

Chapter 2 - Basin Overview

2.1 General Overview

The Pasquotank River basin encompasses 3,635 square miles of low-lying lands and vast open waters, including Albemarle Sound, in the state's northeast outer coastal plain (Figure A-4). It includes all or portions of Camden, Chowan, Currituck, Dare, Gates, Hyde, Pasquotank, Perquimans, Tyrrell and Washington counties. It contains numerous small watersheds that drain into Albemarle, Currituck, Croatan, Roanoke and Pamlico Sounds.

Pasquotank River Basin Statistics

Total Area: 3,635 mi²
Stream Miles: 474.1
Estuary Acres: 918,223.6
Freshwater Acres: 22,770.2
Coast Miles: 110.6
No. of Counties: 10
No. of Municipalities: 11
No. of Subbasins: 7
Population (2000): 118,912 *
Estimated Pop. (2020): 151,192 *
% Increase (2000-2020): 27 %
Pop. Density (1990): 46 persons/sq. mi.

* Based on % of county land area estimated to be within the basin.

A small portion of the Pasquotank River basin is located in Virginia, managed by Virginia as the Chowan River and Dismal Swamp basin (Figure A-5). The portion of the basin managed by Virginia covers 4,061 square miles of the Chowan River and Pasquotank River basin's headwaters. The basin is approximately 145 miles in length and varies from 10 to 50 miles in width. The basin is mostly rural with approximately 64 percent of its land covered by forest, 28 percent cropland and pasture, and about 6 percent urban areas (Hill, 2000). The Albemarle Sound is a large fresh to brackish estuarine system with major tributaries including the Pasquotank,

Roanoke, North, Little and Perquimans Rivers on the north side. On the south portion of the sound, the Scuppernong and Alligator Rivers drain into the estuary. Salinities in the sound are low due to dilution from the large inflow of freshwater from the Pasquotank and Roanoke Rivers relative to the sound's volume.

Major tributaries on the northwestern side of the Albemarle Sound include the Perquimans, Little and Pasquotank Rivers. The Perquimans River originates in the Great Dismal Swamp, takes flow from a system of drainage canals, and flows southeast into the sound. East of the Perquimans River lies the Little River, a slow-flowing coastal stream that flows along the border of Perquimans and Pasquotank counties. The Pasquotank River flows along the border of Pasquotank and Camden counties, originating as freshwater above Elizabeth City. As it drains southeast toward the Albemarle Sound, the river becomes brackish and tidally influenced.

On the southeastern side of the Albemarle Sound are the Alligator and Scuppernong Rivers. The Alligator River is a large blackwater river, designated as Outstanding Resource Waters. It is remote from any urban areas and is bordered by wooded swamps and pocosins. The river's outstanding resource is its function as a major spawning area for anadromous fish (those species that migrate from freshwater to saltwater back to freshwater during their life cycles), including

Figure A4 General Map of the Pasquotank River Basin

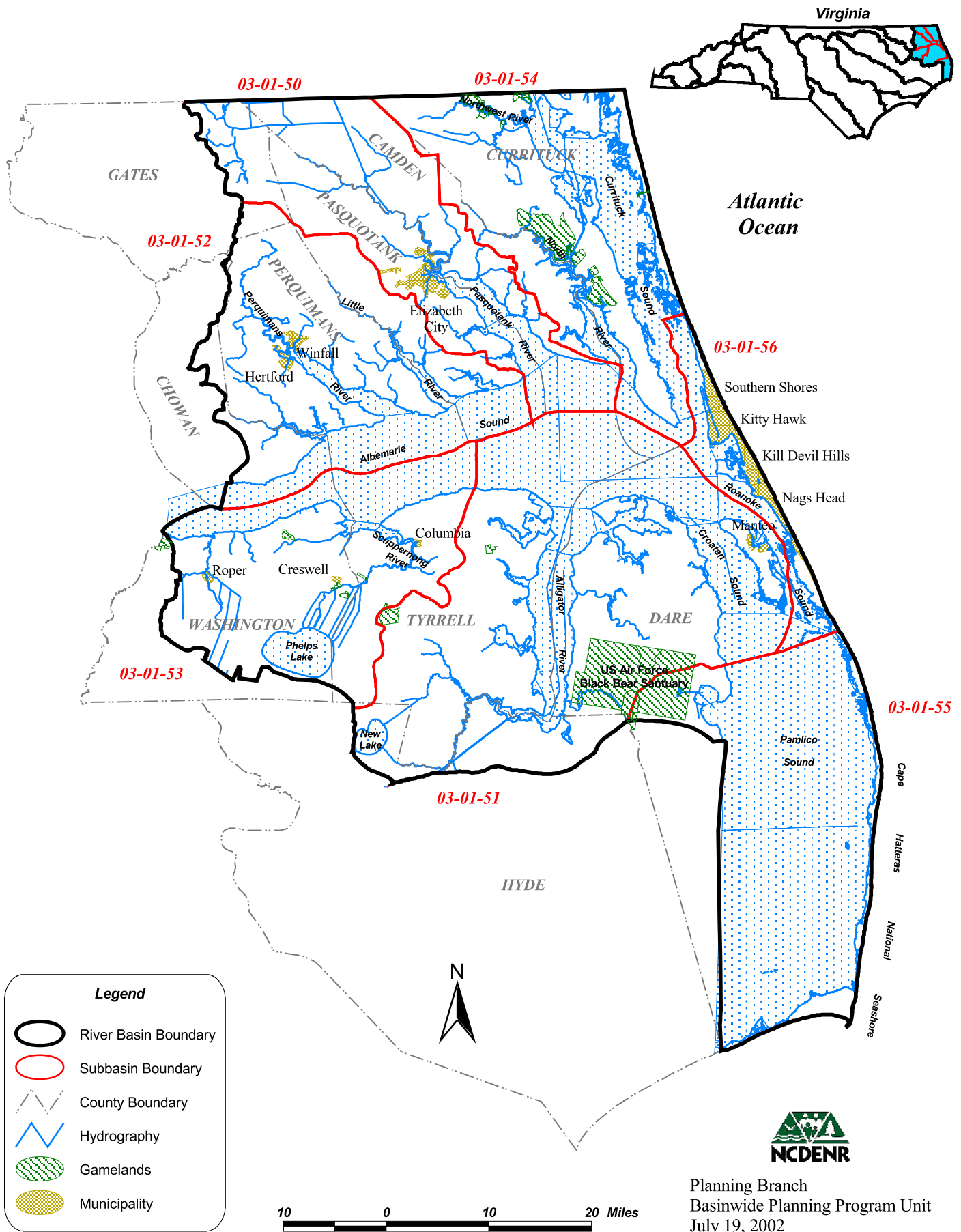
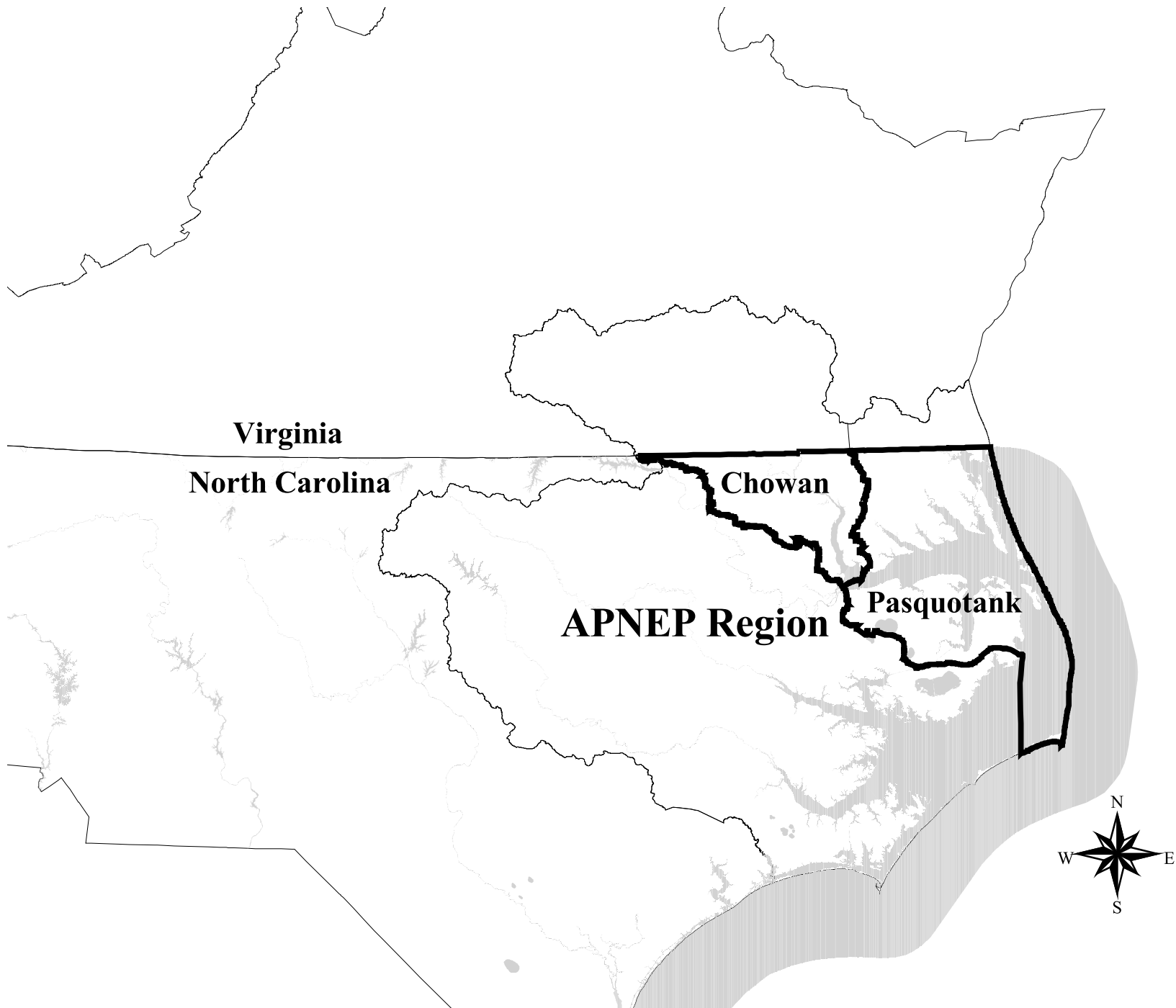


Figure A-5 Virginia Portion of Chowan and Pasquotank River Basins



river herring (alewife and blueback herring), and the river's inclusion as a National Wildlife Refuge. The Pasquotank River basin also contains several lakes including Lake Phelps, the second largest natural lake in the state.

Northeast of the Albemarle Sound lies Currituck Sound, a shallow, fresh to brackish estuary influenced greatly by wind movement. Historically, Currituck Sound supported a waterfowl hunting industry and largemouth bass fishery, both of which have declined due to habitat changes. Serving as part of the Atlantic Flyway for migratory waterfowl, the Currituck Sound offers habitat to thousands of wintering ducks, geese and swans. Inputs to the Currituck Sound come from the Northwest River and numerous canals originating in the Great Dismal Swamp.

South of Currituck Sound, the Pasquotank River basin contains waters along the Outer Banks including Roanoke Sound, Croatan Sound and Pamlico Sound from Oregon Inlet to Hatteras Inlet. These waters are predominantly estuarine with the exception of a few small lakes in the maritime forest of the outer banks. Much of the area is adjacent to the Cape Hatteras National Seashore and Pea Island National Wildlife Refuge.

Water quality is generally good in the Pasquotank River basin. The basin contains a mixture of each type of primary classification possible in North Carolina ranging from Class B, C, SB, SC to SA (see Section A, Chapter 3). In addition to the diversity of primary water quality classifications, many waters are designated as Outstanding Resource Waters such as Lake Phelps, the Alligator River, Swan Creek Lake and many others. Other supplemental classifications in the basin include High Quality Waters, Water Supply Watersheds and Swamp Waters.

Population of the basin, based on 1990 census data, was estimated to be 97,215. The 2000 population was estimated at 118,912. The projected change in population between 2000 and 2020 shows a 27 percent increase in population. In 1998, population among the municipalities ranged from 278 in Creswell to 17,188 in Elizabeth City. The overall population density of the basin is 46 persons per square mile compared to an estimated statewide average of 139 persons per square mile. The greatest population and density are concentrated in the coastal area of the basin.

The Pasquotank River basin is part of the Albemarle-Pamlico Estuarine system, the second largest estuarine system in the United States. In 1987, this estuarine system became part of the Environmental Protection Agency National Estuary Program and was the subject of a major study known as the Albemarle-Pamlico Estuarine Study (refer to Section C, Chapter 2).

The land comprising the Pasquotank River basin is dominated by open water. Forty-one percent of the land use in the basin is water with another 38 percent characterized as forest/wetlands. Important natural resources in the basin include wetlands, anadromous fish spawning areas, National Seashore and National Wildlife Refuges. Most of the water used in the basin comes from surface water and groundwater sources, but the vast majority comes from groundwater sources.

2.2 Local Governments and Planning Jurisdictions in the Basin

The basin encompasses all or part of the following ten counties and 11 municipalities (Table A-3). All local governments fall within the Region R Council of Governments overseen by the Albemarle Regional Planning and Development Commission located in Hertford.

Table A-3 Local Governments and Planning Units within the Pasquotank River Basin

County	Municipalities
Camden	Elizabeth City *
Chowan	None
Currituck	None
Dare	Kill Devil Hills Kitty Hawk Manteo Nags Head Southern Shores
Gates	None
Hyde	None
Pasquotank	Elizabeth City *
Perquimans	Hertford Winfall
Tyrrell	Columbia
Washington	Creswell Roper

* Located in more than one county

Note: Counties adjacent to and sharing a border with a river basin are not included as part of that basin if only a trace amount of the county (<2%) is located in that basin, unless a municipality is located in that county.

2.3 Surface Water Hydrology

Most federal government agencies, including the US Geological Survey and the 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. Under the federal system, the Pasquotank River basin is made up of one hydrologic area referred to as a hydrologic unit. DWQ has a two-tiered system in which the state is divided into 17 major river basins with each basin further subdivided into subbasins. Table A-4 compares the two systems. The Pasquotank River basin is subdivided by DWQ into seven subbasins that correspond with the watershed of the Albemarle Sound (shown on Figure A-4). Maps of each subbasin are included in Section B of this plan.

Table A-4 Hydrologic Subdivisions in the Pasquotank River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ 6-digit Subbasin Codes
<i>Albemarle Sound</i> Pasquotank River Alligator River and Croatan Sound Perquimans, Little and Yeopim Rivers Scuppernong River and Phelps Lake Currituck Sound and North River Roanoke Sound and surrounding areas	03010205	03-01-50 03-01-51 03-01-52 03-01-53 03-01-54 03-01-56

Note: Pasquotank River subbasin 03-01-55 is contained in hydrologic unit 03020105, and it is not included in the above table. The hydrologic unit 03020105 is discussed in the Tar-Pamlico River Basin Water Quality Plan.

Hydrologic Features

In this basin, 465 miles of freshwater streams drain 3,635 square miles of low-lying lands and vast open waters. The average drainage area per stream mile is 0.13 square mile, the lowest drainage density per stream mile in the state. In comparison, the largest river basin in the state, the Cape Fear, drains 1.5 square miles per stream mile. In the Cape Fear, there are fewer streams draining much larger portions of land as compared to the Pasquotank. Areas with low drainage density are associated with low flood peaks, low sediment production, relatively high suitability for traditional agriculture.

The basin lies in the Coastal Plain Physiographic Region. The geology of this area consists of alternating layers of sand, silt, clay and limestone. In this portion of the basin, the land is relatively flat. The slope dips downward at a rate of only a few feet per mile. A smaller number of streams drain a large area of land on the Coastal Plain. In addition to low drainage density, the lower portion of the basin also has the lowest potential for sustaining base flow in streams. The low flow frequency, measured by a 7Q10 (annual minimum 7-day consecutive low flow, which on average, will be exceeded 9 out of 10 years) flow calculation, is zero for all but the largest drainages. This very low flow over the warmest months of the year limits streams' ability to maintain high dissolved oxygen levels (increased temperature depletes dissolved oxygen while decreased velocity inhibits reaeration). The capacity for assimilating oxygen-consuming wastes is also limited under these conditions.

2.4 Land Cover

Land cover information in this section is from the most recent National Resources Inventory (NRI), as developed by the Natural Resources Conservation Service (USDA, updated June 2001). The National Resources Inventory (NRI) is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on the nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time – 1982, 1987, 1992 and 1997.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process is that the previously recorded data are carefully reviewed as

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

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

Table A-5 summarizes acreage and percentage of land cover from the 1997 NRI for the North Carolina portion of the basin, as defined by the USGS 8-digit hydrologic units, and compares the coverages to 1982 land cover. Land cover in the basin, as presented in Table A-5, is dominated by open waters, characterized as "Other" which covers approximately 37.9 percent of the land area. Forest and federal lands combined cover approximately 37.1 percent. Agriculture (including cultivated and uncultivated cropland and pastureland) covers approximately 21.6 percent. Only 3.3 percent of the land area is developed. Table A-6 describes the land cover types.

Table A-5 Land Cover in the Pasquotank River Basin by Major Watersheds - 1982 vs. 1997 (Source: USDA-NRCS, NRI, updated June 2001)

LAND COVER	MAJOR WATERSHED AREAS *						% change since 1982
	Albemarle Sound Watershed		1997 TOTALS		1982 TOTALS		
	Acre (1000s)	%	Acre (1000s)	% of TOTAL	Acre (1000s)	% of TOTAL	
Cult. Crop	437.1	21.3	437.1	21.3	493.2	24.0	-11.4
Uncult. Crop	0.1	0.0	0.1	0.0	0.0	0.0	10.0
Pasture	6.7	0.3	6.7	0.3	3.9	0.2	71.8
Forest	491.7	23.9	491.7	23.9	668.7	32.5	-26.5
Urban & Built-Up	68.7	3.3	68.7	3.3	36.9	1.8	86.2
Federal	271.8	13.2	271.8	13.2	69.1	3.4	293.3
Other	779.5	37.9	779.5	37.9	783.8	38.1	-0.5
Totals	2055.6	100.0	2055.6	100.0	2055.6	100.0	
% of Total Basin		100.0		100.0			
SUBBASINS	03-01-50 to 03-01-54 03-01-56 **						
8-Digit Hydraulic Units	03010205						

* = Watershed areas defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin titles used by DWQ.

** Pasquotank River subbasin 03-01-55 is contained in hydrologic unit 03020105.

It is not currently feasible to estimate the land use in the Pasquotank portion of hydrologic unit 03020105 to include above.

The hydrologic unit 03020105 is discussed in the Tar-Pamlico River Basin Water Quality Plan.

A small portion of Chowan River subbasin 03-01-04 is contained in hydrologic unit 03010205.

The hydrologic unit 03010205 is discussed in the Pasquotank River Basin Water Quality Plan.

Table A-6 Description of Land Cover Types (Source: USDA-NRCS, NRI, updated June 2001)

Land Cover Type	Land Cover Description
Cultivated Cropland	Harvestable crops including row crops, small grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow or other cropland not planted.
Pastureland	Forage plants for livestock grazing, including land that has a vegetative cover of grasses, legumes and /or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) 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. The minimum area for classification of forestland is 1 acre; must be at least 1,000 feet wide.
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. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	<p><i>Rural Transportation:</i> 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).</p> <p><i>Small Water Areas:</i> Waterbodies less than 40 acres in size and streams less than one-half mile wide.</p> <p><i>Census Water:</i> Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width.</p> <p><i>Minor Land:</i> Lands not in one of the other categories.</p>

Comparisons of land cover between 1982 and 1997 (Figure A-6) show decreases in cultivated croplands and forest. Over the 10-year period, substantial increases were experienced in the pasture, urban and federal categories.

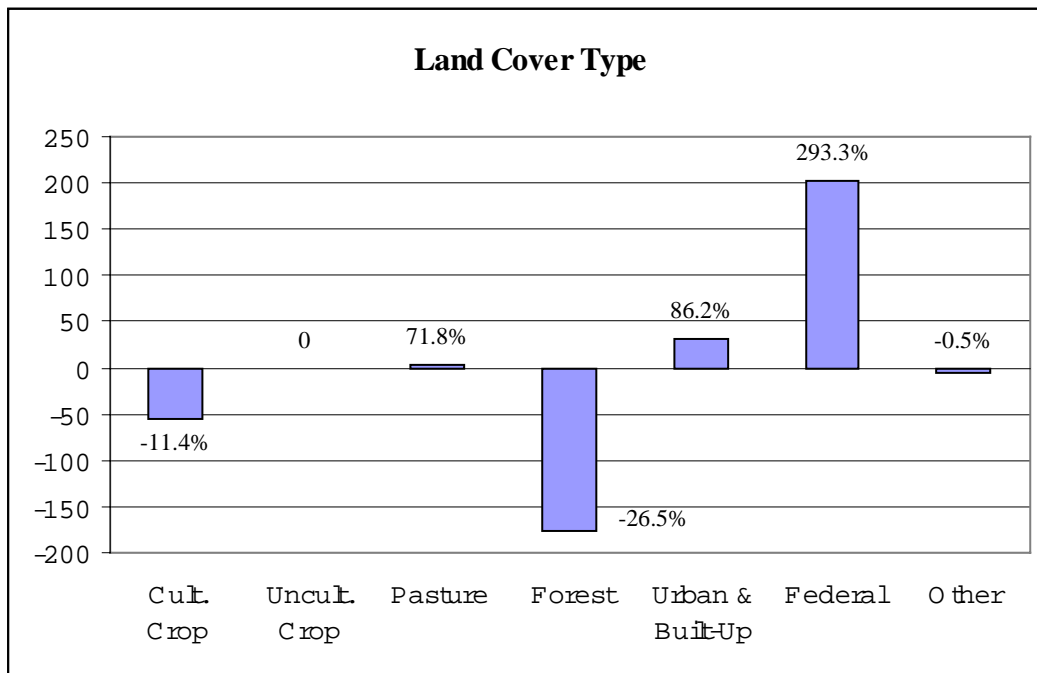


Figure A-6 Land Cover Changes from 1982 to 1997 for the Pasquotank River Basin
(Source: USDA-NRCS, NRI, updated June 2001)

The most recent land cover information for the Pasquotank River basin is based on satellite imagery collected from the North Carolina Corporate Geographic Database. The state's Center for Geographic Information and Analysis (CGIA) developed statewide land cover information based on this 1993-1995 satellite imagery. The land cover data are divided into 24 categories. For the purposes of this report, those categories have been condensed into five broader categories as described in Table A-7. An important distinction between this land cover dataset and that of the NRI is that there is no actual groundtruthing of the satellite-generated data.

Table A-7 Description of Major CGIA Land Cover Categories

Land Cover Type	Land Cover Description
Urban	Greater than 50% coverage by synthetic land cover (built-upon area) and municipal areas.
Cultivated	Areas that are covered by crops that are cultivated in a distinguishable pattern (such as rows).
Pasture/Managed Herbaceous	Areas used for the production of grass and other forage crops and other managed areas such as golf courses and cemeteries. Also includes upland herbaceous areas not characteristic of riverine and estuarine environments.
Forest/Wetland	Includes salt and freshwater marshes, hardwood swamps, shrublands and all kinds of forested areas (such as needleleaf evergreens, conifers, deciduous hardwoods).
Water	Areas of open surface water, areas of exposed rock, and areas of sand or silt adjacent to tidal waters and lakes.

Unfortunately, due to differences in the system of categorizing various land cover classes, it is not possible to establish trends in land cover changes by comparing this data set to previously attained land cover data. However, it is anticipated that comparisons will be possible with future satellite data since a strong consensus-based effort was made to develop the classification system that was used with the 1996 data. Satellite imagery from a 1998 fly-over is available; however, it is not in a format conducive for analysis. DWQ is collaborating with CGIA to make this data available for future analysis in the next basin plan update.

Figure A-7 provides an illustration of the relative amount of land area that falls into each major cover type for the Pasquotank River basin. Section B of this plan provides land cover data specific to each subbasin.

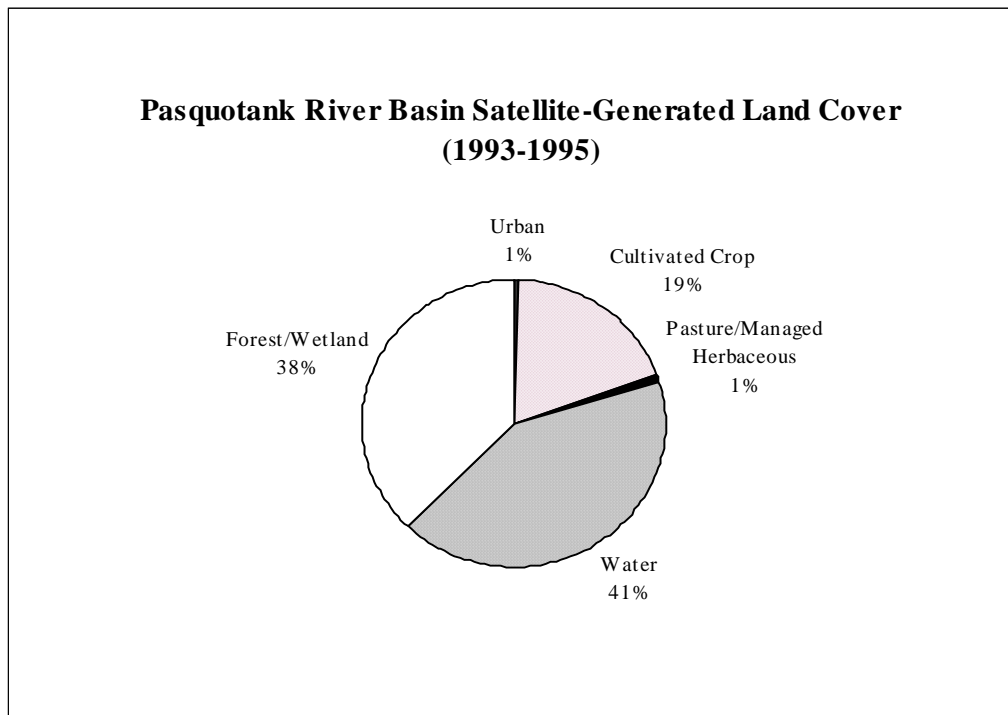


Figure A-7 Percentages within Major CGIA Land Cover Categories in the Pasquotank River Basin

2.5 Population and Growth Trends

Population

The Pasquotank River basin has an estimated population of 118,913 based on 2000 census data. Table A-8 presents census data for 1970, 1980 and 1990 for each of the subbasins. It also includes population densities (persons/square mile) based on the *land area* (excludes open water) for each subbasin. Approximately one-third of the basin’s population is located in subbasin 03-01-50, which includes Elizabeth City. Subbasin 03-01-56, which includes the Outer Banks’ municipalities of Nags Head, Kitty Hawk and Kill Devil Hills, has a population density of 305

persons/square mile, making it the most densely populated land area in the Pasquotank River basin.

Table A-8 Pasquotank River Subbasin Population, Densities (1970, 1980 and 1990) and Land Area Summaries

SUBBASIN	POPULATION ¹			POPULATION DENSITY ²			LAND AND WATER AREAS ³			
	(Number of Persons)			(Persons/Square Mile)			Total Land and Water Area		Water Area	Land Area
	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-01-50	28,271	29,867	31,369	72	77	80	291,066	455	64	390
03-01-51	5,287	6,220	9,240	9	11	16	625,919	978	410	568
03-01-52	13,603	15,217	18,399	34	38	46	346,203	541	142	399
03-01-53	8,190	8,782	8,836	24	26	26	304,012	475	139	336
03-01-54	8,320	12,525	14,653	27	41	48	322,062	503	199	304
03-01-55	1,763	3,801	3,436	18	40	36	367,331	574	478	96
03-01-56	1,524	4,807	11,282	41	130	305	70,010	109	72	37
TOTALS	66,958	81,219	97,215	31	38	46	2,326,603	3,635	1,504	2,130

¹ Population estimated based on US Census data and percentage of census block that falls within the subbasin.

² Population density based on land area only. Large wetlands (swamps) not included in area used to calculate density.

³ Information generated by the NC Center for Geographic Information Analysis.

In using these data, it should be noted that some of 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 is 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 change every ten years, so comparisons between years must be considered approximate.

Growth Trends

Basinwide, the percentage increase in population from 1980 to 1990 was 16.4 percent, exceeding the statewide increase of 12.7 percent over the same 10-year period. The projected population figures indicate that the majority of the basin is expected to continue to grow at significant rates. The highest levels of growth are expected on the Outer Banks.

Table A-9 presents population data for municipalities that are located wholly or partially within the basin. The table indicates that Kitty Hawk is currently the fastest growing municipality in the basin with an increase in population of 54.4 percent from 1990 to 2000. Population in Elizabeth City, Kill Devil Hills, Nags Head, Southern Shores and Winfall also increased over the same 10-year period from between 10.6 and 52.1 percent. Population growth in the majority of municipalities in the basin slowed considerably after 1990. For instance, between 1980 and 1990, Kill Devil Hills, Kitty Hawk and Southern Shores increased by over 125 percent each, slowing down to 54.4 percent between 1990 and 2000. This information was obtained from the Office of State Planning (April and May 2001).

Table A-9 Population (1980, 1990, 2000) and Percent Change for Municipalities Located Wholly or Partly in the Pasquotank River Basin

Municipality	County	Apr-80	Apr-90	April 2000	% Change (1980-1990)	% Change (1990-2000)
Columbia	Tyrrell	758	836	819	10.3	-2.0
Creswell	Washington	426	361	278	-15.3	-23.0
Elizabeth City	Camden, Pasquotank	14,007	14,292	17,188	2.0	20.3
Hertford	Perquimans	1,941	2,244	2,070	15.6	-7.8
Kill Devil Hills	Dare	1,671	4,238	5,897	153.6	39.1
Kitty Hawk	Dare	849	1,937	2,991	128.2	54.4
Manteo	Dare	902	991	1,052	9.9	6.2
Nags Head	Dare	1,020	1,838	2,700	80.2	46.9
Roper	Washington	795	669	613	-15.8	-8.4
Southern Shores	Dare	520	1,447	2,201	178.3	52.1
Winfall	Perquimans	634	501	554	-21.0	10.6

* The numbers reported reflect municipality population. All of the municipalities are completely contained within the basin.

Table A-10 shows the projected population and change in growth between 1990 and 2020 for counties that are wholly or partly contained within the basin. Since river basin boundaries do not usually coincide with county boundaries, these numbers are not directly applicable to the Pasquotank River basin. Even though 100 percent of Camden, Currituck, Pasquotank, Perquimans and Tyrrell counties are contained within the basin, only nine percent of Hyde County is encompassed.

Table A-10 Past, Projected and Change in Population (1990, 2000, 2020) by County

County	% of County in Basin *	1990	2000	Estimated Population 2020	Estimated Pop Change 1990-2000	Estimated Pop Change 2000-2020
Camden	100	5,904	6,885	8,794	981	1,909
Chowan	33	13,506	14,526	16,026	1,020	1,500
Currituck	100	13,736	18,190	27,060	4,454	8,870
Dare	89	22,746	29,967	44,061	7,221	14,094
Gates	20	9,305	10,516	12,869	1,211	2,353
Hyde	9	5,411	5,826	6,310	415	484
Pasquotank	100	31,298	34,897	41,567	3,599	6,670
Perquimans	100	10,447	11,368	12,873	921	1,505
Tyrrell	100	3,856	4,149	4,534	293	385
Washington	68	13,997	13,723	12,823	-274	-900
Total		130,206	150,047	186,917	19,841	36,870

* Source: North Carolina Center for Geographic Information and Analysis

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

For more information on past, current and projected population estimates, contact the Office of State Planning at (919) 733-4131 or visit their website at <http://www.ospl.state.nc.us/demog/>.

2.6 Natural Resources

2.6.1 Public Lands in the Pasquotank River Basin

The Pasquotank River basin contains multiple diverse public lands including several National Wildlife Refuges, National Estuarine Research Reserves, state parks, preserves and a National Seashore. Figure A-8 shows public lands and significant natural heritage areas in the basin.

2.6.2 Ecological Significance of the Pasquotank River Basin

The Pasquotank River basin has a large number of significant natural areas and rare species, many with coastal affinities. For instance, six of the seven federally listed threatened and endangered aquatic species are predominantly marine species -- the American Alligator being the exception -- although the Shortnose Sturgeon is anadromous, spending some stages of its life in freshwater rivers. The Pasquotank River basin contains some extensive conservation lands, which correspond to a number of expansive natural features (swamps, marshes, pocosins, etc.). The Natural Heritage Program inventories areas for natural diversity and catalogs rare plant and animal species and natural communities.

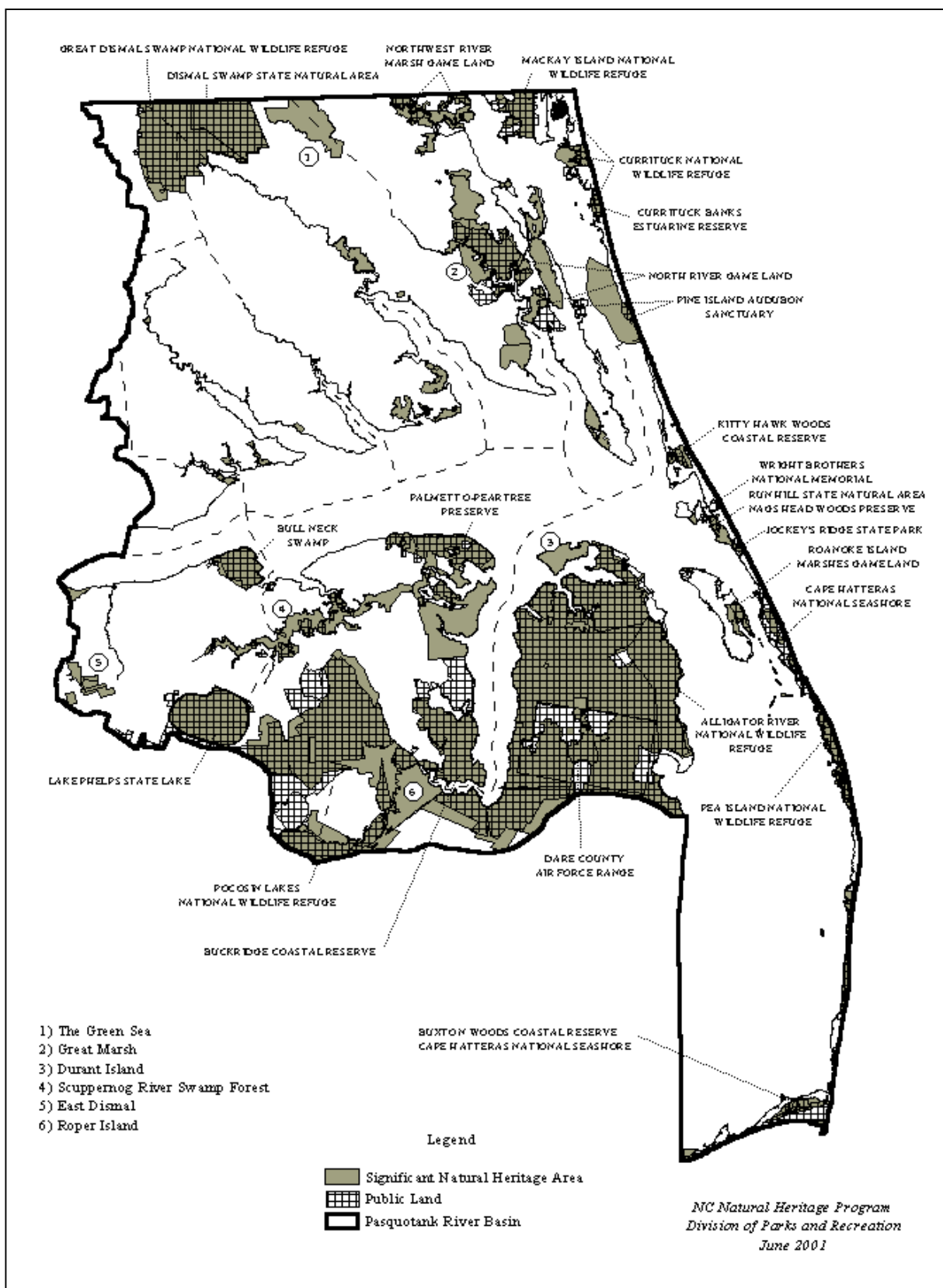


Figure A-8 Public Lands and Significant Natural Heritage Areas in the Pasquotank River Basin

Wetland Communities in the Pasquotank River Basin

The Pasquotank River basin constitutes a significant portion of the North Carolina Coastal Plain known as the Embayed Region. This name refers to the prominence of drowned river valleys that form the large sounds and many bays. The land in the Embayed Region is universally low and flat, and most is poorly drained. This region contains the largest acreage and proportion of wetlands in the state. The Pasquotank River basin has many types of wetland communities. Vast peatlands occupy the centers of peninsulas between the drowned rivers. On the fringes of the peatlands are flat mineral soil wetlands that are kept saturated primarily by rainfall and sheet flow. Additional large areas of organic and mineral soil swamps and marshes lie adjacent to the sounds and tidally influenced rivers.

Freshwater Tidal Wetlands

Freshwater tidal wetlands are an important component of the landscape in the Pasquotank River basin, especially along Currituck Sound and the North and Northwest Rivers. Along the Albemarle Sound, the land-water interface is characterized by Tidal Cypress-Gum Swamp communities.

Nonriverine Wetlands

Nonriverine wetland communities in the Pasquotank River basin include Nonriverine Swamp Forest, Nonriverine Wet Hardwood Forest, High Pocosin, Low Pocosin, Pond Pine Woodland, Peatland Atlantic White Cedar Forest and Bay Forest. Both the Dismal Swamp and the Dare County mainland contain extensive Nonriverine Swamp Forest and also support patches of Atlantic White Cedar, Pocosin and Pond Pine Woodland. The extent of the natural areas in both the Dismal Swamp and the Dare mainland allows for the natural 'shifting mosaic' pattern of these wet peatland communities. The Nonriverine Wet Hardwood Forest community, which is dominated by oaks, is not part of the 'shifting mosaic' pattern, being associated more with mineral soils than organic soils and peatlands. The high productivity of the Nonriverine Wet Hardwood wetland community soils when cleared for agriculture has led to a drastic decline in the acreage of this community type across the state.

Natural Lake Shoreline Wetlands

Natural Lake Shoreline is a wetland community type composed of the vegetated shoreline zone of large natural lakes. The vegetation may include herbs, shrub thickets, Cypress-Gum Swamps or various bottomland species. The Natural Lake Shoreline of Phelps Lake in Washington County is a high quality example of this wetland community type that is protected within Pettigrew State Park.

Nontidal Coastal Fringe Wetlands

Nontidal coastal fringe wetlands occur primarily on the outer banks. Wetland communities on the Outer Banks include Maritime Swamp Forest and Maritime Shrub Swamp, examples of which are protected at Nag's Head Woods; Maritime Wet Grassland, an example is found in the

Pine Island Audubon Sanctuary in Currituck County; and Interdune Pond, an example is found along the Cape Hatteras National Seashore.

2.6.3 Significant Natural Heritage Areas

The North Carolina Natural Heritage Program (NHP) compiles the list of Significant Natural Heritage Areas. The list is based on the program's inventory of natural diversity in the state. Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determine a site's significance rating. The sites included on this list are the best representatives of the natural diversity of the state, and therefore, have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Figure A-8 shows the Significant Natural Heritage Areas (SNHA) in the Pasquotank River basin. Certain sites that contribute to the maintenance of water quality in the Pasquotank River basin are highlighted below.

Currituck Sound Significant Natural Heritage Areas

The Currituck Sound region includes the Northwest River, North Landing River and Currituck Banks. Many of the Significant Natural Heritage Areas in Currituck Sound are Tidal Freshwater Marsh and Nonriverine Swamp Forest/Nonriverine Wet Hardwood Forest communities surrounding the estuarine shoreline and drowned river mouths. Several of the sites in this region are extensive, such as Great Marsh (6,037 acres), Pine Island/Currituck Club Natural Area (11,709 acres), and Buckskin Creek/Great Swamp (5,044 acres). These high quality natural areas provide water quality benefits as well as outstanding wildlife habitat.

North River Significant Natural Heritage Areas

Significant Natural Heritage Areas in the North River are characterized by vast, high quality Tidal Freshwater Marshes and Cypress-Gum Swamps, as well as nonriverine wetland communities of Swamp Forest and Atlantic White Cedar. However, only a small fraction of the area is protected.

Great Dismal Swamp Significant Natural Heritage Areas

The combined acreage of the Dismal Swamp State Natural Area and the Great Dismal Swamp National Wildlife Refuge is over 41,000 acres. This vast area extends into Virginia and consists mostly of Nonriverine Swamp Forest, High Pocosin, Atlantic White Cedar and other associated nonriverine wetland communities. Together with the Green Sea, a 9,592-acre natural area to the east, the Great Dismal Swamp provides habitat for rare plant and animal species and is home to wildlife such as black bear that require large undeveloped areas for survival. Sizeable portions of the Dismal Swamp State Natural Area and the National Wildlife Refuge are Registered Natural Heritage Areas, yet drainage of adjacent lands has significantly affected the hydrology of these areas.

Albemarle Sound Significant Natural Heritage Areas

The Significant Natural Heritage Areas that border Albemarle Sound are areas of high quality Tidal Freshwater Marsh, Nonriverine Swamp Forest, Maritime Forests and important Nonriverine Wet Hardwood Forests. These areas, though scattered, serve important roles as natural vegetated buffers for Albemarle Sound, in addition to providing habitat for wildlife.

East Dismal Swamp Significant Natural Heritage Areas

East Dismal Swamp is a 3,868-acre remnant of a Nonriverine Swamp Forest that once stretched over 100,000 acres in Washington and Beaufort counties. Certain old-growth forest characteristics of the East Dismal Swamp make it an attractive stop over for neotropical migrant birds. When protected, the East Dismal Swamp will contribute to the overall ecosystem function of natural areas in the region.

Scuppernong River/Lake Phelps Significant Natural Heritage Areas

Emptying into Albemarle Sound, the Scuppernong River drains northern Washington and Tyrrell counties. The high quality communities bordering the river comprise over 14,000 acres and include Coastal Plain Small Stream Swamp (Blackwater Subtype), Cypress--Gum Swamp (Blackwater Subtype), Atlantic White Cedar and Nonriverine Swamp Forest. Lake Phelps, one of the Coastal Plain's few natural lakes, drains into the Scuppernong River via canals. Lake Phelps is noteworthy for its unique shoreline community.

Alligator River, Dare/Tyrrell/Northern Hyde Counties Significant Natural Heritage Areas

This large area is made up of extensive peatlands on either side of Alligator River. This region has the greatest extent of peatland communities in North Carolina, and probably in the whole eastern United States. Nonriverine communities -- Swamp Forests, Pocosins, Pond Pine Woodland, Atlantic White Cedar Forests -- dominate the landscape here, although they are quite rare outside the Pasquotank River basin. Some areas along the shores of the Albemarle Sound and the Alligator River support marshes and Tidal Cypress--Gum Swamps. Much of the land in this region is publicly owned. Protection of Roper Island, Buck Island Bay Forest and Alligator River/Swan Creek Swamp Forest in southern Tyrrell and northern Hyde counties could add significantly to the ecological integrity of the area by acting as a link between protected natural areas on either side of Alligator River.

Coastal Region Significant Natural Heritage Areas

The Coastal Region includes the barrier islands and peninsulas, along with their associated marshes. These narrow ridges of land are among the most dynamic environments in the state, subject to reworking by erosion and overwash by storms as well as the more regular effects of tides, surf, salt spray and wind. Significant Natural Heritage Areas in the coastal region of the Pasquotank River basin include communities of Maritime Grassland, Maritime Forest, Sand Flats and Salt Marshes. Protection exists for portions of several of these sites, such as Buxton Woods, Jockey's Ridge State Park, Pea Island National Wildlife Refuge, Nags Head Woods and

part of Kitty Hawk Woods. Because of the extreme rarity of these barrier island communities, protection should be a priority for the unprotected Significant Natural Heritage Areas.

2.6.4 Rare and Threatened Aquatic Species in the Pasquotank River Basin

The following information on rare aquatic and wetland-dwelling species (Table A-11) was obtained from the Division of Parks and Recreation, NC Natural Heritage Program.

Table A-11 Rare and Threatened Aquatic Species in the Pasquotank River Basin (as of June 2001)

Major Taxon	Common Name	Scientific Name	State Status	Federal Status
fish	Shortnose Sturgeon	<i>Acipenser brevirostrum</i>	E	E
reptile	American Alligator	<i>Alligator mississippiensis</i>	T	T(S/A)
reptile	Loggerhead	<i>Caretta caretta</i>	T	T
reptile	Green Turtle	<i>Chelonia mydas</i>	T	T
reptile	Hawksbill	<i>Eretmochelys imbricata</i>	E	E
fish	Lyre Goby	<i>Evorthodus lyricus</i>	SR	
fish	Waccamaw Killifish	<i>Fundulus waccamensis</i>	SC	FSC
reptile	Northern Diamondback Terrapin	<i>Malaclemys terrapin terrapin</i>	SC	FSC
mammal	Manatee	<i>Trichechus manatus</i>	E	E

Rare Species Listing Criteria	
E =	Endangered (those species in danger of becoming extinct)
T =	Threatened (considered likely to become endangered within the foreseeable future)
T(S/A) =	Threatened due to similarity of appearance.
SR =	Significantly Rare (those whose numbers are small and whose populations need monitoring)
SC =	Species of Special Concern
FSC =	Federal Species of Concern

While there are other rare mammals in the Pasquotank River basin, the manatee is the only rare aquatic mammal. A migratory animal that typically lives in the warmer waters of Florida and other Gulf states, manatees occasionally inhabit North Carolina's inlets, estuaries and rivers from June to October. Manatees rest near the surface of the water, which makes them vulnerable to motor boats and propellers.

The shortnose sturgeon is a large, anadromous fish that once was common in North Carolina waterways. The shortnose sturgeon may live for up to 30 years and inhabits the lower sections of larger rivers and estuaries along the Atlantic coast. The fish moves from the ocean and estuaries into freshwater rivers to spawn between February and May. Juveniles may remain upriver for up to five years after birth before migrating to the ocean. The species has suffered from excessive harvesting and habitat degradation and is now in danger of extinction. Current distribution is not

well known, and the shortnose sturgeon has not been reported from the Pasquotank River basin for more than 20 years.

Several rare reptiles are found in the Pasquotank River basin. Three species of sea turtles have been identified in the basin: the Loggerhead Turtle, the Green Turtle and the Hawksbill Turtle. A fourth turtle, the Northern Diamondback Terrapin, is basically restricted to estuarine situations and lives in coastal marshes, tidal flats, coves, estuaries and lagoons behind barrier beaches. It is intolerant of long-term exposure to freshwater or 100 percent seawater. The American alligator lives in slow-moving coastal rivers, canals, lakes, marshes and estuaries. The American alligator has recovered from the low populations of the past century and is no longer biologically threatened or endangered under the Endangered Species Act. However, it retains the federally threatened status due to its similarity of appearance to other rare crocodylians, and commercial hunting and trade are regulated.

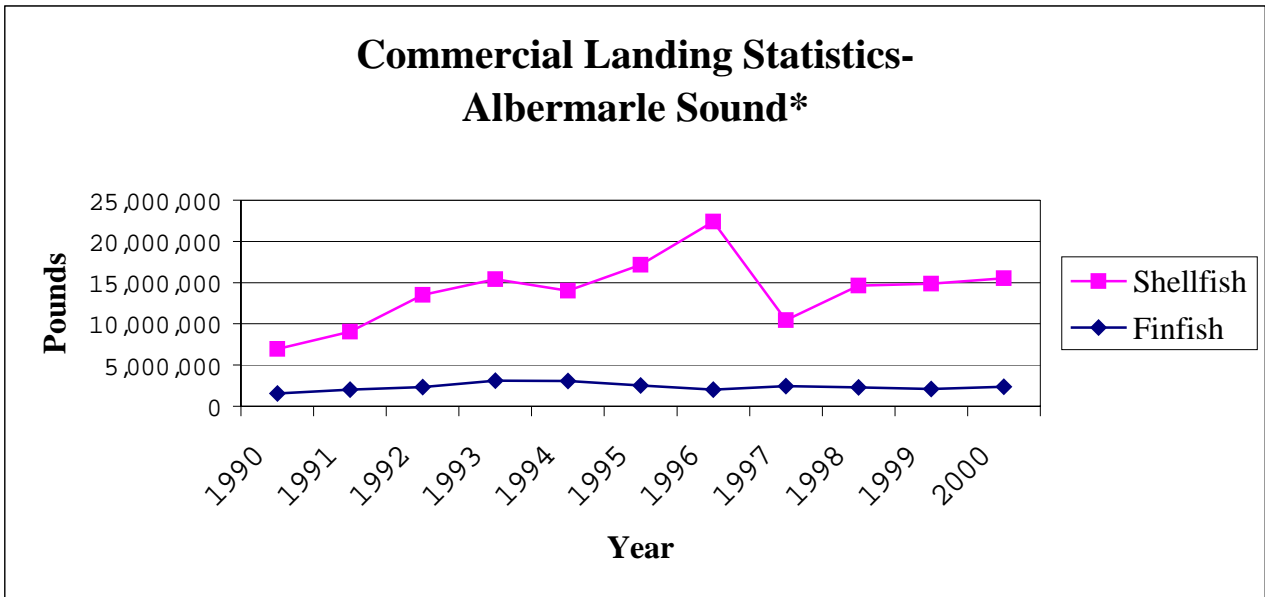
Two rare fishes currently occur in the Pasquotank River basin. The lyre goby, so named for the lyre-shaped marking on its caudal fin, is a small fish limited to coastal areas in North Carolina. It is found in the Cape Fear River estuary, tidepools at Wrightsville Beach, and Bogue and Pamlico Sounds. It prefers shallow, muddy tidepools dominated by smooth cordgrass. Human impacts to smooth cordgrass marshes place constant pressures on the natural habitat of the lyre goby. The second rare fish is the Waccamaw Killifish, endemic to North Carolina. The main population occurs in Lake Waccamaw in Columbus County, but a distinct population also occurs in Phelps Lake in Washington County.

For more information on the Division of Parks and Recreation's NC Natural Heritage Program, contact (919) 715-8702. Information is also available on-line at <http://ils.unc.edu/parkproject/nhp/index.html>.

2.6.5 Fisheries Resources

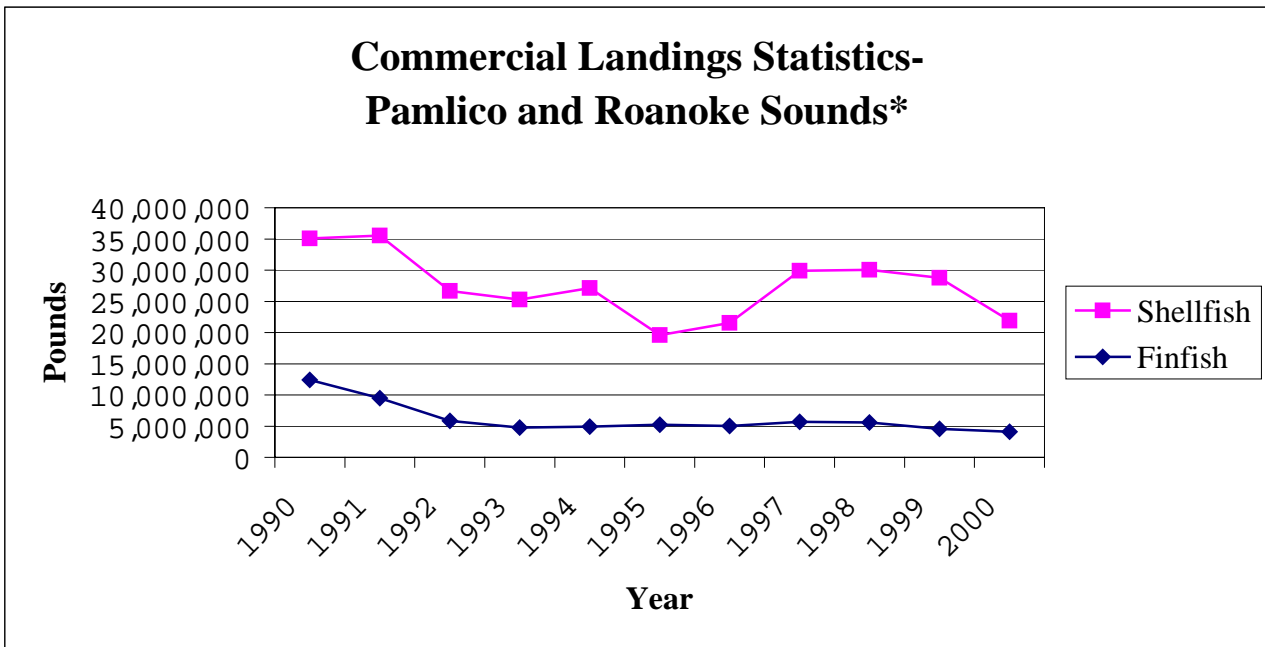
The waters of the Pasquotank River basin are an important habitat for several anadromous fish species. Anadromous species found in the area include blueback herring, alewife, hickory shad, American shad, Atlantic sturgeon and striped bass. Blueback herring and alewife are commonly referred to as 'river herring'.

In an effort to examine the status of the populations in the Pasquotank River basin, Figures A-9 and A-10 provide landing statistics (NCDENR-DMF, 2000). Commercial landings measure the number of pounds of fish caught. The value is an indicator of the direct income generated from the landings. The North Carolina Division of Marine Fisheries (DMF) also conducts stock status reports of important commercial fisheries in the state. River herring in Albemarle Sound is reported as overfished. This was evidenced by a reduced number of age classes in harvest, low juvenile production and a fewer number of repeat spawners. Atlantic sturgeon is listed as overfished as well due to low landings since 1960. The Albemarle-Roanoke Striped Bass community is listed as viable. American shad's status is unknown due to a lack of a current sampling program.



* A portion of the Albermarle Sound landing data may include landing statistics which coincide with DWQ's Roanoke or Chowan River basins. Includes blue crab.

Figure A-9 Commercial Landing Statistics - Albermarle Sound



* A portion of the Pamlico Sound landing data may include landing statistics which coincide with DWQ's Tar Pamlico or Neuse River basins. Includes blue crab.

Figure A-10 Commercial Landing Statistics - Pamlico and Roanoke Sounds

2.7 Permitted Wastewater and Stormwater Discharge Facilities

Discharges that enter surface waters through a pipe, ditch or other well-defined point are broadly referred to as "point sources". Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities that serve populations greater than 100,000 and stormwater discharges associated with certain industrial activities. Point source dischargers in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit. The Environmental Protection Agency issues discharge permits under the NPDES program, which is delegated to DWQ.

The primary pollutants associated with point source discharges are:

- ❖ oxygen-consuming wastes
- ❖ nutrients
- ❖ toxic substances including chlorine, ammonia and metals
- ❖ color

2.7.1 Wastewater Discharges in the Pasquotank River Basin

Type of Wastewater Discharge

Major Facilities: Municipal Wastewater Treatment Plants with flows ≥ 1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts on public health and water quality).

Minor Facilities: Any facilities not meeting the definition of Major.

100% Domestic Waste: Facilities that only treat domestic-type waste (water from bathrooms, sinks, washers).

Municipal Facilities: Public facilities that serve a municipality. Can treat waste from homes and industries.

Nonmunicipal: Non-public facilities that provide treatment for domestic, industrial or commercial wastewater. This category includes wastewater from industrial processes such as textiles, mining, seafood processing, glass-making and power generation, and other facilities such as schools, subdivisions, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

There are 34 permitted discharges in the Pasquotank River basin. Table A-12 provides summary information (numbers of facilities and permitted flows) regarding the discharges by types and subbasin. More detailed information regarding the dischargers characterized in the table is provided in Appendix I.

Figure A-11 shows the location of major and minor permitted wastewater discharges within the basin. The number of triangles on the map depicting major discharges does not correspond exactly to the number of major facilities listed in Table A-12, because some major facilities have more than one discharge location (outfall). Each outfall received its own triangle on Figure A-11.

Table A-12 Summary of NPDES Dischargers and Permitted Flows for the Pasquotank River Basin

Facility Categories	Subbasin							TOTAL
	03-01-50	03-01-51	03-01-52	03-01-53	03-01-54	03-01-55	03-01-56	
Total Facilities	7	6	5	7	2	6	1	34
Total Permitted Flow (MGD)	4.507	0.7	0.472	0.455	0.07	2.31	0.06	8.574
Major Discharges	1	1	0	0	0	0	0	2
Total Permitted Flow (MGD)	4.5	0.6	0.0	0.0	0.0	0.0	0.0	5.1
Minor Discharges	6	5	5	7	2	6	1	32
Total Permitted Flow (MGD)	0.007	0.1	0.472	0.455	0.07	2.31	0.06	3.474
100% Domestic Waste	1	1	1	4	0	1	1	9
Total Permitted Flow (MGD)	0.007	0.6	0.4	0.455	0.0	0.06	0.06	1.582
Municipal Facilities	1	1	1	3	0	1	0	7
Total Permitted Flow (MGD)	4.5	0.6	0.4	0.449	0.0	0.06	0.0	6.009
Nonmunicipal Facilities	6	5	4	4	2	5	1	27
Total Permitted Flow (MGD)	0.007	0.1	0.072	0.006	0.07	2.25	0.06	2.565

2.7.2 Stormwater Discharges in the Pasquotank River Basin

Amendments were made to the Clean Water Act in 1990 and, most recently in 1999, pertaining to permit requirements for stormwater discharges associated with industrial activities and storm sewer systems. DWQ administers these regulations in North Carolina through the state stormwater program. The goal of the DWQ stormwater discharge permitting regulations is to prevent pollution via stormwater runoff by controlling the source(s) of pollutants.

The municipal permitting requirements are designed to lead into the formation of comprehensive stormwater management programs for municipal areas. Elizabeth City is the only local government in the Pasquotank River basin large enough to require a stormwater discharge permit under Phase II requirements. North Carolina is developing further guidelines that may result in additional municipalities designated as Phase II areas.

EPA Stormwater Rules

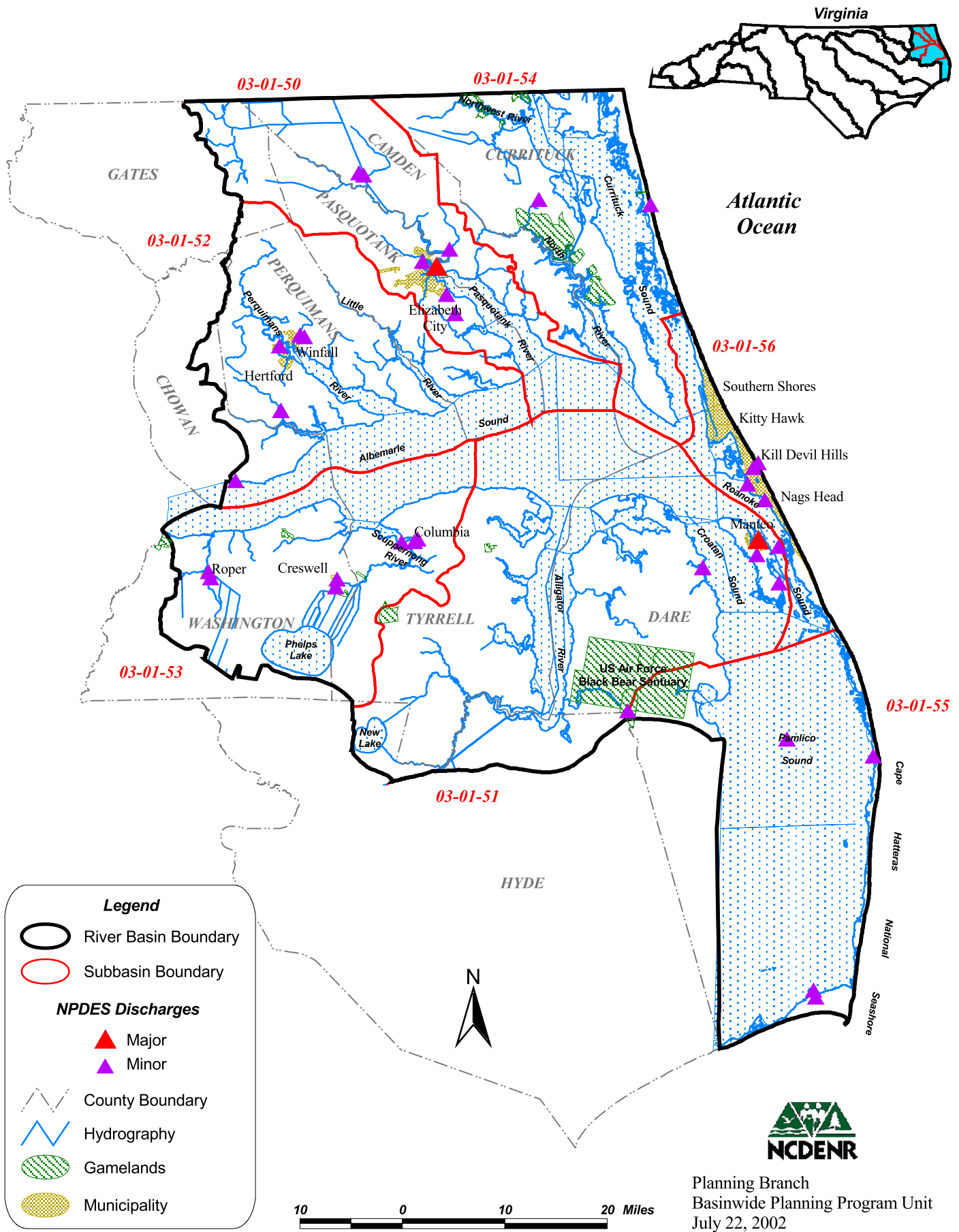
Phase I – December 1990

- Requires a NPDES permit for municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more.
- Requires a NPDES stormwater permit for ten categories of industry.
- Requires a NPDES stormwater permit for construction sites that are 5 acres or more.

Phase II – November 1999

- Requires a NPDES permit for some municipal storm sewer systems serving populations under 100,000, located in urbanized areas.
- Provides a "no stormwater exposure" exemption to industrial facilities covered under Phase I.
- Requires a NPDES stormwater permit for construction sites that are 1-5 acres.

Figure A-11 NPDES Discharges in the Pasquotank River Basin



Virginia

Atlantic Ocean

GATES

03-01-52

03-01-50

03-01-54

03-01-56

Southern Shores

Kitty Hawk

Kill Devil Hills

Nags Head

03-01-53

WASHINGTON

03-01-51

TYRRELL

DARE

03-01-55

Cape

Hatteras

National

Seashore

HYDE

Legend

○ River Basin Boundary

○ Subbasin Boundary

NPDES Discharges

▲ Major

▲ Minor

--- County Boundary

~ Hydrography

▨ Gamelands

▨ Municipality



10 0 10 20 Miles



Planning Branch
Basinwide Planning Program Unit
July 22, 2002

Industrial activities that require permitting are defined in categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Stormwater permits are granted in the form of general permits (which cover a wide variety of more common activities) or individual permits. Excluding construction stormwater general permits, there are 51 general stormwater permits active within the basin. Two individual stormwater permits are currently held: South Atlantic Wood Preserving and Universal Forest Products Eastern Division, Inc.

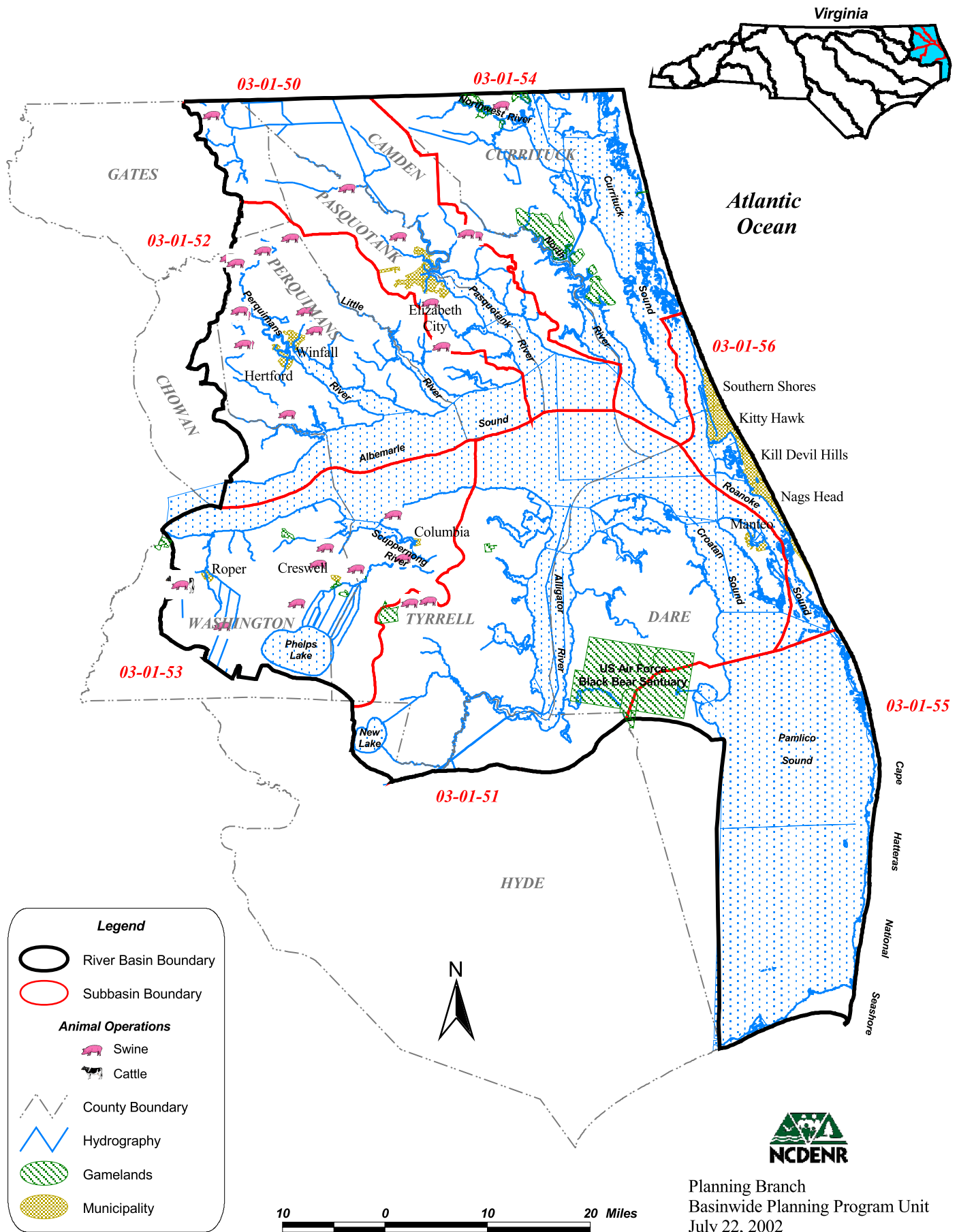
The primary concern with runoff from industrial facilities is the contamination of stormwater from contact with exposed materials. Poor housekeeping can lead to significant contributions of sediment and other water quality pollutants. To address these issues, each NPDES stormwater permitted facility must develop a Stormwater Pollution Prevention Plan (SPPP) that addresses the facility's potential impacts on water quality. Facilities identified as having significant potential to impact water quality are also required to conduct analytical monitoring to characterize pollutants in stormwater discharges under individual NPDES stormwater permits.

The state stormwater management rules (15A NCAC 2H .1000) regulate development activities in 20 coastal counties and on land statewide that drains to Outstanding Resource Waters (ORW) and/or High Quality Waters (HQW). Under this program, development is permitted as either low density or high density. Low density limits the impervious, or built upon, area and allows natural infiltration and attenuation of stormwater runoff. High density requires installation and maintenance of a structural best management practice to control and treat stormwater runoff from the site. Surface waters in the Pasquotank River basin classified as ORW or HQW are presented in Section A, Part 3.2 on Figure A-13.

2.8 Animal Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. Figure A-12 displays locations of animal operations in the Pasquotank River basin. Within the past five years there have been several additional pieces of legislation enacted that affect animal operations in North Carolina and the Pasquotank River basin.

Figure A-12 Registered Animal Operations in the Pasquotank River Basin



Key Animal Operation Legislation (1995-2000)

- 1995 – Senate Bill 974 requires owners of swine facilities with 250 or more animals to hire a certified operator. Operators are required to attend a six-hour training course and pass an examination for certification. Senate Bill 1080 established buffer requirements for swine houses, lagoons and land application areas for farms sited after October 1, 1995.
- 1996 – Senate Bill 1217 required all facilities (above threshold populations) to obtain coverage under a general permit, beginning in January 1997, for all new and expanding facilities. DWQ was directed to conduct annual inspections of all animal waste management facilities. Poultry facilities with 30,000+ birds and a liquid waste management system were required to hire a certified operator by January 1997 and facilities with dry litter animal waste management systems were required to develop an animal waste management plan by January 1998. The plan must address three specific items: 1) periodic testing of soils where waste is applied; 2) development of waste utilization plans; and 3) completion and maintenance of records on-site for three years. Additionally, anyone wishing to construct a new, or expand an existing, swine farm must notify all adjoining property owners.
- 1997 – House Bill 515 placed a moratorium on new or existing swine farm operations and allows counties to adopt zoning ordinances for swine farms with a design capacity of 600,000 pounds (SSLW) or more. In addition, owners of potential new and expanding operations are required to notify the county (manager or chair of commission) and local health department, as well as adjoining landowners. NCDENR was required to develop and adopt economically feasible odor control standards by March 1, 1999.
- 1998 – House Bill 1480 extended the moratorium on construction or expansion of swine farms. The bill also requires owners of swine operations to register with DWQ any contractual relationship with an integrator.
- 1999 – House Bill 1160 extended (again) the moratorium on new construction or expansion of swine farms, required NCDENR to develop an inventory of inactive lagoons, and requires owners/operators of an animal waste treatment system to notify the public in the event of a discharge to surface waters of the state of 1,000 gallons or more of untreated wastewater.
- 2000 Attorney General Easley reached a landmark agreement with Smithfield Foods, Inc. to phase out hog lagoons and implement new technologies that will substantially reduce pollutants from hog farms. The agreement commits Smithfield to phase out all anaerobic lagoon systems on 276 company-owned farms. Legislation will be required to phase out the remaining systems statewide within a 5-year period (State of Environment Report, 2000).

Table A-13 summarizes, by subbasin, the number of registered livestock operations, total number of animals, total acres in operation and total steady state live weight as of March 2001. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin.

Since 1997, many facilities have become inactive, though inactive facilities may continue to be certified and registered with the state. Some likely causes for the inactivity may include financial difficulties, the state moratorium, or a request by the facility for state buyout to close the lagoons. Therefore, Table A-13 may overestimate the number of registered animal operations that still actively raise livestock in the basin.

Table A-13 Registered Animal Operations in the Pasquotank River Basin (as of March 16, 2001)

Subbasin	Cattle			Poultry			Swine		Total Steady State Live Weight
	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	
03-01-50	0	0	0	0	0	0	4	5,455	634,940
03-01-51	0	0	0	0	0	0	2	25,350	3,583,050
03-01-52	0	0	0	0	0	0	11	14,803	1,779,191
03-01-53	1	120	96,000	0	0	0	8	15,241	2,196,085
03-01-54	0	0	0	0	0	0	3	23,978	3,463,611
03-01-55	0	0	0	0	0	0	0	0	0
03-01-56	0	0	0	0	0	0	0	0	0
Totals	1	120	96,000	0	0	0	28	84,827	11,656,877

Steady State Live Weight (SSLW) is the result, in pounds, after a conversion factor has been applied to the number (head count) of swine, cattle or poultry on a farm. The conversion factors, which come from the Natural Resources Conservation Service (NRCS) guidelines, vary depending on the type of animals on the farm and the type of operation (for example, there are five types of hog farms). Since the amount of waste produced varies by the size of the animal, SSLW is the best way to compare the sizes of the farms.

The NC Department of Agriculture provided information on animal capacity by subbasin (Table A-14). A negligible percentage of the state's total capacity for swine, dairy and poultry is found in the Pasquotank River basin. Overall, the poultry and swine capacity increased from 1994 to 1998; whereas, the dairy capacity decreased over the same time period.

Table A-14 Estimated Populations of Swine, Dairy and Poultry (1994 and 1998) in the Pasquotank River Basin

Subbasin	Total Swine Capacity		Swine Change	Total Dairy Capacity		Dairy Change	Poultry Capacity		Poultry Change
	1998	1994	94-98 (%)	1998	1994	94-98 (%)	1998	1994	94-98 (%)
03-01-50	15,864	13,889	14	0	0	0	746,500	694,000	8
03-01-51	12,902	1,157	1015	0	1	-100	3,406,420	0	34,064
03-01-52	20,672	28,660	-28	0	0	0	1,375,000	1,610,000	15
03-01-53	86,810	49,313	76	0	0	0	943,100	817,400	15
03-01-54	21,580	14,445	49	0	0	0	175	50	250
03-01-55	13	13	0	0	0	0	0	0	0
03-01-56	0	0	0	0	0	0	0	0	0
TOTALS	157,841	107,477	47	0	1	-100	6,471,195	3,121,450	107
% of State Total	<1	2	---	0	<1	---	3	2	---

2.9 Water Use

2.9.1 Local Water Supply Planning

The North Carolina General Assembly has mandated a local and state water supply planning process under North Carolina General Statute 143-355(l) and (m) to assure that communities have an adequate supply of water for future needs. Under this statute all units of local government that provide or plan to provide public water supply service are required to prepare a Local Water Supply Plan (LWSP) and to update that plan at least every five years. The information presented in a LWSP is an assessment of a water system's present and future water needs and its ability to meet those needs. LWSPs were submitted by 20 public water systems to the Division of Water Resources.

There are six countywide systems and one regional water supply system in the area. Total water use in the basin in 1997 was 18.4 MGD consisting of 35 percent residential use, 11 percent non-residential, and 20 percent unaccounted for use (NCDENR-DWR, 2001). By the year 2020, the area expects to see a 59 percent increase in water demand over the 1997 levels. In addition, 10 out of the 20 systems submitting LWSPs in 1997 indicated that their peak demands would exceed their water treatment capacity by 2010 (NCDENR-DWR, 2001). An additional 6.6 MGD of water is necessary to ensure that the projected 2010 demands do not exceed 80 percent of the available water in the area. In addition to treatment concerns, water quantity concerns are paramount in the region. Nine out of the 20 LWSP systems indicated that their average daily use currently exceeds 80 percent of their available supply, and nine systems predict that demand levels will exceed 80 percent of their available supply by 2020.

Based on 1995 USGS estimates, nonmunicipal users account for 272 MGD in the following areas: irrigation (57 percent), livestock (20 percent), domestic (20 percent), industrial (2 percent) and commercial (1 percent) uses rely on self-supplied water (NCDENR-DWR, 2001). DWR recommended that those systems with "Demand as Percent of Supply" above 80 percent to actively manage demand and pursue additional supplies (NCDENR-DWR, 2001).

More information is available for these and other systems across the state that submitted a LWSP from the Division of Water Resources Website at www.dwr.ehnr.state.nc.us/home.htm.

Table A-15 Water Use and Population for Water Systems in the Pasquotank River Basin

Population and Water Use for Water Systems in the Albemarle Sound Basin							
		Year-Round Service Population		Average Daily Demand (MGD)		Demand as % of Supply	
County	System	1997	2010	1997	2010	1997	2010
Camden	South Camden WSD	1585	2760	0.154	0.437	103	291
	South Mills	4520	5573	0.255	0.515	62	88
Currituck	Currituck County (mainland)	8791	11001	0.597	0.689	70	76
Dare	Cape Hatteras	7037	11020	1.172	1.837	184	90
	Dare County RWS	7764	10538	11.971	14.456	77	90
	Dare County RWS-RO Plant	2085	2830	0.185	0.259	29	40
	Kill Devil Hills	5136	7265	1.565	2.214	52	74
	Manteo	1200	1700	0.192	0.306	27	44
	Nags Head	2113	2995	2.692	3.272	77	93
	Stumpy Point WSD	0	412	0	0.038	0	21
Hyde	Ocracoke SD	720	740	0.438	0.539	61	67
Pasquotank	Elizabeth City	16921	19172	4.71	5.14	298	144
	Pasquotank county	14229	18876	1.85	2.25	92	93
Perquimans	Perquimans County	6469	7000	0.596	0.68	86	98
	Hertford	2333	2434	0.231	0.478	92	91
	Winfall	520	560	0.051	0.063	86	107
Tyrrell	Columbia	980	1020	0.124	0.127	35	36
	Tyrrell County	2517	3150	0.214	0.267	55	69
Washington	Creswell	500	500	0.161	0.069	107	46
	Roper	643	703	0.247	0.256	86	89

2.9.2 Capacity Use Areas

When the long-term sustainability of groundwater resources is threatened or when an area requires coordination to protect the public interest, the EMC can designate an area as a Capacity Use Area (CUA) (NCDENR-DWR, 2001). In 1976, the state exercised its authority by designating CUA #1 to extend radially from Beaufort County north to the Albemarle Sound. The CUA #1 affects portions of the Pasquotank River basin, specifically parts of Washington, Hyde and Tyrrell counties. In the operation of a phosphate mining facility near Aurora, a cone of depression began to form in the Castle Hayne aquifer, affecting groundwater levels several counties away. Since the 1976 designation of the CUA, water use appears to be at sustainable levels (NCDENR-DWR, 2001). Water use by many existing and new permittees has increased; however, the high recharge to the aquifer with decreased pumping at the phosphate mine has lessened the overall water use impacts. DWR has begun a monitoring well network and to develop a model to assess cumulative impacts of multiple water withdrawals within CUA #1.

In 1998, DWR data indicated that declines in the Black Creek and upper Cape Fear aquifers of the Central Coastal Plain increased faster than predicted, resulting in a demand that has exceeded the safe yield of these aquifers (WRRI, 2001). Given the situation, DWR was concerned that the dewatering could result in serious impairment to the aquifer and ultimately to groundwater quality. In response, DWR developed a three-part program to address the issue: 1) expanding and rehabilitating groundwater level monitoring; 2) assisting local governments to develop sustainable water supply plans; and 3) establishing a Central Coastal Plain Capacity Use Area (CCPCUA) to coordinate the usage of water in the most critical areas. The CCPCUA involves 15 counties, including Washington, that fall within the Pasquotank River basin. DWR presented draft rules in 1999, hosted a collaborative stakeholder process in 2000, and is working toward finalizing the rules in 2002.

2.9.3 Water Withdrawals and Interbasin Transfers

Prior to 1999, North Carolina General Statute 143-215.22H only required water users to register their water withdrawals and transfers with DWR if the amount was one million gallons or more of surface water or groundwater per day. Beginning in 1999, withdrawals and transfers greater than 100,000 gallons per day must be registered with DWR. In addition, transfers of 2 MGD or more require a certification from the Environmental Management Commission, according to G.S. 143-215.22I. The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina* and filed in the Office of the Secretary of State.

Six of the registered agricultural water users irrigate, with the largest irrigation requiring an average of 49 MGD in 1997 (Table A-16). Seven of the total nine agricultural users are permitted through the CUA #1 program. In the nonagricultural sector, there is one industrial user and five private water supply systems with registered withdrawals.

Table A-16 Registered Water Withdrawals for 1999 in the North Carolina Portion of the Pasquotank River Basin

Purpose of Withdrawal	Number of Facilities	Withdrawal Amount (MGD)	Percentage of Total Withdrawal
Agricultural	9	57.6	98.9
Nonagricultural	6	0.62	1.1
Total	15	58.2	----

Though interbasin transfers occur in the state, no surface water transfers affect this basin (NCDENR-DWR, 2001). All local water systems are required to report existing and anticipated interbasin transfers as part of the local water supply planning process. This information will be available for future updates of this basinwide water quality plan and will allow for cumulative impact assessments.