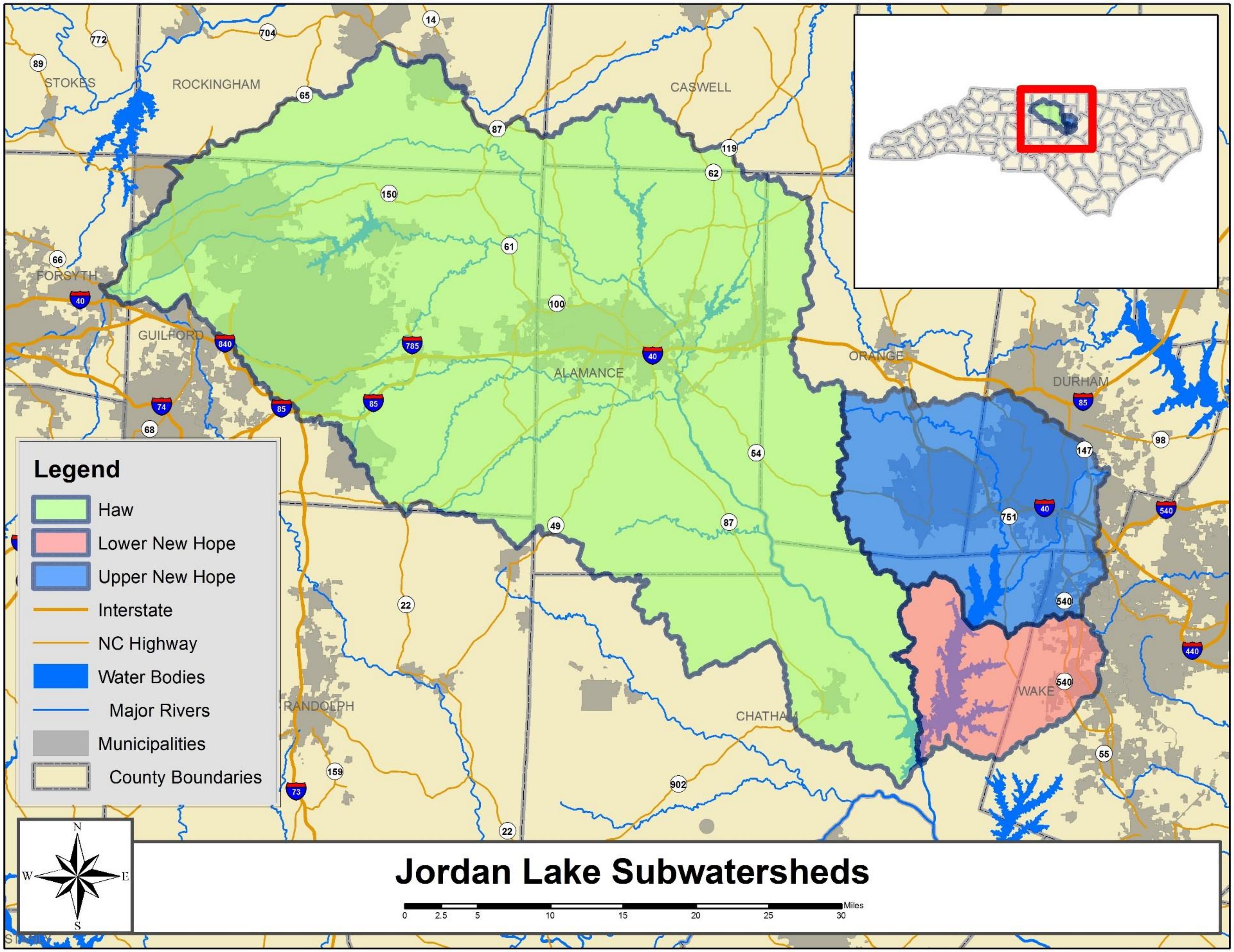
NCDA&CS

Annual Progress Report for the Jordan Lake Agriculture Rule (15A NCAC 02B.0264) for the Baseline Period (1997-2001) for Crop Year 2016

A Report to the Division of Water Resources from the Jordan Lake Watershed Oversight Committee: Crop Year 2016, Submitted 2018


Jordan Lake Subwatersheds
Legend
Haw
Lower New Hope
Upper New Hope
Interstate
NC Highway
Water Bodies
Major Rivers
Municipalities
County Boundaries
STOKES
ROCKINGHAM
CASWELL
FORSYTH
GUILFORD
ALAMANCE
ORANGE
DURHAM
RANDOLPH
CHATHAM
WAKE
Miles
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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, 2016. 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 data from agricultural staff in eight counties, and the WOC reviewed and approved 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. Each of the three subwatersheds is meeting their cropland nitrogen loss reduction goal from baseline to CY2016, with the Upper New Hope Watershed reporting a 67% reduction, the Lower New Hope Watershed reporting a 73% reduction, and the Haw River Watershed reporting a 33% reduction. Table 1 illustrates the estimated reductions in nitrogen loss collectively achieved by cropland agriculture compared to the 1997-2001 baseline.

Reductions in cropland nitrogen loss have been achieved through crop shifts and reduction in nitrogen application rates for most major crops in the watershed. From the baseline to 2016, 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 significantly. Nitrogen application rates for most crops in 2016 were stable, but the application rate on corn acres increased.

Jordan Lake Watershed Oversight Committee Composition, Jordan Agriculture Rule:

1. NC Division of Soil & Water Conservation – Joey Hester
2. USDA-NRCS – Pete Crawford
3. NCDA&CS – Joe Hudyncia
4. NC Cooperative Extension Service – Deanna Osmond
5. NC Division of Water Resources – Patrick Beggs
6. Watershed Environmental Interest – Vacant
7. Watershed Environmental Interest – Gerald Featherstone
8. Environmental Interest – Catherine Deininger
9. General Farming Interest – Anne Coan
10. Pasture-based Livestock Interest – Frank Bell
11. Equine Livestock Interest – Sue Gray
12. Cropland Farming Interest – Jane Iseley
13. Scientific Community – Janet MacFall

Pasture nitrogen loss accounting relies on USDA-NASS data which is gathered via the Census of Agriculture every five years. The next pasture-based nitrogen loss calculation will be included in a future report once the 2017 Census of Agriculture is published. Each of the three subwatersheds met their pastureland nitrogen loss reduction goal from baseline to CY2012, the most recent year of publication.

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.

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 were 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.

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.

All counties provided information for the annual report to the WOC in March 2018. Collectively, each of the three subwatersheds is meeting their cropland nitrogen loss reductions, with the Upper New Hope Watershed reporting a 67% reduction, the Lower New Hope Watershed reporting a 73% reduction, and the Haw River Watershed reporting a 33% 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 which 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.

The Nitrogen Loss Estimation Worksheet (NLEW) was developed to estimate a baseline nitrogen loading and percent N reductions based on the regulatory framework developed for the agricultural accounting tool[1]. Changes in nitrogen occur due to nitrogen fertilizer management, conservation practices, cropping shifts, and loss of agricultural lands. The Jordan Lake Agriculture Rule was written so that each sub watershed has a nitrogen loss reduction requirement.

Nitrogen Reduction from Cropland from Baseline for CY2016

All counties submitted their progress report to the WOC in March 2018.

- For the Lower New Hope Watershed, agriculture achieved a cropland nitrogen loss reduction of 67% compared to the average nitrogen loss from 1997 to 2001.
- For the Upper New Hope Watershed, agriculture achieved a cropland nitrogen loss reduction of 73% compared to the average nitrogen loss from 1997 to 2001.
- For the Haw Watershed, agriculture achieved a cropland nitrogen loss reduction of 33% 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 CY2015 and CY2016, along with nitrogen loss percent reductions from baseline values in CY2015 and CY2016. In particular, Durham County had no cropland reported to North Carolina Agricultural Statistics, so their cropland nitrogen loss reduction is currently reported as N/A.

[1] Osmond, D.L., L. Xu, N.N. Ranells, S.C. Hodges, R. Hansard, and S.H. Pratt. 2001. Nitrogen loss estimation worksheet (NLEW): agricultural Nitrogen loading reduction tracking tool. In: Optimizing Nitrogen Management in Food and Energy Production and Environmental Protection. Eds: J. Galloway, E. Cowling, J. Erisman, J. Wisniewski, C. Jordan. Contributed Papers from the 2nd International Nitrogen Conference. October 14-18, 2001. Potomac, MD, USA. Pp.777-783.

Table 1. Estimated reductions in agricultural nitrogen loss (cropland) from baseline (1997-2001), CY2015 and CY2016, Jordan Lake Watershed †

County	Baseline Nitrogen Loss (lb) †	CY2015 Nitrogen Loss (lb) †	CY2015 N Loss Reduction (%)	CY2016 Nitrogen Loss (lb) †	CY2016 N Loss Reduction (%)
Upper New Hope Subwatershed: Goal of 35% nitrogen loss reduction (1% of total Jordan Lake Watershed cropland)					
Chatham	43,063	7,457	83%	6,781	84%
Durham	37,618 ¤	12,068	68%	N/A ¤	N/A ¤
Orange	68,632	39,488	42%	41,170	40%
Wake	9,694	2,378	75%	4,171	57%
Total	**121,389 ¤**	**61,391**	**61%**	**52,122**	**57%**
Lower New Hope Subwatershed: Goal of no increase in nitrogen loss (3% of total Jordan Lake Watershed cropland)					
Chatham	56,632	11,041	81%	10,027	82%
Wake	38,362	15,643	59%	15,394	60%
Total	**94,994**	**26,684**	**72%**	**25,421**	**73%**
Haw Subwatershed: Goal of 8% nitrogen loss reduction (96% of total Jordan Lake Watershed cropland)					
Alamance	697,634	522,796	25%	476,897	32%
Caswell	260,254	193,974	25%	170,777	34%
Chatham	245,458	51,419	79%	46,329	81%
Guilford	1,393,551	753,566	46%	1,064,003	24%
Orange	231,272	128,285	45%	133,437	42%
Rockingham	169,080	116,751	31%	109,771	35%
Total ‡	**2,997,249**	**1,766,791**	**41%**	**2,001,214**	**33%**

† *Nitrogen loss values are for comparative purposes. These are produced via NLEW calculations and based on best available nitrogen application rates to cropland in the watershed. Loss totals represent nitrogen neither used by crops nor intercepted by BMPs in a Soil Management Group. 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.*
¤ Baseline nitrogen loss totals for Durham County were removed from the total reported nitrogen loss for this year's report. Durham's CY2016 cropland acreage fell below the reporting threshold for Agricultural Statistics, and the removal was necessary to ensure that the Upper New Hope Subwatershed's overall reduction percentage wasn't affected by an artificial reduction to zero caused by these thresholds.

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), 2013, 2014, 2015, and 2016. 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 .[2]

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

Table 2: Nitrogen loss reduction percentages by buffer practice installation width

Buffer width	Nitrogen loss reduction percentage[3]
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.

Since the baseline, a significant number of buffer practices has been installed in the Jordan Lake Watershed through the Division of Mitigation Services (DMS). DMS has completed 57 projects in the watershed from

[2] 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.

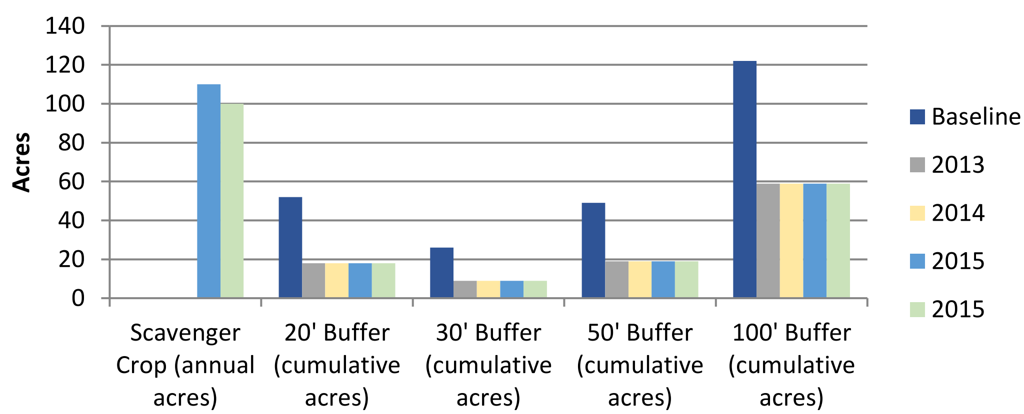
[3] These percentages represent the net or relative percent improvement in nitrogen removal resulting from riparian buffer implementation.

the baseline through 2016, and at least six private mitigation banks from which DMS purchases credits are currently operating in the watershed. DMS project data is not tracked either for previous land use or for the area of buffer restored in conjunction with stream restoration projects. Because DMS funded these buffers for 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 and purchase credits generated on agricultural land, this decreases the possibility for buffers to be installed for credit under agriculture rule progress reporting.

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 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.

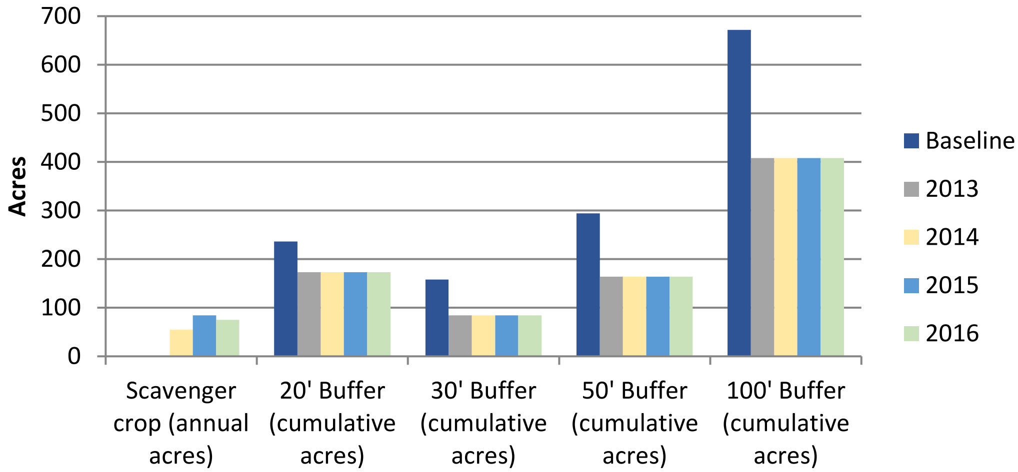
Of the cropland acres in the Jordan Lake Watershed, 1% are in the Lower New Hope Subwatershed.

Figure 1. Nitrogen Reducing BMPs installed on Croplands from Baseline (1997-2001), 2013, 2014, 2015, and 2016, Lower New Hope Subwatershed, Jordan Lake Watershed *



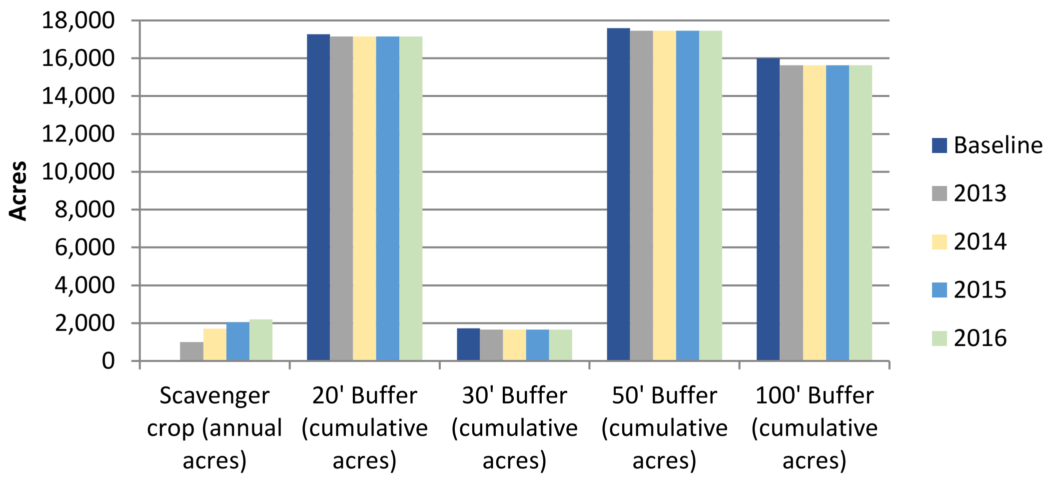
Of the cropland acres in the Jordan Lake Watershed, 3% are in the Upper New Hope Subwatershed.

Figure 2. Nitrogen Reducing BMPs installed on Croplands from Baseline (1997-2001), 2013, 2014, 2015, and 2016, Upper New Hope Subwatershed, Jordan Lake Watershed*



Of the cropland acres in the Jordan Lake Watershed, 96% are in the Haw Subwatershed.

Figure 3. Nitrogen Reducing BMPs installed on Croplands from Baseline (1997-2001), 2013, 2014, 2015, and 2016, 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.*[4]

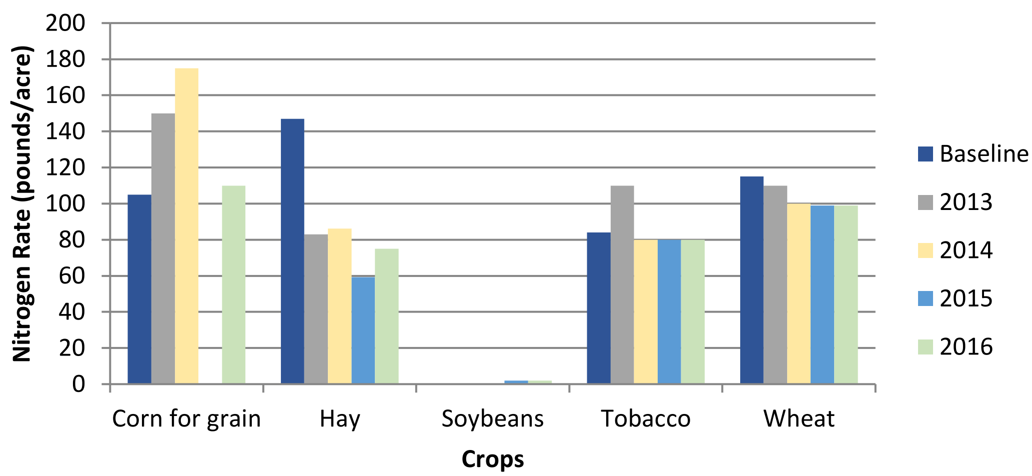
[4] Bruton, Jeffrey Griffin. 2004. Headwater Catchments: Estimating Surface Drainage Extent Across North Carolina and Correlations Between Landuse, Near Stream, and Water Quality Indicators in the Piedmont Physiographic

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 and 2016 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 and 2016 compared to the baseline. No corn was grown in the Lower New Hope subwatershed in 2015.

Of the cropland acres in the Jordan Lake Watershed, 1% are in the Lower New Hope Subwatershed.

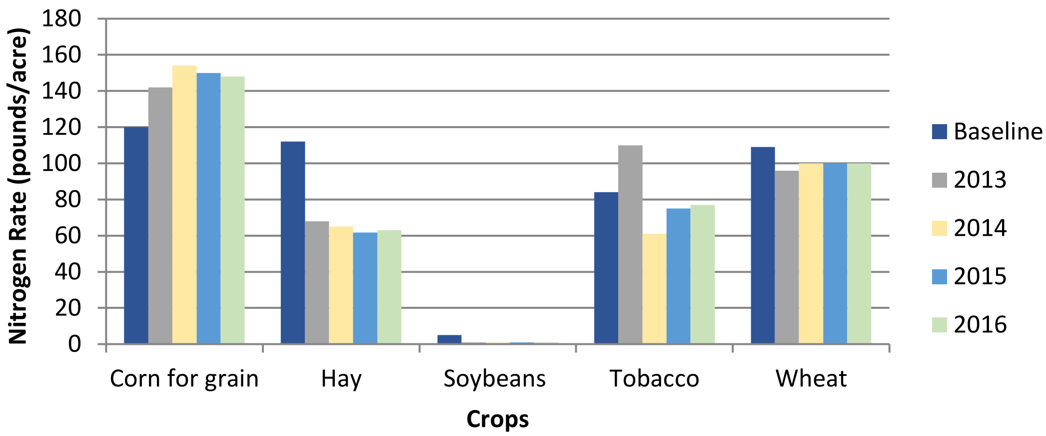
Figure 4. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2013, 2014, 2015, and 2016, Lower New Hope Subwatershed, Jordan Lake Watershed



Region. Ph.D. Dissertation. Department of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC 27606.

Of the cropland acres in the Jordan Lake Watershed, 3% are in the Upper New Hope Subwatershed.

Figure 5. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2013, 2014, 2015, and 2016, Upper New Hope Subwatershed, Jordan Lake Watershed



Of the cropland acres in the Jordan Lake Watershed, 96% are in the Haw Subwatershed.

Figure 6. Average annual nitrogen fertilization rate (lb/ac) on cropland for the baseline (1997-2001) 2013, 2014, 2015, and 2016, Haw Subwatershed, Jordan Lake Watershed

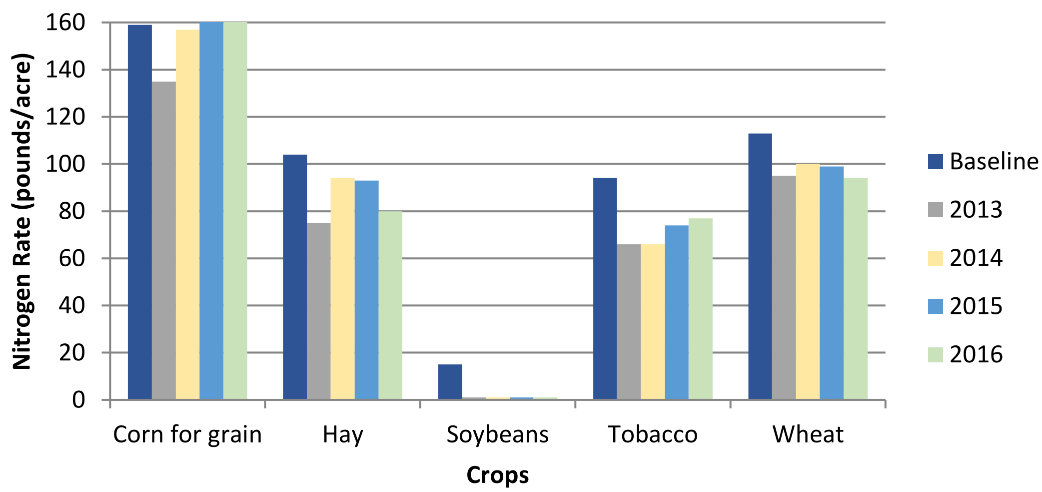
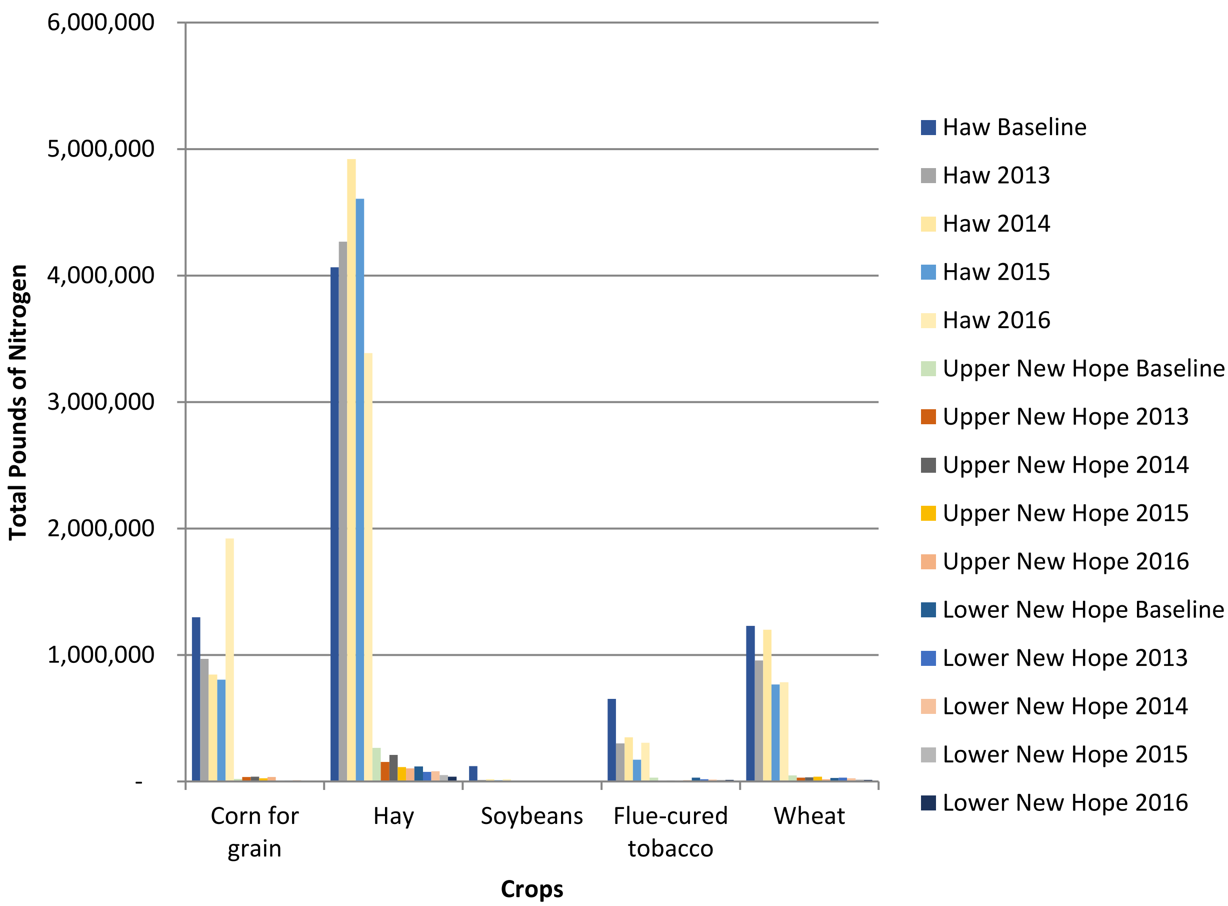


Figure 7 depicts the total annual nitrogen (in pounds) applied to cropland during the baseline (1997-2001), 2013, 2014, 2015, and 2016 to show the impact of fertilization rates related to crops that are grown in each subwatershed. Due to the small size of the subwatersheds in Jordan Lake, minor changes 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), 2013, 2014, 2015, and 2016 by Subwatershed, Jordan Lake Watershed



Cropping Shifts

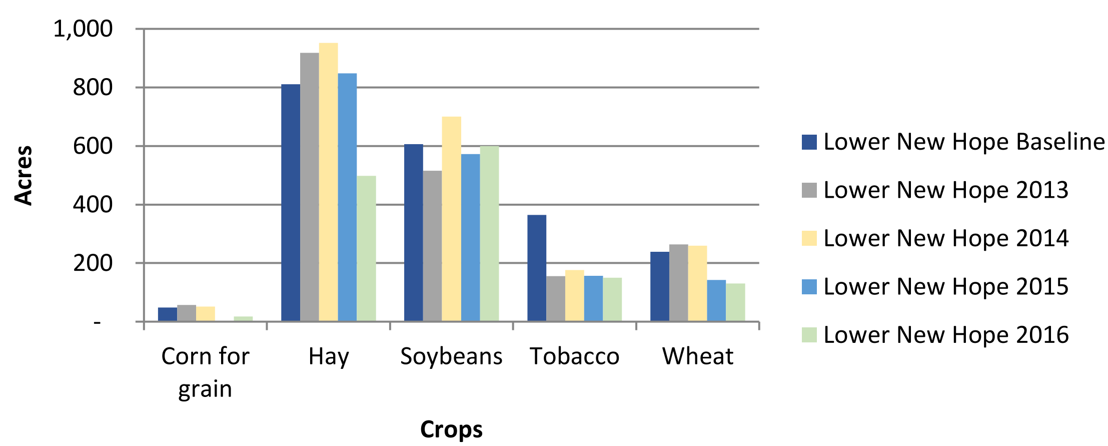
Counties calculated cropland acreage by utilizing crop data reported through the North Carolina Agricultural Statistics Service of the U.S. Department of Agriculture in cooperation with the North Carolina Department of Agriculture and Consumer Services.

Agricultural Statistics reports selected major commodity crops, which means that smaller acreages of vegetable produce and specialty crops are not included in their annual reports. In addition, in any county where it occurs, Agricultural Statistics does not report planted or harvested acreage for any crop where fewer than 500 acres were grown or where fewer than 3 individual producers reported growing a particular crop. 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, 2013, 2014, 2015, and 2016. The acres of mixed cool season grass (hay) increased by 3,249 acres in the Haw subwatershed since the baseline but decreased by 313 acres in the Lower New Hope subwatershed and 885 acres in the Upper New Hope subwatershed. This shift to hay production in the Haw subwatershed may be due to the tobacco quota buyout program and increased reporting of hayland by farmers. Soybean and corn acreage has increased by 10,519 and 2,864 acres, respectively, and tobacco acres decreased by 3,495 in the subwatersheds. A host of factors from individual to global determine crop choices. Crop acreages are expected to fluctuate with the market yearly.

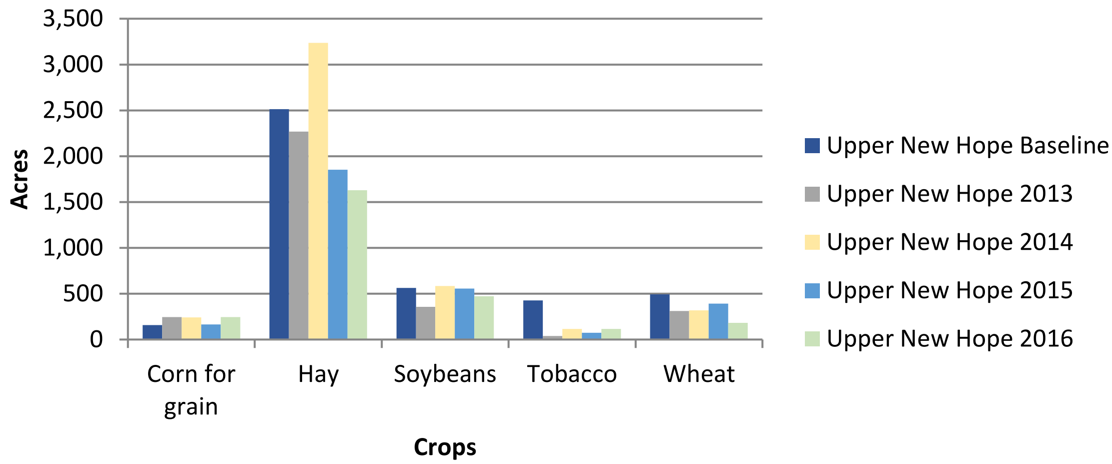
Of the cropland acres in the Jordan Lake Watershed, 1% are in the Lower New Hope Subwatershed.

Figure 8. Acreage of Major Crops for the Baseline (1997-2001), 2013, 2014, 2015, and 2016, Lower New Hope Subwatershed, Jordan Lake Watershed



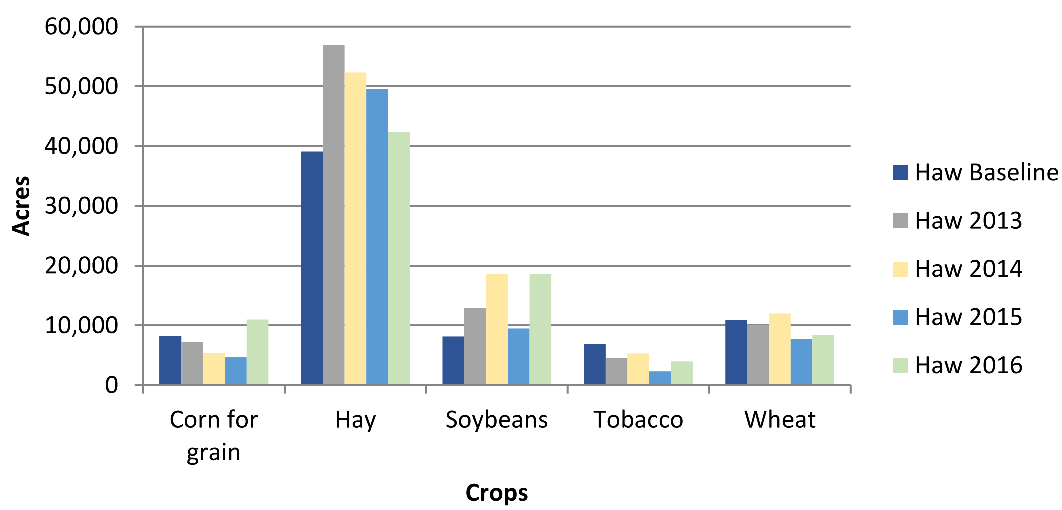
Of the cropland acres in the Jordan Lake Watershed, 3% are in the Upper New Hope Subwatershed.

Figure 9. Acreage of Major Crops for the Baseline (1997-2001), 2013, 2014, 2015, and 2016, Upper New Hope Subwatershed, Jordan Lake Watershed



Of the cropland acres in the Jordan Lake Watershed, 96% are in the Haw Subwatershed.

Figure 10. Acreage of Major Crops for the Baseline (1997-2001), 2013, 2014, 2015, and 2016, Haw Subwatershed, Jordan Lake Watershed

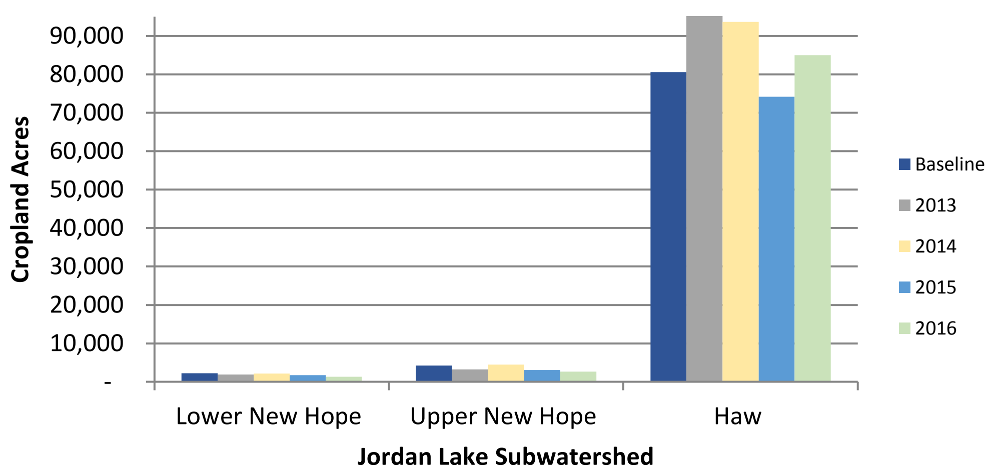


Land Use Change to Development and Cropland Conversion

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, 2013, 2014, 2015, and 2016. 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), 2013, 2014, 2015, and 2016



Pasture Accounting

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. This committee developed a methodology for calculation of nitrogen loss from pasture systems based on pasture acres, number of livestock, fertilization rates, volatilization, and livestock exclusion system acres (for more information see Crop Year 2012-2015 Annual Report). Livestock exclusion systems have been assigned the nitrogen reduction rates specified in Table 3[5]. 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. Percent nitrogen reduction from pastureland for different BMPs

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%

For CY2012, the Upper New Hope subwatershed reported a 48% nitrogen loss reduction from baseline, the Lower New Hope subwatershed reported a 39% nitrogen loss reduction from baseline, and the Haw subwatershed reported a 29% nitrogen loss reduction from baseline. All three subwatersheds have exceeded their mandated goals. Pasture nitrogen loss accounting relies on USDA-NASS data which is gathered via the Census of Agriculture every five years. The next pasture-based nitrogen loss calculation will be included in a future report once the 2017 Census of Agriculture is published.

[5] 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

‡In order to ensure consistency between pasture and cropland NLEW accounting, the livestock exclusion acres reported above represent cumulative actual setback and buffer acres. The area draining through these exclusion systems is likely substantially higher.

Phosphorus Indicators for CY2013 through CY2016

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), CY2014, CY2015, and CY2016. 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 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.

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.

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)	CY2014	CY2015	CY2016	Percent change (baseline to CY2016)	CY2016 P Loss Risk +/-
Cropland	Acres	NC Ag Statistics	87,384	100,271	78,933	88,945	+2%	+
Cropland conversion (to grass & trees)	Acres	USDA-NRCS & NCACSP	1,359	2,476	2,827	2,901	113%	-
Conservation tillage[6]	Acres	USDA-NRCS & NCACSP	1,997	18,039	19,790	19,790	891%	-
Vegetated buffers (cumulative)	Acres	GIS analysis	54,212	52,831	52,833	52,835	-3%	+
Tobacco acres	Acres	USDA-NRCS & NCACSP	7,667	4,762	2,601	4,242	-45%	-
Scavenger crop	Acres	USDA-NRCS & NCACSP	0	1000	2238	2378	N/A	-
Animal waste P	lbs of P/ yr	NC Ag Statistics	7,965,784	4,395,314	4,462,939	4,432,752	-44%	-
Soil test P median	P-Index	NCDA& CS	72	62	55	61	-15%	-

[6] Conservation tillage is being practiced on additional acres but this number only reflects acres under active cost share contracts, not acres where farmers have adopted the use of conservation tillage without cost share assistance. An estimated 93% of producers are practicing conservation tillage on cropland in the Jordan Lake Watershed. Source: *O'Connell, C. and D.L. Osmond. 2018. Carolina Dreamin': A case for understanding farmers' decision-making and hybrid agri-environmental governance initiatives in agricultural communities as complex assemblages in Agri-environmental Governance as an Assemblage: Multiplicity, Power, and Transformation. Editors: Jérémie Forney, Hugh Campbell, Chris Rosin. Rutledge Press.*

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.

Due to the number of permitted biosolids application fields in the piedmont, 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 7 identifies these BMPs and tracks their implementation in the watershed since the end of the baseline period.

Table 7. Best management practices installed from 2002 to 2016, Jordan Lake Watershed[7] (cumulative)

Conservation practice	Units	2013	2014	2015	2016
Ag road repair-stabilization	feet	2,880	2,880	3,207	3,207
Agricultural pond restoration/repair	units	18	20	22	25
Closure-waste impoundments	units	18	19	19	19
Conservation cover	acres	815	815	815	865
Constructed wetland	acres	2	2	2	2
Critical area planting	acres	68	71	74	78
Cropland conversion-grass	acres	1,063	1,063	1,065	1,139
Cropland conversion-trees	acres	916	960	1,002	1,002
Diversion	feet	6,450	6,450	6,450	6,450
Fencing (USDA programs)	feet	6,741	6,741	41,253	60,503
Field border	acres	144	144	147	147
Filter strip	acres	0.4	0.4	0.4	0.4
Grassed waterway	acres	290	293	293	295
Habitat management	acres	310	310	310	310
Nutrient management	acres	5,110	5,110	5,290	5,295
Nutrient management plan	number	29	29	30	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	2
Prescribed grazing	acres	4,093	4,706	5,113	5,169
Sediment control basin	units	2	2	2	2
Sod-based rotation	acres	9,710	9,710	9,916	9,940
Streambank and shoreline protection	acres	16,905	16,905	16,905	17,050
Terrace	feet	31,379	31,379	31,379	31,379
Tillage management	acres	18,039	18,314	19,790	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 by farmers 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.

Members of the Falls and Jordan Lake WOCs have been working with DWR on issues regarding nutrient offsets that arise from trades involving agricultural land. Also, the WOC feels that additional research is needed on accounting procedures for pasture operations, and supports such research being conducted. Additionally, should readily accessible information become available on biosolids applications to agricultural acres in the watershed, the WOC will consider whether separate accounting for those applications of nutrients is feasible and appropriate.

Funding is an integral part in the success of reaching and maintaining the goal through technical assistance and BMP implementation. It is also important for data collection and reporting.

In 2001, grants from several sources funded a total of two watershed technicians and two basin coordinators. The technicians' primary responsibility was to assist farmers with BMP implementation. These technicians assisted existing county staff to expedite the installation of nutrient reducing BMPs in the basin. On June 30, 2015 the last technician funding was expended, and technician funding is no longer eligible for grant awards by funding entities in the state. Therefore, less technical assistance for BMP implementation is available. Ongoing responsibility for conservation practice planning and installation now depends on local staff that also have other duties. Budget changes at the USDA have necessitated a statewide restructuring of North Carolina NRCS field staff, and these changes have led to a reduction in federally-funded technical capacity at the local level. At the present time there is also no funding for a basin coordinator. Part of the responsibilities of the technicians and basin coordinators was to assist with the reporting requirements for the Neuse and Tar-Pamlico Agriculture Rules. In addition to his other duties, an employee within the NCDA&CS Division of Soil and Water Conservation funded by EPA 319(h) funds has been assigned the data collection, compilation and reporting duties for the Agriculture Rules for all existing Nutrient Sensitive Waters Strategies.

Now that watershed technician funding has been eliminated, a more centralized approach to data collection and verification is necessary. This evolving approach will involve GIS analysis and more streamlined FSA acreage documentation. Durham County, for example, has hired part-time staff to assist with detailed agricultural land delineation, including field verification of intact best management practices. Results of this analysis should be available for the CY2017 annual report. Because most district staffs have neither the time nor financial resources to synthesize county level data, this centralized collection approach will come at the expense of local knowledge. Annual agricultural reporting is required by the rules; therefore, continued funding for the Division's only remaining nutrient coordinator position is essential for compliance.

Previously, funding was available for research on conservation practice effectiveness, realistic yields, and nitrogen use efficiencies. Due to eligibility changes and other funding constraints, it is unlikely that new data will be developed. Prior funding sources for such research, which provided much of the scientific information on which NLEW was based, are no longer available. Should new funding be made available, additional North Carolina-specific research information could be incorporated into future NLEW updates.

Phosphorus accounting and reporting will continue to address qualitative factors and evaluate trends in agricultural phosphorus loss annually. Periodic land use surveys with associated use of PLAT are needed every five years, but it is unlikely that funding will be available for this activity. Additionally, understanding of agricultural phosphorus management could be improved through in-stream monitoring contingent upon the availability of funding and staff resources.

Conclusion

The Jordan Lake WOC will continue to monitor and evaluate crop trends. The current shift to and from crops with higher nitrogen requirements may continue to influence the yearly reduction. Significant progress has been made in agricultural nitrogen loss reduction, and the agricultural community is achieving its reduction goals. However, the measurable effects of these BMPs on overall in-stream nitrogen reduction may take years to develop due to the nature of non-point source pollution. Nitrogen reduction values presented in this annual summary of agricultural reductions reflect "edge-of-management unit" calculations that contribute to achieving the nitrogen loss reduction goals. Significant quantities of agricultural BMPs have been installed since the adoption and implementation of the nutrient management strategy, and agriculture continues to do its part towards achieving the overall nutrient reduction goals of Jordan Lake.

Final report submitted April 30, 2018.