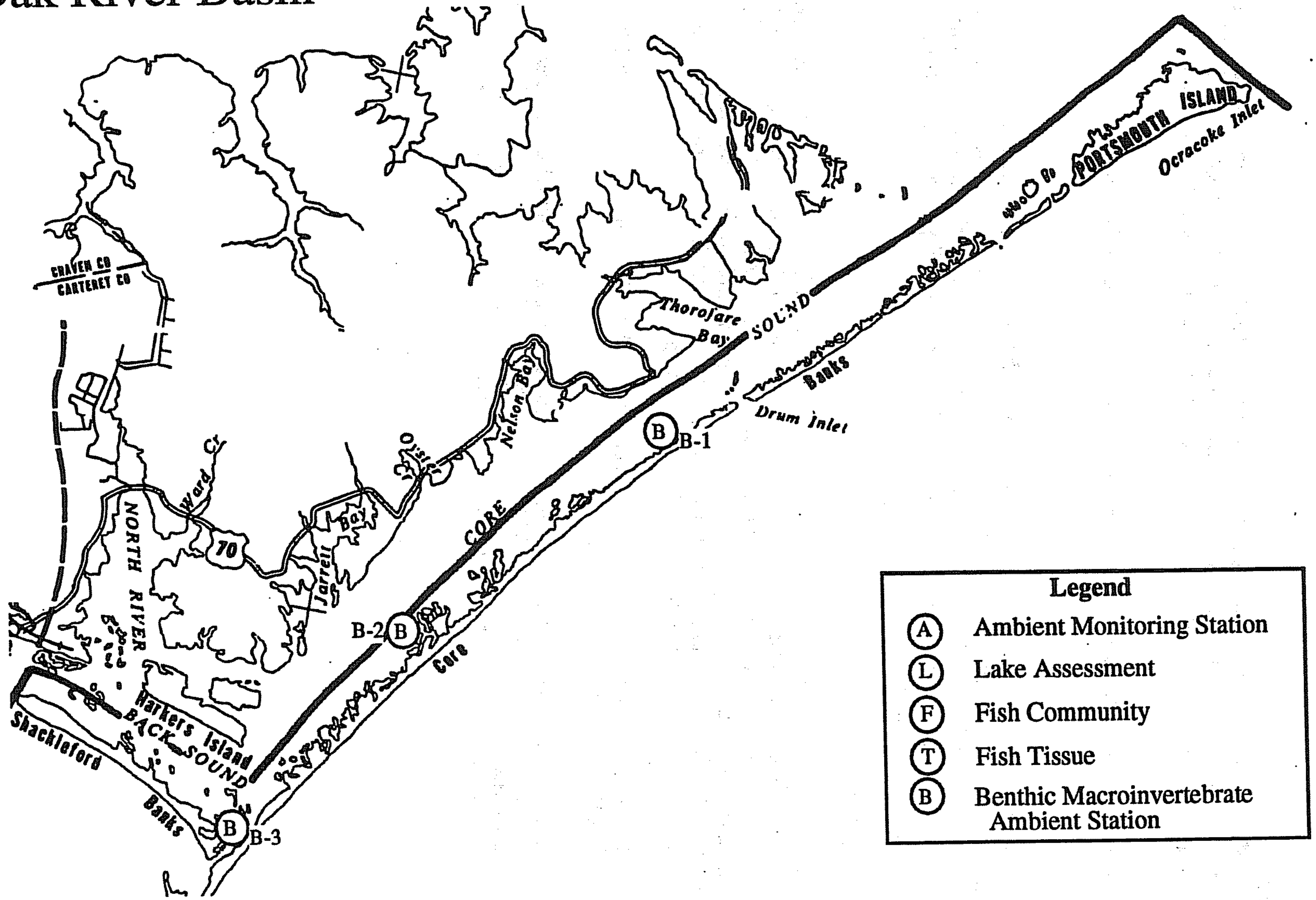


Figure 4.22 Sampling Sites in Subbasin 05 (Eastern Side of Core Sound and Southern Side of Back Sound)

4.4 USE-SUPPORT: DEFINITIONS AND METHODOLOGY

4.4.1 Introduction to Use Support

Determining the *use support* status of a waterbody, (that is, how well a waterbody supports its designated uses), is another important method of interpreting water quality data and assessing water quality. Use support assessments are presented in this section using figures, tables and maps for freshwater streams, lakes and estuaries within the White Oak River Basin.

Surface waters (streams, lakes or estuaries) are rated as either *fully supporting* (S), *support-threatened* (ST), *partially supporting* (PS), or *nonsupporting* (NS). The terms refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are being fully supported, partially supported or are not supported. For instance, saltwaters classified for commercial shellfish harvesting (SA) would be rated as fully supporting if bacterial levels in the water were low enough to allow harvesting (<14 MPN). However, if fecal coliform bacteria levels were too high to allow shellfish to be harvested (>14 MPN), but not too high to prevent swimming (<200 MPN), then the waters would be rated as partially supporting since they only support the swimming. If the waters were impacted to the point that even swimming was disallowed, the waters would be rated as nonsupporting. Streams rated as either partially supporting or nonsupporting are considered *impaired*. The support-threatened category for freshwater rivers and streams refers to those waters classified as good-fair based on water quality data, in contrast to excellent or good which are considered fully supporting. An overall fully supporting rating, however, does include <u>both</u> fully supporting and support-threatened waters. Streams which had no data to determine their use support were listed as non-evaluated (NE).

For the purposes of this document, the term *impaired* refers to waters that are rated either partially supporting or not supporting their uses based on specific criteria discussed more fully below. There must be a specified degree of degradation before a stream is considered impaired. This differs from the word impacted, which can refer to any noticeable or measurable change in water quality, good or bad.

4.5.2 Interpretation of Data

The assessment of water quality presented below involved evaluation of available water quality data to determine a water body's use support rating. In addition, an effort was made to determine likely causes (e.g., sediment or nutrients) and sources (e.g., agriculture, urban runoff, point sources) of pollution for waters that did not support their designated uses (i.e., those found to be either partially or nonsupporting). These data consisted of biological and chemical ratings, reports of citizen complaints, responses to mailings requesting water quality information, land-use reviews of topographic maps, and best professional judgment (see Data Analysis Methodology section for more details). By including best professional judgments (i.e., perceived water quality problems) in deciding the overall water quality ratings and the potential sources of pollution, a much broader, but less precise, picture of water quality conditions in the basin was developed.

Interpretation of these data compiled by DWQ should be done cautiously. The methodology used to acquire the numbers must be understood, as should the purpose for which the numbers were generated. The intent of this use-support assessment was to gain an overall picture of the relative contribution made by different categories of pollution within the White Oak basin. In order to comply with guidance received from EPA to identify likely sources of pollution for all impaired stream mileage, DWQ used the data mentioned above.

The data are not intended to provide precise conclusions about pollutant budgets for specific watersheds. Since the assessment methodology is geared toward general conclusions, it is important to not manipulate the data to support policy decisions beyond the accuracy of these data. For example, according to this report, nonpoint source pollution is thought to be the most widespread source of the impairment of water quality. However, this does not mean that there should be no point source control measures. As discussed in previous sections of this chapter, and in Chapter 6, some stream miles in the basin are impacted by point source dischargers, but the degree of impact has not resulted in a partial or nonsupport rating. What is clear from the plan is that all categories of point and nonpoint source pollution have the potential to cause significant water quality degradation if proper controls and practices are not utilized.

This threat to water quality from all types of activities heightens the need for point and nonpoint source pollution control. It is important to not neglect any source (or potential source) of pollution in developing appropriate management and control strategies. Data exist which document water quality problems from every major pollution category that has been considered in this report. Certainly, the potential for further problems remains high as long as the activity in question continues carelessly. Because of this potential, neglecting one pollution source in an overall control strategy can mask the benefits achieved from controlling all other sources.

4.4.3 Assessment Methodology - Freshwater Bodies

Many types of information were used to make use support assessments and to determine causes and sources of use support impairment. Chemical, physical and biological data as well as wastewater treatment plant self-monitoring data and toxicity data were the primary sources of information used to make use support assessments. Information was also obtained from other agencies, workshops, and pertinent reports.

The most recent water quality chemical data (January 1988 through August 1993) were interpreted for use support utilizing the STAND(ards) program available through the STORET system. The program determines water quality standard violations and computes percentages of the values in violation based on applicable North Carolina water quality standards. According to EPA guidance, use support determinations based on chemical data are to be made as follows:

Fully Supporting - for any one pollutant, criteria exceeded in ≤ 10% of the measurements,
Partially Supporting - for any one pollutant, criteria exceeded in 11- 25% of the measurements, and
Not Supporting - for any one pollutant, criteria exceeded in > 25% of the measurements.

The following parameters were evaluated in the STAND(ards) program: dissolved oxygen (surface values), temperature, pH, turbidity, fecal coliform bacteria (exceedance of 200 MF/100 ml geometric mean), chlorophyll *a*, ammonia, arsenic, cadmium, chromium, copper, lead, nickel, mercury, zinc, chloride, fluoride and selenium.

Another valuable data source used for the report was biological rankings from 1983 through 1994 as determined from benthic macroinvertebrate surveys discussed in section 4.2. The most recent report on these surveys (NCDEHNR, DEM 1995) is available from DWQ's Environmental Sciences Branch. Data from North Carolina's Biological Monitoring Ambient Network (BMAN), in addition to special macrobenthic studies were ranked on a five point scale. This scale is based on taxa richness for the three pollution intolerant groups of macroinvertebrates: Ephemeroptera, Plecoptera and Trichoptera (EPT).

Collected specimens are identified to the lowest possible taxonomic level. Total species (or taxa) richness values for the EPT groups are calculated and biological classifications assigned to each station (Excellent, Good, Good-Fair, Fair or Poor). Higher species richness values are associated with better water quality. For ranking purposes, stations classified as "Poor" with regard to biological data are rated not supporting (NS) and stations classified as "Fair" are rated partially supporting (PS). Stations classified as "Good-Fair" are rated as support-threatened (ST) and those having a Good to Excellent biological classification are rated as supporting their designated uses (S).

Other types of DWQ-collected data used to make use support assessments were toxicity data related to discharging facilities, fish tissue and fish community structure data and phytoplankton bloom information. In addition, fish consumption advisories and information from other agencies, workshops held in 1987 and pertinent reports were utilized. In general, stream segments which received a discharge from a facility significantly out of compliance with permit limits or failing their whole effluent toxicity test were rated as support-threatened, unless water quality data indicated otherwise. Streams which had a fish consumption advisory in place were rated as partially supporting. Assessments were made on either a monitored (M) or evaluated (E) basis. A *monitored* basis represents data which are less than five years old. An *evaluated* basis refers to the use of best professional judgment or data older than five years. Overall ratings were determined for stream segments as follows:

1. *Biological ratings* generally were preferred over any other source of information since they are a direct measurement of aquatic life support.
2. *Chemical ratings* (when biological ratings were unavailable) were preferred over information from older reports or information from workshops.
3. *Workshop "evaluations"* or best professional judgments were preferred over information from older reports.
4. Information from older reports was used when no other information was available.

After overall ratings were assigned, probable sources of pollution (point or nonpoint) for partially supporting and nonsupporting streams were sought. Information on point sources, such as permit compliance records, was reviewed in order to identify major and minor dischargers potentially affecting streams. The Aquatic Survey and Toxicology Unit was also consulted to identify facilities known to have toxic effects based on chronic and acute toxicity tests. Information related to nonpoint source pollution (e.g., agricultural, urban and construction) was obtained from other agencies (federal, state and local), citizens, land-use reviews and best professional judgment.

Causes of use support impairment, such as sedimentation and low dissolved oxygen, were also identified for specific stream segments. For ambient water quality stations, those parameters which exceeded the water quality standard >10% of the time for the review period were included as probable causes. For segments without ambient stations, information from reports, other agencies and best professional judgment were used. In general, facility self-monitoring data and facility aquatic toxicity data were not included in the cause or overall problem parameter column since these data may not reflect instream conditions occurring during the reporting period because they are based on 7Q10 conditions.

Once all monitored and evaluated information was located on water basin maps, remaining "unassessed" streams and segments were evaluated to have the same use-support if they were a direct or indirect tributary to monitored or evaluated segments rated supporting and support-threatened. Partially and nonsupporting segments were not extended. US Geological Survey (USGS) 7.5 minute topographic maps (1:26,000 scale) and orthophotoquads were used to determine probable sources for all impaired streams when other sources, such as WWTP compliance data, were insufficient.

4.4.4 Assessment Methodology - Saltwater Bodies

Estuarine areas are assessed by the DEH shellfish management areas. The following data sources are used when assessing estuarine areas:

DEH Sanitary Surveys

The DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Growing areas are sampled continuously and reevaluated every three years to determine if their classification is correct. Growing waters are classified as follows:

- ***Approved Area*** - an area determined suitable for the harvesting of shellfish for direct market purposes.
- ***Conditionally Approved Open*** - waters that are normally open to shellfish harvesting but are closed on a temporary basis in accordance with management plan criteria.
- ***Conditionally Approved Closed*** - waters that are normally closed to shellfish harvesting but are open on a temporary basis in accordance with management plan criteria.
- ***Restricted Area*** - an area from which shellfish may be harvested only by permit and subjected to an approved depuration process or relayed to an approved area.
- ***Prohibited Area*** - an area unsuitable for the harvesting of shellfish for direct market purposes.

Chemical / Physical Data

Water quality data are collected from estuarine ambient monitoring stations. Parameters are evaluated based on the salt waterbody classification and corresponding water quality standards.

Phytoplankton and Algal Bloom Data

Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms: in which one or more species of algae may discolor the water or form visible mats on top of the water. Blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An algal sample with a biovolume larger than 5000 mm3/m3, density greater than 10,000 units/ml, or chlorophyll a concentration approaching or exceeding 40 micrograms per liter (the NC state standard) constitutes a bloom.

Salt waterbodies are classified according to their best use. When assigning a use support rating, the water body's assigned classification is used with the above parameters to make a determination of use support. Table 4.12 describes how these factors are combined in use support determination.

It is important to note that the DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) as to their suitability for shellfish harvesting but different DWQ use classifications may be assigned to separate segments within a DEH management area. In determining use support, the DEH classifications and management strategies are only applicable to those areas that DWQ has assigned the use classification of SA. This will result in a difference of acreage between DEH areas classified as prohibited or restricted, and DWQ waterbodies rated PS. For example, if DEH classifies a 20 acre waterbody as prohibited, but only 10 acres have a DWQ use classification of SA, only those 10 acres classified as SA will be rated as partially supporting their uses. DWQ areas classified as SB and SC are rated using chemical/physical data and phytoplankton data.

Table 4.12 Description of Factors Determining Use Support Ratings in Saltwaters

DWQ Class.	DEH Shellfish Class.	Chemical/Physical	Phytoplankton
Fully Supporting			
SA	Approved	standard exceeded ≤ 10% of measurements	no blooms
SB & SC	Does not apply	standard exceeded ≤ 10% of measurements	no blooms
Support Threatened			
SA	Conditionally Approved	no criteria	no blooms
SB & SC	Does not apply	no criteria	no blooms
Partially Supporting			
SA	Prohibited or Restricted	standard exceeded 11-25% of measurements	blooms
SB & SC	Does not apply	standard exceeded 11-25% of measurements	blooms
Not Supporting			
SA	Prohibited or Restricted	standard exceeded >25% of measurements	blooms
SB & SC	Does not apply	standard exceeded >25% of measurements	blooms

4.5 USE SUPPORT RATINGS FOR THE WHITE OAK RIVER BASIN

Use Support ratings for all monitored and evaluated surface waters in the basin are presented on color-coded maps in Figure 4.23 (a and b - 2 pages). The following sections describe the assignment of ratings to both the fresh and salt waters in the basin.

4.5.1 Freshwater Streams and Rivers

Of the 290 miles of freshwater streams and rivers in the White Oak basin, use support ratings were determined for 95% or 276 miles with the following breakdown: 70% were rated fully supporting, 21% support-threatened, 4% partially supporting, and 5% not evaluated. Only subbasins 30501 through 30503 contain freshwater streams. Table 4.13 presents the use support determinations by subbasin. In subbasins 01 and 03 the total of the miles rated fully supporting accounted for more than 91% of the stream mileage for each basin. In subbasin 02, 35% of the stream miles were rated fully supporting, 44% were rated support threatened, 9% were rated partially supporting, and 12% were not evaluated.

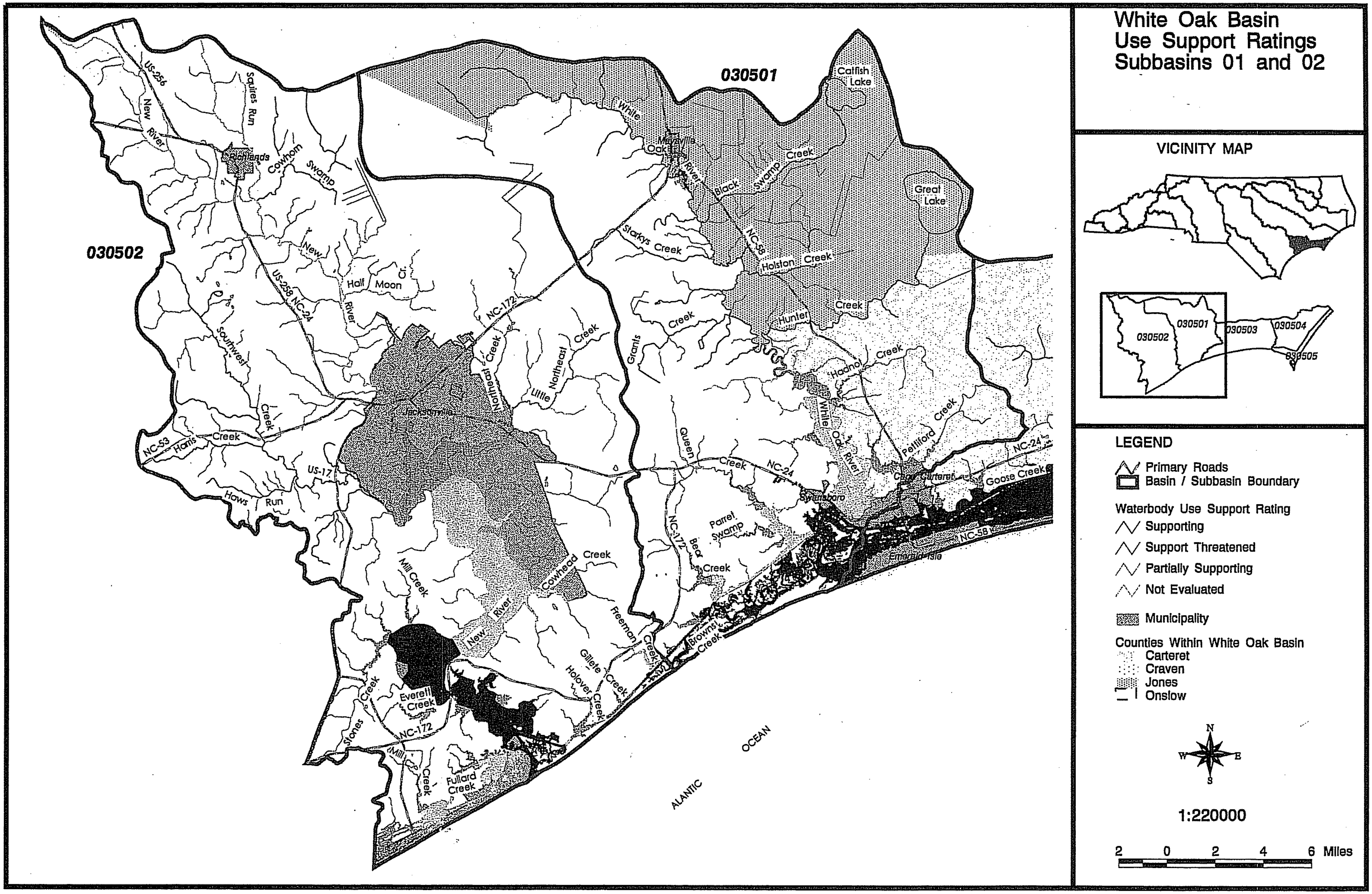
Table 4.13 Use Support Status for Freshwater Streams (miles) in the White Oak River Basin (1990 to 1994)

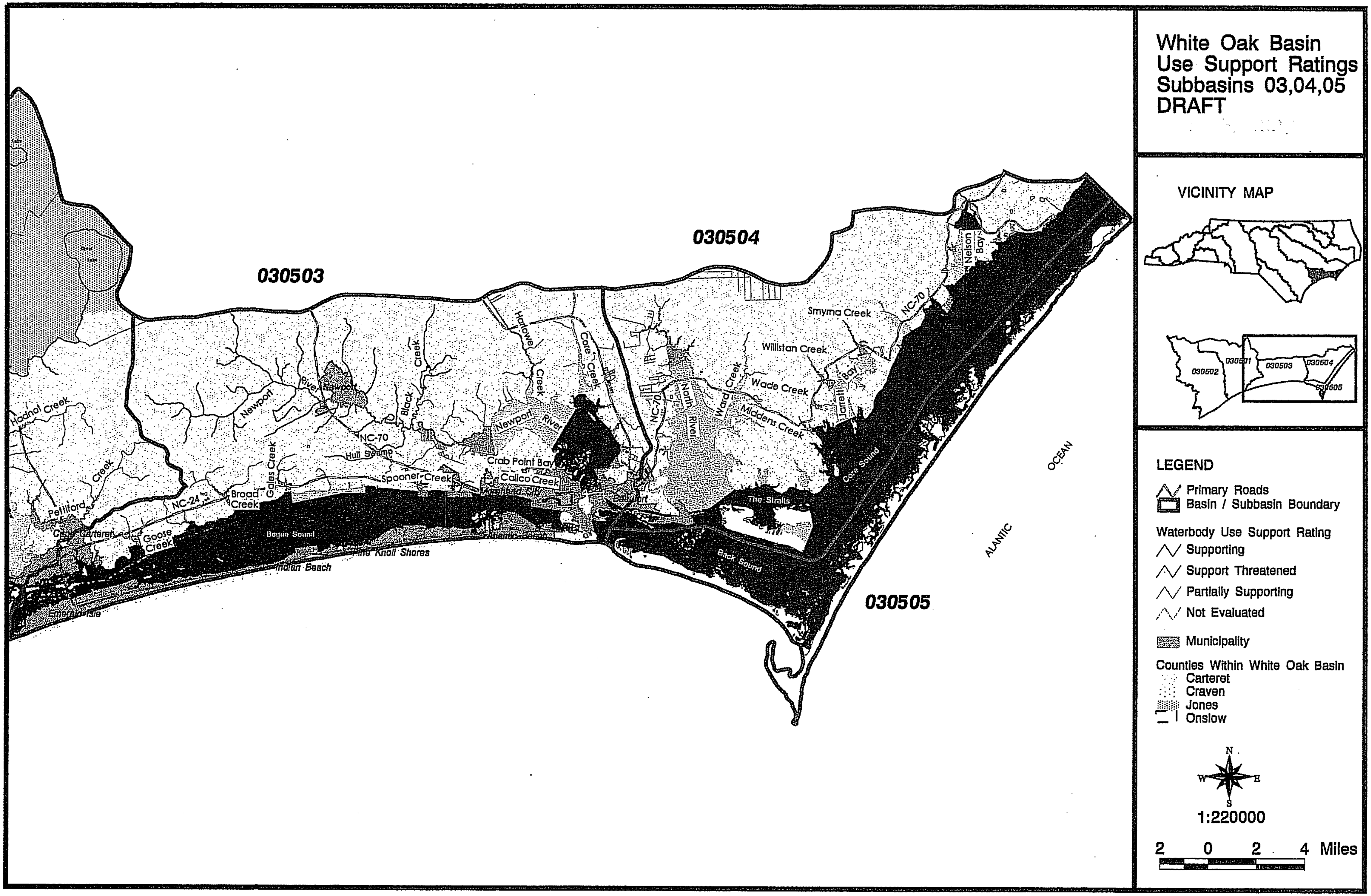
Subbasin	Supporting	Support-Threatened	Partially Supporting	Non-Supporting	Not Evaluated	Total Miles
030501	93.7	9.1	0	0	0	102.8
030502	42.1	51.9	10.9	0	14.5	119.4
030503	68.2	0	0	0	0	68.2
TOTAL	204	61	10.9	0	14.5	290.4
PERCENT	70	21	4	0	5	

Subbasin 02 contained all of the freshwaters (10.9 miles) rated partially supporting. This mileage is attributed to two streams, Little Northeast Creek, and Southwest Creek. Little Northeast Creek is a tributary to Northeast Creek which is a tributary to the New River, and Southwest Creek is also a tributary to the New River. This section of the New River and its tributaries have historically had problems with algal blooms and fish kills. In response to a special study from 1986 through 1989, the supplemental classification of nutrient sensitive waters (NSW) was applied to this section of the New River and it's tributaries. (Impaired waters due to this bloom data are also represented in the estuarine portion of the assessment in the DEH shellfish management area C-3.) Both creeks have demonstrated high chlorophyll a values, and the ambient station on Little Northeast Creek indicates problems with low DO. The impairment on both creeks is due to nonpoint source runoff. In addition to this, the cumulative effects of several small point sources contribute to the impairment on Little Northeast Creek.

4.5.2 Salt (Estuarine) Waters

Use support determinations were made for all of the 121,875 acres of saltwater in the White Oak Basin. Approximately 65% of the saltwaters were rated as fully supporting, 25% were rated support threatened and the remaining 10 percent were rated partially supporting. Table 4.14 presents the use support determinations subdivided by Division of Environmental Health (DEH) shellfish management area. Figure 4.24 provides an illustration of the location of the DEH areas referenced in the table. Probable causes and sources of use support impairment are also listed in Table 4.14


White Oak Basin
Use Support Ratings
Subbasins 01 and 02
030501
030502
VICINITY MAP
030501
030502
030503
030504
030505
LEGEND
Primary Roads
Basin / Subbasin Boundary
Waterbody Use Support Rating
Supporting
Support Threatened
Partially Supporting
Not Evaluated
Municipality
Counties Within White Oak Basin
Carteret
Craven
Jones
Onslow
N
E
S
W
1:220000
2 0 2 4 6 Miles
Catfish Lake
Great Lake
White Oak River
Maysville
Black Swamp Creek
Holston Creek
Hunter Creek
Hadnot Creek
Pettiford Creek
Goose Creek
NC-24
NC-58
NC-172
Starkys Creek
Grants Creek
Queen Creek
Parrot Swamp
Bear Creek
Browns Creek
Freeman Creek
Gillete Creek
Holover Creek
Cowhead Creek
Little Northeast Creek
Northeast Creek
Jacksonville
New River
Mill Creek
Everett Creek
Stones Creek
Fullard Creek
Half Moon Cr.
Cowhorn Swamp
Squires Run
Richlands
US-256
US-258 NC-24
Southwest Creek
Harris Creek
NC-53
US-17
Haws Run
Swansboro
Cape Carteret
Emerald Isle
ALANTIC OCEAN


White Oak Basin
Use Support Ratings
Subbasins 03,04,05
DRAFT
VICINITY MAP
030501
030502
030503
030504
030505
LEGEND
Primary Roads
Basin / Subbasin Boundary
Waterbody Use Support Rating
Supporting
Support Threatened
Partially Supporting
Not Evaluated
Municipality
Counties Within White Oak Basin
Carteret
Craven
Jones
Onslow
N
W
E
S
1:220000
2 0 2 4 Miles
030503
030504
030505
Hadnot Creek
Creek
Pettiford
NC-24
Broad Creek
Goose Creek
Gales Creek
Newport
River
Newport
NC-70
Hull Swamp
Black Creek
Spooner Creek
Calico Creek
Crab Point Bay
Newport River
Harlowe Creek
Core Creek
NC-70
North River
Ward Creek
Wade Creek
Middens Creek
Williston Creek
Jarrett Bay
Smyrna Creek
NC-70
Nelson Bay
Core Sound
The Straits
Back Sound
Bogue Sound
Pine Knoll Shores
Indian Beach
ALANTIC
OCEAN

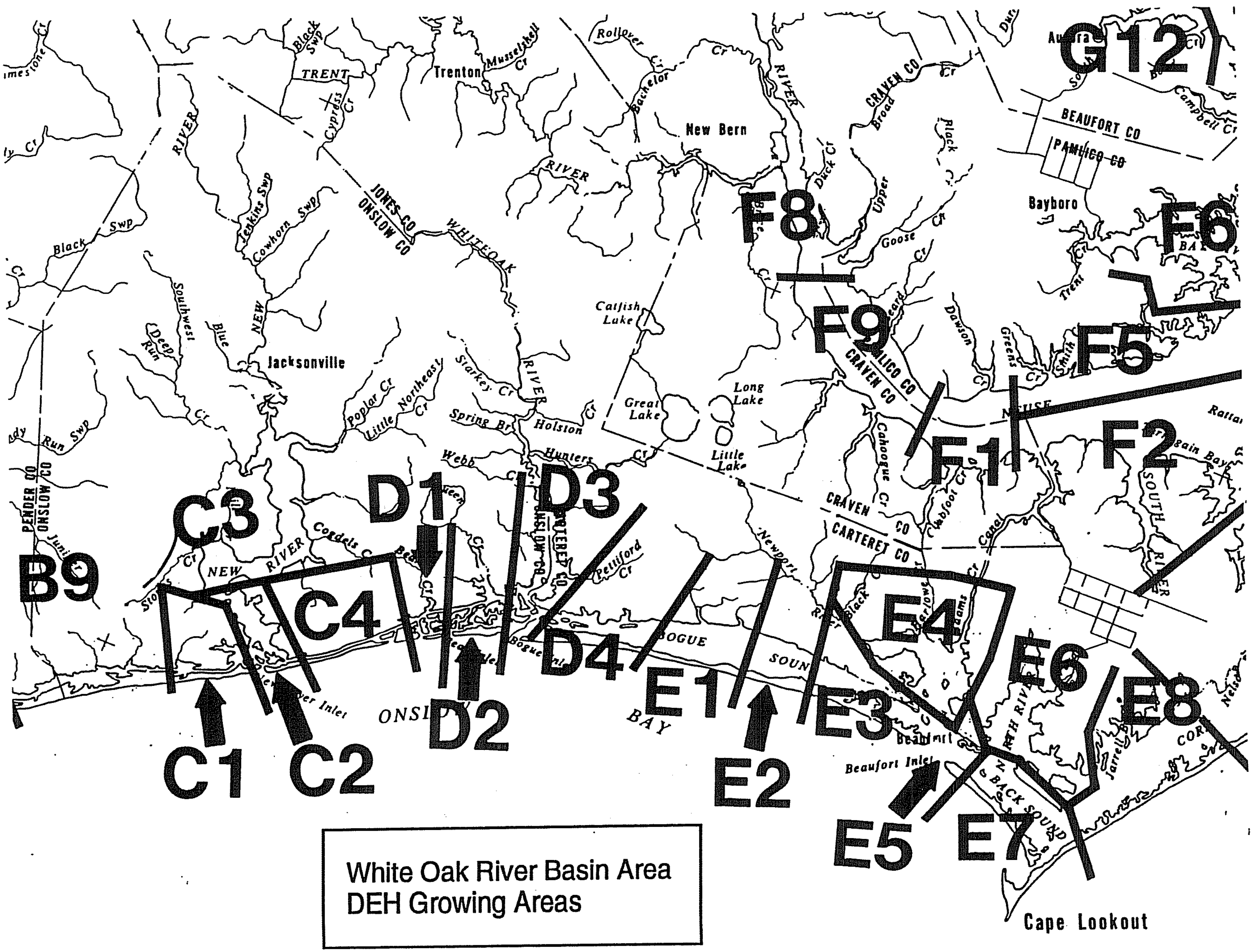


Figure 4.25 Map of DEH Shellfish Growing Areas

Table 4.14 Use Support Status for Estuarine Waters in the White Oak River Basin

Area Name	Total Acres	DEH Area	Overall Use Support: Support	Support Threatened	Partial Support	Non-Support	Major Causes: Fecal	Chla	Major Sources: Point	Nonpoint	Descriptions for Potential Sources of Pollution
Chadwick Bay	1,700	C1	0	1,477	223	0	223			NP	urban runoff, septic tanks, marinas
Sneads Ferry	3,100	C2	2,911	0	189	0	189		p	NP	WWTP, septic tanks, marinas,urban runoff
Stones Bay	15,025	C3	3,005	8,264	3,756	0	751	3,005	P	NP	WWTP, urban runoff, marinas
Hurst Beach	500	C4	205	135	160	0	160		p	NP	WWTP, urban runoff,forestry
Bear Creek	700	D1	480	150	70	0	70			NP	ag, marinas,wildlife,forestry
Queen Creek	2,100	D2	927	428	745	0	745		p	NP	WWTP, ag, urban runoff, septic tanks
White Oak Riv	8,500	D3	3,083	4,000	1,417	0	1,417		p	NP	WWTP, ag, urban runoff, septic tanks, marina,wildlife
Deer Creek	2,300	D4	2,078	0	222	0	222			NP	urban runoff, marinas, septic tanks, urban runoff
Broad Creek	4,700	E1	4,567	0	133	0	133			NP	urban runoff, septic tanks, marinas
Bogue Sound	7,100	E2	6,406	600	94	0	94			NP	urban runoff, septic tanks, marinas
Morehead City	4,900	E3	3,616	0	1,284	0	1,284			NP	urban runoff, septic tank, marina, state port
Newport River	8,600	E4	3,057	3,680	1,863	0	1,863		p	NP	WWTP, ag, forestry, urban runoff, septic tanks, marina
Taylor Creek	6,250	E5	5,800	0	450	0	450		p	NP	WWTP, urban runoff, septic tanks
North River	10,000	E6	460	8,893	647	0	647		p	NP	WWTP, ag, forestry, urban runoff, marina,septic tanks
Back Sound	8,100	E7	8,068	0	32	0	32			NP	septic tanks, marinas
Core Sound	21,000	E8	19,245	1,555	200	0	200			NP	ag, forestry, marinas
Nelson Bay	17,300	E9	15,754	1,090	456	0	456		p	NP	WWTP, ag, septic tanks
Total Acres	121,875		79,662	30,272	11,941	0	8,936	3,005			
Percent	100		65.36	24.84	9.80	0	74.83	25.17			

MAJOR SOURCES:
p (lower-case) indicates that point sources (WWTP) discharge but are operating efficiently or it is noted that they are not affecting the shellfish waters.
P (upper-case) indicates that they are experiencing problems and are a major source affecting water quality.
NP indicates that surveys note they are the major factor influencing the water quality, or there are no WWTPs or major point sources of pollution.

Fecal coliform bacteria was the most widespread probable cause of impairment followed by chlorophyll a. Elevated levels of fecal coliform bacteria are an indicator of water quality degradation that requires the closure of shellfishing areas.

Nonpoint source pollution is estimated to be the primary pollution source in all of the management areas. Point sources are also responsible for impairment in management areas C2, C3, C4, D2, D3, E4, E5, E6 AND E9. Waters are impacted primarily by multiple nonpoint sources including agriculture, forestry, urban runoff, septic tanks and marinas.

4.5.3 Lakes

Two lakes in the White Oak basin totaling 3910 acres were monitored and assigned use support ratings. Great Lake and Catfish Lake are both dystrophic lakes rated C-Swamp waters, and both are used for recreation. These lakes were most recently sampled August 1994 and found to be supporting their designated uses.

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CHAPTER 5

EXISTING POINT AND NONPOINT SOURCE POLLUTION CONTROL PROGRAMS

5.1 INTRODUCTION

This chapter summarizes the point and nonpoint source control programs available for addressing water quality problems in the White Oak River Basin. **Sections 5.2 and 5.3**, respectively, describe existing point and nonpoint source control programs. Chapter 6 presents the application of these programs to specific water quality problems. **Section 5.4** discusses integration of point and nonpoint source management strategies and introduces the concept of *total maximum daily loads* (TMDLs).

5.2 NORTH CAROLINA'S POINT SOURCE CONTROL PROGRAM

5.2.1 Introduction

North Carolina does not allow point source discharges without a permit (the permitting program is described in Section 3.3 of Chapter 3). Discharge permits are issued under the authority of North Carolina General Statute (NCGS) 143.215.1 and the National Pollutant Discharge Elimination System (NPDES) program. The NPDES program was delegated to North Carolina from the US Environmental Protection Agency (EPA). These permits serve as both state and federal permits. NPDES permits establish effluent limitations on the maximum level of wastes or pollutants, that may be discharged into surface waters. North Carolina has a very comprehensive NPDES program that includes the following major components:

1. NPDES Permit Review and Processing (Section 5.2.2),
2. Wasteload Allocation Modeling (Section 5.2.3),
3. Compliance Monitoring and Enforcement (Section 5.2.4),
4. Aquatic Toxicity Testing (Section 5.2.5),
5. Pretreatment (Section 5.2.6),
6. Operator Certification and Training (Section 5.2.7) and
7. Nondischarge and Regional Wastewater Treatment Alternatives (Section 5.2.8).

Below is a brief summary of key components of North Carolina's NPDES program

5.2.2 NPDES Permit Review and Processing

In North Carolina, the issuance of discharge permits is coordinated with the basinwide planning process. Thus, DWQ issues all discharge permits within a given basin at approximately the same time and these permits are valid for five years. New discharge permits issued during an interim period between cycles will have a shorter expiration period in order to coincide with the next basin permitting cycle. Thus, DWQ can more effectively monitor and modify its permitting system consistently across the river basins. In the White Oak Basin, for example, all of the existing permits will expire and be renewed between June 1997 and August 1997. The permitting schedule for each subbasin in the White Oak Basin is presented in Chapter 1.

DWQ will not process a permit application until the application is complete. The requirements for discharge permit application and processing are outlined in Administrative Code Section: 15A NCAC 2H .0100 - Wastewater Discharges to Surface Waters. Under this rule, all applications must include a feasibility analysis on alternative disposal options, such as spray irrigation, and justification for the selection of the discharge option.

Applications for new discharges greater than 500,000 gallons per day of wastewater, 10 million gallons per day (MGD) of cooling water, or 1 MGD of any other type of effluent must include an *assessment* report in addition to the normal permit application. The assessment is to provide sufficient information to describe the impact of the proposed action on the waters in the area. DWQ may also require an Environmental Impact Statement or Environmental Assessment, under the NC Environmental Policy Act for certain publicly funded projects.

DWQ staff establish waste limits for permit applications based on a wasteload allocation process (described in the following section). The staff review also includes a site inspection (for existing facilities up for renewal, the inspection may be conducted prior to submittal of a complete application). If DWQ finds the application acceptable, it will issue a public notice (called a Notice of Intent to Issue) in newspapers having wide circulation in the local area. The Notice of Intent includes all of the permit applications for a particular subbasin (or subbasins) that will be issued within a given month. The public then has a 30-day period to comment on the proposed permit. If the public expresses sufficient interest in one or more of the applications, DWQ may hold a public hearing.

DWQ also sends copies of the Notice of Intent to a number of state and federal agencies for comment. For example, the Division of Environmental Health reviews the applications for their potential impact on surface water sources of drinking water. Once DWQ received and evaluates the comments, the Director of DWQ decides whether to issue or deny the permit. The final permit will include recommended waste limits and other special conditions that may be necessary to ensure protection of water quality standards.

5.2.3 Establishing Discharge Permit Effluent Limitations/Wasteload Allocations

Effluent limitations, also called waste limits, dictate the amounts of wastes (pollutants), that the permittee is allowed to discharge into surface waters under an NPDES permit. Before DWQ issues a discharge permit, it evaluates the projected impact of the discharge on the receiving waters. This determination, called a wasteload allocation (WLA), is usually based on a computer model which considers many factors, including the characteristics of the waste (e.g., flow and type) and the characteristics of the receiving waters (e.g., flow, waste assimilative capacity, channel configuration, rate of reaeration, water quality classification). DWQ determines permit limits using models called water quality-based limits. DWQ also bases some permit limits based on federal effluent guidelines established by the USEPA.

DWQ performs wasteload allocations by using various models, depending on the parameter (type of pollutant) of interest and the characteristics of the receiving waters. Model frameworks (discussed in more detail in Appendix IV) can range from simple mass balance analyses to 3-dimensional dynamic water quality models. Modeling fits into the basin plan by drawing on the current conditions within the basin and evaluating the effects of various management strategies. DWQ uses models for a number of objectives, including determining the fate and transport of pollutants, setting reduction goals for point and nonpoint sources, and to derive effluent limits for NPDES permits. For example, models can be used to predict concentrations of a parameter at a given site, such as instream DO or chlorophyll *a* in a lake.

Models can also be a tool for determining the level of pollutant reductions needed to protect instream standards. In addition, DWQ performs uncertainty analyses of water quality models to expand their predictive capabilities and increase confidence in results. Waste limits may vary from summer to winter for some parameters, such as nutrients and ammonia, with winter limits being somewhat less stringent than summer limits due to higher instream flows during the winter months.

When point sources are responsible for water quality problems, WLAs can yield appropriate permit limits that offer adequate water quality protection. Where a sole discharge is responsible for the water quality impacts, DWQ can perform a simple WLA without considering other discharges. In this case, DWQ will establish limits in accordance with the state's Standard Operating Procedures (SOP) for Wasteload Allocations manual. The SOP manual has been developed to support State and Federal regulations and guidelines and has been approved by the EPA.

A critical factor in determining the wasteload for an individual discharge is whether the receiving waters have a flow during 7Q10 or 30Q2 conditions. DWQ's policy prohibits new or expanded discharges into "no flow" streams that have a 7Q10 and a 30Q2 equal to zero. In addition, DWQ will look for ways to remove existing discharges on such streams unless it is determined that there are no reasonable alternatives. If it is not feasible to remove the discharge, then the facility will be required to meet limits of 5 mg/l BOD_5 and 2 mg/l NH_3N in summer (and 10 mg/l BOD_5 and 4 mg/l NH_3N in winter).

When numerous discharges affect water quality, the Environmental Management Commission is required to consider the cumulative impacts of all of the permitted discharges to a water body (pursuant to NCGS 143-215.1(b)(2)). Such areas are identified and discussed in Chapter 6. Generally, these are areas where the SOP alone does not provide adequate guidance. Since the SOP addresses mostly single discharge or relatively simple interaction of multiple discharges, WLA procedures outside the realm of the SOP represent the larger, basinwide strategy that DWQ is implementing.

5.2.4 Compliance Monitoring and Enforcement

Most dischargers are required to periodically sample the treated effluent from their discharge pipes. Also, many larger and more complex dischargers are required to sample points in the receiving waters both up and downstream from the discharge point. This process is called self-monitoring and it is typically required five days a week for some parameters (Monday through Friday) for major facilities. The sampling results (contained in a daily monitoring report or DMR) are then submitted each month to DWQ for compliance evaluations.

If a plant does not meet its permitted limits, DWQ may take one or more of the following actions: issue a notice of violation, initiate enforcement action, place the facility on moratorium, and/or enter into a Special Order by Consent (SOC). An SOC is a legal commitment entered into by the state and the discharger that establishes a time schedule for bringing the wastewater treatment plant back into compliance. During this time period, interim waste limits may be assigned to the facility until the improvements can be made. These interim limits may be less stringent than those in the permit although they are still required to protect water quality in the receiving waters.

In addition to the DMR data, illegal or improperly treated discharges may be identified in other ways including through third party reports, routine DWQ site inspections, and water quality monitoring conducted by DWQ staff.

5.2.5 Aquatic Toxicity Testing

There are thousands of chemicals and compounds that can enter wastewater systems and potentially be discharged to surface waters. Treatment plants are unable to monitor each of these chemicals individually due to limited funds and time, and limits in the ability of current analytical techniques to detect some pollutants. Even if the existence and potential effects of every constituent of a wastewater were known, the combined effects of these constituents could not be predicted.

North Carolina uses an integrated approach to aquatic toxicity testing that includes monitoring specific chemicals, assessing resident aquatic populations, and analyzing whole effluent toxicity (WET). Whole effluent toxicity limits predict the impacts of toxicants by measuring those impacts in a laboratory setting. It is from this same foundation of aquatic toxicity laboratory tests that chemical specific limits and criteria are derived for the majority of chemical toxicants.

In February 1987, North Carolina implemented a policy to incorporate WET limits for all major and complex minor permits. As of June 1996, 567 permitted NPDES discharges were required to perform WET monitoring, and over 15,000 individual toxicity analyses had been performed for plants across the state. WET limits were developed to protect aquatic life from the discharge of substances in toxic amounts as prescribed by 15 NCAC 2B. 0208 (i.e. so as not to result in chronic toxicity at permitted discharge flow and 7Q10 receiving flow volumes). Since the inception of the program, a change in WET limitations has been observed. Previously, DWQ had predicted that approximately 25% of the facilities tested to be acutely toxic instream; however, DWQ has lowered that prediction to ten percent.

Aquatic toxicity testing, like other complex analytical techniques, requires a great deal of quality assurance and control to achieve reliable results. In 1988, North Carolina initiated a program that requires all laboratories performing NPDES analyses in North Carolina to be certified by the state as a biological laboratory. As of June 1996, 22 commercial, municipal, and industrial laboratories had achieved this certification in either aquatic toxicity analyses and/or aquatic population survey. The NC Biological Laboratory Certification Program, much like WET permitting in North Carolina, is looked at as a national leader in its field.

5.2.6 Pretreatment Program

The goal of pretreatment program is to protect municipal treatment plants or publicly-owned treatment works (POTWs) as well as the environment from the discharge of hazardous or toxic wastes into a public sewage system. The pretreatment program regulates non-domestic (e.g., industrial) users of POTWs that discharge toxic wastes under the Domestic Sewage Exclusion of the Resource Conservation and Recovery Act (RCRA). In essence, the program requires that businesses and other entities that use or produce toxic wastes pretreat their wastes prior to discharging their wastewater into the sewage collection system of POTW. State-approved pretreatment programs are typically administered by local governments that operate POTWs.

Local pretreatment program address four areas of concern: (1) interference with POTW operations, (2) pass-through of pollutants to a receiving stream, (3) municipal sludge contamination, and (4) exposure of workers to chemical hazards. Interference refers to any problem with plant operation, including physical obstruction and inhibition of biological activity. DWQ and the local government develop local pretreatment limits by determining the maximum amount of each pollutant the plant can accept at the influent (or headworks) and still protect the receiving water, the POTW itself, and the POTW's sludge disposal options.

5.2.7 Operator Certification and Training Program

Water pollution control systems must be operated by individuals certified by the North Carolina Water Pollution Control System Operators Certification Commission (WPCSOCC). The level of training and certification that the operator must have is based on the type and complexity of the wastewater treatment system. These systems include: wastewater treatment plants, wastewater collection systems and "non-discharge" ground absorption systems, such as alternative on-site disposal technologies and spray irrigation facilities. The Commission currently certifies operators in four grades of wastewater treatment, four grades of collection system operation, subsurface operation, spray irrigation operation, animal waste management and a variety of specialized conditional exams for specific technologies (e.g. oil/water separators).

The Technical Assistance and Certification Group of the North Carolina Division of Water Quality provides staff support for the Commission and assists in organizing training for operators in cooperation with the North Carolina University System, the North Carolina Community College System and through the professional associations for operators and pollution control professionals. Specialty courses and seminars for operators are also offered by the North Carolina combined Section Of The Water Environment Association/American Water Works Association (WEA/AWWA).

Training and certification of operators is essential to the proper operation and maintenance of pollution control systems. Without proper operation and maintenance, even the most effectively designed treatment system will not function efficiently. The goal of the WPCSOCC is to train competent and conscientious professionals that will provide the best wastewater treatment and thus protect the environment and public health.

5.2.8 Nondischarge and Regional Wastewater Treatment Alternatives

As discussed in section 5.2.2, DWQ requires NPDES permit applicants to consider alternatives for disposal of wastewater effluent other than discharge to a stream. For some, there may be no other economically feasible alternatives. However, for others, particularly smaller dischargers, there are a number of potentially cost-effective and environmentally sound alternatives. There are several types of non-discharging wastewater treatment systems including spray irrigation, rapid infiltration, trickling systems and underground injection. Researchers in North Carolina are evaluating artificial wetlands as wastewater treatment systems. Permit requirements for nondischarging systems are listed in Administrative Code Section 15 NCAC 2H .0200 - Waste Not Discharged to Surface Waters.

Another alternative to a surface water discharge is to tie into an existing wastewater treatment system. Where possible, DWQ is encouraging smaller dischargers to connect to large established municipal systems. Regionalization, as this is called, has several advantages. Large municipal facilities, unlike smaller package-type plants, have a larger and better-trained staff, thereby reducing the potential for plant malfunctions. When malfunctions do occur in a large plant, they can be caught and remedied more quickly than in a small plant. Larger facilities provide a higher level of treatment more economically and more consistently than can smaller plants. Larger plants are monitored daily. Additionally, centralizing the discharges reduces the number of streams receiving effluent. As DWQ evaluates future permit expansion requests from regional facilities, it will look favorably upon plants that accept flows from smaller discharges.

Nondischarge permits are required for alternative methods of wastewater treatment. Nondischarge permits are also issued for the land application of residual solids (sludge) from wastewater treatment processes.

5.3 NONPOINT SOURCE CONTROL PROGRAMS

Nonpoint source pollution occurs when rainfall or snowmelt runs off the ground or impervious surfaces like buildings and roads and drains into waterways. Some of the most common nonpoint source pollutants and sources include:

1. Sediment: Construction sites, disturbed areas, streambank erosion and alterations, cultivated farmland
2. Nutrients: Fertilizer on agricultural, residential, commercial and recreational lawns, animal wastes, leaky sewers and septic tanks, atmospheric deposition
3. Bacteria: Failing septic tanks, animal waste, urban runoff and wildlife
4. Oxygen Demanding Substances: Animal wastes, leaking sewers and septic tanks, gas stations
5. Oil and Grease: Leaky automobiles, industrial areas, illegal dumping
6. Trace Metals: Automobile wear and tear, exhaust, industrial areas
7. Road Salt: Applications to snow and ice
8. Toxic and Synthetic Chemicals: Pesticide applications, automobile fluids, accidental spills, illegal dumping
9. Thermal Impacts: Heated landscape/impervious areas, tree removal, shallow ponds

The two approaches that are used to address nonpoint source pollution are prevention and engineered controls. Some of the methods of pollution prevention include optimum site planning, use of natural drainage systems rather than curb and gutter, nutrient management plans, public/farmer education, storm drain stenciling, and hazardous waste collection sites. It is generally more cost-effective to prevent and minimize pollution than to build engineered controls. For example, developers who are subject to stormwater requirements often choose to build low density developments rather than bearing the expense of building engineered BMPs. Engineered BMPs also have on-going expenses associated with long-term operation and maintenance.

Engineered BMPs generally work by capturing, retaining, and treating runoff before it leaves an area. Some commonly used typed of BMPs include stormwater wetlands, wet detention ponds, water control structures, bioretention areas, and infiltration basins. Often higher levels of pollutant removal can be achieved by using a combination of different control systems. The main advantage of engineered controls is that they can treat runoff from high density developments.

The current trend is toward a more comprehensive "systems approach" to managing nonpoint source pollution. This involves using an integrated system of preventive and control practices to accomplish nonpoint pollution reduction goals. This approach emphasizes site planning, protecting important natural areas such as wetlands, and finding the most cost-effective engineered controls for high density areas. Programs which are currently using the systems approach include the animal waste regulations and the regulations for coastal stormwater management and water supply watersheds.

The goals of the North Carolina nonpoint source management program include:

1. prioritize, target, and restore designated uses of impaired waters;
2. protect or restore highly valued resource waters, such as High Quality Waters, Outstanding Resource Waters, Water Supply I, Water Supply II, and critical areas of Water Supply III and IV waters;
3. identify and implement the most cost-effective NPS management measures to improve and protect water quality;
4. coordinate efforts of the various NPS agencies within the state;
5. identify interagency programmatic deficiencies toward control of nonpoint sources of pollution, cultivate agencies' program capabilities to address these deficiencies, and develop new programs as needed;
6. integrate the NPS program with related management studies (e.g. Albemarle-Pamlico Estuarine Study); and
7. monitor effectiveness of BMPs and management strategies in improving and protecting both surface and groundwater quality.

In keeping with the nature of nonpoint sources of pollution, the responsibility for controlling them is spread among a collection of management agencies in North Carolina. Under Section 208 requirements, the Governor has designated appropriate agencies to be responsible for NPS controls for the various sources. These responsibilities are presented below in Table 5.1.

Table 5.1. NC Regulatory Agencies and NPS Responsibilities

Agency	NPS Category
Environmental Management Commission	general water quality, urban runoff, wetlands and groundwater
Soil and Water Conservation Commission	agriculture
Sedimentation Control Commission	construction
Mining Commission	mining
Division of Environmental Health	on-site wastewater treatment, solid waste disposal
Division of Forest Resources	forestry
Department of Transportation	transportation
NC Cooperative Extension Service	education

Each of the agencies has its own program for addressing NPS issues. The DWQ Nonpoint Source Planning Group coordinates activities of these agencies, and works with them to strengthen their efforts to control NPS pollution. The NPS Planning Group works with these agencies to prioritize and target water bodies, to focus their resources on prioritized areas, to identify agency program weaknesses, and to develop measures to address those weaknesses. An important tool used by the NPS Planning Group to conduct these efforts is the NPS Basin Team concept, discussed below.

NONPOINT SOURCE WORKGROUP

In April 1995, DWQ (then DEM) established a Nonpoint Source (NPS) Workgroup consisting of representatives from both State and Federal lead NPS agencies, as listed in Table 5.2.

Table 5.2. Lead Agencies In the NPS Workgroup by Source/Resource Category

CATEGORY	AGENCY
Agriculture:	Division of Soil and Water Conservation NCSU-Cooperative Extension Service NC Dept. of Agriculture USDA Natural Resources Conservation Service
Construction/Mining:	Division of Land Resources
Forestry:	Division of Forest Resources
Groundwater:	DWQ Groundwater Section
On-site Wastewater:	Division of Environmental Health
Solid Waste:	Division of Waste Management
Urban Stormwater:	DWQ Water Quality Section, Technical Support Branch
Wetlands:	DWQ Water Quality Section, Environmental Sciences Branch
General Surface Water:	DWQ Water Quality Section, Planning Branch US Fish and Wildlife Service US Geological Survey US EPA Division of Water Resources Division of Coastal Management Wildlife Resources Commission Division of Marine Fisheries

Agencies represented on the Workgroup include those originally stipulated by the governor as well as others, chosen to form a fairly comprehensive collection of programs that influence NPS activities in North Carolina. DWQ seeks to coordinate the efforts of these agencies to prioritize NPS pollution control activities across the state.

Responsibilities of the NPS Workgroup members include:

- Point of contact and clearinghouse agent for constituents,
- Identifying stakeholders that need to be represented on NPS Teams,
- Appointing or recruiting NPS Team members,
- Coaching NPS Team members to provide work products on schedule for the NPS Workgroup,
- Developing Section 319 project proposals (maximum 3 submittals per year and category),
- Evaluating and prioritizing Section 319 project proposals, and
- Reviewing outputs from NPS Basin Teams.

NONPOINT SOURCE (NPS) BASIN TEAMS

Coordinated by DWQ, NPS Basin Teams consist of representatives of the NPS agencies and governmental jurisdictions engaged in issues or located in each of the state's river basins. DWQ staff strive to gain participation from as many locally based groups with strong working knowledge of basin and watershed issues as possible, operating under the belief that local knowledge and support is key to program success. Subgroups may be formed for each source category and may bring in other participants as needed, such as industry, producers, special interest groups and other state, federal and local government agencies. Representation in the subgroups changes to reflect the types of activities occurring in each basin. Groups invited to participate in NPS Teams may include:

- all of the agencies (listed above) on the NPS Workgroup, both state-level staff and local staff from each county office within the basin;
- NC Department of Transportation;
- staff from any federal lands within the basin, (e.g., national forests, wildlife refuges, military installations, etc.);
- DWQ regional office staff;
- local resource user groups;
- local industries and trade groups, such as the Farm Bureau;
- local governments in the basin (i.e. counties, cities, towns) - managers, planners, health department staff, engineers, etc.;
- university researchers working in the basin, and established research facilities; and
- local and state ad hoc and established environmental groups and agency task forces and councils.

The following is a list of activities conducted by NPS Teams in each basin:

- Take inventory of programs, initiatives, and activities of Team agencies, by NPS category and/or pollutant.
- Prioritize water bodies and water quality issues.
- Determine needs in each prioritized watershed, based on agency knowledge, water quality data and other information gathered in the basinwide process. Needs may include:
  - public education;
  - source reduction;

- implementation of BMPs;
- ecosystem restoration, protection, and management;
- monitoring of land treatment and/or water quality; and
- local water quality planning.

- Develop five-year Action Plans for chosen NPS categories/pollutants (including goals and supporting activities by agency, schedule for completion, estimated costs and funding sources). Assistance may come from one or more of the following programs:
  - NPS Team agency activities;
  - Section 319 grants;
  - NC Agriculture Cost Share Program;
  - Wetlands Restoration Program;
  - Water Quality Improvement Trust Fund;
  - Proposed URW Program;
  - Sedimentation and Erosion Control Program;
  - Federal Initiatives; and
  - Other programs.
- Develop Section 319 project proposals for targeted watersheds to be submitted to the NPS Workgroup.
- Implement Action Plans.
- Monitor to evaluate effectiveness of management strategies.
- Reconsider, revise management strategies as necessary.

Table 5.3 lists a number of federal and state regulations and programs that address nonpoint source pollution by categories based on the type of activity.

5.3.1 Agricultural Nonpoint Source (NPS) Control Programs

Agricultural BMPs have been developed largely to control the five major agriculturally-related causes of pollution: nutrients, sediment, pesticides, oxygen-demanding substances and bacteria. BMPs vary from site to site and are dependent upon a particular pollutant but include practices such as grassed waterways and vegetated buffers, nondischarging animal waste lagoons, integrated crop and pest management and soil testing. BMPs may be administered through one or more of the agricultural programs described below. Common agricultural BMPs are listed in Appendix VI.

- **North Carolina Agriculture Cost Share Program**
  In 1984, the North Carolina General Assembly budgeted approximately $2 million to assist landowners in 16 counties within the "Nutrient Sensitive Water" (NSW) watersheds including the Upper Neuse River (Falls Lake) and the New River in Onslow County to implement BMPs for agricultural and silvicultural activities. These funds were increased in May 1987 to include 17 additional coastal counties by the passage of a General Statute formally creating the *Agriculture Cost Share Program for Nonpoint Source Pollution Control (NCACSP)*. In 1989 the NCACSP became a statewide program. The NCACSP will pay a farmer 75 percent of the average cost of implementing approved BMPs and offer technical assistance to the landowners or users which would provide the greatest benefit for water quality protection. The primary purpose of this voluntary program is water quality protection.

Table 5.3. List of Nonpoint Source Programs (abbreviations are presented in Table 5.4)

	MANAGEMENT AGENCIES		
PROGRAM	LOCAL	STATE	FEDERAL
AGRICULTURE			
Agriculture Cost-Share Program	SWCD	SWCC, DSWC	
Animal Waste Management	SWCD	DWQ, DSWC, CES	NRCS
Laboratory Testing Services		NCDA	
Watershed Protection (PL-566)			NRCS
1985, 1990, and 1996 Farm Bills			USDA
Federal Insecticide, Fungicide, and Rodenticide Act			EPA
URBAN			
Coastal Stormwater Program		DWQ	
ORW, HQW, NSW Management Strategies		DWQ	
Stormwater Control Program	city,county	DWQ	EPA
Water Supply Watershed Protection Program	city,county	DWQ	
NPDES stormwater permitting		DWQ	EPA
Federal Insecticide, Fungicide, and Rodenticide Act			EPA
CONSTRUCTION AND MINING			
Sedimentation Pollution Control Act	ordinance	DLR, DOT	
Sedimentation and Erosion Control and NPDES program	ordinance	DLR, DOT, DWQ	EPA
Coastal Area Management Act	ordinance	DCM	
Mining Act of 1971 and NPDES program		DLR, DWQ	EPA
ON-SITE WASTEWATER DISPOSAL			
Sanitary Sewage Systems Program	county	DEH	
SOLID WASTE DISPOSAL			
Resource Conserv. and Recovery Act			EPA
Solid Waste Management Act of 1989	city,county	DWM	
FORESTRY			
Forest Practice Guidelines		DFR	
National Forest Management Act			USFS
Forest Stewardship Program		DFR	
HYDROLOGIC MODIFICATION			
Clean Water Act (Section 404)		DCM, DWQ	COE
Rivers and Harbors Act of 1899			COE
Dam Safety Permit		DLR	
WETLANDS			
Clean Water Act (Sec.s 401 and 404)		DWQ	COE
GROUNDWATER			
Wellhead Protection Program	city,county	DWQ	
Underground Storage Tank Program		DWQ	
Leaky Undergd Storage Tk Trust Fund		DWQ	EPA
Generic State Management Plan			
GENERAL			
Section 319 Clean Water Act		DWQ	EPA
CZARA		DWQ, DCM	EPA, NOAA
Stream Classification and Standards		DWQ	EPA

Table 5.4. Agency Name Abbreviations for Table 5.3.

ABBREVIATIONS FOR TABLE 5.3: **COE**, US Army Corps of Engineers; **DCM**, Div. of Coastal Mgmt.; **DEH**, Division of Environmental Health; **DWQ**, Div. of Water Quality; **DLR**, Div. of Land Resources; **DFR**, Div. of Forest Resources; **DOT**, Dept. of Transportation; **DSWC**, Division of Soil and Water Conservation; **DWM**, Div. of Solid Waste Mgmt.; **EPA**, U.S. Environmental Prot. Agency; **NCDA**, NC Dept. of Agric.; **NOAA**, National Oceanic and Atmospheric Administration; **NRCS**, Natural Resources Conservation Service; **SWCC**, Soil and Water Conservation Commission; **SWCD**, Soil and Water Conserv. District; **USDA**, US Dept. of Agric.; **USFS**, US Forest Service.

The local Soil and Water Conservation District Boards under the administration of the North Carolina Soil and Water Conservation Commission (SWCC) are responsible for identifying treatment areas, allocating resources, signing contractual agreements with landowners, providing technical assistance for the planning and implementation of BMPs and generally encouraging the use of appropriate BMPs to protect water quality. The criteria for allocating funds to the District is "based on the identified level of agricultural related nonpoint source pollution problems and the respective District's BMP installation goals and available technical services as demonstrated in the Districts annual strategy plan" (NC Administrative Code, Title 15, Chapter 6, Section 6E). This local participation is crucial to the success of the program.

The DEHNR-Division of Soil and Water Conservation (DSWC) provides staff, administrative and technical support to the SWCC. The DSWC also coordinates the efforts of various associated Program committees and acts as the clearinghouse for District strategy plans, contracts, etc. A legislated Technical Review Committee meets quarterly "to review the progress of the Program" (G.S. 143-215.74B) and to make technical recommendations to the Commission.

Technical assistance for the implementation of approved BMPs is provided to the Districts through a 50:50 cost share provision for technical positions to be filled at the District level. The USDA-Natural Resources Conservation Service (NRCS) also provides technical assistance.

The current annual statewide budget to cost share BMPs (75% - NCACSP / 25% landowner) with landowners is approximately $ 6.7 million. The budget to share the cost of providing technical assistance with Districts is approximately $ 1.3 million. Additional support for administration and staff is provided by local governments. In White Oak River Basin districts, approximately $682,450 in BMP cost share dollars have been spent since the program was initiated. These cost share dollars are estimated to have affected over 19,000 acres of land and saved over 17,100 Tons of soil from eroding. In Carteret County, approximately 75 water control structures have been installed on 15 farms, including 3 animal operations. There is also federal assistance through NRCS and the USDA Farm Services Agency (FSA) for BMP implementation.

- **North Carolina Pesticide Law of 1971**
  In 1971 the General Assembly created and authorized the North Carolina Pesticide Board to regulate the use, application, sale, disposal and registration of pesticides for the protection of the health, safety, and welfare of the people and for the promotion of a healthy and safe environment. Some of the responsibilities of the Pesticide Board and the North Carolina Department of Agriculture include registering all pesticides prior to distribution and sale in North Carolina, sampling pesticides to insure that all products are up to guaranteed analysis and unadulterated by any other pesticide, sampling pesticides at time of application to insure that the applicator is following label instructions, and certifying the competency of applicators and dealers of restricted use pesticides.

The Pesticide Section of the North Carolina Department of Agriculture conducts mandatory annual inspections of all aircraft used in pesticide application and conducts random inspections of ground application equipment and chemigation systems (application of pesticides through irrigation systems). These inspections are intended to encourage proper calibration and use of equipment in order to avoid excessive application rates and accidental spills from faulty systems. Stop use orders are issued for noncompliance with the regulations.

Inspections are also required for bulk storage tanks prior to filling. All commercial pesticide storage facilities are required to have an approved Pre-fire Plan. In addition, each large commercial storage facility is required to develop and maintain an Emergency Contingency Plan. This plan describes the actions facility personnel shall take to respond to fires, explosions, spills, or any other sudden or gradual release of pesticides or pesticide contaminated materials to air, soil, or surface waters. The Contingency Plan is designed to minimize hazards to human health and the environment.

Penalties are assessed to careless pesticide applicators. Enforcement of the law is based on where the pesticide is deposited rather than just where it is applied. For example, if a pesticide is found in a stream as a result of wind drift, the applicator is subject to legal action. The Raleigh Office staff of the NCDA Pesticide Section is comprised of 20 employees. There are 10 Inspectors who conduct field-level compliance monitoring and investigation services. The annual budget for pesticide control and analytical work is $1.4 million.

- **NCDA Pesticide Disposal Program**

In 1976, the North Carolina Pesticide Board adopted regulations governing the disposal of pesticides. These regulations make it illegal in North Carolina to dispose of hazardous waste (which includes certain pesticides) in sanitary landfills. While households and farms which generate less than 220 pounds of hazardous waste and less than 2 pounds of acutely hazardous waste are exempt from federal disposal requirements, the regulations prohibiting the disposal of these wastes in sanitary landfills still applies to them. The option to use commercial hazardous waste disposal companies is too expensive and most companies will not pickup small quantities. As a result of this dilemma, the NCDA created the Pesticide Disposal Program in 1980 through appropriations from the General Assembly.

The goal of the Program is to provide an available, affordable and environmentally acceptable mechanism in which any homeowner, farmer, or institution can dispose of unwanted or unusable pesticides. It is mandatory, however, that all pesticide products are labeled correctly before NCDA will pick them up. An EPA permitted hazardous waste treatment or disposal facility (TSD) requires proper identification before the products can be disposed.

The Food and Drug Division of the North Carolina Department of Agriculture administers the Pesticide Disposal Program. The same staff used for enforcing the North Carolina Pesticide Law of 1971 are used in the Disposal Program.

- **Animal Waste Management**

Regulations

On December 10, 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for properly managing and reusing animal wastes from intensive livestock operations. The goal of the rule is for intensive animal operations to operate so that animal waste is not discharged to waters of the state. This means that if criteria are met and no waste is discharged to surface waters, then an individual permit from DWQ is not required. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds with a liquid waste system. These operations are deemed permitted if a signed registration and an approved waste management plan certification are submitted to DWQ by the appropriate deadlines.

The deadline for submittal of registrations to DWQ for existing facilities was December 31, 1993. There were 74 registered operations in the White Oak Basin as of January 1996. Animal waste management plans for existing facilities must be certified by a technical specialist designated by the Soil and Water Conservation Commission and submitted to DWQ by December 31, 1997. The standards and specifications of the USDA Natural Resources Conservation Service are the minimum criteria used for plan approval by the local Soil and Water Conservation Districts.

Operator Training and Certification
The North Carolina General Assembly ratified Senate Bill 974 (NCGS 143-215.74C - E) on July 29, 1995, which requires that the Department of Environment, Health and Natural Resources, in cooperation with the Cooperative Extension Service, develop and administer a training and certification program for operators of swine facilities with more than 250 swine that land apply animal waste. The Department assigned the task of developing and administering this program to the Technical Assistance and Certification Group of the Water Quality Section. The purpose of this program is to reduce nonpoint source pollution associated with the operation of animal waste management systems. Animal waste management systems are defined as a combination of structural and non-structural practices that collect, treat, store, or apply animal waste to the land. All animal operations with 250 or more swine (Sus scrofa) are required to designate an Operator in Charge who has primary responsibility for the operation of the animal waste management system. There are approximately 4,000 animal operations in the state that are required to designate an Operator in Charge.

A steering committee was established that included representatives from the animal agriculture industry, environmental groups, North Carolina Department of Agriculture, Natural Resources Conservation Service, Division of Soil and Water Conservation, North Carolina Cooperative Extension Service and the Division of Water Quality. The primary purpose of this committee was to develop the instructional manual and exam questions for the training and certification program. The manual was completed and is being used in the training sessions that are being conducted primarily by the Cooperative Extensive Service in each county. Also involved in the training are personnel from the NC Department of Agriculture, Natural Resources Conservation Service, DWQ, and pork producers. The training sessions for the operators began in April 1996. The examinations have been administered by the Technical Assistance and Certification Group in eighteen locations throughout the state since May, 1996. As of August 1, 1996, 2,296 individuals had been tested, with 2,103 passing the exam.

Persons who wish to be certified as operators of animal waste management systems must attend a minimum of six hours of training and demonstrate competence in the operation of animal waste management systems by passing an examination. The training and certification requirements must be completed once every five years. Participants in the training program will receive instruction in the following areas: 1) proper operation of animal waste management system components such as lagoons and irrigation systems; 2) waste utilization plans and proper waste, soil and tissue sampling techniques; 3) proper application of waste including calculation of application rates and calibration of equipment; and 4) consequences of improper management and environmental stewardship.

Inspection and Enforcement
Prior to July, 1995, DWQ's limited compliance resources were most directed toward getting existing facilities registered, insuring that new and existing facilities had approved waste management plans and responding to citizen complaints.

Following the major lagoon dike breaks in late June and July, 1995, DWQ and the Department's natural resources divisions made a major commitment to inspecting all animal operations. These major breaks include facilities in Brunswick, Onslow, Sampson and Duplin counties. As of December 1, 1995, over 4,000 were inspected.

These inspections have found a very high percentage of these facilities to have problems. DWQ is currently working with these problem facilities to return them to compliance. These efforts include technical assistance, Notices of Violations, notification of loss of deemed permitted status and other appropriate enforcement actions. Approximately 1,800 out of the 3,922 reports entered in the Division's database indicate a compliance problem. As of May 13, 1996, approximately 200 facilities were discovered to have a discharge during an inspection.

Table 5.5. Animal Inspection Database; May 13, 1996

Inspections	Total	Swine	Cattle	Poultry
Reports Entered	3922	3,012	803	107
Inadequate Freeboard	579	449	87	43
Seepage observed from lagoon	118	85	26	7
Erosion observed	426	376	32	18
Inadequate acreage available for spray	112	96	3	13
Cover crop inadequate	225	206	4	15
Man made conveyance of wastes	154	99	52	3
Inadequate Records	1,078	868	162	48
Non-Man made conveyance of wastes	59	43	8	8

This is preliminary information based on only the inspection reports entered as of the date of the report. These numbers are not considered accurate until a quality assurance procedure is in place. These numbers will change daily based on the entry of new reports and quality assurance checks of the information in the data base.

As of May 13, 1996, 40 civil penalty cases have been assessed and 8 court injunctions have been filed. 85 facilities have lost their deemed permitted status and required to obtain a certified waste management plan prior to the December 31, 1997 deadline.

Swine Farm Siting Act
The Swine Farm Siting Act, SB 1080, was adopted on July 11, 1995 to minimize adverse impacts on property adjoining concentrated animal operations. The Act specifies that a swine house or lagoon of a new farm sited on or after October 1, 1995 is required to be at least 1,500 feet from any occupied residence; at least 2,500 feet from any school, hospital, or church; and at least 100 feet from any property boundary. The Act restricts the application of lagoon effluent to land at least 50 feet from a residential property line and from any perennial stream or river, excluding irrigation ditches and canals. If written permission is given by the property owner and recorded with the Register of Deeds, a swine house or lagoon may locate closer to a residence, school, hospital, church, or property boundary.

Blue Ribbon Commission on Animal Waste
A Blue Ribbon Study Commission on Agricultural Waste was created by legislation passed during the 1995 session of the General Assembly. The Commission consisted of a committee of 18 members; six were appointed by the Governor, six were appointed by the President Pro Tempore, and six were appointed by the Speaker of the House of Representatives. The committee was co-chaired by former Representative Tim Valentine and former DEHNR official Ernie Carl, Ph.D. The Commission held numerous technical sessions and two public meetings to review the effectiveness of animal waste management regulations and the environmental impacts of agricultural waste.

The Commission submitted a final report of its findings and recommendations to the 1996 Regular Session of the 1995 General Assembly. The final report discusses areas in the State where there is a significant concentration of agricultural waste and makes recommendations for reducing waste where significant adverse impacts to groundwater and drinking water are identified. The final report also includes proposals for implementing recommendations of a Swine Odor Study and a Groundwater Study.

Animal Waste Management Statute Revisions - S 1217
Senate Bill 1217, ratified in June 1996 by the NC General Assembly, is the latest change to animal waste statutes, and it includes some of the recommendations of the Blue Ribbon Commission on Animal Waste. It establishes the statutory authority under GS 143-215.10 for a tiered permitting program for animal waste management systems. This program supplants the "deemed permitted" approach established in the original 1992 regulations (see above). The ratified bill is quite detailed and contains the following major components:

- Permits are required for $\geq$ 250 swine, $\geq$ 100 cattle, $\geq$ 75 horses, $\geq$ 1,000 sheep, $\geq$ 30,000 birds [liquid system]). The EMC shall develop general permits to be issued by DWQ.
- Dry poultry operations with $\geq$ 30,000 birds are to develop animal waste management plans, not previously required, and retain records on site for three years. Plans are to include nutrient testing of waste within 60 days of application, annual soil testing, nitrogen as the limiting nutrient for land application, monitoring of zinc and copper in soils and alternative crop sites if zinc and copper levels are excessive; and record keeping for waste application (dates, rates, locations). Operators must be compliant with testing and record keeping requirements by January 1, 1998.
- Permits are to be issued on a phased-in priority basis by the Department within 5 years, beginning January 1, 1997. Priority is to be given to the largest operations.

Provisions were also included in the S1217 for:
- the design storm for waste management systems,
- a permit review and approval period,
- required components of animal waste management plans,
- evaluation and encouragement of alternative and innovative animal waste management technologies,
- annual review of animal operations by technical specialists,
- types of violations requiring immediate notification by state or local employees,
- yearly inspections of animal operations by DWQ,
- establishment of a fee schedule based on steady state live weight,
- revision of the maximum penalty for first offense from $5,000 to $10,000,
- addition of two animal industry representatives to the Water Pollution Control System Operators Certification Commission,

- certified operator requirements, certification, training, examination, fees, and revocation or suspension of certificate,
- siting requirements for swine houses, lagoons and land areas onto which waste is applied at swine farms,
- civil action provisions against swine farmers,
- required written notice for new operations, and
- addition of specific BMPs into Agricultural Cost Share Program.

• **NC Cooperative Extension Service and Agricultural Research Service**
Crop and animal production programs are administered under the research and education activities of the NC Agricultural Research Service (ARS) and the NC Cooperative Extension Service (CES). The research and education efforts are broad and include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development and irrigation. Guidelines for most agricultural enterprises have been developed and made available to farmers. A more intensified water quality emphasis is being incorporated in these areas and many other projects undertaken by ARS and CES. The local contact that county CES agents have with farmers and homeowners provides an excellent opportunity for dialogue and education in nonpoint source pollution control. This network of contacts can be used to inform people about BMPs and to provide some structure for a general NPS education program.

The NC Agricultural Research Service and the NC Cooperative Extension Service conduct broad research and education efforts that include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development, and irrigation. County Cooperative Extension agents work closely with farmers and homeowners, providing an excellent opportunity for dialogue and education in nonpoint source pollution control. In addition, CES has begun assisting DWQ in holding a series of public workshops in each river basin prior to DWQ's preparation of the draft basin plan. The October 1995 workshops for this basin are discussed in the Executive Summary and in Appendix V.

During 1996, the Onslow County CES conducted numerous NPS-related activities, including:

- trained 95 animal waste land applicators,
- performed animal waste analyses for application to over 1,000 acres of land,
- assisted in composting 9,570 tons of poultry waste,
- performed soil analyses for 32, 957 acres, largely farmland,
- assisted implementation of agricultural conservation practices for 316 acres of farmland with anticipated savings of 1,137 tons of soil,
- presented septic system care and maintenance information to more than 400 people, and mailed information to an additional 200,
- presented watershed and urban BMP educational information to more than 500 people.

• **Soil, Plant Tissue, and Animal Waste Testing Program**
These services provide farmers with information necessary to improve crop production efficiency, to manage the soil properly and to protect environmental quality. The Soil, Plant Tissue and Animal Waste Testing Program is administered by the Agronomic Division of the North Carolina Department of Agriculture. Water and wastewater from lagoons is also tested for irrigation and fertilizer use.

In 1994-1995, the Division analyzed hundreds of thousands of samples to assist landowners, farm operators and others in making sound management decisions in using fertilizers, animal wastes and chemicals. The Division provided over 43,000 advisory reports, conducted hundreds of laboratory lectures and tours, and completed almost 15,000 consultations with landowners and operators. Regional Agronomists assist individuals in-the-field so that management recommendations are carried out in the most cost-effective and environmentally safe manner. The agronomists conduct field tours as part of the outreach program and the Division is involved in over one hundred research projects at NCDA research stations and on private lands.

- **Watershed Protection and Flood Prevention Program (PL 83-566)**
  The purpose of the Watershed Protection and Flood Prevention Program is to provide technical and financial assistance in planning, designing, and installing improvement projects for protection and development of small watersheds. The Program is administered by the USDA-Natural Resources Conservation Service in cooperation with the NC Division of Soil and Water Conservation, the State Soil and Water Conservation Commission, the U.S. Forest Service, Soil and Water Conservation Districts, and other project sponsors.

  The emphasis of the Program over the past three decades has been to provide flood control. However, legislation has shifted emphasis of PL-566 land treatment projects so that a project proposal must demonstrate off-site water quality benefits in order to have any chance of funding. In the White Oak River Basin, there are no land treatment projects underway.

- **Food Security Act of 1985 (FSA),**
  The Food, Agriculture, Conservation and Trade Act Of 1990 (FACTA), and The Federal Agricultural Improvement and Reform Act Of 1996 (FAIRA)

  There are several provisions authorized by the FSA and re-authorized, modified, or added by the FACTA and the FAIRA that offer excellent opportunities for the abatement of agricultural nonpoint source pollution. These Acts make the goals of the USDA farm and conservation programs more consistent by encouraging the reduction of soil erosion and production of surplus commodities while encouraging the protection of water quality and the preservation and restoration of wetlands. Provisions of these acts can serve as tools to remove from production those areas that critically degrade water quality by contributing to sedimentation. Important water quality-related provisions establish or modify the Conservation Reserve, Conservation Compliance, Sodbuster, Swampbuster, Conservation Easement, Wetland Reserve, Water Quality Incentive, and Environmental Quality Incentives Programs. These programs are administered by the USDA.

Conservation Reserve Program (CRP)
The CRP was established in the FSA of 1985 as an incentive program to encourage the removal of highly erodible land from crop production and to promote the planting of long-term permanent grasses and tree cover. The intent of the program is to protect the long term ability of the U.S. to produce food and fiber by reducing soil erosion, to improve water quality and to enhance fish and wildlife habitat. Additional objectives are to curb the production of surplus commodities and to provide farmers with income replacement through rental payments over a 10 year contract period for land entered under the CRP. The CRP is administered by the USDA Farm Services Agency (FSA) and the USDA Natural Resource Conservation Service (NRCS). Other cooperating agencies include the NC CES, NC Division of Forest Resources and local Soil and Water Conservation Districts. The USDA FSA will share up to half of the cost of establishing this protective cover. Contracts under the original FSA legislation began to expire in 1995 and 80% will expire in 1996 and 1997.

The 1996 FAIRA extended the CRP through 2002 with a cap of 36.4 million acres and new eligibility criteria to protect the most environmentally sensitive lands.

Conservation Compliance
The Conservation Compliance provision of the FSA and FACTA discourages the production of crops on highly erodible cropland where the land is not carefully protected from erosion. Conservation Compliance could be considered a quasi-regulatory program based on its use of economic disincentives. Farmers with highly erodible land in cultivation were required to develop and begin applying a conservation plan on that acreage by January 1, 1990. Plans were required to be operational by January 1, 1995 for farmers to avoid loss of eligibility for price and income supports, crop insurance, FHA loans, Commodity Credit Corporation storage payments, farm storage facility loans, Conservation Reserve Program annual payments, and other programs under which USDA makes commodity-related payments. Highly erodible land is defined as land where the potential erosion (erodibility index) is equal to eight times or greater than the rate at which the soil can maintain continued productivity. This rate is determined by the Natural Resource Conservation Service.

The FAIRA of 1996 made several changes in the Conservation Compliance program to simplify it and to improve its administration. These include: allowing landowners one year to correct problems observed by USDA employees before a violation is reported; authorizing county committees to provide relief in cases of undue economic hardship; and making penalties commensurate with violations.

Sodbuster
The Sodbuster provision of the FSA and FACTA is designed to discourage the conversion of highly erodible land to agricultural production. The provision applies to highly erodible land that was not planted in annually tilled crops during the period 1981-85. As with the other provisions of the FSA, the Natural Resource Conservation Service determines if a field is highly erodible. Farmers/landowners who plant highly erodible land in an agricultural commodity without an approved conservation system, become ineligible for certain USDA program benefits.

Swampbuster
The purpose of Swampbuster was to discourage the conversion of wetlands to cropland use. Similar to other FSA and FACTA provisions, the Swampbuster provision called for loss of producer eligibility for USDA program benefits on all cropland on the same farm if a wetland area was converted to cropland. Program benefits were not restored until the producer restored the wetland or mitigated for its loss. Wetlands were defined as areas that

have a predominance of hydric soils that are inundated or saturated by surface water or groundwater at a frequency or duration sufficient to support a prevalence of hydrophytic (water-tolerant) vegetation. The NRCS makes wetland determinations on agricultural land.

The FAIRA of 1996 made several changes that provided greater flexibility for farmers. These included: expanding areas where mitigation could be used; increasing the options for acceptable mitigation, including restoration, enhancement, and creation; encouraging NRCS to work with state technical committees to identify wetland-related practices that have "minimal effect" on the environment, to allow their expedited use; eliminating the stipulation that "abandoned" farmland that reverts to wetland is subject to Section 404 permitting requirements - such lands could subsequently be converted back to farmed uses without violating Swampbuster provisions; providing the Secretary with greater discretion to waive or reduce penalties; and establishing a pilot wetland mitigation banking program.

Conservation Easement
The Conservation Easement provision encouraged producers whose FHA loans are in or near default to place their wetland, highly erodible land, and fragile land in conservation, recreation, or wildlife easements for periods of at least 50 years. The producer benefits by having the FHA loan partially canceled. Environmental benefits include reduced erosion and sedimentation, reduced pollution from agrochemical, and increased wildlife habitat.

Wetland Reserve Program
FACTA established a voluntary incentive program to encourage wetland restoration and protection in agricultural areas by offering farmers payments in exchange for granting the federal government 30-year or perpetual easements over wetlands on their property. The WRP legislation also authorized cost-share payments for wetland restoration. Landowners retained control of access to the easement areas; could utilize the land for hay, grazing, and recreation if activities did not impact the wetlands; and could sell the land. Areas eligible for enrollment included lands with restorable wetlands, lands adjacent to wetlands that contributed to wetland values, wetlands restored by other federal and state programs, riparian areas that linked WRP wetlands, and non-forested CRP land that was likely to be returned to production. Unlike the CRP, WRP wetland easements under the original FACTA legislation were permanent in nature, a feature that both provided for long-term protection and deterred many farmers from signing up. The WRP legislation authorized enrollment of 1,000,000 acres of prior converted or farmed wetlands by the year 2000. Pilot enrollments of 50,000 and 75,000 acres took place in 1992 and 1994, and the first nationwide enrollment occurred in June 1995 for another 118,000 acres.

The FAIRA of 1996 extended the Program at the 975,000 acre enrollment cap, broadened eligibility criteria to protect environmentally sensitive acres adjacent to wetlands and waterways, and provided greater enrollment flexibility: permanent easements were required on only one-third of total program acres, with 30-year easements on another third and 10-year restoration cost-share agreements on the final third; a ban was placed on enrollment of permanent easements until at least 75,000 acres of temporary easements were enrolled; and up to 100% cost-share was provided on restoration of easement wetlands.

Environmental Quality Incentives Program (EQIP)
FACTA established the Water Quality Incentive Program (WQIP), a cost-sharing program to help farmers control pollution problems associated with agricultural activities. Producers were eligible to receive up to $3,500 in cost-share assistance upon implementation of approved management practices. The original goal was to enroll 10 million acres by 1995.

The central thrust of the FAIRA's conservation title was creation of the EQIP, a new program that consolidated and phased out the functions of the WQIP, ACP, Great Plains Conservation Program, and the Colorado River Basin Salinity Control Program. The EQIP Program broadened the predecessor WQIP focus on soil conservation and water quality to include related natural resource problems, specifically habitat issues. It established the concept of conservation priority areas where these three problems exist. The Program established 5- to 10-year contracts for technical and educational assistance and up to 75% cost-share for conservation practices on such lands. It gave higher priority to areas already receiving state assistance, and excluded large livestock operations from cost-share eligibility.

5.3.2 NPS Programs for Urban and Developed Lands

- **Federal Urban Stormwater Discharge Program / NC NPDES Stormwater Program**

In 1987, Congress passed the Water Quality Act Amendments to the Clean Water Act requiring the U.S. Environmental Protection Agency (EPA) to develop regulations on permit application requirements for stormwater discharges associated with industrial activities as well as those associated with large and medium municipal separate storm sewer systems (population greater than 100,000). These regulations became effective in December 1990.

The goal of the stormwater discharge permitting regulations in North Carolina is to prevent stormwater runoff pollution by controlling the source(s) of pollutants. Defining the potential pollutant sources and establishing controls of the sources that will reduce and minimize pollutant availability will result in an improvement to the water quality of the receiving streams, consistent with the overall goal of the water quality program. Authority to administer these regulations has been delegated to the North Carolina Division of Water Quality (DWQ). The NPDES stormwater regulations require that facilities with stormwater point source discharges associated with industrial activity and municipalities defined as either large or medium municipal separate storm sewer systems be permitted.

The municipal permitting requirements are designed to lead to the formation of site-specific stormwater management programs for a municipal area. Therefore, the permits issued to municipalities for their municipal separate storm sewer systems will be explicitly written for each individual municipality. Municipal permits of this type in North Carolina are currently required for Charlotte, Durham, Greensboro, Raleigh, Winston-Salem and Fayetteville/Cumberland County. The municipalities will develop and implement comprehensive stormwater quality management programs to reduce the discharge of pollutants in stormwater to the maximum extent practicable (MEP). MEP will be defined separately for each municipality required to be permitted. Industrial facilities discharging through a municipal separate storm sewer system are required to submit a permit application to the state and receive their own NPDES stormwater permit. Common best management practices to address urban runoff are listed in Appendix VI.

Industrial activities which require permitting are defined in eleven categories in the federal regulations ranging from sawmills and landfills to phosphate manufacturing plants and hazardous waste treatment, storage or disposal facilities. The regulations cover point source discharges that are related to manufacturing, processing, or material storage areas at an industrial facility. Stormwater discharges associated with industrial activities are required to be covered by permits which contain technology based controls based on Best Available Technology (BAT)/Best Conventional Pollutant Control Technology (BCT) considerations or water quality controls, if necessary. Through monitoring and regulating stormwater discharge quality, the goal of the NPDES stormwater program is to reduce the pollutant load in stormwater runoff.

The permitting requirements described here represent Phase I of the stormwater program. EPA and Congress are currently involved in studies to determine the scope of additional stormwater coverage under Phase II of the stormwater program. Further stormwater NPDES coverage could include additional industrial activities or additional municipal areas. If additional areas of coverage are added under the federal stormwater programs, DWQ will be responsible for the appropriate permitting of these areas within North Carolina.

Camp Lejeune NPDES Industrial Permitting

Camp Lejeune has embraced the industrial NPDES permitting program. The Camp submitted applications for several industrial stormwater permits in August 1994 under the NPDES program. In preparation for submittal, the Camp completed a comprehensive, 4-phase stormwater discharge study, addressing storm drain mapping, illicit discharge investigation, characterization of discharges, and stormwater management planning. In the first phase, the existing drainage system was identified, including drainage areas and industrial activities within each drainage area, as well as identification of existing and needed structural BMPs. Sites were grouped under a total of 185 identified outfalls. In the second phase, 24 illicit connections were identified and site-specific BMPs were recommended. In phase three, the illicit connections were characterized through water quality sampling and permitting needs were identified. In phase four, costs were estimated for the 172 BMPs proposed in phases one and two. In addition to its NPDES activities, Camp Lejeune added several ponds to one of its golf courses during a recent upgrade to provide greater detention time for surface waters. Also, under its pollution prevention program, the Camp is currently studying methods for significantly reducing the release of pollutants of all types through source reduction.

- **Water Supply Protection Program**

  Approximately 50 percent of North Carolina's population depends on surface water supplies for drinking, commercial, and industrial uses. Water supplies have become more important in recent years because of increased demand for water, concern over potential contamination by toxic substances, and protection of human health. As a result, the General Assembly passed the Water Supply Watershed Protection Act of 1989 (NCGS 143-214.5). This Act requires all local governments that have land-use jurisdiction within surface water supply watersheds, or a portion thereof, to be responsible for implementation and enforcement of nonpoint source management requirements related to urban development according to minimum standards adopted by the state. NPS control strategies are included in the rules for urban, agricultural, silvicultural, and Department of Transportation activities. The Water Supply Watershed Protection Rules were adopted by the Environmental Management Commission on February 13, 1992 and became effective on August 3, 1992. These rules were recently revised (effective August 1, 1995) to give local governments more flexibility in the implementation of water supply programs.

  The purpose of the Water Supply Protection Program is to encourage communities to work with the state to provide enhanced protection for their water supply from pollution sources. There are five water supply classes that are defined according to existing land use and the amount and types of permitted point source discharges. (See Appendix I for a summary of the management requirements for the five water supply classifications.) By classifying a watershed as a water supply watershed, local governments having land use jurisdiction within the watershed will take steps to control nonpoint sources of pollution at their sources and thereby reduce the potential of pollutants contaminating their drinking water supply. In turn, the state limits the point source discharges that can locate within the watershed and thereby reduces the potential of contamination of the water supply.

This dual approach of state and local government action to preclude potential impacts from stormwater runoff and wastewater discharges is important since only a small fraction of the possible pollutants have water quality standards. As more is learned about the types and effects of pollutants in our drinking waters, the state will proceed to adopt additional water quality standards. One of the effects this would have is that water treatment facilities will be required to remove these pollutants. This could require additional technology and possibly more expensive treatment facilities or operation to ensure safe drinking water. It is therefore very important for the state and local governments to consider the important alternative of preventing pollution from entering their drinking water supplies.

The General Assembly extended the deadline for completing reclassification of existing surface water supply waters to July 1, 1992 in House Bill 873. The bill also established a schedule for local governments' submittal of water supply protection ordinances as follows:

1) July 1, 1993 for municipalities with populations of 5,000 or more,
2) October 1, 1993 for municipalities with smaller populations, and
3) January 1, 1994 for counties.

The Water Supply Protection Program is administered by staff in the Operations Branch of the DWQ. These staff coordinate with the Division of Community Assistance (NCDCA) who helps local governments develop land-use ordinances, the Division of Environmental Health, which certifies that a proposed reclassification is suitable for a drinking water supply, and DWQ staff in NCDEHNR regional offices who are responsible for water quality sampling in the proposed water supply.

Statewide, the compliance rate for submittals is 100%. There are no local governments in the White Oak River basin required to submit a water supply protection ordinance for approval.

- **CAMA Land Use Plans**

The Coastal Area Management Act (CAMA), passed in 1974, requires the development of land use plans by each of the 20 coastal counties that fall within the coastal area. These plans must be consistent with state guidelines and address a wide range of issues, including resource protection and conservation, hazards mitigation, economic development and public participation. Land use plans must be updated every five years. 1995 revisions to the land use planning guidelines strengthened the connection between land use planning and surface water quality. Future land use plan updates must consider water quality use classifications, watershed planning and problems identified in basinwide plans. Of the 91 jurisdictions that have prepared and adopted CAMA land use plans, 12 fall within the White Oak River Basin. In Onslow County, Jacksonville, North Topsail Beach, Richlands and Swansboro have adopted plans. In Carteret County, Atlantic Beach, Beaufort, Cape Carteret, Emerald Isle, Indian Beach, Morehead City, Newport and Pine Knoll Shores have adopted land use plans.

A land use plan is a "blueprint" used by local leaders to help guide the decisions that affect their community. Through land use planning, local jurisdictions can influence how growth will affect surface water quality by adopting policies supported by local ordinances, promoting better sedimentation and erosion control standards, stream buffers and lower levels of impervious surface cover. Although land use plans are required only in the state's coastal area, these land use planning tools for the protection of water quality are available to any jurisdiction which chooses to implement them.

- **Coastal Stormwater Management**
  In November 1986, the EMC adopted rules which required new development in a limited zone (575 feet) around Class SA (shellfish) waters to control stormwater either by limiting density or completely controlling a 4.5 inch, 24-hour storm with the use of a stormwater treatment system. The regulations applied to development activities that required either a CAMA major permit or a Sediment/Erosion Control Plan (generally development disturbing more than one acre). The design storm, low density limits, and areal coverage were all quite controversial and the adopted rules represented a compromise by all parties. A sunset provision was added to the rules to force the staff and Commission to reconsider the rules after a year. These rules expired December 31, 1987, but new stormwater regulations were adopted having an effective date of January 1, 1988. These regulations are administered by the DWQ. Approximately five man-years are allocated to implementing this program. Planning Branch staff are responsible for providing guidance and interpretation to promote consistent implementation of the rules. DWQ regional staff review and approve plans and enforce the requirements of the regulations.

  Perhaps the most important measure accomplished with the regulations has been the applicability of stormwater controls to development activities within the 20 CAMA coastal counties. Certainly the near-water impact of stormwater as addressed in the original rules is important, but the staff believed the cumulative impact of stormwater runoff throughout the coastal zone also needed to be addressed. Therefore, the expanded area of coverage helps provide better protection of both shellfish waters and coastal water quality in general.

  Other major items specified in the rules address the sizing of stormwater treatment systems. For developments adjacent to SA waters, infiltration systems must be able to retain 1.5 inches of rainfall, whereas development in other areas must control one inch of rainfall. Wet detention ponds are not allowed for stormwater control near SA waters and must be sized for 85 percent TSS removal in other areas. In addition, porous pavement is considered an innovative infiltration system (only five are allowed until they are proven to work) as evidence has not been provided regarding its effectiveness in coastal areas. A low density option of the new regulations applies a built-upon area limit of 25 percent for SA areas and 30 percent for other coastal areas rather than a limit on effective impervious cover. Development exceeding these levels is required to have an engineered stormwater system as indicated.

  In summary, the stormwater regulations in place since 1988 have an expanded areal coverage over previous limits. This expanded coverage has increased the number of projects affected each year from approximately 50 (original rules) to 500. This increase is coincident with a reduction in design storm that is comparable to requirements in other states. In addition, the low density option, retained from the original regulations, is encouraged as operation and maintenance concerns associated with stormwater controls are not applicable.

- **ORW and HQW Stream Classifications**
  Outstanding Resource Waters (ORW) and High Quality Waters (HQW) have management strategies that address handling of urban stormwater. Controls for urban stormwater, either through development density limitations or stormwater treatment systems, are required by DWQ. Some of these controls are outlined in Appendix I. Other NPS management agencies are expected to place priority on protecting these waters as well. For example, the NC Department of Transportation and the NC Division of Land Resources require more stringent sediment control on construction sites in ORW and HQW areas. There are currently 16 waters in the White Oak River Basin supplementally classified as HQW, primarily located in the New River Drainage Area. There are also many waters throughout the basin supplementally classified as ORW.

- **State Stormwater Management Rule Changes**
  The state coastal stormwater regulations, along with stormwater requirements for High Quality Waters (HQW) and Outstanding Resource Waters (ORW) areas, were amended by the EMC effective December 1, 1995. A summary of the changes made as part of this process is given in Table 5.6.

Table 5.6: Summary of Changes to State Stormwater Management Rules, Effective December 1, 1995 (15A NCAC 2H .1000)

- Consolidated requirements for 20 coastal counties, HQW, and ORW areas into one area of the rules
- Removed exemption from stormwater requirements for projects that build less than one acre of built-upon area
- Required a more formal permit for development activities subject to the stormwater requirements (including permit application fees)
- Allowed case-by-case alternative engineered stormwater control devices that provide equal or better protection of waters of the state. Identified alternatives include: constructed stormwater wetlands; sand filters; vegetative practices (eg, buffers, grassed swales, filter strips); bioretention areas; extended dry detention; and infiltration practices.

- **Coastal Nonpoint Pollution Control Programs**
  As part of the Coastal Zone Act Reauthorization Amendments of 1990, Congress enacted a new section 6217 entitled "Protecting Coastal Waters". This provision requires states with coastal zone management programs (which includes North Carolina) that have received Federal approval under section 306 of the Coastal Zone Management Act (CZMA) to develop and implement Coastal Nonpoint Pollution Control Programs. The coastal nonpoint programs will provide additional control for sources of nonpoint pollution that impair coastal water quality. Sources subject to the 6217 Coastal NPS Program include: agriculture, forestry operations, urban and developing areas, marinas, hydromodification projects, and wetlands and riparian areas.

  Section 6217 requires coastal states to submit their coastal nonpoint control programs to the National Oceanic and Atmospheric Administration (NOAA) and the U.S. EPA for approval by July 1995. North Carolina's Coastal Nonpoint Pollution Control Program was submitted for approval on July 26, 1995 by the NC Division of Coastal Management (DCM). The Program received conditional approval in June, 1996, pending the resolution of a set of issues identified by NOAA and EPA. The programs are to be implemented by January, 1999. The coastal nonpoint program will be developed and administered jointly by the NC Division of Coastal Management and DWQ.

Summary of Changes Since 1989

- The N.C. DWQ has developed programs for the administration of NPDES stormwater permits for industries and municipalities.
- The N.C. DWQ has developed and issued eighteen general permits to cover a variety of facilities that discharge stormwater associated with industrial activity.
- Water Supply Protection Legislation was passed in N.C. which has resulted in the development and implementation of statewide water supply watershed protection requirements. The rules were amended effective August 1, 1995 to provide greater

clarity and flexibility to local governments. There has been 100% compliance with the adoption and submittal requirements for ordinances by local governments.

- The stormwater management rules governing coastal areas, High Quality Waters and Outstanding Resource Waters were modified effective December 1, 1995. Modifications included more formalized permit requirements, removal of the threshold for minimum built-upon area, and allowance for case-by-case evaluation of alternative BMP proposals.
- Educational Efforts: The N.C. DWQ has instituted a number of educational efforts related to stormwater management across the state. These efforts have included:
  - Guidance Manuals:
    1 *Stormwater Management Guidance Manual*
    2 *Stormwater Management In North Carolina: A Guide For Local Officials*
    3 *Stormwater Best Management Practices*
    4 *Established contract to produce guidance manual for site stormwater planning and design.*
  - Fact Sheets on Stormwater Management:
    1 Stormwater Problems and Impacts
    2 Stormwater Control Principles and Practices
    3 Stormwater Management Roles and Regulations
    4 Local Stormwater Program Elements and Funding Alternatives
    5. Municipal Pollution Prevention Planning;
    6. Managing Stormwater in Small Communities;
    7. Maintaining Wet Detention Ponds;
    8. Plan Early for Stormwater in Your New Development;
    9. How Citizens Can Help Control Stormwater Pollution.
  - Training Events:
    1. Statewide Stormwater Conference - (1994)
    2. Statewide Workshops on The Water Supply Protection Program (1994 & 95)
    3. Statewide Workshops on Stormwater Management (1995)
    4. Statewide Nonpoint Source Pollution Management Conference (1996).

5.3.3 Construction - Sedimentation and Erosion Control NPS Program

In 1973, the North Carolina General Assembly enacted the Sedimentation Pollution Control Act (SPCA). The Act authorized the establishment of a sediment control program to prevent accelerated erosion and off-site sedimentation caused by land-disturbing activities other than agriculture, forestry, and mining. The Land Quality Section of the Division of Land Resources is responsible for administration and enforcement of the requirements of the Act under the authority of the NC Sedimentation Control Commission.

The sediment control program requires, prior to construction, the submission and approval of erosion control plans on all projects disturbing one or more acres. On-site inspections are conducted to determine compliance with the plan and to evaluate the effectiveness of the BMPs (see examples listed in Appendix VI) which are used. The intent is to offer permanent downstream protection for stream banks and channels from damages caused by increased runoff velocities. If voluntary compliance with the approved plan is not achieved and violations occur, the Land Quality Section will pursue enforcement through civil penalties and injunctive relief. House Bill 448, passed in 1991, authorized the issuance of stop-work orders for violations of the SPCA. This additional enforcement mechanism will help improve the overall performance of the program.

Sedimentation control rules are more stringent for areas draining to waters supplementally classified as Trout Waters or High Quality Waters.

There are currently over 250 active construction sites under DLR permit within the White Oak basin. In addition to performing compliance activities on these sites, Land Quality Section staff also attempt to monitor for problem sites of less than one acre and for construction occurring without permits. The Section currently has the equivalent of less than one full-time staff person to perform these activities along with implementing the mining program for the basin.

There is one local erosion and sedimentation control program with its jurisdiction in the White Oak River Basin, administered by the City of Jacksonville. Local programs are reviewed annually for compliance with the requirements of the Sedimentation Pollution Control Act. The Land Quality Section also conducts educational programs directed toward state and local government officials in order to strengthen the local programs. Persons engaged in land-disturbing activities and interested citizen groups are included in the educational effort.

The Sedimentation Control Commission has delegated to the Division of Highways of the North Carolina Department of Transportation (DOT) the authority to approve erosion and sedimentation control plans for land-disturbing activity conducted by that agency or by other persons under highway contracts with that agency. The DOT sedimentation control program has been reviewed by the Division of Land Resources under the authority of the Sedimentation Control Commission. DOT uses more stringent sedimentation controls in areas adjacent to High Quality Waters and Outstanding Resource Waters. The NC Department of Environment, Health, and Natural Resources (NCDEHNR) has established a position to evaluate environmental aspects of DOT highway projects and programs. DOT, in cooperation with DWQ, has developed and adopted formal BMPs for protection of surface waters. These BMPs and other efforts are significant improvements in developing a proactive system at DOT toward environmental issues.

5.3.4 On-Site Wastewater Disposal - Sanitary Sewage Systems NPS Program

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. More than 52 percent of all housing units in the state are served by septic tank systems or other systems besides public or community sewage systems. A conventional septic system consists of a septic tank, a distribution box or equivalent branching lines, and a series of subsurface absorption lines consisting of tile or perforated pipes laid in a bed of gravel. All subsurface sanitary sewage systems are under the jurisdiction of the Commission for Health Services (CHS) of the Department of Environment, Health, and Natural Resources. The CHS establishes the rules for on-site sewage systems which are administered by the Division to Environmental Health. BMPs for onsite sewage systems are listed in Appendix VI.

According to GS 130A-335(e) and (f), the rules of the CHS and the rules of the local board of health shall address at least the following: sewage characteristics; design unit; design capacity; design volume; criteria for the design, installation, operation, maintenance, and performance of sanitary sewage collection, treatment, and disposal systems; soil morphology and drainage; topography and landscape position; depth to seasonally high water table, rock, and water impeding formations; proximity to water supply wells, shellfish waters, estuaries, marshes, wetlands, areas subject to frequent flooding, streams, lakes, swamps, and other bodies of surface or groundwaters; density of sanitary sewage collection, treatment, and disposal systems in a geographical area; requirements for issuance, suspension, and revocation of permits; and other factors which affect the effective operation in performance of sanitary sewage collection treatment and disposal systems.

The rules also must provide construction requirements, standards for operation, and ownership requirements for each classification of sanitary systems of sewage collection, treatment, and disposal in order to prevent, as far as reasonably possible, any contamination of the land, groundwater, and surface waters. There exists a strict permitting procedure which regulates site selection, system design, and installation of on-site sewage systems. Privately owned subsurface sewage discharging systems are governed by NCDEHNR through local county health departments. Authorized local sanitarians serve as agents of NCDEHNR and assist in implementing the state sewage rules. Local boards of health may adopt by reference the state rules and append to those rules more stringent laws and local criteria which they desire. These amendments, however, must be approved by the state. Only nine counties in the state currently operate under local rules. The 1983 amendments of the state public health laws eliminated the co-mingling of state rules with local rules except by state approval.

An additional position was established in the On-site Wastewater Program in 1996 using Section 319 (h) NPS grant funding. The position will be NPS water quality-oriented and its duties will include:

- Coordination of demonstration projects,
- Education/technology transfer,
- On-site drainage issues in lower coastal areas,
- Surveys to find and evaluate failing septic tank systems,
- Study the impacts of seasonal failures of on-site systems,
- Conduct a shoreline survey in coordination with Shellfish Sanitation.

5.3.5 Solid Waste Disposal NPS Programs

- **Federal Program**
  The major federal legislation in the area of solid waste management is the Resource Conservation and Recovery Act (RCRA) administered by the U.S. Environmental Protection Agency (EPA). RCRA deals almost entirely with hazardous waste management but it does require that states meet minimum standards for solid waste facilities. EPA does not have permitting authority over solid waste management facilities.

- **State Program**
  States are accorded a major role in solid waste management by RCRA. North Carolina now operates under revisions by the General Assembly to Chapter 130A of the General Statutes. The Division of Waste Management (DWM) in the Department of Environment Health and Natural Resources is authorized as the single state agency for management of solid waste. The DWM is responsible for development of the state's solid waste management plan, has permitting authority over all solid waste management facility siting and operation, inspects permitted facilities, provides technical assistance, investigates complaints, responds to emergencies, monitors ground water quality at facilities, promotes the state's recycling effort, and closes non-conforming sites.

  The Solid Waste Management Act of 1989 established the policies and goals of the state to recycle at least 25 percent of the total waste stream by January 1, 1993. This Act created a Solid Waste Management Trust Fund to promote waste reduction and fund research and demonstration projects to manage solid waste. In 1991, the Solid Waste Management Act of 1989 was amended to broaden the goal to reduce the solid waste stream by 40 percent through source reduction, reuse, recycling, and composting by June 30, 2001.

  The state adopted solid waste management rules, effective February 1, 1991, requiring liner, leachate collection, and final cover systems at all new landfills, lateral expansions of existing landfills, and at all active landfills by January 1, 1998. Septage rules and regulations also have been adopted and are administered through a permit program.

The Division of Waste Management has several NPS initiatives in place that can benefit the White Oak basin. The Division provides technical assistance and training courses on proper solid waste management techniques for landfill, business, and industry personnel and individuals. The DWM is in the process of documenting abandoned landfill locations in the basin, and of developing long-term management and remediation strategies for these landfills. Staff are also currently developing prevention and enforcement programs for uncontrolled dumping, and an education program for local officials. The Division has recently completed and implemented a system for cataloging illegal dump sites.

- **Local Program**
  Solid waste collection and disposal has long been a municipal function. The operation of solid waste collection and disposal facilities is among the enterprises which municipalities are expressly authorized by statute to operate (G.S. 160A-311 through 160A-321). Municipalities are also authorized to regulate the disposal of solid waste within their corporate limits. Such regulations may specify the location and type of receptacles to be used for collection (G.S. 160A-192).

  Outside municipal limits, counties are authorized to operate solid waste collection and disposal facilities either as a function of county government or through establishment of a special service district (G.S. 153A-292 and 301). Since 1970, county governments have increasingly accepted responsibility for solid waste disposal activities and most disposal facilities in the state are now operated by counties or with county financial assistance.

5.3.6 Forestry NPS Programs

- **Forest Practice Guidelines Related to Water Quality**
  In 1989 the Sedimentation Pollution Control Act (SPCA) was amended to limit the forestry exemption to those operations that adhere to forest practice guidelines. The forestry amendment to the SPCA required the Division of Forest Resources to develop these performance standards, to be known as the Forest Practices Guidelines Related to Water Quality.

  Guidelines consist of nine performance standards for activities such as maintaining streamside management zones and applying fertilizer and pesticide applications. These Guidelines are used to determine if a forestry operation will fall under the jurisdiction of the Division of Land Resources which enforces the SPCA. The Guidelines were developed in October 1989 and were put into effect on January 1, 1990. A Memorandum of Agreement was also signed between the Division of Forest Resources and the Division of Land Resources to coordinate their respective activities in the sedimentation control program. DLR has also signed an MOA with DWQ.

  Site-disturbing forestry activities are inspected by local DFR personnel as part of a training, mitigation, and monitoring program. Site inspections are conducted when a problem or potential problem is suspected to exist. Sites not brought into compliance within a reasonable time schedule are referred by DFR to DLR or DWQ for appropriate enforcement action. Commonly used forestry BMPs are listed in Appendix VI.

  The DFR has several ongoing activities related to NPS management. The Division distributes a Forestry BMPs Manual developed in 1989 in support of the Forest Practice Guidelines. The Division's ongoing monitoring program in support of the Forest Practice Guidelines has conducted a total of 14,542 site evaluations since its inception in 1989. In recent years, numbers of evaluations have averaged around 3,000/yr. In FY95, 3318 site evaluations were conducted, yielding 94.2% compliance and 9 enforcement referrals to the Division of Land Resources. Loggers are not currently required to notify the state prior to commencement of harvesting activities, but DFR is working on a system to encourage prior notification from the industry. Also, in January 1997 the Division completed development of a set of BMPs for logging in wetlands.

- **National Forest Management Act (NFMA)**
  The National Forest Management Act was passed in 1976 and applies to all lands owned or administered by the National Forest System. The Act stipulates that land management plans be prepared which consider economic and environmental aspects of forest resources. The Act further states that timber will be harvested from National Forest lands only where soil, slope, or other watershed conditions will not be irreversibly damaged; and where protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of watercourses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat.

- **Forest Stewardship Program**
  The U.S. Forest Service initiated the Forest Stewardship Program in 1991, with the Division of Forest Resources as the lead agency in North Carolina, and with the cooperation and support of several other natural resource and conservation agencies. A major goal of the program is to bring more forest land under management. The program encourages landowners with ten or more acres of forestland to become involved and committed to the wise development, protection and use of all natural forest resources they own or control. Participating landowners agree to manage their forest lands to improve them in at least three of the four following resource categories: timber, wildlife and wildlife habitat, recreation and aesthetics, and soil and water conservation.

5.3.7 Mining NPS Program

In 1971 the North Carolina General Assembly passed the Mining Act to ensure that the usefulness, productivity, and scenic values of all land and waters involved in mining will receive the greatest practical degree of protection and restoration. The Mining Commission is the rule-making body for the Act and has designated authority to administer and enforce the rules and regulations of the Act to the Mining Program within the Land Quality Section of the NCDEHNR Division of Land Resources.

The Mining program has four major areas of responsibility. First, the Program requires submission and approval of a mining permit application prior to initiating land disturbing activity if the mining operation is one (1) or more acres in surface area. The mining permit application must have a reclamation plan for these operations. Second, the Program conducts on-site inspections to determine compliance with the approved application and whether or not the plan is effective in protecting land and water quality. Third, the program pursues enforcement action through civil penalties, injunctive relief, and/or bond forfeiture to gain compliance when voluntary compliance is not achieved. Finally, the Mining Program conducts educational efforts for mine operators. Common BMPs for mining activities are listed in Appendix VI.

5.3.8 Wetlands Regulatory NPS Programs

There are numerous reasons for preserving wetlands, but of special interest within the context of basinwide planning is their role in protecting water quality. Because of their intrinsic characteristics and location within the landscape, wetlands function to protect water quality in a number of ways. These functions include the retention and removal of pollutants, stabilization of shorelines, and storage of flood waters.

Numerous authors have studied the effectiveness of riparian wetland forests for nutrient retention and transformation (Jones et al. 1976; Yates and Sheridan 1983; Brinson et al. 1984; Lowrance et al. 1984; Peterjohn and Correll 1984; Jacobs and Gilliam 1985; Budd et al. 1987; and Groffman et al. 1991). The location of riparian wetlands allows them the opportunity to receive nutrients from the surrounding landscape as well as through overbank flooding. In addition to the storage of nutrients in wetland vegetation, the microbial and chemical processes within wetland soils may function to completely remove nutrients from the system.

Headwater riparian wetlands are extremely important and effective in terms of sediment and associated nutrient and toxicant retention and transformation. Since small streams comprise most of the total stream length within a watershed (Leopold 1974), these areas intercept the greatest proportion of eroded sediments and associated substances from uplands before these pollutant reach waters downstream. Novitzki (1978) found that approximately 80% of the sediments entering a stream were retained in headwater wetlands.

Wetlands adjacent to streams, rivers and lakes stabilize shorelines and help protect these bodies of water from erosive forces. This function is particularly important in urbanized watersheds where the prevalence of impervious surfaces contributes to greater peak storm flows. Wetland vegetation serves to dissipate erosive forces and anchors the shoreline in place preventing sediments and associated pollutants from entering waterways. Wetlands by their very nature of being "wet" are also vital for water storage. Those wetlands adjacent to surface waters, that have the opportunity to receive flood waters and surface runoff, are most important to water storage. Wetlands located in headwaters generally minimize peak flood waters in tributaries and main channels. Lakes and wetlands with restricted outlets hold back flood waters and attenuate flood peaks (Carter et al. 1978).

Several important state and federal wetland protection programs are described below. In addition to the following wetlands programs, provisions of the 1985, 1990, and 1996 Farm Bills should also help reduce wetlands impacts (see the Agriculture section Farm Bill discussion for details). Agriculture conversions have been reduced by the "swampbuster" provision of the 1985 Farm Bill, which established a disincentive for the conversion of wetlands to commodity crop production. The disincentive involved loss of all USDA crop program subsidies, crop insurance, disaster payments, and price supports for all cropland on a violating farm. A Wetland Reserve Program was established by the 1990 Farm Bill, and extended by the 1996 Farm Bill, with the goal of allowing one million acres of prior-converted wetlands to revert back to wetlands or be restored by the year 2002. The Conservation Reserve Program allowed for retirement of both wetlands and uplands from production, and 410,000 acres of the 36.4 million acre total under contract in the first ten years were wetland. The CRP was extended under the 1996 Farm Bill for another ten years at the same acreage cap. Silviculture is exempted from the swampbuster provision and therefore, conversion of wetlands for intensive or managed forestry is not significantly restricted.

- **Section 10 of the Rivers and Harbors Act of 1899**
  This act, administered by the US Army Corps of Engineers, provides the basis for regulating dredge and fill activities in navigable waters of the United States. Originally, this Act was administered to protect navigation and the navigation capacity of the nation's waters. In 1968, due to growing environmental concerns, the review of permit applications was changed to include factors other than navigation including fish and wildlife conservation, pollution, aesthetics, ecology, and general public interest. Activities which may be covered under the Act include dredging and filling, piers, dams, dikes, marinas, bulkheads, bank stabilization and others.

- **North Carolina Dredge and Fill Act (1969)**
  This act requires permits for "excavation or filling begun in any estuarine waters, tidelands, marshlands, or state-owned lake". This law is currently administered with North Carolina's Coastal Area Management Act (CAMA) (1974).

- **Section 404 of the Clean Water Act**
  The U.S. Army Corps of Engineers administers a national regulatory program under Section 404 of the Clean Water Act aimed at controlling the discharge of dredged or fill

material into waters of the United States. Section 404 applies to the discharge of dredged or fill materials into waters of the United States, including incidental discharges associated with excavation activities. Following a 1993 legal challenge, 404 jurisdiction was expanded to include excavation, land clearing, ditching, and channelization including dredging. Waters of the United States refers to navigable waters, their tributaries, and adjacent wetlands. Activities covered under Section 404 include dams, dikes, marinas, bulkheads, utility and power transmission lines and bank stabilization. Although the 404 program does not fully protect wetlands, it is nonetheless the only existing federal tool for regulating wetland development statewide. State legislation has not been adopted to protect inland freshwater wetlands in North Carolina, as has been done for coastal wetlands, but the EMC in March of 1996 adopted rules that will formalize the wetlands protection measures associated with the 401 Water Quality Certification review process.

- **CWA Section 401 Water Quality Certification**
  The Division of Water Quality is responsible for the issuance of 401 Water Quality Certifications (as mandated under Section 401 of the federal Clean Water Act). A 401 certification is required for the discharge of pollutants into surface waters and wetlands for projects that require a section 404 federal permit. The 401 certification indicates that the discharge activity will not violate state water quality standards. A federal 404 permit cannot be issued if a 401 certification is denied. The 401 certification process is coordinated with the 404 and CAMA processes in the 20 counties of CAMA jurisdiction. While coastal wetlands in NC are afforded protection through CAMA requirements beyond that given by the 401 process, State legislation has not been adopted to similarly protect inland freshwater wetlands.

  The EMC passed rules, effective October 1, 1996, that upgraded and formalized wetland protection in NC. The rules provided for wetland classifications, a wetland definition, designated uses for wetlands, wetland water quality standards, and a formalized 401 Water Quality Certification process for wetlands and surface waters, including mitigation requirements. Two classes of wetlands were recognized, freshwater (WL) and coastal (SWL), and one supplemental classification, unique wetlands (UWL), was created for systems with exceptional state or national ecological significance. The Corps of Engineers wetland definition was adopted. The adopted wetland uses reflected wetland functional areas of water storage, water quality, erosion protection, and habitat. Narrative wetland water quality standards were adopted that were designed to protect the newly specified designated uses. Section 401 Water Quality Certification criteria were structured based on wetland impact size and distance from surface waters: any proposed impacts of less than one-third acre require no notification to the Division nor Division review; proposed impacts of one-third to one acre within 150 feet of surface waters require notification, and a review for minimization of impacts if within 50 feet of surface waters; all proposed impacts of between 1 and 3 acres require notification and varying ratios of mitigation based on distance from surface waters; while impacts of greater than 3 acres require, additionally, review of alternatives to and minimization of impacts.

- **North Carolina's Wetlands Restoration Program**
  DWQ's persistent efforts to establish a state-wide prioritized wetland restoration program met with success in the Second Extra Session of the 1996 General Assembly. A Wetlands Restoration Program was established and funded at $500,000, including 8 staff, for FY96-97. The program's purposes are: to replace both historic losses of wetland functions and values and current and future permitted losses; to provide greater consistency and simplicity to the 404 mitigation process; to increase the ecological effectiveness of mitigation efforts; to achieve a net increase in wetland acres, functions and values in each river basin; and to foster a comprehensive approach to environmental protection. In addition, the Clean Water Management Trust Fund also passed by the 1996 General Assembly will provide

$9,200,000 in seed money to initiate a wetland mitigation banking process as part of the Wetland Restoration Program.

5.3.9 Hydrologic Modification

Hydrologic modification is defined as channelization, dredging, dam construction, flow regulation and modification, bridge construction, removal of riparian vegetation, streambank modification/destabilization, and dam collapse. By its very nature hydrologic modification is closely tied to wetland issues. It is not surprising then that the U.S. Army Corps of Engineers (Corps) is the agency most involved in issuing permits for land-disturbing activities in wetlands. These permits are issued through Section 404 and the Rivers and Harbors Act discussed above.

In addition to wetland issues, dam construction and the lack of low flow releases into streams can severely impact downstream aquatic resources. Dam construction, repair, modification, and removal are regulated by the NC Division of Land Resources under the Dam Safety Law of 1967. A dam safety permit is required for any dam which is 15 feet or greater in height (from top of dam to lowest point on downstream toe) and the impoundment capacity is 10-acre-feet or greater at the top of the dam. Low-flow release requirements to maintain adequate instream flows are established in permits where appropriate. Instream flows are recommended by the NC Division of Water Resources.

There are several other programs which can affect hydrologic modification. The Forest Practice Guidelines Related to Water Quality requires streamside management zones to be maintained during logging operations. The Water Supply Watershed Protection Program also has requirements to maintain buffers for certain activities. The Conservation Reserve Program encourages the establishment of vegetative filter strips (66-99 feet wide) for farming operations. A significant number of local governments have established greenway programs within urban settings in order to maintain and protect riparian areas.

5.3.10 Water Supply Legislation in North Carolina

- **Water Supply Planning Law**
  The Water Supply Planning law (G.S. 143-355 (l) and (m)) was adopted in 1989 and amended in 1993. It requires all local governments that supply or plan to supply water to prepare a local water supply plan. In their plans, local governments are to include present and projected population, industrial development and water use within the service area, present and future water supplies, an estimate of technical assistance needs and other information that may be required by the Department. All local plans are to be approved and submitted to DWR by January 1, 1995. Information in those local plans is to be included in a State Water Supply Plan. The State Plan will also investigate the extent to which the various local plans are compatible.

- **Registration of Water Withdrawals and Transfers Law**
  The Registration of Water Withdrawals and Transfers law (G.S. 143-215.22H) requires any person who withdraws or transfers 1 MGD or more of surface water or groundwater to register the average daily and maximum daily withdrawal or transfer with the Environmental Management Commission (EMC). The law also provides that if a local government has an approved local water supply plan on file with DWR, it does not have to register that withdrawal, thereby reducing duplication of effort by local governments that otherwise would be subject to both laws. In addition, the law includes a 5-year renewal requirement, which will ensure that the data is regularly updated.

- **Regulation of Surface Water Transfers Act**
  In 1993, the legislature adopted the Regulation of Surface Water Transfers Act (G.S. 143-215.22I et seq.). This law was designed to regulate large surface water transfers by requiring a certificate from the EMC and by repealing several other laws that had previously affected interbasin transfers. The law applies to anyone initiating a transfer of 2 MGD from one river basin to another and to anyone increasing an existing transfer by 25 percent or more if the total transfer is 2 MGD or more. Applicants for certificates must petition the EMC and include a description of the transfer facilities, the proposed water uses, water conservation measures to assure efficient use and any other information desired by the EMC. A certificate will be granted for the transfer if the Commission concludes that the overall benefits of the transfer outweigh its detriments. The Commission may grant the petition in whole or in part, or deny it, and it may require mitigation measures to minimize detrimental effects. The law also provides for a $10,000 civil penalty for violating various statutes.

- **Capacity Use Act**
  DWR administers the Capacity Use Act (G.S. 143-215.11 et seq.), which allows the EMC to establish a Capacity Use Area where it finds that the use of ground water, surface water or both requires coordination and limited regulation. If after an investigation and public hearings a Capacity Use Area is designated, the EMC may adopt regulations within the area, including issuance of permits for water users. In the near future, DWR plans to review the rules for implementation of the Capacity Use statute and develop a model of the aquifer system, in coordination with the Groundwater Section of DWQ, for Capacity Use Area 1, which was created to regulate surface water and ground water withdrawals in an area surrounding Texasgulf, Inc. in Aurora, N.C. A new ground water flow model will be used to simulate Capacity Use Area 1 as a basis for permitting withdrawals.

- **Dam Safety law**
  The Dam Safety law (G.S. 143-215.24) was amended in 1993, and rules are being developed for implementation of these amendments. Among the changes, the amendment defines "minimum stream flow" as a quantity and quality sufficient in the judgment of the Department of Environment, Health and Natural Resources (DEHNR) to meet and maintain stream classifications and water quality standards established by DEHNR and to maintain aquatic habitat in the affected stream length.

  The Dam Safety Law applies to dams that are 15 feet or more high or with impoundment capacity of 10 acre feet or more. The law requires that the EMC adopt rules specifying minimum stream flow in the length of the stream affected by a dam and sets specific parameters for minimum stream flow for dams operated by small power producers that divert water from 4,000 feet or less of a natural stream bed and return the water to the same stream.

5.3.11 Section 319 Nonpoint Source Management and Other Programs

- **Section 319**
  In 1987, Congress enacted Section 319 in revisions to the Clean Water Act. Section 319 is unique because it not only requires states to develop comprehensive programs to control nonpoint source pollution, but also provides grant funds for NPS projects.

  Each year, DWQ makes Section 319 grant funds from EPA available as cost-share to agencies and groups that seek to address NPS problems in the state. Projects that have been funded in the past include BMP demonstrations, water quality improvements, data management, educational activities, modeling, stream and wetland restorations, riparian buffers, and others.

These projects may address agriculture, construction, mining, on-site wastewater, solid waste, forestry, urban stormwater, resource protection, and other NPS topics.

To select projects, DWQ convenes the State NPS Workgroup (see Section 5.3 above). Workgroup members review the proposals and then meet to discuss individual projects' merits and decide on final rankings. The Workgroup seeks to balance available funding between geographic regions of the state and types of projects. Proposals must meet certain minimum criteria:

- support state Program milestones;
- address targeted, high priority watersheds;
- provide sufficient cost-share match (40% of project costs);
- propose adequate time periods;
- identify measurable outputs;
- use compatible GIS products with those of the state; and
- make commitment for educational activities and a final report.

Workgroup members separately review and rank each proposal. In their review, members consider such factors as: technical soundness; likelihood of achieving water quality results; degree of balance lent to the state Program in terms of project type; and competence/reliability of contracting agency. They then convene to decide on final rankings for the projects based on their pooled individual rankings. All proposals that rank above the funding target are included in the annual grant application to EPA. Actual funding depends on approval from EPA and yearly Congressional appropriations.

- **Use Restoration Waters**

The North Carolina Division of Water Quality is currently developing the Use Restoration Waters (URW) program to restore surface waters to their designated uses. If adopted, this program will allow the state to work with local governments, businesses, and residents to develop management strategies appropriate for the area. In order to be effective, the URW program will include a mix of mandatory and voluntary programs. The voluntary and mandatory programs will be coordinated on a site-specific basis by DWQ and a group of stakeholders who have an interest in the impaired water body and associated watershed. In addition, the URW program will attempt to develop cooperative relationships among these agencies so that overlapping efforts can be consolidated and targeted to restore designated water body uses.

The URW Program will apply to polluted surface waters where the following conditions apply:

- Biological, physical and/or chemical data indicate specific sources of pollution.
- A use attainment study indicates that the sources of pollution are not transitory.
- It is possible to control the sources of pollution by implementing appropriate management strategies under the existing authority of the North Carolina Environmental Management Commission (EMC), other state commissions, and local agencies or voluntary actions implemented by citizens and other groups.

Based on current water quality data, there are approximately 4,300 miles of freshwater streams (or about 1.4 percent of total miles) and about 40,000 saltwater acres (or about 2 percent of total saltwater acres) that would be potential candidates for URW consideration.

The restoration strategies developed under the URW Program will be site-specific to the watershed of the nonsupporting or impaired water body. DWQ and the stakeholders will coordinate each URW strategy with other agencies' programs to create a holistic approach to address the array of pollution problems in the watershed.

- **Clean Water Management Trust Fund**
  The 1996 General Assembly passed a new initiative titled the Clean Water Management Trust Fund. The Fund will annually receive 6.5% of the year-end general fund credit balance to help finance projects within the broadly focused areas of restoring and protecting state surface waters and establishing a network of riparian buffers and greenways. More detail is provided in Section 7.3.3.

5.4 ALBEMARLE-PAMLICO ESTUARINE STUDY

5.4.1 Introduction

By authority of the Clean Water Act, the Governor of North Carolina and the U.S. Environmental Protection Agency (EPA) designated the Albemarle and Pamlico sounds as an "estuary of national significance" because of the diversity and importance of the region's natural resources. The area was selected for inclusion in EPA's National Estuary Program (NEP) in 1987. Through a cooperative agreement between the NC Department of Environment, Health and Natural Resources and the EPA, the Albemarle-Pamlico Estuarine Study (APES) was created to study the environmental conditions in over 23,000 square miles of watershed in North Carolina and Virginia.

Four committees consisting of 95 members have guided its work. These committees, known as the APES Management Conference, represented nearly every group with an interest in the region: farmers, foresters, fishermen, environmentalists, developers, business and industry leaders, university researchers, government agencies, and local government officials. Their goals were to identify problems in the estuarine system, generate research where gaps in knowledge existed, increase public awareness of environmental issues, and find solutions to address those issues.

5.4.2 Comprehensive Conservation and Management Plan (CCMP)

As a result of the APES program, more is known about the Albemarle-Pamlico estuary than ever before. The culmination of this six-year collaboration is the APES Comprehensive Conservation and Management Plan (CCMP). The CCMP addresses three main environmental concerns - water quality, vital habitats, and fisheries - as well as the need for public involvement and education. This document, which proposed management strategies designed to protect the region's natural resources and allow for responsible economic growth, was officially endorsed by Governor James B. Hunt and the EPA in November of 1994. Currently, several key objectives of the CCMP are being implemented through the Division of Water Quality.

5.4.3 Regional Councils

The CCMP recommends the establishment of a Regional Council for each of the five river basins in the Albemarle-Pamlico watershed. Membership to the Regional Councils consists of citizens and local government officials, representing every county and interest group in the region. The Regional Councils have no regulatory authority. The role of the Councils is to advise and consult with the general public, interest groups, and local, state, and federal governments on the implementation of environmental management programs in the basins. To date, one Regional Council has been formed for the Neuse River. Their first meeting was held on November 27, 1995. The state is considering establishing a Regional Council for the White Oak Basin in the near future.

5.5 INTEGRATING POINT AND NONPOINT SOURCE POLLUTION CONTROLS STRATEGIES

Integrating point and nonpoint source pollution controls and determining the amount and location of the remaining assimilative capacity in a basin are key long-term objectives of basinwide management. The information can be used for a number of purposes including determining if and where new or expanded municipal or industrial wastewater treatment facilities can be allowed; setting the recommended treatment level at these facilities; and identifying where point and nonpoint source pollution controls must be implemented to restore capacity and maintain water quality standards.

The U.S. Environmental Protection Agency (USEPA) has developed a means to help accomplish these objectives called *total maximum daily loads (TMDL)*. The TMDL approach, which is being required by the United States Environmental Protection Agency (USEPA) pursuant to Section 303(d) of the Clean Water Act, is based on the concept of determining the total waste (pollutant) loading, from point and nonpoint sources, that a waterbody (such as a stream, lake or estuary) can assimilate while still maintaining its designated uses.

A TMDL is a strategy for establishing water quality-based controls on point and nonpoint sources of a given pollutant identified as contributing to a waterbody's impairment. In the White Oak Basin, biochemical oxygen demand (BOD) and nutrients are the primary pollutants for which TMDLs are being developed. The TMDL can reflect quantifiable limits to be placed on specific pollution sources or it can be comprised of programmatic strategies (e.g., implementation of nonpoint source best management practices) established to reduce pollutant loadings, in general, throughout the targeted waterbody. The overall goal in establishing the TMDL is to set forth a course of management actions necessary for a waterbody to meet water quality standards.

It should be noted that a targeted water body does not necessarily refer to an entire basin. In the Cape Fear River Basin, for example, there are several major drainage areas (e.g., Deep River, Haw River and Cape Fear River) for which individual TMDLs are being recommended. TMDLs for smaller streams may also serve as important elements in a TMDL covering a larger portion of the basin. Nesting of TMDLs in this fashion constitutes a flexible yet comprehensive management approach that allows for specific strategies to be developed for smaller problem areas and yet offers the means to address the large scale problems as well.

As DWQ's abilities to quantify and predict the impacts of point and nonpoint source pollution become more sophisticated, the basinwide approach will make more innovative management strategies possible. Possible strategies that might be considered in future White Oak Basinwide Plans or in the plans for basins that come up later in this first five-year cycle include agency banking, pollution trading among permitted dischargers, industrial recruitment mapping and consolidation of wastewater discharges.

Agency banking refers to the concept of holding assimilative capacity in reserve by DWQ for future growth and development in the basin. *Pollution trading* involves trading of waste loading and stream assimilative capacity among permitted dischargers, or between point and nonpoint sources, adding flexibility to the permitting system and also using the free market system as an aid to identifying the most cost effective solution to water quality protection. *Industrial recruitment mapping* involves providing specific recommendations on the types of industry and land development best suited to the basin's long-term water quality goals and also an individual basin's ability to assimilate a particular type or quantity of discharge or nonpoint source pollutants. *Consolidation of wastewater discharges*, also referred to as regionalization, entails combining several dischargers into one facility. Input from local authorities, regulated industries, landowners, and other interested parties will be needed to develop these strategies. By accommodating, to the degree possible, local needs and preferences, the probability of the plan's long-term success can be increased.

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CHAPTER 6

MAJOR WATER QUALITY CONCERNS AND RECOMMENDED MANAGEMENT STRATEGIES FOR THE WHITE OAK BASIN

6.1 MAJOR WATER QUALITY CONCERNS AND PRIORITY ISSUES

The White Oak Basin has seen a significant increase in population over the past twenty years, most of it concentrated immediately along the coast and sounds. Pressure for continued growth is expected to be strong during the coming decades. As coastal areas grow, more development takes place causing the generation of more stormwater runoff, the addition of new septic tanks, the need for more wastewater treatment capacity, a need for new and expanded water supply sources and the location of new marinas. Yet options for wastewater disposal and water supply are extremely limited. And the region's economically important wetland and estuarine resources are sensitive to the effects of increased development.

It is clear that the quality of many waterbodies in the basin has been impaired or threatened, especially by high nutrient loads and fecal coliform contamination. Proactive planning at the local level, giving consideration to water quality protection, is what is needed to strike a balance between economic growth and natural resource management. The need for proactive planning is founded in the knowledge that it is the natural resources and related uses (the water-based recreational and commercial activities, the fish and the shellfish) that attract the growth in the first place. Therefore, growth management - planning for future increases in population and associated needs - is critical to water quality management and the quality of life of the basin's residents.

An important mission of basinwide planning is to assist in addressing the complex problem of balancing increased development and economic growth while protecting and restoring the quality and intended uses of the White Oak Basin's surface waters. In striving towards this mission, the Division of Water Quality's (DWQ) highest priority near-term goals will be as follows:

- To identify and restore impaired waters in the basin. Section 6.2 lists those non-shellfish waters in the basin identified as being impaired and discusses recommendations for restoration. Restoration of impaired shellfish waters is discussed in Section 6.3.

- To identify and protect high value resource waters and biological communities of special importance. Section 6.3 discusses strategies for protecting shellfish waters. Section 6.4 discusses the option of assigning a more protective classification to waters that warrant such reclassification. These can include designated primary nursery areas, commercial shellfish waters, and critical habitats for endangered species. Wetlands are also important both because of their habitat values and because of their water purifying functions. Strategies for protection of wetlands are discussed in Section 6.5.

- To manage the causes and sources of pollution to ensure the protection of those waters currently supporting their uses while allowing for reasonable economic growth. In addition to the protection of shellfish waters, wetlands and other high resource value water mentioned above, major water quality issues addressed under this topic include regional wastewater treatment strategies (Section 6.6), nutrient management (Section 6.7), management of oxygen-consuming wastes from point source discharges (Section 6.8), management of urban stormwater runoff (Section 6.9), strategies for managing animal operations (Section 6.10), toxic substance controls (Section 6.11) and sedimentation control options (Section 6.12).

6.2 IDENTIFICATION AND RESTORATION OF IMPAIRED WATERS

6.2.1 What Are the Impaired Waters?

Impaired waters are those waters identified in Chapter 4 as partially supporting or not supporting their designated uses. For the purposes of this basin plan, the impaired waters are divided into two broad categories based on whether or not impairment is related to limitations on shellfish harvesting associated with fecal coliform bacteria.

The first category is represented in Table 6.1 below and includes all water bodies in the basin identified as impaired in Chapter 4 based on biological or chemical monitoring data (collected between 1990 and 1994), except shellfish waters identified as being impaired due to fecal coliform contamination. The second category includes waters classified by DWQ for shellfish harvesting (SA) but where harvesting is restricted or prohibited by the NC Division of Environmental Heath due to fecal coliform contamination. This category is represented by Table 6.2 below. These two tables include the streams on the state's 303(d) list of impaired waters, as required by the U.S. Environmental Protection Agency under Section 303(d) of the Clean Water Act (see Appendix VI).

6.2.2 Prioritization of Nonpoint Source-Impaired Waters

The White Oak basin NPS Team has met several times, beginning in August 1996. The role and organization of NPS Teams is described in Chapter 5, Section 5.3, and the White Oak NPS Team's activities are described further in Section 6.3.6. The Team has developed an initial priority list of nonpoint source-impaired waters for action based on the following set of criteria. Primary criteria are:

- Highly valued resource waters, such as High Quality Waters, Outstanding Resource Waters, waters with significant shellfish resources, and Water Supplies I-IV.
- Waters that have a use support rating of non-supporting (none in the White Oak basin).
- Waters that have a use support rating of partially supporting.
- Shellfish Waters (Class SA) having a significant shellfish resource and moderate bacteriological problems, as identified by the Division of Environmental Health, in which harvesting is prohibited or restricted
- Shellfish Waters (Class SA) that drain to Outstanding Resource Waters and in which shellfish harvesting is prohibited or restricted

Additional criteria for selecting the priority NPS-impaired waterbodies are:

- Waters that pose a potential threat to human health,
- Waters that are important for ecological reasons not reflected in their classification and use support ratings (such as endangered species, unique habitats, or significant biological resources),
- Waters with evidence of serious erosion problems that are not reflected in use support ratings,
- Waters that have experienced a recent, rapid decline in water quality,
- Waters with identifiable pollution sources, and
- Waters with a high likelihood of successful restoration.

The resulting prioritized list of NPS-impaired waterbodies is provided in Table 6.2. The tiers in the table represent rankings of groups of waterbodies with the same attributes, with the highest-ranked group first. The table includes only fecal coliform-impaired or threatened shellfish waters because the Team made the decision to limit its initial focus to these waters, given that they constitute most of the NPS problems in the basin. The Team recognized that pilot efforts made to address this problem would be transferable to the great majority of the problem waters in the basin. The Team made one further refinement to the list, not shown in Table 6.2, by eliminating the White Oak, Newport, and North Rivers' mainstem sections from the Tier 1 listing. In narrowing the choices, the Team considered the last criterion to be key. They felt that choosing achievable projects with the potential for demonstrable water quality improvements was important for the pilot, demonstration efforts in the basin. The Team will use this list as a basis for selecting a number of waterbodies for management action beyond any current efforts. Nonpoint source-impaired waterbodies that meet the primary criteria as well as one or more of the additional criteria listed above are good candidates for further consideration by the Team. Waterbodies that do not meet the primary criteria but meet *several* of the additional criteria may also be selected by the Team. This allows the Team to select waters that DWQ did not monitor or waters for which the use support rating failed to adequately represent the extent of the NPS problem.

One reason for prioritizing impaired waters is to guide the distribution of grant monies available for addressing nonpoint pollution sources. Pursuant to Section 319, federal funding is made available to the state for both restoring waters impaired by nonpoint source pollution and for protecting high value resource waters from nonpoint source degradation. Grants are awarded on a competitive basis across the state. The rankings will be used to establish priorities for awarding Section 319 funds. Also, the ratings can be useful to other federal, state and local agencies involved in addressing nonpoint source pollution problems in their efforts to target their resources and activities.

Table 6.1. Impaired waterbodies in need of restoration (does not include shellfish waters - see Table 6.2).

Subbasin	Waterbody Name	Use Rating	Pollution Sources	Problem Parameters	Planned Management Strategy	NPS Priority
FRESHWATER STREAMS						
03-05-02	Little Northeast Cr	PS	NP, P	DO, fecal	Evaluate NPS contributions and implement appropriate BMPs; removal of discharges through regionalized wastewater treatment	Medium
03-05-02	lower Southwest Cr.	PS	P, NP	chlor a	NSW, removal of discharge	Medium
ESTUARINE WATERBODIES						
03-05-02	New River	PS	P, NP	chlor a	NSW, removal of discharge	Medium
03-05-02	Northeast Creek	PS	P, NP	chlor a	NSW, removal of discharge	Medium
03-05-03	Calico Creek	PS	P, NP	DO, chlor a	removal of discharge	Medium
DEFINITIONS						
Use Rating = Use support rating- See Chapter 4 for explanation					DO = Dissolved oxygen	
PS = Partially supporting classified uses					Chlor a = Chlorophyll a	
P = Impairment due to point source pollution					Fecal = Fecal coliform bacteria	
NP = Impairment due to nonpoint source pollution,					NPS Priority = See Table 6.3	
NSW = Nutrient Sensitive Waters strategy (see section 6.4)						

Shellfish waters affected by fecal coliform contamination constitute the majority of impaired waters in the White Oak basin (see Table 6.2). As defined in Chapter 4, impaired shellfish waters include those SA waters classified as prohibited or restricted by the Division of Environmental Health (DEH), with the exception of buffer areas around marinas. Management strategies for these areas are discussed in Section 6.3.

Table 6.2 Nonpoint Source Priority Waters - Class SA Waters Shellfish Areas Impaired Due to Fecal Coliform Levels

Subbasin (Receiving Water)	Area Name	DEH Area	Notable Features	Suspected Nonpoint Sources
Tier 1: Abundant Shellfish Resources, Partially Supporting (Shellfishing Prohibited or Restricted)				
New (IWW)	Hurst Beach area, incl Salliers Bay & IWW	C-4		urban runoff, forestry
White Oak	White Oak River mainstem, upper estuary	D-3	also drains to S-T waters	agriculture, urban runoff, septic, marina, wildlife
Newport	Newport River mainstem, upper estuary	E-4	also drains to S-T waters	agriculture, urban runoff, forestry, septic, marina
North	North River mainstem, upper estuary	E-6	also drains to S-T waters	agriculture, urban runoff, forestry, septic, marina
Newport (mainstem)	Harlowe Creek	E-4	also drains to S-T waters	
Tier 2: Abundant Shellfish Resources, Support-Threatened (Shellfishing Conditionally Approved)				
New (IWW)	Freeman Creek			
Tier 3: Drain to ORWs, Partially Supporting (Shellfishing Prohibited or Restricted)				
New (Alligator Bay)	Mill Creek	C-1	also drains to S-T waters	
White Oak (delta)	Queen Creek	D-2	also drains to S-T waters	residential development
White Oak (Queen Crk)	Parrot Swamp	D-2	also drains to S-T waters	
North (Jarrett Bay)	Wade Creek	E-8	also drains to S-T waters	septic tanks
North (Jarrett Bay)	Williston Creek	E-8	also drains to S-T waters	septic tanks
North (Jarrett Bay)	Middens Creek	E-8	also drains to S-T waters	septic tanks
Newport (Bogue Sound)	Goose Creek	D-4		marina
Newport (Bogue Sound)	Hunting Island Creek	D-4		
Newport (Bogue Sound)	Broad Creek	E-1		
Newport (Bogue Sound)	Gales Creek	E-1		
North (Core Sound)	Lewis Creek	E-9		fish houses
North (Core Sound)	Cedar Creek	E-9		fish houses
North (Core Sound)	Glover Creek	E-9		fish houses
Tier 4: Partially Supporting (Shellfishing Prohibited or Restricted)				
New (Chadwick Bay)	Bumps Creek	C-1	also drains to S-T waters	marina
New (Chadwick Bay)	Fullard Creek	C-1	also drains to S-T waters	
New	Galleon Bay	C-1		
New (nr. Sneads Ferry)	Fannie and Wheeler Creeks	C-2		marinas
New (Stones Bay)	Mill Creek	C-3		
New (Stones Bay)	Stones Creek - Muddy Creek	C-3		
New (Stones Bay)	Everett Creek	C-3		
White Oak (IWW)	Browns Creek	C-4		
White Oak (IWW)	Bear Creek	D-1	also drains to S-T waters	marina
White Oak (Queen Crk)	Dicks Creek	D-2	also drains to S-T waters	marina
White Oak	Pettiford and Starkey Creeks	D-3	also drains to S-T waters	
White Oak	Stevens Creek	D-3	also drains to S-T waters	
White Oak	Holland Mill Creek	D-3	also drains to S-T waters	
Newport (Bogue Sound)	Salter Path Area	E-2		marinas
Newport (Bogue Sound)	Pine Knoll Shores Area	E-2		marinas
Newport (Bogue Sound)	Bogue Banks Area	E-2		marinas
Newport (Bogue Sound)	Morehead City Area	E-3		marinas, urban stormwater
Newport (Bogue Sound)	Spooners Creek Area	E-3		marina
Newport (Bogue Sound)	Atlantic Beach Area	E-3		marinas, urban stormwater
Newport (Calico Crk)	Willis Creek	E-4		
Newport (Calico Crk)	Crab Point Bay	E-4		
Newport (mainstem)	Gable Creek	E-4		
Newport (mainstem)	Wading Creek	E-4		
Newport (mainstem)	Russell Creek	E-4		
Newport (mainstem)	Beaufort Area	E-5		marinas, urban stormwater
North (mainstem)	Newby Creek	E-6		
North (mainstem)	Lenoxville Pt. Area, including Turner Crk.	E-6		

IWW - Intracoastal Waterway; S-T - Support-Threatened.

The list of impaired waters in Tables 6.1 and 6.2 cannot be considered a comprehensive list of all waterbodies for which water quality improvement is necessary. Some impaired waterbodies may not have been identified by the DWQ due to the unavailability of chemical or biological monitoring data for those areas.

6.2.3 Recommended Management Strategies for Restoring Impaired Waters (not including shellfish waters)

Table 6.1 includes the planned water quality management strategies for these waters. Specific strategies for the four water bodies in this table are summarized in this section. Depending upon the cause and source of impairment, the strategies shown may involve limiting point source discharges through the NPDES permitting program, implementing nonpoint source pollution control measures, or a combination of both. These planned management strategies may include the continued implementation of ongoing programs which have not yet reached their full effectiveness, as well as new initiatives. Where water quality problems have been identified but the source(s) is not evident, further investigation may be necessary before any specific actions can be proposed. This is particularly true for nonpoint source-related problems.

Little Northeast Creek

Frequent violations of the instantaneous dissolved oxygen standard (4.0 mg/l) have been recorded at the ambient station on Little Northeast Creek. Four wastewater treatment facilities discharge treated domestic effluent into the creek. Since a reliable model to assess the assimilative capacity of Little Northeast Creek has not been developed, it is difficult to attribute the water quality problems observed in the creek solely to point source dischargers. Nonpoint source pollution from residential development in the drainage area may be contributing to the problem as well. Little Northeast Creek has been assigned a Medium priority.

The White Oak NPS Team has determined that impaired estuarine shellfish waters merit higher priority for initial NPS management action. Thus, removal of the point source dischargers on Little Northeast Creek is recommended as soon as a non-discharge alternative, such as connection to Jacksonville's land application system, becomes available. The creek should receive follow-up monitoring in the next basin cycle to gauge its response to removal of point source discharges. If the creek remains impaired, it should then be targeted for a nonpoint source survey in order to implement best management practices where appropriate.

New River and lower Southwest Creek

Significant water quality problems within the New River subbasin have been observed for over a decade. In June 1990 the Division of Environmental Management released a technical report (NCDEM, 1990) that concluded that the New River mainstem below Jacksonville was experiencing severe nutrient enrichment and low dissolved oxygen levels. The report also concluded that the City of Jacksonville's wastewater discharge to Wilson Bay has contributed to the eutrophication of the New River. The City of Jacksonville has responded and is currently constructing a 6,275 acre land application system to replace the packed tower trickling filter it currently operates. Estimates indicate that removal of the Jacksonville discharge will result in a 1,116 lbs/day reduction in BOD5 loading to the New River. The City's discharge is scheduled to be removed from Wilson Bay by January 1, 1998.

The United States Marine Corps (USMC), which operates seven wastewater treatment plants in the New River area, has also responded to the water quality problems in the subbasin. Six of the existing seven facilities will be eliminated through construction of a regional plant to be built near the current wastewater treatment plant location at Hadnot Point. This upgrade is anticipated to be completed by the end of 1998. The new facility will be designed to meet advanced tertiary effluent limits and will include nutrient removal capabilities. During the summer a reduction of approximately 266 lbs/day of BOD5 loading is expected as a result of regionalizing the USMC treatment facilities. Improved water quality within the New River mainstem is expected after the removal of Jacksonville's discharge along with the consolidation and improved treatment of the USMC discharges. Management of nutrients and oxygen-consuming wastes related to the New River are discussed in more detail in Sections 6.4 and 6.5, respectively. The New River has been assigned a Medium priority for nonpoint source controls, behind the shellfish waters listed in Table 6.2.

Northeast Creek

Northeast Creek is impaired because of nutrient-related algal bloom problems. Northeast Creek is part of the New River Basin that has been classified as NSW. Under an NSW strategy developed in conjunction with Camp Lejeune, Camp Lejeune is removing a discharge from the creek in order to reduce nutrient loading. Northeast Creek should also be targeted for a nonpoint source survey in order to implement best management practices where appropriate. Northeast Creek has been assigned a Medium priority for nonpoint source controls, also behind the shellfish waters listed in Table 6.2.

Calico Creek

Calico Creek at Morehead City has experienced excessive algal growth, elevated nutrient levels and low dissolved oxygen concentrations for many years. A poorly flushed tidal channel feeding the Newport River at Morehead City, Calico Creek receives effluent from the town's wastewater plant and is also affected by nonpoint source runoff from developed areas. DWQ has indicated to the city that the eventual removal of the discharge is desirable. Morehead City, as a member of the Carteret County Interlocal Agency, has been evaluating alternatives to the present arrangement. While alternative plans are under development, the town should be encouraged to evaluate and optimize the operation of its facility to ensure that all reasonable efforts at nutrient and BOD removal are being made. If removal of the plant is not an option, advanced tertiary limits with nutrient removal are recommended for the facility. Calico Creek has been assigned a medium priority for nonpoint source controls, behind the shellfish waters listed in Table 6.2.

6.3 PROTECTION AND RESTORATION OF SHELLFISH WATERS WHERE HARVESTING IS LIMITED OR PROHIBITED DUE TO FECAL COLIFORM BACTERIA CONTAMINATION

6.3.1 How Fecal Coliform Bacteria Affect Shellfish Harvesting

Water polluted by human or animal wastes can harbor numerous pathogens which may threaten human health. This is of particular concern in waters where shellfish are harvested for human consumption. Because of the tendency of clams and oysters to concentrate the material they filter from the water column, shellfish can potentially become too contaminated for safe human consumption, even when fecal coliform concentrations are relatively low. Therefore, while water quality may be safe enough for swimming, fishing or other forms of primary recreation, the threat to commercial and recreational shellfish harvesting is quite real and requires both corrective and preventive action.

Since routine tests for individual pathogens are not practical, fecal coliform bacteria are widely used as an indicator of the potential presence of disease-causing microorganisms. Fecal coliforms are bacteria typically associated with the intestinal tract of warm-blooded animals and their number is generally assumed to be correlated with the number of pathogens in a water sample. They enter surface waters from a number of sources including urban stormwater, agricultural runoff, improperly designed or managed animal waste facilities, failing on-site wastewater systems, broken sewer lines, improperly treated discharges of domestic wastewater and wild animals.

It should be noted that fecal coliform contamination is not a threat to the health of shellfish populations. While other water quality problems can affect shellfish health (for instance, low oxygen levels due to eutrophic conditions or contamination of sediments by toxicants), these are currently not significant issues in the White Oak basin.

6.3.2 The Extent of the Problem in the White Oak's Shellfish Waters

A system used by the Division of Environmental Health (DEH) Shellfish Sanitation Branch to classify salt waters in the basin based on their suitability for harvesting of shellfish was described in Chapters 3 and 4 (Table 4.12). This system rates all salt waters based on the levels of fecal coliform bacteria found, or predicted to occur (based on rainfall events), in the waters. Classifications include Approved, Conditionally Approved, Restricted and Prohibited. It does not consider whether waters are suitable for shellfish growth. For example, shellfish harvesting in the upper portion of the New River estuary is prohibited even though these waters do not naturally support shellfish because of low salinity. The Division of Water Quality has a different type of classification that classifies those waters in the basin thought to be suitable for shellfish growth. The DWQ classification is called SA and it includes almost all of the saltwaters in the basin other than the upper New River estuary. This classification is designed to protect these waters to standards suitable to allow harvesting of the shellfish.

Figure 3.6 in Chapter 3 depicts the extent of shellfish (SA) waters where shellfish harvesting is either restricted or prohibited by DEH as of early 1996. Approximately 8,900 acres of shellfish waters fall into these two categories which are often termed "closed". An additional 30,000 acres of shellfish (SA) waters are classified by DEH as conditionally approved and are rated as threatened by DWQ. The acreage of shellfish waters that are threatened or closed to harvesting has been steadily increasing since 1984.

In the White Oak River basin there are a variety of activities that have contributed to the impairment of shellfish waters. These include, but are not limited to urban stormwater runoff, failing septic tanks and marinas. Characteristics of land uses contribute to fecal coliform bacteria export to surface waters. Some of these characteristics include:

- land disturbance (area of disturbance, length of time of disturbance, and proximity to surface waters;
- type of land use (urban, agriculture, septic tanks, forested); and
- runoff volume and rate (impervious surface, vegetated areas (width and type), best management practices).

Management measures that address these land use characteristics will be needed so as to decrease fecal coliform levels in surface waters if closed shellfish waters are to be reopened and if the trend in increasing closures is to be prevented.

6.3.3 Findings of the North Carolina Blue Ribbon Advisory Council on Oysters

The NC Blue Ribbon Advisory Council on Oysters (NCBRACO) issued it's final Report on Studies and Recommendations in October 1995. In the report the Council "reaches the inescapable conclusion that oyster harvests have declined sufficiently in North Carolina to justify bold new action and to require initiation of that action immediately. ... Because of the economic, cultural, and environmental value of healthy oyster populations, the council judges the perpetuation of this decline in an important component of our coastal heritage to be unacceptable to the citizens of our state." It cites a number of reasons for this decline including outbreaks of oyster diseases (mostly weather driven), physical degradation of oyster reefs, overharvest and to "substantial deterioration of coastal water quality". Both the Albemarle-Pamlico Estuarine Study and Governor Hunt's Coastal Futures Committee, which preceded the council, have also recognized the importance of protecting and restoring shellfish waters.

The Council's report along with a report from the Council's Public Bottom Production Committee makes a series of specific water quality recommendations (NC Blue Ribbon Advisory Council on Oysters, 1995). The objective of these recommendations is to "restore and protect coastal water quality to create an environment suitable for oysters that are safe for human consumption. These recommendations include, but are not limited to:

- institution of regulatory mechanisms for control of NPS runoff, particularly fecal coliform bacteria and nutrients,
- mandatory 100 foot buffers along all SA waters,
- reducing the allowable built-upon area for low density development,
- promote and fund research on oyster reefs that documents their positive impact on water quality
- urge the Marine Fisheries and Environmental Management Commissions to work together to establish and implement a "Use Restoration Waters" classification in order to restore closed shellfish beds,
- DEHNR should "augment its basinwide management plans to include mechanisms for controlling both point and nonpoint source nutrient additions" and "develop and fund a coastal water quality monitoring system capable of measuring oxygen levels in bottom waters in historically important shellfish grounds."
- work with the NCDOT to reverse past road construction activity that has adversely affected oyster beds through restrictions on normal water flow,

Implementation of these recommendations is discussed in section 6.3.4.

6.3.4 Issues in the Development of Management Strategies for Shellfish Waters Restoration and Protection

Goals and Priorities.

The near-term objective of the state is to protect all areas currently meeting their uses and to develop and implement plans to restore priority areas to a condition which will allow reopening them to harvesting. Table 6.2 lists the closed shellfish waters in the White Oak basin. This list includes areas classified by DEH as either prohibited or restricted and those that have significant shellfish resources and are conditionally approved. Not all prohibited or restricted waters in the basin are included, however. As noted above, while DEH is required by federal guidelines to evaluate the condition of all salt and brackish waters, not all of such waters are classified SA. Water classified as SB and SC in which shellfishing is prohibited or restricted are not considered as impaired since commercial shellfishing is not identified as one of the best uses of these waterbodies. In the White Oak basin, the most notable example is the upper half of the New River estuary, which is classified SC. Additionally, some shellfish waters -- most notably those immediately adjacent to marinas -- are classified as prohibited by regulation, even though fecal coliform levels are not always excessive. These have also been excluded from Table 6.2.

Targeting Locations with Significant Shellfish Resources

The quality of the shellfish resource in a particular area will be an important consideration in setting priorities. Due to differences in physical habitat, salinity and other factors, areas closed to shellfish harvesting vary greatly in their productivity. Some of the impaired areas are located in brackish waters that do not support shellfish populations of great commercial value. The areas in Table 6.2 have been assigned nonpoint source (NPS) priority levels based in part upon the abundance of shellfish resources in the area (memorandum from George Gilbert of DEH to Dr. Dirk Frankenberg, Chairman of the NC Blue Ribbon Advisory Council on Oysters, February 6, 1995 - subject: "Closed Shellfish Areas with Abundant Resource"). Areas in which harvesting is prohibited or restricted that have a resource will receive the highest priority for restoration efforts. Also, areas that experience temporary closures (Conditionally Approved Areas), that have abundant shellfish resources will receive a high NPS priority, although these waters are support-threatened and not considered impaired. These waters are also listed in Table 6.2. The NPS Team for the White Oak River Basin will select areas for management action based in part on existing resources and the potential for successfully identifying and mitigating pollution sources.

Restoring water quality in all closed SA waters may not be an attainable objective, particularly in the short run. Contamination in some waters, especially some of those in which harvesting has been prohibited for a long time, may be due to natural conditions (e.g. poor flushing, fecal coliform inputs from wildlife) or to long-standing inputs from developed areas that cannot be effectively or economically mitigated.

Development Thresholds

It would be useful to identify a development threshold beyond which contamination of shellfish waters is likely to occur. Establishing such a threshold is a difficult task because of the wide variety of factors that must be considered: the amount of development, its type, the specific practices used, and the nature of the land prior to initiation of development. Accumulating research has established that degradation of stream water quality often becomes significant once watershed development exceeds 10-15% impervious cover (Schueler, 1995). These studies have been conducted primarily on freshwater streams, however, and to date no systematic effort has been undertaken to establish a relationship between shellfish closures and the extent of imperviousness (Schueler, 1995). Research (Tschetter and Maiolo, 1984) has confirmed the correlation between coastal population growth in North Carolina and the closure of waters to shellfishing, but this work is too general to be useful for management purposes. A study of coastal watersheds in New Hanover County (Duda and Cromartie, 1982) found that closings generally occurred where more than one septic system drain field was present per every seven acres of watershed. It is not clear how much subsurface drainage networks contributed to the problem or how widely the results of this investigation should be generalized. The bottom line is that there is a strong empirical relationship between land development and shellfish water closures that cannot be ignored if shellfish waters are to be protected or restored.

Construction and Stormwater Issues

While no development threshold can be identified at present, it is apparent that closings have increased despite the management policies currently in place. The reasons for this are not clear. There are many aspects of the development process that relate to factors influencing fecal coliform export from urban areas. These aspects include size of disturbed area, length of non-vegetated stage, size of vegetated buffer, impervious level, and design of sediment or stormwater control devices.

Shellfish closures draining developed areas may be related to buffers and sediment control best management practices (BMPs) not being properly maintained or ditching/piping being installed inappropriately. Recent closings may be related in part to developments approved prior to January 1, 1988 (and thus not subject to the current stormwater regulations) but which have been gradually built out over the past few years. On the other hand, density levels allowed without stormwater BMPs may be too high or required buffers for low density development may be too small. Buffers for high density projects or the cumulative impact of the numerous small projects that are not subject to the regulations may partially relate to closures. Closures may also be related to the lack of vegetative buffers or stringent revegetation schedule during the construction phase. Most likely it is some combination of these factors, but adequate information does not exist to confirm this. DEH shoreline surveys, for example, can be suggestive, but often do not verify specific causes of contamination or identify specific aspects of stormwater management or erosion/sediment control which may need attention. Changes in DWQ's stormwater rules became effective at the end of 1995 (see Section 5.3.2). The intent of these changes was in part to address some of the above issues, including enhancing long-term enforcement and managing the cumulative effects of smaller projects. It is still too early to assess the impact of the modified rules.

Other Land Uses

Shellfish closures can also occur adjacent to agricultural or forested areas. Animal populations (both wildlife and livestock), timber cutting and associated land disturbance, and crop preparation all may contribute to fecal coliform bacteria levels in adjacent waters.

Septic System Impacts

Dealing with contamination from septic systems is also a difficult issue, but increasingly local governments around the country are finding innovative ways to address these impacts. In order to protect water quality in the Chesapeake Bay, Arlington County, Virginia has adopted an ordinance requiring that all septic tanks be pumped at least once every 5 years (USEPA, 1993b). Stinson Beach, California developed a management program for on-site systems after discovering that malfunctioning systems were threatening public health (Herring, 1996). Homeowners pay a monthly fee to cover the cost of inspections and testing, in addition to any construction and repair costs (USEPA, 1993b). In the Puget Sound area, where a significant shellfish resource has been threatened by fecal coliform contamination from a number of sources, most counties have established revolving loan funds to facilitate the repair of failing systems (Center for Watershed Protection, 1995). Experience has shown that widespread community support is generally necessary to mount an effective effort, and that this support is unlikely to be forthcoming in the absence of significant perceived benefits (Herring, 1996).

State and Local Interaction through CAMA

The need for both state and local actions to protect coastal water quality has been clear for many years, forming the rationale for the program established in the 1970s under the Coastal Areas Management Act (CAMA). Since the enactment of CAMA, the state's role in coastal water quality has continued to evolve, encompassing not only permitting by the Division of Coastal Management in Areas of Environmental Concern, but DWQ's coastal stormwater rules and the continuing development of the Sedimentation and Erosion Control Program by the Division of Land Resources. Local governments have also acted, implementing the local planning requirements of CAMA.

Since additional limitations on shellfish harvesting have occurred under current policies, it seems clear that simply continuing these activities will not adequately protect water quality. All parties in this state-local partnership, as well as private landowners, must accept more responsibility for protecting coastal resources.

Growth Management

Growth management--defined here as local planning and development review requirements designed to maintain or improve water quality (Center for Watershed Protection, 1995)--has often been unpopular among local governments for a variety of reasons. While it is important to acknowledge this, we must also acknowledge that further improvements in state programs, while necessary, are by themselves unlikely to prevent further deterioration of coastal water quality. Increasingly, local governments in areas such as the Chesapeake Bay and Puget Sound watersheds have recognized that a more proactive approach is essential to protect their coastal resources. Seventy percent of the local governments in the 12 county Puget Sound region, for example, have adopted some form of a stormwater management plan (Dohrmann, 1995).

Use Restoration Waters

The Use Restoration Waters (URW) strategy, currently being developed by DWQ staff, is a new approach to restoring waters which do not currently meet their uses. This concept, which is further described in Chapter 7, could provide a site-specific mechanism for restoring impaired shellfish waters.

6.3.5 Ongoing and Proposed Strategies for the Restoration of Impaired Shellfish Waters

Removal of Wastewater Treatment Plant Discharges in SA waters

Several existing discharges to SA waters will be removed when Camp Lejeune's new treatment facility, which will discharge into SC waters, is completed. Waters around the Onslow Beach WWTP are currently closed to shellfishing and may be reopened once those facilities are shut down. The Courthouse Bay and Rifle Range WWTPs discharge into SC waters, but reclassification may be appropriate after the discharge is removed.

Implementation of Use Restoration Waters (URW)

DWQ will continue to pursue the development of the Use Restoration Waters (URW) concept as a mechanism for the implementation of site-specific mandatory and voluntary BMPs. While the URW approach has not yet been finalized, the choice of URW areas and the development of appropriate strategies is likely to be a complex process. Designation of an area as URW requires that we be fairly certain that the implementation of the specific strategies will actually result in sufficient improvement to reopen the waters to harvesting. It is clear from both prior investigations and the literature that this level of certainty is difficult to establish for fecal coliform contamination.

The first tiers of waterbodies listed in Table 6.2 will form the initial group to be considered for URW status in the White Oak basin. Other waters may also merit consideration after further review.

Implementation of the URW concept was included as a major recommendation by the North Carolina Blue Ribbon Advisory Council on Oysters in its Final Report on Studies and Recommendations (October 1,1995). A report of the Council's Public Bottom Production Committee strongly endorsed the URW concept and nominated all or portions of the following water bodies located in the White Oak Basin for consideration as URW candidates: White Oak River, North River and Newport River. These areas, which are known to have abundant shellfish resources, have been identified in Table 6.2 as Tier 1 nonpoint source priorities by the nonpoint source team. This information will be considered in the prioritization and implementation phases of URW.

Development and Implementation of Nonpoint Source Team Action Plans

One of the most important missions of the DWQ-NPS Team partnership is to foster coordination and cooperation between the basin's diverse interest groups and NPS agencies. The goal of the White Oak NPS Team is to create and implement an action plan that will address the priority NPS-impaired waterbodies and NPS issues. The implementation schedule will be determined as the plans are developed.

Since NPS Teams cannot reasonably address restoration or protection of all NPS-impaired or threatened waterbodies in a basin within a given 5-year cycle, they need to follow a system for prioritization. As part of the Basinwide process, the Teams prioritize waters and issues within each basin for NPS management action by their members. Ranking of waters is based on monitoring and/or other information compiled by DWQ using a set of criteria defined in Section 6.2.2. Monitoring information includes biological and chemical data collected within the last 5 year cycle for a given basin, and other information can include monitoring data collected prior to the current cycle and other issues, as described below. The NPS Teams prioritize these waters not only for BMP implementation, but for technical assistance, education, and Section 319 and other funding.

As described in Section 6.2.2, The White Oak basin NPS Team has developed an initial priority list of nonpoint source-impaired waters for management action. The priority list given in Table 6.2 includes only fecal coliform-impaired or threatened shellfish waters. The Team made the decision to limit its initial focus to these waters, given that they constitute most of the NPS problems in the basin. The Team recognized that pilot efforts made to address this problem would be transferable to the great majority of the problem waters in the basin. The Team made one further refinement to the list, not shown in Table 6.2, by eliminating the White Oak, Newport, and North Rivers' mainstem sections from the Tier 1 listing. In narrowing the choices, the Team felt that choosing achievable projects with the potential for demonstrable water quality improvements was important for the pilot, demonstration efforts in the basin. The Team will use this list as a basis for selecting a number of waterbodies for management action.

The Team has begun the process of evaluating the highest priority waterbodies more closely. Field surveys will be conducted in the watersheds to observe land uses and conditions in order to narrow possible sources. The ability to pinpoint sources and effect changes will be evaluated. Potential actions include public education, BMPs, ecosystem restoration and management, and local water quality planning.

An action plan or plans will then be developed for a selected group of NPS-impaired waterbodies. The goal of the action plan will be to restore designated uses of the selected waterbodies using a comprehensive, site-specific, and coordinated approach. The action plan will contain objectives and action items. The action items will include lead contacts, goals, and schedules for completion.

Implementing the action plans will be the most important part of the NPS Team process. Action plans will focus on gaining the participation of the communities living in each watershed. Sub-groups addressing various aspects of an action plan will likely be formed in each watershed. During the implementation phase, the team will continue to meet on a regular basis to update each other on their experiences and progress and to provide a forum for continuing coordination between team members.

The Team will identify where additional water quality monitoring sites will be needed to document the effectiveness of management actions. The Team will consider additional strategies if actions are not successful in improving water quality.

Potential funding sources for management actions include the following programs:

- NPS Team agency activities;
- Section 319 grants;
- NC Agriculture Cost Share Program;
- Wetlands Restoration Program;
- Water Quality Improvement Trust Fund;
- Proposed URW Program;
- Sedimentation and Erosion Control Program;
- Federal Initiatives; and
- Other programs.

In December 1996, DWQ convened the state NPS Workgroup (see Section 5.3), which agreed to a significant change in the Section 319 funding process (Section 5.3.11) for basin NPS Teams. The

Workgroup agreed to allot $100,000 from the competitive pool of annual grant funds toward each basin NPS Team once in each 5-year basin cycle, in the year of scheduled basin plan approval. As with all 319 contracts, Teams are required to submit proposals that meet minimum state and federal criteria, that provide 40% cost-share match, and that meet with the Workgroup's approval. Since the White Oak Basinwide Plan was scheduled for approval in 1997, the White Oak NPS Team was one of the basins allotted funds in 1997 (for FY98). The Team was required to submit an acceptable proposal by March 31, 1997, and is currently working on that proposal.

Local Government Initiatives

Local governments should consider the application of growth management techniques outlined in the Blueprint to Protect Coastal Water Quality discussed in Section 6.3.3, above (Center for Watershed Protection, 1995). This document provides practical concepts and tools that can be implemented at the local level to protect coastal water quality. Copies are available free of charge from the DWQ's central office in Raleigh.

Alleviating Water Flow Restrictions Resulting from Bridge and Causeway Construction

The Public Bottom Production Committee of the NCBRACO identified the need to work with the NC Department of Transportation to "reverse harmful actions taken during past road, bridge, and causeway construction that restrict water flow into certain creeks and nearshore water bodies which represent some of the best oyster habitat." The report identified bridges across the White Oak River as being a prime example of where highway structures have impeded flow and adversely impacted naturally productive oyster beds. This issue was also raised by a number of attendees of the basinwide public workshop for the White Oak Basin held in Cape Carteret.

6.3.6 Proposed Strategies for the Protection of Threatened or Unimpaired Shellfish Waters

Continue to Prohibit New Sewage Discharges to SA Waters

DWQ will continue implementation of T15A:02H.0404(a), which prohibits new or expanding point source discharges to SA waters. A request for expansion by the Town of Swansboro was denied in 1993 because of its anticipated effects on adjacent SA waters.

Improvements to Stormwater and Sedimentation/Erosion Control Programs

Changes to or better enforcement of present stormwater and sedimentation/erosion control regulations appear to be necessary to ensure that shellfish waters are adequately protected from runoff from developed areas. Changes in regulations which may be worth investigating include: modification of the size, nature or extent of vegetative buffers for both the construction and stormwater phase of the project; lowering the allowable built upon area for low density development draining to SA waters; increasing the size of vegetative filters for outflows from stormwater management devices; developing requirements for maximum size of disturbed area or a revegetation schedule; and modified design standards for stormwater and sediment control BMPs to maximize fecal coliform die-off.

At this time, however, adequate information is not available to determine which specific changes to the stormwater and sedimentation/erosion control regulations, if any, may be appropriate. In order to provide this information, DWQ will investigate the feasibility of conducting, in cooperation with other appropriate agencies, a study of how current stormwater and sedimentation /erosion control programs are implemented in areas draining to SA waters. The scope of the study could include the DWQ stormwater program, the sedimentation and erosion control program administered by the DLR, and programs administered by DCM.

Improving On-site Wastewater Controls

A collaborative effort is needed among state agencies and local health departments to assure that these waste systems are properly sited, designed and maintained so as not to contribute to the further contamination of shellfishing areas. Several approaches are possible, including: a) discuss with DEH and local governments the need to assure compliance with construction and siting standards; b) work with the Groundwater Section of DWQ to evaluate the extent of contamination from systems which have been installed and maintained as designed; c) discuss with DEH the need to revise siting regulations; d) review NC regulations which require property owners to inspect and maintain septic systems, but provide no mechanism to ensure that this occurs for conventional single family systems (Center for Watershed Protection, 1995); and e) discuss with DEH the need for a more formal inspection and maintenance program. Currently there are no minimum inspection or maintenance requirements for these systems.

Local Growth Management

Over the past several years DWQ has been involved in a number of projects to encourage and assist local governments in carrying out wastewater planning and growth management activities. These include participation in the Regional Wastewater Task Force (Carteret, Craven, Onslow and Pamlico Counties), and in preparation of the *Blueprint to Protect Coastal Water Quality: A Guide to Successful Growth Management in the Coastal Region of North Carolina* (Center For Watershed Protection, 1995) developed for the Neuse River Council of Governments. Local governments should consider the application of growth management techniques outlined in the "Blueprint" document. It provides practical concepts and tools that can be implemented at the local level to protect coastal water quality.

The following two tables summarize key features of the document. Table 6.3 lists growth management elements that are discussed in detail in *Blueprint*. Each element can be tailored to both rural and developed areas and to inland, soundside and barrier island locations. Table 6.4 lists 22 growth management tools also presented in *Blueprint*. These tools range from on-the-ground best management practices, such as modifying parking areas in order to reduce impervious surface areas, to establishing regional wastewater and/or stormwater authorities.

Table 6.3 Growth Management Elements Applicable to the North Carolina Coast

1. Use Watershed-based Land Use Planning
2. Protect Sensitive Natural Areas
3. Establish Buffer Network
4. Minimize Impervious Cover in Site Design
5. Limit Erosion During Construction
6. Treat Stormwater
7. Maintain Coastal Growth Measures

Table 6.4 Growth Management Tools

1. Overlay Zoning	8. Septic System Siting Criteria	16. Septic System Inspection and Maintenance
2. Greenbelts	9. Shoreline and Wetlands Buffers	17. Septic System Alternatives
3. Transfer of Development Rights	10. Cluster Zoning	18. Regional CAMA Planning
4. Watershed Impervious Limits	11. Modification of Street Standards	19. Wastewater Authority
5. Marina Siting and Design	12. Modification of parking Areas	20. Stormwater Authority
6. Sensitive Habitat Protection Ordinance	13. Site Clearing Standards	21. Wastewater/Stormwater Authority
7. Forest Conservation	14. Stormwater Treatment	22. Water Quality Authority
	15. Marina Pumpout	

Copies are available free of charge from the DWQ's central office in Raleigh.

Revisions to Animal Waste Management Regulations

Changes in the permitting requirements for confined animal operations and modification of the regulations pertaining to land application of animal waste were proposed by the Blue Ribbon Study Commission on Agricultural Waste in the spring of 1996. In June of 1996, the General Assembly ratified a bill, S1217, that establishes a formal permitting process for animal waste management systems. The measures will formalize and improve the Division of Water Quality's permitting, inspection and enforcement process for these systems (see Section 5.3.1 for details). Although the primary intent of these proposals is to limit nutrient inputs, reduction in fecal coliform inputs from these activities is also likely as the revisions are implemented.

Continue to Improve and Implement NPS BMPs for Reducing Fecal Coliform Bacteria

Other NPS programs, such as agriculture and forestry, could be examined for potential changes to reduce fecal coliform bacteria export to surface waters. Also, a number of projects were recently funded by 319 grants to investigate the effectiveness of various BMPs in removing different pollutants including fecal coliform bacteria. Although these projects are located outside of the White Oak River Basin, the information that they will provide can be applied within it.

Development of Guidelines for Protecting Conditionally Approved Shellfish Waters

A management framework is needed that includes requirements that would need to be applied to waters that are conditionally approved in an attempt to stop any further degradation to the prohibited status.

6.4 IDENTIFICATION AND PROTECTION OF BIOLOGICALLY SENSITIVE OR HIGH VALUE RESOURCE WATERS

Waters considered to be biologically sensitive or of high resource value may be afforded protection through reclassification as HQW (high quality waters), ORW (outstanding resource waters) or WS (water supply). They may also be protected through more stringent NPDES permit limits or through the implementation of localized watershed protection efforts.

Waters eligible for reclassification to HQW or ORW may include those designated as primary nursery areas, critical habitats for threatened or endangered species (as designated by the NC Wildlife Resources Commission), and waters having excellent water quality. Waters classified for shellfishing (SA) or for domestic water supply purposes (WS-I or WS-II) are considered to be HQW by definition. The HQW, ORW and WS classifications generally require more stringent point and nonpoint source pollution controls than do class SC or C waters.

Waters in the White Oak basin currently classified as HQW or ORW are illustrated in Figure 2.15 in Chapter 2. Also, the listing of classifications of all waters in the White Oak River Basin is reproduced in Appendix I. There are no waters in the basin classified as water supplies (WS).

There are two areas in the basin (French's Creek and a portion of the New River) that have been designated as inland PNA's by the Wildlife Resources Commission. These areas include all of French's Creek which is a tributary to the New River and the New River upstream of highway 17 for approximately 4,300 feet. This designation makes these areas eligible for consideration for designation as HQW. These reclassifications are currently pending internal review.

One of North Carolina's most important resources is its commercial and recreational fisheries. The Final Recommendations of the Moratorium Steering Committee (established by the NC General Assembly to investigate and make recommendations pertaining to declines in the state's fisheries) have recently been released. Their recommendations cover a variety of subjects, including water quality. DWQ recognizes that protection of water quality is an important component of protecting North Carolina's fishery resources and will continue to work toward the maintenance and improvement of coastal water quality to protect these resources.

Where waters are known to support state or federally listed endangered or threatened species or species of concern, but where water quality is less than excellent and where no critical habitat has been designated, consideration will be given during NPDES permitting to minimize impacts to these habitat areas consistent with the requirements of the federal Endangered Species Act and North Carolina's endangered species statutes. Possible protection measures may include dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, backup power provisions to minimize accidental plant spills, and others. The need for special provisions will be determined on a case by case basis during review of individual permit applications and will take into account the degree of impact and the costs of protection. Chapter 2 provides a list of threatened and endangered species in the White Oak River basin and the specific subbasins in which they are known to occur.

6.5 PROTECTING, ENHANCING AND RESTORING NPS POLLUTION ABATEMENT FUNCTIONS OF WETLANDS

Wetlands perform a wide variety of functions. When society perceives the function to be beneficial, the benefit is considered a value. Often, laws and regulations are established to protect the value. Wetland values include water quality improvement, flood control, wildlife habitat, nursery areas for fisheries, and recreation. Water quality values are of special interest for basinwide planning purposes.

Wetlands are important in protecting state waters from nonpoint source degradation. Extensive research shows that vegetated buffers and streamside management zones are effective measures to protect the quality of rivers, streams, and lakes from nonpoint source sediments (Trimble 1957; Budd et al. 1987; Cooper et al. 1987; Howard and Allen 1988; Nutter and Gaskin 1989; Nieswand et al. 1990). Numerous authors have studied the effectiveness of riparian forested wetlands for nutrient retention and transformation (Jones et al. 1976; Yates and Sheridan 1983; Brinson et al. 1984; Lowrance et al. 1984; Peterjohn and Correll 1984; Jacobs and Gilliam 1985; Budd et al. 1987; Groffman et al. 1991). Bastian and Benforado (1988) note that under the right conditions, natural and constructed wetlands have achieved high removal efficiencies for BOD, suspended solids, heavy metals, and trace organics.

However, nonpoint source loadings cannot be processed satisfactorily if the system is overloaded. Excessive nutrient and sediment loadings cause a decline in the removal efficiencies of wetlands. The size of the wetland and its position in the landscape relative to pollutant sources are important factors in preventing a decrease or loss of the NPS pollution abatement values of wetlands.

6.5.1 Current Management Strategies

Several programs are in place that utilize, protect, and enhance the nonpoint source pollution abatement functions of wetlands. Following is a brief description of some of these programs.

- The Agricultural Conservation Program (ACP), administered by the USDA Farm Services Agency, is a voluntary program that provides financial and technical assistance to farmers to install soil-saving practices addressing point and nonpoint source pollution. ACP approved practices include the construction of wetland systems to treat wastewater derived from livestock, poultry, or aquaculture and the restoration or establishment of riparian buffers to remove nutrients, sediment, pesticides, and organic matter.

- The Natural Resources Conservation Service, through the Watershed Protection and Flood Prevention Program (PL 83-566), assists local communities in developing watershed protection. NRCS can assist state, local, and non-profit organizations with water control and conservation projects, including projects to restore wetlands and stream characteristics throughout a small watershed to improve water quality.
- The Natural Resources Conservation Service offers landowners a chance to receive payments for restoring and protecting wetlands on their property through the Wetlands Reserve Program. The location criteria (ranking factor) for the 1996 enrollment in the program gives strong emphasis on those wetlands within a watershed that is designated as Nutrient Sensitive Waters or to waters which are not fully supporting their uses.
- The forestry Stewardship Incentives Program (SIP) provides financial assistance to private landowners to enhance and improve soil and water quality, fisheries and wildlife habitat, timber resources, recreation, and aesthetics. Authorized under the 1990 Farm Bill, SIP encourages management of non-industrial, private forests through cost-sharing of approved practices, including wetland restoration for soil and water quality protection and enhancement.
- There are several important state and federal wetland regulatory programs that protect the water quality functions of wetlands. These programs are discussed in 5.3.8.

6.5.2 Future Management Strategies

Future management strategies will be targeted at protecting and maintaining the water quality functions of wetlands and encouraging their use for nonpoint source pollution abatement. This will include both regulatory and non-regulatory measures.

Non- Regulatory Measures

The Wetland Restoration Program (WRP) was passed by the 1996 General Assembly and is currently being implemented by the Divisions of Water Quality and Coastal Management. It will be an important part of future wetland management strategies. The objectives of the WRP are to increase the net wetland acres and functions in each river basin and foster a comprehensive approach to environmental protection by coordinating planned wetland restoration with basinwide water quality planning, coastal management, watershed improvement planning, and local land use planning. The goal of these restoration efforts will be to restore wetlands within a watershed context in a manner that is consistent with the goals of the basinwide planning initiatives. The incorporation of wetland restoration and management plans into the basinwide planning process may reduce the need for more expensive methods of controlling point and nonpoint sources of pollution.

To begin this effort, DCM has identified the wetlands of part of the White Oak basin. In addition to identifying the location, DCM has developed a comprehensive procedure to evaluate the ecological significance of each wetland within its own small watershed, based on the wetland's contribution to water quality, hydrology and habitat functions. Local governments are encouraged to consider these data when designing their land use plans, thus potentially providing greater protection to the most significant wetlands.

A parallel initiative includes the identification and prioritization of potential wetland restoration sites based on their potential capacity for performing water quality, hydrology and habitat functions. Since DCM has identified the functional significance of existing wetlands, it is now possible to select restoration sites that have the greatest potential for restoring the lost function that has created the need for restoration. DCM is in various stages of completion for these data. Establishment of the Wetland Restoration Program will provide the resources necessary to develop these data for the remainder of the White Oak basin, as well as the remaining coastal plain.

Figure 6.1 illustrates potential sites for wetland restoration in Carteret County and the adjacent portion of the White Oak River Basin. This restoration site map identifies areas with soil and landscape characteristics that make these sites potentially suitable for wetland restoration. DWQ would use the maps to identify potential sites for compensatory mitigation, addressing specific water quality problems and focusing on the replacement of lost wetland functions within the same geographical area. This would ensure that compensatory mitigation is more effectively targeted and environmentally beneficial than today's numerous, scattered site-by site projects. Similar data are currently being used to identify compensatory mitigation sites for the Department of Transportation to mitigate losses due to construction of the New Bern Bypass and Neuse River Bridge between Bridgeton and New Bern in the Neuse River basin.

Regulatory Measures

Future regulatory management strategies will continue to emphasize protection of wetlands with water quality values and the prevention of downstream impacts. In March 1996, the Environmental Management Commission adopted wetland rules, to become effective in the fall of 1996, that establish classifications for wetlands, define wetlands that will be classified, designate uses for wetlands, and provide greater detail on the procedures used to review requests for 401 water quality certifications. The emphasis of the 401 review procedures will be on projects that impact less than 3 acres of wetlands and are located within 150 feet of surface waters to protect those wetlands that have been determined most important to water quality. Mitigation requirements have also been made explicit in the rules to encourage minimization of impacts to all wetlands.

Additionally, 401 water quality certifications are often issued with conditions such as stormwater control to protect water quality and prevent downstream impacts. These conditions become part of the 404 permit and are enforceable through this permit. DWQ is currently revamping its existing computer tracking system and developing a follow-up protocol to monitor compliance with 401 conditions. If conditions are not being met, then the U.S. Army Corps of Engineers can halt the project and require remediation.

6.6 REGIONAL WASTEWATER TREATMENT OPTIONS AND THE POTENTIAL NEED FOR AN OCEAN OUTFALL

Waste disposal options are limited in the White Oak basin, which is dominated by SA waters and sensitive aquatic habitats. The development of effective long-term wastewater management strategies is one of the most critical issues facing the basin, from the perspective of both environmental protection and economic development. For some time DWQ has been encouraging local governments to consider options other than discharge to surface waters. Potential alternatives include conservation and reuse, land application and the use of constructed wetlands. Discharge to the Atlantic Ocean may be a long term option, but there are many unresolved questions regarding the viability of an ocean outfall.

North Carolina has recognized that an effluent discharge to the Atlantic Ocean may be necessary in the future in order to meet wastewater demands in coastal areas, including the area of the White Oak basin. In 1993 the NC Department of Environment, Health and Natural Resources and the Neuse River Council of Governments sponsored the NC Ocean Outfall Forum to gather experts and stakeholders together to provide federal, state, and local management agencies with educated and diverse perspectives on the possible impacts of choosing ocean outfalls for wastewater disposal in North Carolina (NC DEHNR, 1993). The Forum revealed that several important issues must be addressed before this option could be pursued. These can be broken down into three main issues: 1) technical criteria (whether or not the project is technically viable and can meet state and federal permitting requirements); socioeconomic considerations (whether or not the

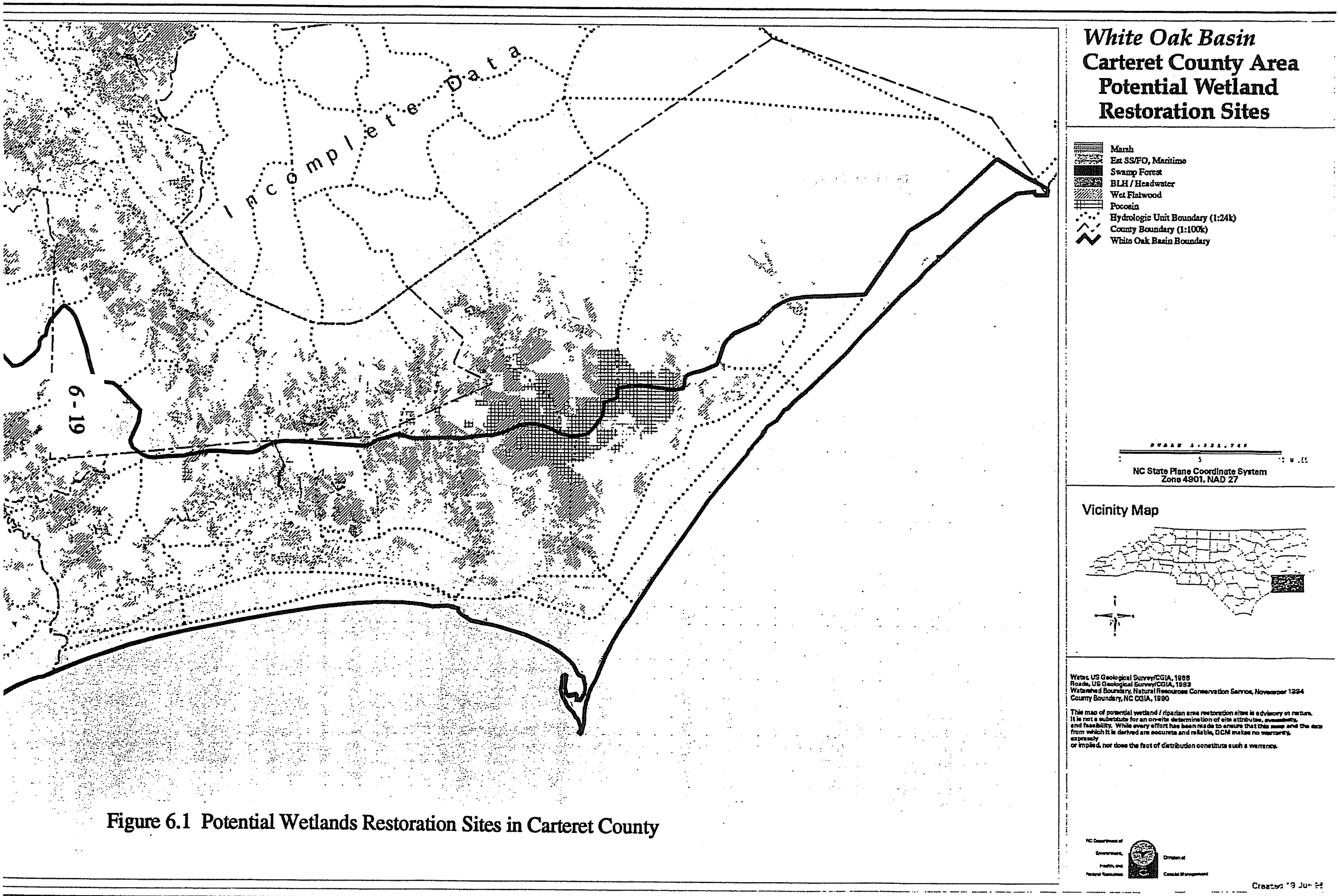


Figure 6.1 Potential Wetlands Restoration Sites in Carteret County

project is politcally and socially viable); and 3) whether or not environmental concerns associated with the project can be sufficiently addressed (especially the issue of accelerated growth that could result from the region having increased wastewater treatment capacity). The Federal gudielines for issuance of an NPDES permit for an ocean discharge are reprinted in Appendix X.

Two local groups have been working to address local wastewater issues. The Regional Wastewater Task Force has been evaluating long term options for the Carteret, Craven, Onslow and Pamlico County area (see Malcolm Pirnie Inc., 1995). The Carteret County Interlocal Agency, consisting of nine Carteret County towns, has been meeting to assess alternatives on a more local level (see Camp Dresser and McKee, 1995). The Interlocal Agency has determined that land application alone cannot meet the needs of municipalities in Carteret County. This group has suspended further action on its part pending the outcome of a feasibility study being conducted through the Regional Wastewater Task Force. The Task Force conducted public meetings on several regional waste treatment alternatives in May of 1996. This group should make final recommendations during 1996. DWQ will continue to work with these groups, as well as individual local governments, on the development of viable long-term options for wastewater disposal.

6.7 RECOMMENDED MANAGEMENT STRATEGIES FOR NUTRIENTS IN THE NEW RIVER AND NEWPORT RIVER WATERSHEDS

Control of nutrients is necessary to limit algal growth potential, to assure protection of the instream chlorophyll *a* standard, and to avoid the development of nuisance conditions in the state's waterways. Point source controls are typically NPDES permit limitations on total phosphorus (TP) and total nitrogen (TN). Nonpoint controls of nutrients generally include best management practices (BMPs) to control nutrient loading from agricultural land, urban areas and other activities, as well as the establishment and protection of riparian forested buffers. This section will address specific problem areas and provide general management goals as well.

6.7.1 New River (Subbasin 02)

Nutrients and algal growth are a significant concern primarily in the New River drainage, much of which was designated as nutrient sensitive waters (NSW) in 1991. The remainder of the basin does not have notable problems with eutrophication.

Chapter 3 documented that point source discharges contribute the majority of the nutrients to the New River. Point sources account for 59% of the phosphorus load to the NSW area and 44% of the nitrogen load. Over 94% of point source inputs of both nutrients originates from the Jacksonville WWTP and four Camp Lejeune facilities.

These major dischargers to the New River estuary are currently in the process of either undertaking major improvements or removing their discharge entirely. The City of Jacksonville is currently under a Special Order of Consent to eliminate its discharge to the New River. The city is in the construction phase of a 6 MGD land application system, the largest in the state, utilizing over 6,200 acres of spray fields and buffers. When construction is complete in late 1997, Jacksonville's discharge will be removed from Wilson Bay, which is currently one of the most degraded waterbodies in the entire basin.

Camp Lejeune currently operates seven facilities discharging into the New River or adjacent waters. Four of them discharge into the NSW area, including outfalls in Northeast Creek and in the New River just upstream of Wilson Bay. The seven discharges are being consolidated and a single advanced treatment facility will be constructed near the site of the current Hadnot Point plant. The plant is scheduled for completion by December, 1998, and will operate under summer TP (total phosphorus) and TN (total nitrogen) limits of 0.5 mg/l and 5.0 mg/l respectively and winter limits of 1.0 mg/l (TP) and 10.0 mg/l (TN). The new plant will represent a small increase in permitted capacity over the total capacity of the existing plants (15 MGD vs. 13.2 MGD). However the high level of nutrient removal provided by this facility--coupled with the removal of the Jacksonville discharge--will result in a substantial decrease in both phosphorus and nitrogen loads from current levels (Figure 6.2).

Since point sources contribute such a significant proportion of the New River's nutrient load and the largest dischargers are still implementing projects which will decrease those loadings substantially, it is still too early to fully evaluate the NSW strategy. Water quality improvements in Wilson Bay and Northeast Creek are anticipated after these projects are completed.

Recommended actions

The following nutrient reduction strategies are recommended for the period covered by this plan:

- As specified by the current NSW strategy, existing facilities with a permitted capacity of 0.05 MGD or greater should continue to receive TP limits of 2.0 mg/l (summer and winter). New or expanding facilities should continue to receive a TP limit of 0.5 mg/l (summer and winter), with the requirement that prospective permittees first establish that nondischarge options or connection to an existing facility are not feasible.
- The original NSW strategy allowed for the implementation of TN limits where appropriate. Since this strategy was approved, DWQ has become increasingly aware of additional research on the importance of nitrogen to estuarine algal growth (for example: Paerl et al, 1990; Rudek et al, 1991; Stanley, 1993). Additionally, the feasibility of point source TN limits has become more firmly established (USEPA, 1993a; Randall et al, 1992). It is therefore recommended that TN limits be required for new and expanding facilities with a capacity of 1 MGD or greater. While specific levels should be determined on a case by case basis, limits similar to those given to Camp Lejeune (5.0 mg/l summer, 10.0 mg/l winter) should be anticipated. All facilities without nutrient limits will be required to monitor TN and TP.
- While agricultural BMPs have been implemented in the New River watershed, the impact of these activities has not yet been assessed. A Nonpoint Source Team for the White Oak basin was established in the fall of 1995. The responsibilities of this team include the assessment of NPS controls and the development of an action plan for reducing NPS nutrient loads in the New River. The implementation of new regulations governing the treatment and land application of waste from confined animal operations (see Section 6.9), more stringent enforcement of existing regulations, and a focused educational initiative should serve to reduce nutrient loading from these sources.

The strategy outlined above constitutes a phased TMDL (Total Maximum Daily Load) for nitrogen and phosphorus in the New River estuary. No adequate predictive tool exists for developing a specific estimate of the assimilative capacity of the New River for these nutrients. Current DWQ ambient monitoring sites are not sufficient to provide data on long-term trends in the NSW area. While Camp Lejeune is currently conducting extensive monitoring in the estuary, additional DWQ monitoring stations may be necessary to ensure that adequate data are available to assess the condition of the estuary once the Jacksonville discharge is removed and the new facility at Camp Lejeune becomes operational. The need for any additional nutrient control measures--especially BMPs to reduce loadings from nonpoint sources--will be evaluated after the point source improvements have been completed and the water quality data analyzed.

6.7.2 Nutrients in the Newport and North River Watersheds

Calico Creek at Morehead City in the Newport River watershed has experienced excessive algal growth, elevated nutrient levels and low dissolved oxygen concentrations for many years. A poorly flushed tidal channel feeding the Newport River at Morehead City, Calico Creek receives effluent from the city's wastewater plant and is also affected by nonpoint source runoff from developed areas. DWQ has indicated to the city that the eventual removal of the discharge is

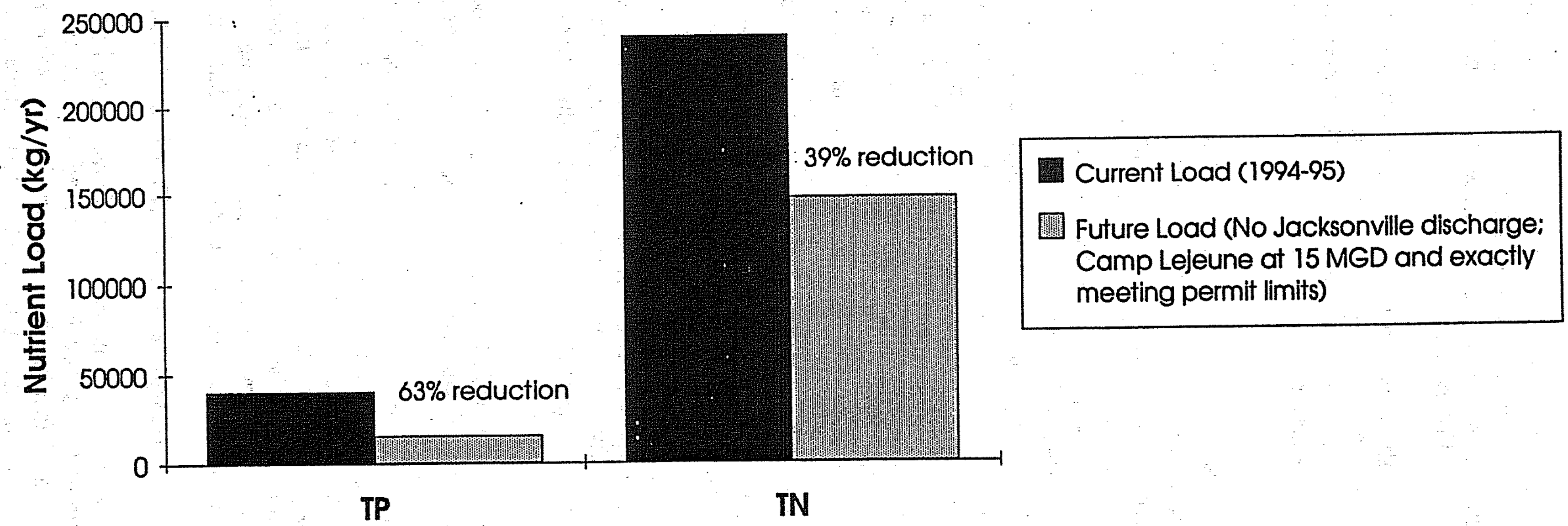


Figure 6.2. Nutrient loads to the New River NSW Area from Jacksonville and Camp Lejeune.

desirable. Morehead City, as a member of the Carteret County Interlocal Agency, has been evaluating alternatives to the present arrangement. While alternative plans are under development, the city should be encouraged to evaluate and optimize the operation of its facility to ensure that all reasonable efforts at nutrient and BOD removal are being made. If removal of the plant is not an option, advanced tertiary limits with nutrient removal are recommended for the facility. Calico Creek has been assigned a Medium priority.

On a unit area basis, nitrogen and phosphorus inputs from nonpoint source runoff from land surfaces are generally low to moderate (see Chapter 3). The North River drainage, which contains substantial agricultural acreage (including part of Open Grounds Farm), has the highest nonpoint source inputs among these watersheds (approximately 440 kg per square km of land area). While this level is not elevated compared with highly impacted areas in basins such as the Neuse, the North River merits continued monitoring as well as consideration by the Nonpoint Source Team for voluntary implementation of agricultural BMPs.

6.7.3 Wetlands Protection and Nutrient Reductions

Protection and/or restoration of wetlands may prove to be a cost-effective tool in controlling nutrients. Numerous authors have studied the effectiveness of riparian wetland forests for nutrient retention and transformation. The location of riparian wetlands allows them the opportunity to receive nutrients from the surrounding landscape and from overbank flooding. In addition to the storage of nutrients in wetland vegetation, the microbial and chemical processes within wetland soils may function to completely remove nutrients from the system. Kuenzler and Craig (1986) found that the riparian systems along the Chowan River removed 64% of the total nitrogen and 43% of the total phosphorus from upland, predominantly nonpoint, sources.

Headwater riparian wetlands are the most important wetlands in terms of sediment and associated nutrient and toxicant retention. Since small streams comprise most of the total stream length within a watershed, these areas intercept the greatest portion of eroded sediments and associated substances before these pollutants reach waters downstream. One study found that approximately 80% of the sediments entering a stream were retained in headwater wetlands.

The White Oak River basin contains expanses of headwater forests, bottomland hardwood forests, and swamp forests along its coastal streams and rivers. Protection of these significant forested wetlands will protect important nutrient and sediment removal values. Nonpoint source reduction measures should capitalize on and protect the nutrient removal and transformation functions of these important floodplain wetlands. This can be accomplished through the following initiatives.

- Continue acquisition and restoration efforts to protect riparian forested wetlands in the coastal plain of the basin. Section 319(h) funds can be used to acquire and restore riparian wetlands that are important to preventing and controlling NPS pollution in the White Oak River Basin.

- Encourage the use of riparian buffers in agricultural and urban areas. Riparian buffers can be restored and established along cropland, pasture, hayland, or rangeland or along the rear lot lines of subdivisions to remove nutrients, sediments, organic matter and pesticides.

- Encourage riparian wetland restoration, enhancement, protection, or some combination of them for compensatory mitigation.

- Utilize forestry incentives programs to reduce sediment and nutrient inputs from forestry practices in the White Oak River Basin. The Forest Stewardship Incentives Program administered by the Division of Forest Resources and the U.S Forest Service provides cost-share funds for implementing Forest Stewardship Plans.

- Continue emphasis of the 401 Water Quality Certification Program on protecting wetlands with water quality values and preventing downstream impacts.

6.8 MANAGEMENT STRATEGIES FOR OXYGEN-CONSUMING WASTES

Maintenance of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of North Carolina's surface waters. The daily average dissolved oxygen standard for most waters in the state, those waters not classified as trout waters, is 5.0 mg/L. Waters classified as swamp waters or waters with swamp-like characteristics may have naturally lower dissolved oxygen. This fact is taken into consideration when applying the 5.0 mg/L standard in waters with swamp-like characteristics. Although very few streams in the White Oak basin are classified as swamp waters, swamp-like conditions are prevalent in many areas of the basin.

Biochemical oxygen demand (BOD) and ammonia nitrogen (NH_3-N) associated with wastewater treatment plants are generally the types of oxygen-consuming wastes of greatest concern. During summertime conditions, when temperature is high and stream flow is low, point source BOD and NH_3-N have the greatest impact on instream dissolved oxygen concentrations. NPDES permits for wastewater facilities generally limit BOD_5 (or $CBOD_5$) and NH_3-N in point source discharge effluents to ensure protection of the DO standard during warm, low flow conditions. Under these conditions, nonpoint source pollution input, which typically occurs as a result of rainfall events, has a minor impact.

Where residual BOD is significant, management of nonpoint sources to reduce loading is recommended by implementation of best management practices. Additionally, constructed wetlands can be strategically engineered and positioned in the landscape to reduce the input of oxygen demanding wastes. Constructed wetland treatment systems can remove between 50% and 90% of the BOD_5 from primary effluent (Bastian and Benforado 1988).

BOD/DO models are used by DWQ to determine NPDES permit limits for oxygen-consuming wastes. The choice of model in free-flowing streams, North Carolina's desktop empirical model (Level B) or the field calibrated, QUAL2E model, is determined by the amount of data available for a given stream reach (Appendix III). Modeling is not conducted in some instances, such as for discharges into zero flow streams and HQW stream segments where NPDES permit limitations are determined by special procedures and regulations.

6.8.1 Discharges to Low Flow Streams

Many low flow streams exist across the state. In 1980 studies were performed on zero flow streams (7Q10 and 30Q2 = 0 cfs) to determine the effect of wastewater discharges to these waterbodies. The studies concluded that:

- steady-state models do not apply to zero flow streams, particularly those receiving waste from small discharges;
- the pool/riffle configuration of these small streams results in violations of the DO standard even when the wastewater is well treated;
- small streams receiving wastes from schools, mobile home parks, subdivisions, etc. flow through populated areas where children have easy access to the streams;
- noxious conditions were found in the low flow streams that were part of the study.

As a result of the study, regulations were developed that prohibit new or expanded discharges of oxygen-consuming wastes to zero flow streams. Existing facilities discharging to zero flow streams were evaluated for alternatives to discharge. Many facilities found alternatives to a surface water discharge and some facilities built new treatment plants to meet advanced tertiary limits for BOD_5 and NH_3-N. Facilities that currently discharge to a zero flow stream but which have not yet been evaluated will receive the following language in their NPDES permit:

> *Removal of the discharge will be required if a more environmentally sound and economically achievable alternative is available. An engineering report evaluating alternatives to discharge is due 180 days prior to permit expiration along with the permit renewal application. As part of the report, the cost of constructing a treatment facility to meet limits of 5 mg/l BOD_5, 2 mg/l NH_3-N, 6 mg/l dissolved oxygen and 17 ug/l chlorine must also be included if there are no alternatives to a surface water discharge. Upon review of the results of the engineering report, the Division may reopen and modify this NPDES permit to require removal of the discharge, modified treatment designs, and/or revised effluent limitations within a specified time schedule.*

This policy typically covers small discharges, i.e., schools, mobile home parks, rest homes, subdivisions, etc. which discharge to zero flow streams in headwater areas. While these discharges may not cause severe water quality problems in mainstem reaches of the White Oak Basin they can cause localized problems in their low flow receiving streams.

The results of the 1980 study were extrapolated for facilities discharging to low flow streams with a 7Q10 = 0 and a 30Q2 > 0 since similar adverse impacts are expected in the receiving streams. Regulations were developed to set effluent limitations for new and expanded discharges of oxygen consuming waste at 5 mg/l BOD5, 2 mg/l NH3-N, and 6 mg/l DO, unless it is determined that these limitations will not protect water quality standards.

6.8.2 Discharges to Swamp Waters

Although few streams in the White Oak Basin are classified as swamp waters, many streams have swamp-like characteristics. At this time, DWQ does not have a good tool to evaluate the ability of these waters to assimilate oxygen-consuming wastes as our desktop dissolved oxygen model assumes a steady-state, one-dimensional flow, and these conditions may not exist in swamp waters. In addition, data analyses from a previously studied system in the Lumber River Basin indicated that critical conditions in a swamp system are not necessarily limited to low flow conditions. Inadequate flow and water quality data prevent verification of the relationship between flow and dissolved oxygen in many of the tributaries with swamp-like characteristics.

Given the difficulty of determining assimilative capacity in these waters, DWQ has identified the need to develop a better tool to evaluate a swamp system's ability to assimilate waste flow. Since many swamp systems are very slow moving and naturally have low dissolved oxygen concentrations, the criteria to determine the impact from a wastewater discharge is currently being reevaluated. A work group has been formed in the Water Quality Section to determine wastewater impacts given various treatment levels and flow conditions in a swamp. Instream data above and below several facilities will be used as part of the study. The focus of the study is to evaluate discharge impacts during various hydrologic regimes within the swamps in question. Emphasis will be placed on data collected during high, low and medium flows and during a falling hydrograph event when swamp backwaters drain to the mainstem carrying potentially lower dissolved oxygen concentrations.

Until these studies are completed, new discharges will not be permitted at limits less stringent than 15 mg/l BOD_5 and 4 mg/l NH_3-N. More stringent limits may be needed on a case-by-case basis if existing data or conditions suggest that adverse impacts are occurring. Existing facilities will receive current permit limits unless they expand or site specific information is available which indicates more stringent limits are needed. Upon expansion, they will receive existing loading (mass basis).

6.8.3 Recommended Strategies for Oxygen Consuming Wastes in Subbasin 01 (White Oak River Drainage)

Instream monitoring data indicate that overall water quality within the subbasin is good. There are no major dischargers in the subbasin. The largest discharger, Swansboro WWTP, releases 0.3 MGD of treated effluent into Fosters Creek. Although Fosters Creek appears to have additional assimilative capacity, Swansboro WWTP was denied an expansion to 0.6 MGD in 1993 in order to protect downstream shellfish waters from potential fecal coliform contamination. The protection of shellfish waters, as well as the dissolved oxygen standard, should be considered if the Town of Swansboro applies for any future expansions.

The Town of Maysville's WWTP, with a discharge of 0.18 MGD to the White Oak River, is the second largest facility in the subbasin. The Maysville WWTP has maintained the same design capacity since 1976. Instream monitoring data reported by the facility indicates that Maysville's discharge is having little impact on the dissolved oxygen concentrations downstream. During the summer of 1995 instream DO concentrations as low as 4.2 mg/L were reported both up and downstream of the discharge. These occasional excursions below the state standard can likely be attributed to naturally low DO swamp waters draining into the mainstem.

Two schools operate wastewater treatment facilities in the basin, Tabernacle Elementary and Silverdale Elementary. Both these facilities discharge to zero flow streams. No major DO problems have been reported in the receiving streams for either facility. The fact that both facilities cease discharging during the summer months has helped to minimize the potential for instream DO problems. The removal of these two discharges is recommended when an alternative to a surface water discharge becomes available.

6.8.4 Recommended Strategies for Oxygen Consuming Wastes in the New River Watershed (Subbasin 02)

Subbasin 02 includes the New River, a blackwater river located within Onslow County, and its tributaries. Approximately half the waters in this subbasin are estuarine with the freshwater portion limited predominately to the upper region of the subbasin. Significant water quality problems within this subbasin have been observed for over a decade. In June 1990 the Division of Environmental Management released a technical report (NCDEM, 1990) that concluded that the New River mainstem below Jacksonville was experiencing severe nutrient enrichment and low dissolved oxygen levels. The report also concluded that the City of Jacksonville's wastewater discharge to Wilson Bay has contributed to the eutrophication of the New River. The City of Jacksonville has responded and is currently constructing a 6,275 acre land application system to replace the packed tower trickling filter it currently operates. Estimates indicate that removal of the Jacksonville discharge will result in a 1,116 lbs/day reduction in BOD5 loading to the New River. The City's discharge is scheduled to be removed from Wilson Bay by January 1, 1998.

The United States Marine Corps (USMC), which operates seven wastewater treatment plants in the New River area, has also responded to the water quality problems in the subbasin. Six of the existing seven facilities will be eliminated through construction of a regional plant to be built at the current Hadnot Point wastewater treatment plant location. This facility will be designed to meet advanced tertiary effluent limits and will include nutrient removal capabilities. During the summer a reduction of approximately 266 lbs/day of BOD5 loading is expected as a result of regionalizing the USMC treatment facilities. Improved water quality within the New River mainstem is expected after the removal of Jacksonville's discharge along with the consolidation and improved treatment of the USMC discharges.

Freshwater tributaries to the New River are typically characterized by low flow, swamp-like conditions. While low DO concentrations occur naturally in these swampy streams, point source dischargers in the subbasin have pushed instream DO concentrations down even further. Models based on the assumption of steady state conditions tend to be poor predictive tools in many of the low flow streams in this subbasin. Therefore, assessing the impact point source dischargers have on streams, such as Little Northeast Creek for example, is difficult. Frequent violations of the instantaneous DO standard (4.0 mg/L) have been recorded at the ambient station on Little Northeast Creek (figure 6.3). Four wastewater treatment facilities discharge treated domestic effluent into the creek. Since a reliable model to assess the assimilative capacity of Little Northeast Creek has not been developed, it is difficult to attribute the water quality problems observed in the creek solely to point source dischargers. Nonpoint source pollution from residential development in the drainage area may be contributing to the problem as well. Northeast and Little Northeast Creeks should be targeted for a nonpoint source survey in order to implement best management practices where appropriate. Removal of the dischargers on Little Northeast Creek is recommended as soon as a non-discharge alternative, such as connection to Jacksonville's land application system, becomes available.

Data from the ambient monitoring station located near the mouth of Wallace Creek indicates no severe DO violations have been recorded at this site. Three dischargers are located in the Wallace Creek drainage area, Piney Green WWTP, Big Pines MHP WWTP, and Webb Creek Water & Sewer. Piney Green WWTP has had a history of permit compliance problems. As a result, the receiving stream, an unnamed tributary to Wallace Creek, has experienced long periods of hypoxic conditions. Removal of Piney Green WWTP's discharge is recommended. Big Pines Mobile Home Park and Webb Creek Water & Sewer both discharge into receiving waters with an estimated 7Q10 flow of zero. Summer time DO concentrations can be well below the standard both up and downstream of the discharges. Developing models for Wallace Creek is difficult due to the wind tides near the mouth and low flows at the head waters. Therefore, the assimilative capacity of Wallace Creek and its tributaries is difficult to quantify. Webb Creek Water & Sewer is planning to expand its discharge into a low flow UT from 0.24 MGD to 0.5 MGD. During the next five year planning period close observation of the water quality in the Wallace Creek drainage area is recommended. Removal of the Big Pines MHP and Webb Creek Water & Sewer is recommended when an alternative to discharge becomes available.

Instream monitoring data indicates that there is little to no assimilative capacity in the upper New River basin. It is recommended that no additional loading of oxygen consuming wastes be allowed in the upper New River basin as illustrated in figure 6.4. Specifically, it is recommended that no new discharges should be allowed and that expansions of existing facilities only be allowed if there is no increase in permitted loading of oxygen consuming wastes. The area affected includes the tributaries and mainstems of Northeast Creek, Southwest Creek, and the New River above the confluence with Northeast and Southwest Creeks. This strategy allows for expansions to wastewater treatment plants, but the increase in wasteflow must be coupled with more stringent permit limits to ensure no increase in mass loading of oxygen consuming wastes to streams within the management area. New or expanding discharges to the lower New River basin will be considered on a case-by-case basis (except in SA waters where domestic discharges are not allowed). Before any additional loading is allowed in the lower New River basin emphasis should be placed on closely examining the engineering alternatives analysis to ensure that an alternative to a surface water discharge does not exist. All dischargers in subbasin 02 are encouraged to cease discharging at the earliest possible date and connect to either Jacksonville's land application system.

6.8.5 Recommended Strategies for Oxygen Consuming Wastes in Newport River Watershed (Subbasin 03).

With the exception of Morehead City WWTP, point source dischargers appear to be having a minimal impact to the receiving streams in this subbasin. Calico Creek, which receives wastewater from the Morehead City WWTP, is a poorly flushed tidal stream constricted at the mouth by the Piggots Street Bridge. Low DO concentrations along with high chlorophyll-a concentrations have

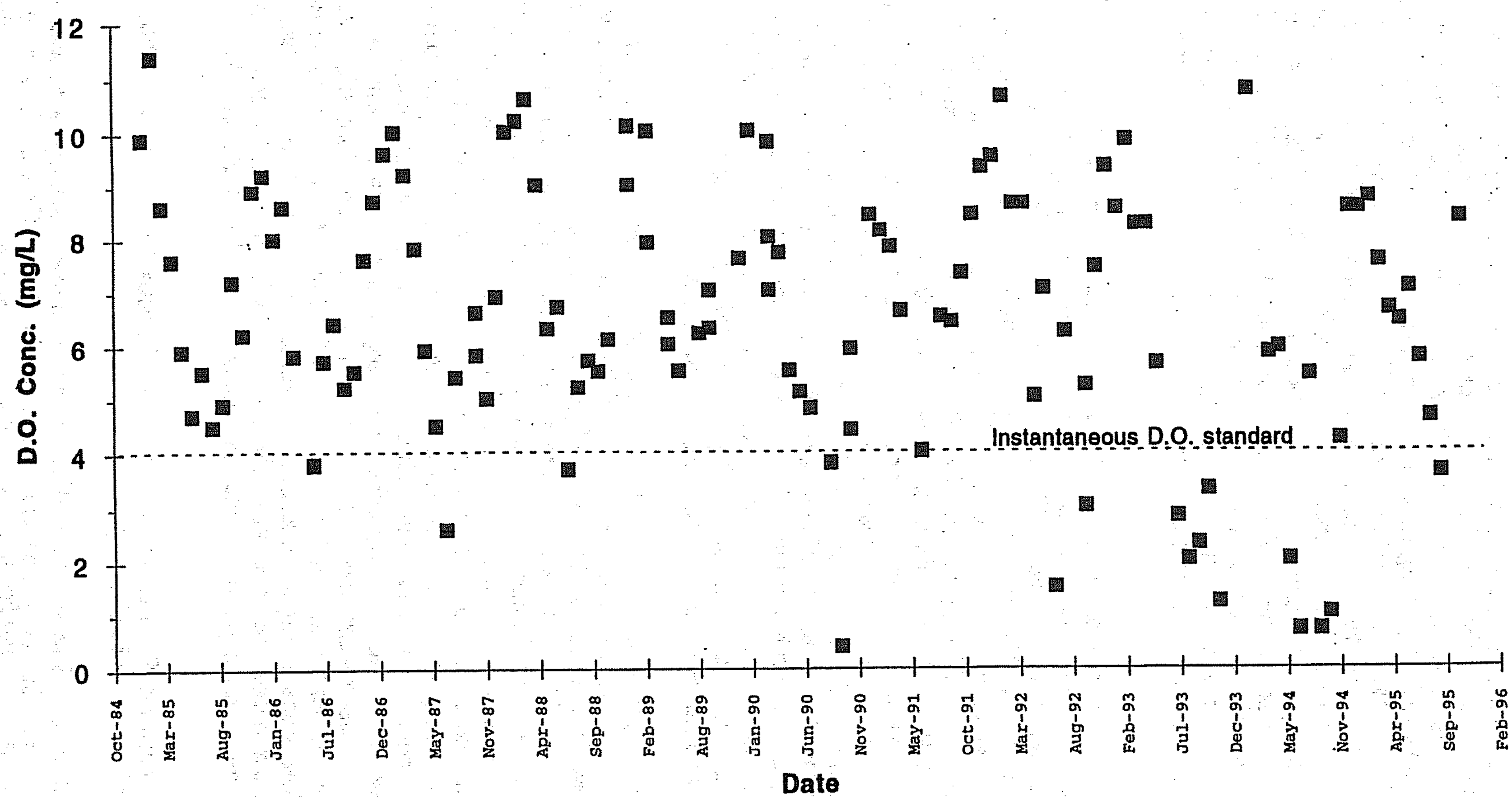
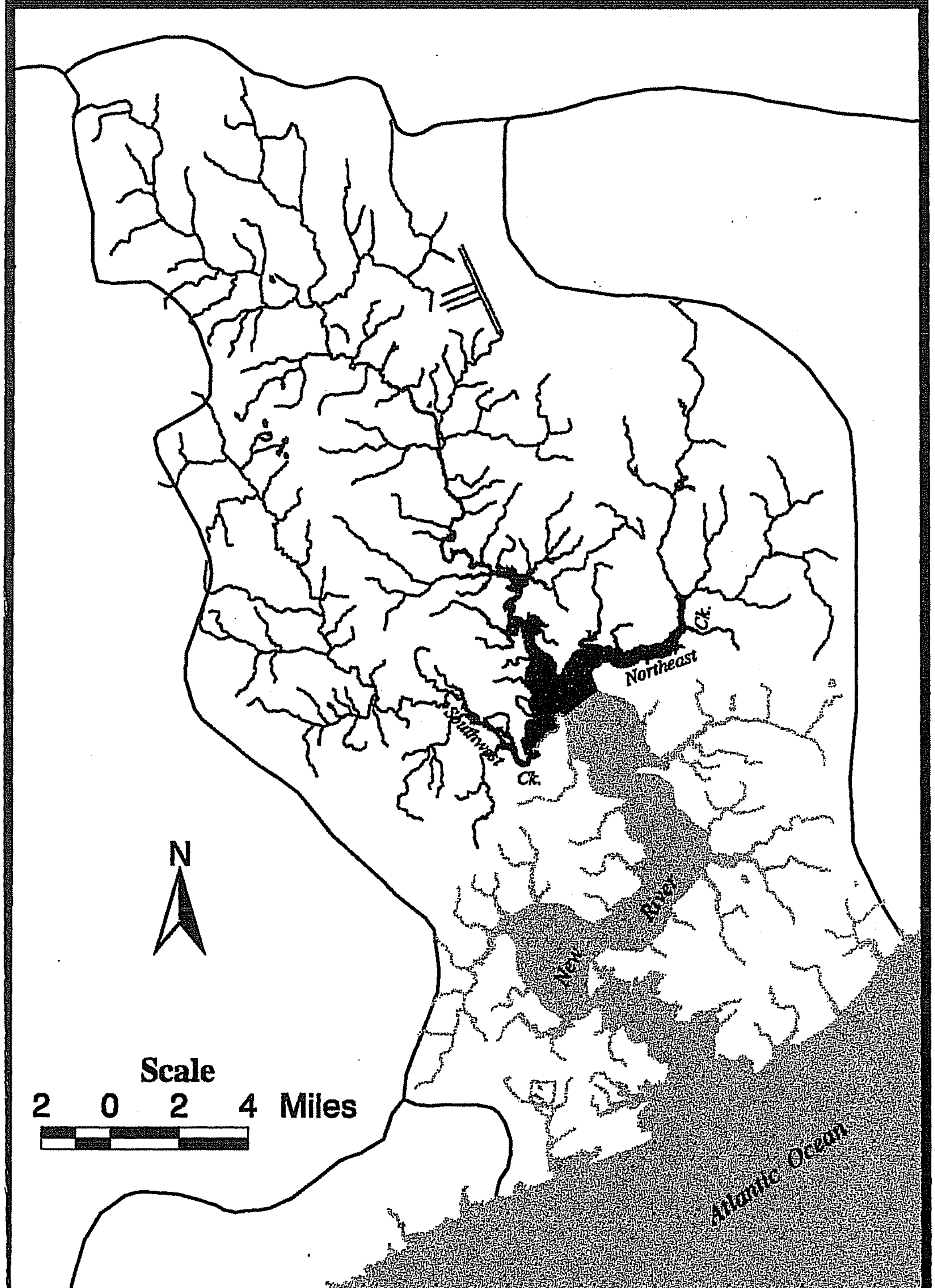
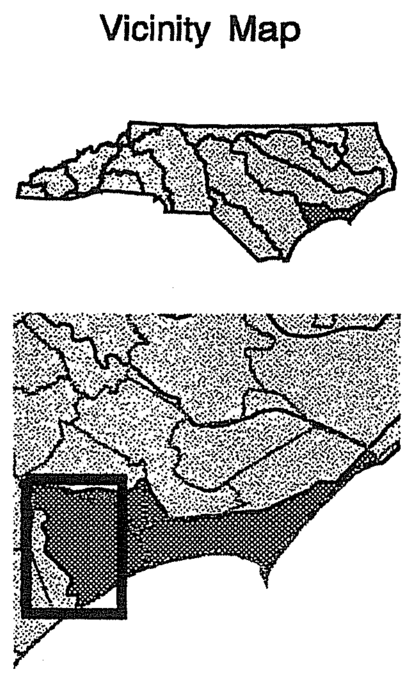


Figure 6.3. Little Northeast Creek instream dissolved oxygen concentrations: October 1984 - February 1996. Data collected at ambient station #0209317585.

Figure 6.4 Upper New River Basin Management Area





Legend

- No additional loading of oxygen consuming wastes is recommended to these streams.
- New or expanding discharges to the lower New River and its tributaries will be considered on a case-by-case basis. New or expanding discharges of domestic wastes are not allowed to SA waters.
- ☐ Subbasin Boundary

DEHNR

Produced by:
Instream Assessment Unit
Water Quality Section
June 1996

been measured in Calico Creek. The eutrophic conditions in Calico Creek can be attributed to impacts from the Morehead City discharge and urban stormwater runoff. Since the waters surrounding Morehead City are classified as SA, the City has few options for an alternative discharge location. To address this problem, as well as the wastewater disposal needs of the surrounding area, a four county regional task force has been formed to evaluate the feasibility of regionalized wastewater treatment in Onslow, Carteret, Craven, and Pamlico Counties. Removal of the Morehead City discharge to Calico Creek is recommended as soon as a practical alternative is available. As an interim measure Morehead City is encouraged to evaluate and optimize its treatment units to ensure the maximum removal of oxygen consuming wastes from its effluent. If removal is not a future option, advanced tertiary limits with nutrient removal are recommended for the facility.

Low instream DO concentrations have also been recorded in the Newport River near Newport. Although the City of Newport discharges its wastewater to the Newport River instream DO measurements indicate that the discharge is having a minimal impact. The low instream DO concentrations observed in the Newport River can most likely be attributed to swamp waters naturally low in DO draining to the mainstem.

Taylor Creek receives wastewater from two major dischargers, the Town of Beaufort WWTP and Beaufort Fisheries, Inc. Frequent measurements of DO concentrations below 5 mg/L have been recorded near the Beaufort WWTP outfall during the summer. Dye studies in Taylor Creek indicate that it is a very well flushed, tidally influenced stream. The studies do suggest however that effluent from the Beaufort WWTP may hang along the north shore. The Beaufort WWTP has a history of very good removal of BOD5 and ammonia. In addition, Beaufort Fisheries disposes of its highest strength wastewater, known as stickwater, out to sea. Therefore, due to the tidal flushing of Taylor Creek, it is likely that the substandard DO concentrations measured near the Beaufort WWTP outfall are a very localized phenomenon. Widespread water quality problems in Taylor Creek are unlikely to develop as a result of these discharges under their current treatment practices.

In this subbasin, western Bogue Sound and the waters around the Theodore Roosevelt State Natural Area have been designated as ORW. In the Bogue Sound ORW area, the only type of new or expanded wastewater discharges allowed are non-domestic or non-process industrial discharges, and a public hearing is mandatory for these proposals. In the Theodore Roosevelt Natural Area ORW, a public hearing must be conducted for any proposed discharge permits.

6.8.6 Recommended Strategies for Oxygen Consuming Wastes in the North River Watershed (Subbasin 04)

Water quality is this subbasin is generally very good. There are only two minor dischargers of oxygen consuming wastes in the subbasin, Sea Level Extended Care Facility and The Sailor's Snug Harbor. Both facilities discharge to Nelson Bay. These two dischargers appear to be having no measurable impact to the water quality in Nelson Bay.

The ambient station on Broad Creek near Masontown has recorded occasional DO violations as low as 0.4 mg/L as discussed in section 6.3. Broad Creek receives agricultural runoff from Open Grounds Farm. The sporadic DO violations may be the result of localized eutrophication problems within the creek.

6.8.7 Recommended Strategies for Oxygen Consuming Wastes in Subbasin 05.

There are no NPDES permitted dischargers in the subbasin. The entire subbasin has been classified as Outstanding Resource Waters. The ORW classification prohibits new wastewater discharges in the subbasin.

6.9 MANAGEMENT STRATEGIES FOR URBAN STORMWATER CONTROL

6.9.1 NPDES Stormwater Management

There are no municipalities in the White Oak River Basin that are currently required to obtain municipal NPDES permits for the management of stormwater runoff within their jurisdiction. (Some municipalities may have municipally-owned industrial activities that do require permitting).

Throughout the White Oak Basin, various types of industrial activities with point source discharges of stormwater are required to be permitted under the NPDES stormwater program. These include activities related to manufacturing, processing, materials storage areas and construction activities with greater than five acres of disturbance. All of those areas requiring coverage must develop Stormwater Pollution Prevention Plans (SWPPP) to minimize and control pollutants discharged from their stormwater systems. These SWPPPs are subject to review and modification by the permitted facilities and DWQ to assure that management measures are appropriate.

6.9.2 Recommendations for Controlling Stormwater Impacts by Local Governments Not Subject to NPDES Stormwater Requirements

For local governments that are not currently required to develop stormwater programs but where urban stormwater impacts have been identified and/or where urban water quality is of concern to local citizens, there are several basic steps, listed below, that could be undertaken at relatively low cost to help control urban stormwater pollution.

- Mapping of municipal storm sewer systems and outfall points, and developing procedures to update this information.
- Developing programs to locate and remove illicit connections (illegal discharge of non-stormwater materials) to the storm sewer system. These often occur in the form of floor drains and similar connections.
- Evaluating existing land uses in the local government's jurisdictional area to determine where sources of stormwater pollution may exist. In addition, local government activities and programs could be evaluated to determine where existing activities address stormwater management in some way, or could be modified to do so. In practice, stormwater management programs represent an area where local governments can develop their own ideas and activities for controlling sources of pollution.
- Developing educational programs to inform citizens of activities that may contribute pollutants to stormwater runoff (dumping oil, paint or chemicals down storm drains, inappropriate use of pesticides and fertilizers, etc.) and offering ways of carrying out such activities in an environmentally sound manner. Storm drain stenciling is a good example of a low cost educational tool.
- Reviewing local ordinances pertaining to parking, curb and gutter and open space requirements. Many of these local ordinances could be modified to enhance water quality protection from urban stormwater runoff impacts by minimizing impervious area, encouraging use of natural drainage patterns, grassed swales and landscaped areas for stormwater control. Maintaining riparian buffer strips along streams is an example.

Wetlands can be created along streams in urbanized areas of the watershed to receive stormwater runoff. In many cases, natural wetlands already serve as water treatment systems for agricultural and urban runoff. Water quality parameters including nutrients, heavy metals, pesticides, organics, and other chemical constituents can be affected by passage through a wetland (Bastion and Benforado 1988). When transported into a wetland, pollutants can be removed by burial, chemical breakdown, and/or assimilation into plant tissue. Careful design of these systems is needed in order to adequately handle the altered hydraulics of urban areas.

DWQ's urban stormwater staff and the Land-of-Sky Regional Council of Governments conducted a series of stormwater workshops across the state in 1995 for the benefit of local governments and others on addressing urban stormwater pollution. DWQ can provide additional information to interested local governments or can provide references of other local governments in the state that are undertaking programs on their own. Below is a list of available literature prepared by the NC Cooperative Extension Service, the Land-of-Sky Regional Council and DWQ. Also, there is currently a document in preparation to provide assistance to local governments and developers in the development of stormwater management measures during the planning and design stages of a project. This document should be available toward the end of 1996.

- *Stormwater Management Guidance Manual,* 1993, Cooperative Extension Service (NCSU)
- *Stormwater Management in North Carolina: A Guide for Local Officials*, 1994, Land-of-Sky Regional Council, Asheville, NC (Eaker, 1994)
- Stormwater Fact Sheets by Land-of-Sky Regional Council, 1994
  1) *Stormwater Problems and Impacts: Why all the Fuss?*
  2) *Stormwater Control Principles and Practices*
  3) *Stormwater Management Roles and Regulations*
  4) *Local Stormwater Program Elements and Funding Alternatives*
- *Stormwater Best Management Practices*, 1995, NC Division of Environmental Management

6.10 MANAGEMENT STRATEGIES FOR WASTE FROM ANIMAL OPERATIONS

DWQ is currently pursuing a number of efforts to improve the management of waste generated from animal production operations and has been monitoring the deliberations of the General Assembly on proposed animal waste laws. These efforts are both new and ongoing and will work toward the goal of eliminating the contribution of animal waste into North Carolina's surface waters. They include the implementation and enforcement of animal waste management regulations and the training and certification of operators of animal waste systems. Detailed descriptions of these programs have been provided in Chapter 5. DWQ will continue implement these efforts, some of which were precipitated by a number of lagoon failures that occurred during the rainy summer of 1995. The largest of these spills occurred in the New River Drainage portion of the White Oak River Basin.

6.11 TOXIC SUBSTANCES

While toxicants have not been identified as a major cause of water quality impairment in the White Oak basin, there are a number of programs underway that intended to prevent significant problems from occurring.

North Carolina has adopted standards and *action levels* for several toxic substances. These are contained in 15A NCAC 2B .0200. Usually, limits are not assigned for parameters which have action levels, such as copper, unless monitoring indicates that the parameter may be causing toxicity or federal guidelines exist for a given discharger for an action level substance. This process of determining action levels exists because these toxic substances are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics and/or associated waste characteristics. Water quality-based limits may also be assigned to a given NPDES permit if data indicate that a substance is present for which there is a federal criterion but no state water quality standard.

Whole effluent toxicity (WET) testing is required on a quarterly basis for all major dischargers (≥1 MGD) and any discharger releasing complex (industrial) wastewater. There are 11 such dischargers in the White Oak River Basin. A complete listing of these facilities is included in Appendix II. This test shows whether the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity. If the effluent is found to be toxic, further testing is done to determine the specific cause. This follow-up testing is called a *toxicity reduction evaluation* (TRE). WET testing is discussed in Sections 4.2.4 and 5.2.5 of Chapters 4 and 5, respectively.

Metals

Municipal and industrial dischargers along with urban runoff, and possibly atmospheric deposition, are the main sources of metals contamination in surface water. North Carolina has stream standards for many heavy metals. The most common metals limited in municipal permits are cadmium, chromium, nickel, lead, mercury, silver and zinc. Each of these is monitored at the 21 ambient monitoring stations in the basin along with aluminum and arsenic. Point source discharges of metals are controlled through the NPDES permit process. Mass balance models (Appendix III) are employed to determine appropriate limits. Municipalities with significant industrial users discharging wastes to their treatment facilities limit the heavy metals coming to them from their industries through their *pretreatment program* (there are no municipalities in the White Oak basin with a pretreatment program). Source reduction and wastewater recycling at WWTPs also reduces the amount of metals being discharged to a stream. Nonpoint sources of pollution are controlled through best management practices.

Chlorine

Chlorine is commonly used as a disinfectant at NPDES discharge facilities which have a domestic (i.e., human) component. These discharges are a major source of chlorine in the State's surface waters. Chlorine dissipates fairly rapidly once it enters the water, but it can have significant toxic effects on sensitive aquatic life such as trout and mussels. North Carolina has adopted a freshwater standard for trout waters of 17 ug/l (micrograms per liter). For all other waters an action level of 17 ug/l is applied to protect against chronic toxicity. It is recommended that new and expanding discharges provide dechlorination or alternate disinfection of wastewater. A total residual chlorine limit is assigned based on the freshwater action level of 17 ug/l or a maximum concentration of 28 ug/l for protection against acute effects in the mixing zone. Federal guidelines for residual chlorine of 8 ug/l for chronic effects and 13 ug/l for acute effects are used in saltwaters. In 1993, letters were sent to existing facilities with chlorine monitoring requirements. These letters encouraged permittees to examine their effluent chlorine levels and noted that limits may be implemented in the future. At this time, the State requires chlorine limits for all trout waters and any new or expanding facilities using chlorine for disinfection.

Ammonia (NH_3)

Point source dischargers are one of the major sources of ammonia. In addition, decaying organisms which may come from nonpoint source runoff and bacterial decomposition of animal waste products also contribute to the level of ammonia in a waterbody. At this time, there is no numeric standard for ammonia in North Carolina. However, DWQ has agreed to address ammonia toxicity through an interim set of instream criteria of 1.0 mg/l in the summer (April - October) and 1.8 mg/l in the winter (November - March). Currently, limits will be given no less than 2 mg/l in summer and 4 mg/l in winter, unless dissolved oxygen problems or modeling analysis dictate stricter limits. These interim criteria are under review, and the State may adopt a standard in the future.

6.11.1 Assimilative Capacity

The assimilative capacity (that is, the amount of a substance a waterbody can assimilate under designated flow conditions) available for toxicants in the White Oak basin varies from one waterbody to another. In streams, the 7Q10 is used as the flow condition for aquatic life based standards, while average flow is used for carcinogens. In larger streams where more dilution flow exists there is more assimilative capacity for toxics. In areas with little dilution, facilities will receive chemical specific limits which are close to the water quality standard. In estuarine waters assimilative capacity can be difficult to determine since it is generally dependent on tidal forces, wind-driven mixing and proximity to inlets and not primarily on freshwater discharge. Toxics from nonpoint sources typically enter a waterbody during storm events. All waters must be protected from both immediate acute impacts and longer term chronic effects.

6.11.2 Control Strategies

Chemical specific toxics limits and monitoring requirements for point source dischargers will be determined using the techniques discussed in the Instream Assessment Unit's Standard Operating Procedures manual and discussed in Appendix III of this report. These methods utilize an EPA recommended approach which considers the maximum predicted effluent concentration and the amount of variation in effluent monitoring data. Whole effluent toxicity limits are assigned to all major dischargers and to any discharger of complex wastewater.

Nonpoint source strategies being implemented through the industrial NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters. Agricultural BMPs implemented to reduce nutrient and sediment loading from cropland are likely to result in lower pesticide inputs.

6.12 MANAGEMENT STRATEGIES FOR CONTROLLING SEDIMENT

Sedimentation has not been identified as a source of stream impairment in the White Oak River Basin. However, sedimentation is a potential widespread nonpoint source-related water quality problem which results from land-disturbing activities. The most significant of these activities include agriculture and land development (e.g., highways, shopping centers, and residential subdivisions). For each of these major types of land-disturbing activities, there are programs being implemented by various government agencies at the state, federal and/or local level to minimize soil loss and protect water quality.

Some control measures, principally for construction or land development activities of 1 acre or more, are required by law under the state's Sedimentation and Erosion Control Act administered by the NC Division of Land Resources. For activities not subject to the act such as agriculture, erosion and sediment controls are carried out on a voluntary basis through programs administered by several different agencies. The NC Agricultural Cost Share Program administered by the NC Division of Soil and Water Conservation provides incentives to farmers to install best management practices (BMPs) by offering to pay up to 75% of the average cost of approved BMPs. A federal Farm Bill program administered by the Natural Resource Conservation Service provides an incentive not to farm on highly erodible land (HEL) by taking away federal subsidies to a farmer that fails to comply with the provision.

The NC Agricultural Cost Share Program funding totals for 1985 through 1994 are presented in Table 6.5 (next page). Table 6.5 presents expenditures by subbasin within the White Oak basin. The cost share figures include a wide array of BMPs including conservation tillage, terraces, diversions, critical area plan, sod-based rotation, crop conservation grass, crop conservation trees, filter strip, field border, grass waterway, water control structure and livestock exclusion.

No sediment control measures are 100% effective so some level of sedimentation is expected as long as land-disturbing activities occur. But there are still additional improvements that can be made. Education and promotion of stewardship are keys to improvement along with judicious strengthening of regulations and enforcement.

Table 6.5. Summary of NC Agricultural Cost-Share Program Expenditures in the White Oak River Basin, Program Inception (1988) Through FY96.

PRACTICE	QUANTITY				ACSP PAYMENT ($)			
	Carteret	Jones	Onslow	Total	Carteret	Jones	Onslow	Total
EROSION/NUTRIENT CONTROL MEASURES								
Conservation Tillage (ac.)	198	0	21	219	1,980	0	210	2,190
Diversions (ft.)	2500	0	0	2,500	866	0	0	866
Critical Area Planting (ac.)	0	0	54	54	0	0	28,970	28,970
Sod-Based Rotation (ac.)	34	36	200	270	1,737	3,240		23,317
Cropland Conservation - Grass (ac.)	0	0	560	560	0	0	66,961	66,961
Cropland Conservation - Trees (ac.)	0	0	27	27	0	0	2,929	2,929
Grade Stabilization Structures	1	0	0	1	3,467	0	0	3,467
SEDIMENT/NUTRIENT CONTROL MEASURES								
Filter Strip (ac.)	1.5	0	0	1.5	430	0	0	430
Field Border (ac.)	.8	.5	3.0	4.2	1,399	631	5,516	7,546
Grassed Waterway (ac.)	2.4	.2	6.3	9	1,983	345	10,395	12,723
Water Control Structures	8	6	2	16	5,884	4,278	1,602	11,764
ANIMAL WASTE MANAGEMENT MEASURES								
Number Swine Served	350	0	38,069	38,419				
Waste Lagoons	2	0	20	22	14,938	0	170,865	185,803
Retrofits	0	0	3	3	0	0	23,150	23,150
ANIMAL WASTE LAND APPLICATION MEASURES								
Number Swine Served	350	0	36,985	37,335				
Number Poultry Served	0	0	938,800	938,899				
Application Area (ac.)	8	0	3,684	3,692				
Liquid Application (gal. hog/dairy waste)	0	0	6.0×10^6	6.0×10^6	0	0	12,000	12,000
Dry Waste Application (tons litter)	0	0	10,765	10,765	0	0	45,262	45,262
Solid Set Irrigation Equipment	2	0	7	9	20,282	0	86,429	106,711
Dry Hydrant Irrigation Equipment	0	0	3	3	0	0	17,375	17,375
GRAND TOTALS								
Acres Farmland Affected	1,294	151	5,114	6,559				
Tons Soil Saved	6990	518	8,843	16,351				
Number of Contracts	29	9	206	244				
Total Payments					52,946	8,494	480,032	541,472

Sediment and soil stabilizing values of wetlands cannot be ignored when developing an NPS pollution control strategy. The same characteristics important for nutrient removal and transformation are important for physical removal of sediments. Therefore, the previous discussion on nutrient removal and transformation in this chapter also addresses strategies for controlling sedimentation.
The role of riparian wetlands in sediment removal is based on their opportunity and ability to receive and retain sediment, respectively. Approximately 41% of the White Oak River Basin's use-impaired stream miles are impacted by agriculture. Riparian wetlands in predominantly agricultural watersheds have more opportunity to receive sediments and, therefore, play an essential role controlling sedimentation in the current landscape. Headwater wetlands and bottomland hardwood forest wetlands are ideally located in the watershed to perform sediment retention functions. In the White Oak basin, bottomland hardwood and swamp forests in the coastal plain can retain sediments not held by headwater wetlands. The preservation of the riparian forested wetlands is critical to controlling sedimentation.

In addition to protecting wetlands for their NPS pollution abatement value, the creation and restoration of forested wetland buffer strips should continue to be encouraged through existing sedimentation control programs, both voluntary and regulatory. These programs include the Agricultural Conservation Program, Watershed Protection and Flood Prevention Program, the Sedimentation and Erosion Control Program, the 404 Permit/401 Water Quality Certification Program. In a non-sensitive watershed, a forested wetland buffer strip of 25 ft on each side of an intermittent stream would provide a reasonable level of protection from sedimentation. For perennial streams, a forested wetland buffer of 50 ft would provide sufficient safeguards. In sensitive watersheds, additional protection, such as doubling the width of the buffer strips, may be required to provide sufficient sedimentation control (DEM 1993). In addition, the Division of Forest Resources have Best Management Practices for forested wetlands that should be followed to control silvicultural impacts.

Recommendations for Improving Erosion and Sediment Control

- Continue to promote effective implementation and <u>maintenance</u> of erosion and sediment control measures by contractors, developers, farmers and other land owners. Even the best-designed plans will not work if those responsible for maintaining silt fences, ground cover, settling ponds, grassed waterways, etc. are not carrying out those responsibilities either due to lack of understanding or carelessness.
- Evaluate effectiveness of enforcement of existing sediment control programs.
- Encourage more widespread adoption of erosion and sediment control programs by local governments, especially in rapidly developing areas. Coastal counties can include recommendations to address erosion and sedimentation in development of land use plans under the Coastal Area Management Act. Other city and county governments that have not adopted programs can be still become involved through local education efforts, maintaining publicly-owned lands, and coordinating with other agencies such as local soil and water conservation districts and NC Division of Land Resources to identify and correct problems.
- Promote public education at the state and local level on the impacts of sedimentation and the need for improved sediment control. The cumulative effects of a number of small projects can significantly degrade water quality and habitat downstream.
- Evaluate existing sedimentation and erosion control rules and statutes for possible strengthening at the state and local level. Examples include limiting the area of disturbed land on a given site and reducing the time period for reestablishing vegetation on denuded areas.
- Maintaining vegetated stream buffers along fields and in urban areas is an excellent means of controlling sedimentation and other nonpoint source pollution.

Appendix V provides a list of agencies and corresponding contacts that can be used to obtain technical assistance to implement the above recommendations.

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CHAPTER 7

FUTURE INITIATIVES

7.1 OVERVIEW OF WHITE OAK BASINWIDE GOALS AND OBJECTIVES

Near-term objectives, or those achievable at least in part during the next five years, include implementing the strategies, or TMDLs (total maximum daily loads) outlined in Chapter 6 to reduce point and nonpoint source loadings of BOD, nutrients and other pollutants. These steps are necessary to progress towards restoring impaired waters, protecting high resource value and biologically sensitive waters and maintaining the quality of other waters currently supporting their uses.

The long-term goal of basinwide management is to protect the water quality standards and uses of the basin's surface waters while accommodating reasonable economic growth.

Attainment of these goals and objectives will require determined, widespread public support; the combined cooperation of state, local and federal agencies, agriculture, forestry, industry and development interests; and considerable financial expenditure on the parts of all involved. However, with the needed support and cooperation, DWQ believes that these goals are attainable through the basinwide water quality management approach.

7.2 FUTURE ACTIVITIES IN THE WHITE OAK RIVER BASIN

7.2.1 Specific Areas in Need of Management Strategies - Closed Shellfish Waters

One of the White Oak River Basin's most important resources is its shellfishing waters. As with other coastal areas, shellfish closures have been increasing in this basin. Many sources of contamination have contributed to these closures. Fecal coliform bacteria originate from a variety of sources governed by numerous governmental agencies and interest groups. Therefore, management of shellfish resources will have to be a coordinated effort among all of these parties.

The recommendations made in Chapter 6 will need to be implemented in the context of a strong sampling program in order to measure the effectiveness of applied management strategies. In addition, it may be necessary to reevaluate the current Stormwater Management Rules that are applied in the 20 coastal counties as well as the management strategies applied in coastal ORW and HQW areas. These measures have been in place for several years, but North Carolina continues to experience an increase in areas closed to shellfish harvesting. Revisions have been made to these rules recently (late 1995) to address some areas of the rules, but it is too early to judge their effectiveness.

The Use Restoration Waters approach to water quality management will also be an appropriate avenue to address problems in areas where there is a shellfish resource but the waters are closed to harvesting due to fecal coliform contamination.

The Use Restoration Waters (URW) strategy, currently being developed by DWQ staff, is a new approach to restoring waters which do not currently meet their uses. As now envisioned, the strategy would be used only where data have demonstrated that the impairment is persistent and not transitory, that the causes and sources of impairment are known, and that these can be adequately controlled using strategies implemented under existing EMC authority. A site specific study would be required, with strategies developed in coordination with a team of stakeholders. Both point sources and nonpoint sources could be targeted, using a site specific mixture of voluntary and regulatory methods, as appropriate to the situation. The concept could be implemented either as a new supplemental classification or as a focused, coordinated non-regulatory effort for particular waterbodies. If the regulatory pathway is followed, formal rule-making procedures, including public hearings, would be undertaken for the establishment of the rules and subsequently for each waterbody to which the strategy is applied.

While the precise actions implemented under the URW approach will depend on site-specific requirements, the South River study (NCDEM 1994) listed numerous examples of actions which could be considered. Some examples are listed below.

For all land uses:
- control structures on drainage ditches and small tributaries
- restoration of stream buffers
- frequent inspections

Developed areas:
- performance testing of all on site septic systems under worst hydrographic conditions and remediation of any problems identified
- vegetated buffer requirement for all new development
- new septic system siting criteria where appropriate
- investigate mandatory installation of water conservation devices to minimize generation of effluent

For agricultural land:
- mandatory vegetated buffers along main ditches
- fencing along ditches through pasture land
- limitation on density of grazing stock
- implementation of applicable BMPs (conservation tillage, stock trails, etc.)

Forestry operations:
- notification of land clearing or logging
- mandatory streamside management zones along all drainage ways
- BMPs for logging in wetlands

7.2.2 Regionalization of Wastewater Treatment

As has been mentioned elsewhere in this document, four counties in the White Oak River Basin area (Carteret, Craven, Onslow and Pamlico) have formed the Regional Wastewater Task Force to investigate long term wastewater treatment management alternatives at a regional level. This group has recently decided on 6 possible alternatives to present to the local public for their input. Meetings on these alternatives were held in May of 1996. The following provides a short description of the alternatives that were presented for consideration.

1) Status Quo - Under this scenario unincorporated areas will continue to be served by septic tanks and existing centralized plants will only be upgraded as necessary to meet demands of population growth and comply with changing regulations.

2) Consolidation of Existing Facilities with Continued Surface Water Discharge - With this option, no additional wastewater treatment facilities would be built, but some existing package plants and wastewater treatment plants would be decommissioned and the rest of the plants would be upgraded to handle their flow.

3) Ocean Outfall Discharge - Under this scenario, one 44 MGD ocean outfall would discharge effluent from all treatment plants into the Atlantic Ocean in the Bear Island Area.

4) Multiple Wastewater Treatment Plants with Two Ocean Outfalls - This option proposes that treated effluent from facilities in the four counties be piped to two ocean outfalls for discharge into the Atlantic Ocean. One outfall would be in the Bear Island Area and one would be in the Core Banks area.

5) Maximum Water Reuse - Under this scenario, wastewater flows adjacent to locations of potentially high water reuse would be consolidated. Primary reuse options considered would be golf course irrigation, wetlands restoration and forest land application. Long term options for consideration would include deep well injection and potentially potable reuse.

6) Maximum Use of Natural Systems - This option would use predominantly natural systems for effluent polishing and disposal after secondary treatment. The primary options would be land application followed by wetlands treatment and restoration as a secondary option.

As mentioned above, these are alternatives being considered by the four-county Regional Wastewater Task Force. They are being presented to the public for comment. Final recommendations from the Task Force are expected in 1996.

DWQ supports the upgrade and consolidation of waste treatment systems, especially in areas such as the White Oak River Basin where failing septic systems and package plants contribute to water quality degradation. DWQ will continue to work with the Task Force to support them in identifying the most feasible long term treatment alternatives for the four-county area.

7.2.3 NPDES Program Initiatives

In the next five years, efforts will be continued to:

- improve compliance with permitted limits;
- improve pretreatment of industrial wastes to municipal wastewater treatment plants so as to reduce the toxicity in effluent wastes;
- encourage pollution prevention at industrial facilities in order to reduce the need for pollution control;
- require dechlorination of chlorinated effluents or use of alternative disinfectants;
- require multiple treatment trains at wastewater facilities; and
- require plants to begin plans for enlargement well before they reach capacity.

Longer-term objectives will include refining overall management strategies after obtaining feedback on current management efforts during the next round of water quality monitoring. Long-term point source control efforts will stress reduction of wastes entering wastewater treatment plants, seeking more efficient and creative ways of recycling byproducts of the treatment process (including nonpotable reuse of treated wastewater), and keeping abreast of and recommending the most advanced wastewater treatment technologies.

7.2.4 Nonpoint Source Control Strategies and Priorities/Nutrient Reduction Efforts

Improving our knowledge of and controlling nonpoint source pollution will be a high priority over the next five years. Nonpoint source pollution accounts for the majority of impaired waters in the White Oak River Basin. There are several initiatives underway to address the protection of surface waters from nonpoint sources of pollution. Three of these are discussed below.

- Establishment of nonpoint source basin teams in each basin. DWQ has begun setting up nonpoint source teams in each of the state's 17 major river basins. These teams will have representatives from agriculture, urban stormwater, construction, mining, on-site wastewater disposal, forestry, solid waste, wetlands, groundwater, the League of Municipalities and wildlife organizations. These teams will provide descriptions of NPS activities within a basin, conduct assessments of NPS controls in targeted watersheds, identify future monitoring sites, develop five-year action plans for NPS pollutants, and develop Section 319 project proposals for targeted watersheds.
- Promote wetlands protection. Future management strategies will be targeted at protecting and maintaining the water quality functions of wetlands and encouraging their use for nonpoint source pollution abatement. This will include the promotion of wetland acquisition and restoration by state, federal, and local government agencies and national, regional, and local land trusts.
- Interagency Water Quality Monitoring. DWQ has begun the process of coordinating with other natural resource agencies on the idea of interagency water quality monitoring across the state. There is a need for more widespread monitoring data in order to better assess water quality, identify trends, improve water quality modeling capabilities and assure an ample supply of high quality water for aquatic life support, water supply and recreation.

7.2.5 Future Monitoring Priorities

Monitoring of the chemical and biological status of receiving waters will provide critical feedback on the success of the basin management strategy. As discussed in Chapter 4, monitoring data will be collected from (1) ambient water chemistry, (2) sediment chemistry, (3) biological communities, (4) contaminant concentrations in fish and other biota, (5) ambient toxicity, and (6) facility self-monitoring data. The specific parameters measured will relate directly to the long-term water quality goals and objectives defined within the basinwide management strategy.

7.2.6 Water Quality Education for Local Officials (WQ-ECO)

Water Quality Education for Local Officials (WQ-ECO) is a pilot program of the North Carolina State University Cooperative Extension Service that seeks to help local officials understand water quality problems in their region and develop management and policy initiatives to address those problems. WQ-ECO is tailored after the Nonpoint Education for Local Officials (NEMO) program of the University of Connecticut Extension Service.

The watershed of the White Oak River is the location for the pilot effort for this program. Currently, an advisory committee of local citizens, land owners, commercial fishermen, farmers, business people and local government officials is being formed. The first meeting of the advisory board is planned for July 25, 1996.

The educational effort is regionally consistent with basinwide management but is focused on developing solutions that are locally specific. To do this, environmental characteristics of the basin, such as land use/land cover, topography, soils, water quality data, stream order, demographics and aquatic habitats are mapped and analyzed using geographic information systems. These analyses identify areas that may need special consideration or management strategies. Policy options are then developed based on regional guideline to address local conditions and issues.

7.3 FUTURE PROGRAMMATIC INITIATIVES

7.3.1 Improved Monitoring Coverage: Citizen Monitoring and Coordination with Other Agencies

DWQ is undertaking a couple of efforts to improve the amount of information that is generated about the quality of waters in the state. Currently, a citizen monitoring program is being developed for areas in the Neuse River Basin. This will serve as a pilot for future citizen monitoring programs in other river basins. Volunteers will be trained in sampling methods and appropriate analytical techniques so that they can help DWQ get a wider picture of water quality conditions in particular basins. Workshops for future monitors will be conducted for the Neuse River Basin in June of 1996. Data and interpretations from that information will be included in future basinwide assessment reports and plans.

In addition to this, DWQ and other environmental agencies have been discussing the potential for coordination of field resources. If individuals from another environmental agency are visiting certain waterbodies to investigate fish populations or wetland areas, they could also collect water quality data from these areas. The coordination of these activities should help to better blend the activities of the various agencies.

7.3.2 Wetland Restoration Program

The 1996 NC General Assembly established a wetland restoration program in this state. As this program is implemented, North Carolina will begin a concentrated effort to inventory and digitally map wetlands throughout the state. As the program progresses, it is envisioned that a conservation plan will be developed for each river basin and incorporated into the basinwide planning process. Through this, the water quality protection function of wetlands can be used more effectively in areas prioritized during basinwide planning.

7.3.3 Clean Water Management Trust Fund

A new initiatives passed by the 1996 General Assembly will help to rehabilitate hydrologically damaged watercourses. The new Clean Water Management Trust Fund will annually receive 6.5% of the year-end general fund credit balance to help finance projects within the broadly focused areas of restoring and protecting state surface waters and establishing a network of riparian buffers and greenways. Based on historical balances, this allocation could be as much as $40,000,000 annually. Monies will be used for the following water quality protection/restoration activities:

- to acquire land for riparian buffers to develop a network of riparian greenways;
- to acquire conservation easements or other interests in real property;
- to restore previously degraded lands;
- to repair failing waste treatment systems;
- to repair and eliminate failing septic tank systems;
- to improve stormwater controls and management practices; and
- to facilitate planning that targets reductions in surface water pollution.

This Fund holds significant promise for basinwide management, and particularly for nonpoint source water quality restoration efforts.

7.3.4 Further Evaluation of Swamp Systems

Many of the waterbodies in the eastern third of the State, including the White Oak River Basin, are classified as swamp waters. It is difficult to evaluate monitoring data in these systems to determine if a waterbody is impaired. For example, a swamp may have low dissolved oxygen concentrations, but these may be due to natural background concentrations rather than from impacts from point and nonpoint sources. DWQ will continue its efforts to evaluate these systems using chemical and biological data.

Currently, DWQ does not have a good tool to evaluate the ability of these waters to assimilate oxygen-consuming wastes as our desktop dissolved oxygen model assumes a steady-state, one-dimensional flow, and these conditions may not exist in swamp waters. In addition, data analyses from a previously studied system in the Lumber River Basin indicated that critical conditions in a swamp system are not necessarily during low flow conditions. Inadequate flow and water quality data prevent verification of the relationship between flow and dissolved oxygen in many of the tributaries classified as swamp waters.

Given the difficulty of determining assimilative capacity in these waters, DWQ has identified the need to develop a better tool to evaluate a swamp system's ability to assimilate waste flow. Since many swamp systems are very slow moving and naturally have low dissolved oxygen concentrations, the criteria by which impact is determined is currently being reevaluated. A work group has been formed in the Water Quality Section to determine wastewater impacts given various treatment capabilities and flow conditions in a swamp. Instream data above and below several facilities will be used as part of the study. The focus of the study is to evaluate discharge impacts during various hydrologic regimes within the swamps in question. Emphasis will be placed on data collected during high, low and medium flows and during a falling hydrograph event when swamp backwaters drain to the mainstem carrying potentially lower dissolved oxygen concentrations.

7.3.5 Use of Discharger Self-Monitoring Data

DWQ will continue to explore the possibilities of making greater use of discharger self-monitoring data to a greater degree to augment the data it collects through the programs described in Chapter 4. Quality assurance, timing and consistency of data from plant to plant would have to be addressed. Also, a system would need to be developed to enter the data into a computerized database for later analysis. One method of data collection that is currently being explored includes developing a comprehensive list of monitoring sites for the basin that would be monitored by an Association of NPDES dischargers with data input to STORET. A basinwide sampling program has been established for dischargers in the Neuse River Basin and to date appears to be successful.

7.3.6 Promotion of Non-Discharge Alternatives/Regionalization

DWQ requires all new and expanding dischargers to submit an alternatives analysis as part of its NPDES permit application. Non-discharge alternatives, including tying on to an existing WWTP or land-applying wastes are preferred from an environmental standpoint. If the Division determines that there is an economically reasonable alternative to a discharge, DWQ may recommend denial of the NPDES permit.

7.3.7 Coordinating Basinwide Management With the Construction Grants and Loans Program

The potential exists to use the basinwide planning process as a means of identifying and prioritizing wastewater treatment plants in need of funding through DWQ's Construction Grants and Loan Program. Completed basin documents are provided to this office for their use.

7.3.8 Improved Data Management and Expanded Use of Geographic Information System (GIS) Computer Capabilities

DWQ is in the process of centralizing and improving its computer data management systems. Most of its water quality program data including permitted dischargers, waste limits, compliance information, water quality data, stream classifications, and so on, will be put in a central data center which will then be made accessible to most staff at desktop computer stations. Much of this information is also being entered into the state's GIS computer system (Center for Geographic Information and Analysis or CGIA). As this and other information is made available to the GIS system, including land use data from satellite or air photo interpretation, and as the system becomes more user friendly, the potential to graphically display the results of water quality data analysis will be tremendous.

Research Triangle Institute performed a pilot study in the Tar-Pamlico River Basin in which high priority waterbodies for nonpoint source control programs were mapped. These maps were used by the various nonpoint source agencies for planning purposes. As resources become available, this tool will be developed for other basins.

APPENDIX I

Summary of North Carolina's Water Quality Classifications and Standards

Antidegradation Policy

Nutrient Sensitive Waters Rule

Nutrient Sensitive Water Management Strategy for the New River

High Quality Waters

Outstanding Resource Waters

Classifications and Water Quality Standards Assigned to the Waters of the White Oak River Basin

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS

PRIMARY CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS[1]	STORMWATER MANAGEMENT	OTHER REQUIREMENTS[2]
Freshwater:				
C (standards apply to all freshwaters, unless pre-empted by more stringent standard for more protective classification)	Secondary recreation (including swimming on an unorganized or infrequent basis); wildlife; fish and other aquatic life propagation and survival; agriculture and any other usage, except for primary recreation, water supply or other food-related ruses	Domestic and industrial wastewater dischargers allowed	Stormwater Management Rules apply in the 20 coastal counties as described in 15A NCAC 2H .1000	
B	Primary recreation (swimming on an organized or frequent basis) and all uses specified for Class C (and not water supply or other food-related uses)	Same as for Class C; wastewater treatment reliability requirements (dual train design; backup power capability) may apply to protect swimming uses (15A NCAC 2H .0124)	Same as for Class C	
WS-I Water Supply	Water supplies in natural and undeveloped watersheds	No point source discharges	Not applicable since watershed is undeveloped	No landfills; residual or petroleum contaminated soils application not allowed in the watershed
WS-II Water Supply	Water supplies in predominantly undeveloped watersheds	Only general permit wastewater discharges allowed in watershed	Local land management program required as per 15A NCAC 2B .0214; 6% built upon area in Critical Area; 12% built upon area in the Balance of the Watershed; up to 24% built upon area in the Critical Area and 30% in the Balance of the Watershed allowed with engineered stormwater controls for the 1" storm[3]	Buffers required along perennial waters; no new landfills allowed in the Critical Area and no new discharging landfills outside of Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area
WS-III Water Supply	Water supplies in low to moderately developed watersheds	General permits allowed throughout watershed; domestic and non-process industrial discharges allowed outside of the Critical Area	Local land management program required as per 15A NCAC 2B .0215; 12% built upon area in Critical Area; 24% built upon area outside of Critical Area; up to 30% in Critical Area and 50% built upon area outside Critical Area allowed with engineered stormwater controls for the 1" storm[3]	Buffers required along perennial waters; no new landfills allowed in the Critical Area and no new discharging landfills outside of the Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

PRIMARY CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS[1]	STORMWATER MANAGEMENT	OTHER REQUIREMENTS[2]
WS-IV Water Supply	Water supplies in moderately to highly developed watersheds	General permits, domestic and industrial discharges allowed throughout watershed[4]	Local land management program required as per 15A NCAC 2B .0216: 24% built upon area in Critical Area and Protected Area [5,6]; up to 50% in Critical Area and 70% built upon area outside Critical Area with engineered stormwater controls for the 1" storm[3]	Buffers required along perennial waters; no new landfills allowed in the Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area
WS-V Water Supply	Former or industrial use water supplies	No categorical restrictions on development or wastewater dischargers	Stormwater Management Rules apply in the 20 coastal counties as described in 15A NCAC 2H .1000	Instream water quality standards for water supply waters are applicable

NOTES: Please refer to 15A NCAC 2B .0101, .0104, .0202, .0211 and .0301 for more specific requirements for surface water supply protection.

1 Groundwater remediation discharges allowed when no alternative exists.

2 See attached tables: *Water Quality Standards for Freshwater Classes* and *Water Quality Standards for Saltwater Classes* for numeric standards associated with specific classes.

3 If the high density option is utilized engineered stormwater control systems must be designed for 85% TSS removal. Refer to Stormwater Management Rules (15 A NCAC 2H .1000) for specific design information.

4 New industrial process wastewater discharges in the Critical Area are allowed but must meet additional treatment requirements.

5 Applies to projects requiring an Erosion/Sedimentation Control Plan.

6 36% built-upon area is allowed for projects without a curb and gutter street system in the Protected Area.

- Critical area is 1/2 mile and draining to water supplies from normal pool elevation of reservoirs, or 1/2 mile and draining to a river intake.
- Protected Area is 5 miles and draining to water supplies from normal pool elevation of reservoirs, or 10 miles upstream of and draining to a river intake.
- Agricultural activities are subject to provisions of the Food Security Act of 1985 and the Food, Agriculture, Conservation and Trade Act of 1990. In WS-I watersheds and Critical Areas of WS-II, WS-III and WS-IV areas, agricultural activities must maintain a 10 foot vegetated buffer or equivalent control as determined by the Soil and Water Conservation Commission.
- Silviculture activities are subject to the provisions of the Forest Practices Guidelines Related to Water Quality (15A NCAC 1I .0101-.0209).
- The Department of Transportation must use BMPs as described in their document, "Best Management Practices for Protection of Surface Waters".

PRIMARY CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS	STORMWATER MANAGEMENT	OTHER REQUIREMENTS
Saltwater:				
SC	Saltwaters protected for secondary recreation, aquatic life propagation and survival and other uses as described for Class C	Domestic and industrial wastewater discharges allowed	Stormwater Management Rules (15A NCAC 2H .1000) apply to all waters in the 20 coastal counties; low density option: 30% built upon area or structural stormwater controls with higher density, as specified	
SB	Saltwaters protected for primary recreation and all Class SC uses (similar to Class B)	Same as Class SC; wastewater treatment reliability requirements (dual train design; backup power capability) may apply to protect swimming uses (15A NCAC 2H .0124)	Same as for Class SC	
SA	Shellfishing and all Class SC and SB uses	No domestic discharges and only non-process industrial discharges such as seafood packing houses or cooling water discharges	Same as for Class SC except low density option is 25% built upon area	

Supplemental Classifications are added to the primary classifications as appropriate (Examples include Class C-NSW, Class SA-ORW, Class B-Trout, etc.) and impose additional requirements.

SUPPLEMENTAL CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS	STORMWATER MANAGEMENT	OTHER REQUIREMENTS
HQW High Quality Waters	Waters rated as Excellent by DEM; Primary Nursery Areas; Native or Special Native Trout Waters; WS-I, WS-II and SA waters are HQW by definition	For new or expanded discharges advanced treatment requirements are: BOD_5=5 mg/l; NH_3-N= 2 mg/l; DO=6 mg/l	For projects requiring Erosion/ Sedimentation Control Plan and that are within 1 mile and draining to HQW waters: 12% built upon area or higher density with engineered structural controls allowed; WS-I, WS-II and 20 coastal counties exempt since stormwater control requirements already apply	Other treatment requirements may apply, dependent upon type of discharge and characteristics of receiving waters (see Antidegradation Policy: Rule 15A: NCAC 2B .0201)

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

SUPPLEMENTAL CLASSIFICATIONS	BEST USAGE	DISCHARGE RESTRICTIONS	STORMWATER MANAGEMENT	OTHER REQUIREMENTS
ORW Outstanding Resource Waters	Unique and special waters having exceptional water quality and being of an exceptional state or national ecological or recreational significance; must meet other conditions and have 1 or more of 5 outstanding resource value criteria as described in Rule 15A NCAC 2B .0225	Water quality must clearly maintain and protect uses, including outstanding resource values; management strategies must include at a minimum: no new or expanded discharges to freshwater ORWs; some discharges may be allowed in coastal areas	Same as for High Quality Waters for Freshwater ORWs; for Saltwater ORWs, development activities within a 575' buffer must comply with the low density option of the Stormwater Management Rules (generally 25% built upon area around SA waters and 30% around other waters)	Other management strategy components as described in 15A NCAC 2B .0225
TR Trout Waters	Protected for natural trout propagation and survival of stocked trout	Domestic and industrial wastewater discharges allowed with stricter treatment requirements		More protective standards for cadmium, total residual chlorine, chlorophyll-a, dissolved oxygen, turbidity and toluene to protect these sensitive species
NSW Nutrient Sensitive Waters	Waters needing additional nutrient management due to their being subject to excessive growth of microscopic and macroscopic vegetation	No increase of nutrients over background levels permitted; domestic and industrial wastewater discharges allowed	Nutrient management strategies developed on a case-by-case basis	Nutrient management strategies developed on a case-by-case basis
SW Swamp Waters	Waters with low velocities and other characteristics different from other waterbodies (generally, low pH, DO, high organic content)			pH as low as 4.3 and DO less than 5 mg/l allowed if due to natural conditions
FWS Future Water Supply	Waters designated for future water supply use	Discharge restrictions will be reflective of those of primary water supply classification	Stormwater management options will be reflective of those of primary water supply classification; not required until after FWS supplemental classification is removed	Requirements for landfill permits, NPDES wastewater discharges, land application of residuals and road construction activities in Critical Area and Balance of Watershed or Protected Area as appropriate (15A NCAC 2H .0101)

Water Quality Standards For Freshwater Classifications

August 2, 1995

Parameters (ug/l unless noted)	Aquatic Life	Human Health[1]	WS Classes[2]	Trout Waters	HQW	Swamp Waters
	Standards for All Freshwater *		Standards to Support Additional Uses			
Arsenic	50					
Barium			1000			
Benzene		71.4	1.19			
Beryllium	6.5	0.117	0.0068			
Cadmium	2.0			0.4		
Carbon tetrachloride		4.42	0.254			
Chloride	230000 (AL)		250000			
Chlorinated benzenes			488 (N)			
Chlorine, total residual	17 (AL)			17		
Chlorophyll *a*, corrected	40 (N)			15 (N)		
Chromium, total	50					
Coliform, total (MFTCC/100ml)[3]			50 (N)[4]			
Coliform, fecal (MFFCC/100ml)[3]		200 (N)				
Copper, total	7 (AL)					
Cyanide	5.0					
Dioxin		0.000000014	0.000000013			
Dissolved gases	(N)					
Dissolved oxygen (mg/l)	5.0[5]			6.0		(N)[6]
Fluoride	1800					
Hardness, total (mg/l)			100			
Hexachlorobutadiene		49.7	0.445			
Iron (mg/l)	1000 (AL)					
Lead	25 (N)					
Manganese			200			
MBAS (Methylene-Blue-Active-Substances)	500					
Mercury	0.012					
Nickel	88		25			
Nitrate nitrogen			10			
Pesticides						
Aldrin	0.002	0.000136	0.000127			
Chlordane	0.004	0.000588	0.000575			
DDT	0.001	0.000591	0.000588			
Demeton	0.1					
Dieldrin	0.002	0.000144	0.000135			
Endosulfan	0.05					
Endrin	0.002					
Guthion	0.01					
Heptachlor	0.004	0.000214	0.000208			
Lindane	0.01					
Methoxychlor	0.03					
Mirex	0.001					
Parathion	0.013					
Toxaphene	0.0002					
2,4-D			100			
2,4,5-TP (Silvex)			10			
pH (units)	6.0-9.0					(N)[6]
Phenolic coumpounds		(N)	1.0 (N)			
Polychlorinated biphenyls[7]	0.001	0.000079				
Polynuclear aromatic hydrocarbons [8]		0.0311	0.0028			
Radioactive substances		(N)				
Selenium	5					
Silver	0.06 (AL)					
Solids, total dissolved (mg/l)			500			
Solids, total suspended (mg/l)					10 Tr, 20 other	
Solids, settleable	(N)					
Sulfates			250000			
Temperature	(N)					
Tetrachloroethane (1,1,2,2)		10.8	0.172			
Tetrachlorethylene			0.8			
Toluene	11			0.36		
Toxic substances	(N)				(N)	
Trialkyltin	0.008					
Trichloroethylene		92.4	3.08			
Turbidity (NTU)	50; 25 (N)			10 (N)		
Vinyl chloride		525	2.0			
Zinc	50 (AL)					

* These standards apply to all freshwater classifications. For the protection of WS and supplemental classifications, standards listed under Standards to Support Additional Uses should be used unless standards for aquatic life or human health are listed and are more stringent.

(AL) Values represent action levels as specified in 2B .0211(4). WS Classes - Water Supply Classifications, same standards for all WS Classes.

(N) See 2B .0211(3) for narrative description of limits. HQW - High Quality Waters, standards for HQW areas only. Tr - Trout Waters.

1 Human health standards are based on consumption of fish only unless dermal contact studies available. See 2B .0208 for equation.

2 Water Supply standards are based on consumption of fish and water. See 2B .0208 for equation.

3 MFTCC/100ml means membrane filter total coliform count per 100 ml of sample. MFFCC/100ml means membrane filter fecal coliform count per 100 ml of sample.

4 Applies only to unfiltered water supplies.

5 An instantaneous reading may be as low as 4.0 mg/l, but the daily average must be 5.0 mg/l or more.

6 Designated swamp waters may have a dissolved oxygen less than 5.0 mg/l and a pH as low as 4.3, if due to natural conditions.

7 Applies to total PCBs present and includes PCB 1242, 1254, 1221, 1232, 1248, 1260, and 1016. See 2B .0208 & .0211.

8 Applies to total PAHs present and includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. See 2B .0208, .0212, .0214, .0215, .0216, & .0218.

Water Quality Standards For Saltwater Classifications

Parameters (ug/l unless noted)	Standards for All Saltwater: Aquatic Life	Human Health[1]	Standards to Support Additional Uses: Class SA	HQW	Swamp Waters
Arsenic	50				
Benzene		71.4			
Beryllium		0.117			
Cadmium	5.0				
Carbon tetrachloride		4.42			
Chlorophyll *a*	40 (N)				
Chromium, total	20				
Coliform, fecal (MFFCC/100ml)[2]		200 (N)	14 (N)		
Copper	3 (AL)				
Cyanide	1.0				
Dioxin		0.000000014			
Dissolved gases	(N)				
Dissolved oxygen (mg/l)	5.0			6.0	(N)[3]
Hexachlorobutadiene		49.7			
Lead	25 (N)				
Mercury	0.025				
Nickel	8.3				
Pesticides					
Aldrin	0.003	0.000136			
Chlordane	0.004	0.000588			
DDT	0.001	0.000591			
Demeton	0.1				
Dieldrin	0.0002	0.000144			
Endosulfan	0.009				
Endrin	0.002				
Guthion	0.01				
Heptachlor	0.004	0.000214			
Lindane	0.004				
Methoxychlor	0.03				
Mirex	0.001				
Parathion	0.178				
Toxaphene	0.0002				
pH (units)	6.8-8.5				(N)[3]
Phenolic compounds		(N)			
Polychlorinated biphenyls[4]	0.001	0.000079			
Polynuclear aromatic hydrocarbons[5]	0.0311				
Radioactive substances		(N)			
Salinity	(N)				
Selenium	71				
Silver	0.1 (AL)				
Solids, total suspended (mg/l)				10 PNA, 20 other	
Solids, settleable (mg/l)	(N)				
Temperature	(N)				
Tetrachloroethane (1,1,2,2)		10.8			
Toxic substances	(N)			(N)	
Trialkyltin	0.002				
Trichloroethylene		92.4			
Turbidity (NTU)	25 (N)				
Vinyl chloride		525			
Zinc	86 (AL)				

(AL) Values represent action levels as specified in 2B .0220(4).
(N) See 2B .0220 for narrative description of limits.
HQW - High Quality Waters, standards for HQW areas only.
Class SA - shellfishing waters see 2B .0101(d)(3) for description.
PNA - Primary Nursery Areas
1 Human health standards are based on consumption of fish only unless dermal contact studies are available. See 2B .0208 for equation.
2 MFFCC/100ml means membrane filter fecal coliform count per 100 ml of sample.
3 Designated swamp waters may have a dissolved oxygen less than 5.0 mg/l and a pH as low as 4.3, if due to natural conditions.
4 Applies to total PCBs present and includes PCB 1242, 1254, 1221, 1232, 1248, 1260, and 1016. See 2B .0208 & .0220.
5 Applies to total PAHs present and includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. See 2B .0208.

.0201 ANTIDEGRADATION POLICY

(a) It is the policy of the Environmental Management Commission to maintain, protect, and enhance water quality within the State of North Carolina. Pursuant to this policy, the requirements of 40 CFR 131.12 are hereby incorporated by reference including any subsequent amendments and editions. This material is available for inspection at the Department of Environment, Health, and Natural Resources, Division of Environmental Management, Water Quality Planning Branch, 512 North Salisbury Street, Raleigh, North Carolina. Copies may be obtained from the U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402-9325 at a cost of thirteen dollars ($13.00). These requirements will be implemented in North Carolina as set forth in Paragraphs (b), (c) and (d) of this Rule.

(b) Existing uses, as defined by Rule .0202 of this Section, and the water quality to protect such uses shall be protected by properly classifying surface waters and having standards sufficient to protect these uses. In cases where the Commission or its designee determines that an existing use is not included in the classification of waters, a project which will affect these waters will not be permitted unless the existing uses are protected.

(c) The Commission shall consider the present and anticipated usage of waters with quality higher than the standards, including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of waters with quality higher than the standards below the water quality necessary to maintain existing and anticipated uses of those waters. Waters with quality higher than the standards are defined by Rule .0202 of this Section. The following procedures will be implemented in order to meet these requirements:

(1) Each applicant for an NPDES permit or NPDES permit expansion to discharge treated waste will document an effort to consider non-discharge alternatives pursuant to 15A NCAC 2H .0105(c)(2).

(2) Public Notices for NPDES permits will list parameters that would be water quality limited and state whether or not the discharge will use the entire available load capacity of the receiving waters and may cause more stringent water quality based effluent limitations to be established for dischargers downstream.

(3) The Division may require supplemental documentation from the affected local government that a proposed project or parts of the project are necessary for important economic and social development.

(4) The Commission and Division will work with local governments on a voluntary basis to identify and develop appropriate management strategies or classifications for waters with unused pollutant loading capacity to accommodate future economic growth.

Waters with quality higher than the standards will be identified by the Division on a case-by-case basis through the NPDES permitting and waste load allocation processes (pursuant to the provisions of 15A NCAC 2H .0100). Dischargers affected by the requirements of Paragraphs (c)(1) through (c)(4) of this Rule and the public at large will be notified according to the provisions described herein, and all other appropriate provisions pursuant to 15A NCAC 2H .0109. If an applicant objects to the requirements to protect waters with quality higher than the standards and believes degradation is necessary to accommodate important social and economic development, the applicant can contest these requirements according to the provisions of General Statute 143-215.1(e) and 150B-23.

(d) The Commission shall consider the present and anticipated usage of High Quality Waters (HQW), including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of High Quality Waters below the water quality necessary to maintain existing and anticipated uses of those waters. High Quality Waters are a subset of waters with quality higher than the standards and are as described by 15A NCAC 2B .0101(e)(5). The procedures described in Rule .0224 of this Section will be implemented in order to meet the requirements of this part.

(e) Outstanding Resource Waters (ORW) are a special subset of High Quality Waters with unique and special characteristics as described in Rule .0225 of this Section. The water quality of waters classified as ORW shall be maintained such that existing uses, including the outstanding resource values of said Outstanding Resource Waters, will be maintained and protected.

History Note: *Authority G.S. 143-214.1; 143-215.1; 143-215.3(a)(1);*
Eff. February 1, 1976;
Amended Eff. October 1, 1995; February 1, 1993; April 1, 1991; August 1, 1990.

MANAGEMENT STRATEGY FOR THE NEW RIVER NSW AREA

The New River was classified NSW on August 1, 1991.

The following NSW management strategy is applicable to the entire New River watershed above a line across the river from Grey Point to a point of land approximately 2200 yards downstream from the mouth of Duck Creek:

- All existing wastewater discharges with a design flow of 0.05 MGD or greater receive permit limits of 2.0 mg/l total phosphorus.
- New and expanding wastewater discharges, regardless of design flow, receive total phosphorus limits of 0.5 mg/l.
- More stringent phosphorus limits and/or the addition of nitrogen limits may be applied to large existing facilities which make a significant contribution of nutrients to the system. These facilities may also be required to remove their discharge from severely impacted areas such as Wilson Bay.
- New discharges must demonstrate that non-discharge options or connection to an existing system is not feasible.
- Implementation of agricultural Best Management Practices (BMPs) through the voluntary Agricultural Cost Share Program to reduce nitrogen and phosphorus loadings is a priority for this watershed.

.0224 HIGH QUALITY WATERS

High Quality Waters (HQW) are a subset of waters with quality higher than the standards and are as described by 15A NCAC 2B .0101(e)(5). The following procedures shall be implemented in order to implement the requirements of Rule .0201(d) of this Section.

(1) New or expanded wastewater discharges in High Quality Waters shall comply with the following:

(a) Discharges from new single family residences shall be prohibited. Those existing subsurface systems for single family residences which fail and must discharge shall install a septic tank, dual or recirculating sand filters, disinfection and step aeration.

(b) All new NPDES wastewater discharges (except single family residences) shall be required to provide the treatment described below:

(i) Oxygen Consuming Wastes: Effluent limitations shall be as follows: BOD_5= 5 mg/l, NH_3-N = 2 mg/l and DO = 6 mg/l. More stringent limitations shall be set, if necessary, to ensure that the cumulative pollutant discharge of oxygen-consuming wastes shall not cause the DO of the receiving water to drop more than 0.5 mg/l below background levels, and in no case below the standard. Where background information is not readily available, evaluations shall assume a percent saturation determined by staff to be generally applicable to that hydroenvironment.

(ii) Total Suspended Solids: Discharges of total suspended solids (TSS) shall be limited to effluent concentrations of 10 mg/l for trout waters and PNA's, and to 20 mg/l for all other High Quality Waters.

(iii) Disinfection: Alternative methods to chlorination shall be required for discharges to trout streams, except that single family residences may use chlorination if other options are not economically feasible. Domestic discharges are prohibited to SA waters.

(iv) Emergency Requirements: Failsafe treatment designs shall be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs.

(v) Volume: The total volume of treated wastewater for all discharges combined shall not exceed 50 percent of the total instream flow under 7Q10 conditions.

(vi) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations shall be set for phosphorus or nitrogen, or both.

(vii) Toxic substances: In cases where complex wastes (those containing or potentially containing toxicants) may be present in a discharge, a safety factor shall be applied to any chemical or whole effluent toxicity allocation. The limit for a specific chemical constituent shall be allocated at one-half of the normal standard at design conditions. Whole effluent toxicity shall be allocated to protect for chronic toxicity at an effluent concentration equal to twice that which is acceptable under design conditions. In all instances there may be no acute toxicity in an effluent concentration of 90 percent. Ammonia toxicity shall be evaluated according to EPA guidelines promulgated in "Ambient Water Quality Criteria for Ammonia - 1984"; EPA document number 440/5-85-001; NTIS number PB85-227114; July 29, 1985 (50 FR 30784) or "Ambient Water Quality Criteria for Ammonia (Saltwater) - 1989"; EPA document number 440/5-88-004; NTIS number PB89-169825. This material related to ammonia toxicity is hereby incorporated by reference including any subsequent amendments and editions and is available for inspection at the Department of Environment, Health, and Natural Resources Library, 512 North Salisbury Street, Raleigh, North Carolina. Copies may be obtained from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161 at a cost of forty-seven dollars ($47.00).

(c) All expanded NPDES wastewater discharges in High Quality Waters shall be required to provide the treatment described in Sub-Item (1)(b) of this Rule, except for those existing discharges which expand with no increase in permitted pollutant loading.

(2) Development activities which require an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or local erosion and sedimentation control program approved in accordance with 15A NCAC 4B .0218, and which drain to and are within one mile of High Quality Waters (HQW) shall be required to follow the stormwater management rules as specified in 15A NCAC 2H .1000. Stormwater management requirements specific to HQW are described in 15A NCAC 2H .1006.

If an applicant objects to the requirements to protect high quality waters and believes degradation is necessary to accommodate important social and economic development, the applicant may contest these requirements according to the provisions of G.S. 143-215.1(e) and 150B-23.

History Note: *Authority G.S. 143-214.1; 143-215.1; 143-215.3(a)(1);*
Eff. October 1, 1995;

.0225 OUTSTANDING RESOURCE WATERS

(a) General. In addition to the existing classifications, the Commission may classify certain unique and special surface waters of the state as outstanding resource waters (ORW) upon finding that such waters are of exceptional state or national recreational or ecological significance and that the waters have exceptional water quality while meeting the following conditions:

(1) there are no significant impacts from pollution with the water quality rated as excellent based on physical, chemical or biological information;

(2) the characteristics which make these waters unique and special may not be protected by the assigned narrative and numerical water quality standards.

(b) Outstanding Resource Values. In order to be classified as ORW, a water body must exhibit one or more of the following values or uses to demonstrate it is of exceptional state or national recreational or ecological significance:

(1) there are outstanding fish (or commercially important aquatic species) habitat and fisheries;

(2) there is an unusually high level of water-based recreation or the potential for such recreation;

(3) the waters have already received some special designation such as a North Carolina or National Wild and Scenic River, Native or Special Native Trout Waters, National Wildlife Refuge, etc, which do not provide any water quality protection;

(4) the waters represent an important component of a state or national park or forest; or

(5) the waters are of special ecological or scientific significance such as habitat for rare or endangered species or as areas for research and education.

(c) Quality Standards for ORW.

(1) Freshwater: Water quality conditions shall clearly maintain and protect the outstanding resource values of waters classified ORW. Management strategies to protect resource values shall be developed on a site specific basis during the proceedings to classify waters as ORW. At a minimum, no new discharges or expansions of existing discharges shall be permitted, and stormwater controls for all new development activities requiring an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an appropriate local erosion and sedimentation control program shall be required to follow the stormwater provisions as specified in 15A NCAC 2H .1000. Specific stormwater requirements for ORW areas are described in 15A NCAC 2H .1007.

(2) Saltwater: Water quality conditions shall clearly maintain and protect the outstanding resource values of waters classified ORW. Management strategies to protect resource values shall be developed on a site-specific basis during the proceedings to classify waters as ORW. At a minimum, new development shall comply with the stormwater provisions as specified in 15A NCAC 2H .1000. Specific stormwater management requirements for saltwater ORWs are described in 15A NCAC 2H .1007. New non-discharge permits shall meet reduced loading rates and increased buffer zones, to be determined on a case-by-case basis. No dredge or fill activities shall be allowed where significant shellfish or submerged aquatic vegetation bed resources occur, except for maintenance dredging, such as that required to maintain access to existing channels and facilities located within the designated areas or maintenance dredging for activities such as agriculture. A public hearing is mandatory for any proposed permits to discharge to waters classified as ORW.

Additional actions to protect resource values shall be considered on a site specific basis during the proceedings to classify waters as ORW and shall be specified in Paragraph (e) of this Rule. These actions may include anything within the powers of the commission. The commission shall also consider local actions which have been taken to protect a water body in determining the appropriate state protection options. Descriptions of boundaries of waters classified as ORW are included in Paragraph (e) of this Rule and in the Schedule of Classifications (15A NCAC 2B .0302 through .0317) as specified for the appropriate river basin and shall also be described on maps maintained by the Division of Environmental Management.

(d) Petition Process. Any person may petition the Commission to classify a surface water of the state as an ORW. The petition shall identify the exceptional resource value to be protected, address how the water body meets the general criteria in Paragraph (a) of this Rule, and the suggested actions to protect the resource values. The Commission may request additional supporting information from the petitioner. The Commission or its designee shall initiate public proceedings to classify waters as ORW or shall inform the petitioner that the waters do not meet the criteria for ORW with an explanation of the basis for this decision. The petition shall be sent to:

Director
DEHNR/Division of Environmental Management
P.O. Box 29535
Raleigh, North Carolina 27626-0535

The envelope containing the petition shall clearly bear the notation: RULE-MAKING PETITION FOR ORW CLASSIFICATION.

(e) Listing of Waters Classified ORW with Specific Actions. Waters classified as ORW with specific actions to protect exceptional resource values are listed as follows:

(1) Roosevelt Natural Area [White Oak River Basin, Index Nos. 20-36-9.5-(1) and 20-36-9.5-(2)] including all fresh and saline waters within the property boundaries of the natural area shall have only new development which complies with the low density option in the stormwater rules as specified in 15A NCAC 2H .1005(2)(a) within 575 feet of the Roosevelt Natural Area (if the development site naturally drains to the Roosevelt Natural Area).

(2) Chattooga River ORW Area (Little Tennessee River Basin and Savannah River Drainage Area): the following undesignated waterbodies that are tributary to ORW designated segments shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule .0203 of this Section. However, expansions of existing discharges to these segments shall be allowed if there is no increase in pollutant loading:
   (A) North and South Fowler Creeks,
   (B) Green and Norton Mill Creeks,
   (C) Cane Creek,
   (D) Ammons Branch,
   (E) Glade Creek, and
   (F) Associated tributaries.

(3) Henry Fork ORW Area (Catawba River Basin): the following undesignated waterbodies that are tributary to ORW designated segments shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule .0203 of this Section:
   (A) Ivy Creek,
   (B) Rock Creek, and
   (C) Associated tributaries.

(4) South Fork New and New Rivers ORW Area [New River Basin (Index Nos. 10-1-33.5 and 10)]: the following management strategies, in addition to the discharge requirements specified in Subparagraph (c)(1) of this Rule, shall be applied to protect the designated ORW areas:
   (A) Stormwater controls described in Subparagraph (c)(1) of this Rule shall apply within one mile and draining to the designated ORW areas;
   (B) New or expanded NPDES permitted wastewater discharges located upstream of the designated ORW shall be permitted such that the following water quality standards are maintained in the ORW segment:
      (i) the total volume of treated wastewater for all upstream discharges combined shall not exceed 50 percent of the total instream flow in the designated ORW under 7Q10 conditions;
      (ii) a safety factor shall be applied to any chemical allocation such that the effluent limitation for a specific chemical constituent shall be the more stringent of either the limitation allocated under design conditions (pursuant to 15A NCAC 2B .0206) for the normal standard at the point of discharge, or the limitation allocated under design conditions for one-half the normal standard at the upstream border of the ORW segment;
      (iii) a safety factor shall be applied to any discharge of complex wastewater (those containing or potentially containing toxicants) to protect for chronic toxicity in the ORW segment by setting the whole effluent toxicity limitation at the higher (more stringent) percentage effluent determined under design conditions (pursuant to 15A NCAC 2B .0206) for either the instream effluent concentration at the point of discharge or twice the effluent concentration calculated as if the discharge were at the upstream border of the ORW segment;
   (C) New or expanded NPDES permitted wastewater discharges located upstream of the designated ORW shall comply with the following:
      (i) Oxygen Consuming Wastes: Effluent limitations shall be as follows: BOD = 5 mg/1, and NH3-N = 2 mg/1;
      (ii) Total Suspended Solids: Discharges of total suspended solids (TSS) shall be limited to effluent concentrations of 10 mg/1 for trout waters and to 20 mg/1 for all other waters;
      (iii) Emergency Requirements: Failsafe treatment designs shall be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs;
      (iv) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations shall be set for phosphorus or nitrogen, or both.

(5) Old Field Creek (New River Basin): the undesignated portion of Old Field Creek (from its source to Call Creek) shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule .0203 of this Section.

(6) In the following designated waterbodies, no additional restrictions shall be placed on new or expanded marinas. The only new or expanded NPDES permitted discharges that shall be allowed shall be non-domestic, non-process industrial discharges. The Alligator River Area (Pasquotank River Basin) extending from the source of the Alligator River to the U.S. Highway 64 bridge including New Lake Fork, North West Fork Alligator River, Juniper Creek, Southwest Fork Alligator River, Scouts Bay, Gum Neck Creek, Georgia Bay, Winn Bay, Stumpy Creek Bay, Stumpy Creek, Swann Creek (Swann Creek Lake), Whipping Creek (Whipping Creek Lake), Grapevine Bay, Rattlesnake Bay, The Straits, The Frying Pan, Coopers Creek, Babbitt Bay, Goose Creek, Milltail Creek, Boat Bay, Sandy Ridge Gut (Sawyer Lake) and Second Creek, but excluding the Intracoastal Waterway (Pungo River-Alligator River Canal) and all other tributary streams and canals.

(7) In the following designated waterbodies, the only type of new or expanded marina that shall be allowed shall be those marinas located in upland basin areas, or those with less than 30 slips, having no boats over 21 feet in length and no boats with heads. The only new or expanded NPDES permitted discharges that shall be allowed shall be non-domestic, non-process industrial discharges.

(A) The Northeast Swanquarter Bay Area including all waters northeast of a line from a point at Lat. 35• 23• 51• and Long. 76• 21• 02• thence southeast along the Swanquarter National Wildlife Refuge hunting closure boundary (as defined by the 1935 Presidential Proclamation) to Drum Point.

(B) The Neuse-Southeast Pamlico Sound Area (Southeast Pamlico Sound Section of the Southeast Pamlico, Core and Back Sound Area); (Neuse River Basin) including all waters within an area defined by a line extending from the southern shore of Ocracoke Inlet northwest to the Tar-Pamlico River and Neuse River basin boundary, then southwest to Ship Point.

(C) The Core Sound Section of the Southeast Pamlico, Core and Back Sound Area (White Oak River Basin), including all waters of Core Sound and its tributaries, but excluding Nelson Bay, Little Port Branch and Atlantic Harbor at its mouth, and those tributaries of Jarrett Bay that are closed to shellfishing.

(D) The Western Bogue Sound Section of the Western Bogue Sound and Bear Island Area (White Oak River Basin) including all waters within an area defined by a line from Bogue Inlet to the mainland at SR 1117 to a line across Bogue Sound from the southwest side of Gales Creek to Rock Point, including Taylor Bay and the Intracoastal Waterway.

(E) The Stump Sound Area (Cape Fear River Basin) including all waters of Stump Sound and Alligator Bay from marker Number 17 to the western end of Permuda Island, but excluding Rogers Bay, the Kings Creek Restricted Area and Mill Creek.

(F) The Topsail Sound and Middle Sound Area (Cape Fear River Basin) including all estuarine waters from New Topsail Inlet to Mason Inlet, including the Intracoastal Waterway and Howe Creek, but excluding Pages Creek and Futch Creek.

(8) In the following designated waterbodies, no new or expanded NPDES permitted discharges and only new or expanded marinas with less than 30 slips, having no boats over 21 feet in length and no boats with heads shall be allowed.

(A) The Swanquarter Bay and Juniper Bay Area (Tar-Pamlico River Basin) including all waters within a line beginning at Juniper Bay Point and running south and then west below Great Island, then northwest to Shell Point and including Shell Bay, Swanquarter and Juniper Bays and their tributaries, but excluding all waters northeast of a line from a point at Lat. 35• 23• 51• and Long. 76• 21• 02• thence southeast along the Swanquarter National Wildlife Refuge hunting closure boundary (as defined by the 1935 Presidential Proclamation) to Drum Point and also excluding the Blowout Canal, Hydeland Canal, Juniper Canal and Quarter Canal.

(B) The Back Sound Section of the Southeast Pamlico, Core and Back Sound Area (White Oak River Basin) including that area of Back Sound extending from Core Sound west along Shackleford Banks, then north to the western most point of Middle Marshes and along the northwest shore of Middle Marshes (to include all of Middle Marshes), then west to Rush Point on Harker's Island, and along the southern shore of Harker's Island back to Core Sound.

(C) The Bear Island Section of the Western Bogue Sound and Bear Island Area (White Oak River Basin) including all waters within an area defined by a line from the western most point on Bear Island to the northeast mouth of Goose Creek on the mainland, east to the southwest mouth of Queen Creek, then south to green marker No. 49, then northeast to the northern most point on Huggins Island, then southeast along the shoreline of Huggins Island to the southeastern most point of Huggins Island, then south to the northeastern most point on Dudley Island, then southwest along the shoreline of Dudley Island to the eastern tip of Bear Island.

(D) The Masonboro Sound Area (Cape Fear River Basin) including all waters between the Barrier Islands and the mainland from Carolina Beach Inlet to Masonboro Inlet.

(9) Black and South Rivers ORW Area (Cape Fear River Basin) [Index Nos. 18-68-(0.5), 18-68-(3.5), 18-68-(11.5), 18-68-12-(0.5), 18-68-12-(11.5), and 18-68-2]: the following management strategies, in addition to the discharge requirements specified in Subparagraph (c)(1) of this Rule, shall be applied to protect the designated ORW areas:

(A) Stormwater controls described in Subparagraph (c)(1) of this Rule shall apply within one mile and draining to the designated ORW areas;

(B) New or expanded NPDES permitted wastewater discharges located one mile upstream of the stream segments designated ORW (upstream on the designated mainstem and upstream into direct tributaries to the designated mainstem) shall comply with the following discharge restrictions:

(i) Oxygen Consuming Wastes: Effluent limitations shall be as follows: BOD = 5 mg/l and NH3-N = 2 mg/l;

(ii) Total Suspended Solids: Discharges of total suspended solids (TSS) shall be limited to effluent concentrations of 20 mg/l;

(iii) Emergency Requirements: Failsafe treatment designs shall be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs;

(iv) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations shall be set for phosphorus or nitrogen, or both.

(v) Toxic substances: In cases where complex discharges (those containing or potentially containing toxicants) may be currently present in the discharge, a safety factor shall be applied to any chemical or whole effluent toxicity allocation. The limit for a specific chemical constituent shall be allocated at one-half of the normal standard at design conditions. Whole effluent toxicity shall be allocated to protect for chronic toxicity at an effluent concentration equal to twice that which is acceptable under flow design criteria (pursuant to 15A NCAC 2B .0206).

History Note: *Authority G.S. 143-214.1;*
Eff. October 1, 1995;
Amended Eff. April 1, 1996; January 1, 1996

STATE OF
NORTH CAROLINA
DEPARTMENT OF
ENVIRONMENT, HEALTH,
AND NATURAL RESOURCES

Classifications and Water Quality Standards Assigned to The Waters of the White Oak River Basin

Division of Environmental Management
Raleigh, North Carolina

Reprint from North Carolina Administrative Code: 15A NCAC 2B .0312
Current through: February 1, 1993

SECTION .0300 - ASSIGNMENT OF STREAM CLASSIFICATIONS

.0301 CLASSIFICATIONS: GENERAL

(a) Schedule of Classifications. The classifications assigned to the waters of the State of North Carolina are set forth in the schedules of classifications and water quality standards assigned to the waters of the river basins of North Carolina, 15A NCAC 2B .0302 to .0317. These classifications are based upon the existing or contemplated best usage of the various streams and segments of streams in the basin, as determined through studies and evaluations and the holding of public hearings for consideration of the classifications proposed.

(b) Stream Names. The names of the streams listed in the schedules of assigned classifications were taken as far as possible from United States Geological Survey topographic maps. Where topographic maps were unavailable, U.S. Corps of Engineers maps, U.S. Department of Agriculture soil maps, and North Carolina highway maps were used for the selection of stream names.

(c) Classifications. The classifications assigned to the waters of North Carolina are denoted by the letters WS-I, WS-II, WS-III, WS-IV, WS-V, B, C, SA, SB, and SC in the column headed "class." A brief explanation of the "best usage" for which the waters in each class must be protected is given as follows:

Fresh Waters

Class WS-I:	waters protected as water supplies which are in natural and undeveloped watersheds; point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of this Subchapter; local programs to control nonpoint source and stormwater discharge of pollution are required; suitable for all Class C uses;
Class WS-II:	waters protected as water supplies which are generally in predominantly undeveloped watersheds; point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of this Subchapter; local programs to control nonpoint source and stormwater discharge of pollution are required; suitable for all Class C uses;
Class WS-III:	waters protected as water supplies which are generally in low to moderately developed watersheds; point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of this Subchapter; local programs to control nonpoint source and stormwater discharge of pollution are required; suitable for all Class C uses;
Class WS-IV:	waters protected as water supplies which are generally in moderately to highly developed watersheds; point source discharges of treated wastewater are permitted pursuant to Rules .0104 and .0211 of this Subchapter; local programs to control nonpoint source and stormwater discharge of pollution are required; suitable for all Class C uses;
Class WS-V:	waters protected as water supplies which are generally upstream and draining to Class WS-IV waters; no categorical restrictions on watershed development or treated wastewater discharges are required, however, the Commission or its designee may apply appropriate management requirements as deemed necessary for the protection of downstream receiving waters (15A NCAC 2B .0203); suitable for all Class C uses;
Class B:	primary recreation and any other usage specified by the "C" classification;
Class C:	aquatic life propagation and survival, fishing, wildlife, secondary recreation, and agriculture.

Tidal Salt Waters

Class SA:	shellfishing for market purposes and any other usage specified by the "SB" and "SC" classification;
Class SB:	primary recreation and any other usage specified by the "SC" classification;
Class SC:	aquatic life propagation and survival, fishing, wildlife, and secondary recreation.

Supplemental Classifications

Trout Waters:	Suitable for natural trout propagation and maintenance of stocked trout;
Swamp Waters:	Waters which have low velocities and other natural characteristics which are different from adjacent streams;
NSW:	Nutrient Sensitive Waters which require limitations on nutrient inputs;
HQW:	High Quality Waters which are waters that are rated as excellent based on biological and physical/chemical characteristics through division monitoring or special studies, native and special native trout waters (and their tributaries) designated by the Wildlife Resources Commission, primary nursery areas (PNA) designated by the Marine Fisheries Commission and other functional nursery areas designated by the Wildlife Resources Commission, critical habitat areas designated by the Wildlife Resources Commission or the Department of Agriculture, all water supply watersheds which are either classified as WS-I or WS-II or those for which a formal petition for reclassification as WS-I or WS-II has been received from the appropriate local government and accepted by the Division of Environmental Management and all Class SA waters.
ORW:	Outstanding Resource Waters which are unique and special waters of exceptional state or national recreational or ecological significance which require special protection to maintain existing uses.

(d) Water Quality Standards. The water quality standards applicable to each classification assigned are those established in 15A NCAC 2B .0200, Classifications and Water Quality Standards Applicable to the Surface Waters of North Carolina, as adopted by the North Carolina Environmental Management Commission.

(e) Index Number.

(1) Reading the Index Number. The index number appearing in the column so designated is an identification number assigned to each stream or segment of a stream, indicating the specific tributary progression between the main stem stream and the tributary stream.

(2) Cross-Referencing the Index Number. The inclusion of the index number in the schedule is to provide an adequate cross reference between the classification schedules and an alphabetic list of streams.

(f) Classification Date. The classification date indicates the date on which enforcement of the provisions of Section 143-215.1 of the General Statutes of North Carolina became effective with reference to the classification assigned to the various streams in North Carolina.

(g) Reference. Copies of the schedules of classifications adopted and assigned to the waters of the various river basins may be obtained at no charge by writing to:

Director
Division of Environmental Management
Department of Environment, Health, and Natural Resources
Post Office Box 29535
Raleigh, North Carolina 27626-0535

(h) Places where the schedules may be inspected:

Division of State Library
Archives -- State Library Building
109 E. Jones Street
Raleigh, North Carolina.

(i) Unnamed Streams.

(1) Any stream which is not named in the schedule of stream classifications carries the same classification as that assigned to the stream segment to which it is tributary except:

(A) unnamed streams specifically described in the schedule of classifications; or

(B) unnamed freshwaters tributary to tidal saltwaters will be classified "C"; or

(C) after November 1, 1986, any newly created areas of tidal saltwater which are connected to Class SA waters by approved dredging projects will be classified "SC" unless case-by-case reclassification proceedings are conducted.

(2) The following river basins have different policies for unnamed streams entering other states or for specific areas of the basin:

Hiwassee River Basin (Rule .0302); Little Tennessee River Basin and Savannah River Drainage Area (Rule .0303); French Broad River Basin (Rule .0304); Watauga River Basin (Rule .0305); Broad River Basin (Rule .0306); New River Basin (Rule .0307); Catawba River Basin (Rule .0308); Yadkin-Pee Dee River Basin (Rule .0309); Lumber River Basin (Rule .0310); Roanoke River Basin (Rule .0313); Tar-Pamlico River Basin (Rule .0316); Pasquotank River Basin (Rule .0317).

History Note: Statutory Authority G.S. 143-214.1; 143-215.1; 143-215.3(a)(1);
Eff. February 1, 1976;
Amended Eff. August 3, 1992; August 1, 1990; October 1, 1989; November 1, 1986.

.0312 WHITE OAK RIVER BASIN

(a) Places where the schedules may be inspected:

(1) Clerk of Court:
Carteret County
Craven County
Jones County
Onslow County

(2) North Carolina Department of Environment, Health and Natural Resources:

(A) Washington Regional Office
1502 North Market Street

(B) Wilmington Regional Office
7225 Wrightsville Avenue
Wilmington, North Carolina

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
	NEW RIVER DRAINAGE AREA			
NEW RIVER	From source to Blue Creek	C NSW	8/1-91	19-(1)
Mill Swamp	From source to New River	C NSW	8/1-91	19-2
Jenkins Swamp	From source to New River	C NSW	8/1-91	19-3
Cowhorn Swamp	From source to New River	C NSW	8/1-91	19-4
Juniper Swamp	From source to Cowhorn Swamp	C NSW	8/1-91	19-4-1
Batchelors Delight Swamp	From source to New River	C NSW	8/1-91	19-5
Half Moon Creek	From source to New River	C NSW	8/1-91	19-6
NEW RIVER	From Blue Creek to U. S. Hwy. 17 bridge	SB NSW	8/1-91	19-(7)
Blue Creek	From source to New River	SC NSW	8/1/91	19-8
Mill Creek	From source to New River	SC NSW	8/1/91	19-9
Deep Gully Creek	From source to Mill Creek	SC NSW	8/1/91	19-9-1
Chainey Creek	From source to New River	SC NSW	8/1/91	19-10
NEW RIVER	From U. S.Hwy. 17 bridge to Atlantic Coast Line Railroad Trestle	SB HQW NSW	8/1/91	19-(10.5)
NEW RIVER	From Atlantic Coast Line Railroad Trestle to Mumford Point	SC HQW NSW	8/1/91	19-(11)
Brinson Creek	From source to New River	SC NSW	8/1/91	19-12
Edwards Creek	From source to New River	SC HQW NSW	8/1/91	19-13
Strawhorn Creek	From source to Edwards Creek	SC HQW NSW	8/1/91	19-13-1
Wilson Bay	Entire Bay	SC HQW NSW	8/1/91	19-14
Stick Creek	From source to New River	SC HQW NSW	8/1/91	19-15
NEW RIVER	From Mumford Point to a line extending across the river from Grey Point to point of land approximately 2200 yards downstream from mouth of Duck Creek	SC NSW	8/1/91	19-(15.5)
Northeast Creek	From source to N. C. Hwy. 24	SC NSW	8/1/91	19-16
Wolf Swamp	From source to Northeast Creek	C NSW	8/1/91	19-16-1
Little Northeast Creek	From source to Northeast Creek	C NSW	8/1/91	19-16-2
Horse Swamp	From source to Little Northeast Creek	C NSW	8/1/91	19-16-2-1
Rocky Run	From source to Little Northeast Creek	C NSW	8/1/91	19-16-2-2
Poplar Creek	From source to Little Northeast Creek	C NSW	8/1/91	19-16-2-3
Mott Creek	From source to Northeast Creek	C NSW	8/1/91	19-16-3
Northeast Creek	From N. C. Hwy.24 to downstream side of mouth of Scales Creek	SC HQW NSW	8/1/91	19-16-(3.5)
Scales Creek	From source to Northeast Creek	SC HQW NSW	8/1/91	19-16-4
Northeast Creek	From the downstream side of mouth of Scales Creek to New River	SC NSW	8/1/91	19-16-(4.5)
Southwest Creek	From source to Mill Run	C NSW	8/1-91	19-17
Catherine Lake Creek	From Catherine Lake to Southeast Creek	C NSW	8/1-91	19-17-1
Catherine Lake	Entire Lake	B NSW	8/1-91	19-17-1-1
Deep Run	From source to Southwest Creek	C NSW	8/1-91	19-17-2
Harris Creek	From source to Southwest Creek	C NSW	8/1-91	19-17-3

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
Haws Run	From source to Southwest Creek	C NSW	8/1-91	19-17-4
Tank Creek	From source to Southwest Creek	C NSW	8/1-91	19-17-5
Hicks Run (Hickory Run)	From source to Southwest Creek	C NSW	8/1-91	19-17-6
Southwest Creek	From Mill Run to New River	C HQW NSW	8/1-91	19-17-(6.5)
Mill Run	From source to Southwest Creek	SC NSW	8/1-91	19-17-7
Morgan Bay	Entire Bay	SC NSW	8/1-91	19-18
Lewis Creek	From source to New River	SC HQW NSW	8/1-91	19-19
Wallace Creek	From source to New River	SB NSW	8/1-91	19-20
Bearhead Creek	From source to Wallace Creek	SB NSW	8/1-91	19-20-1
Beaverdam Creek	From source to Wallace Creek	SB NSW	8/1-91	19-20-2
Town Creek	From source to New River	SC HQW NSW	8/1-91	19-21
Farnell Bay	Entire Bay	SC NSW	8/1-91	19-22
Cogdels Creek (Coglin Creek)	From source to New River	SC NSW	8/1-91	19-23
Frenchs Creek	From source to New River	SC NSW	8/1/91	19-24
Jumping Run	From source to Frenchs Creek	SC NSW	8/1/91	19-24-1
Cowhead Creek	From source to Frenchs Creek	SC NSW	8/1/91	19-24-2
Duck Creek	From source to New River	SC NSW	8/1/91	19-25
Whitehurst Creek	From source to New River	SC HQW NSW	8/1/91	19-26
NEW RIVER	From a line extending across New River from Grey Point to a point of land approximately 2200 yards downstream from mouth of Duck Creek to Atlantic Ocean; including all unnamed bays, creeks, and other waters except restricted areas # 1 and # 2 described below.	SA	6/1/60	19-(27)
Goose Creek	From source to New River	SC HQW	8/1/90	19-28
Two Pole Branch	From source to New River	SC HQW	8/1/90	19-29
Stones Bay	Entire Bay	SA	6/1/56	19-30
Mill Creek	From source to Stones Bay	SA	6/1/56	19-30-1
Muddy Creek	From source to Stones Bay	SA	6/1/56	19-30-2
Stones Creek	From source to Stones Bay	SA	6/1/56	19-30-3
Millstone Creek	From source to Stones Creek	SA	6/1/56	19-30-3-1
New River Restricted Area # 1	All waters within 1,000 yards of earthen dock at the United States Marine Corps Rifle Range	SC	6/1/56	19-31
Everett Creek	From source to New River	SA	6/1/56	19-32
Ellis Cove	Entire Cove	SA	6/1/56	19-33
Sneads Creek	From source to Ellis Cove Bay	SA	6/1/56	19-33-1
Fannie Creek	From source to New River	SA	6/1/56	19-34
Wheeler Creek	From source to New River	SA	6/1/56	19-35
Courthouse Bay	Entire Bay	SA	6/1/56	19-36
New River Restricted Area # 2	All waters within a line beginning at the Government Dock in from of U.S. Coast Guard Detachment Barracks at Marines and running a southwest course 1,000 yards to Channel Marker #13, thence a southeasterly course	SC	6/1/56	19-37

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Name of Stream	Description	Class	Classification Date	Index No.
	1,000 yards to Flash Beacon # 11, thence a northeasterly course 500 yards to al point on the mainland at Wilkins' Bluff, thence following the shoreline to the Government Dock			
Unnamed Tributary to New River (Rufus Creek)	From source to New River Restricted Area # 2	SC HQW	8/1/90	19-37-1
Traps Bay	Entire Bay	SA	6/1/56	19-38
Traps Creek	From source to Traps Bay	SA	6/1/56	19-38-1
Toms Creek	From source to Traps Bay	SA	6/1/56	19-38-2
Intracoastal Waterway	From northeastern boundary of Cape Fear River Basin to Daybeacon #17 including all unnamed bays, guts, and channels	SA ORW	1/1/90	19-39-(0.5)
Rogers Bay	Entire Bay	SA	6/1/56	19-39-1
Goose Bay	Entire Bay	SA ORW	1/1/90	19-39-2
Alligator Bay	Entire Bay	SA ORW	1/1/90	19-39-3
Mill Creek	From source to Alligator Bay	SA	6/1/56	19-39-3-1
Intracoastal Waterway	From Daybeacon #17 to New River including all unnamed bays, guts, and channels	SA	6/1/56	19-39-(3.5)
Chadwick Bay	Entire Bay	SA	6/1/56	19-39-4
Fullard Creek (Salt Branch)	From source to Chadwick Bay	SA	6/1/56	19-39-4-1
Biglins Creek	From source to Fullard Creek	SA	6/1/56	19-39-4-1-1
Charles Creek	From source to Fullard Creek	SA	6/1/56	19-39-4-1-2
Bumps Creek	From source to Fullard Creek	SA	6/1/56	19-39-4-1-3
Hell Gate Creek	From source to Intracoastal Waterway	SA	6/1/56	19-39-5
Wards Channel	From Intracoastal Waterway to New River	SA	6/1/56	19-40
Intracoastal Waterway	From New River to northeast mouth of Goose Creek	SA	6/1/56	19-41-(0.5)
Howard Bay	Entire Bay	SA	6/1/56	19-41-1
Mile Hammock Bay	Entire Bay	SA	6/1/56	19-41-2
Salliers Bay	Entire Bay	SA	6/1/56	19-41-3
Holover Creek	From source to Salliers Bay	SA	6/1/56	19-41-3-1
Gillets Creek	From source to Intracoastal Waterway	SA	6/1/56	19-41-4
Freeman Creek	From source to Intracoastal Waterway	SA	6/1/56	19-41-5
Browns Swamp	From source to Freeman Creek	SA	6/1/56	19-41-5-1
Clay Bank Branch	From source to Freeman Creek	SA	6/1/56	19-41-5-2
Mirey Branch	From source to Freeman Creek	SA	6/1/56	19-41-5-3
Banks Channel	From Browns Inlet to Intracoastal Waterway	SA	6/1/56	19-41-6
Browns Inlet	From Atlantic Ocean to Intracoastal Waterway	SA	6/1/56	19-41-7
Browns Creek	From source to Intracoastal Waterway	SA	6/1/56	19-41-8
Shacklefoot Channel	From Bear Creek to Intracoastal Water-way	SA	6/1/56	19-41-9
Bear Creek	From Shacklefoot Channel to Intra-	SA	6/1/56	19-41-10

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Name of Stream	Description	Class	Classification Date	Index No.
	coastal Waterway			
Bear Creek	From source to Intracoastal Waterway	SA	6/1/56	19-41-11
Mill Creek	From source to Bear Creek	SA	6/1/56	19-41-11-1
Saunders Creek	From Bear Creek to Intracoastal Waterway	SA	6/1/56	19-41-12
Bear Inlet	From Atlantic Ocean to Intracoastal Waterway	SA	6/1/56	19-41-13
Goose Creek	From source to Intracoastal Waterway	SA	6/1/56	19-41-14
Intracoastal Waterway	From the northeast mouth of Goose Creek to the southwest mouth of Queen Creek	SA ORW	1/1/90	19-41-(14.5)
Cow Channel	From Bogue Inlet to Intracoastal Waterway	SA ORW	1/1/90	19-41-15
Intracoastal Waterway	From the southwest mouth of Queen Creek to Whiteoak River	SA	6/1/56	19-41-(15.5)
Queen Creek	From source to Intracoastal Waterway	SA	6/1/56	19-41-16
Bell Swamp	From source to Queen Creek	SA	6/1/56	19-41-16-1
Pasture Branch	From source to Queen Creek	SA	6/1/56	19-41-16-2
Halls Creek	From source to Queen Creek	SA	6/1/56	19-41-16-3
Parrot Swamp	From source to Queen Creek	SA	6/1/56	19-41-16-4
Dicks Creek	From source to Queen Creek	SA	6/1/56	19-41-16-5
Bogue Inlet	From Atlantic Ocean to Intracoastal Waterway	SA ORW	1/1/90	19-41-17
Bear Island ORW Area	All waters within an area north of Bear Island defined by a line from the western most point on Bear Island and running along the eastern shore of Sanders Creek to the northeast mouth of Goose Creek on the mainland, east to the southwest mouth of Queen Creek, then south to green marker #49, then northeast to the northeastern most point on Huggins Island, then southeast along the shoreline of Huggins Island to the southeastern most point of Huggins Island, then south to the northeastern most point on Dudley Island, then southwest along the shoreline of Dudley Island to the eastern tip of Bear Island, then to the western most point on Bear Island including Cow Channel	SA ORW	1/1/90	19-41-18

WHITE OAK RIVER DRAINAGE AREA

Name of Stream	Description	Class	Classification Date	Index No.
WHITE OAK RIVER	From source to Spring Branch	C	6/1/56	20-(1)
North Fork White Oak River	From source to White Oak River	C	6/1/56	20-2

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
South Fork White Oak River	From source to White Oak River	C	6/1/56	20-3
Grape Branch	From source to White Oak River	C	6/1/56	20-4
Fork Branch	From source to White Oak River	C	6/1/56	20-5
Mondin Branch	From source to White Oak River	C	6/1/56	20-6
Mirey Branch	From source to White Oak River	C	6/1/56	20-7
Brick Kiln Branch	From source to White Oak River	C	6/1/56	20-8
Black Swamp Creek	From source to White Oak River	C	6/1/56	20-9
Starkeys Creek	From source to White Oak River	C	6/1/56	20-10
Gravelly Branch	From source to White Oak River	C	6/1/56	20-11
Holston Creek	From source to White Oak River	C	6/1/56	20-12
Mulberry Creek	From source to White Oak River	C	6/1/56	20-13
Spring Branch	From source to White Oak River	C	6/1/56	20-14
Grants Creek	From source to Spring Branch	C	6/1/56	20-14-1
Cummins Creek	From source to Grants Creek	C	6/1/56	20-14-1-1
WHITE OAK RIVER	From Spring Branch to Hunters Creek	C HQW	8/1/90	20-(14.5)
Calebs Creek	From source to White Oak River	C	6/1/56	20-15
Freemans Creek	From source to White Oak River	C	6/1/56	20-16
Hunters Creek (Great Lake)	From source to White Oak River	C	6/1/56	20-17
Catfish Lake	Entire lake and connecting stream to Great Lake, Hunters Creek	C	6/1/56	20-17-1
Wolf Swamp	From source to Hunters Creek	C	6/1/56	20-17-2
WHITE OAK RIVER	From Hunters Creek to Atlantic Ocean, including the Intracoastal Waterway, with exception of restricted shellfish area adjacent to Swansboro	SA	6/1/56	20-(18)
Webb Creek	From source to White Oak River	C	6/1/56	20-19
Taylor Creek	From source to White Oak River	C	6/1/56	20-20
Pitts Creek (Hargetts Creek)	From source to White Oak River	SA	6/1/56	20-21
Cales Creek	From source to White Oak River	SA	6/1/56	20-22
Hadnot Creek	From source to White Oak River	SA	6/1/56	20-23
Schoolhouse Branch	From source to Hadnot Creek	SA	6/1/56	20-23-1
Steep Hill Branch	From source to Hadnot Creek	SA	6/1/56	20-23-2
Caleb Branch (City Weeks Branch)	From source to Hadnot Creek	SA	6/1/56	20-23-3
Godfry Branch	From source to White Oak River	SA	6/1/56	20-24
Hargetts Creek	From source to White Oak River	C	6/1/56	20-25
Holland Mill Creek	From source to White Oak River	SA	6/1/56	20-26
Cartwheel Branch	From source to Holland Mill Creek	SA	6/1/56	20-26-1
Hampton Bay	Entire Bay	SA	6/1/56	20-27
Stevens Creek	From source to White Oak River	SA	6/1/56	20-28
Pettiford Creek Bay	Entire Bay	SA	6/1/56	20-29
Pettiford Creek	From source to Pettiford Creek Bay	SA	6/1/56	20-29-1
Mill Creek	From source to Pettiford Creek	SA	6/1/56	20-29-1-1
Starkey Creek	From source to Pettiford Creek Bay	SA	6/1/56	20-29-2
Mullet Gut	From source to Starkey Creek	SA	6/1/56	20-29-2-1
Dubling Creek	From source to White Oak River	SA	6/1/56	20-30
Boathouse Creek	From source to White Oak River	SA	6/1/56	20-31

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
White Oak River Restricted Area	That portion of White Oak River within an area bounded by a line running in an easterly direction from a point below Foster Creek to east end of Swansboro Bridge (N.C. Hwy. 24), thus across bridge to west end of bridge, thus running along shore line to a point below Foster Creek	SC	6/1/56	20-32
Ward Creek	From source to White Oak River	SC	6/1/56	20-33
Dennis Creek (Demkis Creek)	From source to White Oak River	SC	6/1/56	20-34
Foster Creek	From source to White Oak River	SC	6/1/56	20-35
Bogue Sound (Including Intracoastal Waterway)	From Bogue Inlet (from a line running from the eastern mouth of Bogue Inlet to SR 1117 on the mainland) to a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point	SA ORW	1/1/90	20-36-(0.5)
Deer Creek	From source to Bogue Sound	SA	6/1/56	20-36-1
Hunting Island Creek	From source to Bogue Sound	SA	6/1/56	20-36-2
Taylor Bay	Entire Bay	SA ORW	1/1/90	20-36-3
Goose Creek	From source to Bogue Sound	SA	6/1/56	20-36-4
Sanders Creek	From source to Goose Creek	SA	6/1/56	20-36-4-1
Archer Creek (Piney Cr.)	From source to Bogue Sound	SA	6/1/56	20-36-5
Sanders Creek	From source to Bogue Sound	SA	6/1/56	20-36-6
East Prong Sanders Cr.	From source to Sanders Creek	SA	6/1/56	20-36-6-1
Sikes Branch	From source to East Prong Sanders Creek	SA	6/1/56	20-36-6-1-1
Broad Creek	From source to Bogue Sound	SA	6/1/56	20-36-7
West Prong Broad Creek	From source to Broad Creek	SA	6/1/56	20-36-7-1
Hannah Branch	From source to West Prong Broad Creek	SA	6/1/56	20-36-7-1-1
Sandy Branch	From source to Hannah Branch	SA	6/1/56	20-36-7-1-1-1
Wolf Branch	From source to West Prong Broad Creek	SA	6/1/56	20-36-7-1-2
East Prong Broad Creek	From source to Broad Creek	SA	6/1/56	20-36-7-2
Gales Creek	From source to Bogue Sound	SA	6/1/56	20-36-8
East Prong Gales Creek	From source to Gales Creek	SA	6/1/56	20-36-8-1
Bogue Sound (Including Intracoastal Waterway to Beaufort Inlet)	From a line across Bogue Sound from the southwest side of mouth of Gales Creek to Rock Point to Beaufort Inlet	SA	6/1/56	20-36-(8.5)
Jumping Run	From source to Bogue Sound	SA	6/1/56	20-36-9
Roosevelt Natural Area Swamp	All of the fresh waters within the property boundaries of the natural area including swamp forest, shrub swamp and ponds	C Sw ORW	6/1/88	20-36-9.5-(1)
Roosevelt Natural Area Swamp	All of the saline waters within the boundaries of the natural area including brackish marsh and salt marsh	SA Sw ORW	6/1/88	20-36-9.5-(2)

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
Spooner Creek	From source to Bogue Sound	SA	6/1/56	20-36-10
Peltier Creek	From source to Bogue Sound	SB#	6/1/92	20-36-11
Hoop Pole Creek	From source to Bogue Sound	SA	6/1/56	20-36-12
Money Island Bay	Entire Bay	SA	6/1/56	20-36-13
Money Island Slough	From source to Money Island Bay	SA	6/1/56	20-36-13-1
Allen Slough	From source to Money Island Bay	SA	6/1/56	20-36-13-2
Harbor Channel	Entire Channel	SA	6/1/56	20-36-14
Tar Landing Bay	Entire Bay	SA	6/1/56	20-36-15
Fishing Creek	From source to Tar Landing Bay	SA	6/1/56	20-36-15-1
Fort Macon Creek	From source to Bogue Sound	SA	6/1/56	20-36-16
	NEWPORT RIVER AND NORTH RIVER DRAINAGE AREA			
NEWPORT RIVER	From source to Little Creek Swamp	C	6/1/56	21-(1)
Northwest Prong Newport River	From source to Newport River	C	6/1/56	21-2
Little Run	From source to Northwest Prong Newport River	C	6/1/56	21-2-1
Cypress Drain	From source to Northwest Prong Newport River	C	6/1/56	21-2-2
Southwest Prong Newport River	From source to Newport River	C	6/1/56	21-3
Mairey Branch	From source to Southwest Prong Newport River	C	6/1/56	21-3-1
Millis Swamp	From source to Southwest Prong Newport River	C	6/1/56	21-3-2
Juniper Branch	From source to Southwest Prong Newport River	C	6/1/56	21-3-3
Peak Swamp	From source to Southwest Prong Newport River	C	6/1/56	21-3-4
Jasons Branch	From source to Southwest Prong Newport River	C	6/1/56	21-3-5
East Prong Jasons Branch	From source to Jasons Branch	C	6/1/56	21-3-5-1
Milldam Branch	From source to Southwest Prong Newport River	C	6/1/56	21-3-6
Big Ramhorn Branch	From source to Newport River	C	6/1/56	21-4
Little Ramhorn Branch	From source to Big Ramhorn Branch	C	6/1/56	21-4-1
Meadows Branch	From source to Newport River	C	6/1/56	21-5
Shoe Branch	From source to Newport River	C	6/1/56	21-6
Cedar Swamp Creek	From source to Newport River	C	6/1/56	21-7
School House Branch	From source to Newport River	C	6/1/56	21-8
Smiths Swamp	From source to Newport River	C	6/1/56	21-9
Blakes Branch	From source to Smiths Swamp	C	6/1/56	21-9-1
Smiths Swamp Branch	From source to Newport River	C	6/1/56	21-10
Deep Creek	From source to Newport River	C	9/1/74	21-11
Laurel Branch	From source to Deep Creek	C	9/1/74	21-11-1
Little Deep Creek	From source to Deep Creek	C	9/1/74	21-11-2

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
Snows Swamp Branch	From source to Newport River	C	6/1/56	21-12
Sandy Branch	From source to Newport River	C	6/1/56	21-13
Lodge Creek	From source to Newport River	C	6/1/56	21-14
Hull Swamp	From source to Newport River	C	6/1/56	21-15
Black Creek (Mill Pond)	From source to Newport River	C	6/1/56	21-16
Main Prong	From source to Mill Pond, Black Creek	C	6/1/56	21-16-1
Ghouls Fork	From source to Main Prong	C	6/1/56	21-16-1-1
Money Island Swamp	From source to Mill Pond, Black Creek	C	6/1/56	21-16-2
Billys Branch	From source to Mill Pond, Black Creek	C	6/1/56	21-16-3
NEWPORT RIVER	From Little Creek Swamp to Atlantic Ocean with exception of Morehead City Harbor restricted area	SA	6/1/56	21-(17)
Little Creek Swamp	From source to Newport River	SA	6/1/56	21-18
Mill Creek	From source to Newport River	SA	6/1/56	21-19
Big Creek	From source to Newport River	SA	6/1/56	21-20
Little Creek	From source to Newport River	SA	6/1/56	21-21
Harlowe Creek	From source (at N.C. Hwy. # 101) to Newport River	SA	6/1/56	21-22
Harlowe Canal	From Neuse River Basin Boundary (at Craven-Carteret County Line) to Harlowe Creek (at N.C. Hwy. # 101)	SA	6/1/56	21-22-1
Alligator Creek	From source to Harlowe Creek	SA	6/1/56	21-22-2
Oyster Creek	From source to Newport River	SA	6/1/56	21-23
Core Creek (Intracoastal Waterway - Adams Creek Canal)	From Neuse River Basin boundary to Newport River	SA	6/1/56	21-24
Eastman Creek	From source to Core Creek	SA	6/1/56	21-24-1
Bell Creek	From source to Core Creek	SA	6/1/56	21-24-2
Ware Creek	From source to Newport River	SA	6/1/56	21-25
Russell Creek	From source to Newport River	SA	6/1/56	21-26
Wading Creek	From source to Newport River	SA	6/1/56	21-27
Gable Creek	From source to Newport River	SA	6/1/56	21-28
Willis Creek	From source to Newport River	SA	6/1/56	21-29
Crab Point Bay	Entire Bay	SA	6/1/56	21-30
Newport River Restricted Area (Morehead City Harbor)	All waters within a line beginning at a point of land near the south end of 11th street in Morehead City at Lat. 34 43' 08", Long. 76 43' 04"; thence in straight line to the western end of Sugarloaf Island; thence along the north shore of the Island to the eastern end of the Island; thence in a straight line to Channel Marker C "1" near the western end of the Turning Basin; thence in a straight line to a point in the Turning Basin at Lat. 34 42'50", Long. 76 41' 36"; thence in a northerly direction to a point in Intracoastal Waterway at	SC	6/1/56	21-31

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Name of Stream	Description	Class	Classification Date	Index No.
	Lat. 34 43' 25", Long. 76 41' 40" adjacent to the channel leading to Morehead City Yacht Basin; thence in a straight line in a westerly direction to a point of land on the Morehead City Mainland at Lat. 34 43' 23", Long. 76 42' 24".			
Calico Creek	From source to Newport River (The mouth of Calico Creek is defined as beginning at a point of land on the north shore at Lat. 34 43' 46", Long. 76 43' 07", thence across the creek in a straight line to a point of land on the south shore at Lat. 34 43' 36", Long. 76 43' 05")	SC	6/1/56	21-32
Town Creek	From source to Newport River (The mouth of Town Creek is defined as beginning at a point of land on the north shore at Lat. 34 43' 41", Long. 76 40' 04", thence across the creek in a straight line to a point of land on the south shore at Lat. 34 43' 23", Long. 76 40' 04")	SC	6/1/56	21-33
Taylor Creek	From source to Newport River (The mouth of Taylor Creek is defined as beginning at a point of land on the north shore at Lat. 34 43' 07", Long. 76 40' 13", thence across the creek in a straight line to a point of land on the south shore at Lat. 34 42' 55", Long. 76 40' 10")	SC	6/1/56	21-34
Back Sound	From Newport River to a point on Shackleford Banks at lat. 34 40'57" and long 76 37'30" north to the western most point of Middle Marshes and along the northeast shoreline of Middle Marshes to Rush Point on Harkers Island	SA	6/1/56	21-35-(0.5)
North River	From source to Back Sound	SA	6/1/56	21-35-1
Feltons Creek	From source to North River	SA	6/1/56	21-35-1-1
Deep Creek	From source to North River	SA	6/1/56	21-35-1-2
Crabbing Creek	From source to North River	SA	6/1/56	21-35-1-3
Lynch Creek	From source to North River	SA	6/1/56	21-35-1-4
Thomas Creek	From source to North River	SA	6/1/56	21-35-1-5
Fulcher Creek	From source to North River	SA	6/1/56	21-35-1-6
Ward Creek	From source to North River	SA	6/1/56	21-35-1-7
Gilliklin Creek	From source to Ward Creek	SA	6/1/56	21-35-1-7-1
North Leopard Creek	From source to Ward Creek	SA	6/1/56	21-35-1-7-2
South Leopard Creek	From source to Ward Creek	SA	6/1/56	21-35-1-7-3

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
Newby Creek	From source to North River	SA	6/1/56	21-35-1-8
Goose Bay	Entire Bay	SA	6/1/56	21-35-1-9
Gibbs Creek	From source to North River	SA	6/1/56	21-35-1-10
Davis Bay (Cheney Bay)	Entire Bay	SA	6/1/56	21-35-1-11
Turner Creek	From source to Davis Bay	SA	6/1/56	21-35-1-11-1
The Straits	From Core Sound to North River	SA	6/1/56	21-35-1-12
Sleepy Creek	From source to The Straits	SA	6/1/56	21-35-1-12-1
Whitehurst Creek	From source to The Straits	SA	6/1/56	21-35-1-12-2
Westmouth Bay	Entire Bay	SA	6/1/56	21-35-1-12-3
Henry Jones Creek	From source to Westmouth Bay	SA	6/1/56	21-35-1-12-3-1
Janes Creek	From source to The Straits	SA	6/1/56	21-35-1-12-4
Brooks Creek	From source to North River	SA	6/1/56	21-35-1-13
Back Sound	From a point on Shackleford Banks at lat. 34 40'57" and long 76 37'30" north to the western most point of Middle Marshes and along the north-west shoreline of Middle Marshes (to include all of Middle Marshes) to Rush Point on Harkers Island and along the southern shore of Harkers Island back to Core Sound	SA ORW	1/1/90	21-35-(1.5)
Whale Creek	From source to Back Sound	SA ORW	1/1/90	21-35-2
Cabs Creek	From source to Back Sound	SA ORW	1/1/90	21-35-3
Bald Hill Bay	Entire Bay	SA ORW	1/1/90	21-35-4
Johnson Bay	Entire Bay	SA ORW	1/1/90	21-35-5
Blinds Hammock Bay	Entire Bay	SA ORW	1/1/90	21-35-6
The Ditch	From Lighthouse Bay to Blinds Hammock Bay	SA ORW	1/1/90	21-35-6-1
Core Sound	From northern boundary of White Oak River Basin (a line from Hall Point to Drum Inlet) to Back Sound	SA ORW	1/1/90	21-35-7
Point of Grass Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-1
Little Port Branch	From source to Core Sound (including Atlantic Harbor)	SC	12/1/92	21-35-7-2
Styron Bay	Entire Bay	SA ORW	1/1/90	21-35-7-3
Glover Creek	From source to Styron Bay	SA	6/1/56	21-35-7-3-1
Annis Run	From source to Styron Bay	SA	6/1/56	21-35-7-3-2
Styron Creek	From source to Styron Bay	SA	6/1/56	21-35-7-3-3
Cedar Creek	From source to Styron Creek	SA	6/1/56	21-35-7-3-3-1
Negro Creek	From source to Core Sound	SA	6/1/56	21-35-7-4
Horsepen Creek	From source to Core Sound	SA	6/1/56	21-35-7-5
Sheep Pen Creek	From source to Core Sound	SA	6/1/56	21-35-7-6
Gutter Creek	From source to Core Sound	SA	6/1/56	21-35-7-7
Cedar Inlet	From Old Channel to Core Sound	SA ORW	1/1/90	21-35-7-8
Old Channel	From Core Sound to Cedar Inlet	SA ORW	1/1/90	21-35-7-8-1
Yaupon Hammock Gut	Entire Gut	SA ORW	1/1/90	21-35-7-9
Nelson Bay	From mouth of Salters Creek to a	SC	6/1/56	21-35-7-10-(1)

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
	line extending from mouth of Broad Creek due east across Nelson Bay			
Salters Creek	From source to Nelson Bay	SC	6/1/56	21-35-7-10-2
Mingo Creek	From source to Nelson Bay	SC	6/1/56	21-35-7-10-3
Broad Creek	From source to Nelson Bay	SC	6/1/56	21-35-7-10-4
Nelson Bay	From a line extending from mouth of Broad Creek due east across Nelson Bay to Core Sound	SA	6/1/56	21-35-7-10-(5)
Lewis Creek	From source to Nelson Bay	SA	6/1/56	21-35-7-10-6
Pasture Creek	From source to Nelson Bay	SA	6/1/56	21-35-7-10-7
Willis Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-11
Fulchers Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-12
Brett Bay	Entire Bay	SA ORW	1/1/90	21-35-7-13
Maria Creek	From source to Brett Bay	SA ORW	1/1/90	21-35-7-13-1
Fork Creek	From source to Brett Bay	SA ORW	1/1/90	21-35-7-13-2
Head of the Hold	Entire Bay	SA ORW	1/1/90	21-35-7-14
The Swash	Entire Bay	SA ORW	1/1/90	21-35-7-15
Great Island Creek	From source to Core Sound	SA	6/1/56	21-35-7-16
Horse Island Creek	From source to Great Island Creek	SA	6/1/56	21-35-7-16-1
Fortin Bay	Entire Bay	SA	6/1/56	21-35-7-17
Oyster Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-18
Great Island Bay	Entire Bay	SA ORW	1/1/90	21-35-7-19
Johnson Creek	From source to Core Sound	SA	6/1/56	21-35-7-20
Spit Bay	Entire Bay	SA	6/1/56	21-35-7-21
Jarrett Bay	Entire Bay	SA ORW	1/1/90	21-35-7-22
Smyrna Creek	From source to Jarrett Bay	SA	6/1/56	21-35-7-22-1
Ditch Cove	From source to Jarrett Bay	SA ORW	1/1/90	21-35-7-22-2
Broad Creek	From source to Jarrett Bay	SA ORW	1/1/90	21-35-7-22-3
Great Creek	From source to Jarrett Bay	SA ORW	1/1/90	21-35-7-22-4
Howland Creek	From source to Jarrett Bay	SA ORW	1/1/90	21-35-7-22-5
Williston Creek	From source to Jarrett Bay	SA	6/1/56	21-35-7-22-6
Wade Creek	From source to Jarrett Bay	SA	6/1/56	21-35-7-22-7
Jump Run	From source to Core Sound	SA ORW	1/1/90	21-35-7-23
Middens Creek	From source to Core Sound	SA	6/1/56	21-35-7-24
Tush Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-25
Great Marsh Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-26
Deer Pond	Entire pond	SA ORW	1/1/90	21-35-7-27
Horsepen Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-28
Lewis Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-29
Zack Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-30
Mullet Cove	Entire cove	SA ORW	1/1/90	21-35-7-31
Sheep Pen Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-32
Codds Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-33
Try Yard Creek	From source to Codds Creek	SA ORW	1/1/90	21-35-7-33-1
Hogpen Bay	Entire Bay	SA ORW	1/1/90	21-35-7-34
Caggs Creek	From source to Hogpen Bay	SA ORW	1/1/90	21-35-7-34-1
Rawson Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-35
Iron Creek	From source to Core Sound	SA ORW	1/1/90	21-35-7-36
Lighthouse Bay	Entire Bay	SA ORW	1/1/90	21-35-7-37

.0312 WHITE OAK RIVER BASIN

Name of Stream	Description	Class	Classification Date	Index No.
Barden Inlet	From Atlantic Ocean to Core Sound	SA ORW	1/1/90	21-35-7-38
Atlantic Ocean	The waters of the Atlantic Ocean contiguous to that portion of the White Oak River Basin that extends from the northern boundary of White Oak River Basin (southwest side of Drum Inlet) to the southern boundary of White Oak River Basin (northern boundary of Cape Fear River Basin at the southwest side of the mouth of Goose Bay in the Intracoastal Waterway.	SB	7/1/73	99-(4)

Discharges of sewage are prohibited to segments classified SB or SC with a pound sign according to the provisions of 15A NCAC 2B .0203 and 2H .0404(a) in order to protect adjacent shellfishing waters.

APPENDIX II

DEM Water Quality Monitoring Programs:

- Benthic Macroinvertebrate Sampling
- Fisheries Studies
- Lakes Assessment
- Effluent Toxicity Testing

A - II.1 BENTHIC MACROINVERTEBRATES

Freshwaters

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 in freshwater systems, and polychaetes, crustacea, and mollusks in estuarine systems. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. The benthic community also integrates the effects of a wide array of potential pollutant mixtures. Criteria have been developed for freshwater to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera, and Trichoptera (EPT S). Higher taxa richness values are associated with better water quality. Likewise, ratings can be assigned with a Biotic Index. This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification for qualitative samples. Taxa richness alone is used to assign bioclassifications for EPT samples. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is poorly assessed by a taxa richness analysis. Different criteria have been developed for different ecoregions (mountains, piedmont, and coastal) within North Carolina. Criteria are being developed for estuarine benthos samples, but at the present time estuarine samples cannot be given a water quality evaluation.

Classification Criteria by Ecoregion*

A. EPT taxa richness values

	10-sample Qualitative Samples			4-sample EPT Samples		
	Mountains	Piedmont	Coastal	Mountains	Piedmont	Coastal
Excellent	>41	>31	>27	>35	>27	>23
Good	32-41	24-31	21-27	28-35	21-27	18-23
Good-Fair	22-31	16-23	14-20	19-27	14-20	12-17
Fair	12-21	8-15	7-13	11-18	7-13	6-11
Poor	0-11	0-7	0-6	0-10	0-6	0-5

B. Biotic Index Values (Range = 0-10)

	Mountains	Piedmont	Coastal
Excellent	<4.05	<5.19	<5.47
Good	4.06-4.88	5.19-5.78	5.47-6.05
Good-Fair	4.89-5.74	5.79-6.48	6.06-6.72
Fair	5.75-7.00	6.49-7.48	6.73-7.73
Poor	>7.00	>7.48	>7.73

*These criteria apply to flowing water systems only. Biotic index criteria are only used for full-scale (10-sample) qualitative samples.

Saltwaters

The effort to develop a method to assess water quality based on estuarine macroinvertebrates started in North Carolina in late 1990. By 1992, several standard methods of sampling and data analysis had been tested and found to be inadequate for North Carolina waters. In 1993, it was demonstrated that an Estuarine Biotic Index designed for Florida could also be used in North Carolina to accurately rank sites of varying water quality. It was also shown that sampling by epibenthic trawl was more effective at ranking sites than infaunal sampling with a petite ponar. Even so, using the Florida Estuarine Biotic Index (FEBI) on ponar-collected data was found to yield accurate results more often than not and more consistently than any other metric tested. It was also found that another Florida sampling technique, a semi-quantitative timed sweep, yielded results comparable to our historical samples, so a change in methods would not necessarily nullify previous estuarine work. Sampling for long term databases after December 1993 used the semi-quantitative sweep.

In 1994, further use of this semi-quantitative sweep method and FEBI suggested that they might also be useful at low salinities. A separate test in 1994 suggested that the FEBI was the only one of 17 metrics to accurately rank variably impacted sites for each of three sampling methods (petite ponar, epibenthic trawl, semi-quantitative sweep). Additionally, it was found that for semi-quantitative sweeps, the metrics Total taxa (S) and Amphipoda and Caridian shrimp (A+) taxa could also correctly rank the sites. In an early attempt at biocriteria development, it appeared that in high salinity waters, Total taxa (S), Biotic Index (BI), and Amphipoda and Caridian shrimp (A+) were most useful for delineating the highest quality areas.

These observations were confirmed with additional sampling during which it was also found that the metrics % Crustacean taxa and % Spionid and Capitellid polychaete taxa correctly ranked petite ponar samples 75% of the time. The FEBI was modified to create the North Carolina Estuarine Biotic Index (EBI) which more closely reflects taxa and tolerances in North Carolina.

Twenty-five estuarine locations were sampled for macroinvertebrates in the White Oak River Basin during the summer of 1994. Twenty locations were sampled using the semi-quantitative sweep, and two reference sites were sampled twice. Five sites were sampled only using the petite ponar dredge, while three locations that had been sampled by sweep were also sampled by dredge for comparison.

A - II.2 FISHERIES

Fish Communtiy Structure Assessment

The North Carolina Index of Biotic Integrity (NCIBI) is a modification of the Index of Biotic Integrity (Karr, 1981; Karr et al., 1986). The method was developed for assessing a stream's biological integrity by examining the structure and health of its fish community. The scores derived from this index are a measure of the ecological health of the waterbody and may not necessarily directly correlate to water quality. A stream with excellent water quality, but poor to fair habitat would not rate excellent in this index; however, a stream which rates excellent on the NCIBI would be expected to have excellent water quality. The NCIBI is not applicable to high elevation trout streams, lakes, or estuaries.

The Index incorporates information about species richness and composition, trophic composition, fish abundance, and fish condition. The NCIBI summarizes the effects of all classes of factors influencing aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). The assessment of biological integrity using the NCIBI is provided by the cumulative assessment of 12 parameters, or metrics. While any change in a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicates additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

NCIBI scores and integrity classes are presented in Tables A-II.1 and A-II.2.

Table A-II.1 <u>NCIBI Scores and Integrity Classes</u>

Excellent	58-60
Good-Excellent	53-57
Good	48-52
Fair-Good	45-47
Fair	40-44
Poor-Fair	35-39
Poor	28-34
Very Poor - Poor	23-27
Very Poor	12-22
No Fish	

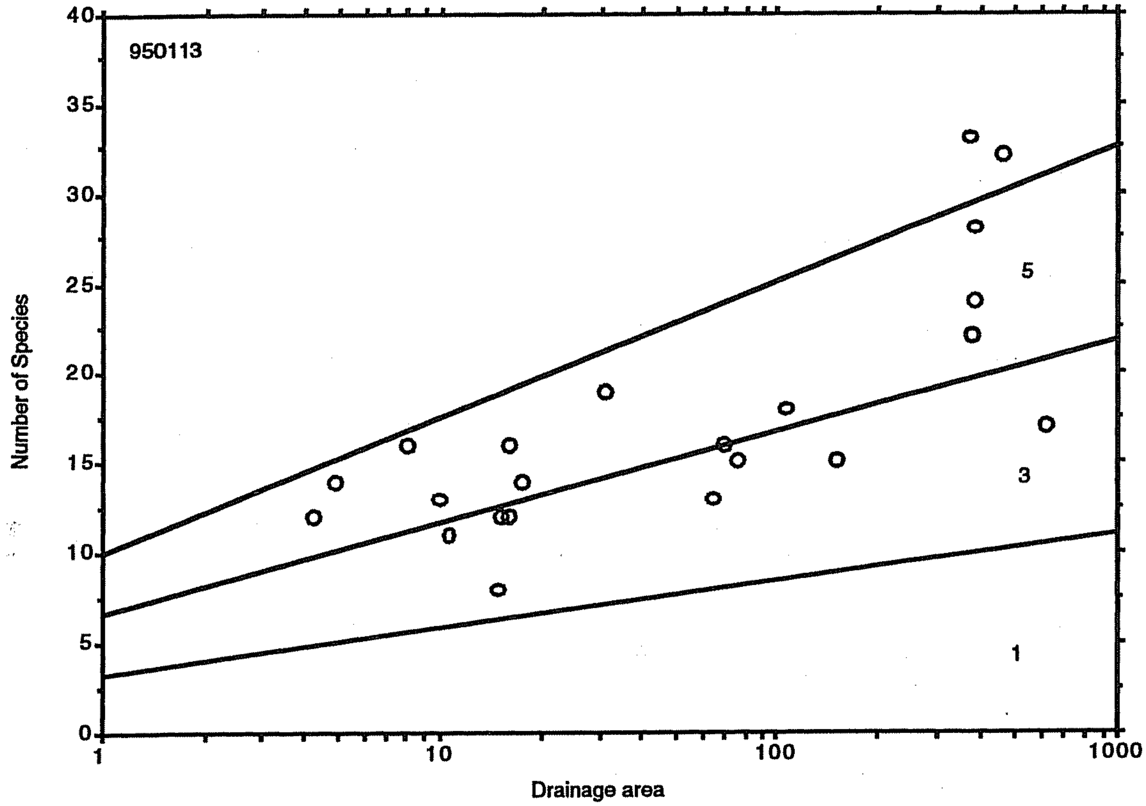
Classes listed above, but not below, have attributes of two classes.

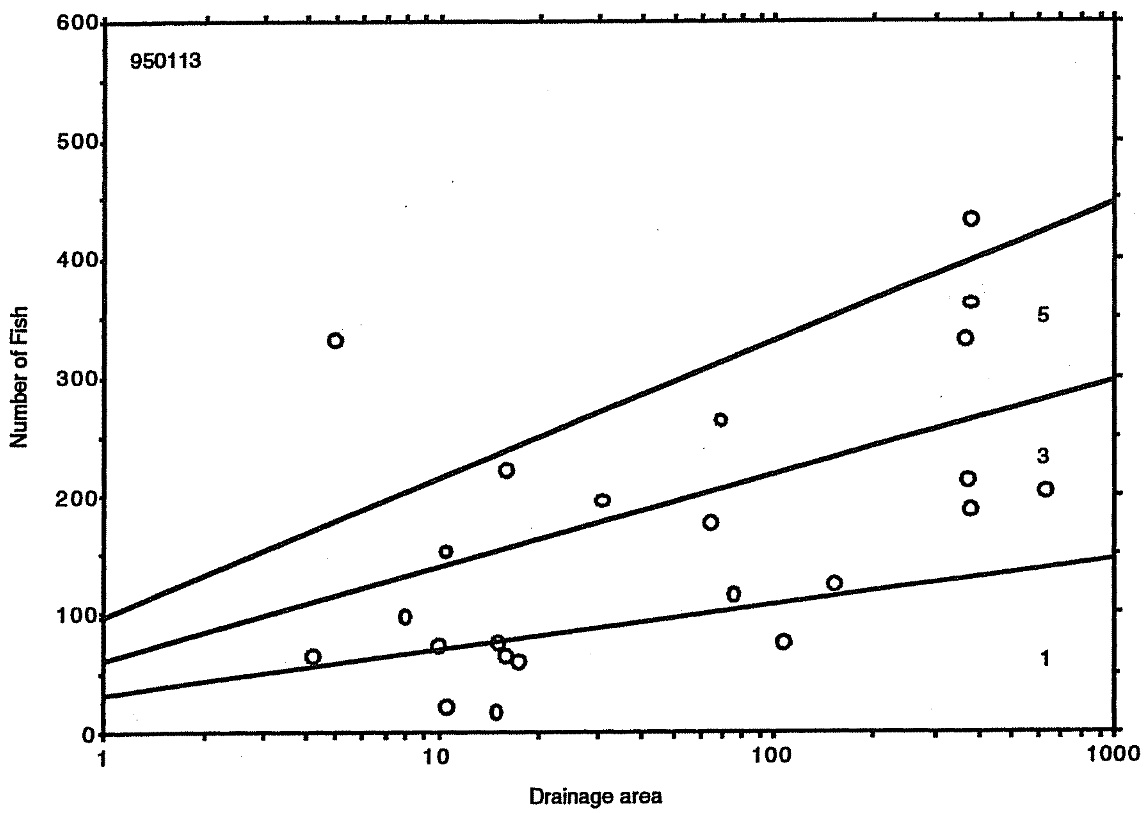
Table A-II.2 <u>NCIBI Integrity Classes and attributes of those classes</u> (modified from Karr et al., 1986)

Integrity Class	Attributes
Excellent	Comparable to the best situations without human disturbance; all regionally expected species for the habitat and stream size, including the most intolerant forms, are present with a full array of size classes; balanced trophic structure.
Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant forms; some species are present with less than optimal abundances or size distributions; trophic structure shows some signs of stress.
Fair	Signs of additional deterioration include loss of intolerant forms, fewer species, highly skewed trophic structure.
Poor	Dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; diseased fish often present.
Very poor	Few fish present, mostly introduced or tolerant forms, disease fin damage and other anomalies regular
No fish	Repeated sampling finds no fish.

Streams with larger watersheds or drainage areas are expected to support more fish species and a larger number of fish. Figures A-II.1 and A-II.2 illustrate the relative number of species and fish that can be expected in the White Oak River Basin based upon the size of the drainage area.

Figures A-II.1. and A-II.2 Expectations of the Number of Species and Fish based upon Drainage Area Size (square miles) in the White Oak River Basin





Fish TIssue

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Contamination of aquatic resources, including freshwater, estuarine, and marine fish and shellfish species, 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.

Fish tissue 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.

In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with Federal Food and Drug Administration (FDA) action levels, U. S. Environmental Protection Agency (EPA) recommended screening values, and criteria adopted by the North Carolina Division of Epidemiology.

The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue analytes accompanied by their FDA criteria are presented below. At present, the FDA has only developed metals criteria for mercury. Individual parameters which appear to be of potential human health concern are evaluated by the North Carolina Division of Epidemiology by request of the Water Quality Section.

Food and Drug Administration (FDA) Action Levels

		Metals	
Mercury	1.0 ppm		
		Organics	
Aldrin	0.3 ppm	o,p DDD	5.0 ppm
Dieldrin	0.3 ppm	p,p DDD	5.0 ppm
Endrin	0.3 ppm	o,p DDE	5.0 ppm
Methoxychlor	None	p,p DDE	5.0 ppm
Alpha BHC	None	o,p DDT	5.0 ppm
Gamma BHC	None	p,p DDT	5.0 ppm
PCB-1254	2.0 ppm	cis-chlordane	0.3 ppm
Endosulfan I	None	trans-chlordane	0.3 ppm
Endosulfan II	None	Hexachlorobenzene	None

In the guidance document, Fish Sampling and Analysis: Volume 1 (EPA823-R-93-002), the EPA has recommended screening values for target analytes which are formulated from a risk assessment procedure. EPA screening values are the concentrations of analytes in edible fish tissue that are of potential public health concern. The DEM compares fish tissue results with EPA screening values to evaluate the need for further intensive site specific monitoring. A list of target analytes and EPA recommended screening values for the general adult population is presented below.

The North Carolina Division of Epidemiology has adopted a selenium limit of 5 ppm for issuing fish consumption advisories. Total DDT includes the sum of all its isomers and metabolites (i.e. p,p DDT, o,p DDT, DDE, and DDD). Total chlordane includes the sum of cis-and trans- isomers as well as nonachlor and oxychlordane. Although the EPA has suggested a screening value of 7.0 x 10-7 ppm for dioxins, the State of North Carolina currently uses a value of 3.0 ppt in issuing fish consumption advisories.

Environmental Protection Agency (EPA) Screening Values

Metals		
Cadmium	10.0	ppm
Mercury	0.6	ppm
Selenium	50.0	ppm
Organics		
Chlorpyrifos	30.0	ppm
Total chlordane	0.08	ppm
Total DDT	0.3	ppm
Dieldrin	0.007	ppm
Dioxins	7.0×10^{-7}	ppm
Endosulfan (I and II)	20.0	ppm
Endrin	3.0	ppm
Heptachlor epoxide	0.01	ppm
Hexachlorobenzene	0.07	ppm
Lindane	0.08	ppm
Mirex	2.0	ppm
Total PCB's	0.01	ppm
Toxaphene	0.1	ppm

The following tables presents results of fish tissue analyses from sampling stations in the White Oak River Basin.

Table A-II.2 Fish Tissue Analyses Conducted in the White Oak River Basin. (** indicates no criteria exceeded. Hg = mercury.)

Station	Years Sampled	# Samples	# Samples exceeding criteria	Criteria exceeded
Subbasin 01				
Great Lake	1983 and 1994	26	6	FDA Hg, EPA Hg
Hunters Cr nr Stella	1983	12	0	**
Subbasin 02				
New R near Gum Branch	1986	4	0	**
New R at Jacksonville	1994	22	0	**
New R at Sneads Ferry	1984	2	0	**
Subbasin 03				
Bogue Sound	1980, 1984	6	0	**
Subbasin 04				
North River	1984	3	0	**
Sleepy Cr	1095	3	0	**

A - II.3 LAKES ASSESSMENT PROGRAM

Lakes are valued for the multitide of benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lake Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed. Data are used to determine the trophic state (a relative measure of nutrient enrichment and productivity) of each lake, and whether the designated uses of the lake have been threatened or impaired by pollution.

Tables presented in each subbasin summarize data used to determine the trophic state and use support status of each lake. These determinations are based on information from the most recent summertime sampling (date listed). The most recent North Carolina Trophic State Index (NCTSI) value is shown followed by the descriptive trophic state classification (O=oligotrophic, M=mesotrophic, E=eutrophic, H=hypereutrophic, D=dystrophic).

Numerical indices are often used to evaluate the trophic state of lakes. An index was developed specifically for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NCDNRCD, 1982). The North Carolina Trophic State Index (NCTSI) is based on total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), Secchi depth (SD in inches), and chlorophyll-a (CHL in µg/l). Lakewide means for these parameters are manipulated to produce a NCTSI score for each lake using the following equations:

$$\text{TON score} = \frac{\text{Log(TON)} + (0.45)}{0.24} \times 0.90$$

$$\text{TP score} = \frac{\text{Log(TP)} + (1.55)}{0.35} \times 0.92$$

$$\text{SD score} = \frac{\text{Log(SD)} - (1.73)}{0.35} \times -0.82$$

$$\text{CHL score} = \frac{\text{Log(CHL)} - (1.00)}{0.43} \times 0.83$$

$$\text{NCTSI} = \text{TON score} + \text{TP score} + \text{SD score} + \text{CHL score}$$

In general, NCTSI scores relate to trophic classifications as follows: less than -2.0 is oligotrophic, -2.0 to 0.0 is mesotrophic, 0.0 to 5.0 is eutrophic, and greater than 5.0 is hypereutrophic. When scores border between classes, best professional judgment is used to assign an appropriate classification. NCTSI scores may be skewed by highly colored water typical of dystrophic lakes. Some variation in the trophic state of a lake between years is not unusual due to the potential variability of data collections which usually involve sampling on a single day during the growing season. This survey methodology does not adequately evaluate changes which might occur throughout the year between lake samplings. More intensive (monthly) monitoring is required to identify lake specific variability. However, monitoring a lake once per growing season does provide a relatively valuable assessment of water quality conditions on a large number of lakes.

Lakes are classified for their "best usage" and are subject to the state's water quality standards. Primary classifications are C (suited for aquatic life propagation/protection and secondary recreation such as wading), B (primary recreation, such as swimming, and all class C uses), and WS-I through WS-V(water supply source ranging from highest watershed protection level I to lowest watershed protection V, and all class C uses). Lakes with a CA designation represent water supplies with watersheds that are considered to be Critical Areas (i.e., an area within 1/2 mile and draining to water supplies from the normal pool elevation of reservoirs, or within 1/2 mile and draining to a river intake). Supplemental classifications in the New Fear River basin may include SW (slow moving Swamp Waters where certain water quality standards may not be applicable), NSW (Nutrient Sensitive Waters subject to excessive algal or other plant growth where nutrient controls are required), HQW (High Quality Waters which are rated excellent based on biological and physical/chemical characteristics), and ORW (Outstanding Resource Waters which are unique and special waters of exceptional state or national recreational or ecological value). A complete listing of these water classifications and standards can be found in Title 15 North Carolina Administrative Code, Chapter 2B, Section .0100 and .0200.

The summary tables presented within the body of this document list lakewide averages of total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), chlorophyll *a* (CHLA in µg/l), and Secchi depth, followed by surface water classification. Causes of use impairment are explained below each table. Algal Growth Potential Tests (AGPT) have not been conducted on these lakes. There were two lakes in the White Oak River Basin sampled as part of the Lakes Assessment Program. These lakes, by river subbasin, are presented below.

SUBBASIN 030501
Catfish Lake
Great Lake

Each lake is individually discussed in the appropriate subbasin section in Chapter 4 with a focus on the most recent available data. These lakes, which were sampled most recently in 1994, fully support their designated uses.

A-II.4 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 by their NPDES permit or by administrative letter. Other facilities may be tested by DEM's Aquatic Toxicology Laboratory. The Aquatic Survey andToxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update of this information to regional offices and DEM administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

The following table presents the facilities in the White Oak River Basin that are monitoring effluent toxicity.

Table A-II.3 NPDES Facilities in the White Oak River Basin Required to Monitor the Toxicitiy of Their Effluent

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Jacksonville-Wilson Bay WWTP	NC0024121/001	New River	Onslow	4.46	NA
USMC Camp Lejeune Camp Johnson WWTP	NC0063011/001	Northeast Cr	Onslow	1.00	NA
USMC Camp Lejeune Courthouse Bay	NC0063045/001	New River	Onslow	0.6	NA
USMC Camp Lejeune Geiger WWTP	NC0062995/001	New River	Onslow	1.60	NA
USMC Camp Lejeune Hadnot Point WWTP	NC0063029/001	New River	Onslow	9.0	42
USMC Camp Lejeune Onslow Beach WWTP	NC0063053/001	Intracoastal W.	Onslow	0.195	NA
USMC Camp Lejeune Rifle Range WWTP	NC0063037/001	New River	Onslow	0.525	NA
USMC Camp Lejeune Tarawa Terrace	NC0063002/001	Northeast Cr	Onslow	1.25	NA
Weston Inc.-ABC One Hour Cleaners	NC0084395/001	Northeast Cr	Onslow	0.216	90.0
Morehead City WWTP	NC0026611/001	Calico Cr.	Carteret	1.7	NA
Beaufort WWTP	NC0021831/001	Taylor Creek	Carteret	1.5	NA

IWC = Instream Waste Concentration
MGD = Million Gallons per Day

APPENDIX III

Modeling Information

APPENDIX III

Modeling Information

INTRODUCTION

In order to assess the impact of pollutants on surface water quality, the Division must often develop and apply water quality models. A water quality model is a simplified representation of the physical, chemical, and biological processes which occur in a water body. The type of model used is dependent on the purpose for which it is needed, the amount of information that is available or attainable for its development, and the degree of accuracy or reliability that is warranted. In most cases, the Division develops and applies a given model to predict the response of the system to a given set of inputs that reflect various management strategies. For example, water quality models such as QUAL2E or the Division's Level B model are used to predict what the instream dissolved oxygen concentration will be under various sets of NPDES wasteflows and discharge limits. The following sections briefly summarize the types of models used by the Division.

Oxygen-Consuming Waste Models

Several factors are considered when choosing an oxygen-consuming waste model including: the type of system (stream, lake, or estuary), whether one, two, or three dimensions are needed, the temporal resolution needed, and the type of data available. Many of the factors are related. For example, in streams, flow usually occurs in one direction and one can assume that a steady state model will result in adequate predictions. A steady state model is one in which the model inputs do not change over time. However, in open water estuaries, the tide and wind affect which way water moves, and they must often be represented by 2 or 3 dimensional models. In addition, the wind and tide can affect the model reaction rates, and therefore a dynamic model must be used rather than one which is steady state. The last factor, the amount of data available, dictates whether an empirical or calibrated model will be used. An empirical model is used when little water quality information is available for a given water body, and hydraulics and decay rates are estimated through the use of equations. For example, in North Carolina's empirical stream model (referred to as a Level B analysis) velocity is determined through a regression equation developed from North Carolina stream time-of-travel (TOT) studies which includes stream slope and flow estimates as independent variables. Stream slope can be measured from a topographic map, and flow is estimated at a given site by the U.S. Geological Survey. Therefore, the empirical model can be run without TOT information specific to a given stream since parameters are estimated through the use of information which can easily be obtained in the office environment. More information regarding the empirical dissolved oxygen model used by DEM can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Field calibration of a BOD/DO model requires collection of a considerable amount of data. For example, in order to develop hydraulics equations specific to a given stream, TOT studies using rhodamine dye are recommended under at least two flow scenarios including one summer low flow period. In addition, during one summer low flow study, dissolved oxygen, temperature, long term BOD and nitrogen series data are collected. Sediment oxygen demand (SOD) data may also be collected. These data are then used to calibrate reaction rates specific to the stream. QUAL2E is the most commonly used calibrated DO/BOD model for streams in North Carolina. A copy of the model guidance can be obtained from EPA's Environmental Research Lab in Athens, Georgia, and further information on North Carolina's calibration procedures can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Data collection for an estuary DO model is even more extensive. Since the system is multi-dimensional and not steady-state, many more data are needed. Dye is often injected into a system over a period of time, and the dye cloud is then followed for a period of time which may last for days. In addition, several tide gages may need to be set up. Due to the stratification which occurs in an estuary, depth integrated data must also be collected. Calibrated estuary models which have been used by DEM include WASP and GAEST. WASP is also supported by EPA, and a user manual may be obtained from them. You should note that both GAEST is a one dimensional and is not applicable to many of North Carolina's estuaries.

Lakes are rarely modeled for BOD. Tributary arms of lakes are modeled as slow-moving streams if it is clearly indicated that the flow goes in one direction at all times. Depending on the system, a one, two, or three dimensional model may be used. If a one dimensional model is needed, the modeler may choose the Level B (if little or no data), or QUAL2E. In multidimensional lake systems, WASP will be used.

The calibrated model will be more accurate than the empirical model since it is based on data collected specifically for a given stream in the State. However, it is much more expensive to develop a calibrated model. Not only do a number of staff spend several days to weeks collecting field data (sometimes having to wait months for appropriate conditions), but it also takes the modeling staff several months to develop and document the calibrated model. An empirical model can be developed and applied in a matter of hours. Therefore, due to resource constraints, the majority of the BOD/DO models developed in North Carolina are empirical.

Eutrophication Models

Eutrophication models are used to develop management strategies to control trophic response of a system to nutrient inputs (usually total phosphorus (TP) or total nitrogen (TN)). Nutrient management strategies are typically needed in areas which are sensitive to nutrient inputs due to long residence times, warm temperature, and adequate light penetration. These characteristics are found in deep slow moving streams, ponds, lakes, and estuaries. Modeling and insitu research are used to relate nutrient loading to the trophic response to the system allowing the manager to establish nutrient targets. Models which may be used include the Southeastern Lakes Model (Reckhow, 1987), Walker's Bathtub Model (Walker, 1981), QUAL2E, and WASP.

Once the nutrient targets are known, watershed nutrient budgets are developed to evaluate the relative nutrient loadings from various point and nonpoint sources. Land use data are obtained for the basin, and export coefficients based on literature values are applied to each land use. An export coefficient is an estimate of how may pounds of nutrient will runoff from each acre of land in a given year.

Toxics Modeling

Toxics modeling is done to determine chemical specific limits which will protect to the "no chronic" level in a completely mixed stream. The standards developed for the State of North Carolina are based on chronic criteria. These chemical specific toxics limits are developed through the use of mass balance models:

$$(Cup)(Qup) + (Cw)(Qw) = (Cd)(Qd) \text{ where}$$

Cup = concentration upstream
Qup = flow upstream
Cw = concentration in wastewater (known being solved for in WLA)
Qw = wasteflow
Cd = concentration downstream (set = to standard or criteria)
Qd = flow downstream (= Qup + Qw)

When no data are available concerning the upstream concentration, it is assumed to be equal to zero. The upstream flow is the 7Q10 at the discharge point unless the parameter's standard is based on human health concerns, in which case the average flow is used.

REFERENCES CITED - MODELING APPENDIX

Reckhow, K. H., 1987. "A Cross-Sectional Analysis of Trophic State Relationships in Southeastern Lakes." Duke University School of Forestry and Environmental Studies, Durham, N.C.

Walker, W. W., Jr. 1981. "Empirical Methods for Predicting Eutrophication in Impoundments," Technical Report E-81-9, prepared by William W. Walker, Jr., Environmental Engineer, Concord, Mass., for the U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

APPENDIX IV

SUMMARY OF BASINWIDE PLANNING WORKSHOPS

October 23, 1995
Jacksonville and Cedar Point

October 24, 1995
Morehead City

Summary of Coastal New River, White Oak River, Newport River, North River Basinwide Water Quality Management Plan Public Workshops

JACKSONVILLE WORKSHOP/October 23, 1995

Group #1
(Facilitator: Greg Jennings, North Carolina Cooperative Extension Service)

Note: After identifying and grouping the issues into categories, participants prioritized the categories. Two categories received the same number of votes in this ranking and are both shown below as #4).

Priority #1: Land Use Planning

-Introduce and address what PS/NPS sources can be controlled through some types of local land use planning
-Better land use controls: locally apply regulations that can work
-Land use plans: better integration into zoning; perception that CAMA is slipping away
-Manage growth to protect water/size waste treatment based on assimilative capacity of service area
-Nutrient assimilative capacity: DEM set total loads for specific waters and do not exceed

Priority #2: Protect existing uses of estuaries

-Shellfish closures/shellfish waters:
- -List temporary closure of waters as "impaired"
- -Re-examine stormwater regulations
- -Re-examine AEC for estuarine shoreline

-Water classifications:
- -Couldn't we work toward making ORWs (areas) grow
- -Protect primary nursery areas/assign water standards
- -Protect ORW waters/re-examine ORW management measures

Priority #3: Nutrient management and reduction

-Atmospheric fallout of nitrogen: determine sources and how to control
-Nutrient runoff from farms: DEM/NRCS require water management plans--enforce, educate
-Nutrients: permitting and land applications
-Protect seagrass beds: nutrient (nitrogen) standards, address turbidity problems

Priority #4: Better enforcement of existing regulations

-Stormwater management/urban and road construction: enforce state and county regulations
-Outline in action plans what resources can or will be used to enforce laws in the basin, i.e. Tar-Pamlico agreement
-Targets and deterrents
-NPDES permits: better enforcement of permit criteria
-Testing measures: determine if present sampling is adequate to protect water quality and human health; determine if better methods are cost effective
-Re-use of treated wastewater: require local governments etc. to consider options and adopt plan for re-use

Priority #4: Wetland protection

-Water quality rules allow lagoon construction in wetlands: revise rules to eliminate this practice
-Protect coastal water quality from nutrients, bacteria/protect wetlands

Priority #5: Education and public involvement

-Watershed education - more workshops showing what DEM, DCM does for local area!
-Identify all issues that impact water quality and put them in priority order; run this by local citizens and local governments for buy in
-Determine cost of pollution reduction of each source, most reduction for dollars spent
-See what it costs to get to levels that are acceptable

Priority #6: Strategies for animal waste

-Examine appropriate density of operations
-Large hog farms are businesses and should be treated as such

Group #2
(Facilitator: Jeff Morton, Onslow County Extension Center)

Issues: (not ranked)
1. Closed shellfish waters/reasons
2. Fragmentation/lack of coordination
3. Livestock spills/animal waste management
4. Continuing point source pollution problems
5. Nature of natural flushing
6. Human waste management
7. Impact of changing hydrology
8. Coastal development: lack of buffers etc. and impact of existing development
9. Wetland fills

10. Ocean setbacks
11. Impact of dredging on shellfish
12. Changing pH - effect on shellfish
13. Action, not research or additional regulation

Actions (not prioritized):

A. Reopening closed shellfish waters and habitat
   - -Dredging practices
   - -Aquaculture
   - -Shoreline land management practices

B. Animal waste management
   - -Improved inspections/enforcement
   - -Utilize soil conservation personnel
   - -Better intergovernmental communication
   - -Attention to appropriate land application procedures

C. Human waste management
   - -Make sure dischargers meet permit limits
   - -Failing septic tanks
   - -Incentives/requirements for more operator education

D. Coastal Development
   - -Setbacks
   - -Local officials - deal with existing development
   - -Local land use planning to protect water quality

E. Hydrology

F. Governmental action
   - -Partnerships (state/local/federal)
   - -Government agencies sharing information
   - -Proceed with solutions based on existing information

Group #3
(Facilitator: Minton Small, North Carolina Cooperative Extension Service)

Priority #1: Developing information base

-Barrier island effects on river cleansing
-Toxic contents of human wastes as compared to swine
-Identify sources of chemical contamination
-Managing NPS pollution inputs
-Waste treatment systems operating beyond capacity
-Is fish sampling considering only human health or ecosystem health in general?

-Oceanview spill was less than 1 days legal discharges
-Topsail Sound has been closed for shellfishing for years because of Topsail homes
-During periods of no rain discharges from point sources curtailed

Priority #2: Public education

-General public unaware that they impact water quality significantly
-Too much finger pointing by individuals/groups in an effort to avoid responsibility for shared blame in water quality degradation
-Misconception that swine farmers have had no nutrient training
-Swine industry condemned for mismanagement; really a low percentage (50 out of 4000 per David Holsinger (of DEM))
-Total focus on swine is ignoring municipal/urban inputs into waters

Priority #3: Enforcing and developing regulations (federal, state and local)

-Enforcement of existing regulations
-More enforcement of existing laws
-How to help public to have confidence in government regulations in view of poor actions
-Lack of control on human house building on waters
-Shouldn't ocean waters be tested?
-Managing growth of population
-Are we trying to accommodate development or improve water quality?
-Are current laws being followed?
-Are we examining alternatives means of waste disposal/treatment?
-Better agency and government cooperation

Priority #4: Training of all waste treatment operators (farm and city)

-Livestock waste treatment operators inadequately trained?
-Training for all waste treatment operators (municipal and farm)

Group #4
(Facilitator: Suzanne Hoover, North Carolina Division of Environmental Management)

Priorities (not ranked):

1. Planning and education
-Development/growth/land use planning
-Devaluation of property/increased value
-Environmental education (solid waste)/Interagency cooperation
-Long range planning for WWTP collection, treatment and disposal
-Comprehensive zoning
-COE dredging/tidal flow

-Citizen input and involvement

2. NPS/Point source/Nutrients
-Atmospheric deposition of ammonia/nitrogen
-N/P ratio - increasing
-Septic systems/package plants
-WWTP overflows
-Urban runoff
-Agricultural runoff
-Highway construction runoff
-Pesticides and herbicides
-Residential runoff (lawn care) and commercial runoff
-Pollution from wildlife/natural causes

3. Enforcement/conflict of interest
-Enforcement of NPDES dischargers - nighttime monitoring
-Conflicts of interests
-Wildlife/wetland protection
-More authority to local governments in WWTP permitting

4. Air quality
-Smell from hog operations

CEDAR POINT WORKSHOP/October 23, 1995
(Facilitator: Catherine McCracken, North Carolina Cooperative Extension Service)

Issues (not ranked):

1. Engineering changes related to Highway 24/curb and gutter through Cedar Point- further block runoff and natural flow of White Oak River
2. Wastewater management-capacity, problems with septics
3. Impact of land application of wastewater on private wells
4. Availability of access to public waters
5. Cross-county issues related to contamination of groundwater supplies--in different basins and re-charge areas
6. Impacts of mining operation in Jones County - environmental impacts
7. Access to White Oak River - reinstitute Boat Path program
8. Land clearing/tree cutting - including land clearing for land application of livestock waste
9. Stormwater runoff
10. Buffers for livestock operations
11. NCDA fertilizer use recommendations
12. Homeowner fertilizer, pesticide and herbicide use
13. Control of population density adjacent to waters

14. Eliminate treatment of human waste on open fields-septic tank pumping violations
15. Animal waste management
16. Impacts of wildlife on water quality
17. Hypo-salinity of estuaries
18. Inter-basin transfer of water-variety of sources
19. Flushing of rivers and estuaries
20. True identification of problems and sources to facilitate development of effective solutions (don't trade one problem for another)
21. Atmospheric deposition of nitrogen from hog farms
22. Tie in with work of Shellfish Sanitation
23. Upstream dischargers - i.e. Raleigh, Durham
24. Coliform as an indicator - specific indicator needed for human waste
25. Stricter regulations-more enforcement of existing regulations
26. Education
27. Equal treatment-concerns of upstream and downstream

<u>**MOREHEAD CITY WORKSHOP/October 24, 1995**</u>

Group #1
(Facilitator: Suzanne Hoover, North Carolina Division of Environmental Management)

<u>Priorities:</u>
Priority 1a. Protection of unimpaired waters
Priority 1b. Use restoration
Priority 2. Wetlands protection
Priority 3. Integration of divisions/resources
Priority 4a. Schedule of implementation-make recommendations meaningful
Priority 4b. Mandated enforcement

<u>Other issues: (not ranked)</u>
1. Protection of Castle-Hayne aquifer
2. Proper application of fertilizer and managed application of waste (agricultural and residential)
3. Stormwater runoff - urban and agricultural
4. Protection of Primary Nursery Areas and Submerged Aquatic Vegetation
5. Identification of sources of NPS pollution
6. Require that hog waste management be aerobic
7. Elimination of N from point sources
8. Control of airborne nutrients
9. Septic systems
10. Incorporate citizen monitoring
11. Prioritizing problems in basin
12. Political methods of achieving goals
13. More effective coordination among agencies

14. Include septic management in nutrient trading
15. Accurate baseline monitoring data
16. Get best information/data available to local governments for land use plans

Group #2
(Facilitator: Catherine McCracken, North Carolina Cooperative Extension Service)

Issues (not ranked):

1. Cost of providing services-DEM needs to be sensitive to how the municipalities have to handle this (i.e. basinwide requirements)
2. Requirements-existing/new facilities
3. Cost of services-low-income residents/assistance or grants to help
4. Public participation-how to involve non-urban areas (location/time of meetings)
5. Education at local level
6. Who do you call if you see violations?
7. NPS in rural areas-lumbering (small landowners)/timber harvesting
8. Enforcement of regulations
9. Who do you call? What do you do? Informational and enforcement issues--
10. Fragmentation of efforts/cross-jurisdictional issues
11. Airshed-what about inputs from far away?
12. Land use planning outside coastal zone--more basinwide regional planning efforts
13. Involvement of NPS/PS sources in local meetings-communication between groups
14. What about water conservation as part of wastewater management?
15. Local participation and local responsibility-will that be lost in regional planning?
16. Who will call meetings to coordinate inter-municipality land use planning at an early stage?
17. Streamline enforcement
18. Enforce what we have already and evaluate it to see if it's working
19. Pump-outs for boat waste
20. Disposal of solid waste-where to put it? convenience? would a bottle law help?
21. Federal/state/municipal facilities--they put parking lots next to the water--"practice what you preach"
22. Laws on animal/hog operations addressing water quality: are buffer zones adequate? should there be buffer zones for all activities adjacent to water?
23. Treat all water as if it is drinking water
24. How do local governments know what will be required in basinwide plans? How can local governments be involved? Who writes the basinwide plans?
25. Will policy statements in basinwide plans be sufficient to deny permits? impact local land use plans and ordinances?
26. What about groundwater pollution from underground storage tanks?
27. Change classification to ORW to increase protection status of waters
28. Can the state be expected to address water quality problems, i.e. with the current climate of reducing government?

29. Education of local officials
30. User-friendly summary of basin plans, land use plans etc.
31. Put information where the people are: libraries, Wal-Mart, 7-Eleven
32. A classification which recognizes the problems and can result in problems being addressed, i.e. something to trigger protection mechanisms, URW designation
33. Mitigation/general environmental mitigation: all varieties, what are the requirements/incentives and will the measures last?
34. Central databank - all information in one place for local governments and residents and a good way to deliver information to those outside Raleigh
35. Make everyone responsible for what they do - upstream/downstream issues.
36. Annexation shouldn't be allowed until they can handle that growth - wastewater, stormwater and health issues
37. Beach replenishment/nourishment - address erosion, cost issues - should we do it?
38. Preserving areas which have good water quality now - proactive v. reactive
39. Watershed councils as a way to address problems and communications

APPENDIX V

LIST OF NONPOINT SOURCE CONTACTS IN THE WHITE OAK RIVER BASIN

LISTS OF BEST MANAGEMENT PRACTICES (BMPS) FOR:

*** Agriculture**
*** Urban Runoff**
***Sedimentation and Erosion Control**
*** Onsite Watewater Disposal**
*** Forestry**
*** Mining**

White Oak River Basin Nonpoint Source Contacts

Agency	Area of Responsibilities	Contacts	Phone	Address
USDA Natural Resources Conservation Service -- Soil & Water Conservation Districts	Formerly the Soil Conservation Service; provides technical specialist for certifying waste management plans; certified trainers for swine applicators training sessions works with landowners on private lands to conserve natural resources helping farmers and ranchers develop conservation systems uniquely suited to their land and individual ways of doing business; provides assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conducts site evaluations and soil surveys; administers the Wetlands Reserve Program and the Agriculture Cost-Share Program; offers planning assistance for local landowners for installing best management practices; offers technical assistance for the determination of wetlands on agricultural lands.			
	Carteret County	Harry S. Tyson	910-455-4472	604 College St Jacksonville NC 28540
	Craven County	Andrew Metts	919-637-2547	302 Industrial Dr. New Bern NC 28562
	Jones County	Michael Harriett	919-448-2731	PO Box 40 Trenton NC 28585
	Onslow County	Harry S. Tyson	910-455-4472	604 College St Jacksonville NC 28540
NCDA Regional Agronomists	Technical specialist for certifying waste management plans; certified trainers for swine applicators training sessions			
	Region I	Roger Sugg	919-793-4118	Tidewater Research Stn, Plymoth NC 27962
	Region III	Bob Edwards	919-523-2949	PO Box 801 Kinston NC 28502
DEM Water Quality Section	Control of water pollution from point sources such as municipal and industrial wastewater discharges, and from nonpoint sources that originate from agricultural drainage, urban runoff, land clearing, construction, mining, forestry, septic tanks and land application of waste; issues permits for both discharging and on-site wastewater treatment systems, conducts compliance inspections, operates an ambient water quality monitoring program, and performs a wide variety of special studies on activities affecting water quality; administers the 319 projects statewide.			
	Central Region	Linda Hargrove (319 Projects)	919-733-5083	DEM Water Quality Section Raleigh NC 27626
	Washington Region	Bill Moore	919-946-6481	1424 Carolina Ave. Washington NC 27889-3314
	Wilmington Region	Dave Adkins	910-395-3900	127 Cardinal Dr Extension, Wilmington NC 28405
DEM Groundwater Section	Groundwater classifications and standards, enforcement of groundwater quality protection standards and cleanup requirements, review of permits for wastes discharged to groundwaters, issuance of well construction permits, underground injection control, administration of the underground storage tank (UST) program (including the UST Trust Funds), well head protection program development, and ambient groundwater monitoring.			
	Washington Region	Roger Thorpe	919-946-6481	1424 Carolina Ave. Washington NC 27889-3314
	Wilmington Region	Rick Shiver	910-395-3900	127 Cardinal Dr Extension, Wilmington NC 28405
DEHNR Land Resources	Conducts land surveys and studies, produces maps, and protects the state's land and mineral resources			
	Central Office	William (Toby) Vinson	919-733-4574	DLR 512 N. Salisbury St. Raleigh NC 27626
	Washington Region	Floyd Williams	919-946-6481	1424 Carolina Ave. Washington NC 27889-3314
	Wilmington Region	Carol Miller	910-395-3900	127 Cardinal Dr Extension, Wilmington NC 28405
DEH Land Application of Wastewater **	Trains and delegates 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; technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems.			
	Central Office	Steve Steinbeck	919-715-3273	DEH 512 N. Salisbury St. Raleigh NC 27626
	Washington Region	Roger Thorpe	919-946-6481	1424 Carolina Ave. Washington NC 27889-3314
	Wilmington Region	Rick Shiver	910-395-3900	127 Cardinal Dr Extension, Wilmington NC 28405
Div Forest Resources	Forest management; forest pest and disease management; prevention, detection and suppression of forest and wildland fires; produce and sell seedlings and trees; implements Forest Stewardship Program.			
	District 4		919-514-4764	3850 Hwy 17 South, New Bern NC 28562
	Central Office	Mickey Henson	919-733-2162	P.O. Box 27687 Raleigh NC 27611
DEH Solid Waste	Management of solid waste in a way that protects public health and the environment. The District includes three sections and one program -- Hazardous			

Management	Waste, Solid Waste, Superfund, and the Resident Inspectors program.			
	Washington Region	Chuck Boyette	919-946-6481	1424 Carolina Ave. Washington NC 27889-3314
	Wilmington Region	John Crowder	910-395-3900	127 Cardinal Dr Extension, Wilmington NC 28405
NC Cooperative Extension Service	Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities.			
	Carteret County	Ray Harris	919-728-8421	Courthouse Sq Beaufort NC 28516
	Craven County	William Dunham	919-633-1477	300 Industrial Dr. New Bern NC 28562
	Jones County	Minton Small	919-448-9621	Box 218 Trenton NC 28585
	Onslow County	Daniel Shaw	910-455-5873	604 College St Jacksonville NC 28540
Div of Soil & Water Conservation	Provides administrative and technical assistance to the Soil & Water Conservation Districts in areas pertaining to soil acience and engineering; distribures Wetlands Inventory maps for a small fee.			
	Central Office	David Harrison (National Wetlands Inventory maps only)	919-715-6108	DSWC 512 N. Salisbury St. Raleigh NC 27626
	Washington Region	Pat Hooper	919-946-6481	1424 Carolina Ave. Washington NC 27889-3314
	Wilmington Region	Jon Chris Ford	910-395-3900	127 Cardinal Dr Extension, Wilmington NC 28405

* Refers to the geographic area within which the agency has responsibility. This can include counties, regional offices, or districts (see maps).

** For questions and concerns pertaining to subsurface applications of wastewater as in septic systems contact the local health department.

BMPs FOR AGRICULTURE

Detailed Implementation Plan*

September 1996 (Revised)

Definition of Practices

(1) An agrichemical handling facility means a permanent structure that provides an environmentally safe means of mixing agrichemicals and filling tanks with agrichemicals for the application and storage of agrichemicals to prevent accidental degradation of surface and ground water.

(2) A conservation tillage system means any tillage and planting system in which at least (30) thirty percent of the soil surface is covered by plant residue to reduce soil erosion and improve the quality of surface water.

(3) A critical area planting means an area of highly erodible land which can not be stabilized by ordinary conservation treatment on which permanent perennial vegetative cover is established and protected to reduce soil erosion and sedimentation and to improve the quality of surface water.

(4) A cropland conversion practice means to establish and maintain a conservation cover of grasses, trees, or wildlife plantings on fields previously used for crop production to reduce soil erosion and sedimentation and to improve the quality of surface water.

(5) A diversion means a channel constructed across a slope with a supporting ridge on the lower side to control drainage by diverting excess water from an area to reduce soil erosion and sedimentation and to improve the quality of surface water.

(6) A field border means a strip of perennial vegetation established at the edge of the field that provides a stabilized outlet for row water to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(7) A filter strip means an area of permanent perennial vegetation for removing sediment, organic matter, and other pollutants from runoff and waste water to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(8) A grade stabilization structure means a structure (earth embankment, mechanical spillway, detention-type, etc.) used to control the grade and head cutting in natural or artificial channels to reduce erosion and sedimentation and to improve the quality of surface water.

(9) A grassed waterway means a natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff to reduce erosion and sedimentation and to improve the quality of surface water.

(10) A heavy use protection area means an area used frequently and intensively by animals which must be stabilized by surfacing with suitable materials to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(11) A livestock exclusion system means a system of permanent fencing (board, barbed, high tensile or electric wire) installed to exclude livestock from streams and critical areas not intended for grazing to reduce erosion, sedimentation and to improve the quality of surface water.

(12) A long term no-till practice means planting all crops for five consecutive years in at least 80 percent plant residue from preceding crops to reduce soil erosion and sedimentation and improve the quality of surface water.

(13) A pastureland conversion practice means establishing trees or perennial wildlife plantings on excessively eroding Class VII land being used for pasture that is too steep to mow or maintain with conventional equipment to reduce soil erosion and sedimentation and to improve the quality of surface water.

(14) A nutrient management practice means a definitive plan to manage the amount, form, placement, and timing of applications nutrients to minimize entry of nutrient to surface and groundwater and to improve water quality.

(15) A rock-lined outlet means a waterway having an erosionresistant lining of concrete, stone or other permanent material where an unlined or grassed waterways would be inadequate to provide safe disposal of runoff, reduce erosion and sedimentation and to improve the quality of surface water.

(16) A sediment basin means a basin constructed to trap and store waterborne sediment where physical conditions or land ownership preclude treatment of a sediment source by the installation of other erosion control measures to improve the quality of surface water.

(17) A sod-based rotation practice means an adapted sequence of crops and grasses established and maintained for a definite number of years which is designed to provide adequate organic residue for maintenance or improvement of soil filth to help reduce erosion and improve surface water quality.

(18) A stock trail or walkway means to provide a stable area used frequently and intensively for livestock movement by surfacing with suitable material to reduce erosion sedimentation and nutrient pollution to improve the quality of surface water.

(19) A stream protection system means a planned system for protecting streams and streambanks which eliminates the need for livestock to be in streams by providing an alternative watering source for livestock to reduce erosion and sedimentation and to improve the quality of surface water. System components may include:

(A) A spring development means improving springs and seeps by excavating, cleaning, capping or providing collection and storage facilities.

(B) A trough or tank means devices installed to provide drinking water for livestock at a stabilized location.

(C) A well means constructing a drilled, driven or dug well to supply water from an underground source.

(D) A windmill means erecting or constructing a mill operated by the wind's rotation of large vanes and is used as a source of power for pumping water.

(E) A stream crossing means a trail constructed across a stream to allow livestock to cross without disturbing the bottom or causing erosion on the banks.

(20) A stripcropping practice means to grow crops and sod in a systematic arrangement of alternating strips on the contour to reduce soil erosion and sedimentation and to improve the quality of surface water.

(21) A terrace means an earth embankment, a channel, or a combination ridge and channel constructed across the slope to reduce erosion, reduce sediment content in runoff water, and to improve the quality of surface water.

(22) A waste management system means a planned system in which all necessary components are installed for managing liquid and solid waste to prevent or minimize degradation of soil and water resources. System components may include:

(A) A waste storage pond means an impoundment made by excavation or earthfill for temporary storage of animal waste, waste water and polluted runoff.
(B) A drystack means a fabricated structure for temporary storage of animal waste.
(C) A composter/storage structure means a facility for the biological treatment, stabilization and environmentally safe storage of organic waste material (such as livestock and poultry manure and dead animal carcasses) to produce a material that can be recycled as a soil amendment and fertilizer substitute.
(D) A waste treatment lagoon means an impoundment made by excavation or earthfill for biological treatment and storage of animal waste.
(E) A waste application system means an environmentally safe system (such as solid set, dry hydrant, mobile irrigation equipment, etc.) for the conveyance and distribution of animal wastes from waste treatment and storage structures to agricultural field as part of an irrigation and nutrient management plan.
(F) A constructed wetlands for land application practice means an artificial wetland area into which liquid animal waste from a waste storage pond or lagoon is dispersed over time to lower the nutrient content of the liquid animal waste.
(G) A controlled livestock lounging area means a planned, stabilized and vegetated area in which livestock are kept for a short duration.
(H) A closure of abandoned waste treatment lagoons and waste storage ponds practice means the safe removal of existing waste and waste water and the application of this waste on land in an environmentally safe manner.
(I) A storm water management system means a system of collection and diversion practices (buttering, collection boxes, diversions, etc.) to prevent unpolluted storm water from flowing across concentrated waste area on animal operations.

(23) A water control structure means to provide control of surface and subsurface water through the use of permanent structures which increase infiltration and reduce runoff to improve the quality of surface and ground water.

(24) A waste utilization plan means a plan of using animal waste on land in an environmentally acceptable manner while maintaining or improving soil and plant resources to safeguard water resources.

(25) An insect control practice means an method of pest management used in an integrated pest management program to control target organisms and minimize contamination of soil, water, and air, and minimize impacts to non-target organisms through cultural, biological and physical practices including safe and prudent use of pesticides.

(26) A riparian buffer means an area adjacent to solid blue line streams as shown on 7.5 minute USGS maps where a permanent, long-lived vegetative cover (sod, shrubs, trees, or a combination of vegetation types) is established to reduce soil erosion, sedimentation, nutrient and pesticide pollution, and to improve the quality of surface water and shallow ground water.

(27) An odor control management system means a practice or combination of practices (planting windbreaks, precharging structures, incorporation of waste into soil, etc.) which manages or controls odors from confined animal operations, waste treatment and storage structures and waste applied to agricultural land.

*To be used in conjunction with the most recent version of the APA Rules for the North Carolina Agriculture Cost Share Program for Nonpoint Source Pollution Control and the NCACSP Manual.

Best Management Practices Eligible for Cost Share Payments

Best Management Practices eligible for cost sharing include the following practices and any approved District BMPs. District BMPs shall be reviewed by the Division for technical merit in achieving the goals of this program. Upon approval by the Division, the District BMPs will be eligible to receive cost share funding.

The minimum life expectancy of the BMPs is listed below. Practices designated by a District shall meet the life expectancy requirement established by the Division for that District BMP. The list of BMPs eligible for cost sharing may be revised by the Commission as deemed appropriate in order to meet program purpose and goals.

Practice	Minimum Life Expectancy (years)
Agrichemical Handling Facility	10
Conservation Tillage System	10
Critical Area Planting	10
Cropland Conversion	10
Diversion	10
Field Border	10
Filter Strip	10
Grade Stabilization Structure	10
Grassed Waterway	10
Heavy Use Area Protection	10
Insect Control	5
Livestock Exclusion	10
Long Term No-Till	5
Mobile Irrigation Equipment	10
Pastureland Conversion	10
Nutrient Reduction Management System	3
Rock-lined Waterway or Outlet	10
Sediment Control Structure	10
Sod-based Rotation	4 or 5
Stock Trail and Walkway	10
Stream Protection System	
Spring Development	10
Trough or Tank	10
Well	10
Windmills	10
Stream Crossing	10
Stripcropping	5

Riparian Buffer	10
Terrace	10

Best Management Practices Eligible for Cost Share Payments (continued)

Waste Management System	
Waste Storage Pond	10
Waste Storage Structure	10
Waste Treatment Lagoon	10
System for Land Application of Animal Waste	10
Wetlands Development for Land Application	10
Controlled Livestock Lounging Area	10
To-Be-Abandoned or Abandoned Confined	
Animal Operation (CAO)	5
Odor Control	1 to 10
Water Control Structure	10

Agricultural Best Management Practices

I. Crop and Pasture Lands

A. BMPs for Sediment Control
- Conservation Tillage System
- Critical Area Planting
- Cropland Conversion
- Diversion
- Field Border
- Filter Strip
- Grade Stabilization Structure
- Grassed Waterway
- Rock-lined Waterways or Outlets
- Sediment Control Structure
- Sod-based Rotation
- Stripcropping
- Terrace
- Water Control Structure
- Pastureland Conversion

B. BMPs for Nutrient Control
- Legumes in Rotation
- Soil Testing
- Liming
- Setting Realistic Crop Yield Goals (determines fertilization rates)
- Fertilizer Waste Application (method, rate, and timing)
- Sediment Control BMPs

C. BMPs for pesticide control
- Alternative Pesticides
- Optimize Pesticide Formulation, Amount, Placement Timing, Frequency
- Crop Rotation
- Resistant Crop Varieties
- Other Cultural or Biological Controls
- Optimize Crop Planting Time
- Plant Pest Quarantines
- Proper Disposal of Obsolete Pesticides and Containers
- Certification of Applicators
- Sediment Control BMP's

II. Animal Production (esp. Confined Animal Operations)

BMPs for bacteria and nutrient control
- Grade Stabilization Structures
- Heavy Use Area Protection
- Livestock Exclusion
- Spring Development
- Stock Trails and Walkways
- Trough or Tank
- Waste Management System
- Waste Storage Pond
- Waste Storage Structure
- Waste Treatment Lagoon
- Land Application of Waste
- Water Control Structure

BMPs FOR URBAN STORMWATER

Structural Best Management Practices for urban runoff control are typically designed to reduce sediment, its attached pollutants, and nutrients. In addition, other BMPs protect the riparian ecosystem, provide streambank stabilization, provide shade to water bodies and reduce the likelihood of excessive water temperatures. Non-structural BMPs, such as a design manual or a public education program, encourage the comprehensive and effective implementation of structural BMPs. The table below contains a list of both structural and non-structural BMPs. This list is taken from the *Stormwater Management Guidance Manual*, published by DWQ's Water Quality Planning Branch in 1995. The *Manual* provides a detailed discussion of each of the BMPs, including its characteristics, pollutant-specific effectiveness, reliability, feasibility, costs, unknown use factors, design considerations, and references for further information.

STRUCTURAL BMPs
I. Wet Detention Basin
II. Constructed Wetlands
• Wet Retention Basin
• Dry Detention Basin
• Infiltration Basin
• Vegetative Practices
◊ Filter Strips
◊ Grassed Swales with Check Dams
• Sand Filter
• Oil and Grease Separator
• Rollover-Type Curbing
NON-STRUCTURAL BMPs
I. Preventive Measures
II. Pollutant Minimization
• Exposure Reduction (proper scheduling, etc. - see Manual)
• Landscaping and Lawn Maintenance Controls
• Animal Waste Collection
• Curb Elimination
• Parking Lot and Street Cleaning
• Road Salt Application Control
• Catch Basin Cleaning
III. Riparian area protection
IV. Design Manual for Urban BMPs
V. Public Education
VI. Identification and Enforcement of Illegal Discharges
VII. Land-Use Control
• Low-Density Development
• Comprehensive Site Planning
• Buffer Zone
• Sanitary Waste Management
VIII. Conservation Easement

Structural BMPs may affect groundwater quality in certain situations. Devices that recharge groundwater pose the risk of passing soluble pollutants into groundwater systems. It is not currently known whether pollutant concentrations in recharged groundwater areas pose a significant environmental or health risk. USGS is presently studying groundwater quality effects of urban BMPs. In addition, if funds are made available, DWQ may conduct a similar study in North Carolina.

BMPs FOR EROSION AND SEDIMENTATION CONTROL

Best Management Practices suggested pursuant to the NC Sedimentation Pollution Control Act of 1973 are selected on the basis of performance in providing protection from the maximum peak rate of runoff from a 10-year storm. This allows the developer/designer of the control measures, structures, or devices to determine and submit for approval the most economical and effective means of controlling erosion and preventing sedimentation damage. Practices are therefore reviewed for acceptability based upon the characteristics of each individual site and its erosion potential. Ideally, the erosion control plan will employ both practices and construction management techniques which will provide the most effective and reasonable means of controlling erosion while considering the uniqueness of each site. The following table provides a list of practices commonly used in sedimentation and erosion control plans across North Carolina.

Check Dam	Sand Fence (Wind Fence)
Construction Road Stabilization	Sediment Basin
Dust Control	Sediment Fence
Grade Stabilization Structure	Sod Drop Inlet Protection
Grass-lined Channels	Sodding
Grass Channels with Liner	Structural Streambank Stabilization
Land Grading	Subsurface Drain
Level Spreader	Surface Roughening
Mulching	Temporary Block & Gravel Inlet Protection
Outlet Stabilization Structure	Temporary Diversions
Paved Channels	Temporary Excavated Drop Inlet Protection Fabric Drop Inlet Protection
Paved Flume (Chutes)	Temporary Gravel Construction Entrance/Exit
Perimeter Dike	Temporary Sediment Trap
Permanent Diversions	Temporary Seeding
Permanent Seeding	Temporary Slope Drains
Permanent Stream Crossing	Temporary Stream Crossing
Right-Of-Way Diversions	Topsoiling
Riprap	Tree Preservation & Protection
Riprap-lined Channels	Trees, Shrubs, Vines & Ground Covers
Rock Dam	Vegetative Dune Stabilization
	Vegetative Streambank Stabilization

BMPs FOR ON-SITE WASTEWATER DISPOSAL

To protect public health and water quality, best management practices (BMPs) need to be implemented throughout the life cycle of an on-site wastewater disposal system. Life-cycle management problems can be addressed in three phases (Steinbeck, 1984). The first phase includes system siting, design, and installation. The second phase involves the operation of the system and phase three involves maintenance and repair when the system malfunctions or fails. As BMPs are applied in each life-cycle phase, the primary factor the success of the system is the participation of the local influencing health department and the cooperation of the developer, owner, design engineer, system operator, and the state. The table that follows gives a summary of the current life-cycle management practices and penalties utilized in North Carolina to implement the on-site sewage systems program (Steinbeck, 1984).

1. Application -- The developer or property owner meets with the staff of the local health department to review the project proposal and submits an application to the local health department that contains information regarding ownership, plat of property, site plan, type of facility, estimated sewage flow, and proposed method of sewage collection, treatment, and disposal.
2. Site Evaluation -- The local health department, with technical assistance from the state, evaluates the proposed sewage effluent disposal site for several factors, including slope, landscape position, soil morphology, soil drainage, soil depth, and space requirements. Next, the local health department will assign a site suitability classification, establish the design sewage flow, and the design loading rate for the soil disposal system.
3. Design Review --The applicant is required to submit plans and specifications for the sewage collection, treatment, and disposal system prepared by a professional engineer, for complex systems, or for systems exceeding 3,000 gal/day. Reviews are made by both state and local health departments. The designer must also include in the plans and specifications, installation procedures, phasing schedules, operation and maintenance procedures, monitoring requirements, and designate the responsible agents for operation and maintenance.
4. Legal Document Review -- For systems with multiple ownership or off-site disposal, the applicant must prepare and submit to state and local health departments for their legal review documents applicable to the project.
5. Improvement Permit -- Issued only after a successful review of the proposed project, including each of the items discussed above and allows construction to begin for the on-site sewage system. The improvement permit must be issued prior to other construction permits and allows only temporary electrical power to the site. This permit contains the necessary conditions for construction of the projects with the plans, specifications, and legal documentation appended to it.
6. Operation Permit -- Issued to the owner of the on-site sewage system by the local health department when it determines that all the requirements in the rules, plans and specifications are met; all conditions on the improvement permit are met; and the design engineer for the sewage collection, treatment, and disposal system certifies in writing to the local health department that the on-site system has been installed in accordance with the approved plans and specifications. The operation permit is also conditioned to establish performance requirements and may be issued for a specific period of time. It allows the on-site sewage system to be placed into use, prevents permanent electrical service to the project and prevents occupancy of the facilities until issued. The operation permit applies to systems larger than 480 gallons per day. A certificate of completion is required for conventional septic tank systems when the design sewage flow is less than 480 gal/day.

On-Site Wastewater Disposal BMPs (continued)

7.	Surveillance -- Once an on-site sewage system is placed into operation the local health department must make routine inspections at least annually for large systems to determine that the system is performing satisfactorily and not creating a public health nuisance or hazard. Additionally, required monitoring reports are routinely submitted to the local health department as required in the permits. The state provides technical assistance to the local health department and the system operator in assuring adequate performance. While annual inspections are required, frequent performance checks must be made by the local health department.
8.	Remedies -- When voluntary compliance with the performance requirements for the on-site system is unsuccessful, the General Statutes (1983) provide for the following remedies:
a)	Right of Entry -- Allows the state or local health department to enter the premises to determine compliance with the laws and rules and provides for an administrative search and inspection warrant when entry is denied.
b)	Injunction -- The state or local health department may institute an action for injunctive relief against the owner to bring the on-site sewage system into compliance.
c)	Order of Abatement -- The state or local health department is empowered to issue an order of abatement directing the owner to take any necessary action to bring the system into compliance. However, if the on-site system is determined to be creating an imminent health hazard, the state or local health department may, after previous unsuccessful attempts at correction, take the necessary action to correct the problem and recover any costs for abatement from the owner. This is the least frequently applied remedy.
d)	Administrative Penalties -- The state may impose administrative penalties up to $300 per day for violation of the laws, rules, or any permit condition for on-site sewage systems serving multi-family residences with a flow greater than 480 gal/day. A penalty of up to $50 per day can be assessed for malfunctioning systems where the flow is less than or equal to 480 gal/day.
e)	Suspension and Revocation of Permits -- The state may suspend or revoke a permit for violations of the laws, rules, or permit conditions upon a finding that a violation has occurred.
f)	Misdemeanor -- The owner who violates the sewage laws or rules shall be guilty of a misdemeanor and punishable by a fine or imprisonment as determined by the courts. This is the most frequently used remedy.

BMPs FOR SOLID WASTE MANAGEMENT

Best Management Practices for solid waste management address the water quality impacts of leachate migration and surface erosion. A list of BMPs for controlling solid waste impacts on water quality can be found in the table below.

The BMPs offer significant benefits for groundwater quality. Landfill liners will prohibit or greatly decrease the volume of leachate entering groundwater. In turn, leachate collection systems capture leachate for subsequent treatment rather than groundwater disposal. For even greater protection, groundwater and surface water monitoring should detect failures in the liner or collection system.

Reduce, Recover, and Recycle Solid Waste to Maximum Extent
Incineration with Energy Recovery
North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities, 1987
Liners (Clay or Synthetic) for All New Landfills
Leachate Collection Systems
Erosion Control Plan
Operation and Maintenance Plan
Buffers Between Landfill and Streams, Property Lines and Dwellings
Groundwater Quality Monitoring
Surface Water Quality Monitoring
Public Education
Stormwater Runoff Control
Sedimentation Control

BMPs FOR FORESTRY

A. General BMPs for Forestry Operations in North Carolina

Forest Practices Guidelines Related to Water Quality (15A NCAC 1I.0101-.0209) have been adopted as published in the NCR, Volume 4, Issue 11, pages 601-604, and were effective January 1, 1990. These guidelines are summarized below.

Streamside Management Zone(SMZ)
• Must establish SMZ along natural, intermittent and perennial streams and water bodies. (Not required along man-made ditches and canals, although erosion protection is needed).
• Must have sufficient width and adequate ground cover to confine visible sediment (usually best to protect existing ground cover).
• Place roads, trails and decks outside of SMZ.
• Limited cutting(harvesting) is permitted within the SMZ.
Prohibition of Debris Entering Streams
• Prevent debris(logging slash, soil) of all types that can cause stream flow impediment or water quality degradation from entering intermittent and perennial streams and water bodies.
• Remove debris that accidentally enters streams.
Access Road and Skid Trail Stream Crossing
• Avoid crossing streams where possible.
• Avoid using stream channels as roads or trails.
• Construct crossings to minimize sediment entering streams.
• Protect stream banks and channels from damage.
• Provide water control devices and/or structures and, within 10 working days of initial disturbance provide ground cover sufficient to restrain accelerated erosion and prevent stream sedimentation.
Access Road Entrance
• Prevent soil and debris from being deposited on public highways which may result in stream sedimentation.
Keep Waste from Entering Streams, Water bodies and Groundwater
• Prevent oil, fuels, fertilizer and other chemical waste from entering streams, water bodies and groundwater.
Pesticide Application
• Application must follow labeling and N.C. Pesticides Board rules. Includes insecticides, fungicides, herbicides, and rodenticides.
Fertilizer Application
• Apply in a manner to prevent adverse impacts on water quality.
Stream Temperature
• Retain shade sufficient to prevent temperature fluctuations which result in a violation.
Rehabilitation of Project Site
• Within 30 working days after ceasing operations, provide sedimentation control measures to prevent water quality damage.
• Permanently stabilize SMZ areas and other areas that may directly contribute visible sediment to streams.

B. BMPs for Forestry Operations in Wetlands

The Division of Forest Resources is in the process of developing BMPs for forested wetlands. Economic pressure to expand forestry activities in wetlands continues to increase. This expansion will require a sound strategy to protect these environmentally sensitive areas.

A Forested Wetlands BMP Committee was established in the winter of 1987. Committee members represent federal and state agencies, industry, education, and environmental groups who have a role in the fate of wetlands.

In the absence of state standards, federal BMPs for forested wetlands are implemented. The table below identifies these federally mandated BMPs for Waters of the United States and wetlands adjacent to such Waters (Fed. Register 53(108): 207775, June 6, 1988). The Clean Water Act Section 404 Permit Exemption for forest roads applies only where the following BMP standards are fully met.

•	Permanent roads (for forestry), temporary access roads (for forestry), and skid trails (for logging) in waters of the U.S. shall be held to the minimum feasible number, width, and total length consistent with silvicultural and local topographic and climatic conditions;
•	All roads shall be located sufficiently far from streams or other water bodies (except for portions of such roads that must cross water bodies) to minimize discharges of dredged or fill material into waters of the U.S.;
•	Road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows;
•	Fill shall be properly stabilized and maintained to prevent erosion during and following construction;
•	Discharges of dredged or fill material into waters of the U.S. to construct road fills shall be made in a manner that minimizes encroachment of trucks, tractors, bulldozers, and other heavy equipment into waters of the U.S. (including adjacent wetlands that lie outside the lateral boundaries of the fill itself);
•	In designing, constructing, an maintaining roads, vegetative disturbance in waters of the U.S. shall be kept to a minimum;
•	Design, construction and maintenance of road crossings shall not disrupt the migration or other movement of those aquatic species inhabiting the water body;
•	Borrow material shall be taken from upland sources whenever feasible;
•	The discharge shall not take, or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species;
•	Discharges into breeding and nesting areas for migratory waterfowl, spawning areas, and wetlands shall be avoided if practical alternatives exist;
•	Discharge shall not be located in proximity to a public water supply intake;
•	The discharge shall not occur in areas of concentrated shellfish production;
•	Discharge shall not occur in a designated National Wild and Scenic River;
•	Discharge shall be of suitable material free from toxic pollutants in toxic amounts; and
•	All temporary fills shall be removed in their entirety and the area restored to its original elevation.

BMPs FOR MINING OPERATIONS

Significant environmental damage can and often times does occur during land-disturbing activities of mining operations, especially during the initial stages. The potential for such damage can be substantially reduced with the installation of BMPs. Once the mining has terminated, BMPs are used to reclaim or reasonably rehabilitate the site (for mined lands after June 11, 1971). The basic objective of the reclamation is to establish on a continuing basis the vegetative cover, soil stability, and water and safety conditions appropriate to the area. The BMPs are performance-oriented, allowing a mining permit applicant to design and propose the most economical and effective means of a) controlling erosion and preventing off-site sedimentation damage; b) preventing contamination of surface waters and groundwater; and, c) preventing any condition that will have unduly adverse effects on wildlife or freshwater, estuarine, or marine fisheries. BMP selection is site-specific and controlled in part by the pre- and post-mining land use(s). The acceptability of a BMP is therefore based upon the characteristics of the individual site and its potential for off-site damage.

The table which follows provides a list of BMPs used for activities associated with mining activities in North Carolina. This list is essentially the same as that provided for Sedimentation and Erosion Control, due to the similar nature of activities in both programs.

Check Dam	Sediment Basin
Construction Road Stabilization	Sediment Fence
Dust Control	Sod Drop Inlet Protection
Grade Stabilization Structure	Sodding
Grass-lined Channel	Structural Streambank Stabilization
Grass Channels with Liner	Subsurface Drain
Groundwater Monitoring Wells	Surface Roughening
Land Grading	Temporary Block and Gravel Inlet Protection
Level Spreader	Temporary Diversions
Mulching	Temporary Excavated Drop Inlet Protection
Outlet Stabilization Structure	Temporary Fabric Drop Inlet Protection
Paved Flume (Chutes)	Temporary Gravel Construction Entrance/Exit
Perimeter Dike	Temporary Sediment Trap
Permanent Diversions	Temporary Seeding
Permanent Seeding	Temporary Slope Drains
Permanent Stream Crossing	Temporary Stream Crossing
Right-of-Way Diversions	Topsoiling
Riprap	Tree Preservation and Protection
Riprap-lined Channels	Trees, Shrubs, Vines & Ground Covers
Rock Dam	Vegetative Dune Stabilization
Sand Fence (Wind Fence)	Vegetative Streambank Stabilization

BMPs FOR HYDROLOGIC MODIFICATION (related to mining operations)

BMPs for Discharges of Dredged or Fill Material (Adapted from 40 CFR 230 - Guidelines for Specification of Disposal Sites for Dredged or Fill Material)

1. Actions concerning the location of the discharge.
a) Minimize smothering of organisms;
b) Avoid disruption of periodic water inundation patterns;
c) Select a previously used disposal site;
d) Select a disposal site with substrate similar in composition to the material being disposed;
e) Minimize extent of any plume; and
f) Minimize or prevent creation of standing bodies of waters in areas of normally fluctuating water levels.
2. Actions concerning the material to be discharged.
a) Maintain physiochemical conditions and reduce potency and availability of pollutants;
b) Limit solid, liquid and gaseous components;
c) Add treatment substances; and
d) Utilize chemical flocculants in diked disposal areas.
3. Actions controlling the materials after discharge.
a) Reduce potential for erosion, slumping or leaching by
i) using containment levees, sediment basins and cover crops to reduce erosion; and
ii) using lined containment areas to reduce leaching.
b) Cap in-place contaminated material with clean material;
c) Prevent point and nonpoint sources of pollution; and
d) Time the discharge to minimize impact, especially during unusual high water flows, wind, wave and tidal actions.
4. Actions affecting the method of dispersion.
a) Maintain natural substrate contours and elevation;
b) Minimize undesirable obstruction to the water current or circulation pattern;
c) Confine suspended particulate/turbidity to a small area where settling can occur;
d) Mix, dilute and disperse the discharge;
e) Minimize water column turbidity;
f) Maintain light penetration for organisms; and
g) Set limitations on the amount of material to be discharged per unit of time or volume of receiving water.
5. Actions related to technology.
a) Use appropriate equipment and machinery, including protective devices;
b) Employ appropriate operation and maintenance of machinery, including training, staffing and working procedures;
c) Use machinery and techniques designed to reduce damage to wetlands, including devices that scatter rather than mound excavated materials, machines with specially designed wheels or tracks, and the use of mats under heavy machinery to reduce compaction and rutting; and
d) Design access roads and channel spanning structures to accommodate fluctuating water levels and circulation patterns.

BMPs for Hydrologic Modification (continued)

6. Actions affecting plant and animal populations.
a) Avoid changes in water current and circulation patterns;
b) Prevent or avoid creating habitat conducive to the development of undesirable predators or species;
c) Avoid sites having unique habitat or other value, including endangered or threatened species;
d) Institute habitat development and restoration;
e) Avoid spawning or migration seasons and other biologically critical time periods; and
f) Avoid destruction of remnant natural sites within areas already affected by development.
7. Actions affecting human use.
a) Prevent or minimize damage to the aesthetically pleasing features of an aquatic site, including water quality;
b) Avoid disposal sites valuable as natural aquatic areas;
c) Avoid seasons or periods when human recreational activity associated with the aquatic site is most important;
d) Avoid sites which will increase incompatible human activity or require frequent dredge or fill maintenance in remote fish and wildlife areas; and
e) Locate disposal site outside of the vicinity of a public water supply intake.

APPENDIX VI

List of 303(d) Waters in the White Oak River Basin

APPENDIX VI

List of 303(d) Waters in the White Oak River Basin

What is the 303(d) list?

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Waters may be excluded from the list if existing control strategies for point and nonpoint source pollution will achieve the standards or uses. Waterbodies which are listed must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed for all listed waters.

303(d) List Development

The 305(b) report was used as a basis for developing the 303(d) list. Section 305(b) of the CWA requires states to report biennially to the U.S. Environmental Protection Agency (EPA) on the quality of waters in their state. In general, the report describes the quality of the state's surface waters, groundwaters, and wetlands, and existing programs to protect water quality. Information on use support, likely causes (e.g., sediment, nutrients, etc.) and sources (point sources, agriculture, etc.) of impairment are also presented in the report.

Many types of information were used to make use support assessments and to determine causes and sources of use support impairment. Chemical, physical, and biological data were the primary sources of information used to make use support assessments. North Carolina has an extensive ambient and biological monitoring network throughout the state. Benthic macroinvertebrate data which indicate taxa richness of pollution intolerant groups are an important data source. North Carolina also collects fish tissue and fish community structure data and phytoplankton bloom data that are used in the assessments. In addition, fish consumption advisories, information from other agencies, workshops, and reports, predictive modeling results, toxicity data, and self monitoring data is considered when making final use support determinations. Data from all readily available sources are used when the Division's standard operating procedures are followed when collecting and analyzing data. Where the list has no problem parameter listed, the use support rating was based on biological data, and available chemical data showed no impairment. It should be noted that where a problem parameter has been identified, the water quality standard for that parameter was exceeded. This parameter is a potential cause of the impairment, but there may be other unidentified causes contributing to the impairment as well.

Only those waterbodies whose use support rating were not supporting (NS) or partially supporting (PS) in the 305(b) report were considered as candidates for the 303(d) list. Of those waterbodies that showed impairment (PS or NS rating) only those waterbodies that had a use support rating based on monitoring data collected in the last five years were included on the 303(d) list. Since many changes can occur within a watershed in a five year period, conclusive information about a waterbody's use support cannot be made with older data. However, North Carolina will be collecting information on as many of these evaluated waterbodies as staffing and time permit for subsequent updates of the basin plans and 303(d) list. As more conclusive information on streams rated using older data or best professional judgment is obtained, evaluated waterbodies will be added to the list if the data indicate impairment. Finally, those waterbodies which were rated as NS or PS were then examined to determine if there were management strategies in place. If so, the streams were eliminated from the list. Management strategies that were considered included the following:

1. Miscellaneous nonpoint programs - Any waterbodies where DEM was aware of nonpoint management studies (e.g. 319 or similar program) were eliminated if nonpoint sources were the only problem.

2. Point sources - All waters where point sources were the only problem were eliminated if the facility was under SOC, under schedule for removal, recently upgraded, or some other strategy was in place.

Changes in the White Oak River Basin's 303(d) list from earlier lists are based on updated chemical and biological monitoring results. If updated information indicated no impairment, a previously listed waterbody was removed. If previously supporting waterbodies had new data that indicated impairment, these waterbodies were added to the list. In addition, if no new data were collected on a given waterbody, and all available data were greater than 5 years old, the waterbody was excluded from the list. If future data indicate impairment, the stream will be added to the list.

The estuarine portion of the 303(d) list is organized by Division of Environmental Health area name as overall use support is determined in this manner. The individual creeks that are impaired in these larger areas due to fecal coliform can be found in Table 6.2. In addition, specific impaired areas can be viewed on the color use support maps included in Figures 4.23 a and b.

Finally, the 303(d) list for the White Oak River Basin has been prioritized. Waterbodies in the New River Subbasin that were impaired due to chlorophyll-a violations were given a medium priority due to the level of public interest in nutrient-related water quality issues in estuarine waters due to the high resource value of these waters. As discussed in Chapter 6 of the plan, point source controls for nutrients have been implemented in the New River Basin. If future monitoring indicates that these waters are still impaired, further management strategies will be developed. Other waterbodies that were assigned a medium priority were based on high priority status for 319 funds in the basin. These 319 priorities are assigned based on the degree of impairment, stream classification, and resource value of the water body. Therefore, creeks and areas with abundant shellfish or which drained to outstanding resource waters were given a higher priority. A detailed explanation of the priorities can be found in section 6.2.2. High priorities for the White Oak Basin were not assigned due to higher priority complex TMDLs that are being developed in other areas of the state. Chapter 7 of the Basin Plan further lists the Division's priorities for future work in the Basin. The amount of work that will be completed in time for the 2002 White Oak Basin Plan will depend on available resources.

Additional Guidance on Using the 303(d) List

The column headings in the 303(d) list refer to the following:

Class - The information in this column indicates the classification assigned to the particular waterbody. Stream classifications are based on the existing and anticipated best usage of the stream as determined through studies and information obtained at public hearings. The stream classifications are described in 15 A NCAC 2B .0300, and a copy of the pertinent pages of these regulations is attached in Appendix I.

Wtrbdy - The number in this column refers to the DEM subbasin in which the waterbody is located. The NRCS 14 digit hydrologic units nest within the DEM subbasins.

Problem Parameter - These are the causes of impairment as identified in the 305(b) report. Where no cause is listed, the rating was based on biological data, and available chemical data showed no impairment. These biological data may include benthic, fish habitat, and fish tissue information. It should also be noted that where a problem parameter is identified, the parameter listed exceeded the state's water quality standards for that substance. This parameter is a potential cause of the impaired stream, but there may be other, unidentified causes contributing to the impairment as well. Problem parameters included in the White Oak 303(d) list are outlined below:

Chla - chlorophyll-a
DO - dissolved oxygen
Fecal - fecal coliform

Rating - This column lists the overall use support rating. These values may be NS (not supporting), PS (partially supporting), and ST (supporting but threatened). the 305(b) report describes these use support ratings further.

Major Sources (P,NP) - This column indicates whether point (P) or nonpoint (NP) sources are the major sources of impairment.

Subcategory - This column breaks the point and nonpoint sources down further. A list describing what each number means is provided in attached after the list.

303(d) LIST FOR THE WHITE OAK RIVER BASIN ESTUARY

Area Name	DEH Area	Partial Support (acres)	Non-Support (acres)	Major Causes Fecal (acres)	Chl-a (acres)	Major Sources Point	Nonpoint	Descriptions for Potential Sources of Pollution	Priority
Chadwick Bay	C1	223	0	223			NP	urban runoff, septic tanks, marinas	Medium
Sneads Ferry	C2	189	0	189		P	NP	WWTP, septic tanks, marinas,urban runoff	Low
Stones Bay	C3	3,756	0	751	3,005	P	NP	WWTP, urban runoff, marinas	Medium
Hurst Beach	C4	160	0	160		P	NP	WWTP, urban runoff,forestry	Medium
Bear Creek	D1	70	0	70			NP	ag, marinas,wildlife,forestry	Low
Queen Creek	D2	745	0	745		P	NP	WWTP, ag, urban runoff, septic tanks	Low
White Oak River	D3	1,417	0	1,417		P	NP	WWTP, ag, urban runoff, septic tanks, marina,wildlife	Medium
Deer Creek	D4	222	0	222			NP	urban runoff, marinas, septic tanks, urban runoff	Medium
Broad Creek	E1	133	0	133			NP	urban runoff, septic tanks, marinas	Low
Bogue Sound	E2	94	0	94			NP	urban runoff, septic tanks, marinas	Low
Morehead City	E3	1,284	0	1,284			NP	urban runoff, septic tank, marina, state port	Low
Newport River	E4	1,863	0	1,863		P	NP	WWTP, ag, forestry, urban runoff, septic tanks, marina	Medium
Taylor Creek	E5	450	0	450		P	NP	WWTP, urban runoff, septic tanks	Low
North River	E6	647	0	647		P	NP	WWTP, ag, forestry, urban runoff, marina,septic tanks	Medium
Back Sound	E7	32	0	32			NP	septic tanks, marinas	Low
Core Sound	E8	200	0	200			NP	ag, forestry, marinas	Low
Nelson Bay	E9	456	0	456		P	NP	WWTP, ag, septic tanks	Low
Total Acres		11,941	0	8,936	3,005				
Percent		9.80	0	74.83	25.17				

MAJOR SOURCES:

P indicates that point sources (WWTP) discharge but are operating efficiently or it is noted that they are not affecting the shellfish waters.

P indicates that they are experiencing problems and are a major source affecting water quality.

NP indicates that surveys note they are the major factor influencing the water quality, or there are no WWTPs or major point sources of pollution.

303(d) LIST FOR THE WHITE OAK RIVER BASIN - Freshwaters

Name of Stream	Description	Class	Wtrbdy	Problem Parameters	Overall Rating	Major Sources (P,NP)	Subcategory	Priority
Little Northeast Creek	Source to NC Hwy 24 Nr J'ville	C-NSW	30502	DO, Chl a	PS	NP,P	43	Medium
Southwest Creek	From Mill Run to New River	C-NSW,HQW	30502	Chl a	PS	NP	86	Medium

APPENDIX VII

LIST OF NPDES DISCHARGES IN THE BASIN

Permit Type	Permit #	Facility Name	Design Flow	Issued Date	Expiration Date	Basin	Pipe #	Receiving Stream Description
MAJOR	NC0021831	BEAUFORT WWTP, TOWN OF	1.5	96/06/14	1/7/31	30503	1	TAYLOR CREEK/WHITE OAK RIVER BASIN
MUNICIPAL	NC0024121	JACKSONVILLE-WILSON BAY WWTP	4.46	95/11/27	98/09/30	30502	1	WILSON BAY-NEW RVR/WHITE OAK RVR BSN
	NC0026611	MOREHEAD CITY, TOWN-WWTP/TP RD	1.7	93/04/16	97/07/31	30503	1	CALICO CREEK/WHITE OAK RIVER BASIN
MAJOR	NC0062995	USMC MCB-CL CAMP GEIGER WWTP	1.6	/ /	96/06/30	30502	1	NEW RIVER/WHITE OAK RIVER BASIN
NON-MUNICIPAL	NC0063002	USMC MCB-CL TARAWA TERRACE WWT	1.25	/ /	96/06/30	30502	1	NORTHEAST CREEK/WHITE OAK RIVER BASN
	NC0063011	USMC MCB-CL CAMP JOHNSON WWTP	1	/ /	96/06/30	30502	1	NORTHEAST CREEK/WHITE OAK RIVER BASN
	NC0063029	USMC MCB-CL HADNOT POINT WWTP	8	94/12/09	97/06/30	30502	1	NEW RIVER/WHITE OAK RIVER BASIN
MINOR	NC0021482	MAYSVILLE WWTP, TOWN OF	0.18	93/03/29	97/06/30	30501	1	WHITE OAK RIVER/WHITE OAK RIVER BASN
MUNICIPAL	NC0021555	NEWPORT WWTP, TOWN OF	0.5	93/07/26	97/07/30	30503	1	NEWPORT RIVER/WHITE OAK RIVER BASIN
	NC0023230	RICHLANDS WWTP, TOWN OF	0.21	92/05/15	97/06/30	30502	1	SQUIRES RUN/WHITE OAK RIVER BASIN
	NC0036153	SWANSBORO WWTP, TOWN OF	0.3	94/01/14	97/06/30	30501	1	FOSTER CREEK/WHITE OAK RIVER BASIN
MINOR	NC0000728	BEAUFORT FISHERIES, INC.	3	93/12/16	97/07/31	30504	1	TAYLOR CREEK/WHITE OAK RIVER BASIN
NON-MUNICIPAL	NC0002585	A-1 CLEANER INC	0.008	93/11/01	97/06/30	30502	1	BRINSON CREEK/WHITE OAK RIVER BASIN
	NC0007749	OWENS-CORNING CORP-MOREHEAD	0.01	94/12/19	97/07/31	30503	1	BOGUE SOUND/ WHITE OAK RIVER BASIN
	NC0007749	OWENS-CORNING CORP-MOREHEAD	0.01	94/12/19	97/07/31	30503	3	NEWPORT RVR RSTRCT/WHITE OAK RVR BSN
	NC0022462	SHERWOOD MOBILE HOME PARK ASSO	0.06	92/03/16	97/06/30	30502	1	UT MOTT CREEK/WHITE OAK RIVER BASIN
A - VII - 2	NC0023825	WEBB APARTMENTS	0.025	93/01/13	97/06/30	30502	1	LITTLE NORTHEAST CREEK/WHITE OAK R B
	NC0028215	BEACHAMS APT #2	0.1	93/02/26	97/06/30	30502	1	UT BRINSON CREEK/WHITE OAK RVR BASIN
	NC0028223	BEACHAMS APT #1	0.04	93/02/26	97/06/30	30502	1	UT BRINSON CREEK/WHITE OAK RIVER BSN
	NC0028827	SAILOR'S SNUG HARBOR (THE)	0.02	92/08/03	97/07/31	30504	1	SALTER'S CREEK/WHITE OAK RIVER BASIN
	NC0030431	HEWITT'S MOBILE HOME PARK	0.03	94/08/22	97/06/30	30501	1	UT BELL SWAMP/WHITE OAK RIVER BASIN
	NC0030813	ONSLOW COUNTY - KENWOOD HOMES	0.049	92/07/10	97/06/30	30502	1	SOUTHWEST CRK/WHITE OAK RIVER BASIN
	NC0031577	MERCER ENV CORP-WHITE OAK EST.	0.12	91/11/08	96/12/31	30502	1	NORTHEAST CREEK/WHITE OAK RIVER BASN
	NC0032239	MERCER ENV CORP-REGALWOOD SUB	0.125	94/03/31	97/06/30	30502	1	NORTHEAST CREEK/WHITE OAK RIVER BASN
	NC0034339	ATLANTIS MOBILE HOME PARK	0.018	94/02/07	97/06/30	30502	1	UT HICKS RUN/WHITE OAK RIVER BASIN
	NC0034991	SENTRY UTILITIES-HICKORY GROVE	0.0225	92/07/17	97/06/30	30502	1	LITTLE NE CREEK/WHITE OAK RIVER BASN
	NC0036226	SCIENTIFIC WATER AND SEWER INC	0.3	92/07/27	97/06/30	30502	1	NEW RIVER/WHITE OAK RIVER BASIN
	NC0036676	REXXON, LTD-JACKSONVILLE SITE	0.025	92/12/04	97/06/30	30502	1	UT ROCKY RUN/WHITE OAK RIVER BASIN
	NC0043672	ONSLOW CO BOE-TABERNACLE ELEM	0.017	93/02/23	97/06/30	30501	1	STARKEY'S CREEK/WHITE OAK RIVER BASN
	NC0043711	ONSLOW CO BOE-MORTON ELEM	0.0075	93/01/13	97/06/30	30502	1	LITTLE NORTHEAST CREEK/WHITE OAK R B
	NC0047759	SEA LEVEL HOSPITAL	0.014	92/05/21	97/07/31	30504	1	NELSON BAY/WHITE OAK RIVER BASIN
	NC0047759	SEA LEVEL HOSPITAL	0.014	92/05/21	97/07/31	30504	2	NELSON BAY/WHITE OAK RIVER BASIN
	NC0049387	VIKING UTILITIES CO, INC	0.25	92/12/17	97/06/30	30502	1	MOTT CREEK/WHITE OAK RIVER BASIN
	NC0050849	ONSLOW CO BOE-SILVERDALE ELEM	0.003	93/03/29	97/06/30	30501	1	CALEBS CREEK/WHITE OAK RIVER BASIN
	NC0051471	BIG PINES MOBILE HOME PARK	0.0065	92/11/25	97/06/30	30502	1	UT WALLACE CREEK/WHITE OAK RIVER BSN
	NC0051853	ARAGONA BROTHERS INC-PLANT #1	0.02	93/03/19	97/06/30	30502	1	UT BRINSON CREEK/WHITE OAK RIVER BSN
	NC0056952	BLUE CREEK UTILITIES INC	0.1	94/03/15	97/06/30	30502	1	BLUE CREEK/WHITE OAK RIVER BASIN
	NC0057053	SENTRY UTILITIES-SPRINGDALE AC	0.05	93/06/18	97/06/30	30502	1	BRINSON CREEK/WHITE OAK RIVER BASIN
	NC0057053	SENTRY UTILITIES-SPRINGDALE AC	0.05	93/06/18	97/06/30	30502	2	SOUTHWEST CREEK/WHITE OAK RIVER BASN
	NC0058874	CWB UTILITIES, INC.	0.06	94/02/24	97/06/30	30502	1	UT WALLACE CREEK/WHITE OAK RIVER BSN
	NC0062294	ROCK CREEK ENVIRONMENTAL CO.	0.1152	92/12/11	97/06/30	30502	1	NEW RIVER/WHITE OAK RIVER BASIN
	NC0062359	HORSE CREEK FARMS UTILITIES CO	0.1	93/03/29	97/06/30	30502	1	UT LITTLE N.E. CRK/WHITE OAK RVR BSN

White Oak

	NC0062642	WEBB CREEK WATER & SEWAGE, INC	0.24	93/06/18	97/07/31	30502	1	WALLACE CREEK/WHITE OAK RIVER BASIN
	NC0062642	WEBB CREEK WATER & SEWAGE, INC	0.24	93/06/18	97/07/31	30502	2	WEBB CREEK/ WHITE OAK RIVER BASIN
	NC0063037	USMC MCB-CL RIFLE RANGE WWTP	0.525	/ /	96/06/30	30502	1	NEW RIVER/ WHITE OAK RIVER BASIN
	NC0063045	USMC MCB-CL COURTHOUSE BAY WWT	0.6	/ /	96/06/30	30502	1	NEW RIVER/ WHITE OAK RIVER BASIN
	NC0063053	USMC MCB-CL ONSLOW BEACH WWTP	0.195	/ /	96/06/30	30502	1	INTRACOASTAL WATERWAY/WHITE OAK RV B
	NC0071536	COASTAL CAROLINA COMM. COLLEGE	0.005	95/02/06	97/06/30	30502	1	NORTHEAST CRK/WHITE OAK RIVER BASIN
	NC0071706	HINSON ARMS APARTMENTS	0.015	95/10/05	97/06/30	30502	1	UT NEW RIVER/WHITE OAK RIVER BASIN
	NC0077143	WEST CARTERET WATER CORP	0.05	94/06/15	97/06/30	30501	1	E.PRONG SANDERS CRK/WHITE OAK RVR BS
	NC0077666	MOREHEAD CITY TERMINALS	0	94/12/19	97/07/31	30503	1	NEWPORT RVR RESTRCTED AREA/WHITE OAK
	NC0077666	MOREHEAD CITY TERMINALS	0	94/12/19	97/07/31	30503	2	NEWPORT RVR RESTRCTED AREA/WHITE OAK
	NC0078328	USMC MCB-CL ONSLOW BEACH WTP	0.01	93/07/12	97/06/30	30502	1	UT GILLETS CREEK/WHITE OAK RIVER BSN
	NC0083089	BOGUE BANKS WATER & SEWER CORP	0	93/07/30	97/06/30	30501	1	BOGUE SOUND/WHITE OAK RIVER BASIN

APPENDIX VIII

ESTIMATION OF NUTRIENT LOADS FOR SELECTED WATERSHEDS IN THE WHITE OAK BASIN

ESTIMATION OF NUTRIENT LOADS FOR SELECTED WATERSHEDS IN THE WHITE OAK BASIN

Introduction

The New River is highly eutrophic and nutrient loads to the upper estuary have been a major concern since the mid 1980s. The trophic state of other waterbodies in the White Oak basin has not been a problem, but the importance of these waterbodies merits further evaluation to assess their nutrient loading characteristics. Nutrient loading estimates for the New River above Hadnot Point were developed when the area was being considered for NSW designation (NCDEM, 1990). Loading estimates have not previously been made for the entire New River NSW area or for other parts of the basin.

Nitrogen and phosphorus loads were calculated for four watersheds in the basin: the New River nutrient sensitive water (NSW) area; the White Oak River; the Newport River; the North River. These are the major waterbodies in the basin for which an evaluation of nutrient loads is warranted. Core and Bogue Sounds are better flushed and do not receive substantial amounts of freshwater input.

Both point and nonpoint source loads are included in the estimates. Point source loads represent the average loading from permitted dischargers in the watershed under current conditions (1994-1995). Nonpoint source loads represent the net export of nutrients from areas of varying land use within each watershed. These loads were calculated using an export coefficient model utilizing land cover information derived from LANDSAT data and nutrient export estimates derived from the literature. Atmospheric loadings were also calculated using export coefficients. The specific methodology used is discussed below.

Watershed Boundaries

While hydrologic units can be aggregated to closely approximate specific watersheds, the match is not exact. The hydrologic units best corresponding to each watershed are shown in Table VIII-1 and Figure VIII-1. A few units include land draining into the Intracoastal Waterway or one of the sounds, in addition to land draining into one of the four rivers. Such areas generally comprise only a small part of the watersheds examined here. In these cases the hydrologic unit was included in the watershed if most of the land area drained into the river in question. For example, part of 03020106040010 drains toward Harkers Island and not into the North River, while part of 03020106030070 drains into Bogue Sound and not into the Newport River. Hydrologic units 03030001020030 (map code I27) and 0040 predominately drain the lower New River, although each also includes portions of Camp Lejeune draining part of the NSW area. Only 0040 is included in the New River NSW watershed as defined here.

Point Source Loads

Discharge monitoring data for the period from November 1994 to October, 1995 were examined for all facilities in the basin. Current nitrogen and phosphorus loads for facilities with available N and P data were calculated as the product of the average concentration and the average discharge. Effluent N and P concentrations were not collected for a number of smaller facilities, all having an average flow of 0.1 MGD or less. Loads for these facilities were calculated using the average concentration from all facilities in the basin of similar size. The concentrations used were 9.1 mg/l for TN (average of 16 facilities) and 1.7 mg/l for TP (average of 17 facilities). There was one facility with an average discharge greater than 0.1 MGD (Newport WWTP, average flow=0.3 MGD) for which no TN data were available. The average TN concentration (9.7 mg/l) of facilities with an average flow between 0.1 and 0.5 MGD was used (n=7). Calculations and loads for all facilities are shown in Table VIII-2.

Nonpoint Source Loads

The nutrient export coefficient approach (Reckhow et al, 1989; Novotny and Olem, 1994) calculates mass nutrient export from a given parcel of land as the product of land area and a unit load. The unit load, or nutrient export coefficient, is a measure of the nutrient export (mass load) per unit area per unit time, for example, kg of N per ha per year). Unit loads will vary by the type of land cover and the nature of land use practices in a particular area. Numerous field studies have been conducted to estimate the amount of nitrogen and phosphorus entering surface waters from various land uses.

The land use/land cover data set used to develop the nutrient loading estimates discussed here was developed by the NC Center for Geographic Information and Analysis (CGIA) utilizing 1988 LANDSAT data. CGIA classified the Albemarle-Pamlico Estuarine Study area into 18 land use/land cover categories, as described by Khorram et al (1992). The Research Triangle Institute (RTI) calculated the total area of each land cover category by 9 digit hydrologic unit (Dodd et al, 1992). These units are generally too large to provide information on the scale needed here. Under contract with the Division of Coastal Management (DCM), RTI recently extended this work to develop land cover estimates for the detailed 14 digit hydrologic units, including hydrologic units in the White Oak basin (Steven Stichter, NCDCM, personal communication, 1995).

More recent land use estimates have been developed by the Soil Conservation Service (now the Natural Resources Conservation Service) as part of its 1992 National Resources Inventory, but this information is not available by 14 digit hydrologic unit. The 1988 LANDSAT data is the most recent data suitable for characterizing land cover at the scale of small watersheds.

The export coefficients used for the various land cover categories (Table VIII-3) are based upon a recent study carried out by RTI under a contract with the DCM (Steven Stichter, NCDCM, personal communication, 1995). The RTI project involved a literature review of nutrient export studies performed on the eastern piedmont and coastal plain, updating similar work conducted by RTI in 1992 (Dodd et al). The median or most likely values from the literature were used.

Forested areas include both natural and managed forests. It was not feasible to develop separate estimates for each forest type, and all forest and freshwater wetland categories were assigned the median forest values. Nutrient export from urban areas includes runoff from residential and commercial areas, industrial facilities, on-site wastewater disposal and solid waste facilities. The median export values for urban areas were assigned to all three categories of developed land because the land cover data could not distinguish between low, medium and high density developed areas with sufficient accuracy (see Khorram et al, 1992). Agricultural land includes rowcrops, pasture land and confined animal operations. However the land cover data could not distinguish between these types of agricultural activities, and the export coefficient used represents the median unit load from a cross-section of agricultural activities. Since literature values for low density vegetation and disturbed land were not available, values for these categories used in the RTI study were intermediate between the values for forested and agricultural land, and were selected taking into account the types of land represented by these two classes.

Atmospheric deposition includes wet and dry deposition of nutrients from all sources, including nitrogen from the burning of fossil fuels and ammonium from sources such as fertilizer and animal waste lagoons. Values for atmospheric deposition were taken from Dodd et al (1992) and are applied to open water as well as sand and salt marsh. This assumes that all nutrients falling on bare sand and salt marsh from atmospheric sources is exported to surface waters, and that on average no net export otherwise occurs from these areas.

As shown in Table VIII-3, the detailed categories were aggregated into 4 major classes. Disturbed land was classified as agricultural because these areas were found to consist primarily of recently plowed fields (Khorram et al, 1992).

No land use/land cover data were available for some areas because of cloud cover or difficulty in classification. Such land was apportioned to the various land cover categories in proportion to the area of known land cover in each hydrologic unit. The amount of unclassifiable land was not significant (<1% of each hydrologic unit). Cloud cover was an issue only in the New River watershed, where hydrologic unit 03030001020040 was almost entirely under cloud cover. No estimate was made for this area and thus nonpoint source loads to the NSW area are slightly underestimated. Since much of the land area in this hydrologic unit drains into the New River downstream of the NSW area, including it would have yielded a small overestimate of nonpoint source loads.

Discussion

The export coefficient approach has a number of limitations. Some of these are inherent in the method itself, while others result from the specific data used.

(1) The available land use/land cover information is based on 1988 data, and significant land use changes have occurred in some areas since that time. Land use/land cover data for the 1993-1995 period is under development and will be available in March 1997. This data set should provide greater refinement in characterizing types of agricultural and urban areas.

(2) Land management practices can affect the export of nutrients from a given category of land use. No data on these practices are currently available for the White Oak basin.

(3) The export coefficients are not based upon site-specific studies of the White Oak basin area, but rely on literature estimates. These estimates are based on studies conducted in the piedmont and coastal plan regions, but soils and other features of the study sites may differ from watersheds in the White Oak basin.
(4) Export estimates for urban areas do not explicitly account for inputs from septic systems or other on-site disposal systems.
(5) As mentioned earlier, the current land use data do not allow us to distinguish between types of agricultural activity, and it is thus not possible to separately evaluate loads from cropland, pasture and confined animal operations.
(6) The export coefficient approach yields an estimate of the total nutrient load to surface waters within a watershed. It does not estimate the load exerted at any particular location. For example, only a portion of the nutrients which enter streams in the upper part of these watersheds will reach the estuarine sections of the rivers. Due to the relatively small size of these watersheds this is not as significant a factor as in larger river basins such as the Neuse. Additionally, some point sources (such as the Morehead City WWTP) discharge to areas which are poorly flushed or which are near the outlet of the estuary. Much of the nutrients from such sources may never impact the main body of the river. These and other fate and transport issues are not addressed by the approach used here.

The use of export coefficients to estimate nutrient loads is the best method available given that detailed watershed models have not been developed for any of the areas examined here. Despite the limitations of this approach, the results provide a rough approximation of the loading to particular watersheds and indicate the general sources of that loading. As noted above, future applications of nutrient export methods to these watersheds will be enhanced by the acquisition of more recent and detailed land use/land cover data.

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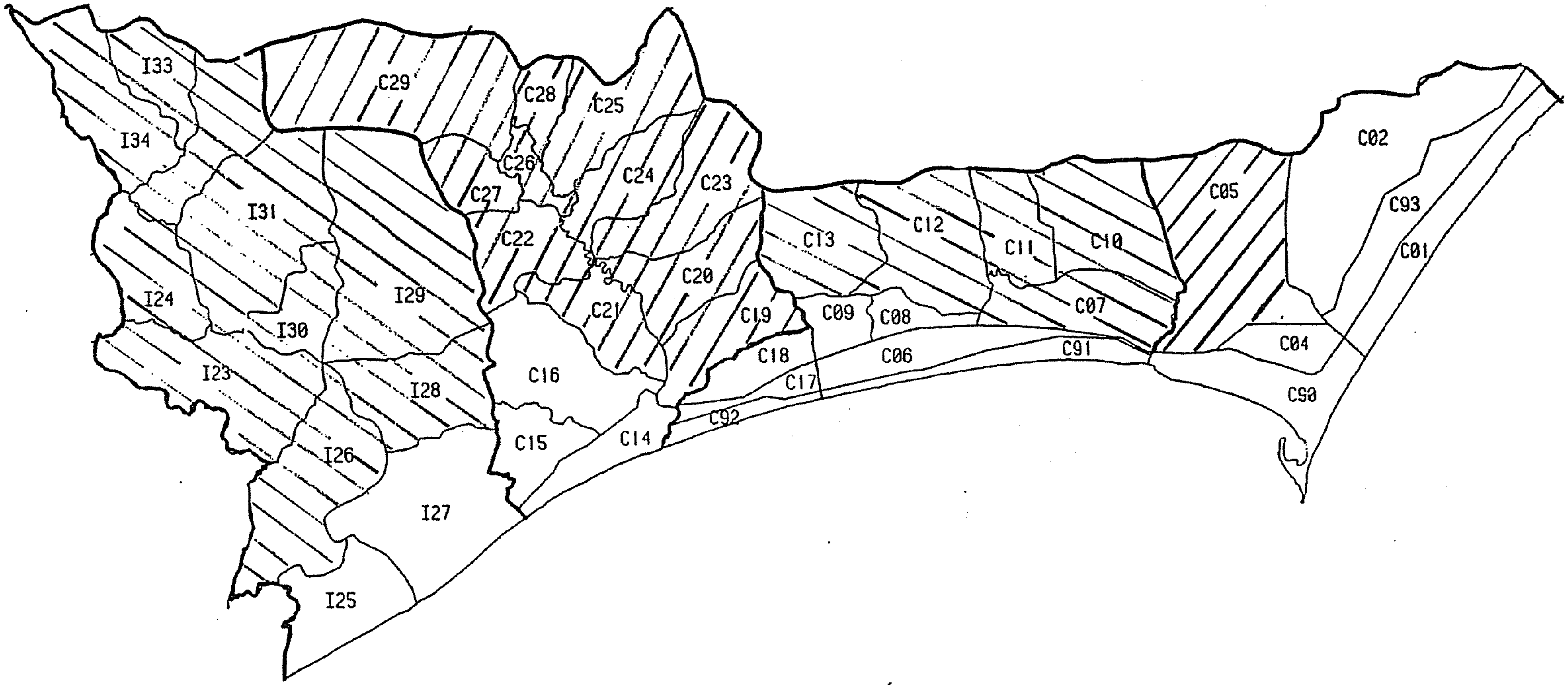
FIGURE VIII-1
14 DIGIT HYDROLOGIC UNITS FOR SELECTED WATERSHEDS IN THE WHITE OAK BASIN



See Table VIII-1 for map key

TABLE VIII-1
14 DIGIT HYDROLOGIC UNITS FOR SELECTED WATERSHEDS

WHITE OAK RIVER

MAP KEY	HU CODE
C29	03020106010010
C28	03020106010020
C27	03020106010030
C26	03020106010031
C25	03020106010040
C24	03020106010050
C23	03020106010060
C22	03020106010070
C21	03020106020010
C20	03020106020020
C19	03020106020030

NEW RIVER NSW AREA

MAP KEY	HU CODE
I34	03030001010010
I33	03030001010020
I32	03030001010030
I31	03030001010040
I30	03030001010050
I29	03030001020010
I28	03030001020020
I26	03030001020040
I24	03030001030010
I23	03030001030020

NEWPORT RIVER

MAP KEY	HU CODE
C13	03020106030010
C12	03020106030020
C11	03020106030030
C10	03020106030040
C07	03020106030070

NORTH RIVER

MAP KEY	HU CODE
C05	03020106040010

TABLE VIII-2
CALCULATION OF TP AND TN LOADS FOR POINT SOURCES

		Permitted Flow (MGD)	Actual Flow (MGD)	TP Concen. (mg/l)	TN Concen. (mg/l)	TP Load (kg/yr)	TN Load (kg/yr)
White Oak River							
NC0021482	MAYSVILLE WWTP, TOWN OF	0.18	0.0825	1.48	3.00	168.2	342.1
NC0043672	TABERNACLE ELEM SCHOOL	0.017	0.0020	**1.70**	**9.13**	4.7	25.2
NC0050849	SILVERDALE ELEM SCHOOL	0.00	0.0019	**1.70**	**9.13**	4.5	24.0
	Total Load					177.4	391.3
New River NSW Area							
NC0063029	USMC MCB-CL HADNOT POINT WWTP	8.00	5.0744	1.99	10.48	13983.9	73521.3
NC0024121	JACKSONVILLE-WILSON BAY WWTP	4.46	4.4471	3.85	21.35	23660.2	131206.3
NC0062995	USMC MCB-CL CAMP GEIGER WWTP	1.60	1.0333	0.18	10.92	256.5	15599.2
NC0063002	USMC MCB-CL TARAWA TERRACE WWTP	1.25	0.6249	1.58	13.09	1360.3	11306.4
NC0063011	USMC MCB-CL CAMP JOHNSON WWTP	1.00	0.3370	1.32	16.33	614.0	7602.6
NC0036226	SCIENTIFIC WATER AND SEWER INC	0.30	0.2356	1.85	13.67	600.9	4450.2
NC0049387	VIKING UTILITIES CO, INC	0.25	0.1100	1.22	15.13	185.6	2299.5
NC0062642	WEBB CREEK WATER & SEWAGE, INC	0.24	0.0333	1.09	13.89	50.0	639.2
NC0023230	RICHLANDS WWTP, TOWN OF	0.21	0.2061	1.07	5.52	305.6	1572.2
NC0032239	MERCER ENV CORP-REGALWOOD SUB	0.13	0.0886	1.15	5.14	141.0	629.5
NC0031577	MERCER ENV CORP-WHITE OAK EST.	0.12	0.0884	1.26	10.62	153.6	1297.0
NC0056952	BLUE CREEK UTILITIES INC	0.10	0.0301	1.63	11.23	67.7	467.2
NC0028215	BEACHAMS APT #2	0.10	0.0380	1.56	6.03	82.1	316.5
NC0062359	HORSE CREEK FARMS UTILITIES CO	0.10	0.0415	1.72	1.40	98.5	80.3
NC0058874	CWB UTILITIES, INC.	0.06	0.0192	2.73	25.45	72.4	674.7
NC0022462	SHERWOOD MOBILE HOME PARK ASSOC	0.06	0.0678	1.96	12.35	183.6	1157.5
NC0057053	SENTRY UTILITIES-SPRINGDALE AC	0.05	0.0557	2.05	6.07	157.5	467.1
NC0030813	ONSLOW COUNTY - KENWOOD HOMES	0.05	0.0298	1.22	10.60	50.3	437.1
NC0028223	BEACHAMS APT #1	0.04	0.0218	1.62	7.01	48.8	211.6
NC0023825	WEBB APARTMENTS	0.03	0.0094	2.59	8.75	33.6	113.9
NC0036676	REXXON, LTD	0.03	0.0013	**1.70**	**9.13**	3.1	16.4
NC0051853	ARAGONA BROTHERS INC-PLANT #1	0.02	0.0069	**1.70**	**9.13**	16.2	87.1
NC0034339	ATLANTIS MOBILE HOME PARK	0.02	0.0059	2.00	**9.13**	16.3	74.6
NC0071706	HINSON ARMS APARTMENTS	0.02	0.0066	0.59	5.75	5.4	52.6
NC0002585	A-1 CLEANER INC	0.01	0.0040	2.34	2.00	13.1	11.2
NC0043711	MORTON ELEM SCHOOL	0.01	0.0040	**1.70**	**9.13**	9.4	50.5
NC0051471	BIG PINES MOBILE HOME PARK	0.01	0.0013	**1.70**	**9.13**	3.1	16.4
	Total Load					42172.7	254358.1
Newport River							
NC0026611	MOREHEAD CITY, TOWN-WWTP	1.70	1.2692	1.12	3.00	1972.4	5268.2
NC0021555	NEWPORT WWTP, TOWN OF	0.50	0.2950	2.79	**9.73**	1135.3	3966.4
	Total Load					3107.7	9234.6

North River--no dischargers

Loads calculated based on actual flows.
Flow and concentration data are averages of available data from Nov. 1994 - October 1995.
Concentrations in bold are based upon averages from other facilities in the basin, since concentration data were not available for the facilities in question. TN Concentration for Newport WWTP is the average of all facilities in the basin with an average flow between 0.1 and 0.5 mgd for which TN data were available.
All other concentrations in bold represent the average of all facilities with average flow of 0.1 mgd or less for which data were available.

TABLE VIII-3

EXPORT COEFFICIENTS USED IN CALCULATION OF NONPOINT SOURCE LOADS, BY LANDSAT CATEGORY (kg/ha/yr)

Code	LANDSAT Category	TP Export	TN Export
URBAN			
3	Low Density Developed	1.2	9.0
4	Medium Density Developed	1.2	9.0
5	High Density Developed	1.2	9.0
AGRICULTURE			
6	Agriculture, Bare Soil and Grass	0.8	8.0
12	Disturbed Land	0.5	5.0
FOREST			
7	Low Density Vegetation	0.5	2.2
8	Pine Forest	0.1	2.2
9	Bottomland Hardwoods	0.1	2.2
10	Hardwood Forest	0.1	2.2
11	Pine/Hardwood	0.1	2.2
14	Riverine Swamp	0.1	2.2
15	Evergreen Hardwood/Conifer	0.1	2.2
16	Atlantic White Cedar	0.1	2.2
17	Low Pocosin	0.1	2.2
ATMOSPHERIC DEPOSITION			
2	Open Water	0.65	12.4
18	Low Marsh	0.65	12.4
19	High Marsh	0.65	12.4
20	Sand	0.65	12.4

Source: NC Division of Coastal Management

APPENDIX IX

TREND ANALYSES FOR NEW RIVER STATIONS

TREND ANALYSES FOR NEW RIVER STATIONS

Introduction

Several important steps that will significantly reduce point source nutrient loads to the New River are still being implemented--the removal of Jacksonville's discharge from Wilson Bay and the construction of a new tertiary facility at Camp Lejeune. While any evaluation of the NSW strategy would thus be premature, it would be useful to determine if the nutrient status of the New River has changed since the area became a major concern in the mid 1980s. Unfortunately, the long-term ambient data required for a statistical analysis of trends are not available for Wilson Bay or most other highly eutrophic sections of the mainstem. Long term data are available, however, for three diverse mainstem stations: Gum Branch-station 02093000; US 17 at Jacksonville-station 02093032; NC 172 near Sneads Ferry-station 02093197. An analysis of conditions at these locations can provide some indication of water quality trends in the watershed.

Trends in total phosphorus, total nitrogen and chlorophyll *a* were evaluated at each of the three stations. Because of the eutrophic nature of much of the New River, nitrogen and phosphorus loads are of particular interest. Nutrient loads could be calculated only for the Gum Branch site, however, as discharge data do not exist for the other locations. TP and TN concentrations were thus analyzed at the Jacksonville and Sneads Ferry stations.

Each of the stations exhibits distinctly different hydrologic and environmental conditions. The Gum Branch site is located in the freshwater segment of the New River, downstream of the Richlands WWTP, and reflects water quality in the largely agricultural upper portion of the watershed. With a drainage area of 94 square miles, Gum Branch accounts for about 56% of the area draining to Wilson Bay. As expected, chlorophyll *a* levels are extremely low, averaging only 1.7 µg/l over the study period. The Jacksonville station is in the relatively brackish waters of the upper estuary, upstream of the major point source discharges. Chlorophyll *a* at Jacksonville averaged 33.7 µg/l from 1985 to 1994. The Sneads Ferry station is situated downstream of the NSW area where the estuary is well flushed, and generally exhibits considerably lower nutrient and chlorophyll levels (Chlorophyll *a* averaged 7.3 µg/l at Sneads Ferry.). Of the three stations studied, the Jacksonville site most closely exemplifies the eutrophic conditions typical of the NSW area.

Methodology

The Mann-Kendall and Seasonal Kendall tests were used to evaluate whether monotonic trends were present in the data. These nonparametric procedures are widely accepted as the best techniques for water quality trend analyses under most circumstances (Gilbert, 1987; Hirsch et al 1991; Loftis et al, 1989; Reckhow et al, 1993). The Kendall techniques can account for seasonal patterns in the data, are not overly sensitive to outliers and extreme values, and allow for analysis when missing observations and censored values (data below detection limits) are present.

For each station, the following parameters were downloaded from STORET: total phosphorus as P (parameter code 665), $NO_2 + NO_3$ as N (630), TKN as N (625) and chlorophyll *a*-corrected (32209). The entire period of record for which monthly data were available at each station was used (see Table IX-1). Total N was calculated as the sum of TKN and nitrite/nitrate. At the Jacksonville station, some nitrite/nitrate values were below the detection limit (BDL) of 0.01 mg/l. Since TKN levels were always substantial (a minimum of 0.7 mg/l) and the contribution of $NO_2 + NO_3$ to total N was clearly insignificant, nitrite/nitrate was assigned a value of 0.005 mg/l (one half the detection level) for observations below detection. Although some small bias may be introduced by this procedure, the alternative--deleting the observations entirely--is undesirable given the dominance of total N by TKN and the effect of the lower sample size on statistical power.

A USGS gage is located at the Gum Branch site. Average daily flows for the date of each nutrient/chlorophyll measurement were obtained from the USGS report *Water Resources Data-North Carolina* for the appropriate years. The analysis time frame for the Gum Branch station was limited to the operational period for the gage. Hydrologic data for the Jacksonville and Sneads Ferry stations are not available.

BDL data were infrequent except for chlorophyll *a* at the Gum Branch station (Table IX-1), at which 58% of the observations were below the detection limit of 1.0 µg/l. Since the Mann-Kendall and Seasonal Kendall techniques utilize only the rank and not the magnitude of each measurement, BDL data do not interfere with trend detection as long as detection limits do not change during the study period (Gilbert, 1987; Hirsch et al, 1982). For highly censored records, however, the magnitude of the trend (the Sen slope estimate) cannot be calculated accurately (Hirsch et al, 1991). Below detection values were recoded to one half of the detection limit (Gilbert, 1987). Choosing one half the detection limit has no effect on the test for trend, and has little effect on the slope estimate when censored values are few (Hirsch et al, 1991).

The trend detection techniques used assume only a single value per time period (month). Methods of aggregation are discussed by Reckhow et al (1993) and by Aroner (1995). When more than one measurement was available for a given month, the observation closest to the midpoint of each month was used. The choice of aggregation method is not an important concern here because months with more than a single observation were infrequent, and the number of observations per month never exceeded three.

The general approach to trend analysis outlined by Reckhow et al (1993) was followed. Monthly time series plots and annual box plots were examined for each parameter. Where flow data were available (Gum Branch only) deterministic patterns were removed from the nutrient data by modeling the relationship between discharge and nutrient loads, and conducting the trend analysis on the residuals (i.e., on that portion of the load which cannot be explained by variations in discharge). LOWESS (Locally Weighted Scatterplot Smoothing), a nonparametric technique, was used to remove variability related to flow (Cleveland, 1979), although various parametric models were also examined. Flow adjustments were not made for the chlorophyll time series at

Gum Branch because the large number of values below detection does not permit accurate modeling of the relationship between discharge and concentration. All analyses were conducted with the WQHYDRO software (Aroner, 1995) using an alpha level of .05.

The presence of seasonality in the data (after adjustments for flow, when applicable) was assessed using the Kruskal-Wallis test. Autocorrelation values (correlograms) and seasonal box plots were also examined.

The Mann-Kendall test for trend was used for nonseasonal data, while the Seasonal Kendall test was used where significant seasonality was present (Gilbert, 1987; Reckhow et al, 1993; Hirsch et al, 1982 and 1991). Correlograms of the deseasonalized and (where appropriate) detrended residuals were examined for the presence of any remaining autocorrelation. No significant residual serial correlation was found in any of the time series.

Results

The trend analysis results are summarized in Table IX-2. Time series plots are available from DEM. Statistically significant downward trends (alpha=.05) were found for chlorophyll *a* at all three stations and for TP at the two upstream stations. While the direction of these trends is clear, there is considerable uncertainty regarding their magnitude, as indicated by the 95% confidence intervals for the slope. Remarks for individual stations and parameters follow.

<u>Gum Branch</u>
LOWESS residuals were used for the analysis of TN and TP loads. The residuals did not show strong evidence of seasonality, and the Mann-Kendall test was used for both parameters. TP loads at Gum Branch declined by an estimated 2.5 lbs/day each year during the 1987-1994 period (this is a decline of 913 lbs/yr). Chlorophyll *a* also showed no seasonality, perhaps because values were generally quite low (the highest level during the time period was 11.0 µg/l). Observations during the final three years consist predominately of censored values.

The above analysis evaluated the data only for the presence of monotonic trends, but a step trend hypothesis (Hirsch et al, 1991) is also reasonable for TP given the implementation of the phosphate detergent ban on January 1, 1988 and the location of the Gum Branch station downstream of the Richlands WWTP. The nonparametric Wilcoxin-Mann-Whitney test (Sokal and Rohlf, 1981; Aroner, 1995) was used to determine whether a step trend could be identified before/after January 1988. The results indicate that a significant downward step (P=.011) of 16.4 lbs/day TP occurs at that time. This must be interpreted cautiously, however, since only 5 observations were available in 1987 and these may not be representative of a longer pre-ban period.

<u>Jacksonville</u>
The Kruskal-Wallis test, monthly box plots and correlograms all showed evidence of obvious seasonality for each of the three parameters. Statistically significant downward trends were found for TP concentration and chlorophyll *a*. The overall TP decline is quite small (0.004 mg/l per year), however, and appears visually to be concentrated in the 1988-1991 period. The

decline in chlorophyll *a* values appears to reflect the relatively low levels found in 1992 and 1993. No data are available to control for the effects of hydrologic or other environmental variations at either the Jacksonville or Sneads Ferry stations.

A step trend hypothesis is also appropriate for this station, although the station is a considerable distance below the Richlands WWTP. Results of the Wilcoxin-Mann-Whitney test (P=.086) do not confirm a step trend at alpha=.05.

<u>Sneads Ferry</u>
The TP and TN data show clear evidence of seasonality. The presence of seasonality in the chlorophyll data is ambiguous, but both the Mann-Kendall and Seasonal Kendall tests yield similar results. Only the Seasonal Kendall results are reported here.
It is not clear why chlorophyll *a* should decline if TN and TP levels are holding constant, although year to year variations in mixing or temperature could be a factor. It is worth noting that while neither TP nor TN show a statistically significant trend, the P values are relatively low (.116 and .098 respectively). It is possible that a more powerful test which controlled for hydrologic variability would find statistically significant trends at alpha=.05.

Discussion

A trend analysis can only evaluate potential trends over a specific time period. Estimated trends may vary if a different set of years is examined. The results of this analysis indicate that chlorophyll *a* levels at all three stations have been lower in recent years than in the mid to late 1980s. No change in nitrogen levels was detected, while total phosphorus declined at the Gum Branch and Jacksonville sites.

The observed declines in chlorophyll at Gum Branch and Jacksonville are presumably due to the drop in TP. The reason for the chlorophyll decline at Sneads Ferry is unclear--nitrogen is in all likelihood the limiting nutrient at this station and changes in neither TN nor TP concentrations were found. The reason for the decline in TP at the two upstream stations is also not clear. The phosphate detergent ban is one likely cause, although the analysis is not conclusive in this regard. In any case, most of the TP decline appears to have occurred in the late 80s, prior to the implementation of the NSW strategy.

We cannot assess how these trends may compare to trends in Wilson Bay or other portions of the NSW area, although prior research has indicated that the total phosphorus load from the Jacksonville WWTP declined by 29% as a result of the phosphate detergent ban (NCDEM, 1991). These findings do indicate stable or slightly improved conditions in three widely dispersed portions of the New River. While there is no evidence of further deterioration in the NSW area, monitoring by DEM and Camp Lejeune indicates that nutrient levels and chlorophyll *a* concentrations continue to be excessive in the upper estuary. The condition of the New River remains one of the major management concerns in the basin.

TABLE IX-1
DATA SUMMARY FOR NEW RIVER STATIONS

		Period of Record with Monthly Data	Number of Observations	Number of Observ. Below Detection
Gum Branch*	**TP**	1987 (July) - 1994	79	0
(Station 02093000)	**TN**	1987 (July) - 1994	79	0
	Chlor a	1987 (July) - 1994	78	45 (1.0 ug/l)
Jacksonville	**TP**	1985 (October) - 1994	107	0
(Station 02093032)	**TN**	1985 (October) - 1994	107	0
	Chlor a	1985 (October) - 1994	105	5 (1.0 ug/l)
Sneads Ferry	**TP**	1987-1994	87	0
(Station 02093197)	**TN**	1987-1994	87	0
	Chlor a	1987-1994	86	4 (1.0 ug/l)

*Period of record corresponds to period for which flow data were available.

TABLE IX-2
TREND ANALYSIS RESULTS FOR NEW RIVER STATIONS

		Flow Adjustment Method	Trend Test	P value	Sen Slope (change per year)	95% Confidence Interval for Slope	Mean over monthly period of record
Gum Branch (Station 02093000)	**TP LOAD**	LOWESS	Mann-Kendall	0.012**	-2.5 lbs/day	-0.6 to -4.9 lbs/day	126.5 lbs/day
	TN LOAD	LOWESS	Mann-Kendall	0.69	na		887.1 lbs/day
	Chlor a	none	Mann-Kendall	<.001**	*		1.7 ug/l
Jacksonville (Station 02093032)	**TP**	none	Seasonal Kendall	0.036**	-0.004 mg/l	0.0 to -0.007 mg/l	0.202 mg/l
	TN	none	Seasonal Kendall	0.65	na		1.14 mg/l
	Chlor a	none	Seasonal Kendall	<.001**	-2.1 ug/l	-0.8 to -4.8 ug/l	33.7 ug/l
Sneads Ferry (Station 02093197)	**TP**	none	Seasonal Kendall	0.116	na		0.060 mg/l
	TN	none	Seasonal Kendall	0.098	na		0.515 mg/l
	Chlor a	none	Seasonal Kendall	0.001**	-0.63 ug/l	-0.20 to -1.01 ug/l	7.30 ug/l

*Slope cannot be estimated reliably due to large number of observations below detection.
** Statistically significant at alpha=.05

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APPENDIX X

FEDERAL OCEAN DISCHARGE CRITERIA

› and implement SPCC plans to prevent
scharges of reportable quantities of desig-
ated hazardous substances. While Subpart
requires only procedural activities and
inor construction, the proposed 40 CFR
art 151 (SPCC regulations) are more strin-
ent and comprehensive with respect to
eir requirements for spill prevention. In
eveloping BMP programs in accordance
ith Subpart K, owners or operators should
so consider the requirements of proposed
) CFR Part 151 which may address many
the same areas of the facility covered by
is Subpart.]

(ii) Shall assure the proper manage-
ent of solid and hazardous waste in
ccordance with regulations promul-
ated under the Solid Waste Disposal
ct, as amended by the Resource Con-
ervation and Recovery Act of 1976
RCRA) (40 U.S.C. 6901 *et seq*). Man-
gement practices required under
CRA regulations shall be expressly
ncorporated into the BMP program;
nd

(iii) Shall address the following
oints for the ancillary activities in
125.102:

(A) Statement of policy;
(B) Spill Control Committee;
(C) Material inventory;
(D) Material compatibility;
(E) Employee training;
(F) Reporting and notification pro-
edures;
(G) Visual inspections;
(H) Preventive maintenance;
(I) Housekeeping; and
(J) Security.

Comment: Additional technical informa-
on on BMPs and the elements of a BMP
rogram is contained in a publication enti-
ed "NPDES Best Management Practices
uidance Document." Copies may be ob-
ained by written request to Edward A.
ramer (EN-336), Office of Water Enforce-
ent, Environmental Protection Agency,
'ashington, DC, 20460.]

(c)(1) The BMP program must be
early described and submitted as
art of the permit application. An ap-
lication which does not contain a
MP program shall be considered in-
omplete. Upon receipt of the applica-
on, the Director shall approve or
odify the program in accordance
ith the requirements of this subpart.
he BMP program as approved or
odified shall be included in the draft
ermit (§ 124.6). The BMP program shall be subject to the applicable permit issuance requirements of Part 124, resulting in the incorporation of the program (including any modifications of the program resulting from the permit issuance procedures) into the final permit.

(2) Proposed modifications to the BMP program which affect the discharger's permit obligations shall be submitted to the Director for approval. If the Director approves the proposed BMP program modification, the permit shall be modified in accordance with § 122.62, provided that the Director may waive the requirements for public notice and opportunity for hearing on such modification if he or she determines that the modification is not significant. The BMP program, or modification thereof, shall be fully implemented as soon as possible but not later than one year after permit issuance, modification, or revocation and reissuance unless the Director specifies a later date in the permit.

NOTE: A later date may be specified in the permit, for example, to enable coordinated preparation of the BMP program required under these regulations and the SPCC plan required under 40 CFR Part 151 or to allow for the completion of construction projects related to the facility's BMP or SPCC program.

(d) The discharger shall maintain a description of the BMP program at the facility and shall make the description available to the Director upon request.

(e) The owner or operator of a facility subject to this subpart shall amend the BMP program in accordance with the provisions of this subpart whenever there is a change in facility design, construction, operation, or maintenance which materially affects the facility's potential for discharge of significant amounts of hazardous or toxic pollutants into the waters of the United States.

(f) If the BMP program proves to be ineffective in achieving the general objective of preventing the release of significant amounts of toxic or hazardous pollutants to those waters and the specific objectives and requirements under paragraph (b) of this section, the permit and/or the BMP program shall be subject to modification to incorporate revised BMP requirements.

(Clean Water Act, Safe Drinking Water Act, Clean Air Act, Resource Conservation and Recovery Act: 42 U.S.C. 6905, 6912, 6925, 6027, 6974)

[44 FR 32948, June 7, 1979, as amended at 45 FR 33513, May 19, 1980; 48 FR 14293, Apr. 1, 1983]

Subpart L—Criteria and Standards for Imposing Conditions for the Disposal of Sewage Sludge Under Section 405 of the Act [Reserved]

* Subpart M—Ocean Discharge Criteria

SOURCE: 45 FR 65953, Oct. 3, 1980, unless otherwise noted.

§ 125.120 Scope and purpose.

This subpart establishes guidelines for issuance of National Pollutant Discharge Elimination System (NPDES) permits for the discharge of pollutants from a point source into the territorial seas, the contiguous zone, and the oceans.

§ 125.121 Definitions.

(a) "Irreparable harm" means significant undesirable effects occurring after the date of permit issuance which will not be reversed after cessation or modification of the discharge.

(b) "Marine environment" means that territorial seas, the contiguous zone and the oceans.

(c) "Mixing zone" means the zone extending from the sea's surface to seabed and extending laterally to a distance of 100 meters in all directions from the discharge point(s) or to the boundary of the zone of initial dilution as calculated by a plume model approved by the director, whichever is greater, unless the director determines that the more restrictive mixing zone or another definition of the mixing zone is more appropriate for a specific discharge.

(d) "No reasonable alternatives" means:

(1) No land-based disposal sites, discharge point(s) within internal waters, or approved ocean dumping sites within a reasonable distance of the site of the proposed discharge the use of which would not cause unwarranted economic impacts on the discharger, or, notwithstanding the availability of such sites,

(2) On-site disposal is environmentally preferable to other alternative means of disposal after consideration of:

(i) The relative environmental harm of disposal on-site, in disposal sites located on land, from discharge point(s) within internal waters, or in approved ocean dumping sites, and

(ii) The risk to the environment and human safety posed by the transportation of the pollutants.

(e) "Unreasonable degradation of the marine environment" means: (1) Significant adverse changes in ecosystem diversity, productivity and stability of the biological community within the area of discharge and surrounding biological communities,

(2) Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms, or

(3) Loss of esthetic, recreational, scientific or economic values which is unreasonable in relation to the benefit derived from the discharge.

§ 125.122 Determination of unreasonable degradation of the marine environment.

(a) The director shall determine whether a discharge will cause unreasonable degradation of the marine environment based on consideration of:

(1) The quantities, composition and potential for bioaccumulation or persistence of the pollutants to be discharged;

(2) The potential transport of such pollutants by biological, physical or chemical processes;

(3) The composition and vulnerability of the biological communities which may be exposed to such pollutants, including the presence of unique species or communities of species, the presence of species identified as endangered or threatened pursuant to the Endangered Species Act, or the presence of those species critical to the structure or function of the eco-

system, such as those important for the food chain;

(4) The importance of the receiving water area to the surrounding biological community, including the presence of spawning sites, nursery/forage areas, migratory pathways, or areas necessary for other functions or critical stages in the life cycle of an organism.

(5) The existence of special aquatic sites including, but not limited to marine sanctuaries and refuges, parks, national and historic monuments, national seashores, wilderness areas and coral reefs;

(6) The potential impacts on human health through direct and indirect pathways;

(7) Existing or potential recreational and commercial fishing, including finfishing and shellfishing;

(8) Any applicable requirements of an approved Coastal Zone Management plan;

(9) Such other factors relating to the effects of the discharge as may be appropriate;

(10) Marine water quality criteria developed pursuant to section 304(a)(1).

(b) Discharges in compliance with section 301(g), 301(h), or 316(a) variance requirements or State water quality standards shall be presumed not to cause unreasonable degradation of the marine environment, for any specific pollutants or conditions specified in the variance or the standard.

§ 125.123 Permit requirements.

(a) If the director on the basis of available information including that supplied by the applicant pursuant to § 125.124 determines prior to permit issuance that the discharge will not cause unreasonable degradation of the marine environment after application of any necessary conditions specified in § 125.123(d), he may issue an NPDES permit containing such conditions.

(b) If the director, on the basis of available information including that supplied by the applicant pursuant to § 125.124 determines prior to permit issuance that the discharge will cause unreasonable degradation of the marine environment after application of all possible permit conditions specified in § 125.123(d), he may not issue an NPDES permit which authorizes the discharge of pollutants.

(c) If the director has insufficient information to determine prior to permit issuance that there will be no unreasonable degradation of the marine environment pursuant to § 125.122, there shall be no discharge of pollutants into the marine environment unless the director on the basis of available information, including that supplied by the applicant pursuant to § 125.124 determines that:

(1) Such discharge will not cause irreparable harm to the marine environment during the period in which monitoring is undertaken, and

(2) There are no reasonable alternatives to the on-site disposal of these materials, and

(3) The discharge will be in compliance with all permit conditions established pursuant to paragraph (d) of this section.

(d) All permits which authorize the discharge of pollutants pursuant to paragraph (c) of this section shall:

(1) Require that a discharge of pollutants will: (i) Following dilution as measured at the boundary of the mixing zone not exceed the limiting permissible concentration for the liquid and suspended particulate phases of the waste material as described in § 227.27(a) (2) and (3), § 227.27(b), and § 227.27(c) of the Ocean Dumping Criteria; and (ii) not exceed the limiting permissible concentration for the solid phase of the waste material or cause an accumulation of toxic materials in the human food chain as described in § 227.27 (b) and (d) of the Ocean Dumping Criteria;

(2) Specify a monitoring program, which is sufficient to assess the impact of the discharge on water, sediment, and biological quality including, where appropriate, analysis of the bioaccumulative and/or persistent impact on aquatic life of the discharge;

(3) Contain any other conditions, such as performance of liquid or suspended particulate phase bioaccumulation tests, seasonal restrictions on discharge, process modifications, dispersion of pollutants, or schedule of compliance for existing discharges,

which are determined to be necessary because of local environmental conditions, and

(4) Contain the following clause: In addition to any other grounds specified herein, this permit shall be modified or revoked at any time if, on the basis of any new data, the director determines that continued discharges may cause unreasonable degradation of the marine environment.

§ 125.124 Information required to be submitted by applicant.

The applicant is responsible for providing information which the director may request to make the determination required by this subpart. The director may require the following information as well as any other pertinent information:

(a) An analysis of the chemical constituents of any discharge;

(b) Appropriate bioassays necessary to determine the limiting permissible concentrations for the discharge;

(c) An analysis of initial dilution;

(d) Available process modifications which will reduce the quantities of pollutants which will be discharged;

(e) Analysis of the location where pollutants are sought to be discharged, including the biological community and the physical description of the discharge facility;

(f) Evaluation of available alternatives to the discharge of the pollutants including an evaluation of the possibility of land-based disposal or disposal in an approved ocean dumping site.

PART 129—TOXIC POLLUTANT EFFLUENT STANDARDS

Subpart A—Toxic Pollutant Effluent Standards and Prohibitions

AUTHORITY: Secs. 307, 308, 501, Federal Water Pollution Control Act Amendments of 1972 (Pub. L. 92-500, 86 Stat. 816, (33 U.S.C. 1251 *et seq.*)).

SOURCE: 42 FR 2613, Jan. 12, 1977, unless otherwise noted.

Subpart A—Toxic Pollutant Effluent Standards and Prohibitions

§ 129.1 Scope and purpose.

(a) The provisions of this subpart apply to owners or operators of specified facilities discharging into navigable waters.

(b) The effluent standards or prohibitions for toxic pollutants established in this subpart shall be applicable to the sources and pollutants hereinafter set forth, and may be incorporated in any NPDES permit, modification or renewal thereof, in accordance with the provisions of this subpart.

(c) The provisions of 40 CFR Parts 124 and 125 shall apply to any NPDES permit proceedings for any point source discharge containing any toxic pollutant for which a standard or prohibition is established under this part.

§ 129.2 Definitions.

All terms not defined herein shall have the meaning given them in the Act or in 40 CFR Part 124 or 125. As used in this part, the term:

(a) "Act" means the Federal Water Pollution Control Act, as amended (Pub. L. 92-500, 86 Stat. 816 *et seq.*, 33 U.S.C.1251 *et seq.*). Specific references to sections within the Act will be according to Pub. L. 92-500 notation.

(b) "Administrator" means the Administrator of the Environmental Protection Agency or any employee of the Agency to whom the Administrator may by order delegate the authority to carry out his functions under section 307(a) of the Act, or any person who shall by operation of law be authorized to carry out such functions.