A Summary of Land-Applied Nutrients from Permitted Animal Operations in North Carolina

North Carolina Department of Environmental Quality
Division of Water Resources
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A Summary of Land-applied Nutrients from Swine Waste in North Carolina

Executive Summary

This report provides a summary of Animal Operation permits issued by the Division of Water Resources (DWR) and estimates for the amount of nutrients applied to the land from swine and wet poultry operations applying liquid waste from anaerobic lagoons. No attempt was made to determine the fate of these nutrients once applied to the land surface or to account for nutrient losses prior to land application. Land application of lagoon sludge was not estimated since lagoons are cleaned out infrequently and irregularly. Estimates were generated based on individual permits which were assigned to a subwatershed (12-digit hydrologic unit) and a county. Subwatershed estimates were then aggregated to the subbasin (8-digit hydrologic unit) and river basin scales.

The estimates of land-applied nutrients from Animal Operations are compared to estimates of land-applied nutrients from other sources, such as chemical fertilizer. The quantity of nutrients applied to the land surface by permitted animal operations is several times greater than the quantity land-applied nutrients from wastewater treatment residuals. Comparison of nutrient loading estimate maps for permitted animal feeding operations to mapped EPA estimates of chemical fertilizer application indicates that subbasins and subwatersheds with the highest nutrient loads from animal waste also receive some of the highest nutrient loads from chemical fertilizer application.

The nutrient application estimates and comparisons presented here are intended to help development management plans for nutrient sensitive watersheds, for development of watershed restoration plans, and for prioritization of nutrient load reduction efforts. These estimates may also be used as a guide to select potential areas for research on impacts of nutrient application from animal operations.

Introduction

The DWR issues permits for land application of livestock wastes to farmers who meet the definition of an animal operation as described in G.S. 143-215.10B. Table 1 provides a summary of the animal operations regulated under a permit issued by the DWR. There are many more livestock operations in the state that are not required to obtain a permit. Table 2 is a list of livestock estimates generated by the North Carolina Department of Agriculture and Consumer Services (NC DA&CS) that includes most livestock in the state.

Nearly all swine operations with a permit have an anaerobic lagoon treatment system where the liquid effluent is sprayed on nearby agricultural fields. In rare instances, a swine operation may not use an anaerobic lagoon and spray field system; however, for the purpose of this study these were considered to be negligible and were included as if they utilized an anaerobic lagoon.

Most poultry operations in the state are dry litter poultry operations which fall under the deemed permitted category per G.S 143-215.10C. However, some poultry operations, particularly egg production farms, utilize anaerobic lagoons and spray fields for liquid waste disposal and beneficial reuse of nutrients. As of November 2013, there were 6,853,219 chickens permitted in NC. Based on the estimate of 33.5 million turkeys raised in 2013 (NC DA&CS, 2015) and assuming a 16–20 week growth period for a commercial turkey (US EPA, 2012) or 2.5 flocks per year, there are approximately 13.4 million livestock turkeys in the state at any one time. When combined with the estimated layer chicken population of 13.3 million and an estimated 157.3 million broiler chickens (786,600,000 divided by 5 flocks per year) it is reasonable to assume a poultry population of 184 million birds statewide (NC DA&CS, 2015). This means that less than 4% of the poultry population in North Carolina is regulated under a permit issued by the DWR.

Cattle operations that confine the animals for part of the time at least 45 days out of the year and spread collected waste are required to obtain a permit. Most permitted cattle facilities are dairy farms where confinement is for milking purposes only. During times when the cattle are not confined, the waste remains in a grazing pasture as with a non-confined cattle operation. Since the duration in which the cattle are confined is not known, nutrient estimates for cattle were not generated. It is estimated that less than 12% of the cattle population in North Carolina is regulated under a permit issued by the DWR.

Table 1: A Summary of Animal Operations with a DWR Permit as of November 13, 2013

Permit Type	Regulated Activity	Total Number of
Cattle State COC	Cattle – Beef Brood Cow	409
Cattle State COC	Cattle – Beef Feeder	7,041
Cattle State COC	Cattle – Beef Stocker Calf	2,885
Cattle State COC	Cattle – Dairy Calf	2,209
Cattle State COC	Cattle – Dairy Heifer	9,352
Cattle State COC	Cattle – Dry Cow	3,496
Cattle State COC	Cattle – Milk Cow	51,591
Cattle NPDES COC	Cattle – Beef Stocker Calf	1,675
Cattle NPDES COC	Cattle – Milk Cow	250
Animal Individual State	Cattle – Beef Brood Cow	500
Animal Individual State	Cattle – Beef Feeder	5,000
Animal Individual State	Cattle – Beef Stocker Calf	5,420
Animal Individual State	Cattle – Dairy Calf	140
Animal Individual State	Cattle – Dairy Heifer	1,300
Animal Individual State	Cattle – Dry Cow	215
Animal Individual State	Cattle – Milk Cow	2,155
Total Cattle		**93,638**
Swine State COC	Swine – Boar/Stud	5,502
Swine State COC	Swine – Farrow to Feeder	68,367
Swine State COC	Swine – Farrow to Finish	21,508
Swine State COC	Swine – Farrow to Wean	862,680
Swine State COC	Swine – Feeder to Finish	5,642,176
Swine State COC	Swine – Gilts	18,671
Swine State COC	Swine – Other	70
Swine State COC	Swine – Wean to Feeder	2,423,785
Swine State COC	Swine – Wean to Finish	229,424
Swine NPDES COC	Swine – Farrow to Wean	6,672
Swine NPDES COC	Swine – Feeder to Finish	51,770
Swine NPDES COC	Swine – Wean to Feeder	1,200
Animal Individual State	Swine – Boar/Stud	500
Animal Individual State	Swine – Farrow to Finish	100
Animal Individual State	Swine – Farrow to Wean	17,450
Animal Individual State	Swine – Feeder to Finish	227,179
Animal Individual State	Swine – Gilts	200
Animal Individual State	Swine – Wean to Feeder	17,760
Total Swine		**9,595,014**
Wet Poultry State COC	Wet Poultry – Layers	751,600
Wet Poultry State COC	Wet Poultry – Non Laying Pullets	56,500
Wet Poultry NPDES COC	Wet Poultry – Layers	95,119
Wet Poultry NPDES COC	Dry Poultry – Laying Chickens	1,200,000
Animal Individual NPDES	Wet Poultry – Layers	4,000,000
Animal Individual NPDES	Wet Poultry – Non Laying Pullets	750,000
Total Poultry		**6,853,219**
Animal Individual State	Horses – Horses	21,340
Animal Individual State	Animals Other	335
NC Division of Water Resources Basinwide Information Management System, November 13, 2013.		

Table 2: NC Department of Agriculture & Consumer Services Livestock Statistics

Species and Classification	Number on Farms, January 1		
	2006	2014	2015
Cattle – Total [1]	860,000	810,000	800,000
Cows & Heifers that have calved	436,000	400,000	410,000
Beef Cows	384,000	355,000	363,000
Milk Cows	52,000	45,000	47,000,
Heifers 500 pounds and over	120,000	116,000	115,000
For Beef Cow replacement	72,000	72,000	69,000
For Milk Cow replacement	22,000	20,000	18,000
Other Heifers	26,000	24,000	28,000
Steers 500 pounds and over	45,000	44,000	36,000
Bulls 500 pounds and over	29,000	30,000	29,000
Calves under 500 pounds	230,000	220,000	210,000
Sheep – Total	18,000	27,000	30,000
Breeding Sheep & Lambs	14,000	21,000	24,000
Replacement Lambs	3,000	4,000	4,000
Ewes 1 year plus	10,000	15,000	18,000
Rams 1 year plus	1,000	2,000	2,000
Market Sheep & Lambs	4,000	6,000	6,000
Goats – Total [2]	-	-	-
Angora Goats [2]	-	-	-
Milk Goats	-	7,000	8,000
Meat and Other Goats	-	45,000	43,000
	Number on Farms, December 1		
	2006	2014	2015
All Hogs and Pigs	9,500,000	8,500,000	8,800,000
Breeding Hogs	1,010,000	870,000	880,000
Market Hogs	8,490,000	7.630,000	7,920,000
Under 50 Pounds	(under 60lbs) 3,390,000	2,600,000	3,010,000
50-119 Pounds	(60-119lbs) 1,970,000	1,800,000	1,830,000
120-179 Pounds	1,680,000	1,630,000	1,580,000
180 Pounds and above	1,450,000	1,600,000	1,500,000
Chickens – Total [3]	19,201,000	21,234,000	21,814,000
Layers	-	14,441,000	-
Broilers (# produced)	749,000,000	795,200,000	-
Turkeys (# raised)	37,500,000	28,500,000	-

1 Totals may not add due to rounding.
2 Not published by NCDA to avoid disclosure of individual operations.
3 Does not include commercial broilers.
Source: North Carolina Department of Agriculture and Consumer Services 2012 Agricultural Statistics

Objective

The objective of this project was to determine the spatial distribution of the phosphorous and nitrogen applied to fields from Animal Operations permits in order to make comparisons to other sources of nutrients. The primary purpose of this estimate is to compare the relative magnitude of nutrients from animal waste application to other known quantities of nutrients applied to the land or discharged to surface waters. These estimates and comparisons can be used to improve management plans for nutrient sensitive watersheds and to help develop nine-element watershed restoration plans. These estimates may also be used as a guide to select potential areas for research on impacts of nutrient application from animal operations.

This project was not intended to determine if land application of animal wastes is having an impact on groundwater or surface water but to simply get an estimate for the amount of nutrients being released into the environment. If waste application rates are limited to the agronomic rate of the cover crop and waste application is conducted in accordance with permit conditions, then the majority of the nutrients should, in theory, be taken up by the vegetation before reaching groundwater or surface waters.

Data Sources and Methodology

A spreadsheet of permitted animal feeding operation locations, animal types, and allowable animal counts were obtained from the DWR Basinwide Information Management System (BIMS) database in November 2013. Some of these permits are for animal operations that are no longer housing animals or are operating at less than the maximum allowed. Estimates for manure production, as well as nitrogen and phosphorous concentration were obtained from the *2014 North Carolina Agricultural Chemicals Manual* published by North Carolina State University (Table 3). These factors were used to generate nutrient estimates for each permit utilizing an anaerobic lagoon system by multiplying the allowable animal count by the manure production per animal.

Each permit was assigned to a county and subwatershed (12-digit Hydrologic Unit) based on a single point location of the farm. While wastes may be spread over an area of tens of acres, a single point is the only coordinate information that is currently stored in BIMS. Moreover, while a polygon of the application area would be more accurate, the degree of inaccuracy introduced by using a single point should be small because lagoon wastes are usually spread immediately adjacent to the barns. The subwatershed estimates were then aggregated to the subbasin (8-digit Hydrologic Unit) and River Basin level.

Table 3: Manure Volume/Weight and Pounds of Nitrogen and P_2O_5 Produced Annually

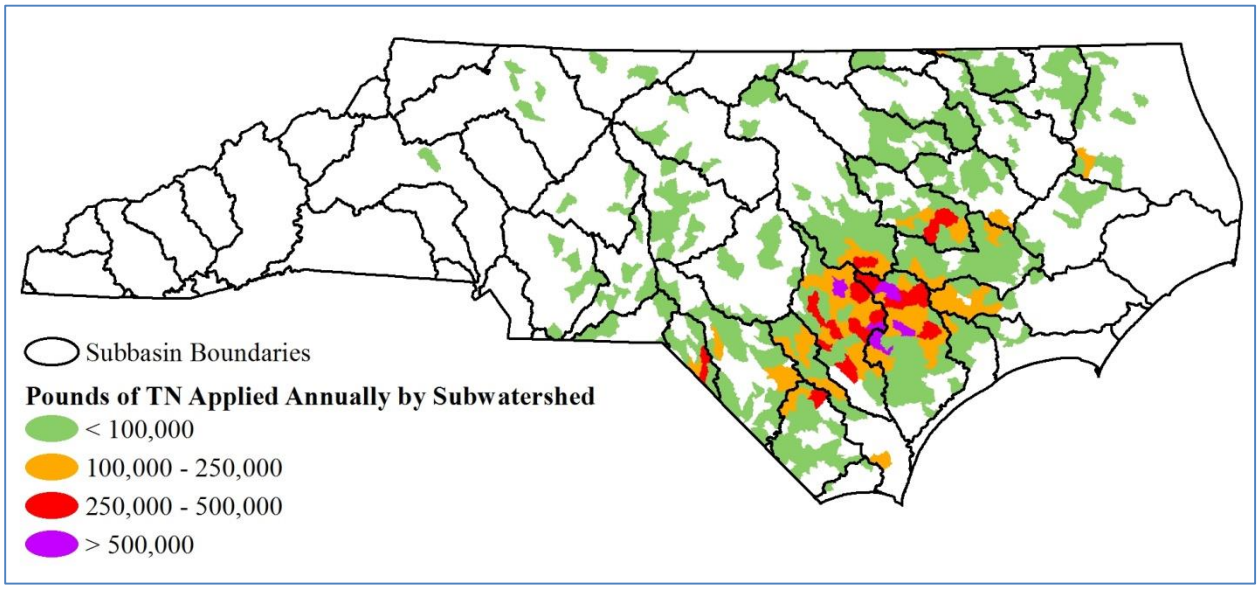
Livestock Type	Manure Volume Gallons/Animal/Year	Total Nitrogen Pounds/1,000 Gallons	Phosphorous as P_2O_5 Pounds/1,000 Gallons
Anaerobic Lagoon Liquid			
Swine – Boars	*2,929	3.6	1.4
Swine – Gilts	*1,000	3.6	1.4
Swine – Farrow to Wean	3,203	2.4	0.9
Swine – Farrow to Feeder	3,861	3.6	1.4
Swine – Farrow to Finish	10,478	3.6	1.4
Swine – Feeder to Finish	927	3.6	1.4
Swine – Wean to Feeder	191	3.6	1.4
Swine – Wean to Finish	776	3.6	1.4
Wet Poultry – Layers	25.373	3.1	1.0
Wet Poultry – Non Laying Pullet	9.11	3.1	1.0
Waste Pit Slurry			
Cattle – Dairy Calf	1,876	16.7	9.1
Cattle – Dairy Heifer	5,535	16.7	9.1
Cattle – Dairy Milk Cow	7,749	16.7	9.1
Livestock Type	**Manure in Tons/Animal/Year**	**Total Nitrogen Pounds/Ton/Year**	**Phosphorous as P_2O_5 Pounds/Ton/Year**
Dry Scraped			
Cattle – Beef Stocker	1.5	13.0	8.3
Cattle – Beef Feeder	2.2	13.0	8.3
Cattle – Beef Brood Cow	3.0	13.0	8.3
Cattle – Dairy Calf	4.1	11.2	7.0
Cattle – Dairy Heifer	12	11.2	7.0
Cattle – Dairy Milk Cow	17	11.2	7.0
Livestock Type	**Manure in Tons /1,000 Birds/Year**	**Total Nitrogen Pounds/Ton/Year**	**Phosphorous as P_2O_5 Pounds/Ton/Year**
Dry Scraped			
Poultry – Breeder Chicken	24	47.6	44.7
Poultry – Broiler Chicken Whole House	7.2	57.8	40.0
Poultry – Broiler Chicken Cake	4.0	57.8	40.0
Poultry – Breeder Turkey	37	54.0	48.2
Poultry – Hen Turkey	17	54.0	48.2
Poultry – Poult Turkey	5.3	54.0	48.2
Poultry – Tom Turkey	25	54.0	48.2

Source: 2014 North Carolina Agricultural Chemicals Manual
*Source: DWR Animal Feeding Operations Branch

Results

By the methods used in this project, it was estimated that over 30.8 million pounds of total nitrogen and over 11.9 million pound of phosphorous as P_2O_5 are applied to the land annually through DWR-permitted animal operations utilizing an anaerobic lagoon and sprayfield system in North Carolina. Since less than 4% of the poultry population is housed in operations utilizing an anaerobic lagoon/sprayfield system, and cattle operations were not included in this project, these estimates mainly reflect swine operations. Thus the geographic distribution of the nutrient application estimated by this project closely mirrors the location of swine operations which are located mostly in the southeastern part of the state (Figure 1).

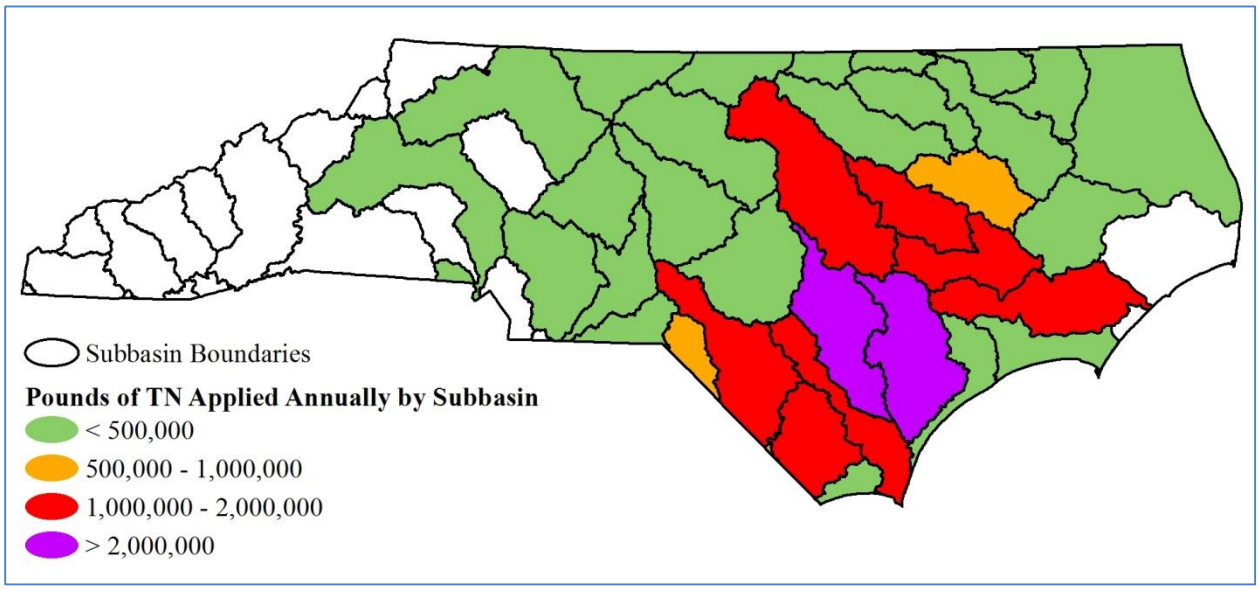
Figure 1: Total Nitrogen Applied Annually by Subwatershed



Subwatershed estimates for total nitrogen ranged from 291 to 740,620 pounds a year based on animal populations at the time of assessment. The subwatershed with the highest total application was Middle Goshen Swamp subwatershed in northwestern Duplin County. Since the same volume factor with a different concentration factor was used to calculate P_2O_5 estimates, the relative distribution of phosphorous loading is identical to the relative distribution of total nitrogen loading.

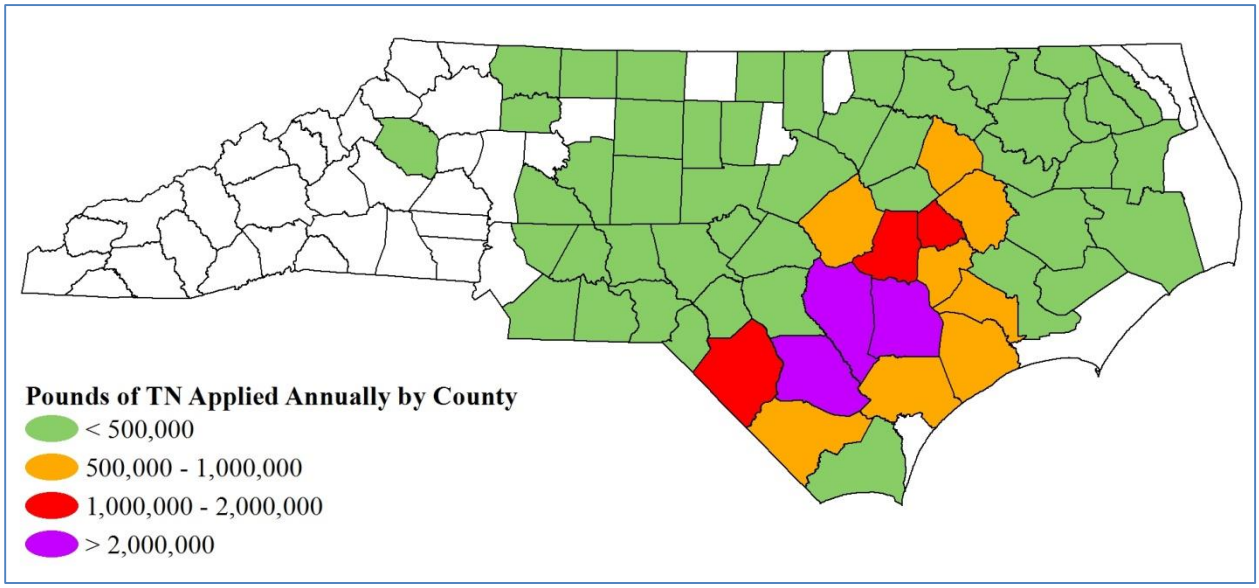
At the subbasin scale, the highest concentration of nutrient application can be found in the Northeast Cape Fear River Subbasin and the Black River Subbasin (Figure 2).

Figure 2: Total Nitrogen Applied Annually by Subbasin



Duplin, Sampson and Bladen counties received the highest estimated total nitrogen and phosphorous from land application of animal wastes in the state. These three counties accounted for more than half of the state's total nutrient loading from permitted CAFOs, with a combined total of 18,374,007 pounds of total nitrogen (59.54% of total) and 6,038,674 pounds of phosphorous as P_2O_5 (59.61% of total). *Note:* total nitrogen numbers can be converted to first year plant available nitrogen (PAN) by multiplying the total nitrogen by an availability coefficient for a specific waste application method; these coefficients range from 0.4 - 0.6 (Crouse, D. A., et al, 2014).

Figure 3: Total Nitrogen Applied Annually by County



A complete list of results by subwatershed, subbasin, and county can be found in the Appendix.

Discussion

Comparison to Nutrient Loads from Land Application of Wastewater Treatment Residuals
It was estimated that between approximately 2 to 4 million pounds of plant-available nitrogen and roughly 2.5 million pounds of phosphorous were applied to the land surface from class B wastewater residual solids permits statewide in 2010 (NC DENR-DWQ, 2012). While these estimates do not include class A wastewater residual solids, the data indicate that, on a statewide scale, the amount of nutrients being land-applied by permitted animal operations is several times greater than the amount of nutrients land-applied as wastewater residual solids.

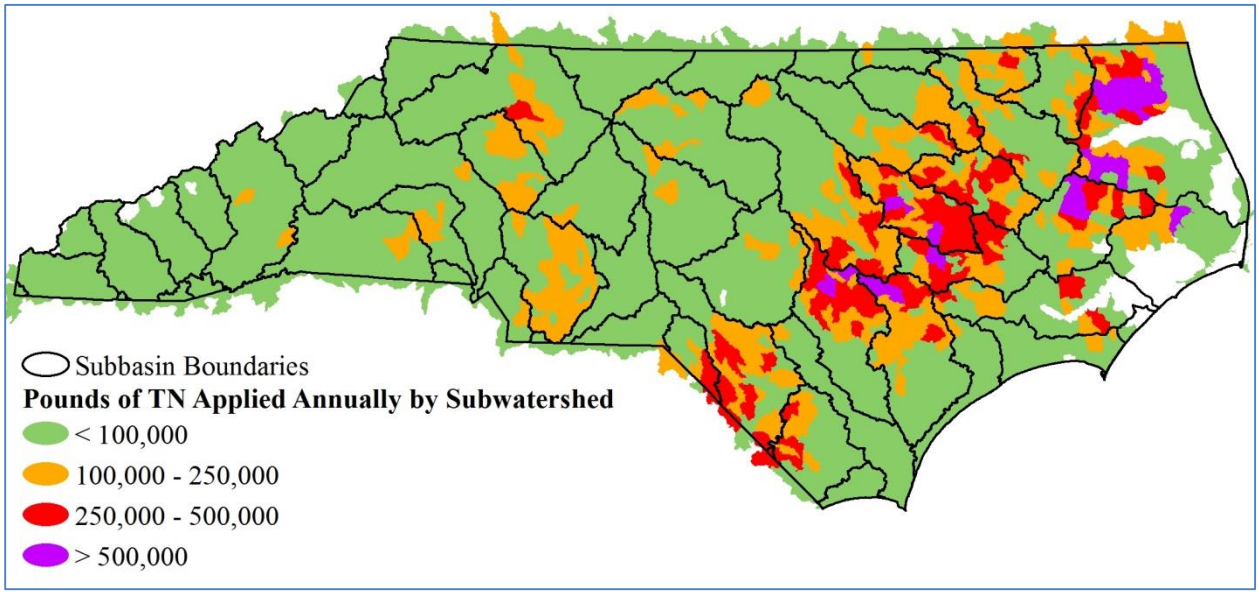
Comparison to Residential Subsurface On-site Septic System
Estimates for land-applied nitrogen from anaerobic lagoon and sprayfield systems associated with DWR animal operation permits are of the same order of magnitude as nitrogen released to septic system drain fields in North Carolina in 1990. It was estimated that in 1990 septic systems drainfields received approximately 31.6 million pounds of nitrogen annually (Pradhan et al., 2007). Although it is known that population has increased substantially in North Carolina since 1990, the change in the number of residents serviced by septic systems in not known.

Comparison to Synthetic Chemical Fertilizer Application Estimates
The US Geological Survey compiled county-level data for the application of synthetic chemical fertilizer for both farm and non-farm application for every year from 1987 through 2006. Statewide it was estimated that 390,793,267 pounds of total nitrogen and 106,178,207 pounds of total phosphorous were applied in North Carolina in 2006. The annual total nitrogen estimates in pounds ranged from 278,223,772 to 512,423,464 with an average of 403,266,487. The total phosphorus estimates in pounds ranged from 71,250,267 to 108,377,393 with an average of 91,570,593 (Gronberg and Spahr, 2012).

The US Environmental Protection Agency (EPA) used the USGS county-level estimates to calculate the average total nitrogen application rates by subwatershed for only the farm applied portion. The county-level data was divided up among the subwatersheds using 2006 National Land Cover Dataset (NLCD) and is not crop specific (US EPA, 2014a). Figure 4 shows total nitrogen applied on farms from chemical synthetic fertilizers by subwatershed derived from the EPA data. This map does not show the portion of total nitrogen applied to residential lawns, golf courses, athletic field, and other non-farm uses.

While Duplin, Sampson, and Bladen counties received the highest estimated nutrient quantities from land application of animal wastes, these counties also were reported to have received very high levels of TN from chemical fertilizer application (Figure 4). These three counties were estimated to receive 19,043,060 pounds of total nitrogen annually by this means, accounting for 14.2% of the state's total loading derived from chemical fertilizer application. This amount exceeds the 18,374,007 pounds derived from DWR permitted application of animal wastes in these three counties. An attempt to study the impact of such operations on water quality could be complicated by spatial density of nutrient release from agricultural non-point sources in the surrounding area.

Figure 4: 2006 Estimated Total Nitrogen Applied to Farms from Synthetic Chemical Fertilizer (US EPA, 2014)



Comparison to Other Manure Application Estimates

The International Plant Nutrition Institute (IPNI) compiled data for total nitrogen and P_2O_5 application from recoverable manure by county for 2007. Recoverable manure is only the portion of animal waste that is collected, stored, and land-applied from confined animal feeding operations and includes confined animal feeding operations both with and without a DWR animal operations permit. Statewide it was estimated that 188,054,000 pounds of total nitrogen and 296,416,000 pounds of P_2O_5 were applied in North Carolina in 2006 (IPNI, 2012). The IPNI estimates suggest either that (1)land-applied nutrient loads from DWR-regulated animal operations account for only a small fraction of statewide nitrogen and phosphorous application from all manure sources or (2)the methods and assumptions used by IPNI are not comparable to the methods and assumptions used in this report, (3) or a combination of the two.

The US EPA calculated subwatershed estimates for total nitrogen application rates from recoverable manure in 2006 using 2007 county-level data from the IPNI and 2006 National Land Cover Dataset (US EPA, 2014). Figure 5 shows total nitrogen applied on farms from recoverable manure by subwatershed derived from the EPA data. Much of the manure application in the EPA dataset overlaps geographically with the waste application estimated by this project and likely reflects the sources accounted for by this report. However, the EPA dataset shows areas in the Piedmont with high application rates where there is little application by DWR-regulated facilities. These areas likely represent nutrients derived from dry litter poultry operations that is not captured under DWR's regulated animal operation permit system.

Figure 5: 2006 Estimated Total Nitrogen Application from Manure Fertilizer (US EPA , 2014b)

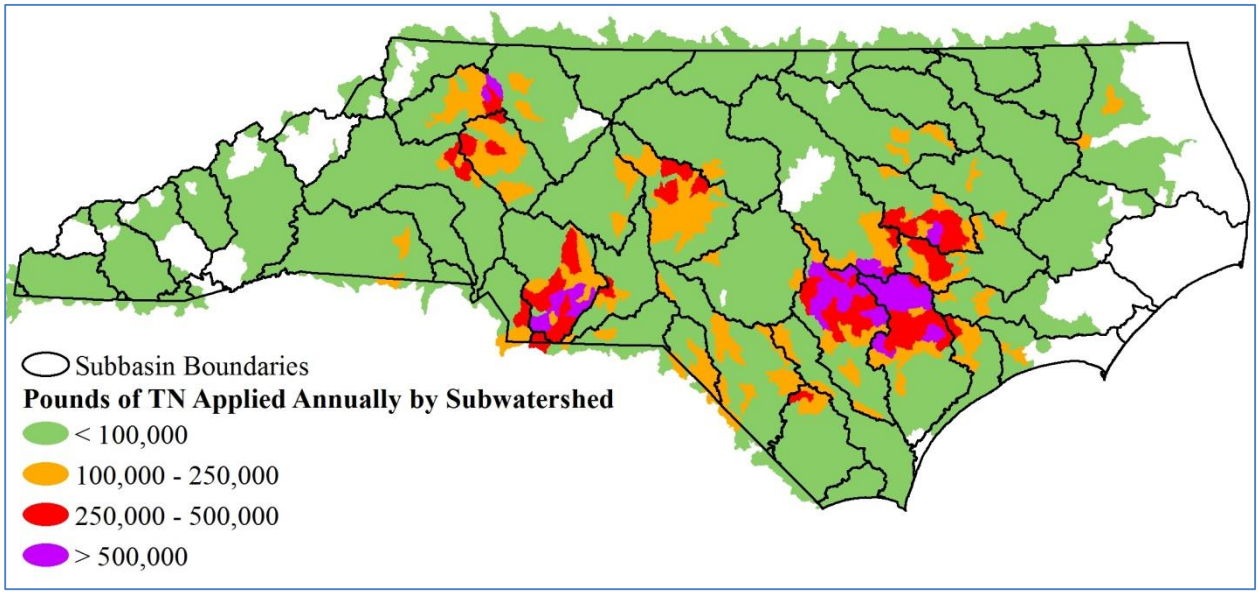
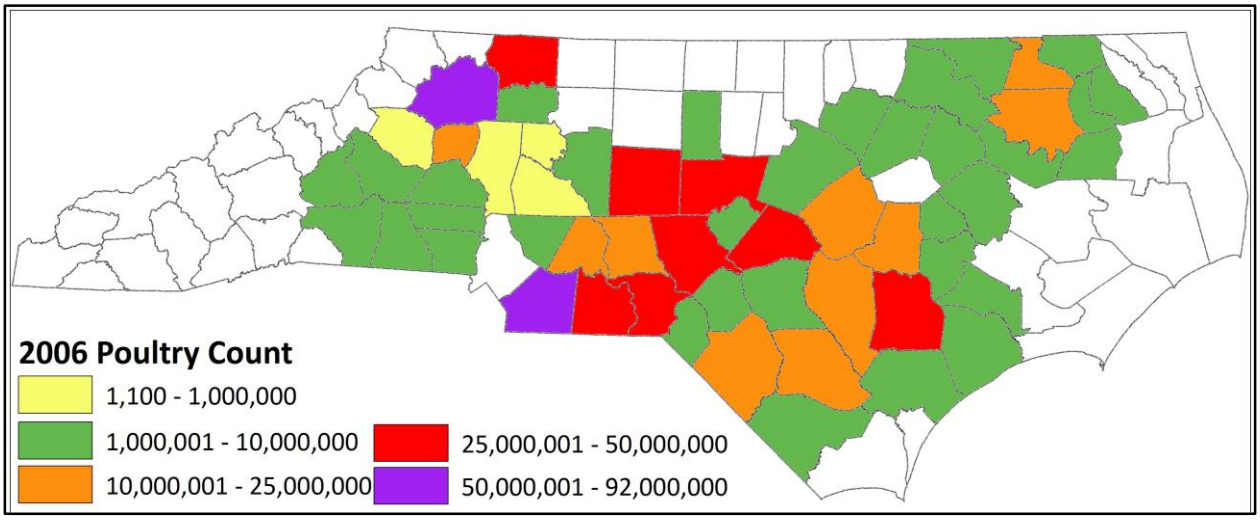


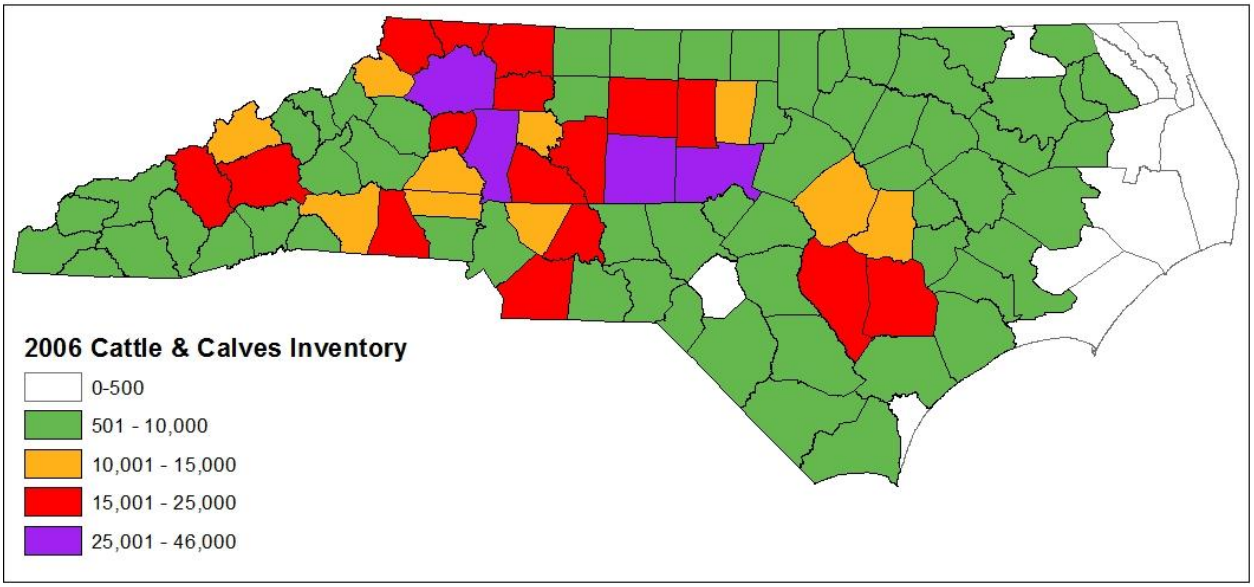
Figure 6 shows county-level estimates by the National Agriculture Statistics Service of layers, broilers and turkeys raised in 2006. Figure 7 shows the number of cattle including calves recorded by the National Agriculture Statistics Service for 2006. These two figures account for the differences between estimates shown in Figure 1 and Figure 5 since most of the waste nutrients for these animals were not estimated. The distribution of these animals overlaps with the areas of high nutrient application from manure in the EPA dataset, suggesting that the high concentrations of nutrient application from manure in these areas comes from dry litter poultry and cattle grazing operations.

Figure 6: 2006 Number of Poultry by County



Agriculture Statistics available from: https://quickstats.nass.usda.gov/

Figure 7: 2006 Number of Cattle and Calves by County



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Appendix: Complete Results by Subwatershed and County

Table A-1: Subwatershed (12-Digit HUC) Results in Pounds Applied Annually

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
Roanoke Basin			
030101020802	Mountain Creek-Grassy Creek	4,192	1,630
030101021004	Eastland Creek-John H Kerr Reservoir	47,151	18,337
030101030301	Snow Creek	11,120	4,324
030101030503	Massy Creek-Dan River	9,263	3,474
030101030504	Rock House Creek-Dan River	6,007	2,336
030101040604	Headwaters Mayo Creek	9,807	3,814
030101060204	Newmans Creek-Smith Creek	8,501	3,306
030101060205	Blue Mud Creek-Smith Creek	5,765	2,162
030101060301	Hawtree Creek	37,721	14,669
030101060303	Sixpound Creek	22,632	8,802
030101070202	Gumberry Swamp	32,161	12,158
030101070203	Headwaters Conoconnara Swamp	18,860	7,335
030101070204	Outlet Conoconnara Swamp	881	284
030101070205	Looking Glass Run	15,989	5,996
030101070302	Flag Run Gut-Roanoke River	10,269	3,993
030101070304	White Millpond-Kehukee Swamp	55,863	21,724
030101070503	Coniott Creek-Roanoke River	38,445	14,951
030101070507	Beaverdam Creek	5,599	2,177
030101070703	Connaritsa Swamp	14,337	5,575
030101070705	Community of Francis Mill-Cashie River	31,979	11,992
Chowan Basin			
030102030204	Headwaters Cole Creek	38,264	14,367
030102030205	Cole Creek-Sarem Creek	2,317	892
030102030301	Town of Aulander-Upper Ahoskie Creek	81,630	30,619
030102030306	Lower Ahoskie Creek	18,449	6,918
030102030404	Chinkapin Creek	11,854	4,610
030102030501	Duke Swamp	14,583	5,671
030102030504	Bennetts Creek	15,492	6,025
030102030601	Trotman Creek	2,403	934
030102030602	Warwick Creek-Catherine Creek	3,671	1,428
030102030603	Holiday Island-Chowan River	5,927	2,305
030102030604	Dillard Millpond-Indian Creek	11,805	4,587
030102030605	Town of Colerain-Chowan River	8,890	3,457
030102030702	Bennett Millpond-Rockyhock Creek	3,337	1,298
030102040704	Beaverpond Creek	155,492	60,368
030102040705	Jacks Swamp	18,449	6,918
030102040801	Wildcat Swamp	8,343	3,245
030102040802	Headwaters Potecasi Creek	6,341	2,466
030102040803	Headwaters Urahaw Swamp	46,314	17,592
030102040804	Outlet Urahaw Swamp	30,716	11,945
030102040805	Upper Potecasi Creek	16,726	6,505
030102040806	Cutawhiskie Creek	25,153	9,432
030102040807	Middle Potecasi Creek	60,660	22,747
030102040901	Cypress Creek	54,266	20,754

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030102040907	Kirbys Creek	11,116	4,168
Pasquotank (Albemarle) Basin			
030102050101	Pembroke Creek	20,744	8,067
030102050103	Headwaters Kendrick Creek	7,544	2,934
030102050104	Outlet Kendrick Creek	205,497	79,796
030102050203	Moccasin Canal-Scuppernong River	45,730	17,784
030102050204	Old Canal-Scuppernong River	77,977	29,478
030102050301	Great Dismal Swamp-Headwaters Perquimmans River	1,869	727
030102050302	Goodwin Creek	19,396	7,543
030102050303	Town of Hertford-Upper Perquimmans River	6,007	2,336
030102050305	Lower Perquimmans River	9,430	3,667
030102050402	Bethel Creek	3,489	1,338
030102050701	Folly Swamp	2,536	986
030102050707	Newbegun Creek	3,844	1,441
Tar-Pamlico Basin			
030201010501	Peachtree Creek-Boddies Millpond	65,460	25,320
030201010502	Pig Basket Creek	19,751	7,243
030201010602	Turkey Creek	24,028	9,344
030201010603	Biddie Toe Creek-Tar River	2,613	1,016
030201010604	Upper Sapony Creek	10,070	3,776
030201010605	Lower Sapony Creek	9,701	3,773
030201010606	Tar River Reservoir	7,208	2,803
030201010704	Red Bud Creek	516	166
030201010705	Middle Sandy Creek	50,925	19,804
030201010706	Lower Sandy Creek	2,613	1,016
030201010801	Flat Rock Branch-Swift Creek	21,656	8,225
030201010802	White Oak Swamp	55,125	21,170
030201010803	Moccasin Creek-Swift Creek	26,909	10,358
030201010903	Buck Swamp-Tar River	56,915	22,134
030201020203	Upper Little Fishing Creek	22,632	8,802
030201020304	Crooked Swamp-Fishing Creek	34,143	13,278
030201020405	Cow Haul Swamp-Beech Swamp	55,928	21,235
030201020501	Beaverdam Swamp	51,204	19,690
030201020504	Town of Bricks-Fishing Creek	12,815	4,984
030201020601	Maple Swamp	28,833	11,213
030201020602	Town of Dawson Crossroads	13,349	5,191
030201020604	Middle Deep Creek	25,630	9,967
030201020605	Lower Deep Creek	62,528	23,448
030201020606	Outlet Fishing Creek	66,718	25,946
030201030103	Headwaters Cokey Swamp	24,946	9,701
030201030104	Outlet Cokey Swamp	9,237	3,592
030201030105	Middle Town Creek	31,281	12,165
030201030107	Lower Town Creek	21,816	8,304
030201030203	Otter Creek	56,889	21,660
030201030301	Upper Conetoe Creek	20,702	7,763
030201030302	Crisp Creek	16,527	6,198
030201030303	Fountain Fork Creek-Middle Conetoe Creek	56,219	21,400

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030201030304	Mitchell Swamp	550	214
030201030305	Lower Conetoe Creek	6,407	2,492
030201030402	Johnsons Mill Run	38,445	14,951
030201030501	Collie Swamp	6,390	2,485
030201030503	Sheppard Millpond-Briery Swamp	18,449	6,918
030201030601	Headwaters Grindle Creek	46,357	17,873
030201030603	Headwaters Chicod Creek	185,618	71,413
030201030604	Outlet Chicod Creek	106,686	41,009
030201040102	Chocowinity Creek	31,979	11,992
030201040106	Headwaters Blounts Creek	33,362	12,511
030201040303	Intercepting Canal-Cuckolds Creek	73,779	28,360
030201040305	Pantego Creek	66,522	25,166
030201040402	Shallop Creek-Pungo River	62,621	20,200
030201040403	Pungo Lake Canal-Pungo River	13,381	5,060
030201040602	Pungo Swamp-Pungo Creek	10,063	3,773
Neuse Basin			
030202010101	North Flat River	710	274
030202010102	South Flat River	22,076	8,556
030202010103	Deep Creek	11,883	4,621
030202010303	Stony Creek-Eno River	881	284
030202010903	Lower Middle Creek	7,830	3,045
030202011002	Lake Benson-Swift Creek	9,921	3,858
030202011005	Little Creek	1,115	433
030202011104	Mill Creek-Neuse River	7,645	2,973
030202011105	Buffalo Creek-Neuse River	35,354	13,611
030202011202	Camp Branch-Black Creek	8,911	3,466
030202011203	Holts Lake-Black Creek	48,601	18,900
030202011301	Upper Hannah Creek	13,113	5,100
030202011302	Lower Hannah Creek	46,988	18,273
030202011303	Upper Mill Creek	80,431	31,065
030202011304	Stone Creek	61,804	24,035
030202011305	Middle Mill Creek	107,831	41,548
030202011306	Lower Mill Creek	127,278	49,283
030202011401	Brooks Swamp	206,073	80,140
030202011402	Thunder Swamp-Thoroughfare Swamp	166,800	64,738
030202011403	Upper Falling Creek	257,039	99,960
030202011404	Lower Falling Creek	215,734	83,320
030202011503	Cattail Creek-Little River	70,756	26,897
030202011602	Little Creek-Little River	19,222	7,475
030202011603	Dennis Branch-Little River	49,554	19,271
030202011604	Buck Swamp-Little River	11,942	4,644
030202011701	Bawdy Creek	20,824	8,098
030202011702	Polecat Branch-Neuse River	3,504	1,363
030202011703	Moccasin Creek	9,611	3,738
030202011704	Charles Branch-Beaverdam Creek	39,833	15,491
030202011705	Quaker Neck Lake-Neuse River	29,969	11,574
030202020103	Seymour Johnson Air Force Base-Neuse River	22,523	8,759

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030202020104	Sleepy Creek	93,171	35,070
030202020105	Sleepy Creek-Neuse River	37,437	14,287
030202020106	Lake Wakena-Walnut Creek	8,303	3,165
030202020107	Walnut Creek-Neuse River	136,292	53,003
030202020201	West Bear Creek	96,111	37,377
030202020202	Headwaters Bear Creek	94,647	36,807
030202020203	Outlet Bear Creek	53,342	20,744
030202020204	Hardy Mill Run-Neuse River	132,845	51,662
030202020205	Falling Creek	26,925	10,471
030202020206	City of Kinston-Neuse River	28,011	10,786
030202020301	Headwaters Southwest Creek	169,153	65,492
030202020302	Outlet Southwest Creek	24,508	9,531
030202020306	Mosley Creek	72,247	28,009
030202020307	Mosley Creek-Neuse River	13,696	5,326
030202020401	Headwaters Swift Creek	28,032	10,902
030202020402	Fork Swamp-Swift Creek	12,815	4,984
030202020403	Creeping Swamp	45,508	17,270
030202020404	Clayroot Swamp	117,005	45,425
030202020405	Clayroot Swamp-Swift Creek	59,969	23,321
030202020501	Palmetto Swamp	43,841	16,490
030202020502	Mauls Swamp	3,576	1,390
030202020503	Town of Vanceboro-Swift Creek	30,517	11,494
030202020504	Headwaters Little Swift Creek	10,474	3,996
030202020506	Swift Creek	6,807	2,647
030202020601	Headwaters Core Creek	10,492	4,080
030202020602	Outlet Core Creek	25,193	9,797
030202020603	Halfmoon Creek-Neuse River	50,834	19,513
030202020604	Pinetree Creek-Neuse River	17,617	6,851
030202020606	Outlet Bachelor Creek	4,218	1,640
030202030101	Upper Moccasin Creek	15,924	6,193
030202030102	Lower Moccasin Creek	32,500	12,639
030202030103	Upper Turkey Creek	3,705	1,389
030202030201	Great Swamp	5,982	2,326
030202030202	Aycock Swamp	37,237	14,054
030202030302	Whiteoak Swamp	10,839	4,215
030202030401	Little Swamp-Contentnea Creek	41,192	15,806
030202030405	Turner Swamp-Contentnea Creek	25,830	10,045
030202030502	The Slough	35,409	13,309
030202030503	Upper Nahunta Swamp	137,574	52,054
030202030504	Middle Nahunta Swamp	68,346	26,579
030202030505	Lower Nahunta Swamp	57,932	22,529
030202030601	Jacobs Branch	14,786	5,750
030202030602	Upper Little Contentnea Creek	55,722	21,392
030202030603	Middle Swamp	316,907	122,832
030202030604	Middle Little Contentnea Creek	11,531	4,324
030202030605	Lower Little Contentnea Creek	134,894	52,176
030202030701	Beaman Run-Contentnea Creek	135,823	52,457

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030202030702	Tyson Marsh-Contentnea Creek	270,650	104,778
030202030703	Rainbow Creek-Contentnea Creek	93,924	36,526
030202030704	Wheat Swamp Creek	52,345	20,125
030202030705	Polecat Branch-Contentnea Creek	184,539	71,068
030202030706	Eagle Swamp-Contentnea Creek	24,508	9,531
030202040101	Headwaters Trent River	178,730	68,962
030202040102	Headwaters Tuckahoe Swamp	123,453	48,010
030202040103	Outlet Tuckahoe Swamp	135,459	52,171
030202040104	Joshua Creek-Trent River	224,877	86,357
030202040105	Town of Comfort-Trent River	159,975	61,366
030202040201	Chinquapin Branch	5,281	2,054
030202040202	Rattlesnake Branch-Beaver Creek	29,496	11,471
030202040203	Health Mill Run-Beaver Creek	47,817	18,339
030202040204	Town of Trenton-Trent River	145,651	55,514
030202040205	Beaverdam Creek-Trent River	47,375	18,424
030202040206	Town of Pollocksville-Trent River	105,112	40,663
030202040302	Island Creek-Trent River	30,180	11,317
030202040402	Headwaters Upper Broad Creek	12,535	4,875
White Oak (Onslow Bay) Basin			
030203010101	Headwaters White Oak River	11,425	4,315
030203010102	Town of Maysville-White Oak River	1,719	669
030203010104	Starkys Creek	26,134	10,163
030203010202	Hunters Creek	19,225	7,263
030203010203	Mulberry Creek-White Oak River	14,010	5,448
030203020101	Town of Richlands-Squires Run	79,022	30,731
030203020102	Headwaters New River	217,518	84,270
030203020103	Cowhorn Swamp-New River	17,620	6,852
030203020104	Blue Creek-New River	42,617	16,445
030203020201	Wolf Swamp-Northeast Creek	2,640	1,027
030203020204	Headwaters Southwest Creek	21,625	8,410
030203020205	Outlet Southwest Creek	29,528	11,483
Cape Fear River Basin			
030300020104	South Buffalo Creek	3,475	1,351
030300020206	Giles Creek-Haw River	8,763	3,286
030300020207	Town of Altamahaw-Haw River	2,306	865
030300020302	Upper Little Alamance Creek	13,683	5,321
030300020306	South Prong Stinking Quarter Creek	8,344	3,245
030300020505	Lower Cane Creek	2,002	779
030300030201	Upper Sandy Creek	9,225	3,459
030300030203	Millstone Creek-Deep River	17,197	6,688
030300030207	Lower Brush Creek	15,485	6,022
030300030208	Flat Creek-Deep River	51,059	19,856
030300030302	Parkwood Branch-Richland Creek	11,462	4,457
030300030401	Fork Creek	26,781	10,415
030300030403	Lower Cabin Creek	76,803	29,519
030300030404	Upper Bear Creek	3,337	1,298
030300030406	Grassy Creek-Deep River	22,468	8,738

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030300030408	Tysons Creek-Deep River	6,196	2,323
030300030504	Tick Creek-Rocky River	14,684	5,710
030300040106	Avents Creek-Cape Fear River	8,009	3,115
030300040205	Walkers Creek-Upper Little River	97,996	37,853
030300040306	Middle Crane Creek	2,442	950
030300040307	Lower Crane Creek	30,579	11,892
030300040401	Buffalo Creek	44,880	17,197
030300040407	Anderson Creek	19,623	7,631
030300040502	Hector Creek-Cape Fear River	12,405	4,694
030300040604	Upper Rockfish Creek	2,442	950
030300040607	Middle Rockfish Creek	2,442	950
030300040701	Town of Wade-Cape Fear River	16,480	6,238
030300050101	Cedar Creek-Cape Fear River	5,253	2,043
030300050102	Willis Creek-Cape Fear River	47,685	18,006
030300050103	Harrison Creek	36,285	13,748
030300050104	Phillips Creek-Cape Fear River	110,318	41,469
030300050201	Ellis Creek	128,445	49,428
030300050202	Browns Creek	36,309	14,120
030300050203	Upper Turnbull Creek	105,609	40,515
030300050204	Middle Turnbull Creek	50,010	19,448
030300050205	Lower Turnbull Creek	21,141	8,222
030300050206	White Lake-Cape Fear River	3,576	1,390
030300050401	Hammond Creek	219,625	85,217
030300050402	Frenchs Creek-Cape Fear River	113,520	43,100
030300050403	Carvers Creek	4,205	1,635
030300050404	Weyman Creek	9,811	3,816
030300050405	Mitchell Landing-Cape Fear River	9,811	3,816
030300050602	Bell Swamp-Rice Creek	121,975	47,125
030300060101	Upper Black River	18,898	7,349
030300060103	Upper Mingo Swamp	3,294	1,281
030300060104	Lower Mingo Swamp	93,668	36,213
030300060105	Williamson Swamp-South River	101,998	39,666
030300060107	Jones Swamp-South River	79,572	30,945
030300060202	Big Swamp	292,290	112,701
030300060203	Gum Swamp-South River	42,686	16,173
030300060204	Beaver Dam Creek	86,347	32,990
030300060205	Cypress Creek	305,765	118,513
030300060206	Peters Creek-South River	239,820	91,535
030300060207	Smith Mill Pond Run-South River	85,725	32,640
030300060208	Lake Creek-South River	349,115	132,543
030300060301	Caesar Swamp-Little Coharie Creek	206,336	80,087
030300060302	Mill Swamp-Little Coharie Creek	56,312	21,899
030300060303	Bearskin Swamp	207,143	80,556
030300060304	Rye Swamp-Little Coharie Creek	58,079	22,386
030300060305	Rattlesnake Branch-Little Coharie Creek	261,482	99,512
030300060401	House Pond-Sevenmile Swamp	124,236	47,742
030300060402	Headwaters Great Coharie Creek	107,911	41,353

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030300060403	Ward Swamp	113,021	43,953
030300060404	Marsh Swamp-Great Coharie Creek	534,386	207,390
030300060405	White Oak Swamp-Great Coharie Creek	141,555	54,793
030300060406	Williams Old Mill Branch-Great Coharie Creek	83,033	32,133
030300060407	Mill Creek-Great Coharie Creek	205,661	79,294
030300060408	Turtle Branch-Great Coharie Creek	91,325	34,637
030300060501	Headwaters Six Runs Creek	328,650	127,744
030300060502	Mill Swamp-Six Runs Creek	346,352	134,273
030300060503	Tenmile Swamp-Six Runs Creek	122,098	47,271
030300060504	Turkey Creek-Six Runs Creek	230,634	89,691
030300060505	Upper Stewarts Creek	279,146	108,172
030300060506	Lower Stewarts Creek	728,879	281,766
030300060507	Rowan Branch-Six Runs Creek	158,309	61,484
030300060508	Crane Creek	335,081	130,309
030300060509	Quewhiffle Creek-Six Runs Creek	374,581	143,848
030300060510	Tarkill Branch-Six Runs Creek	81,866	31,753
030300060601	Upper Colly Creek	28,962	11,263
030300060701	White Oak Branch	93,927	35,374
030300060702	Upper Moores Creek	101,640	38,523
030300060703	Middle Moores Creek	17,617	6,851
030300060704	Lower Moores Creek	8,169	3,177
030300060801	Clear Run-Black River	142,638	54,627
030300060802	Canty Mill Creek-Black River	185,683	71,247
030300060803	Kings Branch-Black River	159,442	61,112
030300060804	Colvins Creek	32,509	12,642
030300070101	Upper Goshen Swamp	280,248	107,576
030300070102	Bear Swamp	200,157	77,839
030300070103	Nahunga Creek	324,617	123,814
030300070104	Middle Goshen Swamp	740,620	285,427
030300070105	Lower Goshen Swamp	426,365	165,210
030300070201	Lewis Branch-Northeast Cape Fear River	58,141	22,397
030300070202	Buck Marsh Branch	97,980	37,979
030300070203	Polly Run Creek-Northeast Cape Fear River	190,036	73,574
030300070204	Mathews Creek-Northeast Cape Fear River	401,030	155,956
030300070205	Burn Coat Creek-Northeast Cape Fear River	319,148	122,832
030300070206	Dark Branch-Northeast Cape Fear River	199,783	76,707
030300070301	Grove Creek	219,776	85,197
030300070302	Upper Limestone Creek	85,882	33,319
030300070303	Lower Limestone Creek	153,315	59,622
030300070304	Headwaters Maxwell Creek	165,459	64,345
030300070305	Maxwell Creek-Stocking Head Creek	613,539	238,129
030300070306	Muddy Creek	339,905	132,185
030300070307	Persimmon Branch-Northeast Cape Fear River	228,600	88,900
030300070401	Ninemile Creek	57,479	22,161
030300070402	Back Swamp	128,400	49,933
030300070403	Cypress Creek	196,426	76,238
030300070404	Island Creek	80,033	31,124

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030300070405	Oakie Branch-Northeast Cape Fear River	51,962	20,208
030300070501	Duff Creek	89,847	34,940
030300070502	Upper Doctors Creek	139,165	54,120
030300070503	Lower Doctors Creek	236,741	91,425
030300070504	Upper Rockfish Creek	710,333	275,133
030300070505	Sills Creek	144,977	55,590
030300070506	Lower Rockfish Creek	57,970	22,133
030300070601	Angola Swamp	99,113	38,544
030300070602	Headwaters Sandy Run Swamp	64,520	24,718
030300070604	Upper Holly Shelter Creek	28,593	11,120
030300070605	Angola Creek	199,218	77,474
030300070606	Upper Shaken Creek	5,765	2,162
030300070609	Lower Holly Shelter Creek	5,757	2,239
030300070611	Lewis Creek-Northeast Cape Fear River	33,588	12,929
030300070701	Bee Branch-Cypress Creek	52,322	20,241
030300070702	Upper Long Creek	51,713	20,111
030300070703	Rileys Creek	42,126	16,382
030300070704	Middle Long Creek	16,162	6,285
030300070801	Burgaw Creek	58,782	22,486
030300070802	Pike Creek-Northeast Cape Fear River	8,169	3,177
030300070804	Harrisons Creek	28,593	11,120
Yadkin-Pee Dee Basin			
030401010503	Snow Creek	18,449	6,918
030401010702	Upper Fisher River	5,281	2,054
030401011002	Hogan Creek-Yadkin River	25,530	9,928
030401011102	North Deep Creek	57,667	22,426
030401030302	Crane Creek-High Rock Lake	21,934	8,530
030401030404	Caraway Creek	6,341	2,466
030401030502	Hannahs Creek-Uwharrie River	2,626	1,021
030401040105	Lower Brown Creek	7,261	2,824
030401040302	West Fork Little River	4,885	1,900
030401040402	Big Town Creek-Little River	5,982	2,326
030401040502	Dry Creek-Pee Dee River	2,442	950
030401040504	Little Mountain Creek	37,372	14,405
030401040505	Mountain Creek	38,178	14,847
030401050304	Lower Dutch Buffalo Creek	15,374	5,765
030401050405	Lower Big Bear Creek	9,193	3,575
030401050507	Lower Richardson Creek	291	94
030401050601	Upper Lanes Creek	73,965	28,764
030401050707	Hardy Creek-Rocky River	41,149	15,618
030401050708	Camp Branch-Rocky River	2,442	950
030402010101	Rocky Fork Creek	1,085	422
030402010102	Upper Hitchcock Creek	62,458	24,044
030402010201	North Fork Jones Creek	4,885	1,900
030402010202	South Fork Jones Creek	29,341	11,175
030402010401	Deadfall Creek	21,986	8,285
030402010402	Headwaters Thompson Creek	16,912	6,342

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030402010506	Crooked Creek-Lake Wallace	14,417	5,606
Lumber (Waccamaw-Pee Dee) Basin			
030402030103	Naked Creek	4,885	1,900
030402030104	Big Branch-Upper Drowning Creek	29,367	11,421
030402030206	Lower Drowning Creek	47,821	18,333
030402030302	Gum Swamp	161,734	62,221
030402030303	Town of Maxton-Lumber River	29,367	11,421
030402030501	Upper Raft Swamp	16,686	6,489
030402030502	Little Raft Swamp	60,233	22,655
030402030503	Richland Swamp	34,942	13,169
030402030504	Middle Raft Swamp	34,714	13,081
030402030602	Lower Little Marsh Swamp	32,031	12,456
030402030603	Upper Big Marsh Swamp	30,196	11,487
030402030605	Gallberry Swamp	64,657	24,246
030402030701	Upper Tenmile Swamp	53,395	20,765
030402030702	Lower Tenmile Swamp	48,389	18,818
030402030703	Goodman Swamp	70,184	26,812
030402030705	Lewis Mill Branch-Big Swamp	75,149	28,592
030402030801	Crawley Swamp	101,400	39,353
030402030802	Jackson Swamp-Big Swamp	124,495	48,158
030402030901	Bryant Swamp	115,007	44,725
030402030903	Horsepen Branch	52,861	20,557
030402030904	Brier Creek-Big Swamp	13,928	5,416
030402031004	Tenmile Branch-Mill Swamp	9,811	3,816
030402031101	Dunn Swamp	49,858	19,389
030402031103	Lower Porter Swamp	96,507	37,531
030402031201	Horse Swamp	79,292	30,836
030402031202	Headwaters Ashpole Swamp	93,937	36,029
030402031205	Mill Branch-Ashpole Swamp	57,699	22,311
030402031206	Indian Swamp	29,367	11,421
030402031207	Coward Swamp-Ashpole Swamp	63,373	24,645
030402031302	Cowpen Swamp-Bear Swamp	9,123	3,548
030402031401	Headwaters Gapway Swamp	60,094	23,370
030402040103	Joes Creek	19,979	7,513
030402040104	Middle Gum Swamp Creek	9,225	3,459
030402040105	Lower Gum Swamp Creek	17,620	6,852
030402040201	Headwaters Leith Creek	2,420	941
030402040203	Leith Creek	112,461	43,059
030402040302	Juniper Creek	85,535	32,076
030402040303	Headwaters Shoe Heel Creek	90,617	34,984
030402040304	Wilkinson Creek	66,120	24,945
030402040305	Maxton Pond-Shoe Heel Creek	335,885	129,946
030402040503	Hayes Swamp	22,746	8,846
030402060101	Whites Creek	35,910	13,965
030402060102	Brown Marsh Swamp	137,944	52,977
030402060103	Elkton Swamp	292,975	111,910
030402060104	Western Prong Red Hill Swamp	174,374	66,744

Hydrologic Unit Code	Subwatershed Name	Total Nitrogen	Phosphorous as P_2O_5
030402060105	Slades Swamp-Red Hill Swamp	62,860	24,163
030402060202	Lower Soules Swamp	19,623	7,631
030402060203	Town of Whiteville-White Marsh	28,847	11,090
030402060303	Green Swamp-Big Creek	98,815	38,428
030402060305	Bogue Swamp	18,860	7,335
030402060403	Upper Juniper Creek	35,149	13,242
030402060404	Alligator Swamp	4,401	1,711
030402060405	Lower Juniper Creek	20,903	8,129
030402060501	Gum Swamp	7,833	3,046
030402060502	Headwaters Monie Swamp	69,547	27,046
030402060503	Toms Fork	9,225	3,459
030402060505	Monie Swamp-Grissett Swamp	66,533	25,500
030402060506	Grissett Swamp-Seven Creeks	16,339	6,354
030402060601	Horse Pen Swamp-Waccamaw River	19,222	7,475
030402060602	Gore Lake-Gore Creek	30,749	11,531
030402060703	Buck Creek	24,508	9,531
030402080102	Headwaters Lockwoods Folly River	24,769	9,632
030402080201	Upper Shallotte River	4,997	1,874
030501010901	Upper Little River	9,807	3,814

Table A-2: County Results in Pounds Applied Annually

County Name	Total Nitrogen	Phosphorous as P_2O_5
Alamance	4,308	1,643
Anson	124,266	47,188
Beaufort	303,498	115,134
Bertie	145,334	55,376
Bladen	2,400,336	922,602
Brunswick	215,397	82,960
Cabarrus	15,374	5,765

County Name	Total Nitrogen	Phosphorous as P_2O_5
Caldwell	9,807	3,814
Chatham	31,036	12,070
Chowan	39,557	15,379
Columbus	833,501	322,158
Craven	267,990	102,685
Cumberland	260,516	99,816
Davidson	2,626	1,021
Duplin	7,000,941	2,710,827
Edgecombe	501,744	192,827
Franklin	86,676	33,707
Gates	73,059	27,889
Granville	4,192	1,630
Greene	1,309,162	506,523
Guilford	25,501	9,917
Halifax	195,014	75,044
Harnett	237,803	91,836
Hertford	130,932	49,470
Hoke	240,279	92,409
Hyde	65,624	21,368
Johnston	623,002	240,431
Jones	906,019	348,209
Lee	2,442	950
Lenoir	934,730	362,309
Martin	11,989	4,662
Montgomery	15,752	6,126
Moore	116,929	45,037
Nash	222,961	85,381
Northampton	411,248	157,873
Onslow	619,566	239,848
Orange	14,230	5,476
Pamlico	4,005	1,557
Pasquotank	6,380	2,428
Pender	915,581	351,661
Perquimans	40,191	15,611
Person	31,127	12,074
Pitt	738,975	284,888
Randolph	113,072	43,844
Richmond	189,352	73,006
Robeson	1,131,368	434,977
Rockingham	24,033	9,096
Rowan	21,934	8,530
Sampson	6,232,513	2,405,245
Scotland	371,010	142,290
Stanly	9,193	3,575
Stokes	11,120	4,324
Surry	49,260	18,900
Tyrrell	77,977	29,478

County Name	Total Nitrogen	Phosphorous as P_2O_5
Union	73,965	28,764
Wake	9,921	3,858
Warren	144,403	56,077
Washington	258,771	100,514
Wayne	1,848,998	713,885
Wilson	97,664	37,767
Yadkin	57,667	22,426