Paying for Nutrient Reduction and Management in Jordan Lake
Summary of First Year Research

Source: NC DEQ

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I. Introduction to Finance Component of the Nutrient Study

In 2016, in House Bill 1030, the North Carolina legislature commissioned a new study through the University of North Carolina at Chapel Hill (UNC) to reevaluate the nutrient strategies for the Jordan Lake and Falls Lake watersheds. Specifically, with respect to costs, the bill states that it is in the best interest of North Carolina "to review the costs and benefits of existing nutrient management strategies" to determine if they need to be modified to better address water quality concerns. Further, the legislature finds that the State should modify the nutrient management strategies in order to "maintain proven measures already shown to be effective; incorporate new technological and management innovations; recognize investments in water quality already implemented by stakeholders; and share costs *on an equitable basis*."

In the specific appropriation of funds, the bill states that as part of the study done by UNC, the entity shall "examine the costs and benefits of basinwide nutrient strategies in other states and the impact (or lack of impact) those strategies have had on water quality."

With these directives in mind, the Environmental Finance Center at UNC proposed to carry out a series of economic and financial research tasks. Our proposal included a general plan to examine finance challenges and strategies. The first year of the research focused on understanding the experiences and perspectives of the entities that will be responsible for implementing and paying for nutrient management strategies. The work involved reviewing documents and studies and holding informational meetings with a wide variety of individuals and organizations within and outside of the Jordan Lake Watershed. While we interacted with individuals from a range of sectors (government, agriculture, environmental advocates), we focused most of our time and energy understanding the role, experiences, and financing options of local governments.

Specific Research Questions Addressed

- Who has been or will be responsible for implementing nutrient management initiatives driven by the Jordan Lake rules?

- What have existing nutrient management initiatives cost in the watershed and what was the anticipated nutrient reduction for different approaches? What methods have been used to generate revenue to cover nutrient management costs?

- How has responsibility for costs been shared/allocated among the different communities that impact or benefit from the Lake?

- What methods are available to reduce costs or increase cost effectiveness of measures?

II. **Summary of the Research**:

We began our research into the financial questions related to nutrient management in Jordan Lake by looking at the current Jordan Lake Nutrient Management Strategy ("the rules") and the financial implications stemming from those. This included understanding the current status of the rules, as well as the projected costs of implementation of the rules as laid out in the 2007 fiscal analysis. One of our key goals was also to identify current streams of revenue and potential streams of revenue that are or could be used to fund nutrient management and reduction activities in the Watershed. We started this through document review, and speaking with members of DEQ for clarification of certain rules and how costs were calculated. In several places in the rules, there are uncertainties about whether costs are currently being expended specifically for the rules. Additionally, there are multiple requirements under the rules related to new or existing development that are also likely required under NPDES Phase II permits, or under Water Supply Watershed requirements. Further, regardless of the status of the rules, it became readily apparent as we started asking questions, that each local government is contributing to nutrient management in Jordan Lake in varying ways based on their understanding of the rules and in preparation for anticipated changes to/enforcement of the rules.

The second part of the document review was to identify if there are any potential streams of revenue under the current framework that have not yet been tapped or to identify different ways that money could be pooled under the existing framework. As is discussed further below, there is current pooling under the rules through the Ecosystem Enhancement Program, which is now the Division of Mitigation Services; however, there is not another broad pool of funds crossing jurisdictions that is directed at nutrient management issues. As we delve into other regional nutrient management strategies that have been effective, we expect to delve deeper into the question of how pooling could be used in conjunction with the goals in the Jordan Lake watershed.

Because the rules are currently only partially being implemented, there is not a simple way to track the costs and current streams of revenue going into Jordan Lake for nutrient reduction and management. Rather, we determined that it would be most helpful to speak directly with representatives from the different jurisdictions in the watershed to get an accurate picture of what has been spent as of 2017 on nutrient management. By the end of the first year of the study, we had spoken formally with six of the utility service providers/local governments, including Orange County Water and Sewer Authority, the City of Greensboro, the Town of Pittsboro, Chatham County, the City of Durham, and the Town of Carrboro. During our interviews, our questions centered around the costs associated with compliance with the rules, voluntary measures, or actions that have been taken (i.e. plant upgrades, stormwater programs/policies, other optimizations) that have resulted in nutrient reduction flowing into Jordan. This part of our research is particularly useful in two ways. One, it provides data to be used to fulfill one of the goals in the study's enabling legislation, which is that the State modify the Jordan Lake nutrient management strategy to "recognize investments in water quality already implemented by stakeholders." Second, it allows us to begin to research the cost-effectiveness of certain measures that either are required by the rules or could be required by a

modified strategy (for example, we calculate a preliminary and simplistic $/lb figure for specific practices.)

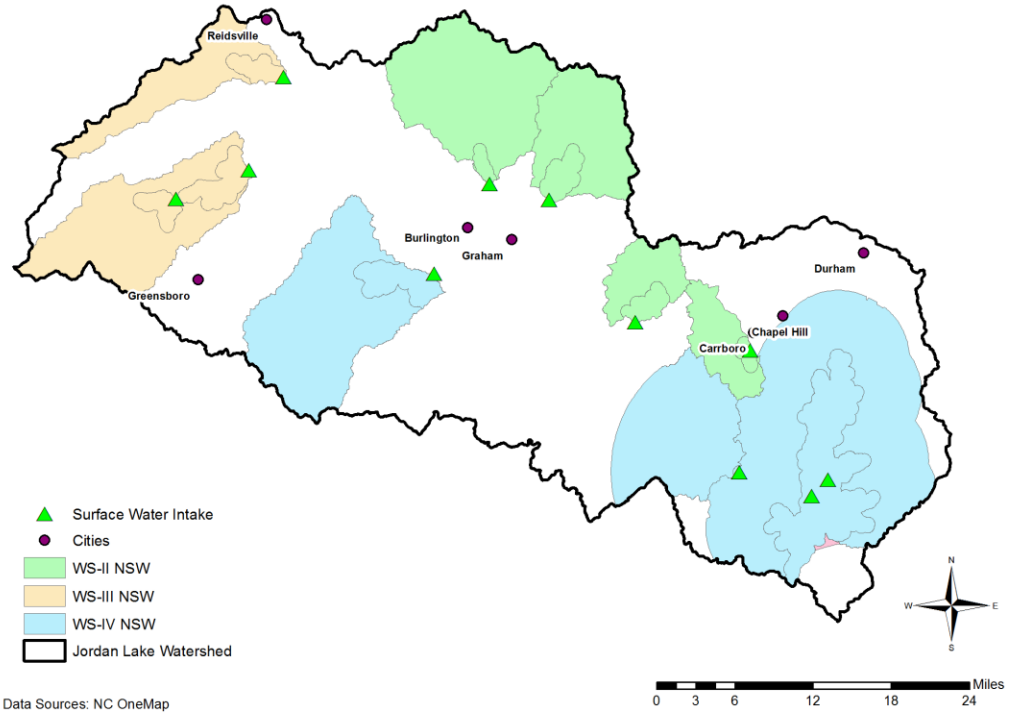
Given that the Jordan Lake watershed has known tensions between upstream and downstream communities, and to hear and better understand what concerns and ideas might be out there for different cost-sharing practices for nutrient management in Jordan Lake, we also participated in all of the listening sessions conducted by the Institute for the Environment. The research gained was mostly background knowledge about the strong financial concerns and limitations of each stakeholder group, although there were some specific cost-sharing/responsibility suggestions that emerged from each session. The listening sessions also served as contact points to identify key players in each municipality or county or organization who we have been following up with for more in-depth discussions about jurisdictional data. We have begun many more informal conversations focused on the same questions discussed above with other jurisdictions, and are currently planning more formal meetings during the next year of the study. It is our intent that during the extent of this nutrient study, our team can serve as a contact point between representatives from all of the local governments in the watershed.

For further research, particularly in the area of urban stormwater management, which is one of the biggest contributors of nutrients in the watershed, and the most expensive to pay for, we attended the Stormwater Association of North Carolina (SWANC) meeting to further identify contacts and concerns arising from stormwater financing issues around the Jordan Lake watershed.

We investigated innovative methods of paying for and allocating the costs of nutrient management that have been implemented in other areas of the country facing similar challenges.

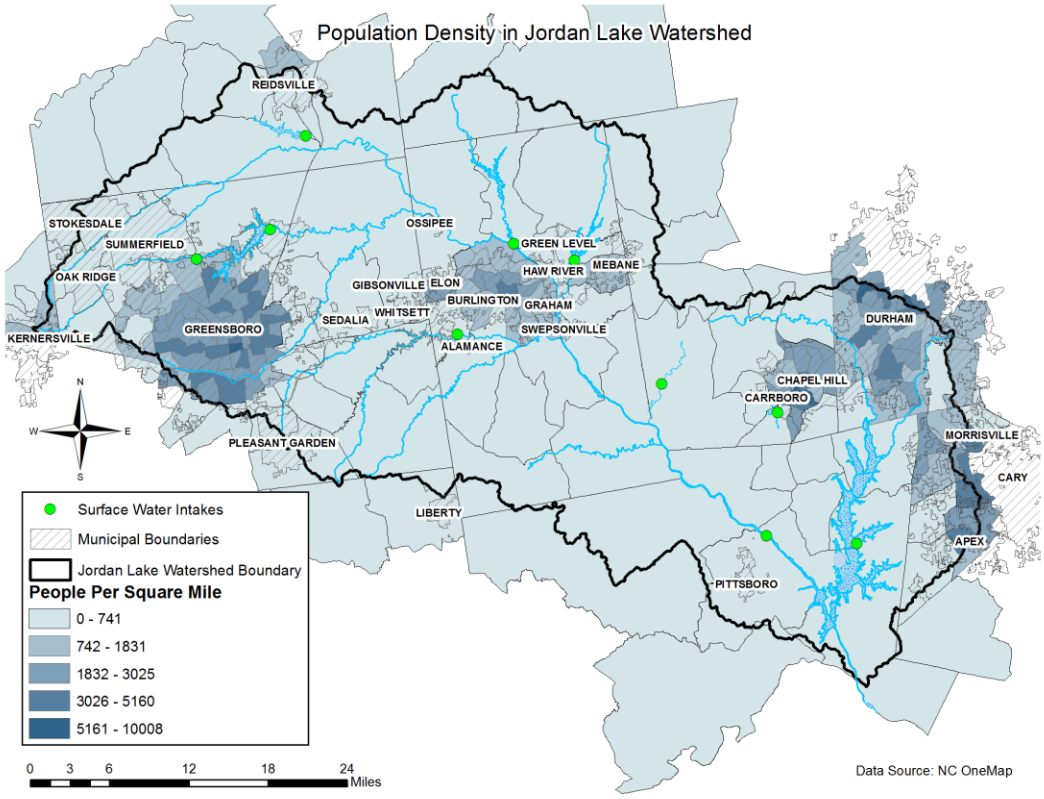
Recognizing the importance of engagement of beneficiaries of Jordan Lake's water supply, we attended the Jordan Lake Water Supply Partnership (JLWSP) meeting to present on possible partnership/collaboration opportunities that they might consider as they move forward with the next iteration of their partnership. The JLWSP is comprised of a group of local governments, some of who currently rely on Jordan Lake for their water supply and others who plan on tapping into the Lake in the future. JLWSP members are working together to coordinate the use of Jordan Lake as a water supply with a focus on planning for future withdrawal increases. We also discussed with the JLWSP group the work being done for the nutrient study and how water quality plays into the future of the water supply issues in Jordan. This was another opportunity to make contacts with key individuals from downstream municipalities who we have begun following up with to continue to gather jurisdictional data. As we identify different ways to share costs, using both polluter pays and beneficiary pays principles, then having key contacts and understanding of those local governments with their eyes on Jordan Lake for water supply will be very useful.

Surface Water Intakes and Watershed Water Supply Classification in the Jordan Lake Watershed



With respect to trading, we evaluated the current trading framework in North Carolina, including looking at the trading provisions that are currently included in the Jordan Lake Rules, and those that are in other nutrient management strategies around the state (Neuse and Tar-Pam). The intention in evaluating the current provisions is to highlight key areas that may or may not incentivize trading as a successful option by holding NC's provisions up against the basic principles of a successful trading system.

Finally, as part of our research, we began to create an extensive database that will allow for financial geospatial analysis and modeling. The database and GIS maps will be used to display the different ways the watershed and watershed beneficiaries can be divided and pooled from a cost and revenue standpoint. These maps reflect jurisdictional boundaries, regulatory boundaries, watershed or subwatershed boundaries; identify the locations of water intakes or discharge locations; depict population density and breakdown the watershed by landcover type. Some of examples of maps that been created are displayed within this report. We intend to use these maps for comparison purposes as we look at other regional cost sharing examples, as well as to continue to build a water quality "revenueshed" analysis to be used to identify cost sharing models that could be applied to fund initiatives driven by future iterations of the rules. Some of the numbers from the previous maps or analyses done at the time of the fiscal analysis (2007) or the rules (2009) are different, due to updated population numbers, changes in land cover, etc. In determining how revenue is flowing (or could flow) in the watershed, updated maps and numbers should help create a more accurate picture.



III. Research Findings

a. Overview of the Rules and Financial Responsibility for their Implementation

Who has been or will be responsible for implementing nutrient management inititives driven by the Jordan Lake rules?

Based on conversations with various stakeholders over the course of our interviews and through our participation in listening sessions, the Jordan Lake rules seem to be a source of confusion and anxiety for many. Our interest in examining the different aspects of the rules stems from a goal of highlighting where the rules trigger spending for nutrient management, and an intent to look for opportunities to get more nutrient reductions for less money, if possible.

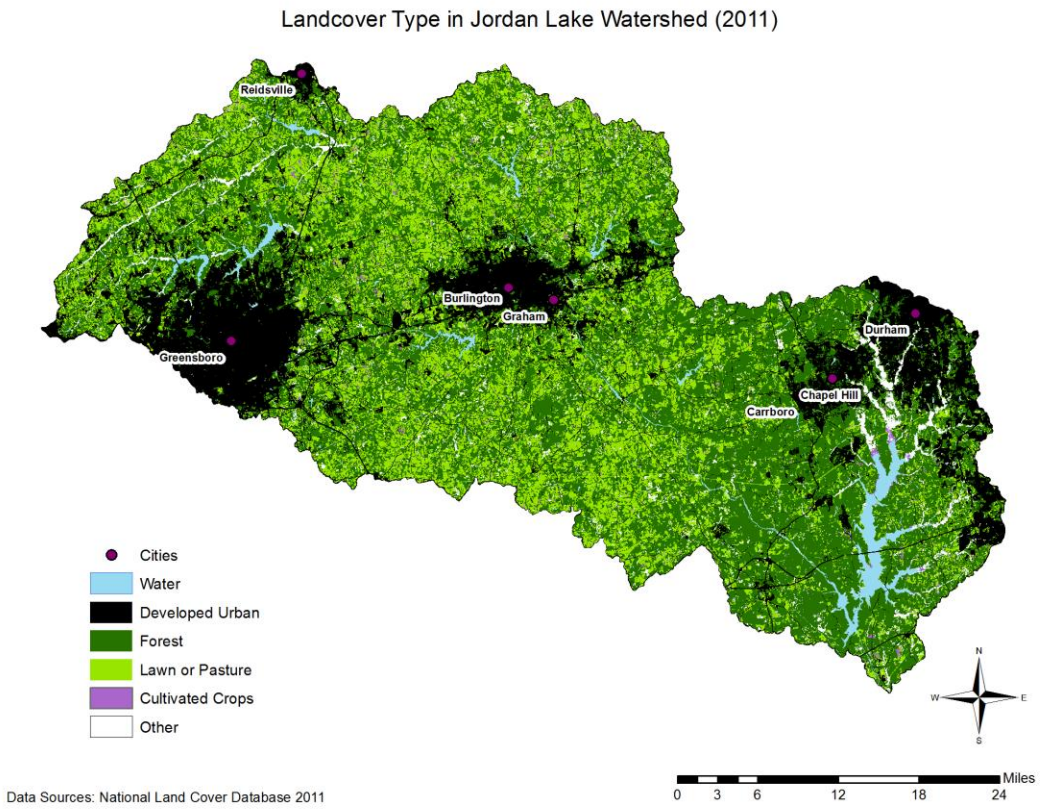
The rules divide the Jordan Lake watershed into three arms: Upper New Hope, Lower New Hope, and Haw River. Each arm of the lake has nutrient reduction goals, total allowable nutrient loads, point source wasteload allocations, and nonpoint source load allocations for both nitrogen (TN) and phosphorus (TP). The rules further identify every local government subject to the rules, which included, at the time the rules went into effect, 25 municipalities and 8 counties. Because the arms have such substantial differences in allocations and reduction requirements, the expected costs for nutrient management fall heavily in certain areas,

particularly in the Upper New Hope arm, which has a TN reduction requirement of 35% (in contrast to the 8% reduction in the Haw arm, and 0% reduction in the Lower New Hope arm).

i.Agriculture (Rule .0264)

The rules lay out specific requirements for the various discharges coming into the lake. For agriculture, the rules require maintaining and achieving reduction goals of "collective agricultural loading of nitrogen and phosphorus" from baseline levels "to the extent that best available accounting practices will allow." The rule further requires accounting for agricultural land management practices at the county and subwatershed levels, and "implementation of practices by farmers in these areas to collectively achieve the nutrient reduction goals on a county and subwatershed basis." Because the agriculture rules are collective, there are no *individual* requirements as long as the county or subwatershed reductions can be met.

Trading is discussed under the agriculture rule, but, trading of nitrogen-reducing credits is only allowed after the TN goal for a subwatershed is met. As is discussed below, the collective requirement for agriculture combined with the requirement that their subwatershed goal must be met before trading can occur, affects the potential for trading in the watershed. As we move forward with comparing Jordan Lake to other regional nutrient management strategies around the country, we can more closely examine how agriculture is treated and how it can promote/encourage trading and cost-effective nutrient reduction. Responsibility for paying for initiatives arising from this part of the rules will fall on individual agricultural landowners or organized groups of landowners operating collaboratively. While, there currently are a number of federal and state programs that provide some financial assistance for agricultural environmental initiatives that could may offset some of the costs of compliance, ultimately much of the cost of nutrient management will have to be covered by agricultural income.



ii.Stormwater Management for New Development (Rule .0265)

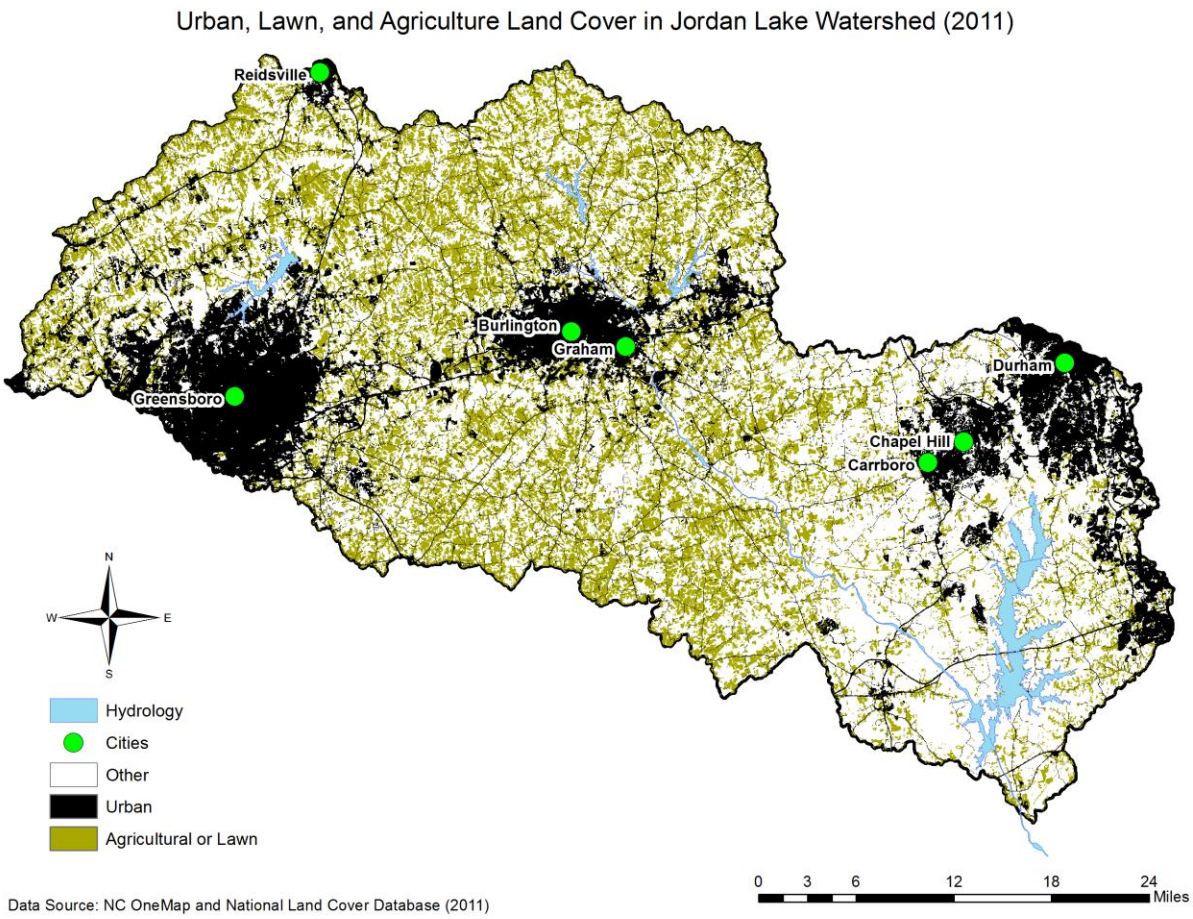
Although stormwater management for new development is regulated under the rules, this particular section has been continuously delayed, and therefore has not been fully implemented. The rule, as written, requires all local governments to implement stormwater management programs by a certain date (it has continued to get pushed back, and is currently pushed back by the delay resulting from the UNC nutrient study). The stormwater management programs must include requirements that new development complies with loading targets set by subwatershed allocations; complies with buffer requirements under the rules; complies with Water Supply Watershed or other additional regulatory limits; and includes any engineered stormwater controls necessary to meet loading targets. Additionally, offsite offsetting is offered for developers if they can't meet their loading targets onsite; one option is to pay funds to the Division of Mitigation Services. However, there are certain requirements and specifications related to that trading option discussed in more detail below.

Although this part of the rule is not currently in effect, there are still some examples in place that provide insight on the impact of the rule. Several communities enacted policies that would put them in compliance with at least parts of the rule in order to meet other important objectives. For example, the City of Durham, which is divided between the Jordan and Falls Lake Watersheds, has developed a unified City approach to stormwater management so that developers working in different parts of the city only have one set of rules to follow. In order to comply with elements of the Falls Lake Rules, Phase 1 stormwater regulations, and the Neuse

Nutrient rules, the City has developed rules that also mirror what is envisioned in the Jordan Lake Rules. Specifically, Durham added an additional 5% charge to go into a nutrient bank if mitigation projects are not done within Durham. They also added charges or required that a higher percentage of nutrient reduction be met if developers increase impervious surface in replacing or expanding existing structures. There are exceptions under the new development rule that allow for use of the previous property stormwater reduction targets, even if the developers replace or expand the structure. Durham's requirement of additional percentage reduction requirements helps to counter that exception, and to spawn redevelopment.

Additionally, Chatham County had stringent stormwater rules in place before the Jordan Lake rules were enacted as part of their Water Supply Watershed Protection Policies. Their county rules were more stringent than the Jordan Lake rules; they don't allow for high density development, they have volume control to keep flows from leaving development sites, and their low-impact development rules are very stringent. According to Durham, the response by developers to the more stringent development rules in the city led to more developers paying into the Division of Mitigation Services for mitigation projects. For Chatham, they stated that their more stringent rules result in lost revenue on the part of developers, but not really direct costs to the county.

While local governments play an essential role in implementing the new development rules, the responsibility for paying the costs associated with this part of the rules falls directly on developers. There are few if any sources of public funds to go towards any additional development costs associated with more stringent rules. Ultimately, the revenues to meet these costs will be passed on to those that use/buy the new development and possibly to the developers in the form of reduced profit. It is possible that the value of some nutrient initiatives such as rain gardens could be seen as an attribute that would increase the value of the property.



iii.Stormwater Management for Existing Development (Rule .0266)

Similar to the new development rule above, the existing development stormwater rule is also not currently being fully implemented. The existing development rule is broken into two stages. The first stage is required of all municipalities and counties listed in the rules, and requires all such local governments to address stormwater in their jurisdictions through public education, mapping, identification and removal of illegal discharges, identification of opportunities for retrofits or other projects, and maintenance of BMPs implemented by the local governments. Stage one of the existing development rule went into effect after the rules were adopted in 2009.

Based on the conversations we have had thus far with different jurisdictions, stage one of the existing development rule has not triggered substantial new costs, other than small amounts of staff time. Most of the tasks are ones that the local governments are already engaging in for compliance with Phase II NPDES permits, Water Supply Watershed requirements, or other local government ordinances. The one exception is that some local governments have contracted to

have studies done to fulfill the requirement to identify opportunities for retrofitting existing development. There have thus been costs associated with such studies.

Stage two of the existing development rule, however, appears to be what the local governments fear would create the greatest direct costs for their governmental jurisdictions. Stage two is triggered by nutrient monitoring reports coming out of the Department of Environmental Quality (DEQ). The rule specifically requires DEQ to report the results of monitoring in each arm of the Jordan Lake reservoir to the Environmental Review Commission, and to continue to submit an updated monitoring report every three years until "such time as the lake is no longer impaired by nutrient pollution." Based on the results of the monitoring reports, DEQ is required to notify certain local governments that they need to implement stage 2 programs. Although DEQ has been engaging in creation of monitoring reports, the requirement for stage 2 programs has not yet gone into effect, due to delays in implementation of the rules. Thus, any costs are speculative for what it would cost to fully implement such programs.

Based on the monitoring reports, DEQ determines which local governments should implement stage 2 programs; notifies those local governments; and establishes a load reduction goal that will result in an 8% reduction in TN and a 5% reduction in TP relative to the baseline loads. The rules specify that the baseline load should not include lands under State or federal control, or agriculture or forestry lands. Local governments are then supposed to impose a program based on a model program, which was supposed to have been approved by the Environmental Management Commission in December of 2013; however, that model program was never approved, and is still pending approval/adoption based on the delay of the rules. Thus, it is unclear what types of load reduction practices and credits associated with such practices will be in that model program, and we can therefore not determine accurate costs associated with implementation of that program.

Relative to new development and wastewater water quality improvements, there is relatively little experience within the Jordan Lake Watershed, the State, or the country on large scale implementation of retrofits on existing development, particularly privately owned development. Several Jordan Lake watershed local governments have carried out or studied retrofits on public land or facilities. (see description in cost section below), but these could be characterized more as demonstration/pilot projects than full implementation. Retrofits on public land have been funded through a combination of state and federal grants and local government revenues including stormwater fees and property taxes.

The second year of this research will examine potential financing approaches for existing development initiatives in much more detail to understand how much of the expenses will have to come from public funds and whether there are regulatory requirements or financial incentives that can result in some of the cost being passed on to private land owners.

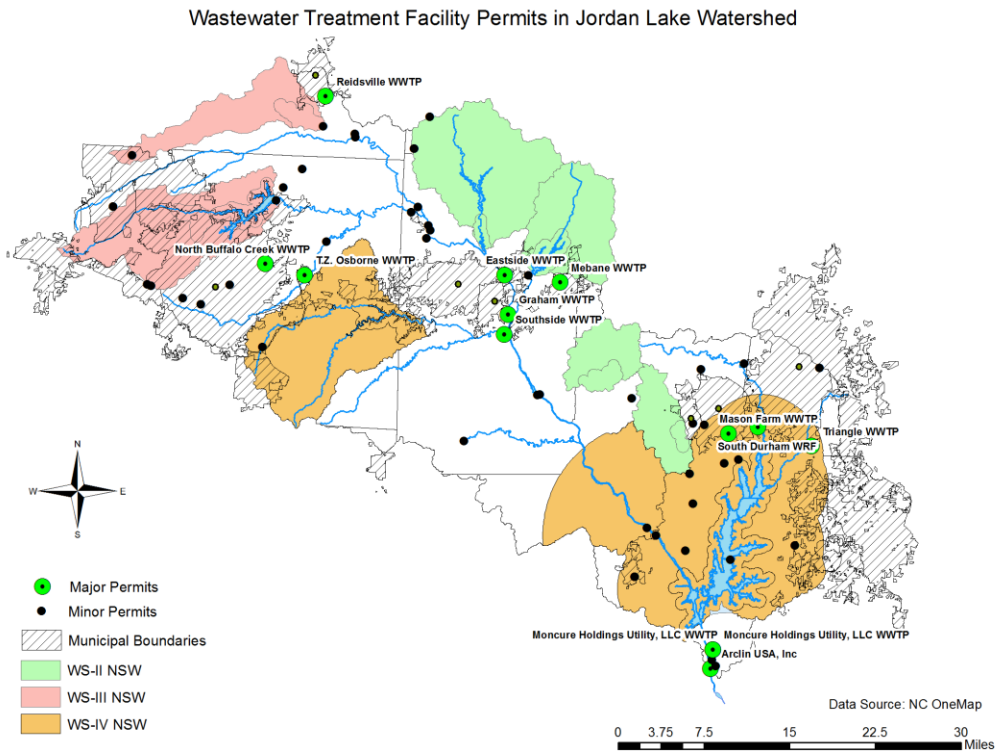
iv. Protection of Existing Riparian Buffers (Rule .0267)

The buffer rule includes many specific requirements about creation of buffers, exempt buffers, maintenance of buffers, etc. However, as for assigning responsibility that carries a cost, the rule simply states that local governments "shall establish programs to meet or exceed the minimum requirements of this rule." Because many of the buffer requirements are required by other regulations, such as Water Supply Watershed requirements, or local government ordinances or building codes, it is difficult to assess any impact of additional costs on local governments or other stakeholders resulting from this rule. The costs of buffer implementation typically fall on property developers in the form of reduced revenue from property development although there is the possibility that some buffer implementation can serve as an amenity for some development that could increase the value of the property.

v. Wastewater Discharge Requirements (Rule .0270)

For wastewater treatment plant effluent dischargers, the Jordan Lake rule applies to all dischargers in the watershed that are subject to requirements for individual NPDES permits. The rule provides an allocation of TN and TP discharge amounts for each subwatershed and then specifies that the allocation shall be "apportioned among the existing dischargers in each subcategory in proportion to the dischargers' permitted flows and the resulting delivered nutrient allocations assigned to each individual discharger."

There is a process with certain requirements for new and expanding dischargers, and there are requirements for all dischargers who meet a certain threshold, which have not yet been implemented due to delays in the rules. Additionally, the wastewater dischargers are permitted to offset nutrients by paying into the Division of Mitigation Services, or may trade with other dischargers in the same subwatershed (discussed in more detail below). There is also a potential for facilities within the same subwatershed to form a "group compliance association," to meet delivered nutrient allocations collectively. Greensboro indicated that they formed an association with four other cities for TP only, but that they will fold TN into that association if it becomes necessary. The association and its members can reapportion individual delivered allocations on an annual basis, and if they don't meet their limits, then can make an offset payment into the Division of Mitigation Services.



vi. Options for Offsetting Nutrient Loads (Rule .0273)

The rules provide the option for parties obligated to reduce their loads of nutrient discharges under the rules to meet such requirements by purchasing credits for activities conducted by others offsite. Those credits represented excess load reductions that have been achieved relative to the rules reduction requirement. The rules state "overall [nutrient trading] provides the potential for more cost-effective achievement of strategy reduction goals." The rule establishes the framework to allow credit trading between different parties regulated under the nutrient management strategy as well as between regulated parties and private parties as sellers of credits representing excess nutrient load reductions. The unit of generated credits are per pound of nitrogen and per pound of phosphorous. This part of the rule does not directly attribute costs to a particular party, but rather provides an opportunity for different parties that are required to meet other parts of the rules to work together to reduce the total cost of compliance.

Table: Nutrient Offset Fees Per Pound

Service Area	Nutrient	DMS Rate (per pound) (July 1 to September 30, 2017)
Jordan Lake watershed	Nitrogen	$127.26
Jordan Lake watershed	Phosphorus	$389.87

Source: NC DEQ

Parties that must meet the requirements of the agriculture rule, new development rule, wastewater rule, and state and federal entities stormwater rule have the option to purchase credits for offsetting nutrient reduction requirements. Before purchasing any credits, minimal baseline obligations must be met by the party seeking to use credits to meet its reduction requirements under the rules. The baseline requirement differs depending on which type of party is seeking to purchase credits (e.g. farmer, developer of a new site, etc.). The rules place a geographic requirement that only permits the purchasing of credits that were generated within the watershed/subwatershed where the buyer is applying the credit. The Division of Water Resources oversees the generation and verification of credits. There is also an option to pay an in-lieu fee to the Division of Mitigation Services/the NC Ecosystem Enhancement Program (EEP) when credits are not available on the market that similarly functions as a credit for offsetting nutrient loads.

b. Current Nutrient Management Costs and "Revenueshed" Flows

- *What have existing nutrient management initiatives cost in the watershed and what was the anticipated nutrient reduction for different approaches? What methods have been used to generate revenue to cover nutrient management costs?*

In our first round of research, we collected information from different jurisdictions in the Jordan Lake watershed to reflect what they are *actually* spending on nutrient management in Jordan Lake or what they have determined they would be *required* to spend if the rules are fully implemented. We have thus far been able to speak with a subset of jurisdictions from the Upper New Hope and the Haw River arms. As we continue to collect the cost data from each jurisdiction, it is our ultimate goal to compile specific examples that show costs and costs per unit of reduction/impact (e.g. $/lb charts and graphs for TN and TP) for each subwatershed and for each type of nutrient reduction/management currently required or anticipated under the rules. As is indicated by the preliminary research, the costs vary greatly between wastewater

treatment and stormwater. We also intend to determine some similar numbers for agriculture from follow-up discussions with the Farm Bureau.

i. Wastewater

Because of NPDES permit compliance and the TN and TP percentage reductions that must be met under the rules, wastewater treatment plant upgrades and modifications require a steady stream of revenue for all jurisdictions that hold a NPDES permit. Most of the funds for these modifications are derived from utility wastewater charges. As was already discussed above, the rules regulate wastewater discharging into Jordan Lake by determining a total allocation for each subwatershed and then designating specific allocations for each discharger. The Upper New Hope arm of the watershed has the biggest dischargers, and those local governments have had to make the most investment to meet the required reductions. Of additional importance, and as is pointed out for OWASA, utilities often see multiple benefits from their investments. For example, OWASA invested in plan upgrades that led to a reduction in energy use and an improvement in nutrient reduction. Thus, it difficult to attribute the entire cost of initiatives that reduce nutrient loading solely to the Jordan Lake Rules. At this point in the analysis, we are focusing on identifying "gross" costs but in the future, will examine costs in more detail. All of the wastewater initiatives outlined below are or will be covered through the use of wastewater customer charges.

Based on the wastewater treatment representatives we spoke with, wastewater treatment upgrades, while expensive as upfront costs, provide a more cost-effective nutrient reduction than many of the stormwater retrofits or BMPs we documented (see below.) In at least two of our meetings with local governments, there were staff members present from both wastewater divisions and stormwater divisions. Interestingly, when we discussed what everyone was spending in a group setting, the stormwater representatives brought up the point that in some cases it likely makes more sense for them to give the wastewater department a certain amount of money for guaranteed reductions at a lower cost per pound than stormwater initiatives could achieve. As we discuss in the remainder of this report, the projected high costs associated with stormwater reductions highlight the potential advantages of some sort of trading or other alternative financing mechanisms.

1. City of Durham

The City of Durham is one of the few local governments in the triangle that falls in both the Jordan Lake and the Falls Lake watersheds. Thus, it is subject to the rules for both. Durham has two wastewater treatment plants, one of which, the South Durham Water Reclamation Plant (SDWRP), is in the Jordan Lake watershed. Staff from the City of Durham indicated that they have an operating budget for the SDWRP of 2.9 million dollars. The entire operating budget ultimately goes towards reducing Jordan Lake pollution inflows including the nutrient reductions requirements.

Staff from the City of Durham indicated that in the past two years, Durham did an upgrade to the SDWRP to improve TN removal. The total cost of the upgrade was 7 million dollars, and resulted in a substantial reduction in TN discharged. In FY2015, without the improvement in place at all, the SDWRP discharged 246,644 lbs of TN. In FY2016, the upgrade was in place for roughly half of the year, and the SDWRP discharged 195,533 lbs of TN. In FY2017 with the upgrade in effect for the entire year, the discharge amount was reduced to 159,793 lbs of TN. Utilizing the same 20-year window of time we use to determine the cost-effectiveness for the stormwater projects below, **the gross cost per pound of nitrogen reduction is $4.03** for the SDWRP wastewater upgrade.

2. City of Greensboro

The rules set TN and TP removal requirements for Greensboro's two wastewater treatment plants both of which are in the Jordan Lake watershed. Staff from the City of Greensboro indicated that the City has been in compliance with TP removal since 2010, and under the Jordan Lake rules, must be in compliance with TN by 2021. Greensboro is currently undergoing a four-phase project to upgrade and modify the plants to comply with the rules requirements, at a total cost of $120 million. Staff from the City estimates that roughly **$60 million of the total cost is attributable to Jordan Lake Rules** TN removal requirements.

3. Town of Pittsboro

The Town of Pittsboro has a small wastewater treatment plant on Robeson Creek, which has a capacity of 750,000 gallons per day. Because of the anticipated growth in the area, the impracticality in expansion of the current plant, and the stringent limits on their discharge requirements under its NPDES permits, the town is planning to pipe its increased sanitary discharge to Sanford, NC. Staff from the Town of Pittsboro indicated that the pipe is being paid for through a Clean Water State Revolving Fund loan for roughly 20 million dollars, which includes design, permitting, easements, and construction of the pipe. The town will then be required to pay an annual fee to Sanford for treatment of the waste.

4. Orange County Water and Sewer Authority (OWASA)

OWASA has a medium-sized facility called the Mason Farm Wastewater Treatment Plant, located in Chapel Hill. The plant has an average monthly peak flow of 14.5 million gallons per day and discharges into Morgan Creek, a tributary of Jordan Lake. In our conversations with OWASA, we discussed wastewater treatment costs that were considered directly attributable to the Jordan Lake rules. Although the OWASA staff did not identify any specific modifications to the plant that have been done solely to comply with the Jordan Lake rules, they did highlight an overall optimization study which was done on the Mason Farm Wastewater Treatment Plant to address a variety of goals including improved treatment. The changes implemented based on the recommendations from the study have resulted in reductions in nutrient discharges into Morgan Creek, as well as added benefits related to reduction of energy costs.

ii. Stormwater New Development and Existing Development

Although there are steady streams of revenue flowing into nutrient management in Jordan Lake to cover stormwater control costs, many of the initiatives were a result of by other requirements such as Water Supply Watershed designations, NPDES Phase II permits, and other local government ordinances. However, as discussed above, the rules create new requirements that local governments must meet to achieve added reductions for stormwater in both new and existing development. Despite the delay in the rules, there are several examples of nutrient reduction measures that were done to meet other water quality requirements or in anticipation of the eventual enacting of Jordan Lake rules. The projects and project costs described below are based on either a projection of retrofit and BMP costs based on studies done for different local governments[2], or on voluntary BMPs or retrofits that have been done separately from the rules.

1. The City of Greensboro

The City of Greensboro has engaged in multiple voluntary stormwater projects to reduce nutrient discharge into Jordan Lake. The City of Greensboro was one of the first local governments in the state to establish a stormwater utility in order to fund city stormwater management activities. Greensboro staff indicated that they probably would not be doing many of the projects if it weren't for the rules, and that they have selected projects, which could be used for credit if the existing development rules are fully implemented and they are required to implement stage 2 stormwater programs. Greensboro staff indicated that they have generally not found any of the retrofit projects to be cost-effective. They further noted that they are able, at times, to do retrofits *during* construction projects. This proves to be more cost effective for them, because they are only required to pay the difference in cost for the BMPs. For example, they did a retrofit for a fire station by putting in a bioretention cell which cost them roughly $60,000. This was substantially less than some of the projects highlighted in the study, discussed below, however, some of the lower cost was attributable to the fact that it was on public land. They also indicated that they have done an additional two retrofits on public property, which cost them a total of $636,000. They were unclear on the TN or TP reduction credit they would get for such projects.

Greensboro staff highlighted the Jaycee Park Retrofit Project to demonstrate the high cost and low cost effectiveness on a per pound removal basis for a retrofit project. The project involved installation of pervious pavement, a bioretention cell, and tree boxes in a public community park. Greensboro staff indicated that the **total cost of the project was $961,000, and**

[2] As is discussed above in the overview of the rules, the stage one programs required for all local governments under the existing development rule require local governments to identify opportunities for retrofitting existing development. This requirement has driven the studies done by many local governments, and referenced here.

resulted in a TN reduction (lb/ac/yr) of 10.26 and a TP reduction of 1.11. These reductions were calculated using the DEQ Jordan Lake accounting tool, and do not include a reduction credit for the tree boxes, which are not yet recognized and included in the tool.

In 2012, Greensboro had a voluntary study done to identify BMP siting for retrofits in the North Buffalo Creek watershed. Based on conversations with staff from the City of Greensboro, the **study itself cost Greensboro $139,700**. We took the project estimates in the report for Greensboro and using a 20-year window of effectiveness, projected out the cost per pound of TN removal. The results are included in the chart below. While these numbers give a rough estimate of cost/pound for removal, and include projected maintenance over 20 years, they are based on estimates for sites from 2012, some of which are likely no longer available.

CITY OF GREENSBORO STORMWATER PROJECT COST-EFFICIENCIES Based on 2012 Nutrient Reduction BMP Siting Report by CDM		
Project Type	**Average Cost Per Pound TN**	**Number of Projects**
Level Spreader - Vegetative Filter Strip	$5.33	6
Wet Pond	$147.54	13
Wetland	$243.81	21
Dry Pond	$366.00	1
Stream Restoration	$1,701.50	10

The chart below displays the percent cumulative TN reduction versus the percent cumulative total project cost for 51 candidate projects in Greensboro representing a total cost of $37.8 million. This chart illustrates the degree to which the marginal benefit of constructing a project decreases as the more efficient projects are completed. The marginal benefit analyzed in this analysis does not include non-nutrient reduction benefits such as recreational, safety, aesthetic, and biological improvements.

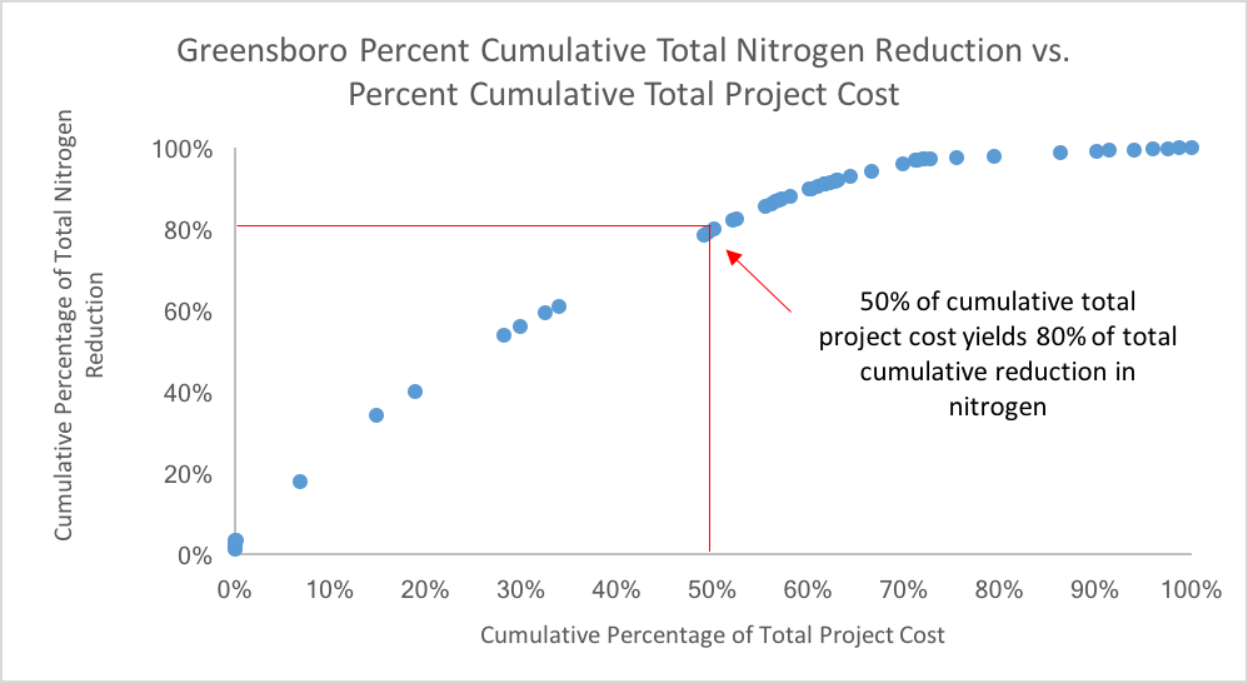
To produce this chart, we first ranked all the projects in order from the least cost per pound of TN reduction (highest efficiency) to the greatest cost per pound of TN reduction (lowest efficiency) over a 20-year window. Then we calculated the cumulative total cost at the nth most efficient project by summing the costs of the *n* most efficient projects. We then divided the cumulative total cost of constructing the *n* most efficient projects by the sum of costs of all the projects and multiplied by 100 to get the percent cumulative total project cost of constructing the nth project.

We repeated this process to calculate the percent cumulative total nitrogen reduction of the nth project by summing the TN reduction of the *n* most efficient projects to get the cumulative TN reduction of constructing the *n* most efficient projects. We then divided the cumulative TN reduction at the nth project by the sum of the TN reductions of all the projects and multiplied by 100 to get the percent cumulative total nitrogen reduction of the nth project.

$$Cumulative\ Total\ Project\ Cost\ of\ the\ n^{th} Project = \left(\frac{\sum Cost\ of\ Projects\ 1\ to\ n}{\sum Cost\ of\ All\ Projects}\right) * 100$$

$$Cumulative\ TN\ Reduction\ of\ the\ n^{th}\ Project = \left(\frac{\sum TN\ Reduction\ of\ Projects\ 1\ to\ n}{\sum TN\ Reduction\ of\ all\ Projects}\right) * 100$$

For example, the point highlighted below is the 16th most efficient project in terms of cost per pound of TN reduction over a 20-year window. The percent cumulative total project cost of constructing the 16th project is the sum of the total cost of constructing projects one through 16 divided by the sum of the costs of all 51 projects. The percent cumulative total nitrogen reduction of the 16th project is the sum of the TN reduction of projects one through 16 divided by the TN reduction of all the projects. Therefore, if Greensboro constructs the 16 most efficient projects, they will see a TN reduction representing 80 percent of the possible reduction of all 51 prospective projects at a cost that equals just 50 percent of the total cost of constructing all 51 prospective projects.



Finally, it is worth noting that Greensboro has engaged in voluntary monitoring of discharges on the Haw River two times a month for the past 6 years. Greensboro staff indicated that **this voluntary monitoring has cost them $25,000 per year.**

2. The City of Durham

Staff from the City of Durham indicated that the City spends approximately $15 million a year in collected stormwater utility fees on stormwater, but that number is not broken down by watershed. Durham is in both the Jordan Lake and Falls Lake watersheds. The Jordan watershed is slightly bigger (55% of the city), so accounts for probably slightly more than half of the budget. Durham is in a somewhat unique situation because it has several TMDLs related to other streams/creeks in their jurisdiction. Thus, when the city implements certain stormwater controls, it can address both the TMDL and the nutrient reduction requirements for Jordan Lake. This affects decision making on the part of Durham as well as cost-efficiency for the city.

Durham staff indicated that one of its biggest initiatives has been **watershed planning studies which cost one to two million dollars each**. The studies include doing field work to identify retrofit locations and then trying to calculate efficiency to remove nutrients (or sediment/bacteria depending on if there is a TMDL). Similar to what we did for Greensboro, we took the numbers projected in a 2013 study done for Durham, and using a 20-year window of effectiveness, projected out the cost per pound of TN removal. The results are included in the chart below. While these numbers give a rough estimate of cost/pound for removal, and include projected maintenance over 20 years, they are based on estimates for sites from 2012, some of which are likely no longer available.

CITY OF DURHAM STORMWATER PROJECT COST-EFFICIENCIES Based on a 2013 Study by Brown and Caldwell		
Project Type	**Average Cost Per Pound TN**	**Number of Projects**
Stream Restoration	$1,514.29	14
Wet Pond	$616.67	6
Wetland	$362.50	8
Bioretention	$300.00	1

3. The Town of Carrboro

Staff from the Town of Carrboro indicated that the Town is in the process of identifying stormwater BMP sites and possibilities, and that based on preliminary research, it has determined that **the cost to do seven or eight retrofits would be about 4 million dollars**. They have not determined an exact calculation for how much of a TN or TP reduction such retrofits would yield, or whether they would meet the needed TN and TP reductions under the rules. Based in part on these retrofit cost projections, in June, 2017, the town approved the creation of a stormwater management utility in order to create an additional revenue source (stormwater fees) to help comply with the rules and with their existing Phase II NPDES permit.

4. The Town of Pittsboro

Staff from the Town of Pittsboro indicated that beyond its Stage One stormwater program under the rules, it has done four voluntary BMPs utilizing some 319 grant funds that are awarded by the DEQ but funded by EPA. One of their projects was a retrofit in the downtown area. Based on conversations with Pittsboro staff, the total project cost for Pittsboro was $90,000, and based on the estimates run using the SNAP tool, the project results in a TN reduction of 3.62 lbs/yr. While it is clear that as a retrofit the project is more expensive than some new BMPs would be, the town also indicated that the project involved re-grading, re-laying, and widening a brick paver sidewalk for improved public safety and access around the parking lot. The town also added ADA features to make it more handicap accessible from the previous layout. Thus, although the retrofit may have cost more, it had added benefits beyond water quality improvement.

5. Chatham County

Chatham County staff indicated that the county has strict stormwater rules already in effect. Chatham County is a very environmentally conscious county, and has had many restrictions since before the rules went into effect. Utilizing funds received from North Carolina's Clean Water Management Trust Fund, Chatham County had a study done to identify sites to implement stormwater BMPs. Again, we took the numbers projected in a 2012 study done by CDM for Chatham County, and using a 20-year window of effectiveness, projected out the cost per pound of TN removal. The results are included in the chart below. While these numbers give a rough estimate of cost/pound for removal, and include projected maintenance over 20 years, they are based on estimates for sites from 2011/2012, some of which are likely no longer available.

CHATHAM COUNTY STORMWATER PROJECT COST-EFFICIENCIES Based on a 2012 Study by CDM		
Project Type	**Average Cost Per Pond N**	**Number of Projects**
Wetland	$117.00	1
Bioretention Cells	$220.50	2
Wet Pond	$469.00	2
Buffer Restoration	$1,750.00	2

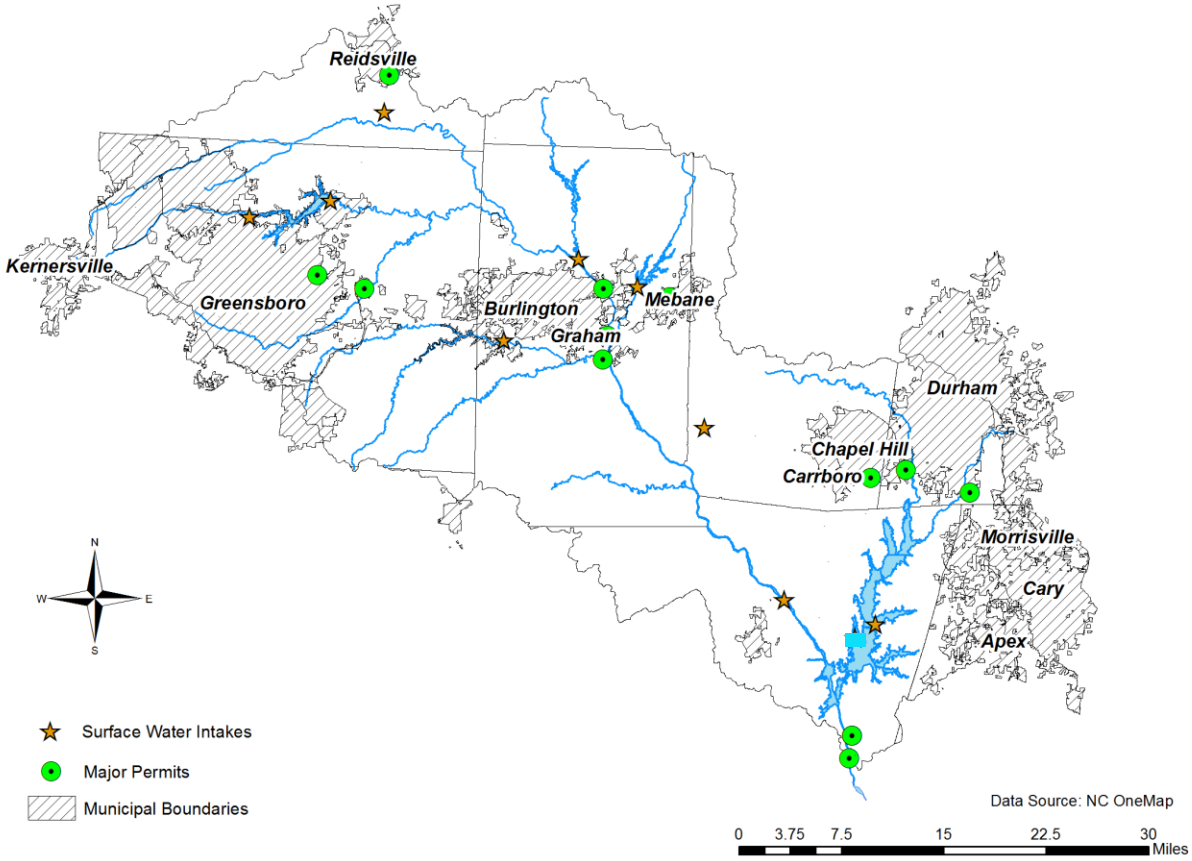
c. Preliminary Investigation of Costs, Revenues, and Financing Models

Different approaches emerge when evaluating how costs should be distributed among the various players in the Jordan Lake watershed. The strongest sentiment emerging from the different groups of interested stakeholders seemed to be that which comes from the Clean Water Act itself – the polluter pays principle. The notion that everyone who puts something into the lake that contributes to nutrient pollution should be required to pay to reduce that input or to clean it up and mitigate the harm is one that everyone understands and agrees with

to some extent. The current Jordan Lake rules as outlined above are framed with this general premise. They regulate and pull revenue from various pools of contributors. However, there is also a desire among many of the interested parties, particularly those who would be deemed contributors to the lake's nutrient issues, that beneficiaries should pay as well. Some, but not all of the parties responsible for nutrient loading also will receive benefits associated with improved water quality, but the farther away from the shores of the Lake, the less pronounced the benefits become.

The following map breaks down the watershed such that we can see the potential for drinking water benefits flowing *out of* the lake (shown through water intake locations) and wastewater pollution flowing *into* the lake (shown through major wastewater facility permits) to help illustrate the different ways in which the two principles would impact the greater region.

Water Intake Locations and Major Wastewater Treatment Facility Permits in Jordan Lake Watershed



In a complex watershed such as Jordan Lake, there does not appear to be a simple solution when it comes to financing nutrient reduction and management in the lake. If a strictly polluter pays framework is used, then the upstream communities carry the burden while the immediate

users of the lake for recreation and water supply reap benefits at a lesser cost. On the other hand, if a strictly beneficiary pays framework is used, the downstream communities pay a premium for use and benefit from the lake while the upstream communities remain unaccountable for how their contributions increase costs for others. Some type of hybrid approach where both upstream communities and Lake Jordan beneficiaries contribute towards nutrient management would likely lead to a more robust financing framework. Given the high cost of some non-point measures, it becomes even more important to find ways of spreading costs among as large a population as possible including beneficiaries outside of the watershed.

d. Emerging and Innovative Financing Methods

Given the high cost of nutrient management, managers within the basin and throughout the country are seeking new ways to implement projects that reduce costs or increase available revenue. Most of the projects we've studied that were attributed to Jordan Lake Rules or other water quality rules have been financed in fairly traditional ways. Wastewater projects have been planned at the individual utility level and funded with wastewater charges from those that use the facility. Urban stormwater projects have been developed by local government stormwater managers and paid for either through local stormwater fees or property taxes and occasionally with some degree of state or federal grant support.

Both stormwater and wastewater projects have followed a traditional public procurement model where engineers/designers create project plans, and contractors bid on the completion of the project and the lowest responsible bidder is awarded the contract. As long as contractors complete the project as designed, they are paid. Once the projects go into service, they become the responsibility of the public sector to maintain and there is the hope that the projects function as modeled.

i. *Pay for Performance*

There are several emerging variations to the approach described above that have been piloted in other areas of the country and to a lesser extent in some areas of North Carolina. DC Water, the metropolitan water, wastewater, and stormwater utility serving Washington D.C. has to meet very aggressive stormwater quantity reductions as part of their long term CSO reduction plan. DC Water has worked towards increasing cost effectiveness of many of its projects by integrating the design and construction process, so that the engineers are working with the contractors throughout the entire project as a team. DC Water also recently used a Pay for Performance bond to fund one of its stormwater projects. Under the model, the investors that lent money to DCWater for the project will receive a premium if the post project monitoring demonstrates that the project is exceeding design expectations. On the other hand, if the monitoring shows the project, despite being built as designed, does not produce the modeled results, the lenders receive lower returns on their investment. Other Chesapeake utilities have experimented with variations of "pay for performance" in which project implementers receive financial benefits for exceeding targets.

ii. Pooling and Aggregating Revenues

Very few revenues that go toward nutrient management ever cross jurisdictional boundaries based on the way projects are designed and funded. There are several state programs such as the Clean Water Management Trust Fund, that have supported nutrient management activities in the past that are, in effect, revenue pooling programs (state tax revenue from across the state is pooled together and used for high impact projects in specific areas of the state), but these programs are relatively modest. For example, the entire budget of CWMTF in 2016 was less than what the City of Durham collects in stormwater fees. The concept of a watershed improvement district or watershed improvement utility where revenue is collected from a larger based to fund priority projects at a regional level rather than at a local government level has been introduced in some parts of the country such as Minnesota. In some ways, limited pooling occurs in the form of association dues. It is worth noting that many of the communities in the watershed pay substantial association or membership fees to be part of organizations that promote water quality through monitoring or other pooled planning efforts in Jordan Lake. Participation in the associations is voluntary, and as we move forward in our research in the next year, we will study the pooling and cost sharing processes in these organizations and more formalized approaches.

iii. Incentives for Encouraging investment on Private Property

A third type of financing innovation relates to the initiatives public agencies use to encourage or incentive private investment on private property. Public entities across North Carolina and the Country do this in a variety of ways. Some utilities, such as Durham County and Raleigh, have created cost sharing grant programs that provide public resources for private BMPs as long as there is substantial private participation. Other utilities, have experimented with offering reductions in stormwater fees to property owners that make investments to improve on-site stormwater management.

iv. Trading and Offsets

Finally, nutrient trading or a vibrant offset market is an approach that has been widely discussed, but which remains difficult to implement. The option for parties to meet nutrient load reduction obligations through credits created by the rules was originally conceived as an important aspect of carrying out the Jordan Lake nutrient management strategy. Credits for offsetting, as stated in the rules, “provides the potential more cost-effective achievement of strategy reduction goals.” During our first round of research, we reviewed the existing framework for trading. The market created between the sellers (who generate credits from additional reduction activities) and buyers is the basis for the potential cost-effectiveness of credits for offsetting nutrient loads compared to other management practices as parties are able to determine the most efficient way for meeting their requirements under the rules. Like the overall rules, confusion abounds regarding credits and credit trading throughout the watershed. Although, municipalities and developers alike have discussed the potential of credits under the nutrient management strategy and recognized the anticipated need to

purchase credits once the rules are in effect. While our research has identified a basic necessity to use credits to develop a new project or to offset a town's excess nutrient loads from stormwater runoff, we anticipate further analyzing the actual cost-effectiveness of credits for offsetting and credit trading through comparison of the trading scheme under the Jordan Lake rules with other regional and national nutrient trading schemes as our research continues.

The stringent nutrient reduction goals established by the rules for multiple types of parties combined with the option of fulfilling those requirements through credits creates a simple incentive for using credits: without using offsite credits, meeting reduction requirements onsite could be prohibitively expensive for developers, municipalities, farmers, and wastewater utilities. Some places in the watershed where the new development rule went into effect prior to the current legislative study and rules delay described the necessity of allowing developers to purchase offsite credits for meeting the specific reduction requirements for a site. This is particularly the case when a new development site is not large enough to place the number of BMPs onsite to meet the required reductions or building the BMPs would be so costly as to make the project no longer financially feasible.

Source: Restoration Systems & NC Division of Water Resources

Before Buffer

After Buffer

As mentioned above, the rules establish a baseline for all of the parties that could be eligible to purchase credits to meet their reduction obligations. This creates a two-step process for using credits to comply the rules: (1) meet the baseline onsite requirements for your type of regulated party and (2) purchase offsite credits to offset nutrient loads from the site. Farmers must satisfy a baseline of reduction prior to generate credits for additional activities, developers must build one onsite BMP before purchasing offsite credits, wastewater dischargers must also make efforts to obtain allocations from existing discharges, and municipalities must meet additional minimum criteria. The role of the baseline requirements was discussed by some stakeholders in the jurisdictions we have interviewed thus far. Some expressed that requiring a baseline is a disincentive for using credits or participating in credit trading. This is mainly an issue for the agriculture community who must, collectively, meet reduction requirements under the rules and who are in a prime position to generate credits for

offsetting excess nutrient loads by making buffers and other land-intensive BMPs. Baseline requirements do not have the same deterring effect on the other parties regulated under the rules because credits are an option intended to give flexibility for those parties in fulfilling requirements that go far beyond the baseline to participate in credit trading.

Generally, the water quality trading market created by the rules does not involve significant involvement from the state. The rules are written in a manner that places a majority of the burden for establishing a credit trading market on the regulated parties and private parties who desires to generate credits through additional reduction activities. Approval of credit generation under the rules is the most involved part of nutrient trading for DEQ and is done by the Division of Water Resources. Stakeholders in some jurisdictions expressed concern about the Division's process for approving credits, stating that a "pick this, pick that" method for certifying credits for reduction projects causes uncertainty around the trading market. Other stakeholders have stated that, while the approval process for credits could be approved, the current process allows for great flexibility in developing unique projects that generate credits for offsetting nutrient loads.

The minimal involvement of DEQ in establishing the actual market may be a weakness of the trading scheme under the rules and inhibit the development of a robust trading market. Although, DEQ and the Division have created tools for helping parties seeking to generate, sell, and buy credits including the SNAP tool and delivery factors. The Division publicly catalogs available credits on its website, but it does not actively facilitate the purchase or sale of credits. The NC Ecosystem Enhancement Program (now the Division of Mitigation Services (DMS)) is one avenue to increase state support for a more robust trading market. Currently under the rules, parties may pay in-lieu fees to DMS if they are able to show that there are no credits available on the market. As mentioned earlier, credits must be generated in the same watershed/subwatershed as the one it is being applied as reduction in under the rules, which limits the size of trading markets but ties reductions directly to a specific watershed's nutrient management strategies, rather than a distant reduction outside of the impaired watershed. Prior to 2007 the DMS functioned more similarly to a nutrient offset bank, and most credits for nutrient offsetting were purchased from DMS. In 2007, the rules for paying DMS an in-lieu fee were changed and, specifically under the Jordan Lake rules, became an option for purchasing offset credits when a regulated party could adequately show DEQ that there were no credits available on the market for purchase. One potential suggestion for making a healthy trading market is to restore DMS' function as a clearinghouse for all nutrient trading. For DMS to function successfully as a clearinghouse across different watersheds and nutrient management, the development of a process for pooling funds from in-lieu fees originating from a specific watershed and for putting those funds to use on reduction projects in that same watershed would be required. Unless, there was an acceptance for larger trading markets between watersheds and nutrient strategies.

V. How the Research Informs Management Decisions and Existing Regulations

The high costs and low cost effectiveness of many of the stormwater measures reinforce the need to identify, develop, and test different cost saving measures. These measures include alternative delivery mechanisms and market mechanisms such as trading.

To date, the implementation of water quality improvements has been fragmented with each sector, each local government, and in some cases each local government department identifying and implementing measures on an individual basis. We will continue to examine potential methods to promote a more integrated approach to nutrient management, both in terms of project identification and in revenue collection.

Given the importance of the Lake to downstream communities and communities outside the watershed that rely on Lake Jordan water for their water supply, we believe there should be continued investigation of financing models where parties that affect the lake as well as parties that benefit from the lake share some responsibility for paying for water quality improvement measures. Likewise, many of the initiatives that reduce nutrient loading also have important secondary finance or economic benefits within the implementing jurisdiction that should be considered in developing financing strategies.

Understanding and potentially expanding the role of cost sharing could have an impact on implementation. One such major source of cost-sharing is in place for the agriculture community, which we have not yet explored in depth. Farmers receive cost-sharing funds through state and federal programs. Additionally, as has been done in Pittsboro, there is the possibility of using Clean Water Act 319 Federal Grant funds to supplement projects. Further, some communities, like Chatham County, have received Clean Water Management Trust Funds to conduct research studies related to compliance with Jordan Lake rules, or have partnerships with NC State or other universities which have assisted in research studies. However, at least one jurisdiction indicated during our conversations that they were reluctant to use and resisted using North Carolina's Clean Water Management Trust Funds for stormwater projects, because of the fact that they did not believe they would receive credit for such projects under the rules. If, in fact, that is the case, not only does such a practice frustrate the process and goal of the Jordan Lake rules to protect and restore the watershed, but it ignores the other community costs and benefits associated with BMP retrofitting projects. We will continue to investigate the secondary impacts of particular funding strategies and programs.

VI. Building Upon this Research in the Coming Year

Next year we intend to continue to document and analyze costs. We will also continue speaking with all the jurisdictions to be able to assess all of the costs and sources of revenue flowing into the entire watershed and to vet potential new financing methods. Additionally, we intend to delve deeper into trading and other market mechanisms. We also intend to pilot at least to one innovative financing method with a jurisdiction in the watershed to gauge the effectiveness of such models.