Compilation of Phosphorous and Plant Available Nitrogen Applied to the Land through Permits for Land Application of Residual Solids in 2010

North Carolina Division of Water Quality
Aquifer Protection Section – Groundwater Planning Unit
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Introduction

Land application of wastewater residual solids to fertilize crops and dispose of treated sewage sludge is a common practice in North Carolina, as well as other states. In recent years, questions have been raised about whether or not residuals application could be contributing to nutrient loading to streams or impacting the quality of nearby groundwater supplies (e.g., DWQ, 2009, 2010). To begin the process of answering these complex questions, it is necessary to know the quantity of nutrients and where wastewater residuals are being applied to the land.

The North Carolina Department of Environment and Natural Resources (DENR) Division of Water Quality (DWQ) issues permits for the land application of treated wastewater residual solids, also known as biosolids. Residual solids can be applied to either dedicated or non-dedicated fields. To be considered a dedicated field, at least one of the following criteria must be met; 1) bulk residuals are applied to the land at greater than agronomic rates, 2) bulk residuals are applied through fixed irrigation facilities or irrigation facilities fed through a fixed supply system or 3) where the primary use of the land to which the residuals are applied, is for the disposal of bulk residuals, and agricultural crop production is of secondary importance.

There are four permit types issued by the DWQ related to wastewater residual solids:

- Land Application of Residual Solids, for application of residuals to dedicated fields;
- Distribution of Residuals Solids, for application of residuals to non-dedicated fields or sale of residuals to the public as fertilizer;
- Surface Disposal of Residual Solids, for placement of residuals in a monofill;
- Distribution of Animal Residual Solids, for the sale of residuals from livestock operations to the public as fertilizer

Land Application of Residual Solids (LARS) permit holders are required to submit an annual report to the DWQ that include details on which permitted fields received residuals and how much phosphorous and plant available nitrogen (PAN) were applied. These reports create a ready source of information for determining potential nutrient loads from these permits on a watershed or county basis. Distribution permits do not require reporting on the application location and nutrient concentration of the residuals, so this report focuses only on nutrient loading from Land Application of Residual Solids permits.

In addition to nutrients, wastewater residuals may also contain metals, pharmaceuticals, and other constituents of potential concern that may be present in the waste stream. This study focuses solely on phosphorous and PAN application from Land Application of Residual Solids permits.

Objective

The objective of this project was to determine the spatial distribution of the phosphorous and PAN applied to fields from Land Application of Residual Solids permits in order to make comparisons to other sources of nutrients. Since the location of application fields and the constituents of the residuals vary from year to year the scope of the project was to examine loading during a single year. The primary purpose of this estimate is to compare the relative magnitude of nutrients from residuals application to other known quantities of nutrients applied to the land or discharged to surface waters. This project may also be used as a guide to select potential areas for future research on ground/surface water interactions.

This project was not intended to determine if land application of residuals 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 residuals application rates are limited to the agronomic rate of the cover crop, then the majority of the nutrients should, in theory, be taken up by the vegetation before reaching groundwater or surface waters.

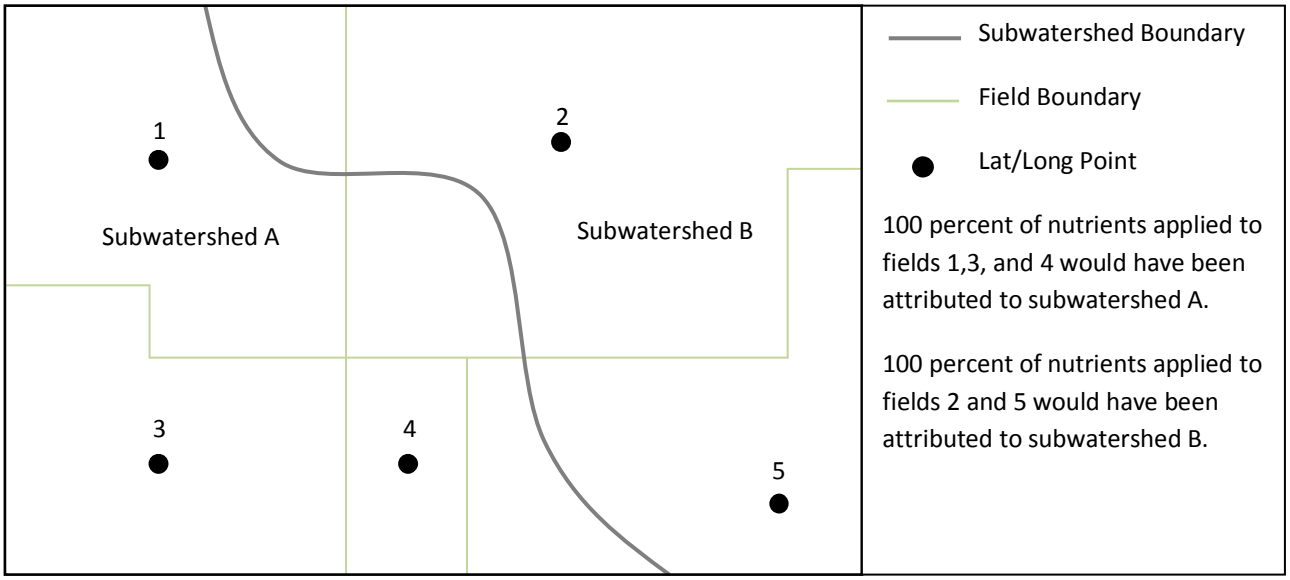
Data Sources and Methodology

As a requirement of the Land Application of Residual Solids permit, the applicator must submit an annual report to the DWQ. These annual reports contain details nutrient levels of the residuals, where they were applied, and how much was applied. The DWQ's Basinwide Information Management System (BIMS) database contains latitude and longitude coordinates for all approved application fields for currently active permits. While a polygon corresponding to the actual shape of each field would have been ideal, only a single point for each field was available.

A GIS shapefile with a point for each field was created and attributed with the field acreage, pounds per acre of phosphorous, and pounds per acre of PAN applied in 2010 according to the annual reports received by the DWQ. This information was used to calculate the amount of both phosphorous and PAN being applied to each field. Next, the ArcGIS intersect tool was used to attribute each field to its corresponding 12-digit subwatershed from the Natural Resource Conservation Service's Watershed Boundary Dataset. Since no polygon data was available, each field was assigned to a subwatershed as though it were completely within that subwatershed. Figure 1 provides an example of how nutrient data associated with a point was attributed to the subwatershed and county polygons.

Once assigned to a subwatershed, the phosphorous and PAN data were summarized by 12-digit subwatershed, 8-digit subbasin, and basin. The basin summarization was then normalized based on the area of the basin. The intersect tool was also used to attribute each field to a county so that they could then be summarized to achieve a county estimate.

Figure 1. Method for Assignment of Fields to Watersheds



Results

Statewide Level

There were 125 LARS permit holders that reported the application of residuals in 2010 out of a total of 193 permits that were active during the year. These residuals were spread over about 26,556 acres. Approximately 2,455,228 pounds of phosphorous and 1,963,873 pounds of PAN were applied averaging out to about 92 pounds of phosphorous per acre and 74 pounds of PAN per acre. However, there was a great amount of variability among the amounts from field to field. The range of concentrations on a single field was from less than one pound/acre to over 1,481 pounds per acre of phosphorous and over 367 pounds per acre of PAN.

Subwatershed Level

North Carolina contains all or a portion of 1,774 subwatersheds. Residuals were applied under LARS permits in 286 of those subwatersheds in 2010, or about 16 percent of them. The mean phosphorous applied for subwatersheds with application was 8,489 pounds and the median was 3,483 pounds. Amounts of phosphorous applied ranged from approximately 2 to 101,319 pounds per subwatershed. PAN levels were lower than phosphorous levels with an average of 6,791 pounds and a median of 3,237 pounds. However, the variability of PAN application was greater with a range from approximately 0.2 pounds to 127,005 pounds. Figures 2 and 3 depict the amount of phosphorous and PAN applied at the subwatershed level. The complete results are listed in Table 1 at the end of this report.

Subbasin Level

Residuals were applied under LARS permits in 38 out of the state's 56 subbasins or about 68 percent. The mean phosphorous applied was 63,890 pounds and the median was 41,111 pounds with a minimum of 1,027 and a maximum of 226,829. The mean PAN applied was 51,108 pounds and the median was 43,390 pounds with a minimum of 301 pounds and a maximum of 242,585 pounds. Figures 4 and 5 show the amount of phosphorous and PAN applied by subbasin level. The complete results are listed in Table 2 at the end of this report.

Basin Level

Five basins did not have any residuals application under LARS permits in 2007, including the Chowan, Hiwassee, Little Tennessee, Savannah, and Watauga. Of the remaining twelve basins, the Cape Fear River basin had the highest amount of phosphorous applied at 657,737 and the highest amount of PAN applied at 522,868 pounds. Since some basins are smaller and others are larger the basin results were normalized to take size into account. When normalized based on size, the Neuse River basin had the greatest concentration of phosphorous with 73.0 pounds square mile of phosphorous and the Yadkin – Pee Dee River basin had the highest level of PAN with 68.3 pounds per square mile, if spread out over the entire basin. Figures 6 and 7 illustrate the amount of phosphorous and PAN applied by basin. The complete results are listed in Table 3 at the end of this report.

County Level

Sixty-eight counties in the state had at least one application occurrence in 2010. Union County had the highest amount of nutrients applied with 260,462 pounds of phosphorous and 264,759 pounds of PAN. Orange, Gaston, and Cumberland Counties had the next highest amounts of residuals application. Figure 8 and 9 show nutrients applied by county. The complete results are listed in Table 4 at the end of this report.

Figure 2. Map of Phosphorous from Land Application of Residual Solids Permits by Subwatershed

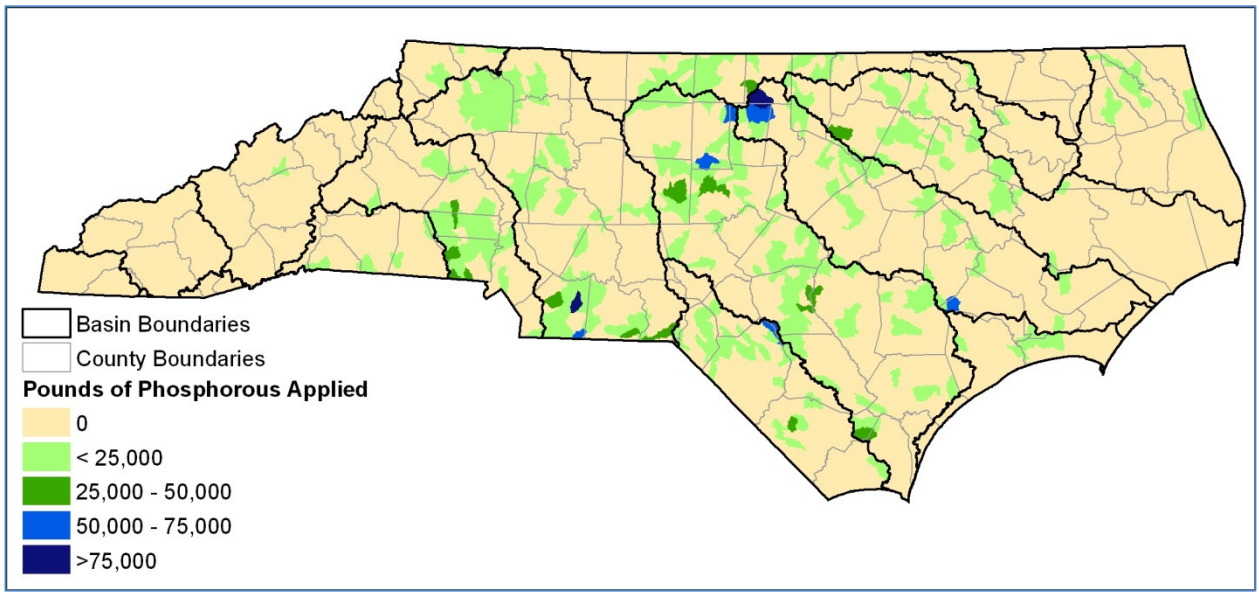


Figure 3. Map of PAN from Land Application of Residual Solids Permits by Subwatershed

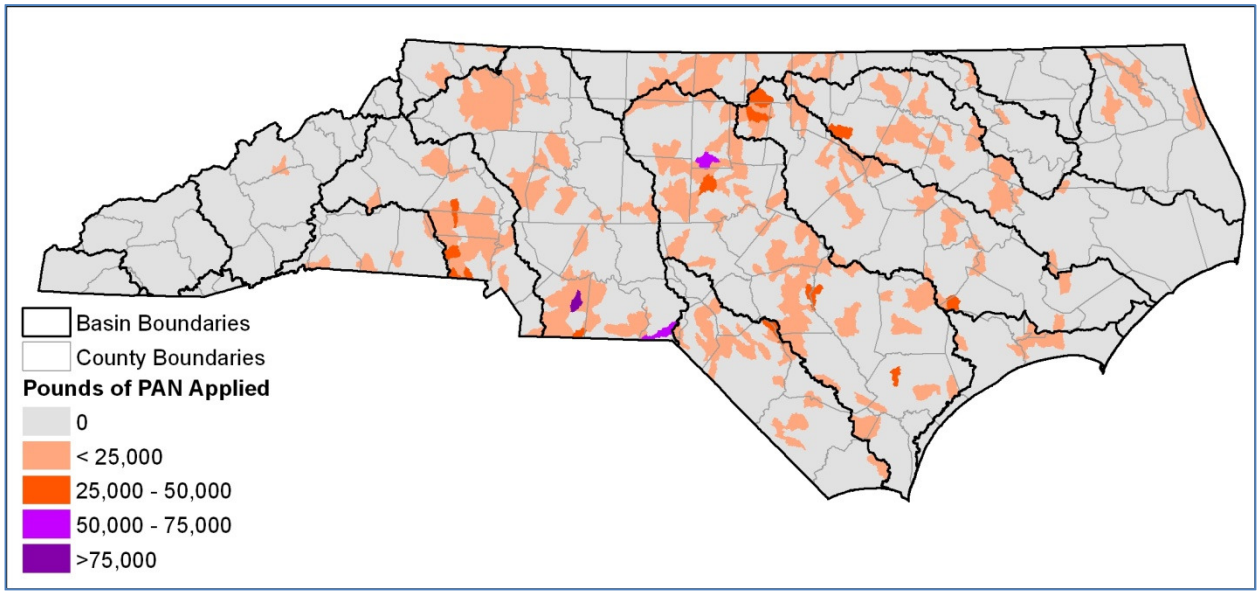


Figure 4. Map of Phosphorous from Land Application of Residual Solids Permits by Subbasin

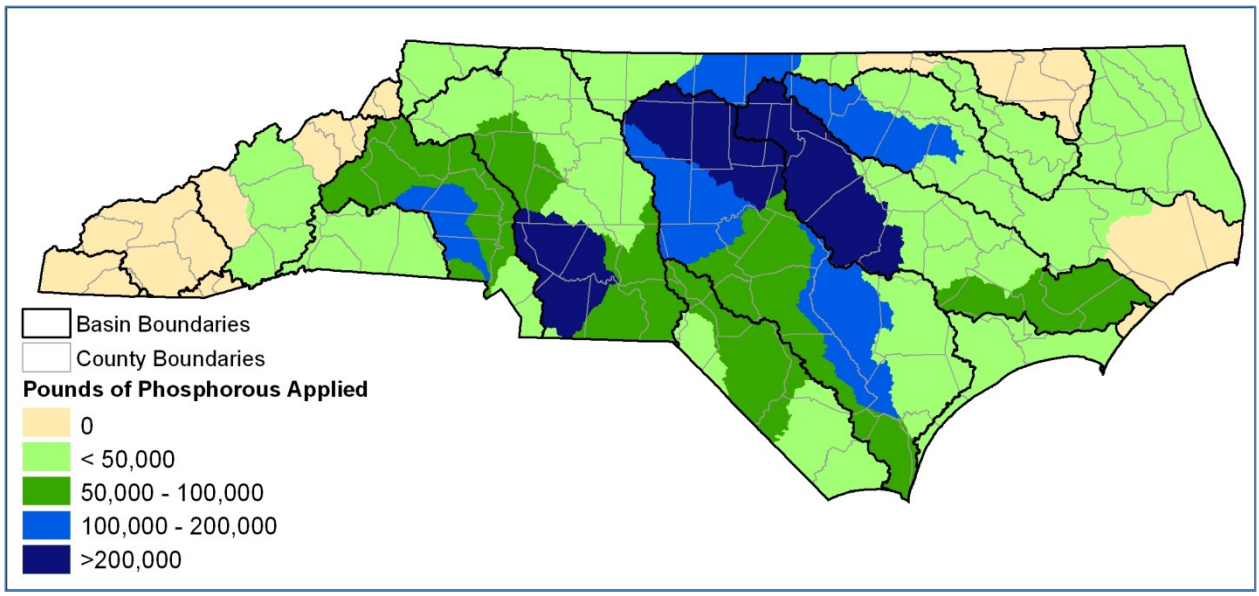


Figure 5. Map of PAN from Land Application of Residual Solids Permits by Subbasin

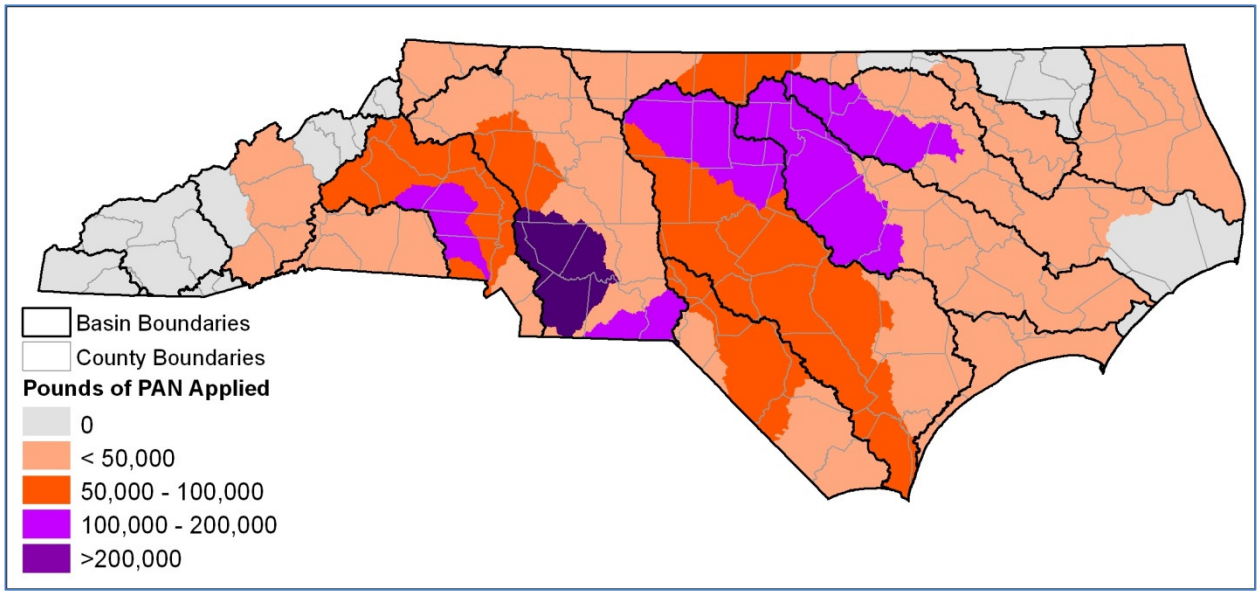


Figure 6. Map of Phosphorous from Land Application of Residual Solids Permits by Basin

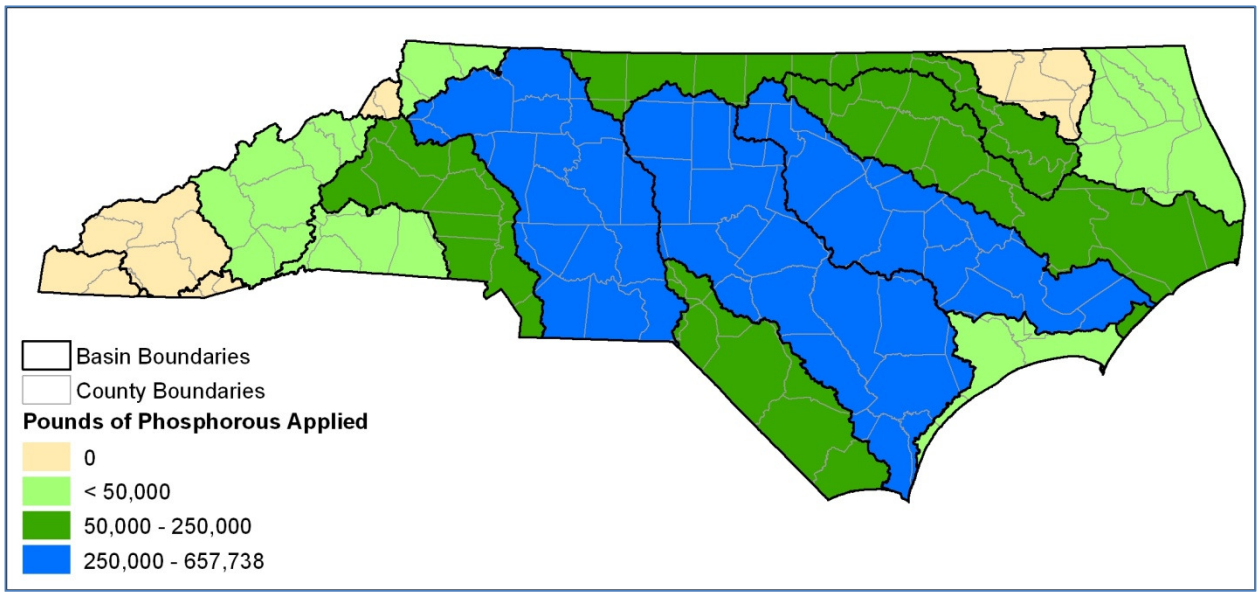


Figure 7. Map of PAN from Land Application of Residual Solids Permits by Basin

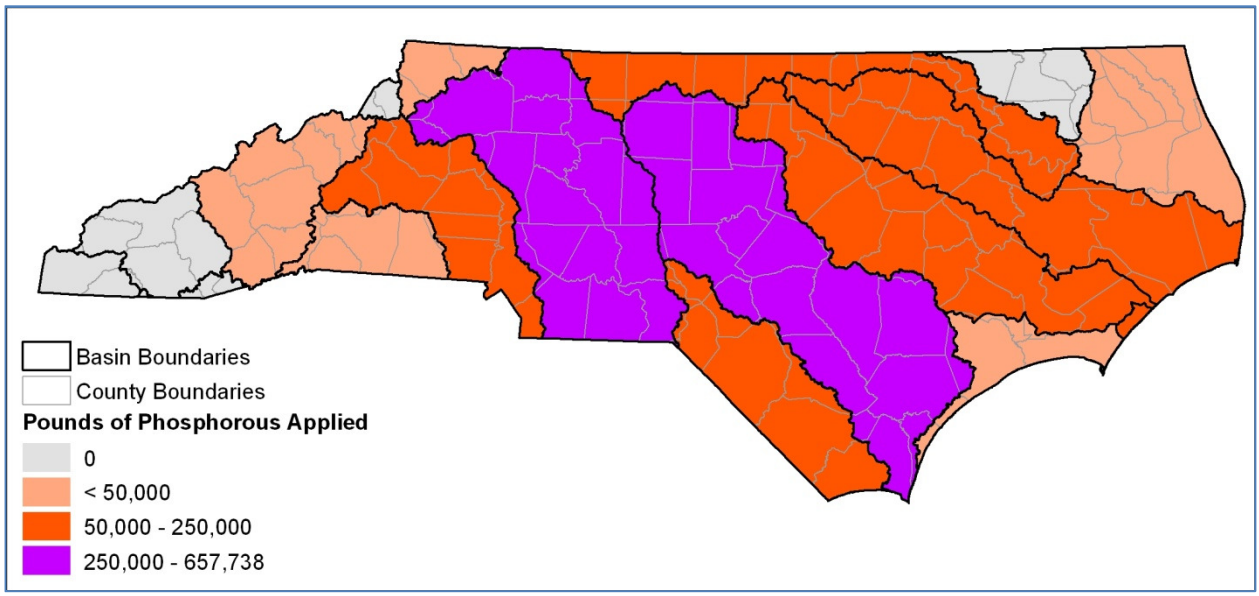


Figure 8. Map of Phosphorous from Land Application of Residual Solids Permits by County

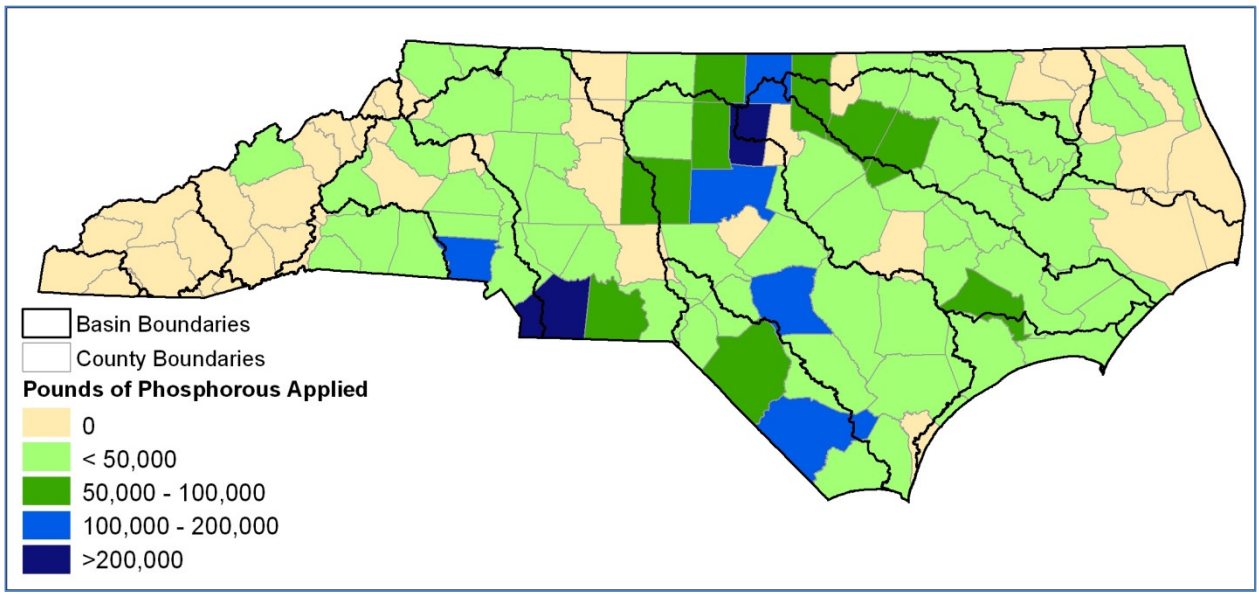
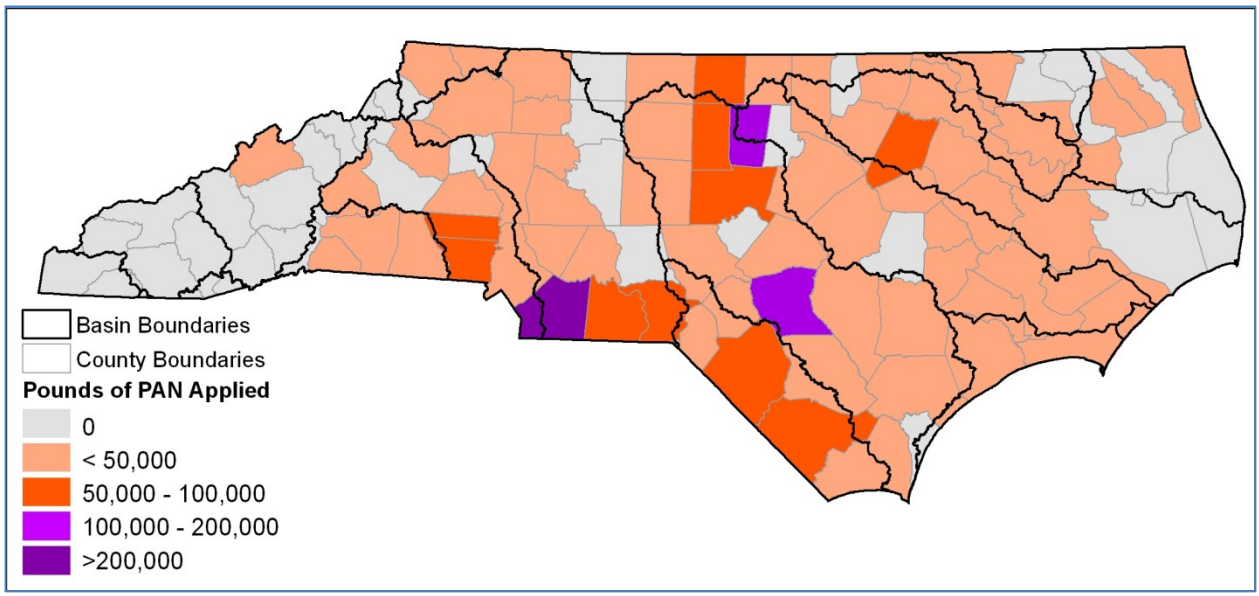


Figure 9. Map of PAN from Land Application of Residual Solids Permits by County



Discussion

Comparison to Other Quantified Sources

A similar study was completed for on-site wastewater treatment systems (septic systems) by North Carolina State University in 2007 called *Potential Nitrogen Contributions from On-site Wastewater Treatment Systems to North Carolina's River Basins and Sub-basins* (Pradham, et al, 2007). Although this study was completed in 2007, it was compiled using 1990 data due to data availability. An estimate of the amount of total nitrogen that was sent to the septic system's drain field and not how much was reaching groundwater or surface waters was reported. The statewide estimate reported was 31,666,655 pounds of total nitrogen per year, which was 16 times more pounds of total nitrogen than the pounds of PAN that were land applied through Land Application of Residuals permits. Total nitrogen includes nitrate, nitrite, ammonia, and organic nitrogen. This differs from PAN which excludes up to 40 percent of the organic nitrogen that is not immediately available for plant use and up to 50 percent of the ammonia that is expected to volatilize, therefore, direct comparisons cannot be made.

National Pollutant Discharge Elimination System (NPDES) permitted wastewater treatment facilities release treated wastewater effluent directly to surface waters. The Triangle J Regional Council of Governments recently generated estimates for the amount of total phosphorous and total nitrogen discharged by select NPDES individual wastewater discharge permits in the Neuse River basin (Hanson, 2011). Estimates for 2009 total phosphorous loading were reported for 38 dischargers and estimates for 2009 total nitrogen loading were given for 40 dischargers. Calculated annual total phosphorous loads for a single treatment facility in 2009 ranged from less than 1 pound per year to 166,311 pounds per year. The 2009 total phosphorous load for the 38 dischargers analyzed was 332,283 pounds. Calculated annual total nitrogen loads for a single treatment facility in 2009 ranged from less than 1 pound per year to 275,768 pounds per year. The total nitrogen load for the 40 dischargers analyzed was 1,227,824 pounds. Currently, a statewide total of nutrients released from NPDES individual wastewater discharge permits cannot be completed because not all dischargers are required to monitor for and report nutrient concentrations. There were 1,314 active NPDES individual wastewater discharge permits in 2009.

Need to Quantify Additional Sources

The quantification of residuals application is limited due to lack of information about application of residuals under permits for Distribution of Residuals Solids. In 2010, there were 77 active permits for Distribution of Residuals Solids. These facilities potentially generate large amounts of residuals that are spread on agricultural fields and other lands, but since they are not required to track and report this information it could not be included in this analysis.

In order to get a complete picture of nutrient contributions from land application of waste, similar analysis is needed for other types of land applied waste, such as treated wastewater, animal operation sprayfields, animal operation residuals application, and septage disposal sites.

Sanitary sewer overflows from wastewater collection systems and leaking wastewater transmission lines also contribute nutrients to surface and groundwater. Data on nutrient releases from these collection systems is needed to gain a more complete understanding of nutrient sources.

Another significant source of land-applied nutrients is conventional fertilizers. As with land-applied wastewater and residual solids, chemical fertilizers are applied to the land with the expectation that the nutrients will be taken up by crops, but it is reasonable to expect that the uptake is not perfect. In order to put the potential magnitude of each source of land-applied nutrients in context, it would be helpful to have a similar compilation of nutrient application from conventional fertilizers on basin, subbasin, watershed and county bases.

Need to Account for Total Nitrogen

If the land application of nutrients is being applied to the ground surface, then the PAN does not account for 50 percent of the ammonia nitrogen found in the residuals. This is because approximately 50 percent of the ammonia nitrogen is expected to volatilize. The volatilized ammonia nitrogen goes into the atmosphere and is then deposited to the land and water by precipitation. It is unknown what impact this may be having on nutrient levels in waters throughout the state. In order to account for all of the nitrogen being released to the environment, reprioritizing the reporting requirement to include the amount of total nitrogen would be needed.

Need to Determine Impacts

It is important to note that this study does not attempt to quantify the actual amount of nutrients that are entering groundwater and surface water. Nutrients can be taken up by plants and can be attenuated by other natural processes. More information is needed about whether or not the nutrients are reaching groundwater or surface waters. The ability of a field to retain nutrients for use by the vegetation may vary based on the characteristics of a particular field. One main factor that may determine whether or not nutrients from land application of residuals are reaching surface waters is whether or not the fields being utilized are underlain with tile drainage. More information on which fields are tile drained is needed to investigate this question. A comparison of application fields with different soil types would provide more information on what influence soil type has on the effectiveness of a field to retain nutrients for plant use. In general, extremely sandy soils do not have the holding capacity of less sandy soils. Field usage frequency may also be a factor to consider when designing these types of projects. Some fields are dedicated fields that are owned by the permit holder and are usually used year after year, while others are privately owned and may receive residuals some years but not others. The information provided in this report may be useful in selecting sites for research projects to answer these types of questions.

Trends in Permitting

Since 2005 the number of Land Application of Residuals permits has decreased from 210 to 193 for a drop of about eight percent. During the same time period Distribution of Residuals permits increased from 69 to 77 or by about 12 percent. The same procedure that was used to estimate

nutrient application from Land Application of Residuals in 2010 was completed for 2007. The results showed a decrease in both phosphorous and PAN between 2007 and 2010. This suggests that facilities may be adding pathogen reduction and switching to a Distribution of Residuals permit.

References

DWQ. *2009 Neuse Basinwide Water Quality Plan.* NC Department of Environment and Natural Resources, Division of Water Quality.

DWQ. *2010 Tar-Pamlico Basinwide Water Quality Plan.* NC Department of Environment and Natural Resources, Division of Water Quality. Raleigh, NC.

Hanson, Lars. *Technical Memorandum 3: Evaluation of Neuse River Basin Wastewater Discharges*. Triangle J Council of Governments. May 2011. Research Triangle Park, NC.

Pradhan S. S., et al. *Potential Nitrogen Contributions from On-site Wastewater Treatment Systems to North Carolina's River Basins and Sub-basins*. North Carolina Agricultural Research Services – North Carolina State University. May 2007. Raleigh, NC.

Table 1. Nutrients from Land Application of Residual Solids Permits by Subwatershed

HUC	Name	P in Pounds	PAN in Pounds
Roanoke			
030101020801	Little Grassy Creek	8,688	5,108
030101020803	Beech Creek – Johnson Creek	23,115	16,704
030101020806	Beaver Pond Creek South – Grassy Creek	10,210	9,390
030101020902	Island Creek	1,297	1,187
030101030502	Jacobs Creek	538	1,011
030101030504	Rock House Creek – Dan River	3,887	1,967
030101030807	Fall Creek – Smith River	13,496	9,808
030101030904	Upper Wolf Island Creek	3,836	2,460
030101030905	Lower Wolf Island Creek	479	900
030101040104	Upper Hogans Creek	309	579
030101040105	Lower Hogans Creek	1,484	5,720
030101040106	Upper Moon Creek	17,633	21,934
030101040107	Lower Moon Creek	281	1,086
030101040109	Cane Creek – Dan River	21,657	15,273
030101040202	Upper County Line Creek	7,196	6,904
030101040303	Winns Creek	23,081	14,400
030101040504	Middle South Hyco Creek	26,831	9,374
030101040507	Cane Creek – Hyco lake	370	1,387
030101040701	Headwaters Aarons Creek	4,234	2,831
030101070202	Gumberry Swamp	778	901
030101070302	Flag Run Gut – Roanoke River	540	0
Pasquotank			
030102050304	Sutton Creek – Middle Perquimmans River	1,055	386
030102050403	Yeopim Creek	732	607
030102050701	Folly Swamp	507	1,937
030102050704	Shipyard Landing – Pasquotank River	244	894
030102050706	Elizabeth City – Pasquotank River	1,344	13,181
030102050707	Newbegun Creek	668	69
030102051306	Dowdy Bay – Currituck Sound	3,323	2,469
030102051401	Pleasant Branch – Albemarle Sound	1,543	1,352
Tar – Pamlico			
030201010102	Headwaters Tar River	9,433	3,290
030201010106	Rocky Creek – Tar River	1,364	924
030201010401	Upper Cedar Creek	49,367	28,144
030201010403	Norris Creek	12,338	3,670
030201010501	Peachtree Creek – Boddies Millpond	12,110	7,472
030201010502	Pig Basket Creek	15,768	13,564
030201010504	Lower Stony Creek	1,956	2,291
030201010603	Biddie Toe Creek – Tar River	7,797	3,237
030201010706	Lower Sandy Creek	7,247	4,135
030201010801	Flat Rock Branch – Swift Creek	18,074	13,079
030201010802	White Oak Swamp	2,252	1,092
030201010902	Beech Swamp	16,565	17,708
030201010903	Buck Swamp – Tar River	5,260	5,587
030201020201	Bens Creek	7,143	3,070
030201020206	Lower Little Fishing Creek	9,018	7,444
030201020302	Possumquarter Creek Fishing Creek	15,615	9,895
030201020303	Maple Branch – Fishing Creek	2,865	2,152

HUC	Name	P in Pounds	PAN in Pounds
030201020502	Bellamy Lake – Rocky Swamp	5,677	4,638
030201020604	Middle Deep Creek	80	130
030201020605	Lower Deep Creek	3,073	4,197
030201030104	Outlet Cokey Swamp	9,418	6,158
030201030501	Collie Swamp	765	536
030201030502	Headwaters Tranters Creek	1,829	1,512
030201030503	Sheppard Millpond – Briery Swamp	8,640	6,734
030201030505	Middle Tranters Creek	4,229	3,803
030201030602	Outlet Grindle Swamp	1,445	1,300
030201030605	Town of Grimesland – Tar River	214	193
030201040203	Headwaters Durham Creek	3	6
030201040303	Van Swamp	1,025	294
Neuse			
030202010102	South Flat River	101,319	41,638
030202010201	North Fork Little River	55,583	23,212
030202010202	South Fork Little River	70,673	35,092
030202010301	Lake Orange – Eno River	200	143
030202010303	Stony Creek – Eno River	8,392	3,850
030202010401	Upper Knap of Reeds Creek	9,927	5,629
030202010402	Lower Knap of Reeds Creek	1,214	663
030202010501	Lodge Creek	5,685	3,437
030202010701	Richland Creek	3,166	2,210
030202010704	Perry Creek – Neuse River	5,620	19,422
030202011103	Poplar Creek – Neuse River	15,158	8,015
030202011104	Mill Creek – Neuse River	4,353	3,470
030202011105	Buffalo Creek – Neuse River	13,455	8,627
030202011303	Upper Mill Creek	797	990
030202011502	Headwaters Little River	9,302	6,819
030202011502	Upper Buffalo Creek	6,689	2,648
030202020204	Hardy Mill Run – Neuse River	1,012	514
030202020306	Mosley Creek	11,967	10,314
030202030101	Upper Moccasin Creek	7,791	2,305
030202030103	Upper Turkey Creek	17,672	6,847
030202030302	Whiteoak Swamp	5,248	3,239
030202030304	Lower Toisnot Swamp	1,750	853
030202030405	Turner Swamp – Contentnea Creek	1,250	366
030202030603	Middle Swamp	1,397	1,052
030202030703	Rainbow Creek – Contentnea Creek	2,385	1,582
030202030706	Eagle Swamp – Contentnea Creek	1,420	2,753
030202040102	Headwaters Tuckahoe Swamp	706	2,229
030202040103	Outlet Tuckahoe Swamp	53,187	30,875
030202040504	Cherry Point – Hancock Creek	18,403	11,786
030202040801	Upper Bay River	6,947	4,683
White Oak			
030203010202	Hunters Creek	4,307	3,378
030203010204	Hadnot Creek	4,634	2,749
030203010206	White Oak River	2,263	1,139
030203010401	Upper Newport River	1,521	554
030203010402	Middle Newport River	167	287
030203020204	Headwaters Southwest Creek	15,163	1,265

HUC	Name	P in Pounds	PAN in Pounds
Cape Fear			
030300020201	Mears Fork – Haw River	3,638	7,023
030300020202	Upper Troublesome Creek	10,350	14,115
030300020203	Lower Troublesome Creek	812	1,194
030300020204	Benaja Creek – Haw River	5,164	4,076
030300020206	Giles Creek – Haw River	1,860	3,238
030300020301	Upper Big Alamance Creek	561	696
030300020401	Stony Creek – Lake Burlington	18,026	17,777
030300020405	Upper Back Creek	51,429	19,132
030300020406	Quaker Creek – Quaker Creek Reservoir	3,050	2,925
030300020501	Haw Creek	8,234	5,023
030300020502	Meadow Creek – Haw River	7,472	5,649
030300020503	Cane Creek	6,013	5,421
030300020504	Upper Cane Creek	61,338	50,295
030300020505	Lower Cane Creek	8,120	7,245
030300020507	Collins Creek	9,416	5,831
030300020509	Terrells Creek – Haw River	682	840
030300020701	Dry Creek – Haw River	3,586	3,915
030300020704	Roberson Creek	10,814	6,167
030300030107	Polecat Creek	514	639
030300030201	Upper Sandy Creek	1,225	1,558
030300030203	Millstone Creek – Deep River	28,767	11,022
030300030205	Lower Richland Creek	10,459	4,656
030300030207	Lower Brush Creek	24,161	8,025
030300030208	Flat Creek – Deep River	1,122	968
030300030403	Lower Cabin Creek	1,045	752
030300030405	Lower Bear Creek	1,434	1,040
030300030501	North Prong Rocky River – Headwaters Rocky R.	6,097	5,192
030300030502	Lacys Creek – Rocky River	2,028	1,966
030300030503	Loves Creek – Rocky River	28,375	26,393
030300030505	Landrum Creek	25,666	13,452
030300030602	Indian Creek	4,425	3,793
030300030604	Smiths Creek – Deep River	15,687	17,835
030300030608	Rocky Branch – Deep River	3,086	1,966
030300040102	White Oak Creek	1,237	1,049
030300040105	Daniels Creek – Cape Fear River	157	141
030300040205	Walkers Creek – Upper Little River	4,116	2,793
030300040302	Thagards Lake – Little River	1,271	1,195
030300040404	Muddy Creek	1,762	1,703
030300040407	Anderson Creek	2,235	2,110
030300040408	Town of Twin Lakes – Little River	304	294
030300040409	Stewarts Creek – Little River	965	1,086
030300040503	Buies Creek	2,466	3,289
030300040506	Juniper Creek – Cape Fear River	10,431	9,947
030300040701	Town of Wade – Cape Fear River	7,671	9,200
030300040705	Headwaters Locks Creek	10,263	7,616
030300040706	City of Fayetteville – Cape Fear River	16,299	10,971
030300040707	Locks Creek – Cape Fear River	3,204	2,624
030300050101	Cedar Creek – Cape Fear River	7,862	7,180
030300050102	Willis Creek – Cape Fear River	12,347	11,446
030300050103	Harrison Creek	2,989	2,762

HUC	Name	P in Pounds	PAN in Pounds
030300050104	Phillips Creek – Cape Fear River	4,689	4,356
030300050301	Upper Livingston Creek	28,720	20,210
030300050302	Middle Livingston Creek	21,462	15,073
030300050303	Lower Livingston Creek	9,043	6,217
030300050401	Hammond Creek	325	891
030300060101	Upper Black River	4,852	3,910
030300060102	Lower Black River	2,503	4,000
030300060104	Lower Mingo Swamp	1,123	1,337
030300060107	Jones Swamp – South River	38,976	31,907
030300060201	Sandy Creek	25,670	21,876
030300060305	Rattlesnake Branch – Little Coharie Creek	4,515	5,475
030300060402	Headwaters Great Coharie Creek	5	348
030300060406	Williams Old Mill Branch – Great Coharie Creek	6,895	4,731
030300060407	Mill Creek – Great Coharie Creek	18,579	13,823
030300060806	Lyon Creek	6,959	6,815
030300070102	Bear Swamp	4,853	1,351
030300070105	Lower Goshen Swamp	1,620	4,823
030300070204	Mathews Creek – Northeast Cape Fear River	1,580	4,936
030300070205	Burn Coat Creek – Northeast Cape Fear River	277	840
030300070206	Dark Branch – Northeast Cape Fear River	564	2,199
030300070304	Headwaters Maxwell Creek	4,191	3,943
030300070305	Maxwell Creek – Stocking Head Creek	1,250	1,100
030300070607	Middle Shaken Creek	2,591	1,571
030300070701	Bee Branch – Cypress Creek	15,313	25,386
030300070802	Pike Creek – Northeast Cape Fear River	948	527
Yadkin – Pee Dee			
030401010302	Town of Wilkesboro – Yadkin River	165	183
030401010305	Reddies River	27	21
030401010306	Mulberry Creek	62	67
030401010307	Cub Creek – Yadkin River	476	476
030401010401	Fishing Creek	22	25
030401010402	Rock Creek – Yadkin River	824	793
030401010404	Middle Prong Roaring River	77	86
030401010405	East Prong Roaring River	39	44
030401010406	Roaring River	71	92
030401010407	Briar Creek – Yadkin River	4,519	5,077
030401010502	South Fork Mitchell River	1,393	1,521
030401010504	Lower Mitchell River	37	42
030401010601	Big Bugaboo Creek	3,379	3,699
030401010602	Grays Creek – Yadkin River	1,129	2,134
030401010603	Little Elkin Creek	37	41
030401010604	Elkin Creek	27	30
030401010605	Swan Creek – Yadkin River	1,038	1,368
030401010606	Sandyberry Creek – Yadkin River	924	919
030401010704	Middle Fisher River	862	704
030401010705	Lower Fisher River	3,804	4,296
030401011001	Double Creek – Yadkin River	517	647
030401011402	Cedar Creek	2,852	1,499
030401011403	Middle Dutchmans Creek	3,043	1,585
030401011404	Lower Dutchmans Creek	1,152	1,387
030401020201	Headwaters Hunting Creek	64	71

HUC	Name	P in Pounds	PAN in Pounds
030401020202	Upper North Little Hunting Creek	1,757	1,557
030401020206	Lower Hunting Creek	1,859	1,531
030401020303	Middle Third Creek	2,651	2,072
030401020304	Lower Third Creek	19,776	14,598
030401020402	Middle Fourth Creek	19,145	17,117
030401020501	Sills Creek – Back Creek	14,858	11,348
030401020502	Withrow Creek	2,376	1,568
030401030102	Lower Grants Creek	2,284	1,454
030401030301	Town of Spencer – Headwaters Crane Creek	1,574	1,229
030401030502	Hannahs Creek – Uwharrie River	14,109	6,205
030401030604	Tuckertown Reservoir – Yadkin River	42	273
030401040101	Headwaters Brown Creek	55,811	41,181
030401040102	Upper Brown Creek	26,85	2,071
030401040301	Headwaters Little River	8,874	3,985
030401050404	Upper Big Bear Creek	2,590	3,713
030401050502	Rays Fork	12,323	5,477
030401050503	Lake Twitty – Stewarts Creek	30,920	24,760
030401050504	Upper Richardson Creek	23,696	16,406
030401050505	Negro Head Creek	77,185	127,005
030401050506	Middle Richardson Creek	1,580	1,168
030401050507	Lower Richardson Creek	13,419	13,532
030401050601	Upper Lanes Creek	18,591	14,248
030401050604	Lower Lanes Creek	17,388	10,342
030401050704	Rock Hole Creek – Rocky River	5,699	3,969
030401050705	Gilberts Creek – Rocky River	16,199	14,299
030401050706	Cribs Creek	7,237	7,666
030402010202	South Fork Jones Creek	21,289	14,864
030402010203	Williams Mill Creek – Jones Creek	3,819	3,627
030402010303	Mill Creek	25,857	18,706
030402010304	Island Creek – Pee Dee River	91	68
030402010305	Everetts Lake – Marks Creek	25,143	66,650
030402020102	Headwaters Lynches River	3,061	1,804
Lumber			
030402030206	Lower Drowning Creek	314	237
030402030302	Gum Swamp	90	574
030402030303	Town of Maxton – Lumber River	667	3,730
030402030503	Richland Swamp	6,837	6,056
030402030504	Middle Raft Swamp	10,184	8,886
030402030602	Lower Little Marsh Swamp	4,793	3,791
030402030605	Gallberry Swamp	57,452	47,773
030402030701	Upper Tenmile Swamp	2,925	2,924
030402030703	Goodman Swamp	3,959	474
030402030705	Lewis Mill Branch – Big Swamp	1	18
030402030902	Peters Branch – Big Swamp	11,422	10,030
030402031102	Upper Porter Swamp	154	324
030402040103	Joes Creek	5,665	8,680
030402040201	Headwaters Leith Creek	603	19
030402040302	Juniper Creek	219	7
030402040303	Headwater Shoe Heel Creek	151	2,087
030402040305	Maxton Pond – Shoe Heel Creek	11	27
030402060105	Slades Swamp – Red Hill Swamp	199	546

HUC	Name	P in Pounds	PAN in Pounds
030402060201	Upper Soules Swamp	26,774	17,426
030402060203	Lower Soules Swamp	15,915	10,751
030402060501	Gum Swamp	4,256	4,667
030402080101	Middle Swamp	1,220	1,323
030402080102	Headwaters Lockwoods Folly River	3,958	3,365
Catawba			
030501010502	South Muddy Creek – Muddy Creek	4,387	4,705
030501010803	Gunpowder Creek	3,130	2,814
030501010901	Upper Little River	751	703
030501010904	Lake Hickory – Catawba River	120	530
030501011201	Mountain Creek	4,657	6,713
030501011301	Upper Leepers Creek	931	1,106
030501011302	Lower Leepers Creek	9,695	14,735
030501011303	Upper Dutchmans Creek	3,663	6,808
030501011304	Lower Dutchmans Creek	869	1,391
030501011401	McDowell Creek	3,325	2,566
030501011403	Mountain Island Lake	1,145	4,346
030501011405	Fites Creek – Catawba River	297	475
030501011501	Upper Crowders Creek	2,262	1,660
030501011504	Lower Crowders Creek	45,850	32,503
030501020303	Lower Clark Creek	7,507	10,474
030501020401	Pott Creek	4,762	9,195
030501020402	Howards Creek	7,746	12,284
030501020403	Town of Startown – South Fork Catawba River	26,033	27,296
030501020501	Upper Indian Creek	339	1,502
030501020502	Lower Indian Creek	18,485	21,296
030501020503	Beaverdam Creek	12,345	8,177
030501020601	Hoyle Creek	3,192	2,357
030501020602	Upper Long Creek	34,703	26,192
030501020603	Lower Long Creek	9,395	6,204
030501020605	Coley Creek – South Fork Catawba River	3,184	2,019
030501030103	Upper Sugar Creek	5,502	5,368
030501030302	Headwaters Cane Creek	10,465	5,838
Broad			
030501050501	Richardson Creek – Broad River	635	816
030501050505	Lower Sandy Run	205	204
030501050801	Headwaters Buffalo Creek	5,190	6,332
030501051201	Upper North Pacolet River	1,184	574
New			
050500010206	Beaver Creek – South Fork New River	196	203
050500010207	Naked Creek – South Fork New River	2,284	2,207
050500010305	Bridle Creek – New River	418	487
050500010407	Crab Creek – Little River	903	649
French Broad			
060101050805	Lower Ivy Creek	117	1,188

Table 2. Nutrients from Land Application of Residual Solids Permits by Subbasin

HUC	Name	P in Pounds	PAN in Pounds
Roanoke			
03010102	Middle Roanoke River	43,309	32,388
03010103	Upper Dan River	22,236	16,146
03010104	Lower Dan River	103,074	79,488
03010107	Lower Roanoke River	1,317	901
Pasquotank			
03010205	Albemarle Sound	9,416	20,896
Tar – Pamlico			
03020101	Upper Tar River	159,530	104,189
03020102	Fishing Creek	43,472	31,525
03020103	Lower Tar River	26,540	20,235
03020104	Pamlico River	301	1,027
Neuse			
03020201	Upper Neuse River	311,534	165,865
03020202	Middle Neuse River	12,978	10,829
03020203	Contentnea Creek	38,913	18,996
03020204	Lower Neuse River	79,244	49,573
White Oak			
03020301	White Oak River	12,891	8,107
03020302	New River	15,163	1,265
Cape Fear			
03030002	Haw River	210,565	160,560
03030003	Deep River	154,091	99,256
03030004	Upper Cape Fear River	62,382	54,018
03030005	Lower Cape Fear River	87,437	68,134
03030006	Black River	110,076	94,223
03030007	Northeast Cape Fear River	33,186	46,677
Yadkin – Pee Dee			
03040101	Upper Yadkin River	26,481	26,729
03040102	South Yadkin River	77,970	61,289
03040103	Lower Yadkin River	18,008	9,161
03040104	Upper Pee Dee River	67,371	47,237
03040105	Rocky River	226,829	242,585
03040201	Lower Pee Dee River	76,006	104,108
03040202	Lynches River	3,061	1,804
Lumber			
03040203	Lumber River	98,799	84,817
03040204	Little Pee Dee River	6,648	10,819
03040206	Waccamaw River	47,145	33,390
03040208	Coastal Carolina	5,179	4,688
Catawba			
03050101	Upper Catawba River	81,082	81,055
03050102	South Fork Catawba River	127,689	127,046
03050103	Lower Catawba River	15,967	11,206
Broad			
03050105	Upper Broad River	7,214	7,927
New			
05050001	Upper New River	3,870	3,477
French Broad			
06010105	Upper French Broad River	117	1,188

Table 3. Nutrients from Land Application of Residual Solids Permits by Basin

Basin	P in Pounds	P/Mi^2	PAN in Pounds	PAN/ Mi^2
Broad	7,214	4.8	1,927	1.3
Cape Fear	657,737	72.8	522,868	57.1
Catawba	224,739	68.4	219,306	66.8
French Broad	117	0.0	1,188	0.4
Lumber	157,771	47.4	133,714	40.2
Neuse	442,669	73.0	245,262	40.6
New	3,870	5.1	3,477	4.6
Pasquotank	9,416	2.8	20,896	6.2
Roanoke	169,937	37.5	128,923	36.9
Tar – Pamlico	230,570	37.5	156,251	25.4
White Oak	28,504	20.3	9,372	6.8
Yadkin – Pee Dee	495,726	68.7	492916	68.3

Table 4. Nutrients from Land Application of Residual Solids Permits by County

County	2007 P in Pounds	2010 P in Pounds	2007 PAN in Pounds	2010 PAN in Pounds
Alamance	86,080	91,909	69,568	73,731
Alexander	1,639	0	38	0
Alleghany	1,936	1,390	1,557	1,067
Anson	64,381	78,083	39,051	57,468
Ashe	2,247	2,481	494	2,410
Beaufort	6,024	3	4,466	6
Bertie	1,998	540	2	0
Bladen	80,386	18,922	39,117	15,297
Brunswick	19,318	5,179	12,966	4,688
Cabarrus	0	397	0	2,184
Caldwell	318	3,881	3,506	3,516
Carteret	9,678	12,891	10,168	8,107
Caswell	56,198	65,004	55,767	66,395
Catawba	22,471	32,928	17,502	33,734
Chowan	148	0	0	0
Chatham	86,051	105,225	74,840	69,113
Cleveland	13,522	205	15,128	204
Columbus	142,331	106,523	87,763	75,213
Craven	21,935	30,369	13,863	22,100
Cumberland	93,031	122,595	74,318	103,115
Currituck	4,828	4,865	4,429	3,822
Davidson	2,330	0	1,959	0
Davie	129,129	8,905	84,951	6,003
Duplin	12,537	14,334	7,926	19,192
Edgecombe	42,876	36,567	18,060	34,741
Franklin	31,553	76,895	18,031	38,741
Gaston	201,048	130,125	128,636	99,398
Granville	42,798	65,733	36,954	45,872
Greene	1,057	2,385	52	1,582
Guilford	10,540	4,266	15,854	6,757
Halifax	30,291	21,919	13,794	15,282
Harnett	76,772	29,488	66,011	28,980
Hoke	48	314	366	237

County	2007 P in Pounds	2010 P in Pounds	2007 PAN in Pounds	2010 PAN in Pounds
Iredell	42,797	34,631	35,176	28,546
Johnston	14,512	39,656	12,033	22,760
Jones	80,268	53,893	30,063	33,104
Lenoir	2,911	1,012	3,908	515
Lincoln	37,508	39,315	71,287	70,513
Madison	19,017	117	778	1,188
Martin	5,251	2,594	3,942	2,048
McDowell	6660	4,387	7,526	4,705
Mecklenburg	18,323	8,827	13,458	7,933
Mitchell	236	0	281	0
Montgomery	13,034	0	42,400	0
Moore	24,220	19,437	33,963	20,822
Nash	58,033	80,624	24,142	50,624
Northampton	15,340	778	7,621	901
Onslow	6,348	15,163	2,115	1,265
Orange	386,215	252,969	214,975	114,107
Pamlico	407	6,947	4,300	4,683
Pasquotank	8,918	2,763	8,839	16,081
Pender	18,386	18,852	19,708	27,485
Perquimans	7,500	1,787	5,459	993
Person	79,333	109,771	42,030	48,662
Pitt	25,673	17,345	22,020	15,833
Polk	2,904	1,184	775	574
Randolph	68,806	64,557	37,819	28,393
Richmond	6,993	30,898	31,127	75,399
Robeson	102,723	94,383	83,296	83,058
Rockingham	94,331	42,450	98,067	43,246
Rowan	59,989	43,517	42,241	32,269
Rutherford	5,324	635	7,668	816
Sampson	76,508	31,913	41,630	26,705
Scotland	8,079	973	11,030	2,864
Stanly	18,324	10,724	15,245	6,732
Surry	7,399	6,096	8,793	6,563
Union	240,436	260,462	211,520	264,759
Vance	20,479	0	19,348	0
Wake	11,298	11,926	25,496	24,861
Warren	20,504	18,480	20,748	12,046
Washington	3,279	1,025	2,418	294
Wayne	831	0	2,316	0
Wilkes	75,427	12,413	78,783	14,700
Wilson	889	8,249	1,676	4,457
Yadkin	127,262	2,747	86,246	2,622
Statewide	3,118,175	2,455,228	2,357,170	1,963,873

Table 5. Nutrient Application Summary by Permit

Permit #	Name	Utilized Acres	Average P lbs./acre	Average PAN lbs./acre	P Load	PAN Load
WQ0000011	Town of Hillsborough	173.4	52.3	93.2	9,255	17,529
WQ0000029	Tyson Poultry Inc. - Monroe, NC Rendering Plant	576.2	149.6	35.2	90,536	23,139
WQ0000048	City of Whiteville	28.7	82.0	30.0	2,580	943
WQ0000057	Charlotte Mecklenburg Utility Department (CMUD)	1,184.5	145.2	193.4	153,103	212,494
WQ0000094	City of Winston-Salem	38.5	79.0	150.7	3,085	5,894
WQ0000430	City of Cherryville	76.2	75.7	89.7	5,607	6,654
WQ0000455	Lewis Farms of Burgaw	314.2	78.7	62.1	27,485	18,852
WQ0000461	Louisiana Pacific Corporation – Roaring River	3,260.7	3.9	3.5	11,823	10,321
WQ0000520	City of Burlington	1,694.4	70.3	76.4	106,283	120,984
WQ0000527	PWC Fayetteville	1,400.3	99.0	123.0	140,371	172,033
WQ0000543	City of Sanford	208.0	137.4	116.0	31,026	24,982
WQ0000672	City of Lumberton	258.4	107.4	122.1	24,757	28,309
WQ0000702	City of Havelock	110.4	126.7	164.0	14,997	18,914
WQ0000759	Tuckertown WTP	8.8	31.1	4.7	273	41
WQ0000783	S & B Maintenance	76.3	18.2	17.6	1,323	1,220
WQ0000838	Granville Farms	1,486.5	88.2	150.3	121,283	202,237
WQ0000974	Atlantic Nutrients, Inc.	51.4	90.0	121.1	4,208	5,921
WQ0001026	City of Washington	335	64.9	81.1	12,029	14,528
WQ0001048	Contentnea Metropolitan Sewerage District (MSD)	33.9	82.6	40.3	2,753	1,420
WQ0001060	Town of Apex	288.7	53.8	67.4	12,423	15,657
WQ0001086	Town of Spring Lake	43.7	47.5	49.1	1,998	2,067
WQ0001169	Orange County Water and Sewer Authority (OWASA)	77.4	79.2	142.5	5,831	9,416
WQ0001271	Cape Fear Public Utility Authority (CFPUA)	494.3	148.3	214.5	73,106	105,693
WQ0001346	City of Monroe	374.0	71.9	128.6	25,422	45,385
WQ0001489	US MCAS Cherry Point	105.8	102.2	159.6	11,786	18,403
WQ0001600	Town of Scotland Neck	18.6	5.5	3.4	130	80
WQ0001618	Town of Granite Falls	31.2	108.8	120.0	3,516	3,881
WQ0001684	City of Asheboro	211.2	131.7	308.1	25,867	62,210
WQ0001730	City of Raleigh	161.4	108.4	313.0	15,072	39,742
WQ0001793	City of Gastonia	977.4	93.1	124.5	87,963	122,227
WQ0001800	Town of Yadkinville	24.3	26.0	20.7	647	517
WQ0001863	City of Mount Holly	168.6	68.0	39.3	11,157	6,371
WQ0001896	City of Wilson	153.5	22.9	49.2	4,457	8,249
WQ0001934	Town of Chadbourn	23.5	21.3	10.2	393	187
WQ0001956	City of Salisbury	282.1	109.5	149.9	32,269	43,517
WQ0001989	Roanoke Rapids Sanitary District	138.9	43.0	109.0	6,360	16,576
WQ0002040	Town of North Wilksboro	35.0	26.4	18.3	924	639
WQ0002047	Town of Tarboro	181.9	23.1	16.9	4,197	3,073
WQ0002269	City of Hamlet	150.9	105.6	95.7	6,788	6,145
WQ0002368	Town of Weldon	48.9	25.0	22.1	833	744
WQ0002376	City of Reidsville	397.2	72.3	46.3	29,494	19,662

Permit #	Name	Utilized Acres	Average P lbs./acre	Average PAN lbs./acre	P Load	PAN Load
WQ0002526	City of Laurinburg	64.5	36.4	0.0	2,388	0
WQ0002544	Clariant Corporation – Mount Holly West	119.2	160.8	29.3	18,853	3,435
WQ0002618	City of Gastonia – Eagle Road WWTP	39.9	55.3	80.9	2,071	2,874
WQ0002712	City of Lincolnton	448.9	101.0	53.1	42,166	23,080
WQ0002883	City of Elizabeth City	731.5	28.4	18.2	16,012	2,095
WQ0002890	City of Clinton	391.7	130.8	185.3	24,030	29,989
WQ0002897	Town of Robersonville	16.8	31.3	26.6	531	451
WQ0003034	Prestige Farms, Inc. – Cargill Turkey Products	68.0	43.0	43.0	2,924	2,924
WQ0003035	City of Eden	232.2	96.8	138.1	25,936	33,399
WQ0003226	Town of Siler City	240.8	86.5	174.9	21,239	51,522
WQ0003281	City of Belmont	79.9	67.1	83.9	5,631	7,045
WQ0003351	Town of Mocksville	36.0	46.1	38.3	1,621	1,346
WQ0003504	City of Durham	931.8	133.3	317.8	123,185	296,899
WQ0003760	White Oak Plant	57.5	64.3	17.9	3,161	882
WQ0003824	City of Graham	89.4	91.9	149.2	7,970	12,646
WQ0003902	City of Newton	243.7	53.2	85.3	14,255	22,585
WQ0003919	City of Kinston	161.8	181.4	319.2	30,246	53,187
WQ0003992	West Jefferson WWTP	25.3	5.6	11.4	134	277
WQ0004038	Town of Elizabeth Town	43.6	20.4	7.5	891	325
WQ0004095	Aurora Mine	5.5	1.2	0.5	6	3
WQ0004166	Town of Jefferson	35.0	54.8	53.1	2,276	2,204
WQ0004298	Town of Mars Hill	18.3	94.2	9.3	1,188	117
WQ0004341	Town of Tryon	9.5	60.5	124.6	574	1,184
WQ0004609	Wayne Farms	52.3	87.0	84.3	5,000	4,665
WQ0004682	Town of Robbins	29.7	71.4	99.2	1,792	2,479
WQ0004825	City of Randleman	59.9	48.0	38.3	2,893	2,299
WQ0004867	Perdue Farms – Lewiston Complex	98.2	0.0	5.6	0	540
WQ0004893	Campbell Soup Company	39.5	100.0	16.4	2,598	444
WQ0004956	Brookwood Farms	13.8	105.7	99.7	1,581	1,509
WQ0005135	Von Drehle Corporation	216.3	27.0	8.1	5,989	1,620
WQ0005387	Town of Oakboro	62.3	38.7	80.0	2,489	4,983
WQ0005537	Mallinckrodt Inc.	172.5	122.5	35.4	21,442	6,198
WQ0005568	City of Rocky Mount	797.8	73.4	82.8	58,007	67,627
WQ0006017	Town of Beaufort	17.0	67.0	133.1	1,139	2,263
WQ0006018	Town of Morehead City	55.9	104.0	158.2	6,127	8,941
WQ0006101	City of Dunn	184.8	83.3	65.6	13,640	10,937
WQ0006242	Town of Sparta	67.1	17.3	23.3	1,067	1,390
WQ0006438	Anson County WWTP	126.3	3.0	12.6	433	1,772
WQ0006984	Delta Apparel Inc. – Maiden, NC Plant	134.9	69.4	15.6	9,202	2,069
WQ0007066	Harnett County	105.4	63.0	74.5	6,433	7,567
WQ0007349	Town of Elkin	50.0	90.8	83.2	4,650	4,259
WQ0007486	Union County	630.7	91.2	102.3	60,837	67,468
WQ0007728	Town of Carolina Beach	41.9	138.8	154.08	5,949	6,659
WQ0008008	Pasquotank County Regional	22.4	3.2	31.0	69	668

Permit #	Name	Utilized Acres	Average P lbs./acre	Average PAN lbs./acre	P Load	PAN Load
	WTF					
WQ0008349	Town of Newport	21.9	22.8	69.6	554	1,521
WQ0008764	Bob Stevens Complex	36.8	37.5	12.4	1,405	463
WQ0008778	Town of Farmville	46.8	25.0	33.2	1,052	1,397
WQ0010198	Town of Williamston	35.5	42.0	59.2	1,518	2,143
WQ0010470	Town of Newton Grove	7.4	47.0	0.6	348	5
WQ0010488	Town of Lagrange	6.6	78.0	153.3	515	1,012
WQ0010490	McCain Correctional Hospital	6.7	35.5	47.0	237	314
WQ0010563	Alamac Knit Fabrics	39.6	0.5	0.0	18	1
WQ0010583	Davie County Public Utilities	34	47.1	57.1	1,531	1,859
WQ0010975	Perdue Farms Inc.	271.5	226.5	81.2	62,622	23,133
WQ0011244	City of Oxford	150.0	75.0	81.6	10,576	11,506
WQ0011413	NC Department of Corrections	41.4	1.6	0.8	68	35
WQ0011448	Town of Snow Hill	12.5	126.6	190.8	1,582	2,385
WQ0012110	Town of Angier	28.1	118.3	88.6	3,289	2,466
WQ0012492	Blake Farms	10.2	123.6	1480.8	1,265	15,163
WQ0012662	Dunbar Foods	177.0	23.3	13.4	4,000	2,503
WQ0013729	Town of Pembroke	124.5	2.2	1.4	214	135
WQ0013982	Interface Fabrics	29.1	31.6	31.8	919	924
WQ0014843	Liquid Waste, Inc.	98.1	40.9	32.3	3,564	2,619
WQ0014868	Smithfield Packing Company	226.8	66.5	70.9	13,332	14,027
WQ0016247	Hines Contractors (Atlantic OBX)	201.4	135.6	164.4	28,546	34,631
WQ0016922	Lincoln County	140.5	19.1	15.3	2,212	1,768
WQ0018007	Town of Broadway	6.0	22.8	25.4	141	157
WQ0018107	Guilford East Mill	224.7	63.2	20.2	15,028	4,747
WQ0018352	Town of Boiling Springs	17.0	11.7	11.7	204	205
WQ0018525	Barnes Environmental	19.5	15.4	8.9	287	167
WQ0019098	Town of Holly Springs	226.6	55.1	90.3	13,122	21,289
WQ0019960	City of Marion	89.4	54.3	50.6	4,705	4,387
WQ0020016	Town of Fuquay-Varina	26.6	84.0	74.4	2,180	1,930
WQ0020019	Pittsboro WWTP	23.4	51.0	92.0	1,191	2,148
WQ0020239	Town of Hertford	51.3	11.8	14.3	607	732
WQ0020912	Town of Dallas	34.0	65.7	50.7	2,235	1,723
WQ0023178	Town of Clayton	119.0	96.4	141.4	12,097	17,808
WQ0030132	Town of Plymouth	18.7	14.4	50.2	294	1,025
WQ0030998	Triple S Farms & Cleaning, Inc.	65.5	81.9	90.0	5,043	5,441
WQ0031725	Baxter Health Care Corp.	80.8	56.4	37.3	4,478	2,934
WQ0032855	Town of Rutherford	26.8	26.1	20.3	816	635
WQ0034195	Synagro Central LLC	597.1	107.5	107.8	54,484	62,126
WQ0034397	Murphy-Brown LLC	21.0	26.9	253.2	500	4,781
WQ0034513	Brunswick County	36.4	107.7	125.4	3,365	3,958