

Section A - Chapter 2

Neuse River Basin Overview

2.1 General Overview

The Neuse River basin is the third largest river basin in North Carolina and is one of only four river basins whose boundaries are located entirely within the state. The Neuse River originates in north central North Carolina in Person and Orange counties and flows southeasterly until it reaches tidal waters near Streets Ferry upstream of New Bern. At New Bern, the river broadens

Neuse River Basin Statistics
Total Area: 6,235 sq. miles
Freshwater Stream Miles: 3,497
Freshwater Lakes Acres: 16,414
Estuarine Acres: 369,977
Coastline Miles: 21
No. of Counties: 18
No. of Municipalities: 74
No. of Subbasins: 14
Population (2000): 1,353,617*
Pop. Density (2000): 211 persons/sq. mi.*
* Based on Triangle J Council of Governments analysis of 2000 Census Data (page 18).

dramatically and changes from a free-flowing river to a tidal estuary that eventually flows into the Pamlico Sound (Figure A-3). Major tributaries of the Neuse River include the Eno and Flat Rivers, Crabtree Creek, Swift Creek, Little River, Contentnea Creek and Trent River.

The most populated areas are located in and around the cities of Raleigh, Durham, Hillsborough, Cary, Apex and Wake Forest, and around the other larger municipalities in the basin such as Goldsboro, Wilson, Greenville, Kinston, New Bern and Havelock. The overall population density is 211 persons per square mile versus an estimated statewide average of 139 persons per square mile.

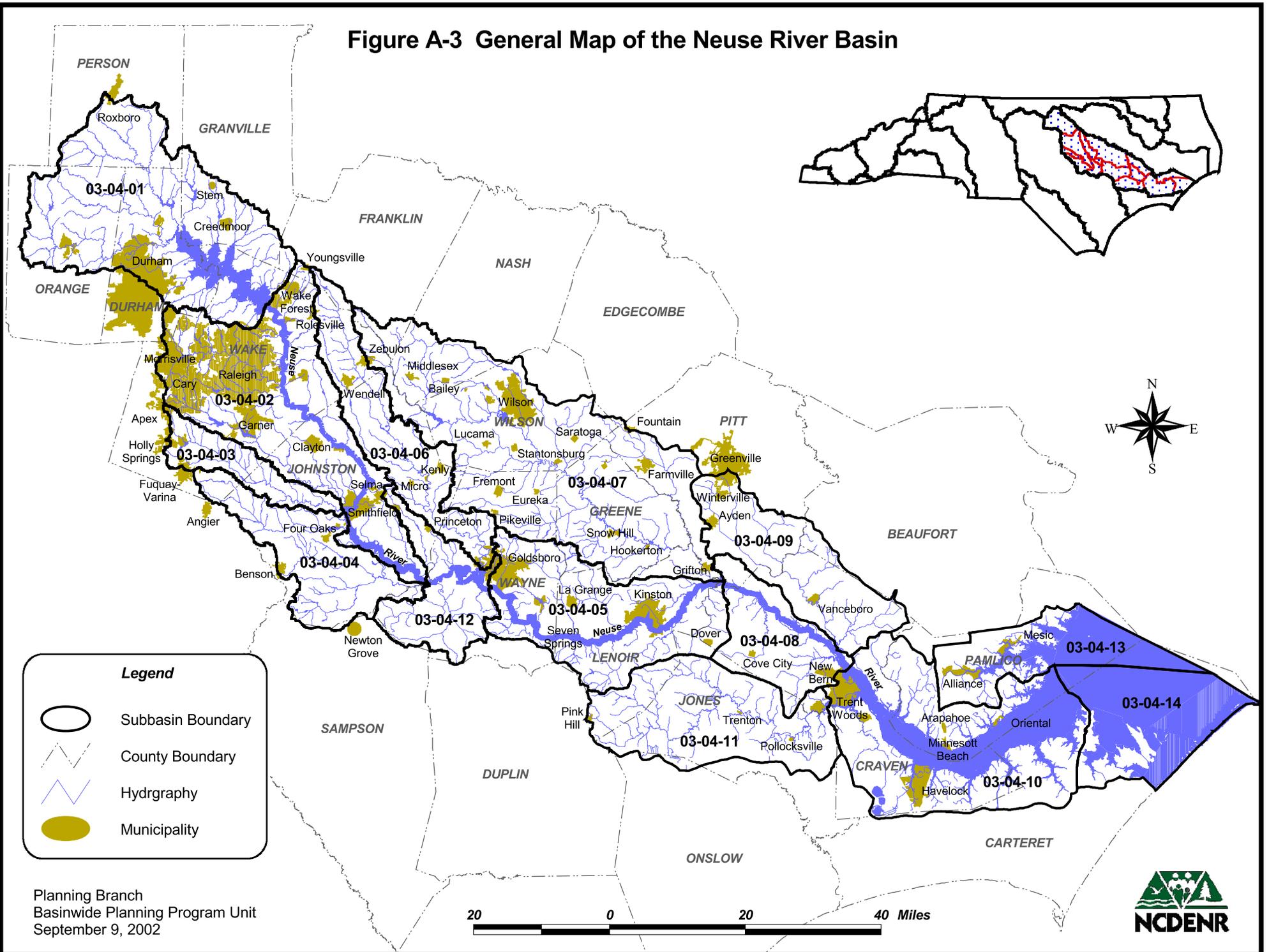
Fifty-six percent of the land in the basin is forested, and about 23 percent is in cultivated cropland. Tobacco, peanuts, cotton and soybeans are among the most commonly grown. Only eight percent of the land falls into the urban/built-up category (CGIA, 1997). Despite the large amount of cultivated cropland and the relatively small amount of urban area, the basin has seen a significant decrease (-180,000 acres) in cultivated cropland and forest and increase (+227,000 acres) in developed areas over the past 15 years (USDA, 2001).

2.2 Surface Water Hydrology

2.2.1 Watershed Descriptions

DWQ has a two-tiered system in which the state is divided into 17 major river basins with each basin further subdivided into subbasins. The Neuse River basin is divided into 14 subbasins (6-digit DWQ subbasins) (Figure A-3). Maps of each subbasin are included in Section B. DWQ and many other state agencies in North Carolina use this two-tiered system to identify watersheds for many different programs. Most federal government agencies, including the US Geological Survey (USGS) and the Natural Resources Conservation Service (NRCS), use a different system of defining watersheds.

Figure A-3 General Map of the Neuse River Basin



Under the federal system, the Neuse River basin is made up of hydrologic areas referred to as hydrologic units (USGS 8-digit hydrologic units). The Neuse River basin is made up of four whole hydrologic units: the Upper Neuse, Middle Neuse, Contentnea and Lower Neuse. The lower part of the basin also contains portions of the Pamlico and Bogue-Core Sounds hydrologic units. Hydrologic units are further divided into smaller watershed units (14-digit hydrologic units) that are used for smaller scale planning like that done by NCWRP (page 203). There are 201 watershed units in the basin. Table A-3 compares the three systems.

2.2.2 Hydrologic Features

There are 3,497 freshwater stream miles, 16,414 acres of freshwater reservoirs and lakes (Table A-4), 369,977 estuarine acres, and 21 miles of Atlantic coastline in the Neuse River basin. There are also countless miles of unmapped small perennial, intermittent and ephemeral streams. The lower Neuse River basin contains extensive wetland communities also. The basin starts in the eastern Piedmont physiographic region with about two-thirds of the basin in the Coastal Plain.

Streams in the Piedmont are typically low gradient with sluggish pools separated by riffles with occasional small rapids. Piedmont soils are highly erodible and are underlain by fractured rock formations that have limited water storage capacity. Piedmont streams tend to have low summer flows and limited ability to assimilate oxygen-consuming wastes. There are no natural lakes in the Piedmont. There are several significant reservoirs that serve as water supplies and flood control structures. There are many old millponds and beaver impoundments scattered across watersheds in the region.

Streams in the Coastal Plain are slow-moving blackwater streams, low-lying swamps and productive estuarine waters. The Coastal Plain is flat and the larger waterbodies are meandering and often lined with swamps and bottomland hardwoods. The swamp streams often stop flowing in the summer and are stained by tannic acid. These streams have limited ability to assimilate oxygen-consuming wastes. Swamp streams often have naturally low dissolved oxygen and pH. Coastal Plain soils are deep sands that have a high groundwater storage capacity. Because of the flat topography and high groundwater supply, there are few reservoirs in the Coastal Plain. Natural lakes include the remnants of bay lakes in the lower Coastal Plain.

There are 19 major reservoirs in the Neuse River basin. Most of them are located in the upper portion of the basin. The largest is Falls of the Neuse (Falls Lake) which is managed by the US Army Corps of Engineers for flood control and is the City of Raleigh water supply. In addition to general protection of aquatic life and secondary recreation, six lakes are classified for primary recreation and 14 are designated drinking water supplies (Table A-4).

Table A-3 Hydrologic Subdivisions in the Neuse River Basin

Watershed Name and Major Tributaries	DWQ Subbasin 6-digit Codes	USGS 8-digit Hydrologic Units	USGS 14-digit Hydrologic Units Local Watersheds*
<i>Upper Neuse</i> Falls Lake and Little, Eno and Flat Rivers	03-04-01	03020201	010010, 060010, 020020, 050040, 010030, 030030, 065030, 010040, 040020, 020040, 065010, 020010, 030020, 0650040, 010020, 060020, 065050, 010050, 030040, 050010, 010010, 020030, 050030, 050020, 030010, 030050, 060030
Crabtree Creek and Swift Creek	03-04-02		070060, 070110, 0110040, 080020, 0110010, 0100040, 070070, 100020, 100050, 070090, 100030, 110070, 080010, 090010, 110050, 070100, 110020, 140020, 070080, 100010, 110060, 070120, 110030, 140010
Middle Creek and Bass Lake	03-04-03		100010, 120020, 120030
Black Creek and Hannah Creek	03-04-04		130010, 130020, 130030, 150010, 150020, 150050, 150030, 150040
Little River and Buffalo Creek	03-04-06		180010, 180070, 180040, 180050, 180060, 200010, 180020, 190010, 200020, 180030, 180080
Neuse River	03-04-12		160010, 170020, 170030, 200030, 170040, 200040, 170010, 170060, 170050
<i>Middle Neuse</i> Bear Creek and Stone Creek	03-04-05	03020202	010010, 030030, 020030, 040010, 040020, 020030, 060040, 030020, 070010, 020020, 010021, 060030, 050020, 060020, 030010, 020010, 050030, 010040, 040030, 060010, 030040, 010020, 010030, 050040, 010022, 050010, 070020, 010050
Core Creek	03-04-08		090020, 080020, 080010, 100020, 090080, 100010
Swift Creek and Clayroot Swamp	03-04-09		090010, 090030, 090040, 090050, 090055, 090060, 090070
<i>Contentnea</i> Contentnea Creek and Little Contentnea Creek	03-04-07	03020203	010010, 010020, 020010, 020020, 020030, 020040, 020050, 030010, 030020, 030030, 030040, 040010, 040020, 040030, 040040, 050010, 050020, 050030, 050040, 050050, 050060, 060010, 060020, 060030, 060040, 060040, 060050, 070010, 070020, 070030, 070040, 070050
<i>Lower Neuse</i> Slocum Creek	03-04-10	03020204	020010, 020020, 020030, 020040, 020050, 020060, 030010, 030020, 030030, 030040, 030050, 040010, 050010, 050020, 050030, 050040, 050050, 060010, 060020, 070010
Trent River	03-04-11		010010, 010020, 010021, 010030, 010031, 010040, 010050, 01051, 010060, 010070, 010071, 010080, 010100
<i>Pamlico Sound</i> Pamlico Sound Bay River	03-04-13	03020105	010010, 010020, 010030, 010040, 020010, 020020, 020030, 090012
<i>Bogue-Core Sounds</i> Core Sound West Bay	03-04-14	03020106	050010, 050050, 050060, 050070

* Numbers from the 8-digit and 14-digit column make the full 14-digit HU.

Table A-4 Statistics for Major Lakes in the Neuse River Basin

Subbasin/Lake	County	Classification*	Surface Area (ac)	Mean Depth (ft)	Volume (X 10 ⁶ m ³)	Watershed (mi ²)
03-04-01						
Lake Michie	Durham	WS-III NSW CA	541.1	26.2	15.6	169.9
Little River Reservoir	Durham	WS-II NSW CA	528.8	24.6	18.0	97.7
Lake Butner	Granville	WS-II NSW CA	373.1	29.5	1.4	30.1
Lake Rogers	Granville	WS-II NSW CA	140.8	8.5	0.5	17.4
Lake Ben Johnson	Orange	WS-II NSW CA	29.7	4.9	0.02	64.9
Lake Orange	Orange	WS-II NSW CA	155.7	13.1	0.3	10.0
Corporation Lake	Orange	WS-II NSW CA	27.2	3.3	0.9	40.9
Falls of the Neuse Reservoir	Wake	WS-III NSW CA	12,490.7	16.4	176.6	769.9
03-04-02						
Lake Benson	Wake	WS-III NSW CA	439.8	9.8	3.6	64.9
Lake Wheeler	Wake	WS-III NSW	551.0	13.1	7.6	28.2
Big Lake	Wake	B NSW	61.8	6.6	0.1	6.9
Reedy Creek Lake	Wake	B NSW	19.8	6.6	0.1	4.2
Sycamore Lake	Wake	B NSW	22.2	23.0	0.2	9.7
Apex Reservoir	Wake	WS-III NSW	74.1	9.8	0.3	2.3
Lake Crabtree	Wake	B NSW	518.9	6.6	0.5	51.4
03-04-05						
Cliffs of the Neuse Lake	Wayne	B NSW	9.9	29.5	0.1	0.4
03-04-07						
Lake Wilson	Wilson	WS-III NSW	81.5	4.9	0.7	40.2
Toisnot Reservoir	Wilson	WS-III NSW CA	9.9	4.9	0.1	50.0
Wiggins Mill Reservoir	Wilson	WS-III NSW CA	200.1	1.6	0.6	237.1

* Refer to page 44 for more information.

2.2.3 Minimum Streamflow

One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water in the length of a stream affected by an impoundment. The Division of Water Resources, in conjunction with the Wildlife Resources Commission, recommends conditions relating to release of flows to satisfy minimum instream flow requirements. The Division of Land Resources issues the permits.

The US Army Corps of Engineers operates Falls Lake dam (subbasin 03-04-01) in Wake County on the Neuse River. The drainage area is 769.9 square miles and has minimum release requirements of 65 cfs (cubic feet/second) from November to March and 100 cfs from April to October. The target flow below the dam at Clayton is 184 cfs from November to March and 254 cfs from April to October. During extreme drought conditions the flows may be lower.

The City of Wilson operates Buckhorn Reservoir dam (subbasin 03-04-07) on Contentnea Creek. Minimum release requirements are 7.6 cfs when water supply storage is above 70 percent. When

water supply storage is below 70 percent and above 50 percent, 5.3 cfs minimum flow is required. Below 50 percent of water supply storage, a 1.4 cfs minimum flow is required.

Bass Lake (subbasin 03-04-02) operated by the Town of Holly Springs on Basal Creek has a minimum release of 5.2 cfs or inflow, whichever is less.

Presentwood Lakes No. 1 and No. 2 (subbasin 03-04-02) in Cary on Crabtree Creek have a minimum release of 0.2 cfs or inflow, whichever is less, from June to February and 0.4 cfs or inflow, whichever is less, from March to May.

Little River dam at Orange Factory (subbasin 03-04-01) in Durham County has a minimum release of 6 cfs from December to May and 2 cfs from June to November. A minimum release of 0.64 cfs is required when normal pool elevation is less than 70 percent of usable storage capacity.

Minimum flows on the Eno River are complicated and determined by two different methods. Table A-5 summarizes withdrawals and instream flow requirements for the portion of the Eno River above Durham.

Table A-5 Maximum Allowable Surface Water Withdrawals and Instream Flow Requirements for the Western Eno River (NCDENR-DWR, October 2001)

	Percent of Storage Remaining at Lake Orange	Allowable Surface Water Withdrawal (MGD)			Instream Flow Requirement at Hillsborough Gage (MGD)		
		Town of Hillsborough †	Orange-Alamance	Piedmont Minerals	From Lake Orange	From West Fork Eno Reservoir	Total Flow at Hillsborough Gage
	> 100	*†	*	**	1.10	0.65	1.75
Stage 1	100 - 80	1.51 †	0.82	0.43	1.10	0.65	1.75
Stage 2	80 - 60	1.36 †	0.74	0.38	0.65	0.65	1.30
Stage 3	60 - 50	1.28 †	0.70	0.36	0.45	0.65	1.10
Stage 4	50 - 40	1.28 †	0.70	0.32	0.45	0.65	1.10
Stage 5	40 - 30	1.13 †	0.62	0.19	0	0.65	0.65
Stage 6	<= 30	0.68 †	0.37	0	0	0.65	0.65

Notes:

† Allowable withdrawals for Hillsborough shown above do not include withdrawals of water supply releases from West Fork Eno Reservoir.

- * - Adjusted to reflect outside source agreement for Hillsborough and Orange-Alamance.
- Excess withdrawals from Eno River based on outside source agreement may be made when flows at the Eno River at Hillsborough Gage are 10 cubic feet per second (cfs) and above, regardless of water level in Lake Orange. Maximum withdrawals shall be limited to the total of the contract amount and the allocated amount.
- A low flow period will begin on the 7th consecutive day of the average daily flow at the Hillsborough Gage dropping below 10 cfs. On the 4th day, the Orange County Engineer will request that affected parties prepare for a low flow period.
- When flows are between 10 cfs and 3 cfs at the Hillsborough Gage during a low flow period, withdrawals from the Eno River shall be limited to the Stage 1 amount shown above (100-80 percent of storage remaining), regardless of water level in Lake Orange.
- When flows are below 3 cfs at the Hillsborough Gage during a low flow period, withdrawals shall be limited to amounts shown above for percent of storage remaining at Lake Orange.
- A low flow period will be terminated when average daily flow at the Hillsborough Gage registers 10 cfs or greater for a period of 7 consecutive days. The Orange County Engineer will notify affected parties when the low flow period is terminated.

** For Piedmont Minerals: When flows at the Hillsborough Gage are 14 cfs and above, withdrawals from the Eno River will be limited to 900,000 gallons per day (GPD). Between 14 cfs and 4 cfs, withdrawals will be limited to 430,000 GPD, regardless of water level in Lake Orange. Below 4 cfs, withdrawals will be limited to amounts shown above for percent of storage remaining.

2.2.4 Water Withdrawals

Prior to 1999, North Carolina required water users to register their water withdrawals with the Division of Water Resources (DWR) only if the amount was 1,000,000 gallons or more of surface water or groundwater per day. In 1999, the registration threshold for all water users except agriculture was lowered to 100,000 gallons per day.

There are 176 registered water withdrawals in the Neuse River basin not including those associated with the 78 public water systems discussed below. Fifty-one of these are surface water withdrawals. Excluding the public water systems or power generating facilities, there is a cumulative permitted capacity to withdraw 192 MGD of water. For more information on water withdrawals, visit <http://www.dwr.ehnr.state.nc.us/> or call DWR at (919) 733-4064.

2.2.5 Interbasin Transfers

In addition to water withdrawals (discussed above), water users in North Carolina are also required to register surface water transfers with the Division of Water Resources if the amount is 100,000 gallons per day or more. In addition, persons wishing to transfer two million gallons per day (MGD) or more, or increase an existing transfer by 25 percent or more, must first obtain a certificate from the Environmental Management Commission (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*, on file in the Office of the Secretary of State. These boundaries differ from the 17 major river basins delineated by DWQ. The 8-digit hydrologic unit boundaries (Table A-3) correspond to these basins within the Neuse River basin. Table A-6 summarizes IBTs involving the Neuse River basin.

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer outweigh the potential impacts. Factors used to determine whether a certificate should be issued include:

- the necessity, reasonableness and beneficial effects of the transfer;
- the detrimental effects on the source and receiving basins, including effects on water supply needs, wastewater assimilation, water quality, fish and wildlife habitat, hydroelectric power generation, navigation and recreation;
- the cumulative effect of existing transfers or water uses in the source basin;
- reasonable alternatives to the proposed transfer; and
- any other facts and circumstances necessary to evaluate the transfer request.

A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition. For more information on water withdrawals, visit <http://www.ncwater.org> or call DWR at (919) 733-4064.

Table A-6 Estimated Interbasin Transfers in the Neuse River Basin (2000)

Supplying System	Receiving System	Source Subbasin	Receiving Subbasin	Estimated Transfer (MGD)
Cary/Apex	Cary/Apex	Haw River	Neuse River	12.1
Cary/Apex	Morrisville	Haw River	Neuse River	< 0.1
Dunn	Benson	Cape Fear River	Neuse River	1.2
Durham	Durham	Neuse River	Haw River	18.7
Franklin County	Youngsville	Tar River	Neuse River	< 0.1
Johnston County	Fuquay-Varina	Neuse River	Cape Fear River	0.25
Orange-Alamance W.S.	Orange-Alamance W.S.	Neuse River	Haw River	0.5
Roxboro	Roxboro	Roanoke River	Neuse River	< 0.1
Zebulon	Zebulon	Neuse River	Contentnea Creek	0.8

2.2.6 Water Supply

The following is summarized from the North Carolina Water Supply Plan developed by the Division of Water Resources (DWR) for the Neuse River basin (NCDENR-DWR, January 2001). The information is compiled from Local Water Supply Plans submitted to DWR by 78 public water systems.

Total water use in the Neuse River basin is reported to be approximately 191 MGD. Residential demand accounted for 79 MGD. Public water systems supplied 82 MGD from surface water and 30 MGD from groundwater. Self-supplied water accounted for 77 MGD. For more information or to view local water supply plans, visit <http://www.dwr.ehnr.state.nc.us/> or call DWR at (919) 733-4064.

2.3 Population and Growth Trends

Below are three different ways of presenting population data for the Neuse River basin. Population data presented by county allow for analysis of projected growth trends in the basin based on Office of State Planning information (April and May 2001). Data presented by municipality summarizes information on past growth of large urban areas in the basin. The data developed by Triangle J Council of Governments allow for 2000 population data to be presented by watershed units and by subbasin. While the three different sets of information cannot be directly compared, general conclusions are apparent by looking at the information. Counties with the highest expected growth are associated with the largest municipal areas and the most densely populated watersheds in the basin.

2.3.1 County Population and Growth Trends

Table A-7 shows the projected population for 2020 and the change in growth between 2000 and 2020 for counties that are wholly or partly contained within the basin. Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to

the Neuse River basin. This information is intended to present an estimate of expected population growth in counties that have some land area in the Neuse River basin.

Table A-7 Past and Projected Population (1990, 2000, 2020) and Population Change by County

County	Percent of County in Basin ♦	1990	2000	Estimated Population 2020	Estimated Pop Change 1990-2000	Estimated Pop Change 2000-2020
Beaufort	2	42,283	44,958	48,755	2,675	3,797
Carteret	50	52,407	59,383	70,365	6,976	10,982
Craven	95	81,812	91,436	105,982	9,624	14,546
Durham	73	181,844	223,314	312,144	41,470	88,830
Franklin	10	36,414	47,260	69,994	10,846	22,734
Granville	25	38,341	48,498	68,600	10,157	20,102
Greene	100	15,384	18,974	25,799	3,590	6,825
Johnston	98	81,306	121,965	210,178	40,659	88,213
Jones	81	9,361	10,381	11,910	1,020	1,529
Lenoir	99	57,274	59,648	62,096	2,374	2,448
Nash	20	76,677	87,420	107,475	10,743	20,055
Orange	49	93,662	118,227	166,971	24,565	48,744
Pamlico	83	11,368	12,934	15,095	1,566	2,161
Person	32	30,180	35,623	45,510	5,443	9,887
Pitt	42	108,480	133,798	187,000	25,318	53,202
Wake	85	426,311	627,846	1,071,768	201,535	443,922
Wayne	91	104,666	113,329	127,945	8,663	14,616
Wilson	81	66,061	73,814	88,418	7,753	14,604
Subtotal		1,513,831	1,928,808	2,796,005	414,977	867,197

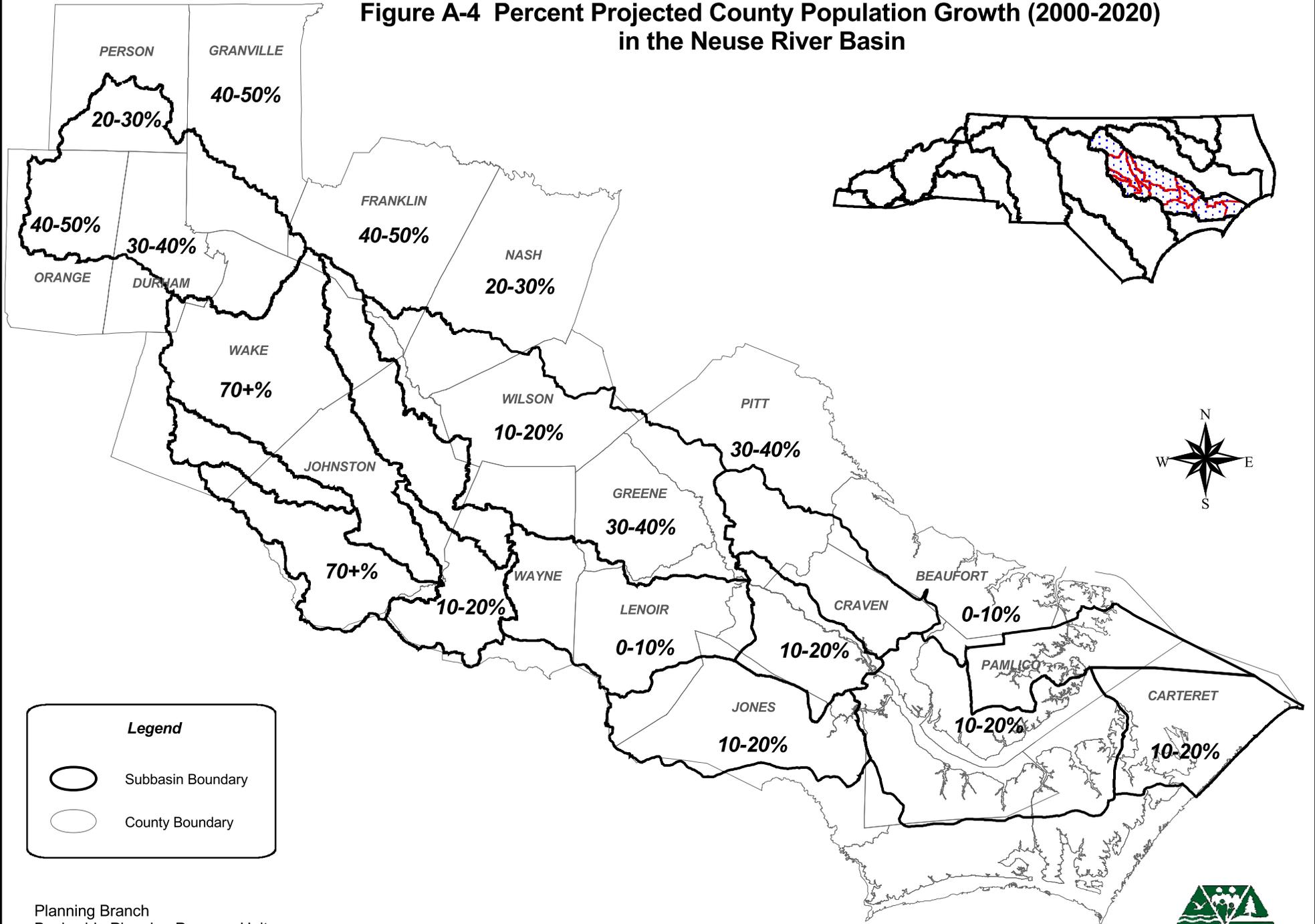
♦ Source: North Carolina Center for Geographic Information and Analysis

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

Populations of counties that are wholly or partly contained within the basin increased by over 414,000 people between 1900 and 2000. Figure A-4 presents projected population growth by county (2000-2020) for the Neuse River basin based on information developed by Triangle J Council of Governments. Durham, Johnston and Wake are growing the fastest in the upper basin, with Pitt County growing the fastest in the lower basin. The county populations are expected to grow by more than 867,000 by 2020 to almost three million people. With the increased population there will be increased drinking water demands and wastewater discharges. There will also be loss of natural areas and increases in impervious surfaces associated with construction of new homes and businesses.

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/>.

**Figure A-4 Percent Projected County Population Growth (2000-2020)
in the Neuse River Basin**



Legend

-  Subbasin Boundary
-  County Boundary

Planning Branch
Basinwide Planning Program Unit
September 9, 2002



2.3.2 Municipal Population and Growth Trends

Table A-8 presents population data from Office of State Planning for municipalities with populations greater than 2,000 persons, located wholly or partly within the basin. The highest urban population growth has occurred in the upper basin around Raleigh, Cary and Durham.

Table A-8 Population (1980, 1990, 2000) and Population Change for Municipalities Greater Than 2,000 Located Wholly or Partly in the Neuse River Basin

Municipality	County	Apr-80	Apr-90	Apr-2000	Percent Change (1980-90)	Percent Change (1990-2000)
Apex •	Wake	2,847	4,789	20,212	68.2	322.1
Ayden	Pitt	4,361	4,883	4,622	12.0	-5.3
Benson •	Johnston	2,792	3,044	2,923	9.0	-4.0
Cary •	Chatham, Wake	21,763	44,397	94,536	104.0	112.9
Clayton	Johnston	4,091	4,756	6,973	16.3	46.6
Creedmoor	Granville	1,641	1,506	2,232	-8.2	48.2
Durham •	Durham, Orange, Wake	101,149	136,612	187,035	35.1	36.9
Farmville	Pitt	4,707	4,446	4,302	-5.5	-3.2
Fuquay-Varina •	Wake	3,110	4,447	7,898	43.0	77.6
Garner	Wake	10,073	14,716	17,757	46.1	20.7
Goldensboro	Wayne	31,871	40,709	39,043	27.7	-4.1
Greenville •	Pitt	35,740	46,305	60,476	29.6	30.6
Grifton	Pitt	2,179	2,393	2,073	9.8	-13.4
Havelock	Craven	17,718	20,300	22,442	14.6	10.6
Hillsborough	Orange	3,019	4,263	5,446	41.2	27.8
Holly Springs •	Wake	688	1,024	9,192	48.8	797.7
Kinston	Lenoir	25,234	25,295	23,688	0.2	-6.4
Knightdale	Wake	985	1,884	5,958	91.3	216.2
La Grange	Lenoir	3,147	2,805	2,844	-10.9	1.4
Morrisville •	Durham, Wake	251	1,489	5,208	493.2	249.8
Mount Olive •	Duplin, Wayne	4,876	4,582	4,567	-6.0	-0.3
New Bern	Craven	14,557	17,363	23,128	19.3	33.2
Raleigh	Wake	150,255	212,092	276,093	41.2	30.2
River Bend	Craven	959	2,408	2,923	151.1	21.4
Roxboro •	Person	7,532	7,332	8,696	-2.7	18.6
Selma	Johnston	4,762	4,600	5,914	-3.4	28.6
Smithfield	Johnston	7,288	7,540	11,510	3.5	52.7
Trent Woods	Craven	1,177	2,366	4,192	101.0	77.2
Wake Forest	Wake	3,780	5,832	12,588	54.3	115.8
Wendell	Wake	2,222	2,921	4,247	31.5	45.4
Wilson	Wilson	34,424	36,930	44,405	7.3	20.2
Winterville	Pitt	2,052	3,069	4,791	49.6	56.1
Zebulon	Johnston, Wake	2,055	3,173	4,046	54.4	27.5

- - The numbers reported reflect municipality population; however, these municipalities are not entirely within the basin. The intent is to demonstrate growth for municipalities located wholly or partially within the basin.

Apex, Cary, Holly Springs, Knightdale, Morrisville and Wake Forest had very high growth rates. Raleigh and Durham also increased population substantially in the last ten years.

2.3.3 Basin Population and Population Density

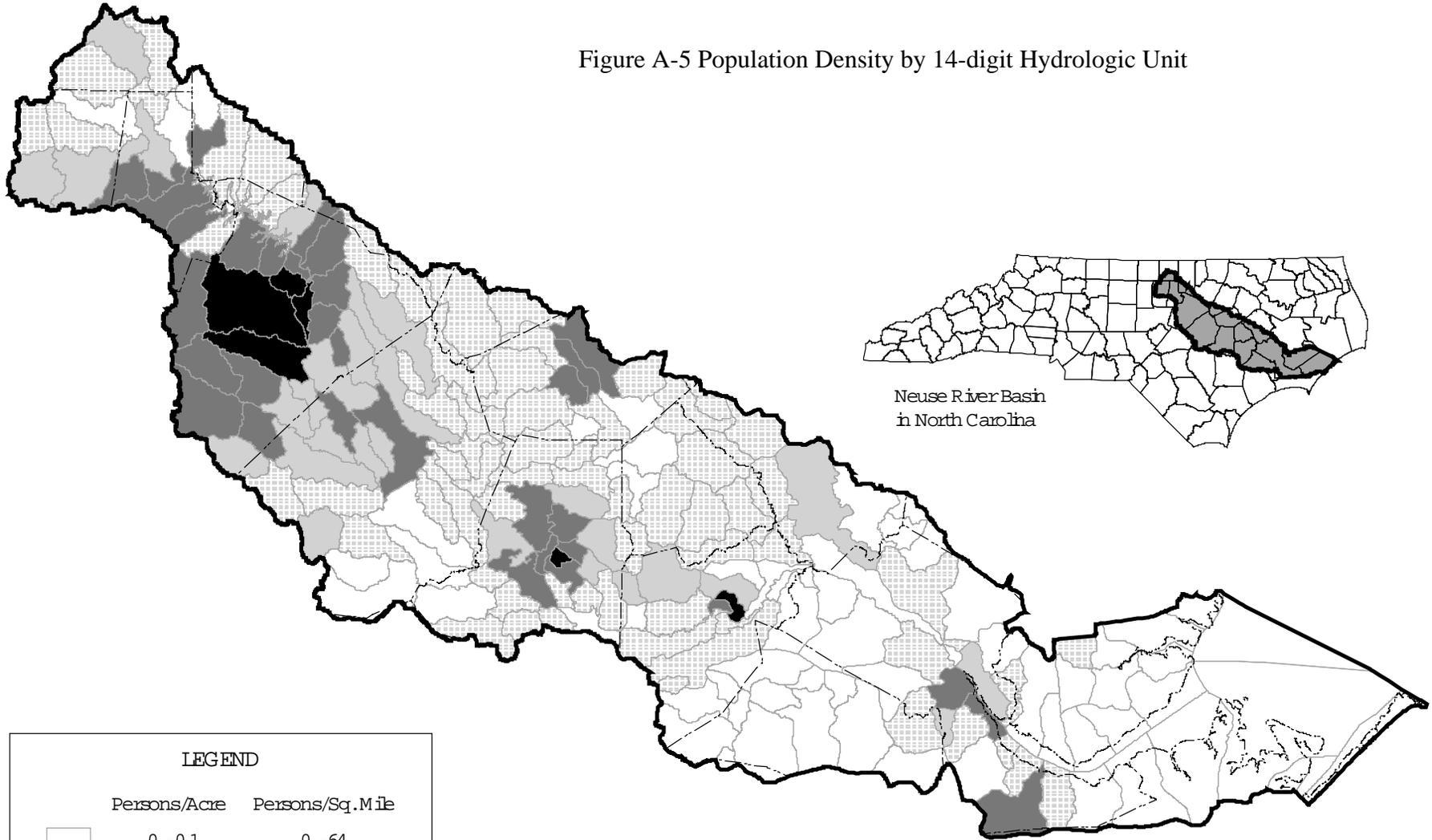
Most population data are collected from within county or municipal boundaries. It is difficult to evaluate population and population density within watersheds using this information. Information on population density at a watershed scale is useful in determining what streams are likely to have the most impacts as a result of population growth. This information is also useful in identifying stream segments that have good opportunities for preservation or restoration. The Triangle J Council of Governments has used GIS to present 2000 census block data by watershed units (Figure A-5). This information is presented to summarize population and population density by each subbasin and for the entire basin.

The overall population of the basin based on Triangle J Council of Governments analysis is 1,353,617, with approximately 211 persons/square mile. Stoney Creek (subbasin 03-04-05) is the most densely populated local watershed with 2,573 persons/square mile. Fifty-four percent of the basin population is located in 10 percent of the basin land area. The watersheds with the highest population densities are near Raleigh, Durham, Goldsboro, Kinston, New Bern and Wilson.

2.4 Local Governments and Planning Jurisdictions in the Basin

The Neuse River basin encompasses all or portions of 18 counties and 74 municipalities. Table A-9 provides a listing of these municipalities, along with the regional planning jurisdiction (Council of Governments). Twelve municipalities are located in more than one major river basin.

Figure A-5 Population Density by 14-digit Hydrologic Unit



LEGEND

Persons/Acre Persons/Sq. Mile

	0 - 0.1	0 - 64
	0.1 - 0.25	64 - 160
	0.25 - 0.5	160 - 320
	0.5 - 2.5	320 - 1600
	2.5 - 5	1600 - 3200

County Boundaries



Prepared by Triangle J Council of Governments; December 2001

Table A-9 Local Governments and Planning Units within the Neuse River Basin

County	Region	Municipalities
Beaufort	Q	None
Carteret	P	None
Craven	P	Bridgeton, Cove City, Dover, Havelock, New Bern, River Bend, Trent Woods, Vanceboro
Duplin	P	Mount Olive * ♦
Durham	J	Durham * ♦, Morrisville * ♦
Franklin	K	Youngsville ♦
Granville	K	Creedmoor, Stem
Greene	P	Hookerton, Snow Hill, Walstonburg
Johnston	J	Benson ♦, Clayton, Four Oaks, Kenly *, Micro, Pine Level, Princeton, Selma, Smithfield, Wilson's Mills, Zebulon *
Jones	P	Pollocksville, Trenton
Lenoir	P	Kinston, La Grange, Pink Hill
Nash	L	Bailey, Middlesex
Orange	J	Durham * ♦, Hillsborough
Pamlico	P	Alliance, Arapahoe, Bayboro, Grantsboro, Mesic, Minnesott Beach, Oriental, Stonewall, Vandemere
Person	K	Roxboro ♦
Pitt	Q	Ayden, Farmville, Fountain ♦, Greenville ♦, Grifton, Winterville
Wake	J	Apex ♦, Cary * ♦, Durham * ♦, Fuquay Varina ♦, Garner, Holly Springs ♦, Knightdale, Morrisville * ♦, Raleigh, Rolesville, Wake Forest, Wendell, Zebulon *
Wayne	P	Eureka, Fremont, Goldsboro, Mount Olive * ♦, Pikeville, Seven Springs, Walnut Creek
Wilson	L	Black Creek, Kenly *, Lucama, Saratoga, Sims, Stantonsburg, Wilson

* Located in more than one county.

♦ Located in more than one major river basin.

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 percent) is located in that basin, unless a municipality is located in that county. (Note: Duplin County is included because of the municipality, Mount Olive. Also, Cary is located in Chatham County, which is not a county within the Neuse River basin.)

Region	Name	Location
J	Triangle J Council of Governments	Research Triangle Park
K	Kerr-Tar Regional Council of Governments	Henderson
L	Upper Coastal Plain Council of Governments	Rocky Mount
P	Eastern Carolina Council	New Bern
Q	Mid-East Commission	Washington

2.5 Land Cover

Land cover can be an important way to evaluate the effects of land use changes on water quality. Unfortunately, the tools and database to do this on a watershed scale are not yet available. Parts 2.5.1 and 2.5.2 below describe two different ways of presenting land cover in the Neuse River basin. The CGIA land cover information is useful in providing a snapshot of land cover in the basin from 1993 to 1995. This information is also available in a GIS format so it can be manipulated to present amounts of the different land covers by subbasin or at the watershed

scale. The NRI land cover information is presented only at a larger scale (8-digit hydrologic unit), but the collection methods allow for between year comparisons. The two datasets cannot be compared to evaluate land cover data. This information is presented to provide a picture of the different land covers and some idea of change in land cover over time. In the future, it is hoped that land cover information like the GIS formatted dataset will be developed to make more meaningful assessments of the effects of land use changes on water quality. This dataset would also be useful in providing reliable and small-scale information on land cover changes that can be used in water quality monitoring, modeling and restoration efforts.

2.5.1 CGIA Land Cover

The North Carolina Corporate Geographic Database contains land cover information for the Neuse River basin based on satellite imagery from 1993-1995. The state’s Center for Geographic Information and Analysis (CGIA) developed 24 categories of statewide land cover information. For the purposes of this report, those categories have been condensed into five broader categories as described in Table A-10. Figure A-6 provides an illustration of the relative amount of land area that falls into each major cover type for the Neuse River basin. Section B of this plan provides land cover data specific to each subbasin based on this information.

Table A-10 Description of Major CGIA Land Cover Categories

Land Cover Type	Land Cover Description
Urban	Greater than 50 percent coverage by synthetic land cover (built-upon area) and municipal areas.
Cultivated Cropland	Areas that are covered by crops that are cultivated in a distinguishable pattern.
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, deciduous hardwoods).
Water	Areas of open surface water, areas of exposed rock, and areas of sand or silt adjacent to tidal waters and lakes.

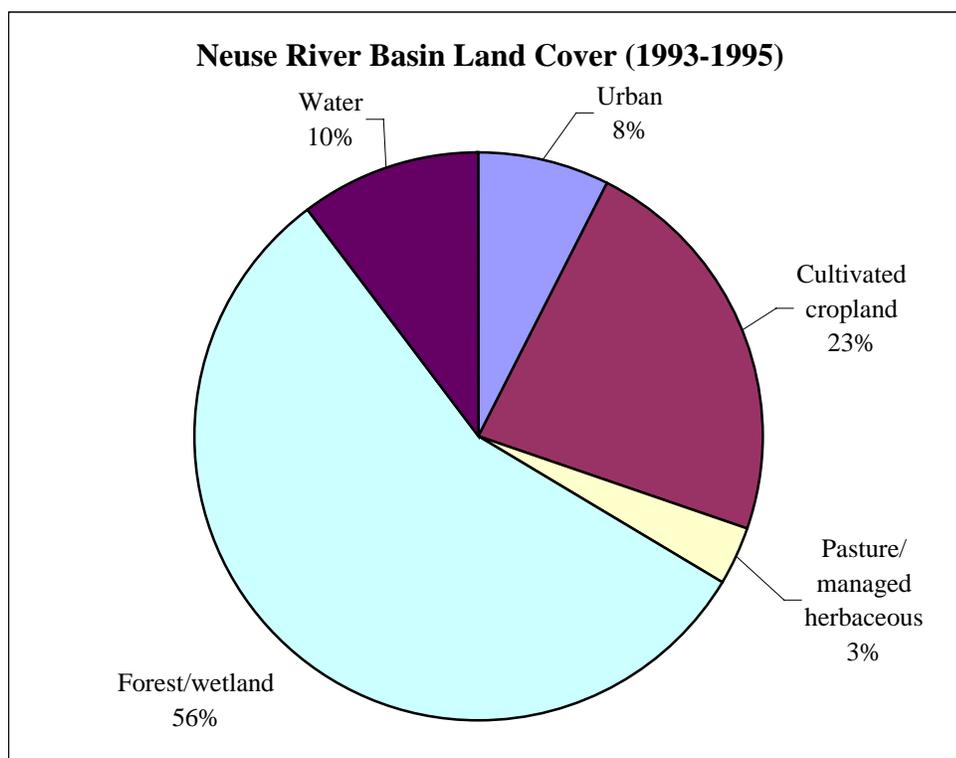


Figure A-6 Percentages within Major CGIA Land Cover Categories in the Neuse River Basin

2.5.2 NRI Land Cover Trends

Land cover information in this section is from the most current 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 previously published for the 1982, 1987 or 1992 NRI may provide erroneous results because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected.”

Table A-11 summarizes acreage and percentage of land cover from the 1997 NRI for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units (Table A-3), and compares the coverages to 1982 land cover. Definitions of the different land cover types are presented in Table A-12.

Data from 1982 are also provided for a comparison of change over fifteen years. During this period, urban and built-up land cover increased by 227,000 acres. Uncultivated cropland and pastureland also increased by 60,000 acres. Forest and cultivated cropland cover significantly decreased by 128,000 and 180,000 acres, respectively. Most land cover change is accounted for in the upper Neuse hydrologic unit that includes rapidly growing areas in Wake, Durham and Johnston counties. Figure A-7 presents changes in land cover between 1982 and 1997.

Table A-11 Land Cover in the Neuse River Basin by Major Watersheds – 1982 vs. 1997
(Source: USDA-NRCS, NRI, updated June 2001)

LAND COVER	MAJOR WATERSHED AREAS								1997 TOTALS		1982 TOTALS		% change since 1982
	Upper Neuse		Lower Neuse		Contentnea		Lower Neuse						
	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	
Cult. Crop	296.7	19.3	208.7	30.7	240.0	38.6	129.3	15.7	874.7	23.9	1054.4	28.8	-17.0
Uncult. Crop	25.4	1.7	16.3	2.4	8.8	1.4	3.4	0.4	53.9	1.5	13.1	0.4	311.5
Pasture	73.2	4.8	44.0	6.5	13.6	2.2	5.4	0.7	136.2	3.7	116.7	3.2	16.7
Forest	684.1	44.6	330.8	48.7	269.7	43.3	356.9	43.4	1641.5	44.9	1769.4	48.3	-7.2
Urban & Built-Up	349.7	22.8	47.7	7.0	48.1	7.7	35.5	4.3	481.0	13.1	254.1	6.9	89.3
Federal	5.8	0.4	2.9	0.4	0.0	0.0	75.1	9.1	83.8	2.3	75.1	2.0	11.6
Other	99.4	6.5	29.2	4.3	42.3	6.8	216.0	26.3	386.9	10.6	381.0	10.4	1.5
Totals	1534.3	100.0	679.6	100.0	622.5	100.0	821.6	100.0	3658.0	100.0	3663.8	100.0	
% of Total Basin		41.9		18.5		17.0		22.4		99.8			
SUBBASINS	03-04-01 03-04-02 03-04-03 03-04-04 03-04-06 03-04-12	03-04-05 03-04-08 03-04-09	03-04-07	03-04-10 03-04-11									
8-Digit Hydraulic Units	03020201	03020202	03020203	03020204									

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

Source: USDA, Soil Conservation Service - 1982 and 1997 NRI

** 270 square miles of Neuse River subbasin 03-04-13 is contained in hydrologic unit 03020105.

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

336 square miles of Neuse River subbasin 03-04-14 is contained in hydrologic unit 03020106.

The hydrologic unit 03020106 is discussed in the White Oak River Basin Water Quality Plan.

It is not currently feasible to estimate the land use in these portions to include the Neuse land cover estimates.

Table A-12 Description of Land Cover Types
(Source: USDA-NRCS, NRI, updated June 2001)

Type	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	Includes 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, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	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><u>Rural Transportation</u>: 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><u>Small Water Areas</u>: Waterbodies less than 40 acres; streams less than 0.5 miles wide.</p> <p><u>Census Water</u>: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than 0.5 miles in width.</p> <p><u>Minor Land</u>: Lands that do not fall into one of the other categories.</p>

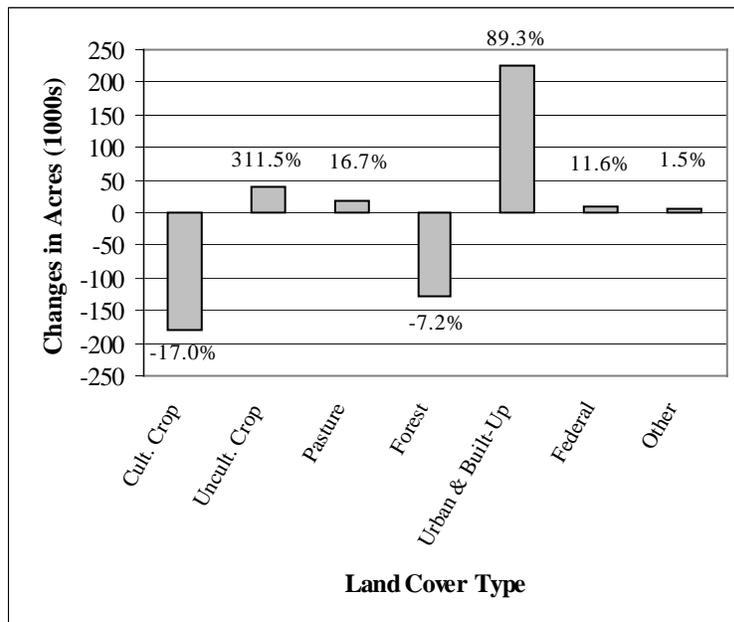


Figure A-7 Land Cover Changes from 1982 to 1997 for the Neuse River Basin
(Source: USDA-NRCS, NRI, updated June 2001)

2.6 NPDES Permits Summary

The primary pollutants associated with point source discharges are:

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

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

municipalities 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. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency.

2.6.1 Permitted Wastewater Discharges

Types of Wastewater Discharges

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

Minor Facilities: Facilities not defined as Major.

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

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

Nonmunicipal Facilities: 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.

Currently, there are 157 permitted wastewater discharges in the Neuse River basin. Table A-13 provides summary information (by type and subbasin) about the discharges. Various types of dischargers listed in the table are described in the inset box. A list of all facilities can be found in Appendix I. Facilities are mapped in each subbasin chapter in Section B. A location key to the facilities is provided at the beginning of Appendix I. Because the GIS data have not been updated as recently as the NPDES database, refer to Appendix I to determine the most current status of individual NPDES permit holders.

The majority of NPDES permitted wastewater flow into the waters of the Neuse River basin are from major municipal wastewater treatment plants. Nonmunicipal discharges also contribute

substantial wastewater flow into the Neuse River basin. Facilities, large or small, where recent data show problems with a discharge are listed and discussed in each subbasin chapter in Section B.

Table A-13 Summary of NPDES Dischargers and Permitted Flows for the Neuse River Basin
(as of 9/26/01)

Facility Categories	Neuse River Subbasin														Total
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	
Total Facilities	19	52	13	2	8	6	24	3	3	19	3	4	1	0	157
Total Permitted Flow (MGD)	26.99	87.35	17.15	1.5	15.66	0.91	21.24	32.44	0.25	11.20	0.4	12.88	0.0	0.0	227.97
Major Discharges	3	7	2	1	3	0	4	1	0	4	0	2	0	0	27
Total Permitted Flow (MGD)	26.5	85.88	16.4	1.5	14.85	0.0	20.2	32.0	0.0	10.2	0.0	12.2	0.0	0.0	219.73
Minor Discharges	16	45	11	1	5	6	20	2	3	15	3	2	1	0	130
Total Permitted Flow (MGD)	0.49	1.47	0.75	0.0	0.81	0.91	1.04	0.44	0.25	1.00	0.4	0.68	0.0	0.0	8.24
100% Domestic Waste	8	23	5	0	2	4	4	1	0	4	1	0	0	0	52
Total Permitted Flow (MGD)	0.31	1.36	0.25	0.0	0.02	0.28	0.06	0.02	0.0	0.84	0.33	0.0	0.0	0.0	3.47
Municipal Facilities	3	5	3	1	4	1	9	0	1	4	1	3	0	0	35
Total Permitted Flow (MGD)	26.5	80.8	16.9	1.5	12.04	0.63	21.15	0.0	0.25	6.75	0.07	11.48	0.0	0.0	178.07
Nonmunicipal Facilities	16	47	10	1	4	5	15	3	2	15	2	1	1	0	122
Total Permitted Flow (MGD)	0.49	6.55	0.25	0.0	3.62	0.28	0.09	32.44	0.0	4.45	0.33	1.4	0.0	0.0	49.90

2.6.2 Other NPDES Permits

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 132 general stormwater permits and 15 individual stormwater permits (see Appendix I for a listing). Refer to Part 4.7 for more information on stormwater programs and permits.

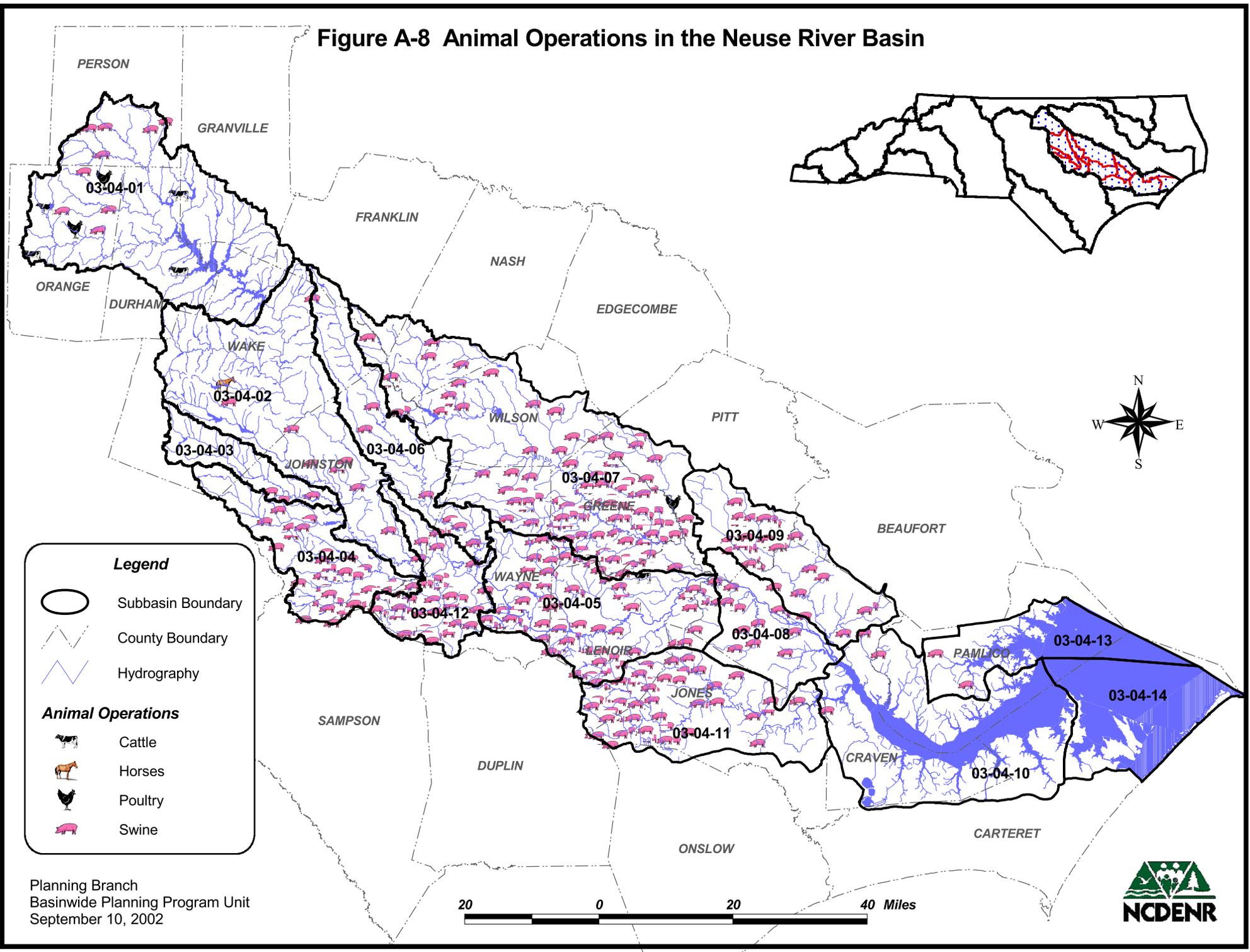
2.7 Animal Operations

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-8 displays general locations of animal operations in the Neuse 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. The Bill 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).

Figure A-8 Animal Operations in the Neuse River Basin



Legend

-  Subbasin Boundary
-  County Boundary
-  Hydrography

Animal Operations

-  Cattle
-  Horses
-  Poultry
-  Swine

Planning Branch
 Basinwide Planning Program Unit
 September 10, 2002

20 0 20 40 Miles



Table A-14 summarizes, by subbasin, the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight as of January 2002. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin.

Overall the majority of registered animal operations are found in the lower portion of the basin. Registered animal operations where recent data show problems are discussed in the appropriate subbasin chapter in Section B.

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 US Department of Agriculture (USDA), Natural Resource 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 hog size, SSLW is the best way to compare the sizes of the farms.

Between 1994 and 1998 there have been substantial increases in swine and poultry in the basin. In several areas, animal density is much greater than human populations. There has also been a decrease in dairy operations. Information on animal capacity by subbasin (Table A-15) was provided by the USDA.

Table A-14 Registered Animal Operations in the Neuse River Basin (as of 02/01/02)

Subbasin	Cattle			Poultry			Swine		
	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	Total Steady State Live Weight
03-04-01	5	860	1,132,000	3	300,000	1,200,000	9	26,479	3,020,399
03-04-02	1	267	373,800				12	40,770	4,803,471
03-04-03							1	2,800	396,760
03-04-04							41	175,555	20,587,095
03-04-05	1	152	212,800				82	302,023	37,093,725
03-04-06							15	33,998	6,181,030
03-04-07							131	562,810	68,479,570
03-04-08							11	35,785	4,326,975
03-04-09							27	110,032	12,481,115
03-04-10							3	8,800	1,188,000
03-04-11							63	391,617	47,272,505
03-04-12				1	70,000	280,000	64	277,089	35,521,683
03-04-13							1	2,798	484,527
03-04-14							0		
TOTALS	7	1,279	1,718,600	4	370,000	1,480,000	460	1,970,556	241,836,855

Table A-15 Estimated Populations of Swine, Dairy and Poultry in the Neuse River Basin (1998 and 1994)

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 (%)
03-04-01	13,249	14,960	-11	2,705	3,469	-22	405,575	289,675	40
03-04-02	24,297	19,905	22	706	706	0	429,439	279,064	54
03-04-03	4,550	5,893	-23	0	377	-100	138,032	138,000	0
03-04-04	175,037	91,124	92	0	0	0	985,640	747,260	32
03-04-05	595,186	339,331	75	818	1,044	-22	5,473,510	5,551,352	-1
03-04-06	38,415	17,709	117	214	214	0	478,607	449,264	7
03-04-07	634,346	354,066	79	220	422	-48	4,466,000	3,517,050	27
03-04-08	54,619	44,431	23	0	150	-100	471,000	480,000	-2
03-04-09	101,145	105,696	-4	0	0	0	130,300	130,300	0
03-04-10	17,152	17,565	-2	0	0	0	32,000	32,000	0
03-04-11	328,528	184,822	78	0	0	0	546,549	472,000	16
03-04-12									
03-04-13									
03-04-14									
TOTALS	1,986,524	1,195,502	66	4,663	6,382	-27	13,556,652	12,085,965	12
% of State Total	20%	22%		5%	5%		6%	7%	

2.8 Permitted Wetland and Stream Losses and Mitigation

DWQ tracks wetland and stream losses that are authorized through the issuance of a 401 Water Quality Certification. In addition to the permitted wetland and stream impacts that are tracked by DWQ, an unknown amount of wetland and stream losses also occurs because projects that affect less than one-third of an acre of wetland or less than 150 linear feet of stream are not required to receive written confirmation from DWQ, and therefore, might not be reported. The magnitude of unauthorized impacts to wetlands and streams is not known.

Over the past seven years (1995-2001), DWQ issued permits for approximately 2,900 acres of wetland fill and alteration activities that affected at least 67,000 linear feet of stream in the Neuse River basin. The Buckhorn Reservoir expansion (subbasin 03-04-07) accounted for 1,570 acres. A significant percentage of stream impacts statewide are associated with highway construction projects.

There were a total of 47.75 acres of wetland losses permitted by DWQ. Of the permitted losses, 35.64 acres were less than one acre in size. In the same period, there were 47,171 linear feet of stream impacts permitted. Of the permitted impacts, 14,954 linear feet were impacts of less than 150 feet in length. A total of 5,342 linear feet have been mitigated.

2.9 Natural Resources

2.9.1 Ecological Significance of the Neuse River Basin

The Neuse River basin contains many rare plants and animals. Nine animals associated with aquatic or wetland habitats are federally listed. Of these, the manatee, loggerhead, Atlantic ridley, piping plover and bald eagle are found primarily in estuarine habitats; whereas, the dwarf wedgemussel and the Tar River spiny mussel occur in the Piedmont and upper Coastal Plain. Especially noteworthy are the number of state-listed mollusk species, nearly all of which are freshwater mussels.

2.9.2 Wetland Communities

Because the Neuse River spans two physiographic provinces - the coast and the lower Piedmont - the river basin contains a wide array of natural communities, both upland and wetland. The basin contains the full array of estuarine wetland communities, such as Salt Marsh, Brackish Marsh and Estuarine Fringe Loblolly Pine Forest. The basin also contains a few good examples of Tidal Freshwater Marsh, notably at the junction of the Trent and Neuse Rivers near New Bern. In addition, the northernmost Pine Savanna natural communities remaining in good condition are located in Croatan National Forest within the basin.

Nonriverine forested wetlands are prominent in the lower part of the basin. Pamlico County, in particular, contains high quality remnant stands of Nonriverine Swamp Forest and Nonriverine Wet Hardwood Forest. Often mixed with these nonriverine hardwood forests are communities of pocosin vegetation, such as Pond Pine Woodland, High Pocosin, Bay Forest and Low Pocosin. This association is especially notable in the Croatan National Forest.

A variety of riverine communities are represented in the basin, although they are not as mature and high quality as those in the Roanoke River basin. Examples of Cypress-Gum Swamp and Bottomland Hardwood communities are located on the Neuse floodplain upstream of New Bern in northwestern Craven County and below Smithfield in Johnston County. In the Piedmont, some of the best examples of Piedmont/Mountain Swamp Forest were destroyed by the creation of Falls Lake, but remnants of this rare natural community still exist in streams above the flooded portion of the lake.

2.9.3 Rare Aquatic and Wetland-Dwelling Animal Species

Table A-16 presents rare aquatic and wetland-dwelling species found in the Neuse River basin.

Table A-16 Rare Aquatic and Wetland-Dwelling Species (as of November 2000)

RARE AQUATIC ANIMALS			
		<i>State Status</i>	<i>Federal Status</i>
<u>Mammal</u>			
<i>Trichechus manatus</i>	Manatee	E	E
<u>Reptile</u>			
<i>Alligator mississippiensis</i>	American alligator	T	T(S/A)
<i>Caretta caretta</i>	Loggerhead	T	T
<i>Lepidochelys kempii</i>	Atlantic ridley	E	E
<i>Malaclemys terrapin centrata</i>	Carolina diamondback terrapin	SC	
<u>Amphibian</u>			
<i>Necturus lewisi</i>	Neuse River waterdog	SC	
<u>Fish</u>			
<i>Acipenser brevirostrum</i>	Shortnose sturgeon	E	E
<i>Ambloplites cavifrons</i>	Roanoke bass	SR	
<i>Etheostoma collis pop 2</i>	Carolina darter	SC	FSC
<i>Lampetra aepyptera</i>	Least brook lamprey	SC	
<i>Lythrurus matutinus</i>	Pinewoods shiner	SR	FSC
<i>Notropis bifrenatus</i>	Bridle shiner	SC	
<i>Noturus furiosus pop 1</i>	Carolina madtom	SC	
<u>Mollusk</u>			
<i>Alasmidonta heterodon</i>	Dwarf wedgemussel	E	LE
<i>Alasmidonta undulata</i>	Triangle floater	T	
<i>Alasmidonta varicosa</i>	Brook floater	E	FSC
<i>Anodonta implicata</i>	Alewife floater	T	
<i>Elliptio lanceolata</i>	Yellow lance	E	FSC
<i>Elliptio marsupiobesa</i>	Cape Fear spike	T	
<i>Elliptio roanokensis</i>	Roanoke slabshell	T	
<i>Elliptio steinstansana</i>	Tar River spinymussel	E	LE
<i>Fusconaia masoni</i>	Atlantic pigtoe	E*	FSC
<i>Lampsilis cariosa</i>	Yellow lampmussel	E*	FSC
<i>Lampsilis radiata conspicua</i>	Carolina fatmucket	T*	
<i>Lampsilis radiata radiata</i>	Eastern lampmussel	T*	
<i>Lasmigona subviridis</i>	Green floater	E	FSC
<i>Ligumia nasuta</i>	Eastern pondmussel	T*	
<i>Somatogyryus virginicus</i>	Panhandle pebblesnail	SR	FSC
<i>Strophitus undulatus</i>	Squawfoot	T	
<i>Villosa constricta</i>	Notched rainbow	SR	
<i>Villosa delumbis</i>	Eastern creekshell	SR	

<i>Crustacean</i>			
<i>Orconectes carolinensis</i>	North Carolina spiny crayfish	SR	
<i>Insect</i>			
<i>Baetisca laurentina</i>	a mayfly	SR	
<i>Ceraclea tarsipunctata</i>	a caddisfly	SR	
<i>Dibusa angata</i>	a caddisfly	SR	
<i>Ephemerella beneri</i>	a mayfly	SR	
<i>Gomphus septima</i>	Septima's clubtail	SR	FSC
<i>Leptohyphes robacki</i>	a mayfly	SR	
<i>Matrioptila jeanae</i>	a caddisfly	SR	
<i>Psilotreta frontalis</i>	a caddisfly	SR	
<i>Shipsa rotunda</i>	a stonefly	SR	
<i>Tachopteryx thoreyi</i>	Gray petaltail	SR	

Rare Species Listing Criteria	
E =	Endangered (those species in danger of becoming extinct)
T =	Threatened (considered likely to become endangered within the foreseeable future)
SR =	Significantly Rare (those whose numbers are small and whose populations need monitoring)
SC =	Species of Special Concern
FSC =	Federal Species of Concern (those under consideration for listing under the Federal Endangered Species Act)

Rare Aquatic Animals – Vertebrates

The manatee is a sporadic visitor to estuarine waters in the basin. The species does not breed in the state, but individuals are sighted every few years, even as far inland as New Bern. The American alligator is present in the lower Neuse River basin, primarily in Croatan National Forest and Cherry Point Marine Corps Air Station. The American alligator is considered Threatened due to its similarity of appearance to other rare crocodilians. Loggerhead turtles nest along coastal beaches and forage in the ocean and in most of the sounds. Estuaries and tidal marshes are the preferred habitat for the other rare aquatic reptiles in the basin -- Carolina diamondback terrapin and Carolina salt marsh snake. An especially significant aquatic amphibian is the Neuse River waterdog, which is endemic to the Neuse and Tar systems in the upper Coastal Plain and lower Piedmont. Recent surveys indicate that its population is stable in the upper Neuse River basin. The lower Neuse River basin has not been evaluated.

Another aquatic vertebrate species endemic to North Carolina is the Carolina madtom. Like the Neuse River waterdog, this small fish lives only in the Neuse and Tar River basins. Among the other rare fishes in the Neuse River basin, the Roanoke bass and Carolina darter have restricted ranges, being limited mainly to the Piedmont and upper Coastal Plain of southern Virginia and North Carolina. The shortnose sturgeon 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. Historically, shortnose sturgeon were widely reported from North Carolina rivers, but their numbers have declined greatly. Current distribution is not

well known. Shortnose sturgeon can grow to over three feet in length and may live for up to 30 years.

Rare Aquatic Animals – Mollusks

Good water quality in the Neuse River basin is critical to the survival of a large number of rare freshwater mussels. Eighteen species of rare freshwater mussels, plus one rare snail (panhandle pebblesnail) are known from the Neuse River basin; and two species, the dwarf wedgemussel and Tar River spinymussel, are federally-listed as Endangered. The majority of the Neuse River basin mollusks, including the dwarf wedgemussel, inhabit small streams. Many of the larger rivers in the state, such as the mainstem of the Neuse River, no longer support populations of rare mussels. Most populations of the rare mollusk species occur in the Piedmont and upper Coastal Plain, in rapidly developing areas. The future of these populations is uncertain.

2.9.4 Significant Natural Heritage Areas in the Neuse River Basin

The North Carolina Natural Heritage Program (NHP) compiles the NC Department of Environment and Natural Resources' (NCDENR) list of Significant Natural Heritage Areas as required by the Nature Preserve Act (NCGS Chapter 113-A-164 of Article 9A). 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 North Carolina, and therefore, have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Figure A-9 shows the Significant Natural Heritage Areas in the Neuse River basin. Highlighted below are certain Significant Natural Heritage Areas known by the NHP as Significant Aquatic Habitats. They are stream segments or other bodies of water that contain significant natural resources, such as a high diversity of rare aquatic animal species. Also described in groups below are several natural areas that contribute to the maintenance of water quality in the Neuse River basin. More complete information on Significant Natural Heritage Areas and Aquatic Habitats may be obtained from the NHP. For more information, contact <http://www.ils.unc.edu/parkproject/nhp/index.html>.

The reaches of a stream identified by the NHP as Significant Aquatic Habitat only show the location of areas known for natural diversity. The impact from lands adjacent and upstream of these stream reaches will determine water quality and the viability of aquatic species.

Eno River

This river in Orange and Durham counties supports 14 rare animals: two fishes, one amphibian, eight mussels, one snail and two dragonflies. It contains the only currently known North Carolina population of the panhandle pebblesnail. Eno River State Park protects much of the land along the river, but protection is still needed for the land bordering the river's headwaters.

Flat River

Ten rare animal species - one fish, one amphibian and eight mussels - make their home in this river in Person and Durham counties. While the lower portions of the river are protected by NC State University's Hill Forest, protection is lacking for the lands along the upper portions of the river.

Swift Creek

This stream in southern Wake and Johnston counties contains 11 rare animals: one fish and ten mussels, including the federally endangered dwarf wedgemussel. Although there are several protected areas along the stream above Lake Wheeler, all of the rare animals live in the creek below Lake Benson, where there are no lands protected along the banks of the stream. Thus, protection efforts are greatly needed downstream of Lake Benson.

Turkey Creek

This stream in Nash and northwestern Wilson counties contains one rare amphibian and six rare mussel species, including the federally endangered dwarf wedgemussel. Though there is a protected site in its floodplain, there are no protected areas along the banks of the creek; thus, protection efforts are greatly needed.

Little River

The Neuse River basin contains two Little Rivers that contain rare species or communities. Beginning in Franklin County, the Little River that flows through Wake, Johnston and Wayne counties contains 12 rare animals: three fishes, one amphibian and eight mussels, including several populations of the federally endangered dwarf wedgemussel. The only protected site along the river is Mitchells Mill State Natural Area in Wake County. A reservoir, which will impact some of these rare species, will be constructed on the river downstream from Mitchells Mill State Natural Area. Aquatic species would benefit from protection efforts along the Little River.

Middle Creek

This tributary in southern Wake and Johnston counties contains 11 rare animals: two fishes, one amphibian and eight mussels, including the federally endangered dwarf wedgemussel. Most of the creek flows through private, unprotected lands.

Moccasin Creek

This stream runs along the boundaries of Wake, Franklin, Nash and Johnston counties and contains one rare amphibian and four rare mussel species, one of which is the federally endangered dwarf wedgemussel. Except for a very small nature preserve in Johnston County, there are no protected lands along this creek; thus, protection efforts are greatly needed.

Little River

The Little River of Durham and Orange counties is located in the headwaters of the Neuse River basin. The significant portion of the aquatic habitat originates as two separate forks in western Orange County, which join just after crossing the Orange/Durham county line. Rare species present in the aquatic habitat include: yellow lampmussel, Atlantic pigtoe, squawfoot, notched rainbow, Neuse River waterdog and Roanoke bass.

Contentnea Creek Aquatic Habitat

The section of Contentnea Creek that is most significant is located between Buckhorn Dam and Wiggin's Mill Reservoir. Known to occur in this high quality aquatic system are populations of the triangle floater, squawfoot, notched rainbow, Neuse River waterdog, pinewoods shiner and Carolina madtom.

Mill Creek Aquatic Habitat

Mill Creek is a small tributary of the Neuse River located in Johnston County, on the state's upper Coastal Plain. The significant aquatic habitat contains: the Carolina madtom, the Neuse River waterdog and large, reproducing populations of several non-listed mussel species.

Cedar Island Marshes; Cherry Point Piney Island; Jones Island; and Pamlico Point Marshes

These four sites collectively consist of thousands of acres of primarily brackish marsh where the Neuse River merges with Pamlico Sound. Large numbers of the rare and secretive black rail nest in these marshes, as do large numbers of other marsh birds. The first two sites, in Carteret County, are in federal ownership; whereas, most of the latter two sites, which are in Pamlico County, are in private ownership except for a portion of Pamlico Point owned by the NC Wildlife Resources Commission.

Sweetwater Creek Natural Area and Trent River/Brice Creek Marshes

These two natural areas lie in close proximity near the mouth of the Trent River near New Bern. Extensive examples of the uncommon wetland community, Tidal Freshwater Marsh, are present at the sites, and the former site contains the only known location of the globally rare Godfrey's sandwort in the state. Both sites are in private ownership and are in need of protection.

Neuse River Floodplain and Bluffs

This floodplain corridor, extending for approximately twenty air miles from New Bern upstream to Pitt County, consists mostly of swamp forests with a few marl outcrops present on vertical riverbanks. Progress has been made in protecting this natural area and the water quality of the Neuse. A few sections of the floodplain are owned by the NC Wildlife Resources Commission, and the North Carolina Coastal Land Trust has protected over 1,000 acres within the floodplain. There is one privately-owned Registered Natural Heritage Area as well. Protection is needed for this floodplain natural area.

Cliffs of the Neuse State Park

This relatively small state park protects about two miles of shoreline along the Neuse River in southeastern Wayne County. The park is best known for the natural communities of its high bluffs and wetlands, including bottomland hardwoods and cypress-gum swamp forests.

Neuse River/Brogden Bottomlands; Cowbone Oxbows; and Sage Pond/Neuse River Floodplain

These are the three most important sites in the floodplain of the Neuse River in southeastern Johnston County. The floodplain is remarkably wide (up to 4 miles) in this part of the basin. Even though much of the floodplain forests have been cut over, considerable acreage still remains in swamp and bottomland forest. This portion of the river contains several oxbow lakes, which are rare in North Carolina. No parts of this natural area are in public or otherwise protected ownership; thus, protection effort is greatly needed.

William B. Umstead State Park

This state park protects nearly 5,400 acres of forestland in the upper part of the Neuse River basin. Crabtree Creek flows for several miles through the park, which features bottomland hardwoods as well as several rhododendron bluffs along the creekbank.

Eno River State Park and Occoneechee Mountain

The state park protects more than eight miles of river frontage, mostly in various upland communities. Occoneechee Mountain is located upstream of the park, opposite the Town of Hillsborough. A portion of this monadnock, one of the highest hills in the eastern Piedmont, is managed by the Division of Parks and Recreation as a State Natural Area.

2.9.5 Fisheries

Since 1998, the NC Wildlife Resources Commission (NCWRC) has sampled the resident fish community using boat-mounted electrofishing gear at a number of locations in the Neuse River downstream of Goldsboro to New Bern as well as in its tributaries, Contentnea Creek and Trent River. Overall the number of species collected ranged from 11-29 with a mean of 20 species. At sites along the mainstem Neuse River, 16-26 species were collected, while at sites in Contentnea Creek and Trent River, 19-29 species and 11-26 species were collected, respectively. Freshwater fish species of recreational importance found in the Neuse River and tributaries included largemouth bass, bluegill, redear and redbreast sunfish, pumpkinseed, warmouth, black crappie, channel catfish, white catfish, blue catfish, flathead catfish, chain and redbfin pickerel, and yellow and white perch. All of the species mentioned above except catfish are classified as inland game fish by the NCWRC. Nongame species commonly encountered included bowfin, common carp, longnose gar, pirate perch, satinfin shiner, V-lip redbreast, swallowtail shiner, silvery minnow and tessellated darter.

Largemouth bass and sunfish support popular fisheries year-round throughout the basin; however, peak fishing is in late spring and early summer. Anglers target black crappie in the late

fall and early spring generally in the lower river and its tributaries. Yellow and white perch provide good fishing from late winter through the spring in the lower Neuse, in particular the Trent River. Channel, blue and flathead catfish provide additional angling opportunities throughout the year. Although large catfish (>20 lbs.) are common throughout the river and its major tributaries, much of the effort is concentrated from Goldsboro downstream to New Bern.

Anadromous species found within the Neuse River basin include striped bass, American shad, hickory shad, blueback herring and alewife. Although striped bass are caught year-round in the Neuse and Trent rivers near New Bern, these species mainly support seasonal fisheries as they migrate into freshwater reaches of the Neuse River to spawn each spring. From 1952 to 1998, spawning migrations of anadromous fish were impeded by Quaker Neck Dam, a low-head dam located near Goldsboro, and in most years spawning areas were limited to areas downstream of the dam. However, with the removal of Quaker Neck Dam in 1998, 74 miles of historical spawning habitat were restored. Anadromous species, in particular striped bass and American shad, now migrate upstream as far as Milburnie Dam near Raleigh, but the extent of upstream migration in a given year is highly dependent on river flows. Hickory shad, blueback herring and alewife are generally found from Goldsboro downstream to New Bern. In 2000, the Neuse River from Pitchkettle Creek upstream to Milburnie Dam in Craven, Pitt, Lenoir, Wayne, Johnston and Wake counties was designated by the NCWRC as Inland Primary Nursery Areas (15A NCAC 10C .0503).

Falls of the Neuse Reservoir is a 20,000-acre impoundment of the Neuse River located just north of Raleigh. This reservoir supports a highly valued largemouth bass fishery. During 2001, there were over 250 tournaments held for largemouth bass on this reservoir. Crappies are also a highly prized species for anglers on Falls of the Neuse Reservoir, along with channel catfish. Other species of interest include white bass, white perch and a variety of sunfish species.

2.9.6 Public Lands

As has been noted above, the Neuse River basin contains ecologically significant public lands in Eno River State Park, Cedar Island and other areas. In addition to Eno River State Park, Division of Parks and Recreation managed areas in the Neuse River basin include: William B. Umstead State Park, Waynesborough State Park, Cliffs of the Neuse State Park, Mitchell Mill State Natural Area and Occoneechee Mountain State Natural Area. The Wildlife Resources Commission manages Butner-Falls of Neuse Game Land, Caswell Farm Game Land, Cherry Farm Game Land, Goose Creek Game Land and Neuse River Game Land. State educational institution-owned land includes North Carolina State University's 1,700-acre Hill Demonstration Forest and Johnston Community College's 2,900-acre Howell Woods Environmental Learning Center. Camp Butner Training Site, owned by North Carolina National Guard, is a 4,000-acre training facility composed primarily of pine plantations and some quality natural areas, including Knop of Reeds Creek. The training facility is a large contiguous block of habitat relatively free of fragmentation – something increasingly rare in the North Carolina Piedmont; therefore, the Camp Butner (CBTS) is considered a significant natural resource.

Federally-owned land in the Neuse River basin includes both military and natural resource reservations. National Park Service owns Cape Lookout National Seashore, which includes Core Banks and Portsmouth Island. The US Fish and Wildlife Service manages Cedar Island National

Wildlife Refuge, while the US Army Corps of Engineers owns Falls Lake and land around the reservoir. State agencies, specifically the NC Wildlife Resources Commission and Division of Parks and Recreation, manage the land around Falls Lake for the Corps. The US Department of Defense owns Cherry Point, a Marine Corps Air Station with a number of large significant natural areas. A portion of the Croatan National Forest lies in the Neuse River basin, including most of the 9,000-acre Sheep Ridge Wilderness and a large part of the 8,000-acre Catfish Lake Wilderness. See Figure A-9 for the location of these state and federal public lands.

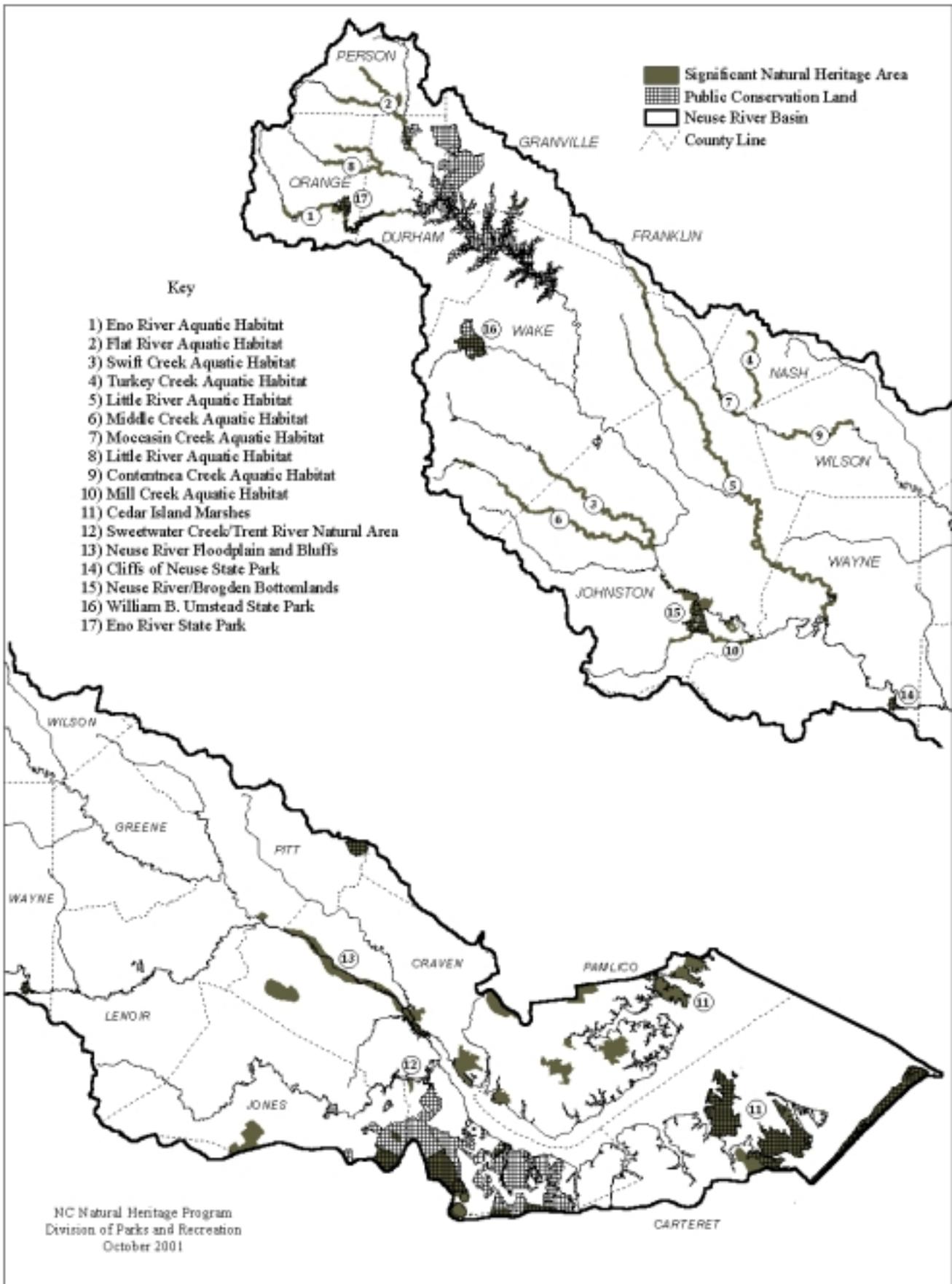


Figure A-9 Neuse River Basin Managed Lands and Significant Heritage Areas