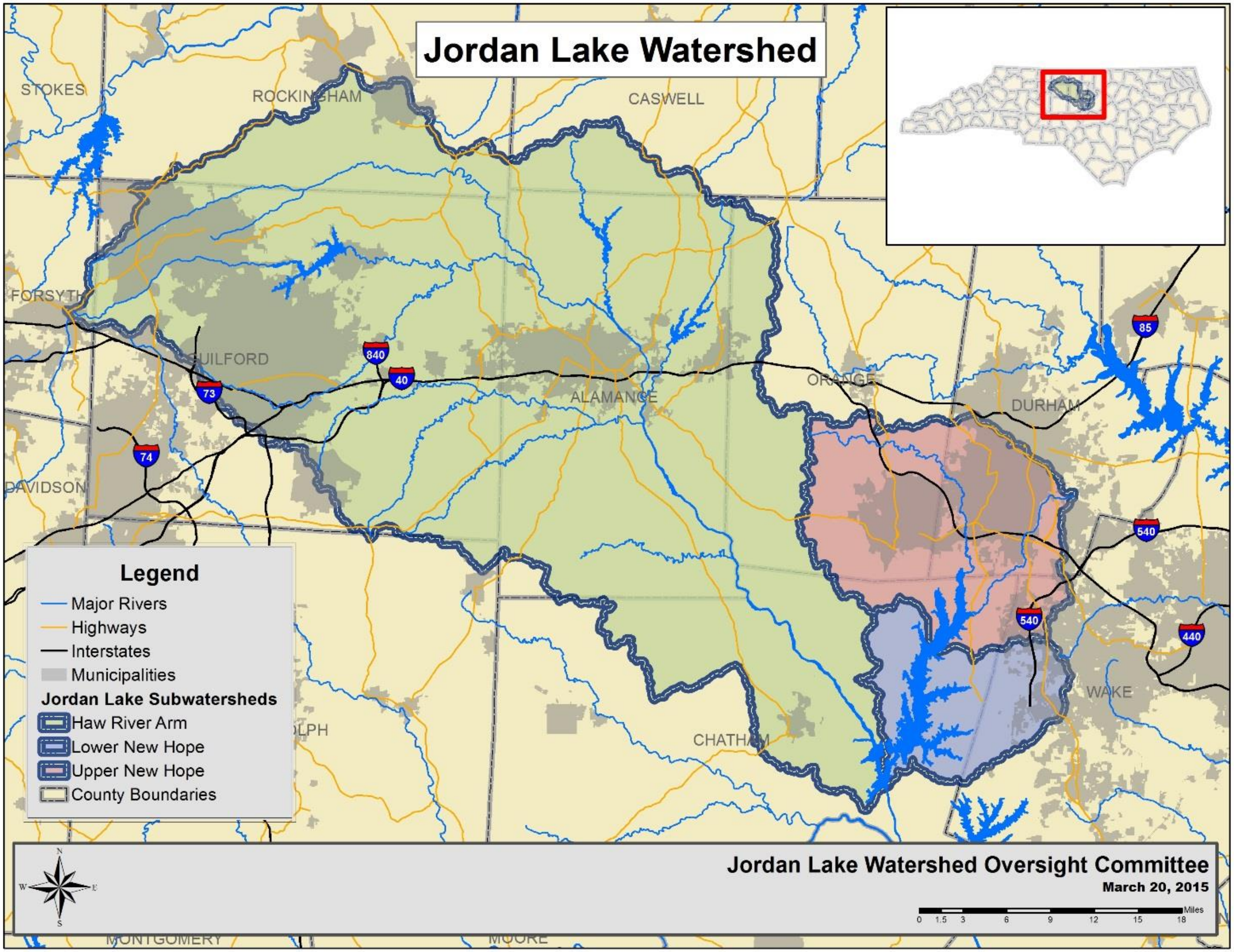
NCDA&CS

Annual Progress Report for the Jordan Lake Agriculture Rule (15A NCAC 02B.0264) for the Baseline Period (1997-2001) for Crop Years 2012 through 2015

A Report to the Division of Water Resources from the Jordan Lake Watershed Oversight Committee: Crop Year 2015, Submitted July 14, 2017



Jordan Lake Watershed
STOKES
ROCKINGHAM
CASWELL
FORSYTH
GUILFORD
ALAMANCE
ORANGE
DURHAM
DAVIDSON
WAKE
CHATHAM
MONTGOMERY
MOORE
85
840
40
73
74
540
440
Legend
Major Rivers
Highways
Interstates
Municipalities
Jordan Lake Subwatersheds
Haw River Arm
Lower New Hope
Upper New Hope
County Boundaries
Jordan Lake Watershed Oversight Committee
March 20, 2015
Miles
0 1.5 3 6 9 12 15 18

Summary

This report provides an assessment of collective progress made by the agricultural community to reduce nutrient losses toward compliance with the Jordan Lake Agriculture rule. For this report, the Jordan Lake Watershed Oversight Committee (WOC) implemented the accounting methods approved by the Environmental Management Commission's Water Quality Committee in July 2011 to estimate changes in nitrogen loss and the phosphorus loss trend in the three Jordan subwatersheds for the period between the strategy baseline (1997-2001) and the most recent crop years (CY) for which data was available, 2012-2015. This report provides progress estimates in three categories: cropland nitrogen, pasture nitrogen, and agricultural phosphorus. To produce this report, Division of Soil and Water Conservation staff received, processed and compiled current-year reports (2012-2015) from agricultural staff in eight counties, and the WOC compiled the information and prepared this report. Refer to Figure 1 for the location of the Jordan Lake Watershed, including the three subwatersheds affected by this rule.

The cropland nitrogen portion of the report demonstrates agriculture's collective compliance with the Jordan Agriculture Rule and estimates progress made by agriculture in the watershed to decrease the amount of nutrients lost from agricultural management units. Agriculture has been successfully decreasing nutrient losses in each of the Jordan Lake subwatersheds. Collectively, each of the three subwatersheds is meeting their cropland nitrogen loss reductions from baseline to CY2015, with the Upper New Hope Watershed reporting a 61% reduction, the Lower New Hope Watershed reporting a 72% reduction, and the Haw River Watershed reporting a 41% reduction. Table 1 illustrates the estimated reductions in nitrogen loss collectively achieved by cropland agriculture compared to the 1997-2001 baseline.

Jordan Lake Watershed Oversight Committee Composition, Jordan Agriculture Rule:

1. NC Division of Soil & Water Conservation
2. USDA-NRCS
3. NCDA&CS
4. NC Cooperative Extension Service
5. NC Division of Water Quality
6. Watershed Environmental Interest
7. Watershed Environmental Interest
8. Environmental Interest
9. General Farming Interest
10. Pasture-based Livestock Interest
11. Equine Livestock Interest
12. Cropland Farming Interest
13. Scientific Community

Reductions in cropland nitrogen loss have been achieved through crop shifts and reduction in nitrogen application rates for the major crops in the watershed. From the baseline to 2015, the watershed has experienced a crop shift from crops with higher nitrogen requirements to mixed cool season grass (hay) and soybeans. In addition, the nitrogen rate on mixed cool season grass (hay) has decreased by more than 10 pounds per acre. Nitrogen application rates for most crops in 2014 and 2015 were stable, but the application rate on corn acres in 2014 and 2015 increased due to yield increases from new corn varieties which require and can take up more nitrogen.

In addition, each of the three subwatersheds is meeting their pastureland nitrogen loss reductions from baseline to CY2015, with the Upper New Hope Watershed reporting a 48% reduction, the Lower New Hope Watershed reporting a 39% reduction, and the Haw River Watershed reporting a 29% reduction. Table 4 illustrates the estimated reductions in nitrogen loss collectively achieved by pastured operations compared

to the 1997-2002 baseline. These reductions have been achieved primarily by reduced nitrogen application rates and an overall reduction in pasture acres.

Qualitative phosphorus indicators demonstrate that there is no increased risk of phosphorus loss. Primary factors contributing to this trend include a reduction in tobacco acres, a decrease in the amount of animal waste phosphorus, and a transition to 90% conservation tillage on cropland in the watershed.

The Jordan Agriculture rule stipulated that if the initial accounting done for CY2010 found that a nitrogen goal had not been achieved in a subwatershed, then Local Advisory Committees were to be formed in that subwatershed and farmers were to register their operations with the committees. Based on the success on cropland nitrogen reductions relative to the strategy goals estimated in initial reports, the WOC found that such actions were not required.

Jordan NSW Strategy:

The Environmental Management Commission (EMC) adopted the Jordan Water Supply Nutrient Strategy in 2008. The strategy goal is to reduce the average annual load of nitrogen and phosphorus from each of its subwatersheds to Jordan Lake from 1997-2001 baseline levels. In addition to point source rules, mandatory controls were applied to addressing non-point source pollution in agriculture, nutrient management, riparian buffer protection, and urban stormwater. The management strategy built upon the Neuse and Tar-Pamlico River Basins efforts.

Rule Requirements and Compliance

Effective August 2009, the Agriculture Rule that is part of the Jordan Water Supply Nutrient Strategy provides for a collective strategy for farmers to meet nitrogen loss reduction goals within six to nine years. Since the August 2009 effective date of the rule and according to the NC Division of Water Resources, these deadlines have been extended by three years by the N.C. General Assembly (Session Law 2013-395). The goals for this nutrient strategy are specified at the subwatershed level in Table 1, and are compared to the 1997-2001 baseline period. The Lower New Hope Subwatershed has a goal of no increase in nitrogen or phosphorus. The Upper New Hope Subwatershed has a goal of 35% nitrogen loss reduction and 5% phosphorus reduction. The Haw River Subwatershed has a goal of 8% nitrogen loss reduction and 5% phosphorus reduction. All reductions are required for both cropland and pastureland, and the two are calculated separately. A Watershed Oversight Committee (WOC) was established to implement the rule and to assist farmers in complying with the rule.

All counties provided information for the annual report to the WOC in May 2017. Collectively, each of the three subwatersheds is meeting their cropland nitrogen loss reductions, with the Upper New Hope Watershed reporting a 61% reduction, the Lower New Hope Watershed reporting a 72% reduction, and the Haw River Watershed reporting a 41% reduction. These reductions have been achieved primarily by reduced nitrogen application rates and cropping shifts from higher nitrogen crops to lower nitrogen crops.

In addition, each of the three subwatersheds is meeting their pastureland nitrogen loss reductions for CY2012, with the Upper New Hope Watershed reporting a 48% reduction, the Lower New Hope Watershed reporting a 39% reduction, and the Haw River Watershed reporting a 29% reduction. These reductions have been achieved primarily by reduced nitrogen application rates and an overall reduction in pasture acres. Pastureland nitrogen loss is calculated on a 5-year cycle, and CY2012 is the most recent year for which data is available.

Scope of Report and Methodology

The estimates provided in this report represent whole-county scale calculations of nitrogen loss from cropland and pastureland agriculture in the watershed made by soil and water conservation district technicians using the 'aggregate' version of the Nitrogen Loss Estimation Worksheet, or NLEW. The NLEW is an accounting tool developed to meet the specifications of the Neuse Agriculture Rule and approved by the Water Quality Committee of the Environmental Management Commission (EMC) for use in the Jordan Lake Watershed. The development team included interagency technical representatives of the NC Division of Water Resources (DWR), NC Division of Soil and Water Conservation (DSWC), USDA-NRCS and was led by NC State University Soil Science Department faculty. The NLEW captures application of both inorganic and animal waste sources of fertilizer to cropland and pastureland. The NLEW is an "edge-of-management unit" accounting tool; it estimates changes in nitrogen loss from cropland and pastureland, but does not estimate changes in nitrogen loading to surface waters. An assessment method was developed and approved by the Water Quality Committee of the EMC for phosphorus, and is described later in the report.

Nitrogen Reduction from Cropland from Baseline for CY2012 - CY2015

All counties submitted their progress report to the WOC in May 2017.

- For the Lower New Hope Watershed, agriculture achieved a cropland nitrogen loss in CY2012 (57%), CY2013 (50%), CY2014 (53%), and CY2015 (72%) compared to the average nitrogen loss from 1997 to 2001.
- For the Upper New Hope Watershed, agriculture achieved a cropland nitrogen loss in CY2012 (48%), CY2013 (56%), CY2014 (46%), and CY2015 (61%) compared to the average nitrogen loss from 1997 to 2001.
- For the Haw Watershed, agriculture achieved a cropland nitrogen loss in CY2012 (41%), CY2013 (25%), CY2014 (28%), and CY2015 (41%) compared to the average nitrogen loss from 1997 to 2001.

Table 1 lists each county's cropland nitrogen loss (lbs/yr) at the time of the baseline and in CY2012, CY2013, CY2014 and CY2015, along with nitrogen loss percent reductions from baseline values in CY2012, CY2013, CY2014, and CY2015.

Table 1. Estimated reductions in agricultural nitrogen loss (cropland) from baseline (1997-2001), CY2014 and CY2015, Jordan Lake Watershed †

County	Baseline Nitrogen Loss (lb)	CY2012 Nitrogen Loss (lb)	CY2012 N Loss Reduction (%)	CY2013 Nitrogen Loss (lb)	CY2013 N Loss Reduction (%)	CY2014 Nitrogen Loss (lb)	CY2014 N Loss Reduction (%)	CY2015 Nitrogen Loss (lb)	CY2015 N Loss Reduction (%)
Upper New Hope Subwatershed: Goal of 35% nitrogen loss reduction									
Chatham	43,063	10,679	75%	10,385	76%	11,623	73%	7,457	83%
Durham	37,618	15,953	58%	-	-	19,423	48%	12,068	68%
Orange	68,632	49,760	27%	51,457	25%	47,585	31%	39,488	42%
Wake	9,694	6,190	36%	8,002	17%	6,866	29%	2,378	75%
Total	**159,007**	**82,582**	**48%**	**69,844**	**56%**	**85,497**	**46%**	**61,391**	**61%**
Lower New Hope Subwatershed: Goal of no increase in nitrogen loss									
Chatham	56,632	15,882	72%	15,421	73%	17,356	69%	11,041	81%
Wake	38,362	24,710	36%	31,968	17%	27,133	29%	15,643	59%
Total	**94,994**	**40,592**	**57%**	**47,389**	**50%**	**44,489**	**53%**	**26,684**	**72%**
Haw Subwatershed: Goal of 8% nitrogen loss reduction									
Alamance	697,634	414,342	41%	745,955	-7%	606,397	13%	522,796	25%
Caswell	260,254	173,813	33%	190,585	27%	194,880	25%	193,974	25%
Chatham	245,458	75,031	69%	72,990	70%	82,120	67%	51,419	79%
Guilford	1,393,551	796,506	43%	950,084	32%	990,288	29%	753,566	46%
Orange	231,272	154,937	33%	160,875	30%	155,418	33%	128,285	45%
Rockingham	169,080	139,343	18%	117,841	30%	134,164	21%	116,751	31%
Total ‡	**2,997,249**	**1,753,972**	**41%**	**2,238,330**	**25%**	**2,163,267**	**28%**	**1,766,791**	**41%**

† *Nitrogen loss values are for comparative purposes. They represent nitrogen that was applied to cropland in the watershed and neither used by crops nor intercepted by BMPs in a Soil Management Group, based on NLEW calculations. This is not an in-stream loading value.*

‡ *Total reduction percentages are calculated by comparing current nitrogen loss to baseline nitrogen loss. Individual county totals contribute proportionally, and so smaller watershed trends tend to be more volatile than large watershed trends.*

Best Management Practice Implementation

Figures 1, 2, and 3 illustrate the amount of buffers on cropland in the Lower New Hope, Upper New Hope and Haw River Subwatersheds in the baseline (1998), 2012, 2013, 2014, and 2015. Riparian buffers have many important functions beyond being effective in reducing nitrogen. Recent research has shown that upwards of 75% of sediment from agricultural sources is from stream banks and that riparian buffers, particularly trees, are important for reducing this sediment. In addition, riparian buffers can reduce phosphorus and sediment as it moves through the buffer and provide other critically important functions. According to a report completed in 2007, *Delineating Agriculture in the Lake Jordan River Basin,* the majority of agricultural land is already buffered. This study found that, six of the counties had more than 75% of their agricultural land buffered, and that the average buffer width was greater than 50 feet .[1]

Agriculture is credited with different nitrogen reduction efficiencies, expressed as percentages, for riparian buffer widths ranging from 20 feet to 100 feet. The NLEW for Jordan Lake provides the percent nitrogen reduction efficiencies for buffer widths on cropland as displayed in Table 2.

Table 2: Nitrogen loss reduction percentages by buffer width

Buffer width	Nitrogen loss reduction percentage[2]
20 feet	20%
30 feet	25%
50 feet	30%
100 feet	35%

Due to data availability and staffing limitations, a decision was made to utilize GIS technology and aerial photography for baseline BMP totals. Baseline acreage of riparian buffers on cropland among the different widths for which agriculture receives reductions was obtained through this process first in 1998 and then again in 2010. Overall, total acres of buffers slightly decreased between 1998 and 2010 due to the fact that overall agricultural production acres decreased during that same time period. This helps explain why the first reported buffer acres were noticeably lower than baseline totals. Since the CY2010 report, however, total buffer acreage has been obtained through individual contracts implemented through state and federal cost share contracts, and buffer acres are added after each project's completion.

In the Lower New Hope Subwatershed, 144 acres (57%) of the buffers in the subwatershed still exist but are no longer eligible for accounting under the agriculture rule because these lands have been taken out of agricultural production. This subwatershed experienced a decrease of 12% of cropland with wide riparian

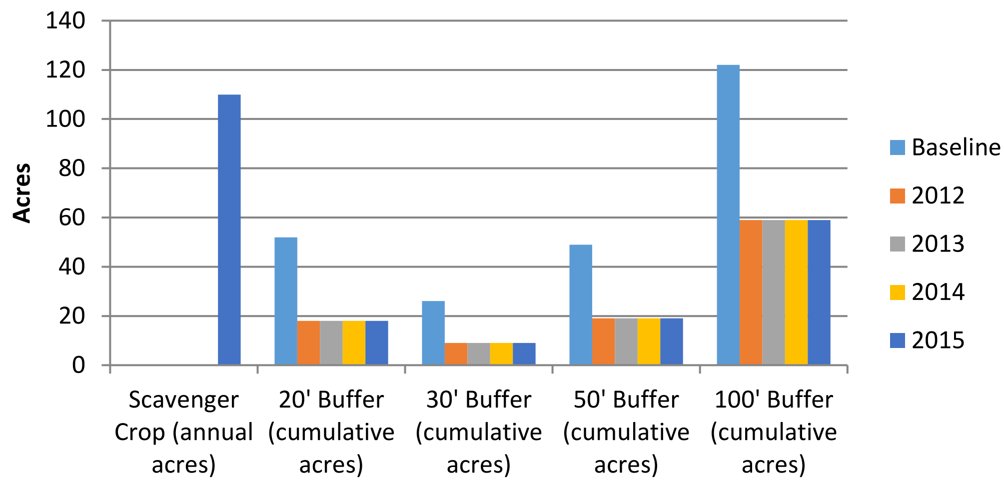
[1] Osmond, Deanna L. 2007. Final Report for the Sampling Analysis: Delineating Agriculture in the Lake Jordan River Basin. Department of Soil Science, North Carolina State University, Raleigh, NC 27606.

[2] These percentages represent the net or relative percent improvement in nitrogen removal resulting from riparian buffer implementation.

buffers over that time period. In the Upper New Hope Subwatershed, 531 acres (39%) of baseline buffers still exist but are no longer eligible for accounting under the agriculture rule, also due to the fact that these lands have been taken out of agricultural production. This subwatershed experienced a decrease of 21% of cropland over that time period. For these two watersheds, the limited number of cropland acres greatly increases the effect of any change in agricultural operation land use on overall nitrogen loss reduction percentage. The Haw River Subwatershed only saw a decrease of 1% of buffer acres in the watershed. This is to be expected, since the subwatershed did not lose any cropland acres from 1998 to 2010. Detailed information regarding buffer acreages by subwatershed is displayed in Figures 1, 2, and 3.

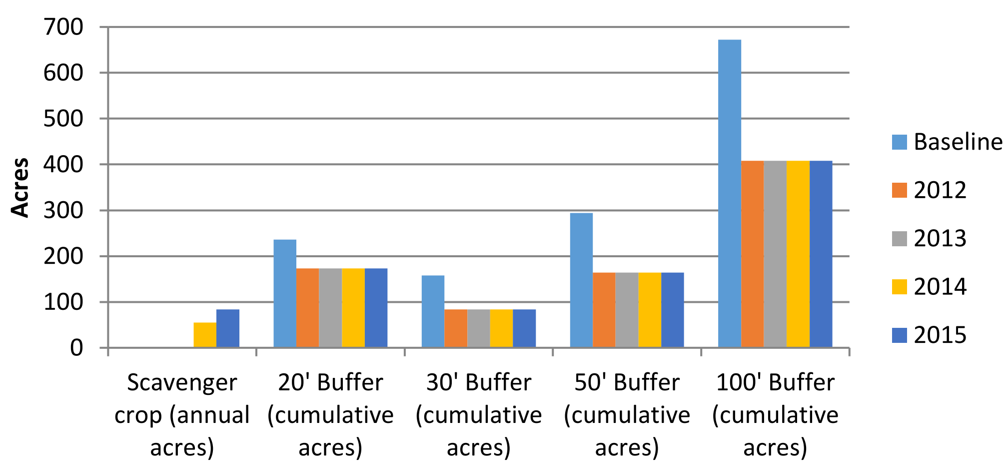
Of the cropland acres in the Jordan Lake Watershed, 2% are in the Lower New Hope Subwatershed.

Figure 1. Nitrogen Reducing BMPs installed on Croplands from Baseline (1997-2001), 2012, 2013, 2014, and 2015, Lower New Hope Subwatershed, Jordan Lake Watershed *



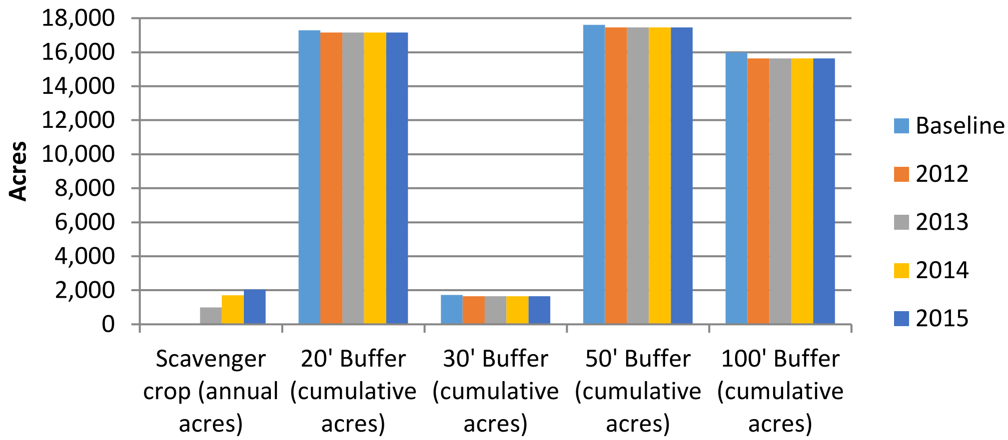
Of the cropland acres in the Jordan Lake Watershed, 4% are in the Upper New Hope Subwatershed.

Figure 2. Nitrogen Reducing BMPs installed on Croplands from Baseline (1997-2001), 2012, 2013, 2014, and 2015, Upper New Hope Subwatershed, Jordan Lake Watershed*



Of the cropland acres in the Jordan Lake Watershed, 94% are in the Haw Subwatershed.

Figure 3. Nitrogen Reducing BMPs installed on Croplands from Baseline (1997-2001), 2012, 2013, 2014, and 2015, Haw Subwatershed, Jordan Lake Watershed*



** The acres of buffers listed include estimated acres from GIS analysis from 1998 and 2010 aerial photography and acres implemented through cost share programs since baseline. Cropland acres affected by the buffer could be 5 to 10 times larger than the acreage shown above.*[3]

A significant amount of buffers has been installed in the Jordan Lake Watershed through the Division of Mitigation Services (DMS) since the baseline. DMS has completed 57 projects in the watershed from the baseline through 2015. Project data is not tracked regarding previous land use nor the area of buffer restored in conjunction with stream restoration projects. Because DMS funded these buffers for purposes of compensatory mitigation for stream or buffer permitted losses also occurring in the watershed, they are not eligible to be counted for reductions under the agriculture rule, even if they are located on agricultural lands. Thus DMS buffer restoration projects are not included in the totals provided in this report. As DMS continues to install buffers adjacent to agricultural land, this decreases the possibility for buffers to be installed on agricultural land for credit for agriculture rule implementation.

[3] Bruton, Jeffrey Griffin. 2004. Headwater Catchments: Estimating Surface Drainage Extent Across North Carolina and Correlations Between Landuse, Near Stream, and Water Quality Indicators in the Piedmont Physiographic Region. Ph.D. Dissertation. Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27606.

Fertilization Management

Fertilization rates are revisited annually by counties using data from farmers, commercial applicators and state and federal agencies' professional estimates. In this watershed, the majority of crops are under fertilized due to economics. Mixed cool season grass (hay) has always been under fertilized in the Jordan Lake Watershed, and continues to be under fertilized. This is important to note as it is the largest acreage crop grown in all three subwatersheds. For many of the high acreage crops, farmers have reduced their nitrogen fertilization from baseline levels, while fertilization rates on other crops have increased or remained the same. Figures 4, 5, and 6 display the nitrogen fertilization rates in pounds per acre for the major crops in the watershed. Nitrogen fertilization rates for mixed cool season grass (hay) decreased in all subwatersheds by over 10 pounds/acre. Nitrogen fertilization rates for soybeans remained consistent with baseline fertilization rates or decreased in the subwatersheds. Nitrogen fertilization rates were higher in 2015 than in the baseline period on corn acres due to differences in crop varieties and increased plant population densities, with expected increases in nitrogen uptake that produce higher yields. Wheat experienced decreases in nitrogen fertilization rates in 2015 compared to the baseline. No corn was grown in the Lower New Hope subwatershed in 2015.

Figure 4. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2012, 2013, 2014, and 2015, Lower New Hope Subwatershed, Jordan Lake Watershed

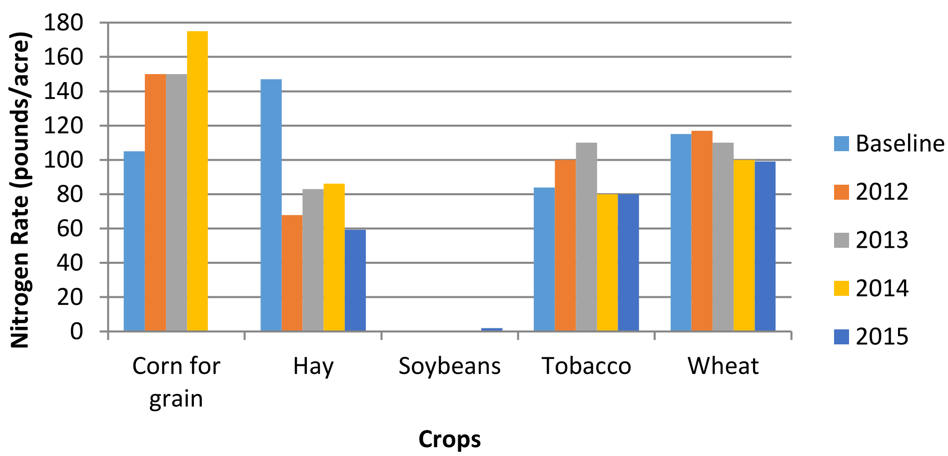


Figure 5. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2012, 2013, 2014, and 2015, Upper New Hope Subwatershed, Jordan Lake Watershed

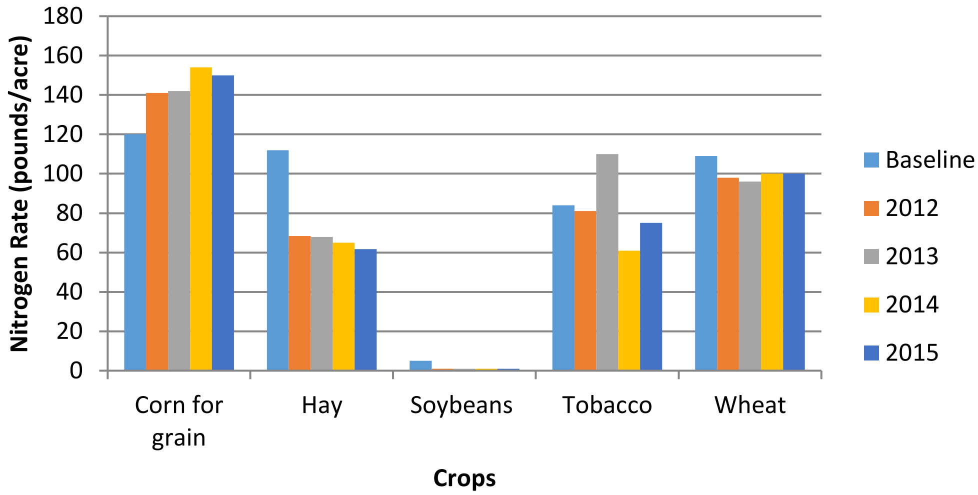


Figure 6. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2012, 2013, 2014, and 2015, Haw Subwatershed, Jordan Lake Watershed

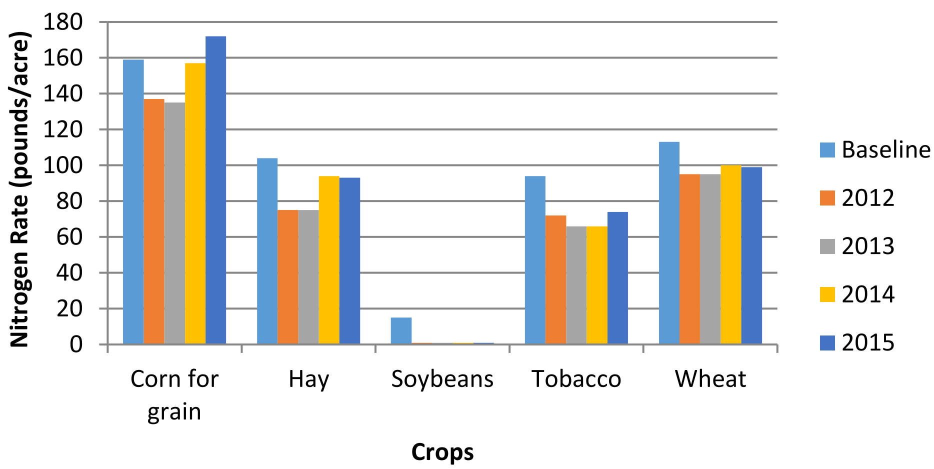
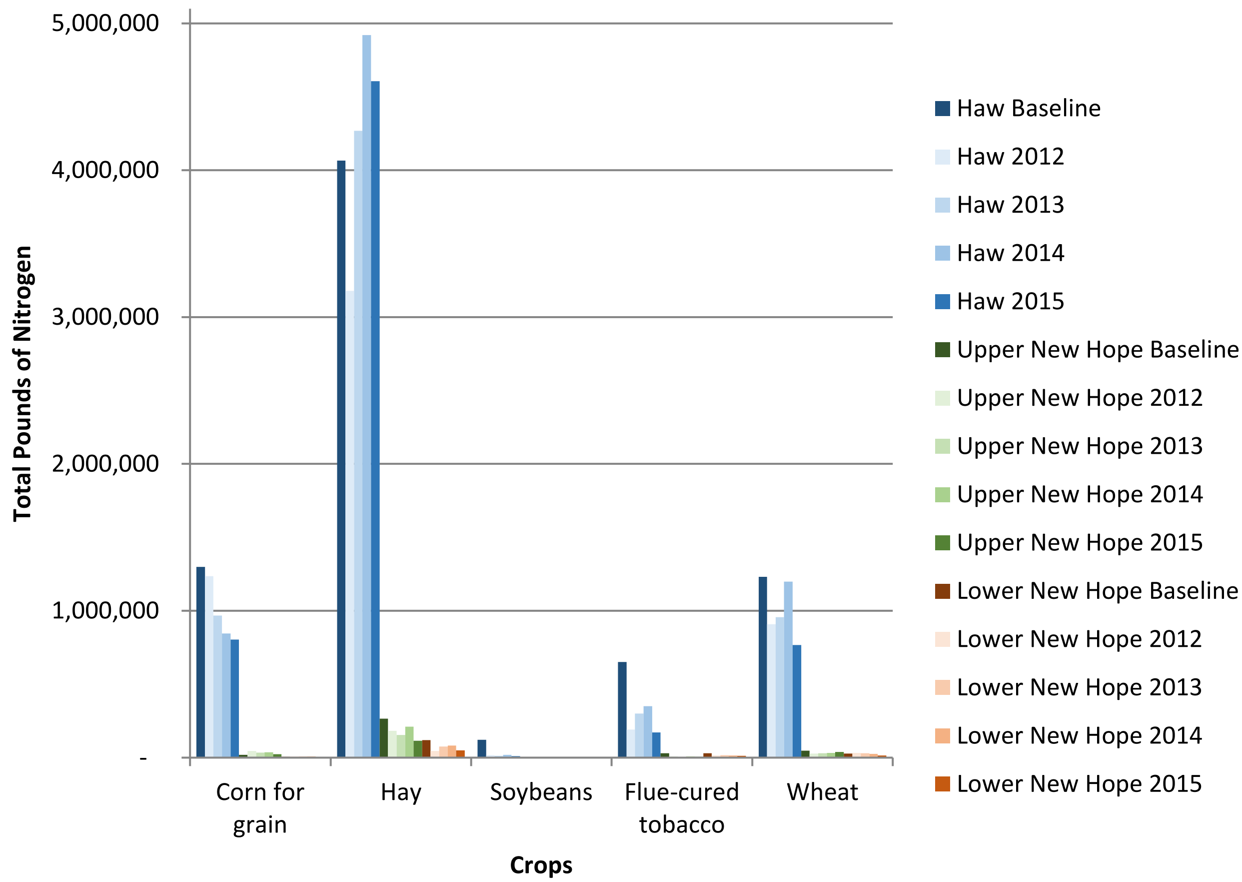


Figure 7 depicts the total annual nitrogen (in pounds) applied to cropland during the baseline (1997-2001), 2012, 2013, 2014, and 2015 to show the impact of fertilization rates related to crops that are grown in each subwatershed. Due to the small size of the subwatersheds in Jordan Lake, minor changes in nitrogen fertilization rates result in significant effects on the reported nitrogen reductions on cropland for smaller subwatersheds. The total amount of nitrogen lost in each of these subwatersheds is a function of the fertilization rate for each crop and the number of acres planted, which means that the largest nitrogen fluxes in the Jordan Lake Watershed occur on hay, wheat, and corn acres in the Haw subwatershed.

Figure 7. Total annual nitrogen applied (lbs) to cropland for the baseline (1997-2001), 2012, 2013, 2014, and 2015 by Subwatershed, Jordan Lake Watershed



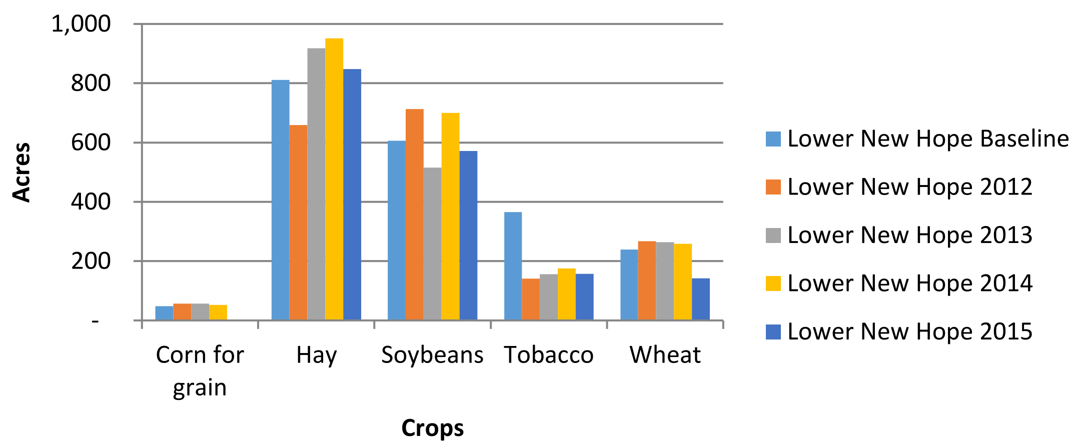
Cropping Shifts

Counties calculated cropland acreage by utilizing crop data reported through the North Carolina Agricultural Statistics Service of the U.S. Department of Agriculture in cooperation with the North Carolina Department of Agriculture and Consumer Services. Federal farm program requirements have changed since the baseline such that farmers have to report more of their agricultural acreage to Farm Service Agency and this acreage is also accounted for in Agricultural Statistics. Each crop requires different amounts of nitrogen and uses the nitrogen applied with different efficiency rates. Changes in the mix of crops grown can have a significant impact on the cumulative yearly nitrogen loss reduction.

Figures 8, 9, and 10 show crop acres and shifts for the baseline, 2012, 2013, 2014, and 2015. The acres of mixed cool season grass (hay) increased substantially since the baseline, by 10,435 acres in the Haw subwatershed and 37 acres in the Lower New Hope subwatershed. This shift to hay production may be due to the tobacco quota buyout program and increased reporting of hayland by farmers. Soybean acreage has also grown by 1,393 acres in the Upper New Hope and Haw subwatersheds. Corn and wheat production decreased in 2015 by 3,541 and 3,288 acres respectively; while tobacco acres decreased by 5,106 acres across the watershed. A host of factors from individual to global determine crop choices. Crop acreages are expected to fluctuate with the market yearly.

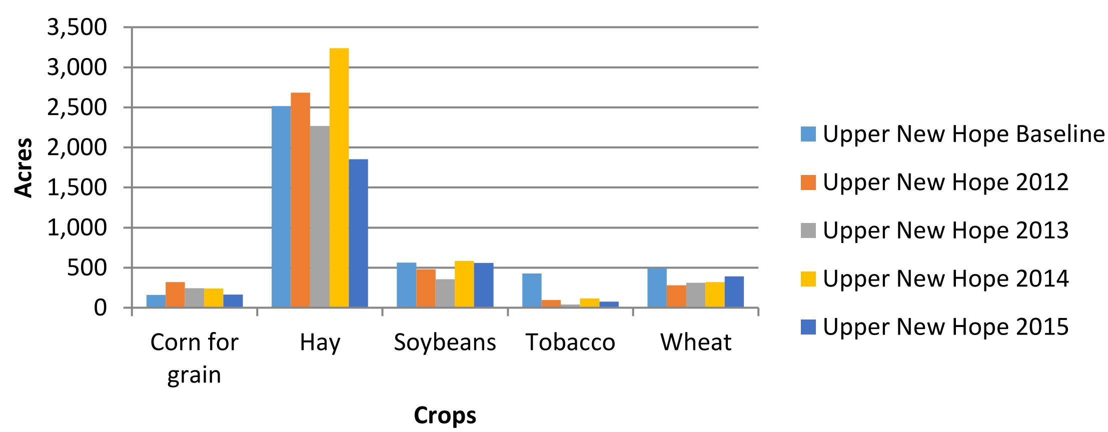
Of the cropland acres in the Jordan Lake Watershed, 2% are in the Lower New Hope Subwatershed.

Figure 8. Acreage of Major Crops for the Baseline (1997-2001), 2012, 2013, 2014, and 2015, Lower New Hope Subwatershed, Jordan Lake Watershed



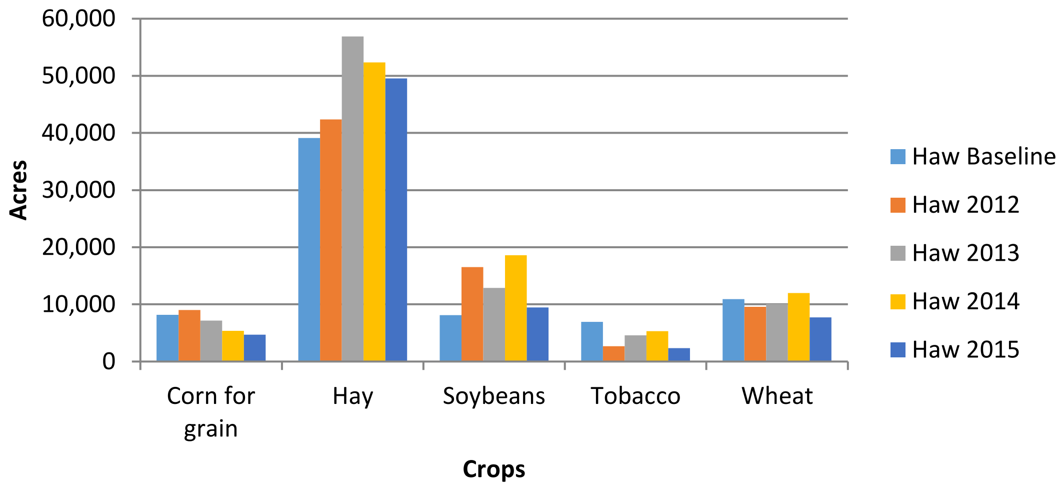
Of the cropland acres in the Jordan Lake Watershed, 4% are in the Upper New Hope Subwatershed.

Figure 9. Acreage of Major Crops for the Baseline (1997-2001), 2012, 2013, 2014, and 2015, Upper New Hope Subwatershed, Jordan Lake Watershed



Of the cropland acres in the Jordan Lake Watershed, 94% are in the Haw Subwatershed.

Figure 10. Acreage of Major Crops for the Baseline (1997-2001), 2012, 2013, 2014, and 2015, Haw Subwatershed, Jordan Lake Watershed

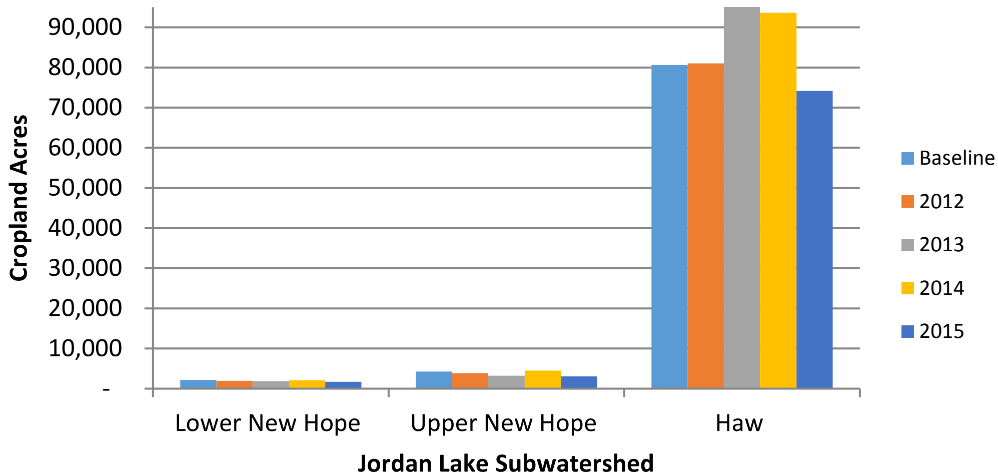


Land Use Change to Development and Cropland Conversion

The number of cropland acres fluctuates every year in the Jordan Lake Watershed and its subwatersheds due to cropland conversion and development. Each year, some cropland is permanently lost to development, or converted to grass or trees and likely to be ultimately lost from agricultural production. Figure 11 displays the total cropland acres in the watershed in the baseline, 2012, 2013, 2014, and 2015. Data regarding land use change since the baseline is summarized below.

Since the baseline, some agricultural acres have been lost permanently to development. These numbers are not directly comparable because they are documented with varying methodologies in each county. In addition to development, cropland can be converted to other uses. The WOC tracks the acres of cropland that are converted to grass or trees through state or federal cost share programs. Since the baseline, the following cropland acres in each subwatershed have been converted to grass or trees through state or federal cost share programs: 46 acres in the Lower New Hope Subwatershed, none in the Upper New Hope Subwatershed and 2,580 acres in the Haw Subwatershed.

Figure 11. Total Cropland Acres in the Jordan Lake Watershed, Baseline (1997-2001), 2012, 2013, 2014, and 2015



Nutrient Management Training

As required by the fertilizer management rule (.0272), nutrient management training was conducted in the Jordan Lake Watershed. NC Cooperative Extension held 26 nutrient management training sessions, and since rule adoption approximately 1,200 farmers and applicators have received training.

Pasture Accounting

The Jordan Lake WOC first began collecting data for pastureland nutrient accounting under an old methodology in 2012. Since that time, the committee originally responsible for developing that methodology has met to assess new data and protocol.

In 2016, the Pasture Points Committee was reconvened with membership representing North Carolina State University (NCSU), United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), NC Division of Soil and Water Conservation (DSWC), NC Division of Water Resources (DWR), NC Department of Agriculture and Consumer Services (NCDA&CS), and Orange County Soil and Water Conservation District. After reviewing newly available data sources and scrutinizing existing research findings, the subcommittee recommended a methodology change for the 5-year accounting process. The pasture point subcommittee found that:

- The pasture point system was adopted separate from NLEW due to data limitations in the applicability of NLEW to pasture systems. New research and a better understanding of USDA data sources, however, have enabled more accurate documentation of animal waste nitrogen content across the state.
- Because pasture acre and animal number totals are still reported only on a 5-year basis in the Census of Agriculture, pasture accounting will continue to be reported every 5-years. For Jordan Lake, the baseline year has been accepted as 2002.

- Nitrogen rates will be a combination of fertilizer nitrogen plus nitrogen deposited from pastured animals. Inorganic fertilizer application rates are determined by local field staff. Animal-derived nitrogen will be calculated based on animal type from animal waste generation values developed by the American Society of Agricultural and Biological Engineers and volatilization coefficients of the animal nitrogen source developed by NC State University. Total nitrogen inputs will be calculated at the county scale. Total nitrogen loss estimates will be calculated using NLEW and compared against the 2002 baseline.
- Pasture BMPs funded by state and federal cost share programs are to be tracked annually and compiled every five years. Individual contracts are reviewed to compile acres within livestock exclusion systems which have been implemented during each 5-year period.

Livestock exclusion systems will be assigned the nitrogen reduction rates specified in Table 3[4]. These reduction percentages include the elimination of direct deposition of waste into surface waters by livestock in addition to the filtration of nitrogen by vegetated buffer areas.

Table 3. Points nitrogen reduction from pastureland for different BMPs, Pasture Point System

Pasture BMP	N Reduction
Exclusion fencing with a 10’ stream setback	30%
Exclusion fencing with a 20’ buffer	35%
Exclusion fencing with a 30’ buffer	40%
Exclusion fencing with a 50’ buffer	45%
Exclusion fencing with a 100’ buffer	50%

This updated methodology is currently being used by the Falls Lake Watershed Oversight Committee and was accepted for use by the Jordan Lake WOC in May of 2017. Nitrogen loss estimates for the 1997-2002, 1997-2007, and 1997-2012 periods are presented in Table 4. The percent of each county in each Jordan Lake Watershed, determined by GIS analysis, was used to calculate the number of pasture acres and pastured animals within the watershed. Despite the fact that hay acres can be grown for both hay and livestock production, grazed pasture acres have never been reported under the cropland category for NLEW nitrogen loss accounting, and only acres which are grazed are reported under the pasture category for NLEW nitrogen loss accounting. For CY2012, the Upper New Hope subwatershed is reporting a 48% nitrogen loss reduction from baseline, the Lower New Hope subwatershed is reporting a 39% nitrogen loss reduction from baseline, and the Haw subwatershed is reporting a 29% nitrogen loss reduction from baseline. All three subwatersheds have exceeded their mandated goals.

[4] Line, D.E., D.L. Osmond, & W. Childres. 2016. Effectiveness of Livestock Exclusion in a Pasture of Central North Carolina. Journal of Environmental Quality. doi:10.2134/jeq2016.03.0089

Table 4. Estimated reductions in pasture land nitrogen loss from baseline (CY1997-CY2002) for CY2007 and CY2012, Jordan Lake Watershed

Upper New Hope: Goal of 35% Nitrogen Loss Reduction					
County	**2002 Nitrogen Loss (lbs)**	**2007 Nitrogen Loss (lbs)**	**2007 N Loss Reduction (%)**	**2012 Nitrogen Loss (lbs)**	**2012 N Loss Reduction (%)**
Chatham	78,302	66,248	15%	49,553	37%
Durham	52,920	41,431	22%	23,279	56%
Orange	145,310	128,040	12%	72,185	50%
Wake	8,124	5,132	37%	3,234	60%
Total	284,656	240,851	15%	148,251	48%
Lower New Hope: Goal of no net increase in Nitrogen Loss					
County	**2002 Nitrogen Loss (lbs)**	**2007 Nitrogen Loss (lbs)**	**2007 N Loss Reduction (%)**	**2012 Nitrogen Loss (lbs)**	**2012 N Loss Reduction (%)**
Chatham	156,574	132,496	15%	99,125	37%
Wake	20,328	12,837	37%	8,005	61%
Total	176,902	145,333	18%	107,130	39%
Haw: Goal of 8% Nitrogen Loss Reduction					
County	**2002 Nitrogen Loss (lbs)**	**2007 Nitrogen Loss (lbs)**	**2007 N Loss Reduction (%)**	**2012 Nitrogen Loss (lbs)**	**2012 N Loss Reduction (%)**
Alamance	777,287	657,550	15%	618,072	20%
Caswell	101,760	47,406	53%	46,298	55%
Chatham	369,013	309,872	16%	231,332	37%
Guilford	418,201	412,906	1%	324,242	22%
Orange	150,473	132,156	12%	74,022	51%
Rockingham	133,955	67,656	49%	92,870	31%
Total	1,950,689	1,627,546	17%	1,386,836	29%

The reduction percentages reported above result from a combination of pasture land loss, fertilization decreases, stocking rate changes, and BMP implementation. Table 5 shows how these factors have changed in the Jordan Lake Watershed since the 2002 baseline.

Table 5. Pasture operation changes from baseline (CY2002) for CY2007 and CY2012, Jordan Lake Watershed

Factor	Baseline	2007	2012	2002-2012 % Change
Pasture Land	99,595 acres	87,237 acres	83,096 acres	-17%
Fertilization†	103 lbs N/acre	93 lbs N/acre	81 lbs N/acre	-21%
Stocking Rate	1.2 animal units/acre	1.4 animal units/acre	1.5 animal units/acre	+22%
Livestock Exclusion System Implementation	976 acres	3,451 acres	4,224 acres	+433%

†Total fertilization rate equals direct waste deposition times volatilization factor plus supplemental application

Phosphorus Indicators for CY2012 through CY2015

The qualitative indicators included in Table 6 show the relative changes in land use and management parameters and their relative effect on phosphorus loss risk in the watershed from the baseline. This approach was recommended by the Phosphorus Technical Advisory Committee (PTAC) in 2005 due to the difficulty of developing an aggregate phosphorus tool parallel to the nitrogen NLEW tool. The PTAC reconvened in April 2010 to make minor revisions for the tool's use in this watershed and the approach was approved for use in the Jordan Lake Watershed by the Water Quality Committee of the EMC. This report includes phosphorus indicator data for the baseline period (1997-2001), CY2012, CY2013, CY2014 and CY2015. Most of the parameters indicate less risk of phosphorus loss than in the baseline.

Contributing to the reduced risk of phosphorus loss is the reduction in the acres of tobacco, the decrease in the amount of animal waste phosphorus, and a movement to 90% conservation tillage on cropland in the watershed.

The soil test phosphorus median number reported for the watershed fluctuates each year due to the nature of how the data is collected and compiled. The soil test phosphorus median numbers shown in Table 6 are

Phosphorus Technical Assistance Committee (PTAC):

The PTAC's overall purpose was to establish a phosphorus accounting method for agriculture in the basin. It determined that a defensible, aggregated, county-scale accounting method for estimating phosphorus losses from agricultural lands was not feasible due to "the complexity of phosphorus behavior and transport within a watershed, the lack of suitable data required to adequately quantify the various mechanisms of phosphorus loss and retention within watersheds of the basin, and the problem with not being able to capture agricultural conditions as they existed in 1991." The PTAC instead developed recommendations for qualitatively tracking relative changes in practices in land use and management related to agricultural activity that either increase or decrease the risk of phosphorus loss from agricultural lands in the basin on an annual basis.

generated by using North Carolina Department of Agriculture and Consumer Services (NCDA&CS) soil test laboratory results from voluntary soil testing and the data is reported by the NCDA&CS. The number of samples collected each year varies. The data does not include soil tests that were submitted to private laboratories. The soil test results from the NCDA&CS database represent data from entire counties in the watershed, and have not been adjusted to include only those samples collected in the Jordan Lake Watershed.

Table 6. Relative Changes in Land Use and Management Parameters and their Relative Effect on Phosphorus Loss Risk in the Jordan Lake Watershed

Parameter	Units	Source	Baseline (average 1997-2001)	2013	2014	2015	Percent change (baseline to CY2015)	2015 P Loss Risk +/-
Cropland	Acres	NC Ag Statistics	87,384	101,427	100,271	78,933	-10%	-
Cropland conversion (to grass & trees)	Acres	USDA-NRCS & NCACSP	1,359	2,472	2,476	2,827	108%	-
Conservation tillage[5]	Acres	USDA-NRCS & NCACSP	1,997	18,039	18,314	19,790	891%	-
Vegetated buffers (cumulative)	Acres	GIS analysis	54,212	52,831	52,831	52,833	-3%	+
Tobacco acres	Acres	USDA-NRCS & NCACSP	7,667	4,762	5,604	2,601	-43%	-
Scavenger crop	Acres	USDA-NRCS & NCACSP	0	1000	1765	2238	N/A	-
Animal waste P	lbs of P/ yr	NC Ag Statistics	7,965,784[6]	4,395,314	4,407,441	4,462,939	-44%	-
Soil test P median	P-Index	NCDA&CS	72	62	55	55	-24%	-

[5] Conservation tillage is being practiced on additional acres but this number only reflects acres under active cost share contracts, not acres where contracts have expired or where farmers have adopted the use of conservation tillage without cost share assistance.

[6] This number differs from previous reports due to correction of a data entry error.

The WOC finds that the decreased risk of P loss is associated with the following three important parameters:

- increase in conservation tillage acreage
- decrease in animal waste phosphorus
- decrease in tobacco acreage

A 44% reduction in animal waste phosphorus is due primarily to the closure of a large poultry processing plant in Siler City, which decreased the demand for broilers in the region, and an overall reduction in poultry and cattle inventories. The WOC recommends that no additional management actions be required of agricultural operations in the watershed at this time to comply with the phosphorus goals of the agriculture rule.

The WOC will continue to track and report the identified set of qualitative phosphorus indicators to the Division of Water Resources (DWR) annually, and to bring any concerns raised by the results of this effort to the DWR's attention as they arise, along with recommendations for any appropriate action. The WOC expects that BMP implementation may continue to increase throughout the watershed in future years, and notes that BMPs installed for nitrogen and sediment control often provide significant phosphorus benefits as well.

The Jordan Lake Watershed Oversight Committee also initially recommended adding tracking of the annual application of human biosolids, but ultimately removed this element from the tracking methodology due to lack of readily accessible biosolids data. Currently, biosolids applicators submit paper copy annual reports containing application and site information; however, due to limited resources NC DEQ is not keying the information into a database. To include this information would require new resources to mine historical and enter new hard copy data. To date, resources have not been obtained for this purpose. When digital biosolids information becomes available the human biosolids component will be tracked as a separate component of the phosphorus accounting. In an effort to improve nutrient management strategies that are part of the residuals (biosolids) application program, NC DEQ formed a stakeholders group to evaluate available nutrient management tools for phosphorus and make recommendations for future phosphorus management of biosolids applications.

BMP Implementation Not Tracked by NLEW

Not all types of nutrient- and sediment-reducing best management practices (BMPs) are tracked by NLEW. Other BMPs include: livestock-related nitrogen and phosphorus reducing BMPs, BMPs that reduce soil and phosphorus loss, and BMPs that do not have enough scientific research to support estimating a nitrogen benefit. The WOC believes it is worthwhile to recognize these practices. Table 6 identifies BMPs and tracks their implementation in the watershed since the end of the baseline period.

Table 7. Best management practices installed from 2002 to 2015, Jordan Lake Watershed[7] (cumulative)

Conservation practice	Units	2012	2013	2014	2015
Ag road repair-stabilization	feet	2,880	2,880	2,880	3,207
Agricultural pond restoration/repair	units	17	18	20	22
Closure-waste impoundments	units	17	18	19	19
Conservation cover	acres	815	815	815	815
Constructed wetland	acres	2	2	2	2
Critical area planting	acres	67	68	71	74
Cropland conversion-grass	acres	1,045	1,063	1,063	1,065
Cropland conversion-trees	acres	872	916	960	1,002
Diversion	feet	6,110	6,450	6,450	6,450
Fencing (USDA programs)	feet	6,741	6,741	6,741	41,253
Field border	acres	141	144	144	147
Filter strip	acres	0.4	0.4	0.4	0.4
Grassed waterway	acres	290	290	293	293
Habitat management	acres	310	310	310	310
Nutrient management	acres	5,110	5,110	5,110	5,290
Nutrient management plan	number	29	29	29	30
Pasture renovation	acres	2,881	2,881	2,881	2,881
Pastureland conversion to trees	acres	31	31	31	31
Pond	number	1	1	1	1
Prescribed grazing	acres	3,722	4,093	4,706	5,113
Riparian forest buffer	acres	85	85	85	85
Sediment control basin	units	2	2	2	2
Sod-based rotation	acres	9,710	9,710	9,710	9,916
Streambank and shoreline protection	acres	16,905	16,905	16,905	16,905
Terrace	feet	31,379	31,379	31,379	31,379
Tillage management	acres	17,906	18,039	18,314	19,790

[7] Values represent active contracts in State and Federal cost share programs. Additional BMPs may exist in the watershed as producers may maintain practices after the life of a cost share contract, and other practices are installed without cost share assistance.

Looking Forward

WOC recognizes the dynamic nature of agricultural business:

- Urban encroachment (i.e., crop selection and production shifts as fields become smaller)
- Age of farmer (i.e., as retirement approaches farmers may move from row crops to cattle)
- Changes in the world economies, energy or trade policies
- Changes in government programs (i.e., commodity support, crop insurance or environmental regulations)
- Weather (i.e., long periods of drought or rain)
- Scientific advances in agronomics (i.e., production of new types of crops or improvements in crop sustainability)

The Jordan Lake WOC will continue to improve rule implementation, relying heavily on the local soil and water conservation districts who work directly with farmers to assist with best management practice design and installation.

Because cropping shifts are susceptible to various pressures, the WOC is working with all counties to continue BMP implementation on both cropland and pastureland that provides for a lasting reduction in nitrogen and phosphorus loss in the watershed while monitoring cropping changes.

The WOC will incorporate recommendations of NC DEQ's stakeholder group on evaluating available nutrient management strategies that are part of the residuals (biosolids) application program and incorporate biosolid application data in agriculture's phosphorus accounting when available electronically.

Local Soil and Water Conservation District and NRCS staffs continue to encourage and implement BMPs in the watershed. Funding for reporting and implementation is an integral part of the success of this strategy. There is limited funding to support nutrient management data collection, so the Division of Soil and Water Conservation must rely heavily on these local staff members who have other duties and responsibilities for information gathering and analysis. Further, in 2011 the staff position in the Division of Soil and Water Conservation previously assigned to work on Jordan Lake reporting was reassigned due to significant budget reductions, and the Division has had to repurpose the workplans of other employees to ensure reports are completed in a timely manner. The WOC considers this to be important work and notes the necessity of future funding to support annual reporting requirements.

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