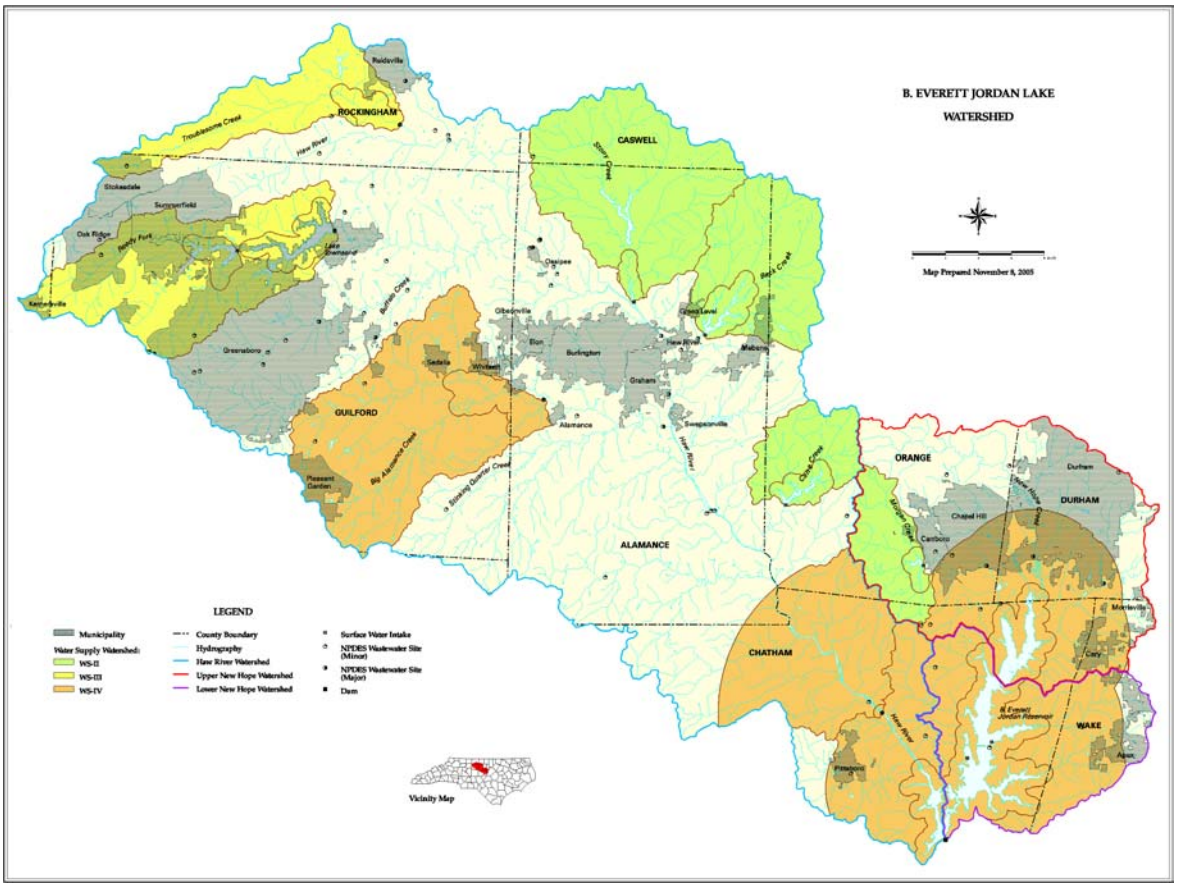
Fiscal Analysis

B. Everett Jordan Reservoir
Water Supply Nutrient Strategy



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Executive Summary

Jordan Reservoir Nutrient Enrichment Problem

Since its impoundment in 1983, the B. Everett Jordan Reservoir has consistently shown substantial nutrient over-enrichment. The NC Environmental Management Commission designated the reservoir a Nutrient Sensitive Water (NSW) that same year. In 2002, the Division of Water Quality determined that the Upper New Hope Creek Arm no longer met its designated uses due to excess nutrient inputs, based on exceedences of the chlorophyll a standard. The Division made the same determination for the rest of the lake in 2006, adding exceedences of the pH standard as a eutrophication indicator in the Haw River Arm. As a result, the entire reservoir is now on North Carolina's list of impaired waters under Section 303(d) of the federal Clean Water Act.

Jordan Reservoir is a multi-use impoundment with an area of 13,940 acres, formed by damming the Haw River in the Cape Fear River Basin. The reservoir is operated for flood control, water quality (low flow augmentation), fish and wildlife conservation, recreation, and water supply. It has three hydraulically distinct segments or arms – Haw, Upper New Hope, and Lower New Hope, as seen in Figure 1. The Haw arm at the bottom of the lake has a very short average hydraulic retention time of five days, and accounts for 70 to 90 percent of the annual flow through the water body. The Upper New Hope Creek arm at the top has a comparatively very long retention time, 418 days.

The potential for excess nutrients was a concern when the reservoir was proposed in 1945. In the 1960s, two major streams in the watershed, Buffalo Creek and Bolin Creek, did not support fish due to sewage pollution. Congress authorized the New Hope Dam in 1963 but water quality concerns continued to grow, and legal actions delayed construction, including an inadequate Environmental Impact Statement in the early 1970's. Although water quality standards were frequently exceeded at most sampling locations in the watershed in the 1970s, a Federal Court decision allowed completion of the lake in 1979.

Following the lake's supplemental classification as NSW in 1983, total phosphorus (TP) limits of 2.0 mg/L were required for wastewater dischargers with permitted flows greater than 0.005 MGD. Such facilities in the more problematic Upper New Hope Arm received TP limits of 0.5 mg/L during the warmer months of April to October.

Despite these early controls, the Division rated the lake as hypereutrophic, reflecting a superabundance of nutrients. Excess nutrients drive excessive growth of different types of algae. In the reservoir setting, these can be both microscopic algae suspended in the water, giving it a cloudy or discolored appearance, and macroscopic algae forming visible mats on the water, both of which detract from its aesthetic appeal. Some algal types, blue-greens in particular, release toxins that make them a poor food source for fish, may have other health effects on aquatic life, and can irritate the eyes and mucous membranes of people who swim in the water. Excessive algal growths can produce unpleasant odors and can have several other impacts. They exaggerate the daily flux in oxygen levels in the water, causing it to drop dramatically at night, which can stress or even kill fish and other aquatic life. They also raise the water's pH, making it more caustic, further stressing aquatic life and potentially irritating mucous membranes of people who contact the water. Excessive algal growth requires greater treatment at additional cost when present in water withdrawn for drinking and other consumptive purposes. It can impart disagreeable taste and odor to the treated drinking water, and can increase the level of undesirable byproducts, called trihalomethanes, in the finished water.

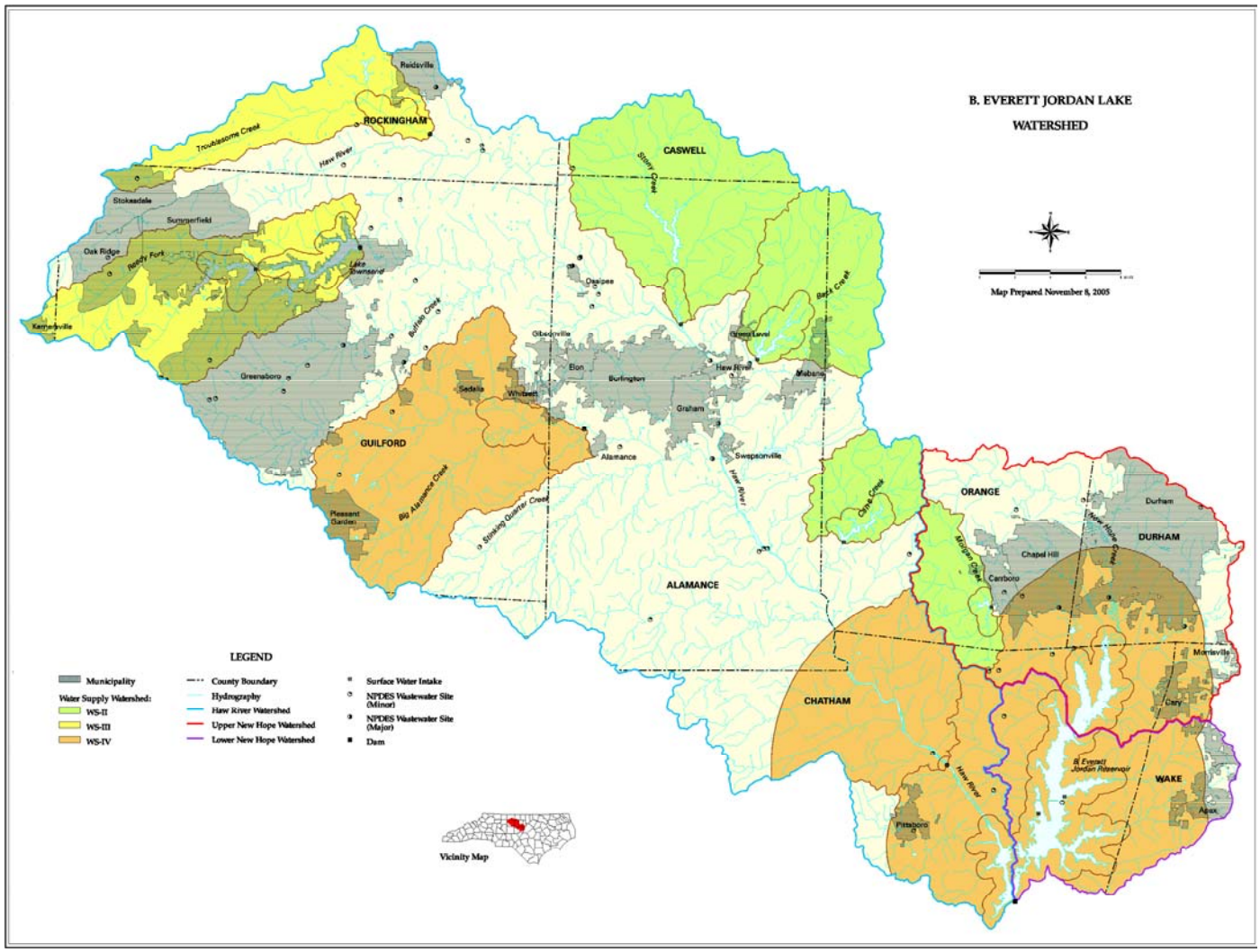
Algal blooms, including harmful blooms of blue-green algae, have been documented consistently in both the Haw and New Hope arms since the time the reservoir was filled. Despite the installation of biological nutrient removal by Orange Water and Sewer Authority (OWASA)'s Mason Farm wastewater treatment plant on Morgan Creek in 1991, water quality problems persisted and elevated nutrients led to periodic algal blooms in the early 1990s. In 1996 and again in 2003, the Town of Cary, which withdraws drinking

water from Jordan Lake, received extensive complaints about the water's taste and odor. Algal blooms continue in the lake to the present. In August 2006, the Division received a complaint from a recreational boater who had accidentally swum in what was later confirmed as a green algae bloom and had experienced unpleasant effects. In March 2006, the Division documented a fish kill in the Upper New Hope Arm. It is likely that the ongoing algal blooms will continue to interfere with recreational uses.

Watershed to Jordan Reservoir

Jordan Reservoir's watershed encompasses 1,686 square miles, just over 1 million acres, including all or portions of eight counties and 26 municipalities. It takes in both the west side of the rapidly growing Triangle area, including Chapel Hill and parts of Durham, Cary and Apex, as well as most of the Piedmont Triad, another of the fastest growing areas in the state. While 51% of the watershed is nested with smaller Water Supply Watersheds (see Figure 1) that impose development density limits and require stormwater controls, these restrictions do not ensure that nutrient loading from new development will be stemmed. In addition, existing developed areas, most of them lacking stormwater treatment, cover significant acreage in the watershed. The Upper New Hope subwatershed is heavily urbanized, while the Lower New Hope subwatershed is being rapidly developed at suburban residential densities. Using 2000 Census data, we estimated a weighted average growth rate in the watershed of 1.6% per year as shown in Table 1 below.

Figure 1: Jordan Reservoir Watershed



Given that a portion of new development occurs on agricultural land, agriculture in the watershed appears to be following the statewide trend of decreasing land area. Most agriculture falls in the Haw subwatershed, which comprises 80% of the entire Jordan watershed. While agriculture is generally decreasing, it appears that dry litter poultry operations are increasing in the Haw subwatershed. Numbers for these operations are difficult to obtain for security reasons and because the Division does not issue individual permits for them, but they may present additional management issues. Also, input from the agricultural community indicates that horse operations are increasing in Triangle bedroom communities. Unlike Neuse and Tar-Pamlico River Basins, traditional agriculture in the watershed is dominated by grazing livestock and other pasture operations, estimated as occupying up to 90% of agricultural land.

Table 1: Population Growth in Jordan Watershed

County	Co. Area, 2000 (mi2)	Fraction of County Area in Jordan W'shed Note 16	Whole-County Population[8] 2000	Estimated 2000 Population in Jordan Watershed	Whole-County Population[8] 2020	Avg Ann County Growth Rate (Pers/yr)	Avg Ann County Growth Rate (%)
ALAMANCE	430	95%	130,794	124,254	171,023	2,011	1.54%
CASWELL	425	20%	23,501	4,700	26,652	158	0.67%
CHATHAM	683	45%	49,329	22,198	73,924	1,230	2.49%
DURHAM	290	35%	223,318	78,161	297,461	3,707	1.66%
GUILFORD	649	55%	421,048	231,576	527,134	5,304	1.26%
ORANGE	400	55%	115,533	63,543	149,080	1,677	1.45%
ROCKINGHAM	566	25%	91,928	22,982	96,450	226	0.25%
WAKE	832	8%	627,866	50,229	1,106,218	23,918	3.81%
		Totals:	1,683,317	597,645	2,447,942	38,231	2.30%
				Average Annual Jordan Growth Rate, Co Pop-Weighted:			1.61%

Table 2: Municipalities in the Jordan Watershed and Their Populations

ALAMANCE CO.	
ALAMANCE	310
BURLINGTON	47,004
ELON	7,176
GRAHAM	13,776
GREEN LEVEL	2,331
HAW RIVER	1,944
MEBANE	7,934
OSSIPEE	452
SWEPSONVILLE	972
CASWELL CO.	
CHATHAM CO.	
PITTSBORO	2,376

DURHAM CO.	
DURHAM	204,783
GUILFORD CO.	
GIBSONVILLE	4,574
GREENSBORO	233,190
OAK RIDGE	4,231
PLEASANT GARDEN	4,851
SEDALIA	631
STOKESDALE	3,465
SUMMERFIELD	7,227
WHITSETT	709

ORANGE CO.	
CARRBORO	17,648
CHAPEL HILL	52,011
ROCKINGHAM CO.	
REIDSVILLE	14,626
WAKE CO.	
APEX	25,951
CARY	110,190
MORRISVILLE	12,126

Management Mandates

The Environmental Management Commission is charged, under NC statutes Chapter 143B-282, with responsibility for restoring and protecting water quality statewide, and is given authority to adopt rules to that end. More recently, the sweeping Clean Water Responsibility Act of 1997, S.L. 1997-458, included requirements to address water quality problems in Nutrient Sensitive Waters. Often referred to as House Bill 515, the act directed the Commission to establish goals for reducing nutrient inputs to these waters, to

ensure that point and nonpoint sources share proportionally in responsibility for reducing inputs, and it set total nitrogen (TN) and total phosphorus (TP) concentration limits of 5.5 and 2.0 mg/L respectively for wastewater facilities discharging greater than 0.5 MGD into NSW waters. It set a 5-year compliance window. The following year, SL 1998-212 amended the Act to allow the Commission to grant a compliance extension under certain conditions: dischargers would need to develop a calibrated nutrient response model for the water body and adhere to its results, optimize the operation of facilities for nutrient removal, and evaluate discharge alternatives to reduce nutrient loading.

In 1999, Haw River municipalities of Greensboro, Mebane, Reidsville, Graham, Pittsboro, Burlington, and OWASA formed the Project Partners and sought a compliance extension under the amended Act, which the Commission granted in April 1999, in order to obtain a reservoir response model. The amended Act did not set time limits on rule adoption by the Commission. Dischargers' optimization plans were presented at the July 2000 Water Quality Committee meeting. The Project Partners contracted with Tetra Tech, Inc. to develop a reservoir model, and the Committee approved the resulting combined hydrodynamic and water quality model in July 2002.

In addition to state legislative requirements, the 2002 impairment determination on the Upper New Hope Arm precipitated federal requirements to set and enforce nutrient load reduction limits, known as a total maximum daily load (TMDL). The Division contracted enhancements to the Project Partners' nutrient response model for purposes of TMDL development. The Division also began a facilitated stakeholder process in 2003 to seek consensus on establishment of lake loading goals, discharger allocation methods, and a conceptual nonpoint source strategy. Results of numerous runs of the reservoir model fed into the deliberations. After 22 formal meetings, the stakeholders issued a report in February 2005. The report contained a mix of consensus recommendations and majority and minority positions on goals, allocations and strategy concepts, and it included a conceptual nonpoint source proposal.

In April 2005, the Division followed with the *B. Everett Jordan Nutrient Management Strategy and Total Maximum Daily Load*. The intent of this strategy is to reduce nutrient inputs to the reservoir to the extent needed to meet nutrient-related standards, and to avoid more serious water quality problems that would likely be seen otherwise in the future. This combined TMDL/strategy document included percentage load reduction goals and mass load equivalents for the three arms, individual discharger TN and TP mass load allocations, and a conceptual nonpoint source strategy. For point sources, the result was slightly more stringent TN limits for Haw dischargers than imposed by HB515, about 5.29 mg/L, and for Upper New Hope dischargers, the most stringent nitrogen limits in the state to date, equating to about 3.04 mg/L TN. The Division provided a 60-day comment period and held two public meetings on May 5, 2005. In addition to public meeting comments, DWQ received 2,278 written comments on the proposed strategy, the vast majority of which were postcards from lake users supporting regulatory actions. The Division expanded the conceptual strategy into draft rules, and in October 2005 the Committee approved moving the rules to public comment.

In January 2006, stakeholder concerns over the modeling basis for strategy goals, point source timelines and costs, existing development load reduction requirements and costs, and timeframes prompted an ad hoc session of the full Commission to postpone further action in favor of additional stakeholder discussions and development of cost estimates. Over the course of 2006, staff held two all-parties stakeholder regroup meetings and a series of subject-specific technical meetings as listed in Table 3.

Strategy refinements resulting from these meetings included the following:

- Draft fiscal analysis and cost estimates for most rules.
- A draft list of alternative nutrient-reducing practices for existing developed lands.
- Revisions to most rules.
- A draft study plan for future remodeling of Jordan reservoir and its watershed.

Table 3: Jordan Public Meetings During 2006

# Meetings	
2	All Parties Meetings – May 2 and Sept 29
	Subject Meetings
4	Existing Development (May – July)
3	Point Source (Jan - June)
5	Adaptive Management (June – Dec)
2	Agriculture (June – July)
3	DOT buffers (April – Sept)
4	DOT Stormwater (April – Dec)
4	Trading Grant – (April – Nov) held by COGs, CH2MHill

Nutrient Loading Sources to Jordan Reservoir

The Division contracted with Tetra Tech, Inc. to develop a watershed model that would estimate loading from the different land uses to Jordan Reservoir. Figures 2 and 3 below are taken from Tetra Tech's November 2003 final report on the watershed model (see Appendix B, page B-1, Reference 13 for a full citation). The figures illustrate point and nonpoint source nutrient contributions to Jordan Reservoir.

Figure 2: Relative Importance of Point and Nonpoint Source Loads Delivered to Jordan Lake

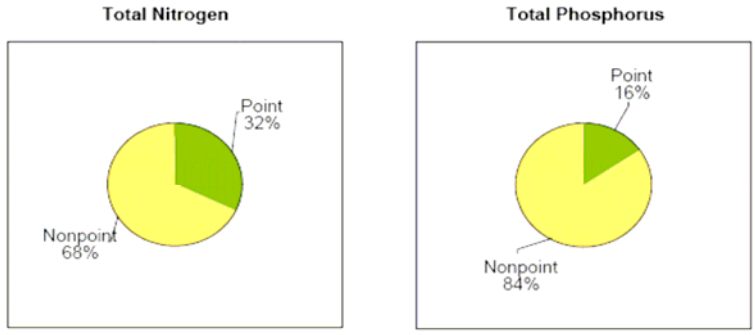
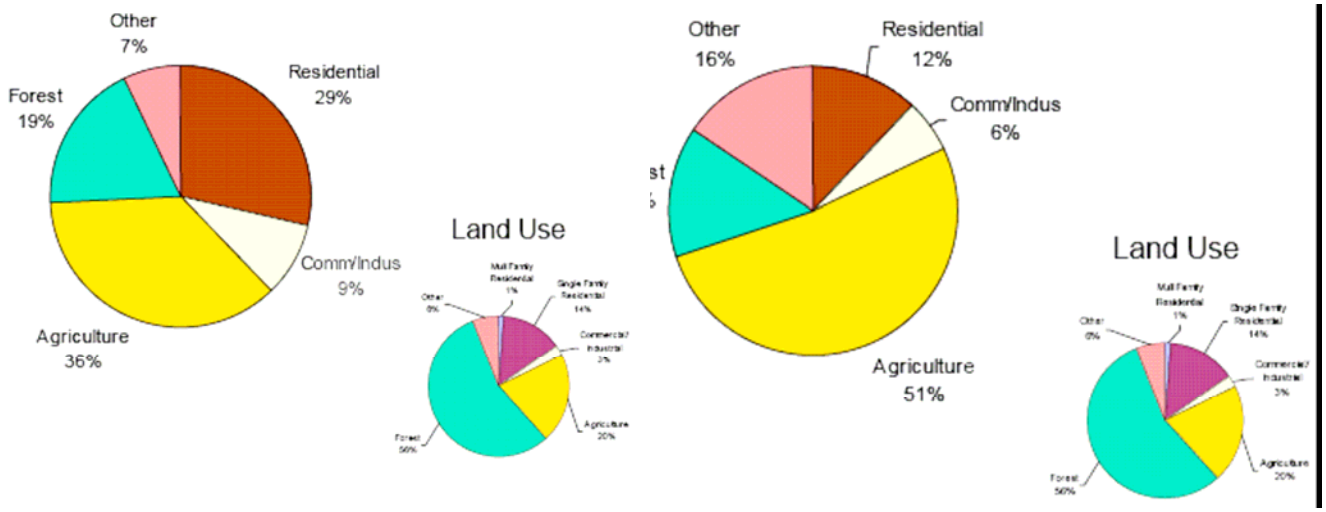


Figure 3: Composition of Nonpoint Source Nutrient Loads to Jordan Reservoir



Total Nitrogen **Total Phosphorus**

Proposed Strategy

The proposed strategy is designed to comprehensively address loading reduction needs to restore each of the three arms of Jordan Reservoir. The set of rules targets point and major nonpoint nutrient sources. They are designed to meet the statutory mandate to distribute reduction responsibility proportionally among all sources relative to a common starting point of 2001. Unlike previous nutrient strategies, staff is developing a watershed Total Maximum Daily Load (TMDL) concurrent and coordinated with our development of this management strategy. This strategy is also distinctive in its design to utilize the water supply watershed statutes to better ensure protection and improvement of the water supply uses of Jordan Reservoir and other designated water supplies within the Jordan watershed. A third major distinction is the segmented hydrologic behavior of Jordan Reservoir, necessitating three sets of loading goals corresponding to the three reservoir arms, as shown in Figure 1.

Departures from Neuse and Tar: The proposed rules follow the framework of previous nutrient strategies and include an overarching goals rule, a point source rule and a suite of nonpoint source rules addressing agriculture, fertilizer management, stormwater control, and riparian buffer protection. Major changes relative to previous nutrient strategies are based on lessons learned, stakeholder input, and the nature of this reservoir and its watershed. Those changes include stormwater requirements for *all* local governments in the watershed, local implementation of buffer rules, a rule requiring local governments to achieve nutrient loading reductions from existing developed lands, a separate stormwater rule for State and Federal entities, and a separate rule outlining a trading framework to maximize options for achieving more cost-effective reductions. Outside of these rules, staff is also evaluating possible improvements to Division rules for land application of wastes, and the potential for improved onsite wastewater management through the Division of Environmental Health.

Nitrogen and Phosphorus Percent Goals: The strategy is designed around percentage N and P reduction goals for each of the three arms of the reservoir. Modeling staff with the Division established these reduction goals after evaluating numerous scenarios using the reservoir model and other supporting models. Staff also considered stakeholder preferences and concerns gathered during the 1 ½-year joint goal-setting and strategy conceptual design process. The reservoir model allowed staff to project the magnitude of loading reductions needed to minimize exceedences of the water quality standard for chlorophyll a, the primary standard on which reservoir impairment is based. Separate N and P goals for each arm were needed because of the separate, hydrologically distinct behavior exhibited by each arm. Resulting strategy percentage goals are as follows:

Table 4. Percentage Reduction Goals from Baseline, Jordan Nutrient Strategy

	Segment of Jordan Reservoir		
	Upper New Hope Arm	Lower New Hope Arm	Haw Arm
Nitrogen	35%	0%	8%
Phosphorus	5%	0%	5%

These goals are relative to a baseline period of 1997 through 2001, which was dictated by the collection time span of data used in the reservoir model. The Division collected water samples to measure N and P loading into each arm of the reservoir during the baseline period, along with other physical and chemical data. The baseline period becomes important for implementation because all subsequent load-changing activities in the watershed need to be quantified either for reduction credit or as additional load to be offset in reaching the goals. This is especially important to local governments where growth occurs subsequent to 2001, likely adding to annual wastewater and stormwater loading for which the local governments become responsible.

For the existing development rule, load reduction goals are actually somewhat greater than the values shown in Table 4. This is due to the inclusion in the rule as part of existing development the 'transition' years, those years between the baseline and implementation of new development permitting, that is 2002-2011, along with their associated growth and resulting load increases. To quantify those load increases we first estimated annual population growth rate in the watershed at 1.6%, as shown in Table 1, and projected that annual growth rate from the 2000 Census population up through rule implementation years. We then translated population growth to acres of residential and non-residential development, then to types of development and associated nutrient export. After crediting stormwater BMPs that we assumed would be implemented to meet other regulations during the transition years, we added the net resulting transition load increases to the baseline load reductions that local governments would need to achieve to meet the existing development rule. Thus, to meet the existing development rule local governments would need to achieve the percent reductions shown in Table 5 from 2011 loading conditions.

Table 5. Percentage Reduction Goals Adjusted to Year 2011, Existing Development Rule

	Segment of Jordan Reservoir		
	Upper New Hope Arm	Lower New Hope Arm	Haw Arm
Nitrogen	37%	2%	10%
Phosphorus	5%	0%	5%

Nitrogen and Phosphorus Mass Load Goals: The watershed model described above estimated loads generated in runoff from all land uses as well as the fractions of those loads delivered instream to the reservoir from each small watershed nested within Jordan watershed. This estimate of relative contributions of the various nonpoint source types is illustrated in Figures 2 and 3. The watershed model included baseline estimates of per-acre load generation rates, total annual loads generated by each land use, and load reduction needs. These values are provided in Table 6.

Table 6: Existing Development and Agriculture Acres, Loads, and Load Reduction Needs

		Existing Development				Agriculture		% Reduction Required	
		Local Gvt.	DOT	Non-DOT State/Fed	Total	Row Crop	Pasture		
Acres	UNH	31,010	4,821	1,451	**37,281**	4,310	2,827		
	LNH	8,316	1,489	389	**10,194**	2,549	1,573		
	Haw	128,811	19,238	6,027	**154,076**	141,128	64,320		
	Total	**168,137**	**25,547**	**7,867**	**201,552**	**147,987**	**68,720**		
Baseline Loads TN (lb/yr)	UNH	594,284	15,281	24,685	**634,250**	73,909	18,674	TN	35%
	LNH	140,257	4,720	5,754	**150,730**	48,079	11,415		0%
	Haw	2,204,857	60,984	92,246	**2,358,087**	1,723,661	334,872		8%
	Total	**2,939,398**	**80,985**	**122,684**	**3,143,067**	**1,845,649**	**364,961**		
Load Reduction Goals TN (lb/yr)	UNH	207,999	5,348	8,640	**221,987**	25,868	6,536		
	LNH	0	0	0	**0**	0	0		
	Haw	176,389	4,879	7,380	**188,647**	137,893	26,790		
	Total	**384,388**	**10,227**	**16,019**	**410,634**	**163,761**	**33,326**		
Baseline Loads TP (lb/yr)	UNH	96,565	2,555	4,014	**103,134**	29,147	3,891	TP	5%
	LNH	22,826	789	937	**24,552**	10,089	1,527		0%
	Haw	325,995	10,196	13,687	**349,878**	784,940	70,702		5%
	Total	**445,386**	**13,540**	**18,638**	**477,564**	**824,176**	**76,120**		
Load Reduction Goals TP (lb/yr)	UNH	4,828	128	201	**5,157**	1,457	195		
	LNH	0	0	0	**0**	0	0		
	Haw	16,300	510	684	**17,494**	39,247	3,535		
	Total	**21,128**	**638**	**885**	**22,651**	**40,704**	**3,730**		

We used the Table 6 values in the cost calculations unless more accurate estimates were available. For example, for agriculture we applied the strategy's percentage reduction goals and established BMP reduction efficiencies to the watershed model's baseline loading values to estimate numbers of BMPs needed and associated costs. As one exception, the watershed model did not distinguish DOT land holdings separately from other developed lands. Thus, we established the DOT values shown in Table 6 using DOT acres and research-based per-acre loading rates provided by DOT.

Together, the rules would provide the most comprehensive effort in the state to date to meet the nutrient loading needs of a large waterbody through a large-scale strategy. The agriculture rule would address the load reduction goals estimated in Table 6 above for agriculture, the existing development rule and the existing development portion of the state and federal rule would address the various load reduction goals shown for existing developed lands, and the new development rule and new development portion of the state and federal rule would address lands that transition from forest and agriculture to development. Other rules would assist in achieving those goals. The riparian buffer rules would avert loading increases that would otherwise result from impacts to the natural water quality improvement functions currently provided by these landscape features. We estimate that without the protections provided by the proposed buffer rules, development and forest harvesting activities could yield incremental load increases to streams in Jordan watershed of greater than one percent of all annual N and P loads to Jordan Reservoir, and on the order of 6% and 26% of the strategy N and P reduction goals, respectively.

We would expect the nutrient management rule to reinforce sound fertilizer management behaviors and potentially improve them where applicators are not optimizing nutrient use. We estimate a potential reduction of nutrient inputs from existing developed lands and agriculture to streams in the watershed of 14,000 lb N/yr and 3,400 lb P/yr, or 2.5% and 14.5% of the N and P at-lake goals for the entire strategy, respectively.

The set of rules comprising the proposed strategy is listed in Table 7 below. Following the table are brief summaries of each rule along with bullet lists of revisions made to each rule during 2006.

Table 7. List of Proposed Rules Comprising the Jordan Nutrient Strategy

15A NCAC 02B Rule Number	Rule Title
.0262	Watershed Nutrient Reduction Goals
.0263	Nutrient Management
.0264	Agriculture
.0265	Stormwater Management for New Development
.0266	Stormwater Management for Existing Development
.0267	Protection of Existing Riparian Buffers
.0268	Mitigation for Riparian Buffers
.0269	Options for Offsetting Nutrient Loads
.0270	Wastewater Discharge Requirements
.0271	Stormwater Requirements for State and Federal Entities
.0272	Riparian Buffer Mitigation Fees
.0311	Cape Fear River Basin (Schedule of Classifications)

Rule .0262, Watershed Nutrient Reduction Goals

This rule provides an overarching framework for the entire set of rules. Specifically it: describes strategy objectives; would reclassify the remainder of Jordan watershed as WS-V; would designate the entire watershed as a 'critical water supply watershed'; defines the three subwatersheds draining to Jordan Reservoir; defines the baseline time period and establishes N and P percentage reduction goals and

corresponding lake loading targets, point and nonpoint source, for each arm relative to that baseline period; enumerates the set of rules designed to achieve the goals and lists the local governments to which certain rules would apply; details where these rules supersede the several existing water supply rules; provides an adaptive management framework following a period of implementation; acknowledges control of atmospheric nitrogen sources as absent from the proposed rules, and reserves interest in such rulemaking pending better science. Each subsequent Rule references parameters set forth in this Rule.

Changes to .0262:

- Removed nonpoint source loading rate targets (revised and added rule-specific values to new development rules, where more appropriate).
- Removed the Lower New Hope arm exemption from the agriculture rule. While that arm has only "no increase" targets, at minimum accounting would be needed to verify and maintain compliance with targets, and depending on changes in activities, implementation may be needed.
- Added counties as subject to the existing development rule in addition to municipalities to achieve targets and accountability within each lake arm and address equity concerns.
- Restructured introductory paragraph for logical flow and clarity of intent.
- Clarified how the rules would supersede existing water supply requirements.

Rule .0263, Nutrient Management

Provides planning and training options for fertilizer applicators. Applicators and consultants in the watershed would either attend nutrient management training offered by the Cooperative Extension Service or complete certified nutrient management plans for the lands to which they apply within five years. Homeowners and business owners would not be subject but applicators they hire would be.

Changes to .0263:

- For efficiency, removed owners and managers of commercial and industrial greenspace from the rule, and instead added individuals hired by those persons and who apply fertilizer to a total of at least 10 acres per year.

Rule 0264, Agriculture

Establishes collective N and P reduction requirements for all persons engaging in agricultural operations in the Jordan Reservoir watershed. After two years, a Watershed Oversight Committee would determine if the collective N goal for each subwatershed has been achieved. If not achieved, Local Advisory Committees (LACs) would be formed and tasked with defining implementation strategies. Five years after the effective date, the Commission would determine if LACs have achieved individual and subwatershed N and P goals. If not achieved, the Commission would require additional BMP implementation designed to achieve the goals within eight years after effective date. P accounting would be qualitative in nature. Pasture accounting would be based on increases in BMP implementation. The Rule also defines BMP options, and establishes parameters for individually meeting Rule requirements. Annual reports would be required.

Changes to .0264:

- To address the concern that the Upper New Hope Arm might not be able to meet its N requirements, added option for the Watershed Oversight Committee to propose an alternative to the EMC after initial evaluation at 2 years. Also broadened trading rule to allow agriculture's participation.
- Lowered numeric horse threshold per technical group's recommendations.
- Modified standard BMP definition to strengthen individual stewardship and facilitate trading.

Rule .0265, Stormwater Management for New Development

Would require all local governments in the Jordan watershed to develop and implement programs to require stormwater controls on new development activities to meet subwatershed nutrient loading rate targets. Developers would control nutrient export to minimum levels onsite, and could meet remaining reduction needs through in-lieu fee payment to EEP, or to local governments with a Division-approved local offset plan. Control of flows for stream protection would also be required. Development in existing water supply watersheds would also be required to comply with density-related treatment thresholds and density caps designed to protect local water supplies where they are more stringent. Within one year of effective date, the Division would submit a model local program to the Commission for approval. Within another six months, local governments would submit programs for Division review and subsequent Commission approval. Within two and a half years after the effective date, local programs would be implemented. Annual reports would be required.

Changes to .0265:

- Added acreage thresholds for new development (Item (3)).
- Revised Goals Rule's loading rate targets to make them specific to this rule and consistent with methods used to date, and moved to this rule. Added clarifying explanatory language that may allow refinements during implementation.
- Revised offsite loading rate thresholds for consistency with other programs, to provide for reasonable onsite measures, and to avoid overtaxing EEP. Added detail to offsite options.
- Deleted redundant requirements with the existing development rule - education, mapping, and illicit discharges removal.
- For clarity, added specifications to BMP design criteria, including water supply requirements that remain applicable.

Rule .0266, Stormwater Management for Existing Development

Would require all local governments to implement loading reduction measures on existing developed lands toward long-term load reduction targets for those lands. They would conduct feasibility studies, then submit program proposals for Division and Commission approval within three years after effective date. Programs would propose implementation rate, nature and overall timeframes envisioned. Programs would be implemented within four years of rule effective date. Programs for public education and illegal discharge detection and elimination are to be implemented within two and a half years. Annual reports are required.

Changes to .0266:

- Added counties as subject consistent with goals rule change.
- Dropped requirement to identify one retrofit site per year per 15,000 population during first three years due to confusion over intent and concern that rate was too high.
- Dropped peak flow rate match for BMPs based on concerns over achievability in developed areas and non-essential nature of the requirement to this rule.
- Added explicit statement crediting BMPs implemented post-baseline as reductions and counting load increases from post-baseline development in reduction needs.
- Added explanation of types of activities that could be credited as load-reducing.
- Added criteria for content of local program submittals at the request of local governments to provide a clearer understanding of expectations.

Rule .0267 & .0268, Protection of and Mitigation for Existing Riparian Buffers

Would require local governments to protect existing vegetated riparian areas 50 feet wide adjacent to intermittent and perennial streams, lakes, and ponds in the Jordan watershed. The first 30 feet adjacent to waters would be largely undisturbed forest, while the outer 20 feet could be managed vegetation. Existing, ongoing activities within these buffers could continue, while a change in land use would invoke the protections. Certain uses of land within the buffer are identified as exempt, allowable, or allowable with mitigation, while uses not listed would be prohibited. It provides for mitigation where no practical

alternatives exist, details variance requirements and forest-harvesting limitations, and would require local governments to ensure that new developments either avoid or mitigate buffer impacts. It would require local governments to make mitigation options available for certain activities based on avoidance and minimization criteria. Three mitigation options would be available: 1) payment to the riparian buffer restoration fund administered by EEP, 2) donation of property, or 3) restoration or enhancement of a non-forested riparian buffer.

Changes to .0267, .0268:

- Clarified that these requirements supersede existing water supply buffer requirements.
- Several minor changes from discussions with DOT based on Neuse/Tar experience.
- Based on Neuse/Tar experience, added allowance for recreational and accessory structures less than 150 ft^2, with those over this threshold requiring mitigation.
- Established the Division as approval agency for activities on state and federal lands.

Rule .0269, Options for Offsetting Nutrient Loads

Would provide parties subject to the various rules - new development, existing development, State and Federal stormwater entities, agriculture, and point sources –options for alternative, offsite sources of loading reduction in addition to the EEP option. It would require each to meet minimum onsite standards before seeking credit elsewhere. It sets criteria for those seeking to sell excess reductions, and would require Division approval.

Changes to .0269:

- Clarified onsite prerequisites, clarified roles of buyers vs. sellers.
- Added agriculture as a party that may provide or seek reduction credit.

Rule .0270, Wastewater Discharge Requirements

Would distribute the entire point source annual N and P mass loading goals for each arm in the form of annual mass allocations to existing dischargers within each of the three subwatersheds. Discharge concentration equivalents at full flow range from 3.04 mg/L TN and 0.23 mg/L TP in the Upper New Hope Arm to 5.30 mg/L TN and 0.67 mg/L TP in the Haw River Arm. By comparison, requirements for lower Neuse dischargers equate to 3.71 mg/L TN and 2.0 mg/L TP. As in the Neuse, includes provisions for new and expanding dischargers, an option for group compliance and in-lieu offset fees to EEP for cap exceedence, and an option for transfer of allocation among individual dischargers. It would also require optimization of existing facilities, and would improve protections against localized water quality degradation.

Changes to .0270:

- Revised P compliance date forward from 2011 to first year after effective date (2009), revised N compliance date back from 2011 to 2016 permit renewal year.
- Corrected Pittsboro's flow limit from 2.0 to 2.25.
- Corrected the split among majors and minors for Haw arm N and P allocations (Glen Raven textiles was incorrectly included in the minor group).
- Simplified problematic allocation change criteria.

Rule .0271, Stormwater Requirements for State and Federal Entities

Would establish parallel stormwater control requirements for state and federal entities to those imposed on local governments under rules .0265 and .0266. Requirements address both new and existing development and call for education and illicit discharge elimination programs. Annual reports would be required.

Changes to .0271:

- Loosened project-by-project treatment requirements for new DOT road projects to give these highly constrained linear projects the broadest latitude to meet load targets.
- Clarified that the Division would approve DOT projects.
- Parallel changes to local government stormwater rules.

Rule .0272, Riparian Buffer Mitigation Fees
Separate rule setting offset payment rates to the Riparian Buffer Restoration Fund for buffer impacts deemed 'allowable with mitigation' under Rule .0267. This rule would not be exclusive to the Jordan nutrient strategy, and would enable uniform future changes in buffer offset fees across multiple basins.

Changes to .0272:
- Revised offset rate down to \$.70/ft^2 (\$30,492/ac) from Neuse/Tar value of \$.96/ ft^2 (\$41,625/ac) to reflect actual costs based on a more extensive cost record from EEP.

Rule .0311, Cape Fear River Basin (Schedule of Classifications)
This rule would formalize reclassification of the non-WSW half of Jordan watershed to WS-V.

Table 8: Anticipated Rule Compliance Timeframes

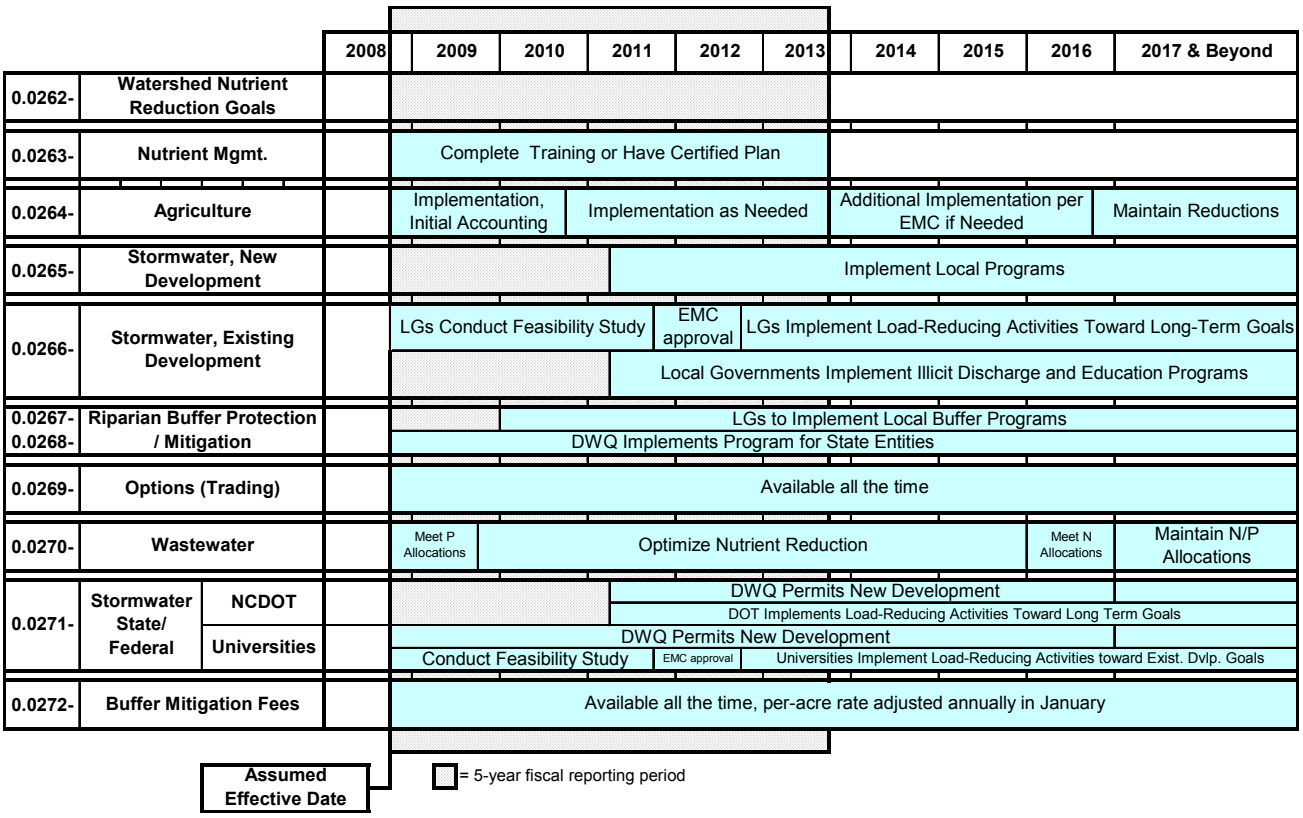


Table 9: Rulemaking Schedule

The current schedule for the Jordan nutrient rulemaking is as follows.

2007	March 8 Mar-May	EMC approved rules for public comment and hearings Review of fiscal analysis by DENR, OSBM
	May 2	Present rules, costs to Board of Transportation
	June 15	Publish Notice of Text of Rules in NC Register
	Jun 15-Aug 15 Mid-July	Public comment period Public hearings
	Aug-Dec	Hearing Officers deliberate
	Nov or Jan	Request adoption by EMC
2008	Dec-Apr	Review by RRC
	May-Aug	Review by General Assembly
	Jan-May	Effective date (< 10 objections)
	July-Sept	Effective date (> 10 objections)

Table 10: Sources of Additional Information

You will find additional information related to the proposed rules on the internet at http://h2o.enr.state.nc.us/nps/JordanNutrientStrategy.htm. That information currently includes:

- Draft text of rules (81 pp)
- This fiscal analysis
- A summary of the need for and content of the strategy (8 pp)
- 2003-004 Stakeholder Process Summary Report & Recommendations (33 pp)
- Hearings Announcement
- Link to Jordan water quality modeling and draft TMDL

Previous documents that led to this proposal are available at the following site hosted by Triangle J Council of Governments, http://www.tjcog.dst.nc.us/regplan/jorlkstk.shtml#. They include the following, listed in reverse chronological order:

1	Draft Rules and Report to WQC	Jan 2007
2	DWQ Responses to Public Comments on Draft Strategy	Sep 2005
3	Report to WQC on Public Comments Received on Draft Strategy	Jul 2005
4	TMDL and Conceptual Strategy	Apr 2005
5	Stakeholder Project Final Report	Feb 2005
6	Stakeholder Project Meeting Documents	2003-2004
7	TMDL Watershed Model Report	Nov 2003
8	Lake Nutrient Response Model Report	2002-2003

Costs to Affected Parties

***Costs Calculated**:* Two sets of costs are presented below. Per rule-making requirements, costs are estimated for the first five years after rule effective date. Where significant costs would occur beyond five years, we calculated full rule compliance costs. This is the case for point sources (Rule .0270) and for existing development stormwater requirements (Rules .0266 and .0271). Also following rule-making requirements, we addressed direct or accounting costs. However in two cases where opportunity costs would be significant, we estimated those also: lost revenue on croplands placed into conserved uses (Agriculture rule, .0264); and timber left unharvested to comply with buffer rule restrictions (Rule .0267).

***Five-year Costs**:* We estimate total combined costs for all rules for the first five years of implementation at approximately $108 million. We note that Session Law SL 1997-458 established more stringent wastewater treatment plant requirements in Jordan watershed that led to the requirements proposed by these rules. The 5-year cost to dischargers if they had chosen to adopt those statutory requirements directly would have amounted to almost $40 million. The alternative chosen by dischargers involved modeling the reservoir and complying with resulting reduction goals, which in fact yielded more stringent point source requirements than the original legislation. The net or additional 5-year point source costs, combined with costs for the rest of the rules, is approximately $68 million. Five-year costs for individual rules range from less than $1 million for Stormwater New Development to $57 million for Wastewater.

***Full-Compliance Costs**:* We estimate total costs for full compliance with reduction requirements under all rules in this strategy at approximately $905 million. Again, considering that point sources would have incurred approximately $195 million in costs to comply directly with SL 1997-458, the net cost of full compliance with the entire set of rules by all affected parties is calculated to be approximately $710 million. As detailed in Table 12, seven of the twelve rules would involve costs. Four of the other five – Goals, Offset Options, Buffer Mitigation and Buffer Mitigation Fees - are administrative in nature. For the other one – Rule .0311 involving reclassification of part of the watershed WS-V– we project no new costs.

Costs beyond five years are associated with the existing development stormwater rule, the existing development portion of the state and federal stormwater rule (timeframes for both to be proposed by affected parties), and the wastewater rule (seven years). We estimated that existing development stormwater requirements would impose the greatest costs of all the rules. Local governments would incur $530 million of that total under Rule .0266. State and federal entities would incur between $78 and $616 million under Rule .0271. The great majority of the state and federal costs, between $58 and $595 million, would go to the DOT. The lower value in this range represents the estimate cost to the DOT using EEP offsets, while the higher value is the DOT's estimate, which assumes a BMP at essentially every outfall on all of their existing roads in the watershed. We also developed a co-mingled drainage treatment scenario for DOT, which puts their costs at approximately $71 million. Point sources would incur the second largest full-compliance cost, with gross cost estimated at approximately $265 million occurring over seven years. Of this cost, local governments would incur the great majority, approximately $256 million. Point source full-compliance net costs beyond mandates in SL 1997-458 would be approximately $70 million.

Costs to the Division of Water Quality: As seen in Table 11, we estimate no new costs to the Division as the primary implementing agency for these rules. The agency intends to add the responsibilities associated with implementing the rules to the workloads of existing staff. Clearly this action has impacts on Division resources. One useful indicator of this impact is the number of staff hours these rules would require. The following table provides estimates of total Division staff hours anticipated for the first five years of implementation. Our estimates sum to the equivalent of more than two full-time positions each year, with year one requiring over three full-time staff.

Table 11: Projected Division of Water Quality Staff Hours to Implement Rules, Years 1-5

Rule	Implementing Units	Projected #FTE's Years 1-5	Total Hours
Nutrient Management	NPS	.05 Yrs 1-5	520
Agriculture	NPS	.25 Yrs 1-2, .2 Yrs 3-5	2,288
New Development Stormwater	NPS, Stormwater Permitting	.3 Yr 1, .45 Yrs 2-3, .2 Yrs 4-5	3,328
Existing Dev. Stormwater	NPS, Stormwater Permitting	Staff .5 Yrs 1-3, .65 Yr 4, .2 Yr 5	4,888
Buffer Protection and Mitigation	NPS, Wetlands/Stormwater Branch: ▪ Program Development ▪ NPS Assistance/Compliance ▪ 401 Permitting ▪ Transportation Permitting	1.25 Yr 1, .6 Yr 2, .50 Yrs 3-5	6,968
Trading	NPS, Point Source Branch	.15 Yrs 1-5	1,560
Wastewater	Point Source Branch	.5 Yr 1, .05 Yrs 2-5	1,456
State/Federal Stormwater	NPS, Wetlands/Stormwater Branch: ▪ Stormwater Permitting ▪ NPS Assistance/Compliance ▪ 401 Permitting ▪ Transportation Permitting	.4 Yrs 1-5	4,160
Reclassification	Stds & Classifications, Point Source	0	0
Total		3.4 Yr 1, 2.0 Yr 2, 2.3 Yr 3, 2.2 Yr 4, 2.2 Yr 5	25,168

Methods: In estimating costs, staff with the Nonpoint Source Planning Unit obtained input from each of the primary agencies that would be involved in implementation, local governments, university technical experts, published and unpublished data sources, and frequently relied on experience gained and tools developed in implementing similar rules in the Neuse and Tar-Pamlico River Basins. We were fortunate to have several tools available that were not so when fiscal estimates were prepared for the previous rule initiatives.

A primary source of data for this current evaluation was the Jordan watershed model, mentioned under 'Sources of Nutrient Loading' above, which was developed for the Division by TetraTech, Inc. as part of the Jordan TMDL development process. The watershed model includes acreages for all land cover types and estimates of baseline loading from each land cover type to the reservoir. This information allowed us to assign annual mass load reduction needs in lb/yr to the source types addressed by the various nonpoint source rules. The watershed model also provided average per-acre loading rates for the various land uses, in lb/ac-yr. We used these values in the agriculture and stormwater rules in combination with BMP efficiencies to estimate load reductions that could be achieved by different types and numbers of practices.

This analysis also benefited from the availability of several tools that were developed specifically for implementing Neuse and Tar-Pamlico rules or that were prompted by the imposition of those rules. Two Tar-Pamlico implementation tools used here include a stormwater loading estimation tool developed by NCSU and pasture load estimation methods and data. We also used nutrient removal efficiency values specific to piedmont North Carolina for agricultural and urban stormwater BMPs that were largely

formalized for implementation of those rules and cost information for both stormwater and agricultural BMPs in piedmont North Carolina that was largely developed since 1997.

In terms of our geographic approach, to avoid undue calculation complexity we carried out calculations at the scale of the entire watershed. We frequently used data specific to counties, municipalities, land use types, discharger types, and subwatersheds, developing weighted averages as appropriate.

Individual Rule Cost Summaries

.0263 Nutrient Management

We estimate minimal new costs associated with this rule based on experience in the Neuse and Tar-Pamlico River Basins. The rule offers a no-cost option in NM training, and we believe that only those who *already* meet the other option, implementing a certified plan, would choose that alternative instead. Training would involve no out-of-pocket costs to applicators since local Cooperative Extension Service offices would conduct trainings, they would charge no fee, would use existing staff resources, would obtain grant funding as in Neuse and Tar-Pamlico Basins to cover the minimal costs, attendees would travel minimal distance since it would be offered in each county, and we assume they would incur no significant travel costs. Trainees would face lost income for the one day they take to complete the training, and we estimate the total lost income as $63,000. We also estimate the Extension staff hours involved in providing the training and convert them to salary reflecting other duties displaced; this totals to approximately $5,500, which we consider insignificant for fiscal reporting purposes. If an applicator were to choose the certified plan option and did not already meet its requirements, we assume there would still be no net cost. While there is up-front planning cost, agricultural evaluations show that applicators are likely to realize net *savings* by obtaining and properly implementing certified nutrient management plans.

.0264 Agriculture

Neither cropland nor pastureland agriculture is currently subject to water quality regulation in the watershed, except to the extent that waste from confined animal operations is applied to crops. Therefore, costs of this rule to producers would be largely new. Both state and federal cost share programs are available to crop and pastureland producers. Thus, we estimated capital costs to farmers for practice installation assuming that 75% of that cost would be defrayed by cost share funding. The costs provided are those to meet nitrogen reduction goals, since phosphorus requirements are qualitative in nature. Our estimates err on the conservative or higher side in at least two notable respects. First, we assumed that producers would meet the N reduction goal within 5 years - the rule provides an additional 3 years with EMC intervention if needed (total 8 years), however we used the shorter-time, higher cost assumption. Second, we met the great majority of reduction need by assuming structural BMPs for pasture and cropland. In Neuse and Tar-Pamlico, such practices have contributed about one-fourth of the total reduction, with factors involving little or no cost comprising the majority - fertilizer rate reductions, crop shifts yielding further N rate reductions, and land loss from agriculture.

.0265 Stormwater Management for New Development

Costs stemming from this rule are relatively minor because in most parts of the watershed, two other stormwater regulations apply in advance of this proposed rule. Smaller Water Supply Watersheds with associated local regulations encompass 51% of Jordan watershed, and the post-construction water quality and quantity requirements of NPDES Stormwater Phase II will apply to almost all communities in the watershed. As a result, net additional requirements and associated costs to developers to meet this rule are significantly less than they would be otherwise. They appear primarily on more intensive development types such as multifamily residential, commercial and industrial, where the loading rate targets of this rule result in treatment needs beyond the single-BMP approach of the other regulations.

Additional treatment needs also result in the Upper New Hope subwatershed for lower intensity development than requires treatment under the other regulations, due to the lower loading rate target in that subwatershed. Similarly to developer costs, net additional costs to property owners who inherit operation and maintenance requirements will be proportional to the added costs to developers.

As with developers and property owners, costs to local governments are significantly less than they would be without the other two regulations. All counties administer Water Supply watershed programs. Eighteen of the twenty-six municipalities will be required to administer local Phase II program and all but two remaining municipalities administer Water Supply watershed programs. Thus we estimated minor additional administrative costs.

The steps set out for local stormwater program development and approval delay implementation until 2 ½ years after rule effective date. This further reduces costs seen in the first five years.

.0266 Stormwater Management for Existing Development

As described in the results summary above, existing development requirements present the greatest overall costs to affected parties of all rules in this strategy. We estimated annual costs beginning at approximately $16.4 million for the entire watershed. Table 12 presents the 5-year total cost as $16.4 million because the first year of implementation would be year 5 with no costs projected for the first four years. We estimated full compliance cost at approximately $529 million, also shown in Table 12. We do not identify a timeframe for full compliance, as the rule calls on local governments to conduct feasibility studies and to propose a pace of implementation and a target compliance timeframe. Depending on the local government and the subwatershed, we would anticipate some compliance timeframe proposals ranging well beyond five or ten years of implementation.

We calculate these costs conservatively, toward higher cost, from the standpoint of assuming that all reductions are achieved using currently recognized, conventional stormwater BMPs. Significant cost reductions to local governments may be obtained using alternative nutrient-reducing activities or trading with other sources. Division staff worked with stakeholders for several months during 2006 to identify a broad range of creditable alternative nutrient-reducing practices. These would be activities such as street-sweeping, conversion of discharging sand filter systems for domestic wastewater to other treatment methods, and requiring treatment on redevelopment or overtreatment on new development. We did not project the use of such alternatives or trading options in this analysis. Potentially offsetting this conservative assumption, we also did not incorporate a factor for increased unit installation costs for retrofits over new development settings.

We based BMP needs on load reduction goals. As described in text preceding Table 5 above, existing development includes lands developed up until the time that new development programs are implemented. As a result, the load reduction requirements for this rule include not only reductions needed from baseline as estimated by the modeling, but also reductions to offset loading added between the baseline and new development programs, or between 2001 and 2011. Table 5 shows the resulting percent loading reductions needed from 2011. The rule recognizes the need to credit practices implemented during this transition period. Accordingly our calculations included credit for Phase II and WSW BMP implementation.

.0267 Protection of Existing Riparian Buffers

While the great majority of the watershed is or will be subject to setback requirements under Water Supply Watershed (30 or 100 feet) and Phase II (30 feet), the proposed rule would involve more stringent controls on the first 30 feet adjacent to waters, mandating that vegetation in this zone remain largely undisturbed. Also, the rule would apply across all land uses, it would apply to intermittent as well as perennial streams, it would require establishment of vegetated buffers during a change of land use, and

importantly from a cost standpoint it would require maintenance of diffuse flow to protected buffers and mitigation for activities deemed necessary.

The parties facing significant costs under the proposed rule would be those whose business involves new activities within the buffer - developers, including state road-building development, and forest harvesting operations. Development activities would face costs associated with installing flow diffusion measures and mitigating impacts through buffer restoration or equivalent offsetting measures. Forestry would face harvesting restrictions, resulting in increased capital costs for selective harvesting and opportunity costs for lost timber yield.

Of the estimated $4.2 million annual cost of this rule, mitigation requirements account for approximately 60% at $2.5 million per year. Forestry lost timber opportunity cost represents another 25% at $1 million per year. The mitigation cost significantly increased as a result of the multipliers required on the impact acreage. The zone 1 and zone 2 multipliers yield a weighted average of 2.4.

.0270 Wastewater Discharge Requirements

In the interest of fuller information, we provide two sets of costs to dischargers. The wastewater chapter estimates not only gross or total costs of complying with this rule's nutrient targets but also *net* costs beyond those originally imposed by the Clean Water Responsibility Act, SL 1997-458. We do so to illustrate the substantial costs that would have resulted by this time from direct compliance with that 1997 session law. The net, additional costs imposed by this rule result from pursuing a watershed-specific set of requirements that emerged from modeling the reduction needs of Jordan Reservoir. Estimated gross cost to all wastewater dischargers for full compliance over a seven-year period would be $256 million, while net cost for the same full compliance period would be $70 million. Of these totals, local governments would incur the vast majority, approximately $256 million gross or $65 million net. The great majority of this local government cost, $247 million gross or $56 million net, would be for the planning and installation of nitrogen-related improvements. This cost is not distributed evenly over the seven-year compliance period. The planning portion, amounting to about one-fifth - $49 million gross or $11 million net - will likely be incurred in years one and two. Capital costs for construction of treatment plant improvements would comprise the other four-fifths, about $198 million gross or $45 million net, and would be incurred in years six and seven. Operation and maintenance costs for nitrogen control would be relatively minor, the remaining $9 million of the $265 million. Operation and maintenance costs for phosphorus control would increase somewhat in the first year and then increase significantly several years later, to approximately $12 million per year, as sludge disposal costs increase and additional systems become necessary to meet the most stringent of the phosphorus limits.

.0271 Stormwater Requirements for State and Federal Entities

The NC Department of Transportation comprises three-fourths of state and federal lands in the watershed. The DOT would bear a much larger percentage of the compliance costs shown in Table 12 for state and federal entities, roughly 90% of existing development costs and 98% of new development costs.

Table 12 provides cost ranges for state and federal entities instead of the single values used through the rest of the table. We felt it was appropriate to provide this fuller information because of the large range of potential costs tied to differing DOT compliance scenarios with existing development requirements, and hence the greater uncertainty around any single cost representation within that range. In general, the linear and continuously trafficked nature of DOT lands results in higher unit costs than conventional development for installing stormwater controls on both retrofits and new roads. The upper end of the range in Table 12 reflects a scenario of treating every mile of existing roadway in the watershed at a total cost of approximately $595 million. While this scenario would ensure compliance with the existing development requirements, Division we believe it is avoidable. The lower end of the range involves a cost to DOT of $58 million based on a scenario of paying an offset fee to the NC EEP to meet the entire existing development reduction requirement. For this we used the EEP offset formula adopted by the

EMC effective March 2006, which involved a $57/lb N and $450/lb P cost-effectiveness value and included multipliers for BMP lifespan and administrative cost and a land cost factor. This approach was conservative, or higher cost, insofar as the cost-effectiveness rate adopted by the EMC has been temporarily reset by the General Assembly to $11/lb N and $110/lb P pending further study. We also developed a third scenario that yielded an intermediate existing development cost to DOT totaling approximately $71 million. This scenario would involve DOT retrofit BMPs treating co-mingled runoff from DOT rights-of-way and surrounding areas, making more cost-effective use of installed practices. The technical details of this scenario will receive fuller evaluation by all parties, which may result in a somewhat higher value. We believe that actual implementation could involve some combination of the last two scenarios, but we believe it would be too speculative to estimate the resulting cost at this point.

Table 12: Estimates of Costs to Affected Parties, Jordan Nutrient Strategy

			Regulated Parties						Implementing Agencies				
			Total	Capital (Incl'g Land)	Operation / Maint.	Planning	Regul'y Transax'n	Other	**Total**	Regul'y Developm't	Monitor'g/ Recordkpg	Permit-ting	Inspect/ Enforce
.0263	Nutrient Management		**Regulated Party: Fertilizer Applicators.** "Other" = Applicator's lost wages to attend NM Training						**Implementing Agency: DWQ - $0** new costs				
		2009	$0	$0	$0	$0	$0	$0					
		2010	$0	$0	$0	$0	$0	$0					
		2011	$31,500	$0	$0	$0	$0	$31,500					
		2012	$31,500	$0	$0	$0	$0	$31,500					
		2013	$0	$0	$0	$0	$0	$0					
		5-Yr Total:	$63,000	$0	$0	$0	$0	$63,000					
.0264	Agriculture		**Regulated Party: Agricultural Community.** 'Other' = opportunity cost of converting crop acres to conserved cover. Cap costs shown assume full cost-share (full cap cost = x4).						**Implementing Agency: DWQ - $0** new costs				
		2009	$ 298,000	$ 190,000	$ 57,100	$0	$0	$ 50,500					
		2010	$ 406,000	$ 190,000	$ 114,000	$0	$0	$ 101,000					
		2011	$ 513,000	$ 190,000	$ 171,000	$0	$0	$ 151,000					
		2012	$ 621,000	$ 190,000	$ 229,000	$0	$0	$ 202,000					
		2013	$ 728,000	$ 190,000	$ 286,000	$0	$0	$ 252,000					
		5-Yr Total:	**$ 2,570,000**	**$ 952,000**	**$ 857,000**	**$0**	**$0**	**$ 757,000**					
.0265	Stormwater, New Dev.		**Regulated Parties: Developers (Capital, Regulatory, Planning) & Property Owners (O&M)**						**Implementing Agency: DWQ - $0** new costs				
		2009	$0	$0	$0	$0	$0	$0					
		2010	$0	$0	$0	$0	$0	$0					
		2011	$203,000	$167,000	$19,800	$16,300	$0	$0					
		2012	$431,000	$338,000	$60,000	$33,200	$0	$0					
		2013	$479,000	$344,000	$100,800	$33,700	$0	$0					
		5-Yr Total:	**$1,113,000**	**$849,000**	**$181,000**	**$83,200**	**$0**	**$0**					
.0266	Stormwater, Existing Dev.		**Regulated Party: Local Governments- $0** (negligible regul'y transx'n).						**Implementing Agency: Local Gov'ts - $48,000,** 2010, rule developm't. Other costs incorporated under buffer rule implem.				
			Regulated Party: Local Gov'ts - BMP planning, implem, and o&m. Implementation begins yr. 5, thus these costs are both 1-yr and 5-yr total.						**Implementing Agency: DWQ - $0** new costs				
		5-Yr Total:	**$16,400,000**	**$14,500,000**	**$108,000**	**$1,720,000**	**$54,300**	**$ (23,200)**					
		Full Cost	**$528,000,000**	**$436,000,000**	**$50,000,000**	**$51,500,000**	**$1,629,000**	**$ (10,800,000)**					
.0267	Riparian Buffer Protection		**Regulated Party: Local Governments -** $0 (negligible o&m public land)						**Implementing Agency: DWQ - $0** new costs				
			Regulated Party: Property Owners - 'Other'=opportunity cost of unharvested timber. Capital costs include mitigation (developers and DOT).						**Implementing Agency: Local Governments** - net costs, stormwater & buffer permitting & compliance.				
		2009	$776,000	$727,000	$3,910	$45,500	$0	$0	$48,000	$ 48,000	$0		
		2010	$4,170,000	$3,030,000	$34,000	$108,000	$0	$1,000,000	$375,000	$ -	$375,000		
		2011	$4,200,000	$3,030,000	$64,100	$108,000	$0	$1,000,000	$375,000	$ -	$375,000		
		2012	$4,230,000	$3,030,000	$94,200	$108,000	$0	$1,000,000	$375,000	$ -	$375,000		
		2013	$4,260,000	$3,030,000	$124,000	$108,000	$0	$1,000,000	$375,000	$ -	$375,000		
		5-Yr Total:	**$17,600,000**	**$12,850,000**	**$320,000**	**$478,000**	**$0**	**$4,000,000**	**$1,550,000**	**$48,000**	**$1,500,000**		

(continued on next page)

Table 12 (continued): Estimates of Costs to Affected Parties, Jordan Nutrient Strategy

.0270	Wastewater Dischargers		**Regulated Party: Local Governments.** Annual O&M starting Yr. 8 = $12.1 m. ***Net costs post-HB515: 5-Yr Total = $17.4 m, 7-Yr Total = $65 m.***						**Implementing Agency: DWQ - $0** new costs
		2009	**$25,800,000**	$0	$1,260,000	$24,500,000	$0	$0	
		2010	**$25,800,000**	$0	$1,260,000	$24,500,000	$0	$0	
		2011	**$1,260,000**	$0	$1,260,000	$0	$0	$0	
		2012	**$1,260,000**	$0	$1,260,000	$0	$0	$0	
		2013	**$1,260,000**	$0	$1,260,000	$0	$0	$0	
		5-Yr Total	**$55,400,000**	**$0**	**$6,300,000**	**$49,000,000**	**$0**	**$0**	
		7-Yr Total	**$256,000,000**	**$198,000,000**	**$8,790,000**	**$49,000,000**	**$0**	**$0**	
			Regulated Party: Private (Domestic & Indust). Annual O&M starting Yr.8 = $552k. ***Net costs post-HB515: 5-Yr Total =$1.2m, 7-Yr Total=$4.9m.***						
		2009	**$868,000**	$0	$58,000	$810,000	$0	$0	
		2010	**$868,000**	$0	$58,000	$810,000	$0	$0	
		2011	**$58,000**	$0	$58,000	$0	$0	$0	
		2012	**$58,000**	$0	$58,000	$0	$0	$0	
		2013	**$58,000**	$0	$58,000	$0	$0	$0	
		5-Yr Total	**$1,910,000**	**$0**	**$290,000**	**$1,620,000**	**$0**	**$0**	
		7-Yr Total	**$8,586,000**	**$6,560,000**	**$406,000**	**$1,620,000**	**$0**	**$0**	
.0271	State & Fed Stormwater		**Regulated Party: State Entities - DOT and Universities.** Includes new dev (Univ's begin Yr 1, DOT begins Yr 2.5) and existing dev (begins Yr 3 for DOT, Yr 5 for Univ's) costs.						**Implementing Agency: DWQ - $0** new costs
		2009	**$16,000**	$13,000	$2,000	$1,000	$0	$0	
		2010	**$16,000**	$13,000	$2,000	$1,000	$0	$0	
		2011	**$1.9m - $17m**	$1.9m - $13m	$2.3k - $215k	$1.2k - $3.3m	$0	$0	
		2012	**$1.9m - $17m**	$1.9m - $13m	$2.3k - $428k	$1.2k - $3.3m	$0	$0	
		2013	**$2.6m - $18m**	$2.5m - $14m	$8.1k - $647k	$68k - $3.4m	$0	$0	
		5-Yr Total	**$6.5m - $52m**	**$6.4m -$40m**	**$17k -$1.3m**	**$73k - $10m**	**$2.2k**	**$0**	
		Exist'g Dev. Full Cost	**$78m - $616m**	**$75m - $413m**	**$2.0m-$100m**	**$2.0m - $102m**	**$4.3k**	**$0**	

.0268 Mitigation for Riparian Buffers - We report mitigation costs under the buffer protection rule since it sets the requirement to mitigate.
Goals (.0262), Offset Options (.0269), Buffer Mitigation Fee (.0272): These rules do not impose new requirements, and thus have no costs.
.0311 Cape Fear River Basin (Reclassification) - no new costs to dischargers to meet water quality standards.

Benefits of the Proposed Strategy

The rulemaking process requires that agencies provide a description of the purpose and benefits of a proposed rule. The Division believes it is essential to recognize the benefits that regulations will provide. At the same time, many benefits are not readily quantifiable and many are 'non-market' in nature, making ascription of monetary values to them even more challenging. Also, some benefits result directly from meeting water quality improvement goals while others are more secondary, potentially resulting from actions taken to meet those goals, or propagating further downstream, or as secondary benefits appearing as consequences of primary benefits. Altogether, benefit estimation is much more involved than direct cost estimation and requires commensurate expertise. Additional resources generally have not been acquired to allow such evaluations, as is the case with this set of rules. In the place of a full quantification of benefits, we offer the following description of larger benefits of this rulemaking, providing statistics where available. Also, in each chapter we provide a description of the nature of the source type and how the rule would contribute to the overall nutrient goals.

Benefits

We group potential benefits of the proposed strategy into primary benefits to the reservoir and its uses derived directly from reducing nutrient inputs to the reservoir, and secondary benefits on a larger geographic scale from actions taken to meet the nutrient goals. Primary benefits to the reservoir and its users could be derived as the converse of the list of problems described in the first section of the Executive Summary. These would include:

- Reduced frequency, severity, and duration of harmful and other algal blooms, improving the aquatic environment with more stable, healthier oxygen and pH levels, reductions in detrimental or toxic chemicals, and improved visibility, making for a healthier environment for fish and the rest of the aquatic food web.
    - More numerous, healthier fish and other aquatic wildlife stocks.
    - Resulting benefits to wildlife that take fish or otherwise draw sustenance from these waters.
    - Correlated improvements to surrounding ecological communities.
    - Increased frequency and quality of recreational and sustenance fishing by humans.
- Improved conditions for primary contact recreation – swimming, bathing, boating, skiing.
    - Reduced incidence of human health problems via exposure to algal blooms.
    - An improved quality of recreational experience.
    - A correlated increase in related recreation such as camping, hiking, and wildlife viewing.
    - An overall increase in lake user-days with correlated spending benefits to the local economy.
- Improved quality of potable water.
    - Reduced costs to treat water:
        - The Town of Cary uses extra carbon and ozone during the months of March-May to treat water from the Jordan Reservoir for taste and odor problems caused by excess algae. Based on data provided by the town, extra chemical costs for treatment amount to approximately $8,450 per month, about $282 per day. Since the plant treats approximately 16 MGD, the additional cost is about $17.60 per MG. In addition to extra chemical costs, plant filters must be backwashed more frequently because of clogging due to algae. Energy costs increase about $320 per month, or about $11 per day. This equates to an additional cost of $.70 per MG. Total cost per MG for extra chemicals and energy amounts to approximately $18.50 per MG.
        - Applying the above cost rate to existing water allocations for all communities, listed in Table 14 below, would amount to approximately $92,000 to treat excess algae March-May each year.
    - Reduced aesthetic concerns with the finished product such as taste and odor complaints.

    - Reduced local government staff time responding to complaints.
    - Marginally improved health conditions for the user population.
- Greater desire to locate housing and businesses near the lake, leading to increased local property values and a more productive economy.
- Reduced nutrient export downstream of Jordan Reservoir within the Cape Fear River Basin, freeing assimilation capacity for the rest of the basin. Given the eutrophication-related water quality problems now recognized in the lower basin, this strategy would carry the same set of benefits listed here to the rest of the basin, including the Cape Fear estuary.

We identify secondary benefits as those on a larger geographic scale and resulting from actions taken to reduce nutrient inputs to the reservoir. Secondary benefits would include reductions of sediment and *other* pollutant inputs as well as water *quantity* improvements - reduced storm flows and increased base flows to streams - resulting from practices implemented by agriculture, development, and wastewater dischargers to reduce nutrient export. These secondary benefits would include the following:

- Improvements to streams:
    - Improved aquatic habitat, aquatic biota, and wildlife that draws sustenance from streams.
    - Reduced impacts to ecological communities surrounding streams.
    - Reduced impacts to wetlands and riparian buffers, protecting their water quality and other services.
    - Reduced destabilization of stream channels by erosive flows, reducing property loss through streambank erosion, reducing property protection measure costs, and reducing future stream restoration needs.
    - Improved quality of passive human recreation in greenways and conserved riparian buffers throughout the watershed - walking, hiking, running, biking, wildlife viewing.
- Reduced sediment and other pollutant delivery to smaller reservoirs within Jordan watershed and to Jordan Reservoir.
    - Longer reservoir lifespan for sediment collection, low flow augmentation downstream, flood control, and associated recreational benefits.
    - A set of benefits for all nested reservoirs similar to those listed above for Jordan Reservoir.
- Reduced irrigation water needs in LID developments, and where wastewater is reused or land applied to meet loading reduction requirements.
- Reduced delivery of other pollutants downstream of Jordan Reservoir within the Cape Fear River Basin, providing a similar set of benefits to those listed above.
- Reduced costs to industries that withdraw water from streams within Jordan watershed and from the Cape Fear River downstream of Jordan Reservoir.

Beneficiaries

The above set of potential benefits implies a list of beneficiaries that would include not only members of the public who directly utilize or enjoy the benefits of Jordan Reservoir, but also businesses and public anywhere within the watershed and downstream within the Cape Fear River Basin. Beneficiaries may include:

- Primary contact recreational users, recreational and subsistence anglers, and related recreational (camping, hiking, wildlife viewing, running, biking) users of Jordan Reservoir, of riparian corridors, greenways and nested reservoirs within Jordan watershed, and of the Cape Fear River and estuary downstream. Table 13 below shows the approximate number of visitors to the Jordan Reservoir for a variety of recreational activities. The numbers were compiled using data provided from the North Carolina Division of Parks and Recreation and the US Army Corp of Engineers.

Table 13: Annual Visitation to Jordan Reservoir

	Approx. # Visitors/Yr
Total *	1.14 - 1.45 million
Boaters	356,000 - 471,000
Skiers	62,000 - 71,000
Fishermen	281,000 - 318,000
Swimmers	256,000 - 315,000
Campers	50,000 - 118,000
Picnickers	91,000 - 97,0000
Hunters	12,000 - 15,000
Others	177,000 - 183,000
Sightseers	325,000 - 328,000

* Visitors often participate in several activities during one visit.

- Fish and other aquatic wildlife stocks in and surrounding ecological communities on Jordan Reservoir, in and on streams within the Jordan watershed, in and on nested reservoirs within Jordan watershed, and in and on the Cape Fear River downstream.
- Local businesses that support recreational users.
- Local governments, their citizens and industries that withdraw water from Jordan Reservoir, from nested Water Supply Reservoirs within Jordan watershed, and from the Cape Fear River downstream. Table 14 below summarizes information obtained from the Division of Water Resources describing entities that rely on Jordan Reservoir as a source of water supply, their allocations and the populations served. Total population served by Jordan Reservoir is approximately 460,000.

Table 14: Jordan Reservoir Water Supply Allocations

	Approx. Residential Pop. Fully or Partially Served	Current Allocations (MGD)	Future Allocations (MGD)
Cary	110,000	32	32
Apex	26,000		
Chatham County (North)	7,500	6	6
City of Durham	205,000	10	10
Town of Holly Springs	15,000	0	2
Town of Morrisville	12,000	3.5	3.5
Orange/Alamance Water	9,000	0	1
Orange Water & Sewer Authority	74,000	0	5
Wake County - RTP South	N/A	3.5	3.5
Totals:	458,500	55	63

- Property owners and the general local economy around Jordan Reservoir, nested reservoirs and buffered streams within Jordan watershed, and the Cape Fear River downstream.

Fiscal Note Format

The format of the fiscal note is based on software created through a cooperative agreement between the University of North Carolina, Chapel Hill and DENR. This software provides a series of questions about the proposed rule organized into six steps as follows:

Step 1: Description of the Proposed Rule
Step 2: Screening Analysis: Exemptions, Prima Facie Determinations and Emergency Rules
Step 3: Defining the Problem and the Regulation
Step 4: Identify Impacts
- **4-A.** Regulated Parties
- **4-B.** Implementing Agency
- **4-C.** Public Beneficiary

Step 5: Threshold Decision After Preliminary Rule Evaluation
Step 6: Analysis for Major Rules

Step 1: Description of the Proposed Rule contains basic information about the proposed rule and identifies the analyst.

Step 2: Screening Analysis: Exemptions, Prima Facie Determinations, and Emergency Rules includes a number of questions that aid in determining whether or not it is necessary to perform a fiscal analysis. For each of the proposed rules, the answers are provided in Table 15.

Table 15: Screening Analysis

Circumstances	Yes or No
2.1 Federal Rule Certification Required. Does the proposed rule require a federal certification statement under NCGS 150B-21(f1)?	No.
2.2 "Substantial Economic Impact" Analysis. Federal Rule Exemption Does this rule meet the criterion of Federal Exemption found in NCGS 150B-21.4(b1)? [If the answer is yes and there is no impact on local government funds, you may prepare a Special Circumstance Report.]	No.
2.3 Temporary Rules. Does this rule meet the criteria listed in NCGS 150B-21 relating to Temporary Rules? [If the answer is yes, you may prepare a Special Circumstance Report.]	No.
2.4 Technical Corrections. Does this rule meet the criteria for a Technical Correction laid out in NCGS 150B-21.5? [If the answer is yes, you may prepare a Special Circumstance Report.]	No.
2.5 Repeal of Regulatory "Deadwood". The Help file lists a series of situations which may render a rule obsolete; does this rule meet any of those criteria? [If the answer is yes, you may prepare a Special Circumstance Report.]	No.
2.6 Service/Financial Program. Where Proposed Rule's Impact on State Funds under $5 Million	No.

Step 3: Defining the Problem and the Regulation contains a more detailed description of the proposed rule and describes how it would change the behavior of the regulated community if it were implemented.

Step 4: Identifying Impacts describes the current practices of the regulated community(ies), and how these practices are contributing to environmental problems. The section contains three parts. For each part, the underlying assumptions (if applicable) and the sources of information are given.

Step 5: Threshold Decision After Preliminary Rule Evaluation includes a table that indicates if the proposed rule shows an estimated annual economic impact of $5 million or more.

Step 6: Analysis for Major Rules includes questions and tables that provide further descriptions of how costs were calculated for rules that show an estimated economic impact of $5 million or more.

General:

One of the most important points of this fiscal analysis is that it is not appropriate to compare the costs of the different rules to each other. Some of the reasons why comparisons between rule costs are not valid are:

- The costs would be borne differently by different regulated parties. For example, the costs to treatment plants may be spread throughout a large customer base while farmers would have individual costs to their businesses, but may be able to defray some of their costs through funding sources such as the NC Agricultural Cost Share Funding.
- There may be some additional non-quantifiable costs and /or savings associated with particular rules, including the Basinwide Stormwater Rule.
- Many assumptions were made for each one of the rules in order to predict the behavior of the regulated parties. The assumptions required to estimate the costs could not be standardized since each rule affects different parties and regulates different issues.
- A summary of the costs to the regulated parties for each of the proposed rules follows. Please note that two of the rules, .0262 and .0269, do not have any costs associated with them because they do not regulate behavior, they only lay the necessary framework for the other rules.

4-A. Regulated Parties

Description of the Regulated Community	The regulated community is defined as the group of North Carolinians that must comply with the proposed rule. The regulated community may include one or more of the following: Specific Industries and Businesses, Specific Geographic Areas, Local or State Governments, Citizens, and Generic Activities (e.g., Use of solvents, tank storage of chemicals).
Fixed Capital Investment	This is the estimated cost associated with a capital investment that is made to comply with the proposed rule. Some examples of fixed capital investments associated with the Jordan Reservoir watershed NSW Rules include: wastewater treatment plant modifications, stormwater best management practices (such as wet detention ponds), and the installation of water control structures.
Operation and Maintenance Cost	Operating and maintenance costs include recurring costs, such as labor and equipment that the regulated entity must obtain to comply with the proposed rule. Some examples of operation and maintenance costs associated with the Jordan Reservoir watershed NSW Rules include: maintenance of additional basins at treatment plants, mowing and repair of best management practices, and updating nutrient management plans.
Planning Costs	The expense of creating plans/designs for the regulated party to comply with the proposed rule. To determine an estimated planning cost, local government staff time and/or consultant time was multiplied by an appropriate compensation rate.
Regulatory Transaction Costs	The estimated expense to the regulated community associated with its new interactions with the implementing agency as a result of the proposed rule.

	There are five possible types of regulatory transaction costs (only the applicable ones were mentioned for each rule). Note that the staff time may apply to many different groups, including local government, industry, business, or consultant staff. The compensation rate used should be adjusted accordingly. ▪ Inspections ▪ Monitoring ▪ Periodic Reporting ▪ Permit Applications ▪ Permit Modification
Opportunity Costs	Opportunity costs associated with the proposed rule are estimated losses in revenue to the regulated party due to one of the following effects of the proposed rule: ▪ Delays associated with the permitting process. ▪ Restrictions to public resources, such as fisheries. ▪ Lowered market value of property due to land use restrictions.
Other Costs	These are additional estimated costs that do not fall under the previous cost categories. An example of an "other cost" could be indirect benefits to a regulated party as a result of the implementation of the proposed rule (such as increased barriers for competitors to enter into a market).

4-B. Implementing Agency Costs/Savings

The costs to DWQ in implementing the Jordan Reservoir watershed NSW Rules represent opportunity costs for DENR to implement the rule component. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff. Buffer programs would be implemented at the local level.

Description of the Implementing Agency	This part describes the branch, section, and unit of DENR that would be responsible for implementing the proposed rule. If this group is currently administering any similar programs, they would be described.
Regulatory Development Costs	This part describes the tasks and estimated opportunity costs for DENR to develop and propose this rule as well as make future modifications.
Monitoring and Recordkeeping Costs	This describes the tasks and estimated opportunity costs for DENR to ensure compliance with the proposed rule and to maintain the required records of compliance.
Permitting Costs	This part states the number and type of permits that would have to be processed each year by DENR staff and an estimate of potential opportunity costs to the agency.
Inspection and Enforcement Costs	This part describes the tasks and estimated opportunity costs for inspecting the regulated party and an inspection schedule if applicable.
Other Costs	If these are additional tasks and opportunity costs that do not fall under the previous categories, they can be covered in this section.

Chapter 1: Watershed Nutrient Reduction Goals

Step 1: Basic Information

1.1 Rule Reference No.	.0262
1.2 Analyst	Rich Gannon, Environmental Supervisor
1.3 Office (Your Organizational Location)	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 ext. 356
1.5 Comments on Agency Contact	None
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Watershed Nutrient Reduction Goals
1.7 Citation	15A NCAC 2B .0262
1.8 Brief Description of the Proposed Rule	▪ Identifies the three arms of the lake, ▪ Establishes nutrient reduction goals, ▪ Identifies new and existing water supplies, ▪ Provides the opportunity for adaptive management, and ▪ Serves as reference point for the remaining nine rules in the strategy.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary.

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

This rule provides the overarching framework that is common to the entire set of rules comprising the Jordan Reservoir nutrient strategy. It establishes geographic boundaries, defines three subwatersheds, sets numerical nutrient baseline and reduction goals for each subwatershed, defines relationships to existing similar requirements, lists the set of rules comprising the strategy, and declares an intent to use adaptive management.

3.2 How does the Proposed Rule Change Behavior?

This rule does not change any behavior since no specific actions are mandated. This rule simply establishes a framework of understanding for the set of rules that follows.

Chapter 2: Nutrient Management

Step 1: Basic Information

1.1 Rule Reference No.	.0263
1.2 Analyst	Rich Gannon, Environmental Supervisor
1.3 Office	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 ext. 356
1.5 Comments on Agency Contact	None
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Nutrient Management
1.7 Citation	15A NCAC 2B .0263
1.8 Brief Description of the Proposed Rule	Rule requires fertilizer applicators to either take one-time nutrient management training offered by Cooperative Extension Service or to obtain and properly implement a nutrient management plan approved by a certified technical specialist for all lands to which they apply fertilizer.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

Nonpoint sources in the watershed make up approximately one-half to two-thirds of nitrogen inputs to Jordan Reservoir, and more than four-fifths of phosphorus inputs. People applying fertilizer is a primary means by which nutrients are added to the watershed. We believe opportunity exists for significant improvements to fertilizer management that would yield reductions in nutrient losses to surface waters. The proposed rule would improve application practices, decrease wasteful loss, and increase beneficial capture and use by crops and other vegetation.

3.2 How does the Proposed Rule Change Behavior?

This rule would require fertilizer applicators in the Jordan watershed to either attend nutrient management training or complete and properly implement certified nutrient management plans for the lands to which they apply within five years of rule effective date.

The training option amounts to a one-time action by affected parties; there is no requirement for subsequent continuing education. The certified plan option involves not only a one-time action of obtaining the plan if not already done, and in addition properly implementing the plan if not already being done. Thus, the certified plan option may result in long-term behavior change of improved fertilizer management (we hope that the training option will also result in such a behavior change where appropriate, but none is mandated under this option). In terms of associated costs, according to the NC Cooperative Extension Service (Hardy et al, 2003) and others, improved nutrient management can be expected to yield cost savings to applicators as opposed to additional costs. Properly implemented nutrient management involves the following:

- Nutrient application based on the priority nutrient concept.
- Optimal timing and application methods.
- Applicators would calibrate and properly operate equipment.
- Nutrient quantities determined by realistic yield expectations (RYEs).
- Soil testing at least every two years.

References:

Hardy, D.H., D.L. Osmond, and A. Wossink, 2003. SoilFacts: An Overview of Nutrient Management with Economic Considerations. Publication Number AG-565-01. North Carolina Cooperative Extension Service, January 2003. Available at http://www.soil.ncsu.edu/publications/Soilfacts/AG-565-01/SFnutmgt12-21-02.pdf.

Step 4: Identify Impact

4-A. Regulated Parties

RP.0 Party Description

Name of Party	Nutrient Applicators

Description	This rule applies primarily to the people who actually apply nutrients to the land, their direct supervisors, and consultants who provide nutrient management advice. These are the parties on whom our fiscal estimates are based. The exception to the above description is that the rule does not apply to residential, commercial, or industrial landowners who apply nutrients to their own property. Owners and managers of lands where fertilizer is applied are also subject to the rule but can meet requirements simply by ensuring that applicators to their lands comply with one of the two options. We assume no cost to these parties and do not discuss them further here. Land uses named in the rule are commercial cropland, greenhouses, golf courses, fertilized public and institutional lands, and fertilized commercial, industrial, and residential lands. We simplify the range of applicators to the following four categories for this analysis: ▪ waste applicators for confined animal operations, or CAFO's; ▪ cropland agriculture; ▪ pastureland agriculture; and ▪ turf, landscape, and nursery.
General Baseline	***CAFO's:*** All waste applicators for CAFO's of sufficient size to require non-discharge permits from the Division would be in compliance with the rule by virtue of having a certified nutrient management plan. We estimate this to be virtually all confined animal operators with the exception of dry litter poultry applicators, who do not need certified plans and so would not comply automatically. ***Cropland and Pastureland Ag:*** These farmers face no regulatory requirements for nutrient management planning. However, any who have obtained a voluntary cost share contract for nutrient management from either the NC Division of Soil and Water Conservation or the USDA Natural Resources Conservation Service would be in compliance with the rule by virtue of having a certified nutrient management plan. Expert opinion is that no more than 10% of watershed farmers would fit this description[1]. This estimate is based on a statistical survey currently underway evaluating farmers' nutrient-related practices in the Jordan Reservoir watershed. This estimate is based on preliminary data. A full report will be developed on completion as part of a grant from the Division. Thus, approximately 90% of farmers would need to take action to comply with the rule. ***Turf, Landscape, and Nursery:*** There are currently no regulatory requirements for these applicators. While many commercial turf managers and nurseries follow sound practices, they would need to take action to meet one of the two rule options.

Assumptions	▪ Overall, based on the Division's experience implementing this rule in the Neuse and Tar-Pamlico River Basins we find that there would be minimal costs to affected parties to implement and comply with this rule. For the implementers, providing the training would displace other responsibilities of existing staff, while trainees would face lost wages for time spent taking training, as further described below. Given the availability of the minimal cost training option to applicators and based on past experience, we assume that only those who *already* meet the certified plan option will choose that alternative instead. As described in the baseline section above, some agricultural applicators do meet that option. However, we also discuss below the scenario of choosing the certified plan option without having a plan in place already. ▪ For those who choose the training option, we assume that this one-time, one-day requirement would have no direct cost but would result in the indirect cost of one day's lost income. Local county offices of the NC Cooperative Extension Service would conduct trainings. They would charge no fee. In Neuse and Tar-Pamlico Basins, Extension obtained grant funding from DWQ to cover the minimal costs of training, and they have made arrangements to do so for this rule as well. Attendees would travel minimal distance since it would be offered in each county; we assume they would incur no significant travel costs. Attendees would incur a day's worth of opportunity costs associated with not carrying out normal job responsibilities. We calculate that indirect cost. We also note that employers routinely incur costs associated with training employees as an accepted part of business. ▪ In the event that an applicator chooses the certified plan option and does not already meet its requirements, we assume there would still be no net cost. While there is up-front planning cost, agricultural evaluations show that applicators are likely to realize net *savings* by obtaining and properly implementing certified nutrient management plans[2]. There would be no new capital, labor, or operation and maintenance costs beyond what applicators incur now associated with obtaining site information and applying fertilizer, even though O&M practices such as equipment calibration, application rates and timing may change as a result of rule compliance. In addition, both the NC Division of Soil and Water Conservation and USDA-NRCS provide cost share for this practice at the rate of $6/acre/yr for three years, further adding to the likelihood of net savings. ▪ As described in the baseline section above, we assume that approximately 90% of cropland and pastureland operators will choose the training option, while the other 10% will comply with the certified plan option specifically because they already implement certified plans. ▪ We assume that all turfgrass operators will choose the training option based on previous experience.
Data Sources	[1] Personal Communication: Dr. Deanna Osmond, NCSU Soil Science Dept, NC Cooperative Extension Service. [2] Hardy, D.H., D.L. Osmond, and A. Wossink, 2003. SoilFacts: An Overview of Nutrient Management with Economic Considerations. Publication Number AG-565-01. North Carolina Cooperative Extension Service, January 2003. http://www.soil.ncsu.edu/publications/Soilfacts/AG-565-01/SFnutmgt12-21-02.pdf.

RP.1 Annual Capital Costs/Savings

(a) Cost Baseline	Capital costs in fertilizer equipment and labor vary by applicator type.
(b) Description	As described in the assumptions section above, we anticipate no additional capital costs to any group associated with the proposed rule. The training option would involve no capital costs. Under the certified plan option, even for applicators who do not already meet the requirements of this option, they may calibrate or use their equipment differently in implementing a certified plan, but it would not require any new capital investments nor increased labor costs.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.2 Annual Operating Costs/Savings

(a) Cost Baseline	Existing operating costs for nutrient management vary by applicator type.
(b) Description	As described in the assumptions section above, we do not anticipate any new operating costs to any group resulting from compliance with this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.3 Annual Planning Costs/Savings

(a) Cost Baseline	All applicators currently face planning costs: ***CAFO's***: Animal waste applicators must complete training and receive certification from the Division, and subsequently keep waste application plans current. As described in the general assumptions section RP.0 above, they would meet certified plan requirements without additional action, so this rule would impose no new planning (or other) costs on them. ***Cropland and Pastureland:*** Farmers plan nutrient applications to varying degrees. The estimated 90% that do not currently have a certified plan either contract with fertilizer dealers for turnkey planning and application services, or hire consultants to develop or revise plans, which the farmers then implement. These operators would take the training option at no cost. The other 10% would choose the certified plan option specifically because they already meet its requirements. ***Turf, Landscape, and Nursery:*** Planning costs vary among these applicators. None have certified plans in place and all would take the training option at no cost.

(b) Description	See above.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	See the Baseline and Assumptions discussion in the General section RP.0 above.
(f) Data Sources	N/A

RP.4 Regulatory Transaction Costs/Savings

(a) Cost Baseline	Agricultural applicators who are required to have and maintain certified waste utilization plans have associated regulatory transaction costs.
(b) Description	There would be no new permitting or compliance costs resulting from this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.5 Other Costs/Savings

(a) Cost Baseline	Producers routinely attend commodity meetings, take training and attend other educational events during the less demanding winter months.
(b) Description	Lost income associated with completing the training option: producers who attend the training would incur lost income for the one day required to travel and participate in the training. Trainings will be held during the winter when farm income is relatively low.
(c) Quantify $	$63,000
(d) Quantification Method	Since the great majority of trainees are expected to be farmers, and the total cost is very small, we used farm-based values for the entire calculation. We estimated the number of applicators who would take training and associated that with a single day's lost income. We estimated the number of applicators who would take training as a proportional fraction of the number who did so in the Tar-Pamlico, proportioned based on land area: 2,000/3.5 = ~600. We estimated a daily crop farm income for winter months. Statewide average net crop farm incomes were available from NC Agricultural Statistics, along with percentage of net annual income by month: Average annual net crop farm income 1997-2001 = ~$50,000 or $192/day Feb-Mar income: 4.5% of annual vs. avg month 8.3% of annual = 54% of avg. 54% ($192) = $104; $104 (600 farmers) = ~$63,000

(e) Assumptions	▪ Assumed that most trainees would be crop farmers as in the Neuse and Tar-Pamlico. ▪ Assumed agricultural incomes are sufficiently close to non-agricultural to apply agricultural values to all trainees, given also the small total cost. ▪ Assumed 1997-2001 wages are sufficiently close to 2009-2013.
(f) Data Sources	USDA-Economic Research Service. Economic Indicators of the Farm Sector. As provided by NC Department of Agriculture & Consumer Services, Agricultural Statistics Division at http://www.ncagr.com/stats/income/incmthyr.htm and as included in North Carolina Agricultural Statistics 2002, p.12.

Table 2.1: Nutrient Applicators Summary

	Costs/Savings:	Nutrient Applicators
RP.1	Capital	$0
RP.2	Operating	$0
RP.3	Planning	$0
RP.4	Regulatory Transaction	$0
RP.5	Other	$63,000
	Total	$63,000

4-B. Implementing Agencies

IA.0 Party Description

Name of Party	Division of Water Quality (DWQ)
Description	The Division of Water Quality (DWQ) would be responsible for implementing the proposed rule. Planning Section staff in the central office would likely coordinate implementation. The Division would rely on and coordinate with the NC Cooperative Extension Service to carry out the training component of the rule. Division Regional Office staff that includes field offices in Raleigh and Winston-Salem would conduct compliance as needed. Several other agencies administer programs that promote and fund sound nutrient management practices that play into implementation of this rule. Local coordination, education, planning assistance, and agronomic testing capability are provided by these programs. The programs would help implement the training or assist farmers to meet the certified plan option. The agencies include: ▪ Cooperative Extension Service – NCSU Soil Science and County Offices ▪ NC Division of Soil and Water Conservation (DSWC) ▪ USDA - Natural Resources Conservation Service (NRCS) ▪ NC Department of Agriculture - Soil Testing Laboratory (NCDA)
General Baseline	Current staffing levels would be sufficient to carry out rule implementation.
Assumptions	N/A

Data Sources	N/A

IA.1 Regulatory Development Costs/Savings (Division of Water Quality)

(a) Cost Baseline	The Planning Section of the Division is responsible for developing and coordinating watershed restoration initiatives. Development of the Jordan nutrient rules is within the scope of our work.
(b) Description	Rule development involves staff time to: research rule components; plan and coordinate the rulemaking process; develop and revise rule language; research and document fiscal impacts; conduct/participate in stakeholder meetings; plan and conduct public workshops/meetings/hearings; present information to the Commission and agencies; and file and process rules, forms, etc.
(c) Quantify $	This cost represents an opportunity cost for the Division. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings

(a) Cost Baseline	The Planning Section of the Division is responsible for developing and coordinating watershed restoration initiatives. Development of the Jordan nutrient rules is within the scope of our work.
(b) Description	DWQ would be responsible for developing a database of applicators including those who complete the training option.
(c) Quantify $	This cost represents an opportunity cost for DWQ. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings

(a) Cost Baseline	N/A
(b) Description	There are no permitting costs associated with this proposed rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.4 Inspection and Enforcement Costs/Savings

(a) Cost Baseline	N/A
(b) Description	Applicators that choose the certified plan option may be subject to compliance inspections and enforcement actions.
(c) Quantify $	Any staff time that may be required for enforcing nutrient management plans represents an opportunity cost for DENR. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.5 Other Costs/Savings: Program Implementation Costs

(a) Cost Baseline	Cooperative Extension staff at NCSU currently develop educational and training information and materials and county Extension staff currently carry out training as part of their job duties.
(b) Description	The proposed rule states that either DWQ or CES would issue the certification for nutrient management training. Based on implementation of this rule in the Neuse and Tar-Pamlico, Extension would conduct the training with support from DWQ. The minimal direct costs would be defrayed through Section 319 grant funds as done in the other basins. There would be indirect costs to Extension staff in the form of displacing other activities to carry these out. We estimate those hours and salaries here.
(c) Quantify $	$5,500
(d) Quantification Method	Proportional to Neuse and Tar-Pamlico experience, we estimate a total of 8 training sessions as 2 sessions in each of four counties. Smaller partial counties would send their producers to one of the four counties' sessions. Trainers would attend a 1-day train-the-trainer session led by NCSU faculty, and would require one additional day total to prepare for conducting local trainings. Altogether: 4 staff x 4 days x $60,000/yr salary, fringe, benefits / 260 work days/yr = $3,700 Add NCSU faculty time: 6 days total x $80,000 / 260 work days/yr = $1,850 Total = $5,500 Overall, we consider this amount insufficient to include in the cost tables.
(e) Assumptions	N/A
(f) Data Sources	N/A

Table 2.2: Nutrient Management Cost Summary

Type of Cost	State Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$0	$0	$0	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Type of Cost	Local Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$0	$0	$0	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Type of Cost	Nutrient Applicators - Private Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$0	$0	$0	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Other	$0	$0	$31,500	$31,500	$0	**$63,000**
Total	**$0**	**$0**	**$31,500**	**$31,500**	**$0**	**$63,000**

Chapter 3: Agriculture

Step 1: Basic Information

1.1 Rule Reference No.	.0264
1.2 Analyst	Rich Gannon, Environmental Supervisor
1.3 Office	NC Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27604
1.4 Your Phone	(919) 733-5083 ext 356
1.5 Comments on Agency Contact	Julie Henshaw NC Division of Soil and Water Conservation Agriculture Cost Share Program Information (919) 715-9630
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Agriculture
1.7 Citation	15A NCAC 2B .0264
1.8 Brief Description of the Proposed Rule	This rule establishes collective nitrogen and phosphorus reduction requirements for all persons engaging in agricultural operations in the Jordan Reservoir watershed.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Jordan Reservoir, and more than four-fifths of phosphorus inputs. Agriculture comprises an estimated one-third to one-half of nonpoint inputs to the lake, the single largest nonpoint contributor. Addressing agricultural loads would be an essential component of a comprehensive nutrient strategy.

3.2 How does the Proposed Rule Change Behavior?

The agriculture rule requires collective reductions in nutrient losses from agricultural lands at the county level and at the subwatershed level within five to eight years. All producers collectively within a county and subwatershed would be required to meet the strategy percentage reduction goals for nutrient loading in that subwatershed within five years. Operators in the Upper New

Hope subwatershed would face the greatest reduction challenge given the greater reduction goal there of 35%. The rule imposes no specific requirements on individual producers for this time period. An initial assessment of progress since the 2001 baseline would be completed within 2 years of the effective date. If additional implementation is needed to reach the goals, farmers would be required to register with local agricultural agency staff, offered the opportunity to participate on local committees, and depending on their level of farm stewardship may be asked by local agency staff to implement additional practices. Thus, in the first five years farmers may volunteer to implement and maintain new nutrient-reducing BMPs for as long as they continue operations. Farmers in any subwatershed may at any point satisfy their rule responsibilities by achieving a certain level of implementation as defined by a list of standard BMPs. If after five years the goals are not achieved as determined by an oversight committee, the EMC may impose uniform BMP implementation requirements, to be met within another 3 years. In that case, farmers would be required to put certain practices in place over the following three years, again depending on their pre-existing level of farm stewardship.

Figure 3.1: Agriculture: Required Activities

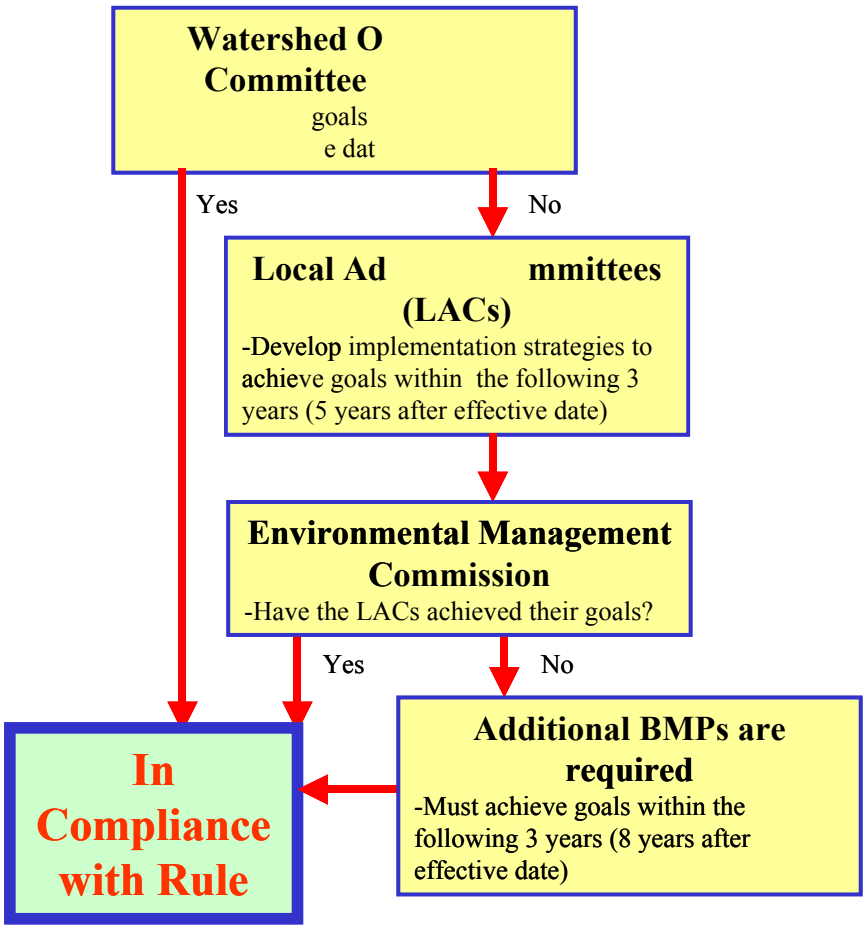


Table 3.1: Agriculture Rule Timeline

Effective Date	9/1/2008	0 months
EMC determines if nitrogen goal achieved. If not, then EMC will require the formation of a LAC for further progress or alternative	9/1/2010	2 years
EMC determines if operations have achieved collective nitrogen goal and phosphorus goal (separately). If not…	9/1/2013	5 years
EMC requires additional BMP implementation or other nutrient-reducing measures.	9/1/2016	8 years

*Based on effective date of September 1, 2008.

Step 4: Identify Impact

4-A. Regulated Parties

There are two options to comply with the agriculture rule. People subject to the rule may either become part of a collective strategy, or implement standard best management practices as specified in the Rule. Costs for both options are similar, and have been combined for this analysis.

RP.0 Party Description

Name of Party	Agricultural operators.
Description	All persons engaging in commercial agricultural operations in the Jordan watershed, including those related to crops, horticulture, livestock, and poultry. The rule applies to livestock and poultry operations above certain specified size thresholds that capture the great majority of livestock operations.
General Baseline	The Division currently regulates confined livestock and poultry operations over certain size thresholds statewide, through both state and federal permitting. The nutrient management practices required of operations under those existing rules would meet standard BMP criteria of this rule, largely removing them as new implementation candidates for at least the first five years. Cropland and grazing livestock agriculture does not currently face regulation in the watershed, other than that associated with the above-mentioned livestock permitting that includes waste application to crop fields. In terms of actions available to producers, all types of producers currently have voluntary technical assistance and cost-share programs available through both the NC Division of Soil and Water Conservation (the NC Agriculture Cost Share Program, or ACSP) and the USDA-Natural Resources Conservation Service, or NRCS (several programs). These programs have assisted individual farmers to implement nutrient-reducing BMPs to varying degrees in the watershed. In terms of actions taken by producers, implementation that occurred subsequent to the 2001 baseline would be credited toward collective rule compliance, and farmers may continue to use these assistance programs to help them meet the rule.

	The great majority of farms in the watershed have voluntarily implemented, either with or without cost share, the fundamental nutrient-reducing practice of maintaining or restoring riparian buffers along waterways (often these lands are too steeply sloped to make cropping practical under any circumstance). Most of these buffers were in place prior to the 2001 baseline and thus would not have achieved reductions relative to the baseline. This pre-existing presence of buffers on most waterways removes that as a BMP option to a large degree. Preliminary input from the agricultural community is that a second practice, nutrient management, has been implemented in significant quantities prior to 2001, reducing opportunities for further reductions. At least it appears that producers in good part substantially reduced nitrogen application rates fairly close to Cooperative Extension Service-recommended levels by 2001. We used this input to guide our projections of BMP implementation in this analysis.
Assumptions	The following overarching assumptions apply to our calculations for this rule: ▪ We assume rule compliance costs would be controlled by nitrogen requirements, since phosphorus criteria in the rule are qualitative in nature and would not allow for meaningful cost estimation. ▪ We summed load reduction requirements across the three subwatersheds and estimated reduction needs for the entire watershed. This approach assumes that any factors unique to an individual subwatershed would not significantly vary its costs relative to the other two, other factors being equal. We believe this approach to be reasonable. ▪ We assumed that proportional load reductions would be sought from both pastureland and cropland. This was the approach used in the Tar-Pamlico agriculture rule, chiefly because the accounting systems could not be merged. That obstacle has not yet been overcome, thus we assume the same here. ▪ We assume that the agricultural community would meet the nitrogen reduction goals within 5 years. While this may prove challenging e.g. for pasture operations or in the Upper New Hope subwatershed, this is a conservative assumption that errs in favor of ***overestimating*** annual costs in the first five years. ▪ We also assume that all costs occur during the 5 years after effective date, and do not distribute any costs over 2007 and 2008, while in reality creditable implementation and associated costs are likely occurring during this intervening period. This assumption further errs in favor of ***overestimating*** costs during the five rule years. ▪ This analysis calculates total unsubsidized costs to farmers, and does not deduct cost share payments that are available from state and federal programs. Cost share would likely occur in substantial amounts, lowering costs to farmers, but we did not project rates of cost share availability in subject counties. In assuming no cost share benefit, we err in favor of ***overestimating*** actual costs. ▪ We assume the universe of agricultural operations, for these calculations, to consist of cropland, hay and pastured livestock operations. This does not account for the following operation types: o Confined animal operations. Under other state and federal regulations they are required to follow nutrient management plans and setback requirements from water bodies for waste application. We assume they would not implement additional practices in the first five years of this

	rule. This was the case under Neuse and Tar-Pamlico agriculture rules. o Horticultural operations. Nutrient loading from and controls on these operations were not addressed under Neuse and Tar-Pamlico agriculture rules, and an approach has not been defined for addressing them under this rule. Trends in the number and size of these operations in the watershed have not been defined, nor has nutrient loading from them. ▪ We assume constant pre-BMP TN loss rates from cropland and pastureland across each of the first 5 years. Rates are those estimated by the Tetratech watershed model. This does not account for certain factors: o Trends or shifts in individual crop acreages. Crop shifts affect TN fertilization rates, and could result in more or less TN loss. Crop shifts result from economic factors that are difficult to forecast and beyond the scope of this analysis. Crop shifts could cause ***higher or lower*** costs than estimated here. o Increases in dry litter poultry operations. Available information indicates an increasing trend in this part of the state in recent years, however the Division does not permit these operations and for security reasons accurate information is difficult to obtain and was not obtained for this analysis. This trend could result in increased N application rates to pastures. Such increased rates should be captured in compliance accounting during implementation, but are not addressed in this cost analysis. While much of an increase would be attenuated at points before reaching surface waters, an increased application rate would likely translate to somewhat ***greater*** reduction need and compliance costs than those estimated here.
Data Sources	

RP.1 Annual Capital Costs/Savings (ACS/S)

(a) Cost Baseline	Please refer to the general baseline discussion under RP.0 above.

(b) Description

We established load reduction needs by estimating baseline loads for cropland and pastureland and applying the strategy percent reduction goals to those loads, as shown in Table 3.2:

Table 3.2: Agriculture Acres, Baseline Loads, and Load Reduction Targets

Sub-w'shed	Acres		Baseline N Load (lb/yr)		N Reduc Goals (%)	N Load Reduc Needs (lb/yr)	
	Pasture	Row	Pasture	Row		Pasture	Row
HAW	237,071	26,958	1,348,934	360,428	8%	107,915	28,834
UNH	4,100	285	23,329	3,810	35%	8,165	1,334
LNH	11,347	1,051	64,564	14,052	0%	-	-
Total	252,518	28,294	1,436,827	378,291		**116,080**	**30,168**

Since these reduction needs are relative to a 2001 baseline, we obtained cost share data on BMP implementation from 2001 through 2006, estimated associated load reductions, and deducted those from the above targets to set net additional reduction needs.

Since cropland and pastureland are fertilized differently and require different management practices, we carried out separate, parallel calculations for each, then summed the costs.

In brief, our calculation method was this: we identified a set of practices for each of cropland and pasture; assigned each practice a proportion of the total reduction target for that sector; estimated acres of each BMP needed based on per-acre loading rate reductions; and calculated costs associated with those acres using per-acre cost-shared and total cost values from NC ACSP.

We estimate both total cost of meeting the goals and the net cost to farmers assuming all implementation is cost-shared. It is important to note that the costs to farmers shown below assume full cost-share of practices. Thus, full capital cost to achieve the reduction goals is four times the amount shown below.

(c) Quantify $

Table 3.3: Agriculture: Capital Costs to Farmers, 5-Yr Full Compliance

Type of Cost	Total Annual Costs (Crop + Pasture) to Producer					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	**$190,470**	**$190,470**	**$190,470**	**$190,470**	**$190,470**	**$952,351**
Operation & Maintenance	$57,141	$114,282	$171,423	$228,564	$285,705	**$857,116**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$50,465	$100,930	$151,395	$201,859	$252,324	**$756,973**
Total	$298,076	$405,682	$513,288	$620,894	$728,500	**$2,566,439**

(d) Quantification Method

We ran parallel calculations for cropland and pasture, using the same approach for both, differing only in some specifics. We first established load reduction needs based on baseline crop and pasture acres and their respective loading rates. We used an EPA land cover database, as detailed in the assumptions section below, which yielded the acres shown in Table 3.2 above. To obtain the baseline loads also shown in Table 3.2, we applied the following watershed average field-scale

	loading rates for cropland and pastureland, provided in the Tetra Tech watershed model report[1], to those acres: Cropland = 13.37 lb N/ac-yr Pastureland = 5.69 lb N/ac-yr
(d) Quantification Method (continued)	We then estimated costs using the following steps, which are reflected in Table 3.4 and 3.5 below: 1. established a set of candidate BMPs, 2. apportioned the load reduction requirement among BMPs, 3. estimated and applied load reduction rates to each BMP to yield acres needed, 4. compared those acres to available acres, 5. deducted acres implemented 2002 to 2006 under ACSP to yield net acres needed, 6. applied per-acre costs provided by the ACSP to yield total capital costs. Steps 1 and 2. During 2006, we held meetings and discussions with representatives of the agricultural community in which we identified practices with the greatest potential for additional implementation[9]. In our calculations, we assigned preliminary proportions of the total reduction need among these practices, estimated costs, then revised proportions of BMPs in an iterative fashion to arrive at reasonable acreages relative to available acres, balanced against relative BMP costs. DSWC staff reviewed these projections. Step 3. Estimating BMP Load Reduction Rates: **Cropland** ▪ *Riparian Buffer* = 6.7 lb N/ac-yr, a 50% removal efficiency applied to the average cropland export rate in Table 10 of the watershed model[1] of 13.4 lb N/ac-yr. A committee of agency staff and university researchers, the NLEW committee, revised the efficiency estimate for a 50' riparian buffer to 50% in January 2007[4]. This committee guides the design of and revisions to the Nitrogen Loss Estimation Worksheet, the compliance accounting tool used for the Neuse and Tar-Pamlico agriculture rules, and which is being adapted for Jordan also. To convert acres needing treatment by buffers to acres of buffer, we used a factor of 10 acres drainage area per acre buffer, a consistent value between two sources [5, 6]. ▪ *Cropland Conversion to Grass or to Trees* = 11.8 lb N/ac-yr, the difference between average cropland (13.4) and forest (1.6) loading rates estimated by the watershed model. We assumed no significant differences in export rates between conserved grassland and conserved forest in non-riparian landscape positions. ▪ *Nutrient Management* = 2.5 lb N/ac-yr, based on an assumed pre-BMP average application rate across all crops of 100 lb N/ac, reduced by an assumed 5%, and recognizing that approximately 50% of applied N is lost

	from fields. The latter value was based on aggregated data for all counties in the Tar-Pamlico River Basin, drawn from annual reports for the period 1991 to 2004 under the Tar-Pamlico agriculture rule.
(d) Quantification Method (continued)	**Pastureland** ▪ *Stream Protection System* = .16 lb N/Linear Foot-yr. This system involves fenced livestock exclusion from streams, a restored riparian buffer within the fenced area, alternate water source and hardened stream crossing. We obtained the reduction rate by applying 50% load reduction efficiency to a pasture loading rate of 6.8 lb N/ac-yr, and converting the resulting 3.4 lb N/ac-yr to lb N/LF of stream-yr. We drew this logic from pasture accounting developed under the Tar-Pamlico agriculture rule. It was developed by a stakeholder team including NCSU pasture researchers, approved by the Tar-Pamlico Basin Oversight Committee, and endorsed by the NC Soil and Water Conservation Commission [7]. For excluded buffers it recognizes two means of loading reduction - removal of direct deposition of waste in the stream and interception and treatment of water draining through the buffer. Our calculation retains the 6.8 lb N/ac-yr untreated pasture loading rate developed by the Tar-Pamlico point system, but updates the calculation by using the revised NLEW buffer efficiency[4] for an excluded 20' buffer described under the riparian buffer BMP above. We assumed a 20' riparian buffer, the narrowest available, assuming producers would want to minimize losses of productive grazing land near streams. We translated pasture acres to linear feet of stream using a stream density factor of 2.61 miles of stream per square mile of land area[8]. This factor is specific to the Piedmont region of the Cape Fear River basin. ▪ *Pastureland Conversion to Trees* = 5.2 lb N/ac-yr, uses the same logic as the cropland conversion BMPs, taking the difference between average pasture (6.8) and forest (1.6) loading rates. Step 4, Comparison to Available Acres. For cropland conversion, nutrient management, and pastureland conversion this was a direct comparison of acres needed to total crop or pasture acres shown in Table 3.2. For riparian buffer and stream protection system BMPs, we translated total crop or pasture acres to linear feet of stream, and potential buffer, using the same 2.61 stream density factor[8] described under the stream protection system above. Step 5, Deducting Acres Implemented 2002-2006. The NC DSWC provided aces of cost shared BMPs for this period from their database. This value does not reflect implementation that has occurred with cost share from USDA programs, which was not readily available. Such data would be incorporated into actual compliance accounting during implementation, so its absence from this calculation would result in a conservative ***overestimate*** of costs to producers. Step 6, Equating Acres Needed to Costs. The NC DSWC provided average per-unit-of-BMP cost-shared capital costs for installation. This value is 75% of full

installation cost. We converted them to full installation cost to get full capital cost of rule implementation. We then took one-quarter of the full cost to get cost to producers, under the assumption that all practices would be cost-shared. We show both of these resulting costs for achieving the reduction goals in Table 3.4 below.

Table 3.4: Agriculture: *Cropland* Cost Calculations

	Cropland Capital Costs											
BMP	**% of Total Reduc**	**Load Reduc (lb N /yr)**	**Reduc Rate (lb N / Ac-Yr)**	**Area Need'g Treated (Ac)**	**Area BMP Needed fr. B'line (Ac)**	**% Avail-able Acres**	**BMPs Added '02-'06 (Ac)**	**Net Area BMP Needed (Ac)**	**Per-Ac BMP Cap Cost ($/ac BMP)**	**Total 5-Yr Cap Cost ($)**	**Total 5-yr Cap Cost to Farmer ($)**	**Annual Cap Cost to Farmer ($)**
50' Riparian Buffer	30%	9,050	6.7	1,351	135	48%	0	135	$ 251	**$ 33,860**	**$ 8,465**	**$ 1,693**
Cropland Conversion to Grass	35%	10,559	11.8	895	895	3%	635	260	$ 400	**$ 103,925**	**$ 25,981**	**$ 5,196**
Cropland Conversion to Trees	15%	4,525	11.8	383	383	1%	189	194	$ 251	**$ 48,752**	**$ 12,188**	**$ 2,438**
Nutrient Management	20%	6,034	2.5	2,413	2,413	9%	0	2,413	$ -	**$ -**		**$ -**
Total	100%	30,168								**$ 186,537**	**$ 46,634**	**$ 9,327**
Buffer Load Reduction Rate			**Unrestored *Cropland* Buffer Available**					**ACSP Cost Share Rate (75% full cost)**				
Avg Cropland Load Rate (lb/ac-yr)	13.4		Cropland Ac			28,294		Riparian Buffer ($/ac BMP)			$188	
Avg 50' Buffer Efficiency (%)	50%		Cropland Mi2			44		Crop Conversion to Grass ($/ac BMP)			$300	
Load Reduction Rate (lb/ac-yr)	**6.7**		Stream Density (mi/mi2 land)			2.61		Crop Conversion to Trees ($/ac BMP)			$188	
			Crop Stream Miles			115						
Cropland Conversion Load Reduc Rate			% Ag Streams Buffered			80%						
Avg Cropland Load Rate (lb/ac-yr)	13.4		Crop Stream Mi Unbuffered			23						
Avg Forest Load Rate (lb/ac-yr)	1.6		Ac 50' Unrestored Buffer			**280**						
Load Reduction Rate (lb/ac-yr)	**11.8**											
Nutrient Mgmt Load Reduction Rate			**Unrestored *Pastureland* Buffer Available**									
Avg N App Rate (lb/ac-yr)	100		Pasture Ac			252,518						
Percent N App Reduc (%)	5%		Pasture Mi2			395						
N App Reduc (lb/ac-yr)	5		Stream Density (mi/mi2 land)			2.61						
Ratio N Lost / N Applied (%)	50%		Pasture Stream Miles			1,030						
Load Reduc Rate (lb/ac-yr)	**2.5**		% Ag Streams Buffered			80%						
			Pasture Stream Mi Unbuffered			206						
			Pasture Stream LF Unbuffered			**1,087,469**						

Table 3.5: Agriculture: *Pastureland* Cost Calculations

	Pastureland Capital Costs									
BMP (Units)	**% of Total Reduc**	**Load Reduc (lb N/yr)**	**Reduc Rate (lb N / Unit-Yr)**	**Units Needed (LF or Ac)**	**% of Avail-able Units**	**Units BMP Added '02-'06 (LF or Ac)**	**Per-Unit BMP Cap Cost ($/Unit**	**5-Yr Total Cap Cost ($)**	**5-yr Cap Cost to Farmer ($)**	**Annual Cap Cost to Farmer ($)**
Stream Protection System (LF)	75%	87,060	0.16	548,134	50%	69,907	$ 4.67	**$2,231,725**	**$557,931**	**$ 111,586**
Pastureland Conversion to Trees (Ac)	25%	29,020	5.2	5,581	2%	31	$ 251	**$1,391,141**	**$347,785**	**$ 69,557**
Total	100%	116,080						**$3,622,865**	**$905,716**	**$ 181,143**
Stream Protection System Load Reduc Rate			**Pastureland Conversion Load Reduc Rate**							
(w/ Excluded 20' Forested Buffer*)										
Pasture Loading Rate (lb/ac-yr)	6.8		Pastureland Loading Rate (lb/ac-yr)				6.8	**ACSP Cost Share Rate (75% full)**		
System Reduc Efficiency (%)*	50%		Forest Loading Rate (lb/ac-yr)				1.6	Stream Prot Sys ($/LF)	$ 3.50	
Load Reduc Rate (lb/ac-yr)	3.4		Load Reduc Rate (lb/ac-yr)				**5.2**	Pasture Conv Trees ($/Ac	$ 188	
Load Reduc Rate (lb/lf stream-yr)	**0.16**									
Pasture Export			**Equivalents to Stream Density Ratio of 2.61 mi / mi^2 Land**							
Pasture 'Runoff' Rate (lb/ac-yr)	4.6		Drainage Area (Ac) / LF Stream				0.0464			
Cattle Direct Dep Rate (lb/ac-yr)	2.2		Drainage Area (ft2) / LF Stream				2,023			
Pasture Total Export Rate (lb/ac-yr)	**6.8**									

(e) Assumptions	▪ We distinguish cropland from pastureland for two reasons – differences in fertilization and different nutrient-reducing management practices. Pasture is generally fertilized at much lower rates, so loading and reduction estimates differ from cropland. Pasture includes livestock-grazing lands, but also includes hay land. Livestock BMPs center on reducing their direct and indirect impacts to streams, clearly differing from cropland BMPs. ▪ Two available land cover sources differed significantly in their estimates of cropland and pastureland acres. The source used by Tetra Tech in its watershed model[1] was USGS National Land Cover Database, while a second source was EPA's BasinPro 8 Thematic Mapper[2]. Both were based on satellite imagery but differed in categorizations of some non-row herbaceous covers. Evaluation of the component covers suggested that the EPA database better represented important distinctions between crop and pasture lands for our purposes. This assessment was supported by preliminary results from a statistical survey of farmers in the watershed being conducted by NCSU Soil Science Dept researchers[3]. Thus, we assume the EPA land cover is most appropriate for these calculations for agricultural lands in the watershed. This assumption results in ***higher, almost doubled,*** total cost estimates than those generated using the USGS data, with most of the cost shifted from cropland to pasture. ▪ We assume no reduction in acres under agricultural control over the first five years of implementation. While a reduction trend exists statewide and likely in this watershed, how that trend weighs into compliance accounting under this rule has not been defined. By assuming no reduction benefit from land loss, we err in favor of ***overestimating*** annual costs. ▪ We assume that our reduction calculations based on the watershed model loading rate values and established BMP efficiencies provide a reasonable approximation of the compliance accounting method that would actually be used, the Nitrogen Loss Evaluation Worksheet (NLEW), during implementation when fuller data is developed. ▪ We assumed compliance would be achieved at a constant annual rate over the 5-year implementation period, and inferred annual costs accordingly. ▪ We assumed that all practices implemented to meet the goals would be cost-share supported at the ACSP rate of 75%. Thus, we report final capital costs to producers that equal one-quarter of full capital costs for meeting the goals.

(f) Data Sources	[1] Tetra Tech, 2003. *B. Everett Jordan Lake TMDL Watershed Model Development*, Tetra Tech, Inc., Research Triangle Park, NC. November 2003. [2] EPA, 1996. BasinPro 8 Thematic Mapper Land Cover. NCSU Soil Science Department, Raleigh, NC. [3] Personal Communication: Dr. Deanna Osmond, NCSU Soil Science Dept, NC Cooperative Extension Service. [4] NLEW Committee Meeting Summary, January 4, 2007, Dr. Deanna L. Osmond, NCSU Soil Science Dept, Raleigh, NC. [5] Gannon, Richard, 1997. *Effectiveness of Wetland and Riparian Areas for Treatment of Agricultural Pollution Sources: A Literature Review* (unpublished). [6] Tar-Pamlico Agriculture Rule, Nash County Local Advisory Committee Baseline survey, 2003. [7] Tar-Pamlico Pasture Point System, 2003. http://www.enr.state.nc.us/DSWC/pages/tar-pamlicoBMP.html. [8] Bruton JG. 2004. *Headwater catchments: estimating surface drainage extent across North Carolina and correlations between land use, near stream, and water quality indicators in the Piedmont physiographic region*. Doctoral Dissertation, North Carolina State University, Raleigh, NC. 92 p. [9] Meeting Summaries for June 9, 2006 and July 17, 2006 Agricultural Technical Committee meetings, Jordan Nutrient Strategy. NC Division of Water Quality, Planning Section, Nonpoint Source Unit.

RP.2 Annual Operating Costs/Savings (AOC/S)

(a) Cost Baseline	Please see the general baseline discussion under RP.0 above.
(b) Description	The BMPs projected in the capital cost section would require varying types of maintenance. DSWC staff has estimated this cost at 15% of installation costs, distributed over the BMP's lifespan as represented by the cost share contract period. O&M costs then are cumulative, increasing annually with the addition of each new increment of BMPs. Calculations are provided in Table 3.7 below.
(c) Quantify $	**Table 3.6: Agriculture: Operating Costs to Farmers, 5-Year Full Compliance**

Type of Cost	Total Annual Costs (Crop + Pasture) to Producer					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$190,470	$190,470	$190,470	$190,470	$190,470	**$952,351**
Operation & Maintenance	**$57,141**	**$114,282**	**$171,423**	**$228,564**	**$285,705**	**$857,116**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$50,465	$100,930	$151,395	$201,859	$252,324	**$756,973**
Total	$298,076	$405,682	$513,288	$620,894	$728,500	**$2,566,439**

(d) Quantification Method	Again we performed separate, parallel estimates for crop and pasture. With the exception of nutrient management, all BMPs used here have contract periods of 10 years. Since we estimate no net costs for nutrient management, we assume a uniform 10-year distribution of maintenance costs, adding to 15% of installation cost over those 10 years. Thus, annual costs in Tables 3.7 and 3.8 below amount to 1.5% of the annual capital cost shown in Tables 3.4 and 3.5 above for each BMP.

Table 3.7: Agriculture: Annual *Cropland* O&M Costs to Farmers

	Pastureland Operation & Maintenance				
BMP (Units)	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Total**
Stream Protection System (LF)	$ 66,952	$100,428	$133,903	$ 167,379	$ 502,138
Pastureland Conversion to Trees (Ac)	$ 41,734	$ 62,601	$ 83,468	$ 104,336	$ 313,007
Total	**$108,686**	**$163,029**	**$217,372**	**$ 271,715**	**$ 815,145**

Table 3.8: Agriculture: Annual *Pastureland* O&M Costs to Farmers

	Cropland Operation & Maintenance Costs					
BMP	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Total**
50' Riparian Buffer	$ 508	$ 1,016	$ 1,524	$ 2,032	$ 2,540	**$ 7,619**
Cropland Conversion to Grass	$ 1,559	$ 3,118	$ 4,677	$ 6,235	$ 7,794	**$ 23,383**
Cropland Conversion to Trees	$ 731	$ 1,463	$ 2,194	$ 2,925	$ 3,656	**$ 10,969**
Nutrient Management	$ -	$ -	$ -	$ -	$ -	**$ -**
Total	**$ 2,798**	**$ 5,596**	**$ 8,394**	**$ 11,192**	**$ 13,990**	**$ 41,971**

(e) Assumptions	▪ Maintenance = 15% of installation cost, distributed over contract life, as recommended by DSWC cost share staff. Since many BMPs continue to function beyond contract life, the annual fraction of installation cost would be proportionally less than estimated here, making this estimate a conservative ***overestimate***.
(f) Data Sources	NC Division of Soil and Water Conservation, in consultation with local Soil and Water Conservation Districts in the Jordan watershed.

RP.3 Annual Planning Costs/Savings (APC/S)

(a) Cost Baseline	Please see the general baseline discussion under RP.0 above.
(b) Description	Farmers would rely on technical assistance provided by ACSP or USDA programs, and would absorb their own planning time into their operations, but would not pay for planning services.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.4 Regulatory Transaction Costs/Savings (RTC/S)

(a) Cost Baseline	Please see the general baseline discussion under RP.0 above.
(b) Description	Based on experience in the Neuse and Tar-Pamlico basins, we estimate that farmers would not incur any explicit regulatory transaction costs. Any participation in rule development would not require business costs. Local agricultural agency staff would incur the great majority of new transaction costs associated with implementing the rule. For this, a Clean Water Act Section 319 grant was obtained from NC Division of Water Quality under its FY2006 funding cycle that would provide for two new Soil and Water Conservation District Technician positions to carry out this work. In addition, an existing Division of Soil and Water Conservation staff position has been given the added responsibility of coordinating the agricultural elements of the Jordan nutrient strategy. No new resources are provided for that responsibility.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.5 Opportunity Costs/Savings (OpC/S)

(a) Cost Baseline	Please see the general baseline discussion under RP.0 above.
(b) Description	There would be opportunity costs associated with taking land out of production for buffers or cropland conversion BMPs. We used a uniform soil rental rate provided by DSWC staff of $37.81/ac-yr to estimate the foregone income from lost land use. This cost is then cumulative over the years of lost use, increasing annually with the addition of each new increment of BMPs. Total opportunity costs are shown in Table 3.9 below, while cropland and pastureland are broken down in tables 3.10 and 3.11.
(c) Quantify $	**Table 3.9: Agriculture: Opportunity Costs to Farmers, Full 5-Year Compliance**

Type of Cost	Total Annual Costs (Crop + Pasture) to Producer					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$190,470	$190,470	$190,470	$190,470	$190,470	**$952,351**
Operation & Maintenance	$57,141	$114,282	$171,423	$228,564	$285,705	**$857,116**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	**$50,465**	**$100,930**	**$151,395**	**$201,859**	**$252,324**	**$756,973**
Total	$298,076	$405,682	$513,288	$620,894	$728,500	**$2,566,439**

(d) Quantification Method	We applied the soil rental rate of $37.81/ac-yr provided by DSWC to the number of BMP acres added each year, which would be one-fifth of the full compliance acreage shown in Table 3.4 & 3.5 above. Since nutrient management does not remove land from production, it generates no opportunity costs.

Table 3.10: Agriculture: Annual *Cropland* Opportunity Costs to Farmers

	Opportunity Costs on Cropland Taken Out of Production					
BMP	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Total**
50' Riparian Buffer	$ 1,021	$ 2,043	$ 3,064	$ 4,086	$ 5,107	**$ 15,322**
Cropland Conversion to Grass	$ 1,965	$ 3,929	$ 5,894	$ 7,859	$ 9,823	**$ 29,470**
Cropland Conversion to Trees	$ 1,471	$ 2,941	$ 4,412	$ 5,883	$ 7,354	**$ 22,061**
Nutrient Management						
Total	**$ 4,457**	**$ 8,914**	**$ 13,371**	**$ 17,828**	**$ 22,285**	**$ 66,854**

Table 3.11: Agriculture: Annual *Pastureland* Opportunity Costs to Farmers

	Opportunity Costs on Pastureland Taken Out of Production					
BMP (Units)	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Total**
Stream Protection System (LF)	$ 3,806	$ 7,612	$ 11,419	$ 15,225	$ 19,031	**$ 57,093**
Pastureland Conversion to Trees (Ac)	$42,202	$ 84,403	$ 126,605	$ 168,807	$ 211,009	**$ 633,026**
Total	**$46,008**	**$ 92,016**	**$ 138,024**	**$ 184,032**	**$ 230,040**	**$ 690,119**

(e) Assumptions	The average soil rental rate estimate is a reasonable estimate of opportunity cost across the watershed.
(f) Data Sources	NC Division of Soil and Water Conservation, in consultation with local Soil and Water Conservation Districts in the Jordan watershed.

4-B. Implementing Agencies

IA.0 Party Description

Name of Party	The Nonpoint Source Program in the Planning Section of DWQ would have primary responsibility for administering and enforcing the proposed rule. Existing staff would assimilate this responsibility. Existing DWQ Regional Office staff in the Raleigh and Winston-Salem offices may carry out compliance and enforcement actions as needed. The Division of Soil and Water Conservation would have key responsibility for coordinating the agricultural elements of the Jordan nutrient strategy. This includes collection and analysis of data, overseeing local District staff, interfacing with the agricultural community, and coordinating and reviewing annual reports. An existing staff position with DSWC has been given this additional responsibility. No new resources are provided. Local agricultural agency staff would incur the majority of new costs associated with implementing the rule. For this, a Clean Water Act Section 319 grant was obtained from NC Division of Water Quality under its FY2006 funding cycle that would provide for two new Soil and Water Conservation District Technician positions to carry out this work for the two counties almost entirely within the watershed and the other 6 counties partially within it.
Description	DWQ currently administers multiple water quality related programs including stormwater and wetlands permitting programs. DWQ works closely with several sister agencies on matters concerning water quality, agriculture, forestry, sediment and erosion control, and soil conservation.
General Baseline	No specific program within DWQ currently exists for implementation and compliance monitoring of agricultural strategies in the Jordan Reservoir watershed.
Assumptions	See this in section RP.0 in this chapter.
Data Sources	See this in section RP.1 in this chapter.

IA.1 Regulatory Development Costs/Savings (RDC/S)

(a) Cost Baseline	Currently, DWQ does not have regulatory development costs associated with agricultural strategies.
(b) Description	The rule-making costs involve staff time to research and review the specific components of the rules, develop into the rule language, research cost/fiscal impacts, participate in meetings with stakeholders, plan and participate in public workshops/meetings/hearings, present information to Commission and Department, and file/process rule, forms, etc.
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost for DENR. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(e) Assumptions	See this in section RP.0 in this chapter.
(f) Data Sources	See this in section RP.1 in this chapter.

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S)

(a) Cost Baseline	Currently, DWQ does not have any monitoring and recordkeeping costs associated with areas agricultural strategies.
(b) Description	Monitoring and recordkeeping activities would be integrated with existing programs to the maximum extent possible. Any costs would be opportunity costs for DWQ to implement the rule component. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff. Activities would include coordination with sister agencies and local governments administering existing programs relevant to agricultural strategies.
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost for DWQ. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(e) Assumptions	See this in section RP.0 in this chapter.
(f) Data Sources	See this in section RP.1 in this chapter.

IA.3 Permitting Costs and Savings (PC/S)

(a) Cost Baseline	N/A
(b) Description	There are no permitting costs associated with this proposed rule.
(c) Quantify $	N/A
(d) Quantification Method	N/A
(e) Assumptions	See this in section RP.0 in this chapter.
(f) Data Sources	See this in section RP.1 in this chapter.

IA.4 Inspection and Enforcement Costs/Savings (IEC/S)

(a) Cost Baseline	N/A
(b) Description	Inspection for compliance with the proposed rule would be integrated with existing on-site compliance efforts.
(c) Quantify $	$0
(d) Quantification Method	This proposed cost represents an opportunity cost for DWQ to implement the rule component. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(e) Assumptions	See this in section RP.0 in this chapter.
(f) Data Sources	See this in section RP.1 in this chapter.

Table 3.12: Agriculture Cost Summary

Type of Cost	State Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$0	$0	$0	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Type of Cost	Local Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$0	$0	$0	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Type of Cost	Producer - Private Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$190,470	$190,470	$190,470	$190,470	$190,470	**$952,351**
Operation & Maintenance	$57,141	$114,282	$171,423	$228,564	$285,705	**$857,116**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$50,465	$100,930	$151,395	$201,859	$252,324	**$756,973**
Total	**$298,076**	**$405,682**	**$513,288**	**$620,894**	**$728,500**	**$2,566,439**

Chapter 4: Stormwater for New Development

Step 1: Basic Information

1.1 Rule Reference No.	.0265
1.2 Analyst	Rich Gannon, Environmental Supervisor Kelly P. Johnson, Environmental Engineer
1.3 Office	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Phone	(919) 733-5083 x356, x376
1.5 Comments on Agency Contact	Mike Randall Division of Water Quality Stormwater Unit Phase II Stormwater Information (919) 733-5083 x 545
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Stormwater Management for New Development
1.7 Citation	15A NCAC 2B .0265

1.8 Brief Description of the Proposed Rule	This rule requires all local governments in the Jordan Reservoir watershed to develop and implement permitting programs to require stormwater controls that meet subwatershed nutrient loading rate targets on new development activities. Developers would be required to control nutrient export to certain levels onsite, and may meet remaining reduction needs through in-lieu fee payment to the North Carolina Environmental Enhancement Program (NC EEP) or to local governments with a Division-approved local offset plan. Control of flows for stream protection is also required. Development in existing water supply watersheds would still be required to comply with those existing density-related treatment thresholds and density caps designed to protect local water supplies where they are more stringent than this rule. Within one year of the effective date, the Division would submit a model local program to the Commission for approval. Within another six months, local governments would submit programs for Division review and subsequent Commission approval. Within two and a half years after the effective date, local programs are to be implemented. Annual reports are required.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary.

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint. Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Jordan Reservoir, and more than four-fifths of phosphorus inputs. Developed land uses currently comprise at least one-third of nonpoint inputs to the lake. While nutrient export rates from developed lands vary, they have the potential to export at rates exceeding those of cropland. The watershed encompasses some of the highest growth areas in the state. Watershed-wide average projected growth rate through 2020 is 2.3% per year. New development left unaddressed will add significant new nutrient loading to Jordan Reservoir.

3.2 How does the Proposed Rule Change Behavior?

Local Governments: This rule would require all local governments in the Jordan Reservoir watershed to develop and implement programs, including ordinances, that carry out permitting

requirements for post-construction, engineered stormwater controls (BMPs) that will meet subwatershed nutrient loading rate targets and runoff flow limits on new development activities for the life of those developments. This would include ensuring continued BMP operation and maintenance over time and through ownership changes. Local governments would obtain Division approval for their programs and would report implementation progress to the Division annually. Thus, they would function as both regulated parties and implementing agencies under this rule.

Local Government Baseline - Municipalities: Eighteen of twenty-six municipalities in the watershed will be required to implement local stormwater programs to comply with NPDES Stormwater Phase II requirements beginning mid- to late 2007. With the exception of two of the smallest towns in the watershed, Alamance and Ossipee, all remaining municipalities not implementing Phase II programs fall within water supply watersheds and implement WSW stormwater programs. Thus, virtually all municipalities are implementing or will implement new development permitting programs prior to the effective date of this rule. To implement this rule, additional responsibilities will involve reviewing additional application information and in some cases ensuring that additional practices are included to address nutrient targets and, in the few water supply-only jurisdictions, where peak flow control is not required, ensuring that peak flow rates are controlled. Overall, we do not expect that Jordan municipalities will incur significant additional administrative costs to implement this rule.

Local Government Baseline - Counties: Water supply watersheds cover fifty-one percent of the Jordan watershed. All counties in the watershed contain significant water supply watershed area and thus administer WSW stormwater programs (also, all counties in the watershed except Rockingham and Caswell are considered "tipped in" under Phase II, which will subject new development throughout the unincorporated portions of those counties to Phase II permitting by the Division, however this will not require county resources). The weight of new development activity in unincorporated areas is likely to fall within municipalities' planning jurisdictions, where permitting would fall to the municipalities. Considering these factors, overall we do not believe that counties would incur significant additional administrative costs to implement this rule either.

Developers: Developers would estimate nutrient export and stormwater flow rate from proposed projects. They would evaluate whether compliance with other applicable stormwater requirements – Water Supply or Phase II – would also satisfy the nutrient and flow criteria of this rule. If not, they would design structural BMPs to meet these requirements or pay offset fees to the extent that they qualify for this option. They would be responsible for making arrangements for long-term operation and maintenance of constructed stormwater conveyance systems and BMPs.

Developers Baseline: Some developers would incur additional costs from two aspects of this rule. The Phase II rules and WS III and WS IV ordinances require stormwater controls where project density exceeds a threshold of 24% imperviousness. The nutrient loading rate targets of this rule result in similar thresholds in Haw and Lower New Hope subwatersheds, but approximately a 12% impervious threshold in the Upper New Hope subwatershed, necessitating BMPs (or offsets) and flow control at a lower threshold in that small portion of the watershed under this rule.

Phase II and WSW use a treatment design criterion of 85% TSS removal, which can be met with a single BMP per drainage area. This rule, in using nutrient export rate targets, results in either an additional BMP or payment of offset fees, or both, as site impervious cover increases above certain thresholds. This additional treatment need would affect more intensive commercial, industrial and multi-family residential development.

Property Owners: In most cases, property owners would inherit long-term operation and maintenance responsibilities for stormwater BMPs from developers. To the extent that this rule

results in additional BMPs beyond those imposed by Phase II and WSW regulations as described above, property owners would inherit those additional maintenance costs.

Table 4.1 Stormwater Regulations & Local Governments Affected

			WSW II	WSW III	WSW IV	Phase II	Proposed Jordan
Permitting Threshold			1 acre				1 ac disturb - residential 1/2 ac. Disturb - commercial/industry
Treatment Threshold	**Non-Critical Area**	Low Density	1 du/ac[1] of single family detached res. dvlp. 12% bua[2] all other dvlp.	2 du/ac[1] of single family detached res. dvlp. 24% bua[2] all other dvlp.	2 du/ac[1] of single family detached res. dvlp. 24% bua[2] all other dvlp.	24% bua[2]	2.2 lb N/ac/yr & 0.82 lb P/ac/yr - UNH 4.4 lb N/ac/yr & 0.78 lb P/ac/yr - LNH 3.8 lb N/ac/yr & 1.43 lb P/ac/yr - HAW
		High Density	up to 30% bua[2] max. - Control first 1" pptn. 10/70 rule[3]	up to 50% bua[2] max. - Control first 1" pptn. 10/70 rule[3]	70% bua[2] max. - Control first 1" pptn.	24%+ bua[2] - Control first 1" of pptn.	
	Critical Area	Low Density	1 du/ac[1] of single family detached res. dvlp.	1 du/ac[1] of single family detached res. dvlp.	2 du/ac[1] of single family detached res. dvlp.		
			6% bua[2] max. - Control first 1" pptn.	12% bua[2] max. - Control first 1" pptn.	24% bua[2] max. - Control first 1" pptn.		
		High Density	24% bua[2] max. - Control first 1" pptn.	30% bua[2] max. - Control first 1" pptn.	50% bua[2] max. - Control first 1" pptn.		
Treatment Performance Standard			85% TSS			85% TSS (high density)	
Offsite Threshold			None				-4 lbs N/ac/yr for single-family, detached and duplex residential dvlp. -8 lb N/ac/yr for other dvlp., including multi-family residential, commercial and industrial.
BMP Water Quality			Runoff for 1″ pptn.				
Peak Rate Requirement			None			1 yr. 24 hr. peak rate match	1 yr. 24 hr. peak rate match
Buffer / Setback			30' (low density); 100' (high (density)			30'	50' Buffer 2 zones Table of Uses Mitigation Requirements

[1]du/ac=dwelling unit per acre
[2]bua=built upon area
[3]A maximum of 10 percent of each jurisdiction's portion of the watershed outside of the critical area may be developed with up to 70% built-upon surface area.

Municipalities	WSW II	WSW II	WSW IV	Phase II
Alamance			X	X
Apex			X	X
Burlington			X	X
Carrboro	X	X	X	X
Cary			X	X
Chapel Hill			X	X
Durham			X	X
Elon				X
Gibsonville				X
Graham				X
Green Level	X			X
Greensboro		X	X	X
Haw River				X
Kernersville		X		X
Mebane	X			X
Morrisville			X	X
Oak Ridge		X		
Ossipee				
Pittsboro			X	
Pleasant Garden			X	
Reidsville		X		
Sedalia			X	
Stokesdale		X		
Summerfield		X		
Swepsonville				X
Whitsett			X	

Counties	WSW II	WSW III	WSW IV	Phase II
Alamance	X		X	DWQ
Caswell	X			DWQ
Chatham	X		X	DWQ
Durham			X	DWQ
Guilford		X	X	x
Orange	X		X	DWQ
Rockingham		X		DWQ
Wake			X	x

Table 4.2: New Development Rule Timeline

Activity	Assumed Date*	Elapsed Time After Effective Date
Effective Date	9/1/2008	0 months
DWQ develops a model plan for EMC approval	9/1/2009	12 months
LGs submit stormwater management programs.	3/1/2010	18 months (6 months after EMC approval)
DWQ requests EMC approval of stormwater management programs.	12/1/2010	27 months (15 months after EMC approval)
EMC Approval		
LGs adopt and implement stormwater management programs.	3/1/2011	30 months (18 months after EMC approval or upon DWQ's first renewal of LG's NPDES permit, whichever is later)
LGs provide annual reports to DWQ documenting program's progress.		

*Based on effective date of September 1, 2008.

Table 4.3: New Development: Summary of Costs by Type of Cost

Year	Annual Total	Capital ($/Yr Developers)	Maintenance ($/Yr Property Owners)		Planning ($/Yr Developers)	Regul'y ($/Yr Loc Gov'ts)	Regul'y ($/Yr Developers)	Trading Credit Note 43 ($/Yr Developers)
			Cum. # BMPs Needed	Cost To Maint. Cum. BMPs				
2009	$0	$0	0	$0	$0	$0	$0	$0
2010	$0	$0	0	$0	$0	$48,000	$0	$0
2011	$202,698	$166,512	71	$19,772	$16,321	$0	$93	$0
2012	$431,682	$338,375	214	$59,951	$33,167	$0	$188	$0
2013	$478,480	$343,812	361	$100,776	$33,700	$0	$191	$0
5-Yr Total	$1,112,859	$848,700	646	$180,500	$83,188	$48,000	$473	$0

Table 4.4: New Development: Summary of Costs by Affected Party

Year	Developers ($Total)			Property Owners ($Total)	Local Gov'ts ($Total)	DWQ Oversight ($Total)
	Capital	Regulatory	Planning			
2009	$0	$0	$0	$0	$0	$0
2010	$0	$0	$0	$0	$48,000	$0
2011	$166,512	$93	$16,321	$19,772	$0	$0
2012	$338,375	$188	$33,167	$59,951	$0	$0
2013	$343,812	$191	$33,700	$100,776	$0	$0
Totals	$848,700	$473	$83,188	$180,500	$48,000	$0
	$932,360					
	$1,160,859					

Step 4: Identify Impacts

4-A. Regulated Parties: Developers

RP.0 Party Description (Developers)

Name of Party	Developers in the Jordan Lake Watershed
Description	Local governments would implement programs 2 ½ years after rule effective date. With an effective date of mid-2008, local governments would implement new development permitting programs by early 2011. Thus, in the first five years, developers would incur costs in 2011, 2012, and 2013. Developers would incur capital, planning, and regulatory costs. Section 3.2 above describes the nature of net additional requirements and associated costs facing developers. They would be required to meet nutrient export rate targets, which vary by subwatershed, using onsite structural BMPs or a combination of BMPs and in-lieu fee payments for off-site measures using either the North Carolina Ecosystem Enhancement Program (NC EEP) or local governments' Division-approved offset plans.
General Baseline	See Section 3.2 above.

Assumptions	At points in the text, we identify supporting information beyond what we provide in the associated assumptions sections. Those references, stated as either "Note *x*" or "Reference *y*", can be found in Appendix B. That appendix provides information common to all three development rules – this rule, Stormwater for Existing Development and Stormwater for State and Federal Entities. We state certain major assumptions here: 1. Instead of separate calculations for each subwatershed, we carry out all calculations using weighted average values for the entire watershed. 2. We project annual acres of new development based on county population growth projections from the NC Census. This assumes that population growth is uniform throughout a county, allowing us to infer growth in the portions that fall within Jordan watershed. We estimate average annual growth rate for the watershed as 1.6 % per year. We make further assumptions, detailed below, that equate this growth rate to acres of residential and non-residential development. Overall, we estimate one-quarter acre of land is developed for every person added to the population. 3. For export rates from different land uses, we use established literature values for the Albemarle-Pamlico region and an export method developed by NCSU for Tar-Pamlico stormwater rule implementation and applicable to this area, the Tar-Pamlico export method, Piedmont Version. 4. To avoid undue calculation complexity, we calculate costs assuming the use of onsite BMPs only. This may provide ***higher*** cost estimates compared to assuming partial compliance through payment of offset fees to NC EEP as allowed under the rule. Because these offset rates are currently under reevaluation by the General Assembly, we use a conservative assumption. 5. We set proportions of BMPs based largely on cost-effectiveness, with minor adjustments based on local governments' input. 6. We assume a BMP lifespan of 30 years. We believe there is relatively little real-world data on BMP longevity with which to guide this assumption.
Data Sources	We reference information sources at points throughout this text and provide citations in Appendix B. Our primary data sources are: o Jordan Reservoir Watershed Model, 2003, developed for the Division by Tetratech, Inc. o NC Census[8] o Hunt, WF and A. Wossink, 2003. An Evaluation of Cost and Benefits of Structural Best Management Practices in North Carolina. o Moran, A. and W.F. Hunt, 2004. BMP Cost Estimate Study. Cooperative Extension Service, North Carolina State University, Raleigh, NC. o Replies to information requests from the following local governments: Cary, Chapel Hill, Durham, Durham County, Greensboro, Guilford County. o Tar-Pamlico Nutrient Export Method, Piedmont Version, http://h2o.enr.state.nc.us/nps/tarpam.htm. o NC BMP Manual, July 2006 draft, NC DWQ.

RP.1 Annual Capital Costs/Savings (Developers):

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	The Jordan rules would require nutrient reduction and flow control for stormwater runoff beyond Phase II and Water Supply requirements in some cases, as described in Section 3.2 above. To meet these additional reduction needs, capital costs would involve land purchase and construction costs of engineered stormwater BMPs.
(c) Quantify ($)	The following table extracts costs to developers from summary Tables 4.3 and 4.4 above. **Table 4.5: Capital Costs to Developers**

Year	Total	**Capital**	Regulatory	Planning
2009	$0	**$0**	$0	$0
2010	$0	**$0**	$0	$0
2011	$182,926	**$166,512**	$93	$16,321
2012	$371,730	**$338,375**	$188	$33,167
2013	$377,703	**$343,812**	$191	$33,700
Total	$932,360	**$848,700**	$473	$83,188

(d) Quantification Method

We use the following steps (note that we use the same process in the state and federal entities stormwater calculations and to address the post-baseline/transition period in the Existing Development Rule calculations) :

1. We estimate acres of residential and non-residential development for each of the first five years.
2. For both N and P, we estimate a weighted average untreated loading rate for new development, quantify rate reductions achieved by compliance with Phase II and Water Supply ordinances, and compare the result to the rule's loading rate target to calculate net additional lb/ac-yr reduction need, which we apply to acres of development to estimate reduction need as annual mass load, lb/yr.
3. We equate load reduction need to cost by calculating weighted average per-BMP cost and annual load reduction values, and applying the resulting single cost-effectiveness value to lb/yr reductions needs.

Our calculations are presented in Tables 4.8 and 4.9 below, with values for supporting variables in Table 4.7.

Step 1 of 3: Acres per Year of New Development

- We used population growth data 2001-2005 and projections 2001-2020 for Jordan counties from the State Demographer to estimate a population-weighted annual watershed population growth rate and resulting annual population growth through the first five years of implementation.

- We equated number of people to number of residences using a reliable Census value of 2.49 people per residence. We converted number of residences to residential acres with an averaged ratio from Durham City and County and Guilford County, assuming that they reflect central tendencies for urban and

rural cases (Note 29).

- To establish an average ratio of residential to non-residential development acres, we averaged existing land use composition data from Durham City and County and nine local governments previously surveyed in the Neuse and Tar-Pamlico River Basins (Note 38 and Table B-2).

Step 2 of 3: Pounds per Year Reduction Needed Beyond Phase II, WSW
Our estimates of reduction needs are shown in Table 4.6 below, labeled as "excess" loading, and explained as follows. Since local governments would implement new development programs beginning 2 ½ years after rule effective date, years one and two involve no costs and year 3 costs are half of a full year's cost. Year 4 and 5 costs are full-year. Phosphorus reduction needs appear as negatives because P loading rate targets for new development are sufficiently high (lenient) that BMPs implemented under Phase II provide greater P load reductions than those needed under this rule.

Table 4.6: New Development: Net Load Reduction Needs

	TN_{Excess} (lb/year)	TP_{Excess} (lb/year)
2009	0	0
2010	0	0
2011	3,236	-816
2012	6,575	-1,657
2013	6,681	-1,684
Total	16,492	-4,157

We used the following approach to develop these estimates. Calculations are shown in Table 4.8 below:

- For the two development types – residential and nonresidential – we established aggregate untreated runoff N and P loading rates, load reductions expected from Phase II/WSW, and finally allowable loading rates as set by this rule. To set these values, we relied on established, published values developed for the Albemarle-Pamlico region (References 14 and 15), supplemented by values estimated by the Tar-Pamlico export method, Piedmont Version (Reference 16). The latter is a tool developed to implement the same type of stormwater rule in the Tar-Pamlico River Basin. The Piedmont Version is appropriate for Jordan Lake watershed. Where these sources overlapped, they were very consistent. For phosphorus, we used the Tar-Pamlico export method, which was very consistent with References 14 and 15 and a study done in the Randleman Lake watershed (Reference 19). We could not use field-scale loading rates produced by the Jordan watershed model for these calculations, as they reflect generated loads as opposed to loads delivered to surface waters. Table 4.8 lists the various loading rates.

- Using the above sources, we established untreated loading rate values for several intensities of residential development, and for characteristic commercial and industrial cases. We then weighted our results for the different residential types into a single residential loading rate value using the acres of these types estimated by the watershed model, and did the same to arrive at a single commercial/industrial loading rate value.

- We applied these untreated loading rates for both residential and non-residential to our estimated annual development acres to yield lb/yr untreated load. We then estimated and subtracted load reductions due to Phase II/WSW rules, and compared the result to allowable loads under this rule using the rule's loading rate targets. This yielded the 'excess' N requiring treatment for each year and the surplus P both shown in Table 4.6 above.

- Loads after Phase II/WSW treatment we established by applying an averaged BMP N or P efficiency, based on meeting those rules' 85% TSS standard, to the untreated load for the fraction of new development estimated to exceed those rules' built-upon area thresholds and thus require treatment. For residential we estimate this treated fraction as 23%, for commercial/industrial 100% (Note 36).

- Remaining load needing treatment was the difference between the post-Phase II load and the rule-"allowed" load, which is the weighted average rule loading rate target applied to annual development acres.

Table 4.7: New Development: Variables Used to Estimate Loads and Costs

People Per House[8]:	2.49
Houses Per Residential Acre[Note 29]	3.15
$TN_{Residential}$(lb/acre-year)[Note 20]	4.04
$TP_{Residential}$(lb/acre-year) [Note 20]	0.58
$TN_{Non\text{-}Residential}$(lb/acre-year)[Note 20]	15.0
$TP_{Non\text{-}Residential}$(lb/acre-year) [Note 20]	1.40
$TN_{Allowed}$(lb/acre-year)[11]	3.66
$TP_{Allowed}$(lb/acre-year)[11]	1.35
Number of Acres of non-res developed per acre res[10, Note 38]:	0.72
Percent new residential dev over 24% impervious[Note 36]	23%
TN Weighted Average Cost-Effectiveness ($/lb):[Note 50]	$43
TP Weighted Average Cost-Effectiveness ($/lb):[Note 50]	$556
Avg PhII-WSW BMP TN Removal Efficiency	36%
Avg PhII-WSW BMP TP Removal Efficiency	32%

Table 4.8 New Development: Calculation of Load Reduction Needs

Year	Estimated W'shed Pop @ 1.6% Annual Growth Rate	Annual Pop Growth (People /Yr)	New Development Rule *Residential* Nutrient Loading								
			Resi-dential Acres Added/Yr Notes29 (Ac/yr)	TN_{New} Untreated Load (lb/yr)	$TN_{PhaseII}$ Treated Load (lb/yr) Note 59	$TN_{Allowed}$ (lb/year)	TN_{Excess} (lb/year)	TP_{New} Untreated Load (lb/yr)	$TP_{PhaseII}$ Treated Load (lb/yr) Note 59	$TP_{Allowed}$ (lb/year)	TP_{Excess} (lb/year)
2000	620,063	-	-	-		-		-		-	-
2001	630,026	9,963	1,270	5,135	4,715	4,645	70	734	680	1,710	-1,030
2002	640,150	10,123	1,291	5,217	4,790	4,719	71	746	691	1,738	-1,047
2003	650,436	10,286	1,311	5,301	4,867	4,795	72	758	702	1,765	-1,064
2004	660,887	10,451	1,332	5,386	4,945	4,872	73	770	713	1,794	-1,081
2005	671,506	10,619	1,354	5,473	5,025	4,950	74	782	725	1,823	-1,098
2006	682,296	10,790	1,376	5,561	5,106	5,030	76	795	736	1,852	-1,116
2007	693,260	10,963	1,398	5,650	5,188	5,111	77	808	748	1,882	-1,134
2008	704,399	11,139	1,420	5,741	5,271	5,193	78	821	760	1,912	-1,152
2009	715,718	11,318	1,443	5,833	5,356	5,276	79	834	772	1,943	-1,170
2010	727,218	11,500	1,466	5,927	5,442	5,361	81	847	785	1,974	-1,189
2011	738,903	11,685	1,490	6,022	5,529	5,447	82	861	797	2,006	-1,208
2012	750,776	11,873	1,514	6,119	5,618	5,535	83	875	810	2,038	-1,228
2013	762,840	12,064	1,538	6,217	5,708	5,624	85	889	823	2,071	-1,247

Year	New Development Rule *Non-Residential* Nutrient Loading										New Development Total (Residential + Non-Residential) Load Reduction Needs and Total Costs Notes 31&28			
	Ratio: Ac Comm/ Ind per Ac Resid'l Note 38	Acres Comm/ Ind Added/ Yr (Ac/Yr)	TN Untreated Load (lb/yr)	TN Ph II-Treated Load (lb/yr) Note 59	TN Allowed Load (lb/year)	TN Excess Load (lb/year)	TP Untreated Load (lb/yr)	TP Ph II-Treated Load (lb/yr) Note 59	TP Allowed (lb/year)	TP Excess (lb/year)	TN Excess (lb/year)	TP Excess (lb/year)	Annual Cost to Remove Excess TN Not Incl'g Maint. ($/yr)	Annual Cost to Remove Excess TP Not Incl'g Maint. ($/yr)
2009	0.72	1,034	15,507	9,969	3,780	6,189	1,447		1,392	-1,392	0	0	$0	$0
2010	0.72	1,050	15,757	10,129	3,841	6,288	1,471	998	1,414	-416	0	0	$0	$0
2011	0.72	1,067	16,010	10,292	3,903	6,389	1,494	1,014	1,437	-423	3,236	-816	$182,926	-$348,906
2012	0.72	1,084	16,267	10,457	3,965	6,492	1,518	1,030	1,460	-430	6,575	-1,657	$371,730	-$709,025
2013	0.72	1,102	16,528	10,625	4,029	6,596	1,543	1,047	1,483	-437	6,681	-1,684	$377,703	-$720,418
										Total 2009-2013:	16,492	-4,157	$932,360	-$1,778,349

Quantification Method (cont'd)	**Step 3 of 3: Equating Pounds per Year Reduction to Cost** We used the following steps. Calculations are shown in Table 4.9 below. ▪ For each BMP in the suite of nutrient-reducing BMPs we calculated annual load reduction. We applied N and P percent treatment efficiencies to the averaged input loading rate, and multiplied the result by the acres of drainage area being treated by that BMP type. Percent efficiencies were established under the Neuse and Tar-Pamlico stormwater rules and are included in the NC Stormwater BMP Manual. Drainage areas are available either in the BMP Manual or in publications from NCSU Dept of Biological and Agricultural Engineering (see the Notes listed for each BMP in Table 4.9 below). ▪ For each BMP, we estimated and summed lifetime capital, planning, and

	regulatory transaction costs and divided by lifespan to obtain annual cost. Capital cost includes installation and land purchase cost for the BMP acreage. We obtained cost values from recent, published work specific to Piedmont North Carolina. Our primary references are listed References 1 and 3, but we made efforts to determine average costs for BMPs, and we used cost information from References 1-6. Calculations and assumptions specific to BMPs are provided as noted in Table 4.9 below, in Notes 1, 3, 6, 22, 23, 24, 25, 30, 32, and 46. ▪ We combined annual cost and reduction rate for individual cost-effectiveness values. We then determined a weighted average cost-effectiveness ($/lb reduced) by applying likely proportions of BMP usage to these individual values. We based the proportions primarily on relative cost-effectiveness values of the individual BMPs, but also adjusted somewhat based on input from local governments on anticipated usage. ▪ We applied this single weighted average cost-effectiveness value to annual load reduction needs determined in Step 1 to derive annual costs. We distributed total cost back out among its components based on their fractional contributions. ▪ Note that while maintenance costs appear in Table 4.9 below, we do not include them in our summary of capital costs. We report them in the operation and maintenance section, where we identify the affected party as property owners and not developers.

Table 4.9: New Development: BMP Cost-Effectiveness Calculations

	Total Cost per BMP ($/BMP)								
	Capital Cost					Annual O&M Cost Note 34 ($/BMP-Yr)	Planning Cost Note 10 ($/BMP)	Reg. Trans'n Cost Note 11 ($/BMP)	Per-BMP Total Cost Not Incl'g Maint ($/BMP)
	Install Cost ($/BMP)	BMP Foot-print (Ac)	Avg Per-Acre Land Cost Note 2 ($/ac)	BMP Land Cost ($/BMP)	Total Capital Cost (Land + Install) ($/BMP)				
Stormwater Wetland Notes 1 & 22	$21,846	0.92	$77,912	$71,824	$93,670	$396	$5,461	$25	$99,156
Bioretention Notes 1 & 22	$7,682	0.04	$77,912	$2,961	$10,643	$179	$1,920	$25	$12,589
Wet Detention Notes 1, 22	$108,002	0.40	$77,912	$31,532	$139,534	$1,075	$27,001	$25	$166,560
Extended Dry Det. Notes 23, 24	$23,500	0.14	$77,912	$10,910	$34,410	$940	$5,875	$25	$40,310
Grassed Swale Notes 6 & 30	$650	0.023	$77,912	$1,789	$2,439	$2	$163	$25	$2,626
Filter Strip/Level Spreader Note 9	$7,575	0.36	$77,912	$27,723	$35,298	$137	$1,894	$25	$37,217
Infiltration Devices Notes 6 & 8	$8,800	0.05	$77,912	$4,058	$12,858	$0	$2,200	$25	$15,083
Buffer w/Level Spreader Notes 32&52	$178	0.23	$77,912	$17,920	$18,098	$2	$45	$25	$18,167
Sand Filter Notes 1 & 22	$55,208	0.03	$77,912	$1,989	$57,196	$609	$13,802	$25	$71,023
				Averages:	$44,953	$279	$4,406	$25	$49,384
				Fraction of Total Cost:	91.03%		8.92%	0.05%	100.00%

Table 4.9: New Development: BMP Cost-Effectiveness Calculations

	BMP TN Treatment Effectiveness and Cost-Effectiveness						
	Input Loading Rate (lb/ac-yr) Note 57	%TN Effic[2]	Drain-age Area[Note 47] (Ac)	Annual Load Reduc (lb/BMP-yr)	Lifetime Load Reduc (lb/BMP-30 yr)	BMP Cost-Eff [Note 25] Not Incl'g Maint ($/lb)	Likely Propor-tions Local Gov'ts Will Use [Note 15]
Stormwater Wetland[Notes 1 & 22]	7.9	40%	40.1	127.1	3,812.2	$26	30%
Bioretention[Notes 1 & 22]	7.9	35%	1.3	3.7	110.0	$114	10%
Wet Detention [Notes 1, 22]	7.9	25%	23.5	46.5	1,394.7	$119	7%
Extended Dry Det. [Notes 23, 24]	7.9	10%	25.0	19.8	594.4	$68	7%
Grassed Swale[Notes 6 & 30]	7.9	20%	1.0	1.6	47.6	$55	27%
Filter Strip/Level Spreader [Note 9]	7.9	20%	2.5	4.0	118.9	$313	0%
Infiltration Devices [Notes 6 & 8]	7.9	55%	2.5	10.9	326.9	$46	10%
Mfg'd BMP Systems[Note 4]		0%	-	-	-	-	-
Buffer w/Level Spreader [Notes 32&52]	7.9	30%	5.0	11.9	356.7	$51	9%
Permeable Pavement[Note 3]		0%	-	-	-	-	-
Rooftop Runoff Mgmt [Note 3]		0%	-	-	-	-	-
Sand Filter[Notes 1 & 22]	7.9	35%	1.3	3.6	108.7	$654	0%
		Averages:	16.5	45.7	1,372.2	$57	100%

	BMP TP Treatment Effectiveness and Cost-Effectiveness						
Stormwater Wetland[Notes 1, 22]	0.88	35%	40.1	12.31	369.26	$269	30%
Bioretention[Notes 1, 22]	0.88	45%	1.3	0.52	15.66	$804	10%
Wet Detention [Notes 1, 22]	0.88	40%	23.5	8.23	247.03	$674	7%
Extended Dry Detention[Notes 23, 24]	0.88	10%	25.0	2.19	65.81	$613	7%
Grassed Swale[Notes 6, 30]	0.88	20%	1.0	0.18	5.26	$499	27%
Filter Strip/Level Spreader [Note 9]	0.88	35%	2.5	0.77	23.03	$1,616	0%
Infiltration Devices [Notes 6 & 8]		-	-	-	-		10%
Mfg'd BMP Systems[Note 4]		-	-	-	-		-
Buffer w/Level Spreader [Notes 32, 52]	0.88	30%	5.0	1.32	39.48	$460	9%
Permeable Pavement[Note 3]		-	-	-	-		-
Rooftop Runoff Mgmt [Note 3]		-	-	-	-		-
Sand Filter[Notes 1 & 22]	0.88	45%	1.3	0.52	15.46	$4,593	0%
		Averages:	16.3	4.64	139.29	$428	100%

(e) Assumptions	We assumed a BMP lifespan of 30 years. This is somewhat speculative; according to experts, lifespans have not yet been very well-established for water quality BMPs, they vary with BMP type and as a function of maintenance performed. We found two sources with the following lifespan estimates - pond materials last 100 years[21], biofilters last 25 years[22], water control structures last 10 years[22], and underground detention lasts 100 years[21].
(f) Data Sources	See Appendix B for references cited above.

RP.2 Annual Operating Costs/Savings (AOC/S) (Developers):

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.

(b) Description	BMPs require maintenance in order to continue to work effectively. Examples of maintenance include establishing desirable vegetation, removing undesirable species, removing accumulated sediment, clearing and repairing control structures, repairing erosion, and other activities. However, developers would not be responsible for maintenance. It would become the responsibility of property owners.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A.
(f) Data Sources	N/A

RP.3 Annual Planning Costs/Savings (APC/S) (Developers):

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	Planning costs to developers would include activities such as stormwater routing design and runoff calculations, BMP selection, placement, sizing calculations, water quality and quantity drawdown design. While much of this is required for Phase II and WSW regulations, this rule would impose additional complexity in some cases. We note that we did not attempt to estimate the incremental planning cost beyond Phase II and WSW requirements, thus our estimate should represent a conservative ***overestimate*** of costs.
(c) Quantify $	**Table 4.10: Planning Costs to Developers**

Year	Total	Capital	Regulatory	**Planning**
2009	$0	$0	$0	**$0**
2010	$0	$0	$0	**$0**
2011	$171,014	$155,658	$81	**$15,275**
2012	$347,524	$316,318	$165	**$31,041**
2013	$353,108	$321,400	$168	**$31,540**
Total	$871,645	$793,376	$414	**$77,855**

(d) Quantification Method	We assumed planning costs at 25% of installation costs, as shown in Table 4.10 above, varying for each BMP.
(e) Assumptions	We assumed planning costs at 25% of construction costs. We found two sources. Planning costs estimated by NC EEP for revisions to the Division's Offset Payments Rule (Reference 6) were 18-47% of construction cost, with 24% as median value. Support calculations for the Cary Stormwater Management Plan (Reference 5) estimate design costs as 25% of construction costs. Based on these two sources, we assumed planning costs at 25% of construction costs. This incorporates staffing needed to implement the rule.
(f) Data Sources	See Appendix B for references cited above.

RP.4 Regulatory Transaction Costs/Savings (RTC/S) (Developers):

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	Developers would incur regulatory transaction costs associated with obtaining stormwater permits from local governments. It is plausible that they could incur *no* significant additional regulatory costs beyond those they face under Phase II and WSW regulations. Thus we felt that the very minor additional cost we attribute here is not unreasonable.
(c) Quantify $	**Table 4.11: Regulatory Costs to Developers**

Year	Total	Capital	**Regulatory**	Planning
2009	$0	$0	**$0**	$0
2010	$0	$0	**$0**	$0
2011	$171,014	$155,658	**$81**	$15,275
2012	$347,524	$316,318	**$165**	$31,041
2013	$353,108	$321,400	**$168**	$31,540
Total	$871,645	$793,376	**$414**	$77,855

(d) Quantification Method	We estimated these costs at $25/BMP. We based this on costs that would be incurred in an upcoming development at Alamance Community College. See Note 11 and Table B-3, both in Appendix B.
(e) Assumptions	We assumed little to no incremental cost beyond that incurred under Phase II and WSW regulations.
(f) Data Sources	See Appendix B as noted above.

RP.5 Other Costs/Savings (OtC/S) (Developers)

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	Developers may have the opportunity to generate trading revenue in this watershed. BMPs treat for both nutrients but at different efficiencies. Our calculations in Table 4.8 above show that overall they would be likely to generate an excess of phosphorus reduction relative to target rates. Through the trading rule, Rule .0269, they could potentially sell such reduction 'credits' to others in need. However, if nitrogen is the nutrient in short supply for all sources, then phosphorus credit would not be of value. Given this and other uncertainties associated with developing a trading program, we did not report the potential benefit to developers from overtreating phosphorus. This is a conservative approach that may over ***estimate*** the cost of complying with the rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

Property Owners

RP.1 Capital Costs/Savings (AOC/S) (Property Owners):

(a) Cost Baseline	In most cases, property owners would inherit long-term operation and maintenance responsibilities for stormwater BMPs from developers. To the extent that this rule results in additional BMPs beyond those imposed by Phase II and WSW regulations as described above, property owners would face additional maintenance costs.
(b) Description	We would not expect property owners to incur capital costs.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A.
(f) Data Sources	N/A

RP.2 Annual Operating Costs/Savings (AOC/S) (Property Owners):

(a) Cost Baseline	In most cases, property owners would inherit long-term operation and maintenance responsibilities for stormwater BMPs from developers. To the extent that this rule results in additional BMPs beyond those imposed by Phase II and WSW regulations as described above, property owners would face additional maintenance costs.
(b) Description	We quantify O&M costs for the BMPs beyond those required under Phase II and WSW regulations.
(c) Quantify $	**Table 4.12: Maintenance Cost to Property Owners**

Year	Maintenance ($/Yr Property Owners)	
	Cum. # BMPs Needed	Cost To Maint. Cum. BMPs
2009	0	$0
2010	0	$0
2011	71	$19,772
2012	214	$59,951
2013	361	$100,776
5-Yr Total	646	$180,500

(d) Quantification Method	Maintenance costs accrue to property owners for the lifetime of the development. These costs are cumulative annually for the entire watershed, increasing proportional to the increment of BMPs added each year. The full increment of BMPs during the first five years is about 145 BMPs per year, equating to a cost increment of approximately $40,000 per year. This is apparent from subtracting the preceding year's values from year 4 and 5 values. O&M costs for each BMP are shown in Table 4.12 above. These costs are based on formulas provided in the publications referenced in the Notes for each BMP.
(e) Assumptions	See Appendix B.
(f) Data Sources	See Appendix B.

RP.3 Annual Planning Costs/Savings (APC/S) (Property Owners):

(a) Cost Baseline	Property owners face Phase II and WSW regulations.
(b) Description	We do not anticipate planning costs to property owners.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.4 Regulatory Transaction Costs/Savings (RTC/S) (Property Owners):

(a) Cost Baseline	Property owners face Phase II and WSW regulations.
(b) Description	We do not anticipate planning costs to property owners.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A

Local Governments

While technically local governments are regulated parties under this rule, the nature of their compliance is to administer programs that impose the substantive requirements of the rule on others. Thus they do not incur costs as regulated parties but rather as implementing agencies. For that reason we address their costs as implementing agencies.

4-B. Implementing Agencies:

IA.0 Party Description (Local governments)

Name of Party	**Local governments**

Description	All counties and incorporated municipalities in the watershed would be required to implement the provisions of this rule, which would involve enacting and implementing stormwater ordinances to control nutrient loading. The local governments are the counties of Alamance, Caswell, Chatham, Durham, Guilford, Orange, Rockingham, and Wake, and the following municipalities: Alamance, Apex, Burlington, Carrboro, Cary, Chapel Hill, Durham, Elon, Gibsonville, Graham, Green Level, Greensboro, Haw River, Kernersville, Mebane, Morrisville, Oak, Ridge, Pittsboro, Pleasant Garden, Reidsville, Sedalia, Stokesdale, Summerfield, and Whitsett.
General Baseline	Almost all municipalities in the watershed are subject to Phase II requirements and are to implement new development programs beginning mid- to late 2007. The Division expects to designate the two largest municipalities not currently designated under Phase II, Reidsville and Pittsboro, based on their contributions under the Jordan Lake TMDL. Virtually all remaining municipalities fall within water supply watersheds and implement WSW stormwater programs. Thus, we do not expect that Jordan municipalities will incur significant, quantifiable additional costs to implement this rule. All counties in the watershed contain water supply watershed areas and administer WSW stormwater programs (while all counties in the watershed except Rockingham and Caswell are considered "tipped in" under Phase II, this will subject new development outside of water supply watersheds to Phase II permitting by the Division and will not require county resources). Much new development activity is likely to fall within municipalities' planning jurisdictions. Thus, counties should not incur significant additional costs to implement this rule either.
Assumptions	
Data Sources	

IA.1 Regulatory Development Costs/Savings (RDC/S) (Local governments)

(a) Cost Baseline	Virtually all local governments have or will have stormwater ordinances to implement Water Supply or Phase II regulations. Those implementing local Phase II programs, 18 of the 26 municipalities, will have both quality and peak flow rate requirements in place.
(b) Description	Local governments would draft and adopt ordinances to implement the nutrient loading and flow rate requirements of this rule. The rule includes a one-year process after effective date wherein the Division works with local governments to develop model programs. We anticipate that the Division will provide them with model ordinances. One such ordinance has been developed for Tar-Pamlico stormwater implementation, and could be readily adapted for this rule.
(c) Quantify $	$48,000 in Year 2

(d) Quantification Method	We assumed the 16 smallest municipalities (under 10,000 population) may need to contract assistance in preparing ordinances. We assumed 80 hours of contract time per local government given the potential for providing model ordinance language and resulting minimal text modification needs, and a pay rate of $36/hr. We did not obtain input from local governments on this cost. Other factors could influence this cost. One scenario could involve sharing of ordinance text among local governments with similar ordinance frameworks. Another is the potential for the Division to utilize grant funds to contract development of model ordinances. Either of these could greatly reduce or eliminate this cost.
(e) Assumptions	▪ In larger jurisdictions we assume that existing staff would absorb this cost. ▪ As noted in the description above, we assume that Division staff will contribute to the rule development process, reducing local time demands.
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S) (Local governments)

(a) Cost Baseline	Virtually all local governments have or will have stormwater ordinances to implement Water Supply or Phase II regulations.
(b) Description	This rule would not impose specific monitoring requirements outside of inspections, which are covered below. Recordkeeping would be needed to track development projects and enforcement cases. We incorporate those costs into one set of estimates for permitting, inspections and enforcement below.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings (PC/S) (Local governments)

(a) Cost Baseline	All eight counties contain significant area in water supply watersheds. Sixteen of the twenty-six municipalities have significant area within Water Supply watersheds. Before this rule would become effective, eighteen of the twenty-six municipalities will have implemented Phase II stormwater programs involving permitting of new development post-construction treatment. In addition, several major municipalities currently implement more involved stormwater rules than required by Phase II or Water Supply.
(b) Description	Local governments would implement permitting programs under this rule that would review for buffer requirements at the same time. Because the two activities are integrated, we address both in the buffer protection chapter. The cost estimate in that chapter would cover costs of permitting, inspections, and enforcement for both stormwater and buffers. Thus, costs reported here are zero.
(c) Quantify $	$0
(d) Quantification Method	See the buffer protection chapter.
(e) Assumptions	See the buffer protection chapter.

(f) Data Sources	See the buffer protection chapter.

IA.4 Inspection and, Enforcement Costs/Savings (IEC/S) (Local governments)

(a) Cost Baseline	See the permitting discussion immediately above.
(b) Description	See the permitting discussion immediately above.
(c) Quantify $	$0
(d) Quantification Method	See the permitting discussion immediately above.
(e) Assumptions	See the permitting discussion immediately above.
(f) Data Sources	See the permitting discussion immediately above.

IA.0 Party Description (Division of Water Quality)

Name of Party	Division of Water Quality
Description	The Division would review and approve local program proposals, including ordinances, review annual implementation reports submitted by local governments, and perform any compliance oversight on local programs.
General Baseline	The Division oversees local water supply watershed programs in the watershed, which include both stormwater permitting and riparian setbacks for new development. The Division will soon implement Phase II permitting for post-construction stormwater in most jurisdictions that are not required to do so themselves. The Division issues, renews, and monitors compliance with NPDES discharge permits and state and federal non-discharge permits.
Assumptions	N/A
Data Sources	N/A

IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff develop and coordinate watershed restoration initiatives and conduct point source and nonpoint source permitting, compliance and enforcement activities.
(b) Description	Rule development involves staff time to: research rule components; plan and coordinate the rulemaking process; develop and revise rule language; research and document fiscal impacts; conduct/participate in stakeholder meetings; plan and conduct public workshops/meetings/hearings; present information to the Commission and agencies; and file and process rules, forms, etc.
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost to the Division. No new funds are requested. Tasks would be integrated into existing workloads.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff develop and coordinate watershed restoration initiatives and conduct point source and nonpoint source permitting, compliance and enforcement activities.
(b) Description	
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost to the Division. No new funds are requested. Tasks would be integrated into existing workloads.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings (PC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff develop and coordinate watershed restoration initiatives and conduct point source and nonpoint source permitting, compliance and enforcement activities.
(b) Description	
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost to the Division. No new funds are requested. Tasks would be integrated into existing workloads.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.4 Inspection and Enforcement Costs/Savings (IEC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff develop and coordinate watershed restoration initiatives and conduct point source and nonpoint source permitting, compliance and enforcement activities.
(b) Description	
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost to the Division. No new funds are requested. Tasks would be integrated into existing workloads.
(e) Assumptions	N/A
(f) Data Sources	N/A

Table 4.13: New Development Cost Summary

Type of Cost	State Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$0	$0	$0	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Type of Cost	Local Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$0	$0	$0	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$0	$48,000	$0	$0	$0	**$48,000**
Opportunity	$0	$0	$0	$0	$0	**$0**
Total	**$0**	**$48,000**	**$0**	**$0**	**$0**	**$48,000**

Type of Cost	Developers and Property Owners - Private Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$166,512	$338,375	$343,812	**$848,700**
Operation & Maintenance	$0	$0	$19,772	$59,951	$100,776	**$180,500**
Planning	$0	$0	$16,321	$33,167	$33,700	**$83,188**
Regulatory Transaction	$0	$0	$93	$188	$191	**$473**
Opportunity	$0	$0	$0	$0	$0	**$0**
Total	**$0**	**$0**	**$202,698**	**$431,682**	**$478,480**	**$1,112,859**

Chapter 5: Stormwater Management for Existing Development

Step 1: Basic Information

1.1 Rule Reference No.	.0266
1.2 Analyst (Name and Title)	Kelly Johnson, Environmental Engineer Rich Gannon, Environmental Supervisor
1.3 Office (Your Organizational Location)	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27604
1.4 Your Phone	(919) 733-5083 x, x356
1.5 Comments on Agency Contact	Mike Randall Division of Water Quality, Stormwater Unit NPDES Phase II Stormwater Information
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Stormwater Management for Existing Development
1.7 Citation	15A NCAC 2B .0266
1.8 Brief Description of the Proposed Rule	The proposed rule would require all municipalities and counties in each subwatershed to achieve and sustain mass loading reductions from existing developed lands that equate to the strategy's percentage goals for each subwatershed as applied to developed lands.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Jordan Reservoir, and more than four-fifths of phosphorus inputs. Developed land uses comprise at least one-third of nonpoint inputs to the lake.

3.2 How does the Proposed Rule Change Behavior?

This rule would require all local governments in the Jordan Reservoir watershed to develop and implement programs to achieve sustained nutrient mass loading reductions from existing

developed lands in the watershed toward specific, quantified reduction goals. No such requirements currently exist in the watershed. Local governments would seek opportunities to implement management practices on developed private and public lands that reduce nutrient inputs to streams in their jurisdictions indefinitely. These practices could include activities such as installation of stormwater BMPs where runoff is currently untreated, increased street sweeping, restrictions or increased education on fertilizer use, connection of individual residential wastewater disposal systems to improved means of wastewater treatment, elimination of illicit discharges to the stormwater system or of wastewater collection system discharges, or requirements to achieve greater treatment of stormwater on new development. Local governments would be responsible for ensuring that reductions are sustained long-term. This would include maintaining installed structural management practices. They would estimate and track loading reductions over time.

Local governments would conduct feasibility studies from which they would propose rates of implementation for load-reducing activities toward existing development reduction goals. Timeframes are expected to be long-term. Local governments would begin to implement load-reducing activities in the fifth year after rule effective date, at which time they would begin to incur significant costs. Because of the long-term nature of compliance with this rule, we provide not only annual and five-year costs, but also total costs.

Table 5.1: Existing Development Timeline

Activity		Effective Date
Effective Date	9/1/2008	0 months
DWQ to work in cooperation with LGs and other watershed interests to develop model programs for EMC approval.	9/1/2009	12 months
EMC Approval		
LGs submit stormwater management programs.	3/1/2010	18 months (6 months after EMC approval)
DWQ requests EMC approval of stormwater management programs.	12/1/2010	27 months (15 months after EMC approval)
EMC Approval		
LGs adopt and implement stormwater management programs.	3/1/2011	30 months (18 months after EMC approval or upon DWQ's first renewal of LG's NPDES permit, whichever is later)
LGs submit loading reduction programs.	9/1/2011	36 months
DWQ requests EMC approval of loading reduction programs.	7/1/2012	46 months
EMC Approval		
LGs adopt and implement loading reduction programs.	9/1/2012	48 Months
LGs provide annual reports to DWQ documenting program's progress.		

*Based on effective date of September 1, 2008.

Step 4: Identify Impacts

4-A. Regulated Parties

RP.0 Party Description (Local Governments)

Name of Party	All local governments in the Jordan Lake watershed.
Description	The rule would apply to all eight counties with more than nominal land area in the watershed. These are: Alamance, Caswell, Chatham, Durham, Guilford, Orange, Rockingham, and Wake. The rule would also apply to all twenty-three incorporated

	municipalities with land area in the watershed. These are: Apex, Burlington, Carrboro, Cary, Chapel Hill, Durham, Elon, Gibsonville, Graham, Green Level, Greensboro, Haw River, Kernersville, Mebane, Morrisville, Oak Ridge, Pittsboro, Pleasant Garden, Reidsville, Sedalia, Stokesdale, Summerfield, and Whitsett.
General Baseline	Local governments in the watershed are not currently required to specifically reduce nutrient loading from existing developed lands. However, some local governments require stormwater controls on development for water supply protection or for quantity control purposes, which decreases the reduction in nutrient loading needed from the untreated runoff condition. Table 4.1 details existing local programs. Local governments also have opportunity to impose controls on new development in advance of 2011, easing load reduction needs for the transition period. We draw estimates of nitrogen (N) and phosphorus (P) annual mass loading to streams (lb/yr) from the range of developed lands in the watershed for the baseline period (1997-2001) from the results of a watershed model developed for this strategy by Tetratech, Inc. We apply the strategy's percentage load reduction goals to these baseline loads to set baseline load reduction targets. We estimate loading associated with additional development for the period after the baseline and before local new development programs are implemented in 2011. We estimate the extent to which this "transitional" loading exceeds loading targets for new development. We add this excess to the baseline reduction targets to establish total existing development N and P load reduction targets.
Assumptions	Throughout the text, we provide references to explanations for the full set of supporting assumptions compiled in Appendix B. That appendix also applies to the other two development rules - Stormwater for New Development and Stormwater for State and Federal Entities - because of common calculations among all three rules. Major assumptions for this rule include the following: o While the Division is working with local governments to develop load reduction estimates for a range of more cost-effective, innovative management practices, these calculations assume the use of only conventional stormwater BMPs. This assumption errs in favor of higher costs. We use the Division's N and P removal efficiencies set out in the NC BMP Manual. o We set proportions of BMPs based largely on cost-effectiveness, and adjust them based on local governments' input. o We assume a BMP lifespan of 30 years. o We assume a uniform 30-year compliance timeframe (not defined in the rule) and a constant rate of implementation over the 30 years. o We base load reduction needs from baseline on estimates generated by the Jordan watershed model. o We base load reduction needs for the transition period on population growth projections from the NC Census. We make assumptions that equate population growth to acres and types of development. Overall, we estimate one-quarter acre of land is developed for every person added to the population. o Local governments would be able to trade excess P reduction accrued in meeting N reduction targets with other sources. We estimate that credit value and deduct it in calculating total cost.
Data Sources	We reference information sources at points throughout this text and provide citations in Appendix B. Our primary data sources are: o Jordan Reservoir Watershed Model, 2003, developed for the Division by

	Tetratech, Inc. o NC Census[8] o Hunt, WF and A. Wossink, 2003. An Evaluation of Cost and Benefits of Structural Best Management Practices in North Carolina. o Moran, A. and W.F. Hunt, 2004. BMP Cost Estimate Study. Cooperative Extension Service, North Carolina State University, Raleigh, NC. o Replies to information requests from the following local governments: Cary, Chapel Hill, Durham, Durham County, Greensboro, Guilford County. o Tar-Pamlico Nutrient Export Method, Piedmont Version. o NC BMP Manual, July 2006 draft, NC DWQ.

RP.1 Annual Capital Costs/Savings (Local Governments)

(a) Cost Baseline	Since there are currently no requirements to reduce nutrient loading from existing developed lands, local governments do not incur capital costs for this activity.
(b) Description	Capital costs include the costs of purchasing land for stormwater BMPs and all construction costs for those BMPs.
(c) Quantify $	The first five years following rule effective date would be 2009-2013. Local governments would begin to incur costs related to retrofits in the fifth year, 2013. Thus, for this rule the annual and 5-year costs are the same. Because the various categorical costs for this rule are integrated in a fairly involved set of calculations, we present the entire calculation process once, in this capital cost section, and refer back to it in the remaining sections. The following table lists all costs.

Table 5.2: Existing Development Rule: Summary of Costs to Local Governments

Type of Cost	Annual (Yr 5)	2009-2013 (5-Yr)	Total (30-Yr)
Capital	$14,545,561	$14,545,561	$436,366,831
Operation & Maintenance	$107,509	$107,509	$49,991,754
Planning	$1,715,494	$1,715,494	$51,464,812
Regulatory Transaction	$54,294	$54,294	$1,628,813
Opportunity	$0	$0	$0
Trading Credit	-$23,201	-$23,201	-$10,788,543
Total	**$16,399,657**	**$16,399,657**	**$528,663,667**

(d) Quantification Method	In brief, our approach is to first calculate load reductions needed, determine per BMP costs for the range of BMPs available, calculate load-reducing effectiveness for each, assign each a proportion of total BMP use, distribute total load reduction among them proportionally, and produce a total reduction cost. The remainder of this section further describes the following steps: 1. Calculate annual mass load reduction needed from baseline loading and separately for development that is added during the post-baseline or transitional period, the period after baseline and before new development programs begin. 2. Cost per BMP ($/yr/BMP): the sum of capital, lifetime maintenance, planning, and transaction costs. Capital includes both construction and land purchase.

	Divided by BMP lifespan to annualize costs. 3. Per-BMP Effectiveness: Annual mass load removed per BMP (lb/yr/BMP), the product of land use loading rate (lb/ac-yr), BMP drainage area (ac) and BMP efficiency (%). 4. BMP cost-effectiveness: divide step 2 by step 3. 5. Distribute baseline load reduction target among the BMPs and multiply by each BMP's cost-effectiveness to determine load reduction cost for each BMP. Sum the cost for all BMPs. 6. Determine excess reduction achieved for one nutrient in fully treating the other and equate to dollar value. Deduct this tradable credit from total cost. **7.** Repeat steps 3-6 for the transitional period load reduction to estimate this additional cost. Add to the baseline reduction cost for total cost. **Step 1: Calculating Load Reductions Needed** Baseline loads are available from the watershed model, while post-baseline loads required estimation. Because of this, and because the loading rates used in the two methods represent slightly different things, we keep baseline and post-baseline calculations separate, combining them only at the cost tabulation stage. For rule implementation, the Division is working with stakeholders on a single, mutually agreeable load estimation method. ***Reduction Needed to Baseline Loads*** The annual mass load reduction needed from baseline loads for all existing developed lands in the watershed is calculated in Table 5.3 below. These values are taken directly from the watershed model. DOT and other state entities would be responsible for portions of this load, but the model did not distinguish these land use types. Thus, we calculate these parties' loads and deduct them from the total to arrive at local governments' responsibility. Results of these calculations are provided in Table 5 of the Executive Summary, and are based on the following: o DOT has estimated their areal loading rates (3.17 TN lb/acre-year and 0.5 TP lb/acre-year) and the number of acres that they occupy (25,547 acres). We calculated DOT's responsibility by multiplying loading rate by acres. o We similarly estimated other state entities' loads from the acres that they occupy and likely loading rates from those acres.
(d) Quantification Method (continued)	***Reduction Needed to Post-Baseline Loads*** In addition to baseline load reduction requirements, entities subject to this rule would be responsible for reducing load to the watershed from development that occurs after the baseline and before new development programs are implemented in 2011. We refer to this element as the post-baseline reduction. We calculate the post-baseline reduction need by equating population growth for the period to acres of residential and non-residential development, then multiplying each of those acreages by appropriate, aggregated per-acre loading rates. Each step is detailed here. ***Population Growth Rate:*** We obtained actual and 2020-projected population growth estimates for watershed counties from the State Demographer's Office, from which we derived an average annual growth rate for the watershed. Table 5.4 below provides

(d) Quantification Method (continued)	this calculation. ***Residential Acres:*** We applied this annual growth rate to the 2000-Censused number of people in the watershed to get annual population growth. We then equated annual population growth to residential acres by dividing people/yr by the product of the number of people per house and the number of houses per acre. $$\frac{Acres_{\text{Residential}}}{Year} = \frac{Growth_{(People)}}{Year} x \frac{House}{People} x \frac{Acres_{\text{Residential}}}{House}$$ To do this, we obtained NC Census whole-county population growth data and projections through 2020 and converted to annual watershed population growth using county land area proportions in the watershed. This assumes even population distribution across each county, which introduces some error. People per house: we used the NC Census value of 2.49. House-per-acre averages differ widely between city and county. For city, we used the following provided by Durham City/County: 242,582 population/(2.49 people/house)/18,365 residential acres = 5.3 houses/ac. By contrast, Guilford County provided complete permitting data on residential lots and acres for the year July 2005-June 2006; the county's 58 cases averaged 1.0 houses/acre. Lacking data with which to project relative proportions of new development falling in city versus county but believing these two values approximate central tendency for the two cases, we averaged them for a final conversion factor of 3.15 houses/acre. A simple sensitivity analysis on this value showed that plausible variations in the city/county range (+/- .5 house/ac) varied the final cost of this rule by only 3.8-5.4%. ***Non-Residential Acres:*** We calculated non-residential development acres associated with population growth using a residential multiplier of .72. This ratio of non-residential to residential acres is based on a staff survey of Jordan local governments, both city and county, requesting proportions of new development in different land use types. Results were variable. We used Durham City/County data because it appeared to be the most representative: values were the most central, it included both city and county, and it was a cumulative data record.

Table 5.3: Existing Development Baseline Loads and Reduction Targets

Lake Arm	RVL[Note5]	RLL[Note5]	RML[Note5]	RMH[Note5]	RHH[Note5]	RVH[Note5]	OFF	CIT	BAR	Total Exist Dev. Baseline Values	% Reduc Required	Existing Dev Reduction Goals (lb/year)	Existing Dev Reduction Goals$_{Watershed}$ (lb/year)
TN (lb/yr)													
HAW	557,601	17,211	524,093	583,764	2,758	97,373	160,078	237,834	177,376	2,358,087	8%	188,647	
UNH	77,756	25,877	50,596	104,698	80,059	93,572	59,421	87,208	55,062	634,250	35%	221,987	**410,634**
LNH	50,126	10,078	11,018	17,465	17,850	17,001	2,968	4,182	20,042	150,730	0%	0	
Total										3,143,067		410,634	
TP (lb/yr)													
HAW	40,148	1,438	41,369	56,768	464	16,026	25,611	36,611	131,442	349,878	5%	17,494	
UNH	6,484	2,898	5,334	12,408	13,472	15,392	9,495	13,411	24,240	103,134	5%	5,157	**22,651**
LNH	2,987	1,197	1,071	1,324	3,004	2,796	474	643	11,056	24,552	0%	0	
Total										477,564		22,651	

Table 5.4: Existing Development: Annual Population Growth Rate for Post-Baseline Period

							(%)
ALAMANCE	430	95%	130,794	124,254	171,023	2,011	1.54%
CASWELL	425	20%	23,501	4,700	26,652	158	0.67%
CHATHAM	683	45%	49,329	22,198	73,924	1,230	2.49%
DURHAM	290	35%	223,318	78,161	297,461	3,707	1.66%
GUILFORD	649	55%	421,048	231,576	527,134	5,304	1.26%
ORANGE	400	55%	115,533	63,543	149,080	1,677	1.45%
ROCKINGHAM	566	25%	91,928	22,982	96,450	226	0.25%
WAKE	832	8%	627,866	50,229	1,106,218	23,918	3.81%
		Totals:	1,683,317	597,645	2,447,942	38,231	2.30%
			Average Annual Jordan Growth Rate, Co Pop-Weighted:				1.61%

(d) Quantification Method (continued)	Values we used in estimating land consumption rate from population growth are included in Table 5.5 below, as is the series of loading rates we developed for those lands. Assumptions not documented below may be found in the assumptions section above. ***Loading Rates:*** As seen in Table 5.5, to simplify calculations we lumped all the developed land uses listed in Table 5.3 into two - residential and non-residential - and developed representative loading rates for each. For nitrogen rates, we relied on published values developed for the Albemarle-Pamlico region (References 14 and 15), supplemented where needed by values calculated with the Tar-Pamlico export method, Piedmont version (Reference 16). Where these sources overlapped, they were very consistent. For phosphorus, we used the Tar-Pamlico export method, which was very consistent with References 14 and 15 and a study done in the Randleman Lake watershed (Reference 19). We did not use field-scale loading rates produced by the Jordan watershed model, as they reflect generated loads as opposed to loads delivered to surface waters. To arrive at aggregated loading rates, for the residential case we calculated or found values for county and municipal development intensities and combined them. For commercial/industrial, we aggregated impervious scenarios in the 70-90% impervious range. In all cases, we weighted combined values by acres of each land use type as taken from the watershed model. The second grouping of loading rates in Table 5.5, denoted by "WSW-PhII", is the first group adjusted down for compliance with Water Supply Watershed and Phase II regulations. We weighted the rates to reflect WSW 60% impervious caps, which affected commercial and industrial scenarios, and the use of one BMP. For commercial/industrial, we also used a 50/50 mixture of rooftop and transportation impervious to reflect a balance between commercial and industrial cases. For the BMP, we used a weighted average efficiency of all BMPs that achieve 85% TSS removal as required by these two regulations (36% N, 32% P). The third group of loading rate values in Table 5.5 includes "allowed" rates, that is the new development loading targets established in the new development rule, weighted across all three subwatersheds. Subtracting these targets from either the top, untreated development rates or the middle, WSW-PhII treated development rates gives the remaining reduction needed from lands developed during the transition years, 2002-2011. For these years we assumed half of all development would fall in a WSW or Phase II community given that 50% of Jordan watershed is occupied by WSWs and that in the latter years, additional area would be subject to Phase II permitting requirements. Thus, half of the total "excess" load came from the difference between untreated and target rates, and half from the difference between WSW-PhII treated and target rates.

(d) Quantification Method (continued)

Table 5.5: Existing Development: Variables Affecting Post-Baseline Load

People Per House[8]:	2.49
Houses Per Residential Acre [Note 29]	3.15
$TN_{Residential}$(lb/ac-yr)[Note 20]	4.0
$TP_{Residential}$(lb/ac-yr) [Note 20]	0.58
$TN_{Comm/Ind}$ (lb/ac-yr)[Note 20]	15.0
$TP_{Comm/Ind}$ (lb/ac-yr) [Note 20]	1.40
$TN_{Residential}$WSW-PhII (lb/ac-yr) [Note 20]	3.2
$TP_{Residential}$WSW-PhII (lb/ac-yr) [Note 20]	0.48
$TN_{Comm/Ind}$ WSW-PhII (lb/ac-yr) [Note 20]	6.75
$TP_{Comm/Ind}$ WSW-PhII (lb/ac-yr) [Note 20]	0.79
$TN_{Exist\ Dev\ Avg}$ (lb/ac-yr) [Note 20]	9.65
$TP_{Exist\ Dev\ Avg}$ (lb/ac-yr) [Note 20]	1.05
$TN_{Allowed}$(lb/ac-yr)[11]	3.66
$TP_{Allowed}$(lb/ac-yr)[11]	1.35
#Years to Achieve Exist. Dev. Load Red.[Note 19]:	30
# Acres comm/ind per acre residential[10, 15, Note 38]:	0.72

$$\frac{lb(TN\ \&\ TP)_{Excess}}{Acre} = \frac{lb(TN\ \&\ TP)_{New}}{Acre} - \frac{lb(TN\ \&\ TP)_{Allowed}}{Acre}$$

Loads: The final step in determining excess load for the post-baseline period is simply to multiply the excess loading rate for residential by residential acres, doing the same for commercial/industrial, and summing the two. Repeat calculation for each year and sum all years. These calculations are shown in Table 5.6 below. Summing the last two columns, the total **Excess N = 71,300 lb N/yr** reduction needed, while total **Excess P = -10,000 lb P/yr** reduction needed. Thus, while N reductions are needed, WSW and Phase II controls result in excess P reduction.

Table 5.6 (Part 1 of 2). Existing Development: Post-Baseline Load Reduction Needs

Year		Population Increases at 1.6% Annual Growth	Growth (# People)	Existing Development Rule Additional *Residential* Loading Post-Baseline						
				Acres[Note 29] Residential Developed 2002 thru 2011[Note 57]	TN_{New} After WSW-PhII (lb/year)	$TN_{Allowed}$ (lb/year)	TN_{Excess} (lb/year)	TP_{New} After WSW PhII (lb/year)	$TP_{Allowed}$ (lb/year)	TP_{Excess} (lb/year)
2000	--	620,063	-	-	-	-		-	-	-
2001	--	630,026								
2002	--	640,150	10,123	1,291	4,674	4,719	-45	746	1,738	-992
2003	--	650,436	10,286	1,311	4,749	4,795	-46	758	1,765	-1,008
2004	--	660,887	10,451	1,332	4,825	4,872	-47	770	1,794	-1,024
2005	--	671,506	10,619	1,354	4,903	4,950	-47	782	1,823	-1,040
2006	--	682,296	10,790	1,376	4,982	5,030	-48	795	1,852	-1,057
2007	--	693,260	10,963	1,398	5,062	5,111	-49	808	1,882	-1,074
2008	--	704,399	11,139	1,420	5,143	5,193	-50	821	1,912	-1,091
2009	Year 1	715,718	11,318	1,443	5,226	5,276	-51	834	1,943	-1,109
2010	Year 2	727, 18	11,500	1,466	5,310	5,361	-51	847	1,974	-1,127
2011	Year 3	738, 03	11,685	1,490	5,395	5,447	-52	861	2,006	-1,145
2012	Year 4	750,776								
2013	Year 5	762,840								

Table 5.6 (Part 2 of 2). Existing Development: Post-Baseline Load Reduction Needs

Year		Existing Development Rule Additional *Commercial / Industrial* Loading Post-Baseline								Existing Development Rule Res + Comm/Ind	
		Ratio: Acres Comm/Ind per Acre Residential Note 38	Acres Comm/Ind Developed 2002 thru 2011[Note 57]	TN_{New} After WSW-PhII (lb/year)	$TN_{Allowed}$ (lb/year)	TN_{Excess} (lb/year)	TP_{New} (lb/year)	$TP_{Allowed}$ (lb/year)	TP_{Excess} (lb/year)	TN_{Excess} (lb/year)	TP_{Excess} (lb/year)
2000	--	-	-	-	-	-	-	-	-	-	-
2001	--										
2002	--	0.72	925	10,056	3,381	6,675	1,295	1,245	50	6,630	-942
2003	--	0.72	940	10,217	3,435	6,782	1,315	1,265	51	6,736	-957
2004	--	0.72	955	10,382	3,491	6,891	1,336	1,285	51	6,844	-973
2005	--	0.72	970	10,548	3,547	7,002	1,358	1,306	52	6,954	-988
2006	--	0.72	986	10,718	3,604	7,114	1,380	1,327	53	7,066	-1,004
2007	--	0.72	1,001	10,890	3,662	7,229	1,402	1,348	54	7,180	-1,020
2008	--	0.72	1,017	11,065	3,720	7,345	1,424	1,370	55	7,295	-1,037
2009	Year 1	0.72	1,034	11,243	3,780	7,463	1,447	1,392	56	7,412	-1,053
2010	Year 2	0.72	1,050	11,424	3,841	7,583	1,471	1,414	56	7,531	-1,070
2011	Year 3	0.72	1,067	11,607	3,903	7,705	1,494	1,437	57	7,652	-1,087
2012	Year 4										
2013	Year 5										

(d) Quantification Method (continued)

Step 2: Per-BMP Costs

In this step we calculate a lifetime per-BMP cost for the range of available BMPs. We include all BMPs the Division currently credits with N or P removal. These conventional structural practices are detailed in the NCDENR draft BMP manual (Reference 2), and a simplified list is provided below. The Division is working with stakeholders to identify and evaluate non-traditional options for reducing nutrients, which may yield more cost-effective options. Thus, these calculations err conservatively in favor of higher costs.

BMP	TSS	TN	TP
Constructed Wetland	85%	40%	35%
Bioretention	85%	35%	45%
Wet Detention	85%	25%	40%
Dry Detention + Grassed Swale	85%	30%	30%
Infiltration Device	85%	55%	0%
Restored Riparian Buffer	85%	30%	30%
Sand Filter	85%	35%	45%
Average Efficiency	85%	36%	32%

Using the fiscal note format, we recognize five cost components to BMPs: Capital, Operation & Maintenance (O&M), Planning, Regulatory Transaction, and Trading Credit. Our estimates for each of these costs for each BMP listed above are provided in Table 5.7 below. Since all costs except O&M are up-front, lifetime costs, we calculate lifetime O&M cost from annual values, and add this to the others to yield complete lifetime costs per BMP, which we later annualize for annual cost calculations.

Table 5.7: Existing Development: Per-BMP Cumulative Cost ($/BMP-1st 30 Yrs)

	Capital Cost					Annual Operating/ Maintenance Cost[Note 34] ($/BMP-Yr)	Cumulative O&M Costs for First 30 Years ($/Bmp-1st 30 Years)	Planning Costs[Note 10] ($/BMP)	Regulatory Transaction Costs [Note 11] ($/BMP)	Cumulative Cost Per BMP for 1st 30 Years ($/BMP-1st 30 Years)
	Installation Cost ($/BMP)	BMP Footprint Area (Ac)	Average Per-Acre Land Cost[Note 2] ($/ac)	BMP Land Cost ($/BMP)	Total Capital Cost: Land + Install ($/BMP)					
Stormwater Wetland[Notes 1 & 22]	$21,846	0.83	$77,912	$64,642	$86,487	$390	$5,844	$5,461	$25	$97,818
Bioretention[Notes 1 & 22]	$7,682	0.03	$77,912	$2,665	$10,347	$176	$2,647	$1,920	$25	$14,939
Wet Detention Basin (Wet	$108,002	0.36	$77,912	$28,379	$136,381	$1,045	$15,677	$27,001	$25	$179,084
Extended Dry Detention Basin[Notes	$23,500	0.14	$77,912	$10,910	$34,410	$940	$14,100	$5,875	$25	$54,410
Grassed Swale[Notes 6 & 30]	$650	0.023	$77,912	$1,789	$2,439	$2	$25	$163	$25	$2,651
Filter Strip/Level Spreader [Note 9]	$7,575	0.36	$77,912	$27,723	$35,298	$137	$2,055	$1,894	$25	$39,272
Infiltration Devices [Notes 6 & 8]	$8,800	0.05	$77,912	$4,058	$12,858	$0	$7	$2,200	$25	$15,090
Manufactured BMP Systems[Note 4]	-	-	-	-	-	-	$0	-	-	
Buffer with level spreader [Notes	$178	0.23	$77,912	$17,920	$18,098	$2	$31	$45	$25	$18,199
Permeable Pavement[Note 3]	-	-	-	-	-	-	$0	-	-	
Rooftop Runoff Management [Note 3]	-	-	-	-	-	-	$0	-	-	
Sand Filter[Notes 1 & 22]	$55,208	0.02	$77,912	$1,790	$56,997	$575	$8,629	$13,802	$25	$79,453

(d) Quantification Method (continued)	We utilize best available published data from North Carolina stormwater experts as well as input from local governments in the above calculations. As noted in Table 5.7 above, see Notes 1, 3, 6, 22, 23, 24, 25, 30, 32, and 46 in support of individual elements. The following points, as well as assumptions identified in the Assumptions section above, summarize information contained in the listed notes: o We include construction and land purchase costs in capital costs. o We estimate an average land cost of $78,000/acre based on data provided by the City and County of Durham. See Table B-2. These values reflected a much larger, more robust data set than values provided by others. However, the range of values provided by others was similar (Note 2). Depending on the BMP, land cost ranges from a small to a large fraction of total cost. However, a simple sensitivity analysis shows that varying land cost by over one-third in either direction, between $50,000 and $100,000/acre, varies the final cost of achieving the baseline reduction by only 8 percent in either direction. o We estimate planning cost as 25% of construction cost (Note10). This incorporates local government staffing costs to implement the rule. o Regulatory transaction costs are assumed to be $25 per BMP (Note11). We believe this cost to be minimal, and this is a rough initial estimate. **Steps 3, 4, and 5: Per-BMP Effectiveness, BMP Cost-Effectiveness, and Total Cost** Calculations are provided in Tables 5.8 and 5.9 below. Table 5.8 contains estimates for TN, and Table 5.9 the same steps with TP values for the same set of BMPs. Since a given BMP treats for both nutrients, the costs are not additive but instead the higher total cost across all BMPs is the result taken forward. The resulting TN estimate, approximately $419 million, represents total cost to achieve percentage reductions on the baseline loading estimated by the watershed model. This cost, combined with the similar cost for the transition period yields the total $529 million existing development reduction cost provided at the beginning of this chapter.

(d) Quantification Method (continued)	Specifics related to the calculations in Tables 5.8 and 5.9 are: o The untreated input loading rate to BMPs for baseline conditions, 14.7 lb N/ac-yr for nitrogen, is a weighted average of values given for all developed land uses in the watershed model. This source and value is appropriate because the resulting reductions are compared against loading reduction needs estimated by the same watershed model. This input rate will differ from the one we use for the transition period and for new development. Those differences are discussed in Step 7. o We see that for existing development, BMPs prove to be significantly more **cost-effective** than for new development (weighted averages: existing = $32/lb N vs. new = $48/lb N). This is due to the higher input loading rates associated with existing developed conditions, which result in more pounds N removed for a given BMP percent efficiency and cost. Those higher input rates result

	from both the largely untreated nature of existing development compared to Phase II and WSW-treated inputs, and from the artifact introduced by the watershed model for existing development baseline input rates. Again, the latter differences are discussed in step 7. o We set proportions of different BMPs based primarily on relative cost-effectiveness, which is calculated and shown in the table. We also surveyed several local governments and adjusted the weighting somewhat based on that input, although projections varied greatly across jurisdictions. We note that final costs are sensitive to changes in the distribution of BMP proportions, but did not see a more definitive method for projecting them. We welcome additional input on this point.

Table 5.8: Existing Development: Baseline BMP *TN* Efficiency, Cost-Effectiveness, and Cumulative Cost

	Number of BMPs (# BMPs) Needed to Treat the TN Load										Cumulative Cost for All BMPs Needed to Achieve N Reduction from Baseline for 1st 30 Years ($Total-1st 30 Yrs)
	Untreated (Input) Loading Rate Note 56 (lb/ac-yr)	%TN Effic[2]	Drainage Area to Each BMP Note 47 (Ac)	Annual Load Reduced by Each BMP (lb/yr)	Load Reduced Over BMP Lifetime (lb/30 yr)	BMP Cost-Effective-ness Note 25 ($/lb)	Likely Proportions Local Gov'ts Will Use Note 15	Total Local Gov't Reduc Needed from Baseline Load (lb/yr)	Reduction Allocated Among BMPs (lb/yr)	Number of BMPs Needed to Treat Allocation (# BMPs) Note 7	
Stormwater Wetland Notes 1 & 22	14.7	40%	36.1	213	6,377	$16	30%	382,510	114,753	540	$52,809,104
Bioretention Notes 1 & 22	14.7	35%	1.2	6	184	$96	10%	382,510	38,251	6,235	$93,148,482
Wet Detention Basin (Wet Pond) Notes 1 & 22	14.7	25%	21.1	78	2,333	$83	7%	382,510	26,776	344	$61,662,302
Extended Dry Detention Basin Notes 23 & 24	14.7	10%	22.5	33	994	$69	7%	382,510	27,201	821	$44,652,582
Grassed Swale Notes 6 & 30	14.7	20%	0.90	3	80	$34	27%	382,510	103,278	38,950	$103,251,723
Filter Strip/Level Spreader Note 9	14.7	20%	2.3	7	199	$208	0%	382,510	0	0	$0
Infiltration Devices Notes 6 & 8	14.7	55%	2.3	18	547	$28	10%	382,510	38,251	2,098	$31,663,218
Manufactured BMP Systems Note 4	-	0%	-	-		-		-			$0
Buffer with level spreader Notes 32&46	14.7	30%	4.5	20	597	$31	9%	382,510	34,426	1,731	$31,503,451
Permeable Pavement Note 3	-	0%	-	-		-		-			$0
Rooftop Runoff Management Note 3	-	0%	-	-		-		-			$0
Sand Filter Notes 1 & 22	14.7	35%	1.2	6	182	$485	0%	382,510	0	0	$0
					Wgtd Avg Cost-Eff Rate	$37	100%		382,935	50,719	$418,690,862

Table 5.9: Existing Development: Baseline BMP *TP* Efficiency, Cost-Effectiveness, and Total Cost

	Number of BMPs (# BMPs) Needed to Treat the TP Load										Cumulative Cost for All BMPs Needed
	Untreated (Input)	%TP Effic[2]	Drainage Area to	Annual Load	Load Reduced	BMP Cost-Effective-	Likely Proportion	Total Local Gov't	Reduction Allocated	Number of BMPs	
Stormwater Wetland Notes 1 & 22	1.58	35%	36.1	20.0	600	$173	30%	21,029	6,309	315	$30,856,554
Bioretention Notes 1 & 22	1.58	45%	1.2	0.8	25	$691	10%	21,029	2,103	2,479	$37,040,599
Wet Detention Basin(Wet Pond)	1.58	40%	21.1	13.4	401	$485	7%	21,029	1,472	110	$19,703,639
Extended Dry Detention Basin Notes	1.58	10%	22.5	3.6	107	$641	7%	21,029	1,495	420	$22,829,335
Grassed Swale Notes 6 & 30	1.58	20%	0.9	0.3	9	$313	27%	21,029	5,678	19,914	$52,789,068
Filter Strip/Level Spreader Note 9	1.58	35%	2.3	1.2	37	$1,104	0%	21,029	0	0	$0
Infiltration Devices Notes 6 & 8	1.58	0%	2.3	0.0	0	$0	10%	21,029	2,103	9	$135,809
Manufactured BMP Systems Note 4	-	0%	-	-			-	-			$0
Buffer with level spreader Notes	1.58	30%	4.5	2.1	64	$284	9%	21,029	1,893	885	$16,106,635
Permeable Pavement Note 3	-	0%	-	-			-	-			$0
Rooftop Runoff Management Note 3	-	0%	-	-			-	-			$0
Sand Filter Notes 1 & 22	1.58	45%	1.2	0.8	25	$3,506	0%	21,029	0	0	$0
					Wgtd Avg Cost-Eff Rate	$311	100%		21,053	24,132	$179,461,639

(d) Quantification Method (continued)	**Step 6: Calculate any Revenue Generated by Trading** As illustrated above, meeting reduction needs for one nutrient will overtreat for the other by some amount. As calculated in Table 5.10 below, we estimate significant excess phosphorus reduction would be achieved in meeting nitrogen needs. Local governments could trade the excess reduction for revenue. To convert from pounds of excess reduction to a dollar value, we took weighted averages of the N and P cost-effectiveness rates we arrived at above. Those averages appear in Tables 5.8 and 5.9 above, $311/lb P and $37/lb N. We estimate total revenue potential in meeting baseline reduction needs as approximately $5.4 million. This value will be added to any additional revenue from the transition period for a total potential revenue value under this rule.

Table 5.10: Existing Development: Baseline Revenue Potential via Trading TP Reduction

Annual TP Load Removed Per BMP (lb/yr)	Annual TP Load Removed by Total #BMPs Needed to Meet TN Reduction (lb/yr)	Existing Dev Baseline TP Reduction Required (lb/year)	Excess TP Load Reduction (lb/yr)	TP Cost-Effective-ness[Note 26] ($/lb)	Possible Revenue Generated by Trading Excess TP[Note 27] ($/Year)
20.0	10,797	21,029	17,395	$311	$5,401,420
0.8	5,288				
13.4	4,607				
3.6	2,925				
0.3	11,106				
1.2	0				
0.0	-				
-	-				
2.1	3,702				
-	-				
-	-				
0.8	0				
Total:	38,424				

(d) Quantification Method (continued)	**Step 7: Repeat Previous Steps for Transition Period, Sum for Total Cost** We estimate the cost to treat the additional reduction needed for the post-baseline/transition portion of existing development at approximately $119 million. This is the cost to achieve nitrogen requirements, as detailed in Table 5.11 below. The required phosphorus reduction for the transition is negative (Table 5.6), and thus a potential source of revenue via trading. We estimate this potential revenue at approximately $5.4 million, as shown in Table 5.12.

	The sum of baseline and transitional period costs, $529 million, less potential trading revenues of $10.8 million equates to a total estimated cost of approximately $518 million. Table 5.13 below provides a year-by-year calculation for the 30 years. Much of the calculation for the transitional period mirrors that for the baseline, and we do not repeat that discussion here. Instead we note the following transition period differences from baseline steps: o Most of the differences between baseline and transitional steps occurred in calculating ***loading reduction needs*** for the transitional period, and we included those in Step 1 discussion. o For transitional and new development untreated input loading rates to BMPs, we relied on established, published values developed for the Albemarle-Pamlico region (References 14 and 15), supplemented by values estimated by the Tar-Pamlico export method, Piedmont version (Reference 16). Where these sources overlapped, they were very consistent. For phosphorus, we used the Tar-Pamlico export method, which was very consistent with References 14 and 15 and a study done in the Randleman Lake watershed (Reference 19). We did not use field-scale loading rates produced by the Jordan watershed model for either the transitional or new development calculations, as they reflect generated loads as opposed to loads delivered to surface waters. Table 5.5 lists the various loading rates – the input rate to BMPs for the transitional period is labeled "Exist Dev Avg", and is 9.65 lb N/ac-yr and 1.05 lb P/ac-yr. These values represent the average untreated export rate from municipal residential and all non-residential land uses. We excluded the county residential rate from this average, assuming that retrofits would not be targeted to these low-loading areas based on cost-effectiveness considerations.

Table 5.11: Existing Development: Post-Baseline/Transition Period TN BMP Needs and Cost

	Number of BMPs Needed (# BMPs)										
	Untreated Input Loading Rate$_{ExistingDev}$ (lb/ac-yr) Note 56	%TN Effic[2]	Drain-age Area[Note 47] (Ac)	Annual Load Reduc (lb/yr)	Load Reduc Over BMP Lifetime (lb/30 yrs)	Total Reduc Needed - i.e. Excess Load Generated 2002 thru 2011 (lb/yr)	Likely Propor-tions Local Gov'ts Will Use[10]	Total Load Reduc Needed Note 7 (lb/yr)	**Number of Each BMP Needed[Note 7] (# BMPs)**	Cumulative Cost Per BMP for 1st 30 Years ($/BMP-1st 30 Years)	**Cumulative Cost for All BMPs Needed to Achieve N Reduction from Baseline for 1st 30 Years ($Total-1st 30 Yrs)**
						TN					
Stormwater Wetland[Notes 1 & 22]	9.6	40%	36.1	139	4,177	71,300	30%	21,390	**154**	$97,818	**$15,028,120**
Bioretention[Notes 1 & 22]	9.6	35%	1.2	4	121	71,300	10%	7,130	**1,774**	$14,939	**$26,507,676**
Wet Detention Basin(Wet Pond)[Notes 1	9.6	25%	21.1	51	1,528	71,300	7%	4,991	**98**	$179,084	**$17,547,514**
Extended Dry Detention Basin[Notes 23 &	9.6	10%	22.5	22	651	71,300	7%	5,070	**234**	$54,410	**$12,706,983**
Grassed Swale[Notes 6 & 30]	9.6	20%	0.9	2	52	71,300	27%	19,251	**11,084**	$2,651	**$29,382,800**
Filter Strip/Level Spreader[Notes 9]	9.6	20%	2.3	4	130	71,300	0%	0	**0**	$39,272	**$0**
Infiltration Devices[Notes 6 & 8]	9.6	55%	2.3	12	358	71,300	10%	7,130	**597**	$15,090	**$9,010,542**
Manufactured BMP Systems[Note 4]		0%	-	-						$0	**-**
Buffer with level spreader[Notes 32&46]	9.6	30%	4.5	13	391	71,300	9%	6,417	**493**	$18,199	**$8,965,077**
Permeable Pavement[Note 3]		0%	-	-			0%			$0	**-**
Rooftop Runoff Management[Note 3]		0%	-	-						$0	**-**
Sand Filter[Notes 1 & 22]	9.6	35%	1.2	4	119	71,300	0%	0	**0**	$79,453	**$0**
						Total:	100%	71,380			**$ 119,148,711**

Table 5.12: Existing Development: Post-Baseline/Transition Period Potential Revenue via Trading TP Reduction

	Other Costs& Savings					
	Annual TP Load Removed per BMP (lb/yr)	Annual TP Load Removed by Total # BMPs Needed to Meet TN Reduc (lb/yr)	Existing Dev Transition TP Load Reduc Required (lb/yr)	Excess TP Load Reduc (lb/yr)	TP Cost-Effective-ness[Note 26] ($/lb)	**Possible Revenue Generated by Trading Excess TP[Note 27] ($/Year)**
Stormwater Wetland[Notes 1 & 22]	13.2	2,028				
Bioretention[Notes 1 & 22]	0.6	993				
Wet Detention Basin(Wet Pond)[Notes 1 & 22]	8.8	865				
Extended Dry Detention Basin[Notes 23 & 24]	2.4	549				
Grassed Swale[Notes 6 & 30]	0.2	2,086				
Filter Strip/Level Spreader[Notes 9]	0.8	0	-10,133	17,349	$311	**$5,387,124**
Infiltration Devices[Notes 6 & 8]		0				
Manufactured BMP Systems[Note 4]		0				
Buffer with level spreader[Notes 32&46]	1.4	695				
Permeable Pavement[Note 3]		0				
Rooftop Runoff Management[Note 3]		0				
Sand Filter[Notes 1 & 22]	0.6	0				
	Total (lb/year)	7,217				

Table 5.13: Existing Development: Summary of Local Government BMPs and Costs

	Per-BMP Costs				Summary Costs for Total (Baseline + Transition) Required BMPs					
	Total Capital Cost - Land + Install ($/BMP)	Annual O&M Cost Note 34 ($/BMP-Yr)	Planning Costs Note 10 ($/BMP)	Regu-latory Trans'n Costs Note 11 ($/BMP)	Total # BMPs Needed (Baseline + Transitional TN BMPs) Note 58	Capital Cost ($_{Total}$)	*Annual* O&M Cost ($/Yr)	Planning Costs Note 10 ($_{Total}$)	Regulatory Transaction Costs Note 11 ($_{Total}$)	Potential Revenue via Trading Note 27 ($_{Total}$)
Stormwater Wetland Notes 1 & 22	$86,487	$390	$5,461	$25	694	$59,979,483	$270,193	$3,787,504	$17,338	
Bioretention Notes 1 & 22	$10,347	$176	$1,920	$25	8,010	$82,874,697	$1,413,293	$15,381,833	$200,238	
Wet Detention Notes 1 & 22	$136,381	$1,045	$27,001	$25	442	$60,322,232	$462,269	$11,942,495	$11,058	
Extended Dry Det. Notes 23, 24	$34,410	$940	$5,875	$25	1,054	$36,275,464	$990,953	$6,193,455	$26,355	
Grassed Swale Notes 6 & 30	$2,439	$2	$163	$25	50,034	$122,012,673	$82,701	$8,130,496	$1,250,846	
Filter Strip/Level Spreader Note 9	$35,298	$137	$1,894	$25	0	$0	$0	$0	$0	-$10,788,543
Infiltration Devices Notes 6 & 8	$12,858	$0	$2,200	$25	2,695	$34,657,488	$1,263	$5,929,934	$67,386	
Manufactured BMPs Note 4	-	-	-	-	0	-		-	-	
Buffer w/Level Spreader Notes 32, 52	$18,098	$2	$45	$25	2,224	$40,244,793	$4,603	$99,095	$55,593	
Permeable Pavement Note 3	-	-	-	-	0	-		-	-	
Rooftop Runoff Mgmt Note 3	-	-	-	-	0	-		-	-	
Sand Filter Notes 1 & 22	$56,997	$575	$13,802	$25	0	$0	$0	$0	$0	

Year #	Year	Annual Total Cos	Capital ($)	Maintenance % BMPs Installed (%)	Maintenance Cum. % BMPs Installed	Maintenance Cum. Maint Cost ($)	Planning ($)	Regulatory ($)	Trading ($)
			$436,366,831	Final Annual Cost to Maintain 100% $3,225,274			$51,464,812	$1,628,813	-$10,788,543
Fisc Yr 1	2009	0	$0	0.0%	0.0%	$0	$0	$0	$0
Fisc Yr 2	2010	0	$0	0.0%	0.0%	$0	$0	$0	$0
Fisc Yr 3	2011	0	$0	0.0%	0.0%	$0	$0	$0	$0
Fisc Yr 4	2012	0	$0	0.0%	0.0%	$0	$0	$0	$0
Fisc Yr 5 Comply Yr 1	2013	$16,399,657	$14,545,561	3.3%	3.3%	$107,509	$1,715,494	$54,294	-$23,201
2	2014	$16,483,964	$14,545,561	3.3%	6.7%	$215,018	$1,715,494	$54,294	-$46,402
3	2015	$16,568,272	$14,545,561	3.3%	10.0%	$322,527	$1,715,494	$54,294	-$69,604
4	2016	$16,652,580	$14,545,561	3.3%	13.3%	$430,037	$1,715,494	$54,294	-$92,805
5	2017	$16,736,888	$14,545,561	3.3%	16.7%	$537,546	$1,715,494	$54,294	-$116,006
6	2018	$16,821,196	$14,545,561	3.3%	20.0%	$645,055	$1,715,494	$54,294	-$139,207
7	2019	$16,905,504	$14,545,561	3.3%	23.3%	$752,564	$1,715,494	$54,294	-$162,408
8	2020	$16,989,812	$14,545,561	3.3%	26.7%	$860,073	$1,715,494	$54,294	-$185,609
9	2021	$17,074,120	$14,545,561	3.3%	30.0%	$967,582	$1,715,494	$54,294	-$208,811
10	2022	$17,158,428	$14,545,561	3.3%	33.3%	$1,075,091	$1,715,494	$54,294	-$232,012
11	2023	$17,242,736	$14,545,561	3.3%	36.7%	$1,182,601	$1,715,494	$54,294	-$255,213
12	2024	$17,327,044	$14,545,561	3.3%	40.0%	$1,290,110	$1,715,494	$54,294	-$278,414
13	2025	$17,411,352	$14,545,561	3.3%	43.3%	$1,397,619	$1,715,494	$54,294	-$301,615
14	2026	$17,495,660	$14,545,561	3.3%	46.7%	$1,505,128	$1,715,494	$54,294	-$324,816
15	2027	$17,579,968	$14,545,561	3.3%	50.0%	$1,612,637	$1,715,494	$54,294	-$348,018
16	2028	$17,664,276	$14,545,561	3.3%	53.3%	$1,720,146	$1,715,494	$54,294	-$371,219
17	2029	$17,748,584	$14,545,561	3.3%	56.7%	$1,827,656	$1,715,494	$54,294	-$394,420
18	2030	$17,832,892	$14,545,561	3.3%	60.0%	$1,935,165	$1,715,494	$54,294	-$417,621
19	2031	$17,917,200	$14,545,561	3.3%	63.3%	$2,042,674	$1,715,494	$54,294	-$440,822
20	2032	$18,001,508	$14,545,561	3.3%	66.7%	$2,150,183	$1,715,494	$54,294	-$464,023
21	2033	$18,085,816	$14,545,561	3.3%	70.0%	$2,257,692	$1,715,494	$54,294	-$487,225
22	2034	$18,170,124	$14,545,561	3.3%	73.3%	$2,365,201	$1,715,494	$54,294	-$510,426
23	2035	$18,254,432	$14,545,561	3.3%	76.7%	$2,472,710	$1,715,494	$54,294	-$533,627
24	2036	$18,338,740	$14,545,561	3.3%	80.0%	$2,580,220	$1,715,494	$54,294	-$556,828
25	2037	$18,423,048	$14,545,561	3.3%	83.3%	$2,687,729	$1,715,494	$54,294	-$580,029
26	2038	$18,507,356	$14,545,561	3.3%	86.7%	$2,795,238	$1,715,494	$54,294	-$603,230
27	2039	$18,591,664	$14,545,561	3.3%	90.0%	$2,902,747	$1,715,494	$54,294	-$626,432
28	2040	$18,675,972	$14,545,561	3.3%	93.3%	$3,010,256	$1,715,494	$54,294	-$649,633
29	2041	$18,760,280	$14,545,561	3.3%	96.7%	$3,117,765	$1,715,494	$54,294	-$672,834
30	2042	$18,844,588	$14,545,561	3.3%	100.0%	$3,225,274	$1,715,494	$54,294	-$696,035
Total 30-Yr Costs		$528,663,667	$436,366,831	100%		$49,991,754	$51,464,812	$1,628,813	-$10,788,543

RP.2 Annual Operating Costs/Savings (Local Governments)

(a) Cost Baseline	Since there are currently no requirements to reduce nutrient loading from existing developed lands, local governments do not incur O&M costs.
(b) Description	BMPs require maintenance to continue to work effectively. Examples of maintenance include maintaining plants, removing debris, and mowing.
(c) Quantify $	The first five years following rule effective date would be 2009-2013. Local governments would begin to incur costs related to retrofits in the fifth year, 2013. Thus, for this rule the annual and 5-year costs are the same. Because the various categorical costs for this rule are integrated in a fairly involved set of calculations, we present the entire calculation process in the capital cost section, and refer back to it in remaining sections. The following table lists all costs.

Table 5.14: Existing Development Rule: Summary of Operation Costs

Type of Cost	Annual (Yr 5)	2009-2013 (5-Yr)	Total (30-Yr)
Capital	$14,545,561	$14,545,561	$436,366,831
Operation & Maintenance	**$107,509**	**$107,509**	**$49,991,754**
Planning	$1,715,494	$1,715,494	$51,464,812
Regulatory Transaction	$54,294	$54,294	$1,628,813
Opportunity	$0	$0	$0
Trading Credit	-$23,201	-$23,201	-$10,788,543
Total	$16,399,657	$16,399,657	$528,663,667

(d) Quantification Method	See Capital Cost Section.
(e) Assumptions	See Capital Cost Section and Appendix B.
(f) Data Sources	See Capital Cost Section and Appendix B.

RP.3 Annual Planning Costs/Savings (Local Governments)

(a) Cost Baseline	Since there are currently no requirements to reduce nutrient loading from existing developed lands, local governments do not incur O&M costs.
(b) Description	Local governments would incur planning costs related to seeking and pursuing retrofit and other load reduction opportunities, then designing practices. Planning is estimated as 25% of the construction cost.
(c) Quantify $	The first five years following rule effective date would be 2009-2013. Local governments would begin to incur costs related to retrofits in the fifth year, 2013. Thus, for this rule the annual and 5-year costs are the same. Because the various categorical costs for this rule are integrated in a fairly involved set of calculations, we present the entire calculation process in the capital cost section, and refer back to it in remaining sections. The following table lists all costs.

Table 5.15: Existing Development Rule: Summary of Planning Costs

Type of Cost	Annual (Yr 5)	2009-2013 (5-Yr)	Total (30-Yr)
Capital	$14,545,561	$14,545,561	$436,366,831
Operation & Maintenance	$107,509	$107,509	$49,991,754
Planning	**$1,715,494**	**$1,715,494**	**$51,464,812**
Regulatory Transaction	$54,294	$54,294	$1,628,813
Opportunity	$0	$0	$0
Trading Credit	-$23,201	-$23,201	-$10,788,543
Total	$16,399,657	$16,399,657	$528,663,667

(d) Quantification Method	See Capital Cost Section
(e) Assumptions	See Capital Cost Section and Appendix B.
(f) Data Sources	See Capital Cost Section and Appendix B.

RP.4 Regulatory Transaction Costs/Savings (Local Governments)

(a) Cost Baseline	Since there are currently no requirements to reduce nutrient loading from existing developed lands, local governments do not incur O&M costs.
(b) Description	Local governments would incur various regulatory costs under this rule. Activities may include obtaining Division approval, obtaining permits for some practices or installations, participating in inspections, and providing reports to the Division.
(c) Quantify $	The first five years following rule effective date would be 2009-2013. Local governments would begin to incur costs related to retrofits in the fifth year, 2013. Thus, for this rule the annual and 5-year costs are the same. Because the various categorical costs for this rule are integrated in a fairly involved set of calculations, we present the entire calculation process in the capital cost section, and refer back to it in remaining sections. The following table lists all costs.

Table 5.16: Existing Development Rule: Summary of Regulatory Transaction Costs

Type of Cost	Annual (Yr 5)	2009-2013 (5-Yr)	Total (30-Yr)
Capital	$14,545,561	$14,545,561	$436,366,831
Operation & Maintenance	$107,509	$107,509	$49,991,754
Planning	$1,715,494	$1,715,494	$51,464,812
Regulatory Transaction	**$54,294**	**$54,294**	**$1,628,813**
Opportunity	$0	$0	$0
Trading Credit	-$23,201	-$23,201	-$10,788,543
Total	$16,399,657	$16,399,657	$528,663,667

(d) Quantification Method	See Capital Cost Section.
(e) Assumptions	See Capital Cost Section and Appendix B.
(f) Data Sources	See Capital Cost Section and Appendix B.

RP.5 Other Costs/Savings (Local Governments)

(a) Cost Baseline	Since there are currently no requirements to reduce nutrient loading from existing developed lands, local governments do not incur O&M costs.
(b) Description	Compliance with loading reduction requirements for one nutrient will result in some amount of over-treatment for the other. Local governments would potentially be able to trade credit for over-treated nutrients and generate revenue.
(c) Quantify $	The first five years following rule effective date would be 2009-2013. Local governments would begin to incur costs related to retrofits in the fifth year, 2013. Thus, for this rule the annual and 5-year costs are the same. Because the various categorical costs for this rule are integrated in a fairly involved set of calculations, we present the entire calculation process in the capital cost section, and refer back to it in remaining sections. The following table lists all costs.
(d) Quantification Method	See Capital Cost Section.
(e) Assumptions	See Capital Cost Section and Appendix B.
(f) Data Sources	See Capital Cost Section and Appendix B.

Table 5:17: Existing Development Rule: Summary of Trading Credit Costs

Type of Cost	Annual (Yr 5)	2009-2013 (5-Yr)	Total (30-Yr)
Capital	$14,545,561	$14,545,561	$436,366,831
Operation & Maintenance	$107,509	$107,509	$49,991,754
Planning	$1,715,494	$1,715,494	$51,464,812
Regulatory Transaction	$54,294	$54,294	$1,628,813
Opportunity	$0	$0	$0
Trading Credit	**-$23,201**	**-$23,201**	**-$10,788,543**
Total	$16,399,657	$16,399,657	$528,663,667

4-B. Implementing Agencies:

IA.0 Party Description (DWQ)

Name of Party	DWQ
Description	In the first year, the Division would work with local governments to establish the tools for developing local programs for existing development loading reduction. This would involve more fully defining the range of nutrient-reducing practices, appropriate reduction credits, loading estimates from developed lands, and a mutually agreeable load estimation tool. Staff would work with local governments to more fully define expectations for feasibility studies. In year four, staff would review feasibility studies and submitted programs, and approve local programs. In succeeding years, staff would monitor implementation progress and assist local governments as needed.
General Baseline	The Division currently administers a number of stormwater programs from central and regional offices. However, none of these programs require reductions from existing developed lands. Neuse and Tar-Pamlico stormwater programs require local governments to identify and report on retrofit opportunities, and the Division reviews those reports.
Assumptions	N/A
Data Sources	N/A

IA.1 Regulatory Development Costs/Savings (DWQ)

(a) Cost Baseline	Several Division staff have worked to develop loading reduction targets for the strategy, collect data and other information, draft rules and fiscal estimates, and coordinate and participate in stakeholder meetings.
(b) Description	Division planning or other stormwater staff would continue to work with stakeholders during rule implementation as described above.
(c) Quantify $	$0
(d) Quantification Method	The Division would rely on existing resources to implement the rule.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (DWQ)

(a) Cost Baseline	This would be a new activity for Division staff.
(b) Description	Division planning or other stormwater staff would continue to work with stakeholders during rule implementation as described above.
(c) Quantify $	$0
(d) Quantification Method	The Division would rely on existing resources to implement the rule.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings (DWQ)

(a) Cost Baseline	The Division has a number of stormwater permitting staff and planning staff whose roles could be expanded.
(b) Description	Division planning or other stormwater staff would continue to work with stakeholders during rule implementation as described above.
(c) Quantify $	$0
(d) Quantification Method	The Division would rely on existing resources to implement the rule.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.4 Inspection and Enforcement Costs/Savings (DWQ)

(a) Cost Baseline	The Division has a number of stormwater permitting, planning, and compliance staff whose roles could be expanded.
(b) Description	Division planning or other stormwater staff would continue to work with stakeholders during rule implementation as described above.
(c) Quantify $	$0
(d) Quantification Method	The Division would rely on existing resources to implement the rule.
(e) Assumptions	N/A
(f) Data Sources	N/A

Table 5:18: Existing Development Cost Summary

Type of Cost	State Costs						
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total	Full (30-Yr) Total
Capital	$0	$0	$0	$0	$0	**$0**	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**	**$0**
Planning	$0	$0	$0	$0	$0	**$0**	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Type of Cost	Local Government Costs						
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	5-Yr Total	Full (30-Yr) Total
Capital	$0	$0	$0	$0	$14,545,561	**$14,545,561**	**$436,366,831**
Operation & Maintenance	$0	$0	$0	$0	$107,509	**$107,509**	**$49,991,754**
Planning	$0	$0	$0	$0	$1,715,494	**$1,715,494**	**$51,464,812**
Regulatory Transaction	$0	$0	$0	$0	$54,294	**$54,294**	**$1,628,813**
Opportunity	$0	$0	$0	$0	$0	**$0**	**$0**
Trading Credit	$0	$0	$0	$0	-$23,201	**-$23,201**	**-$10,788,543**
Total	**$0**	**$0**	**$0**	**$0**	**$16,399,657**	**$16,399,657**	**$528,663,667**

Type of Cost	Private Costs						
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total	Full (30-Yr) Total
Capital	$0	$0	$0	$0	$0	**$0**	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**	**$0**
Planning	$0	$0	$0	$0	$0	**$0**	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Chapter 6: Protection of Existing Riparian Buffers

Step 1: Basic Information

1.1 Rule Reference No.	.0267
1.2 Analyst	Rich Gannon, Environmental Supervisor
1.3 Office	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 ext. 356
1.5 Comments on Agency Contact	None
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Protection of Existing Riparian Buffers
1.7 Citation	15A NCAC 2B .0267
1.8 Brief Description of the Proposed Rule	Requires all local governments to protect existing vegetated riparian areas 50 feet wide adjacent to intermittent and perennial waters within their jurisdictions. Existing, ongoing activities within buffers could continue, but a change in land use would invoke the protections. Certain activities within the buffer are allowable or allowable with mitigation, both requiring approval. The rule includes variance criteria and other specifics.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint. Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Jordan Reservoir, and more than four-fifths of phosphorus inputs. Protection and restoration of riparian buffers would serve a valuable role in stemming nonpoint loading increases and achieving load reductions when land uses change.

3.2 How does the Proposed Rule Change Behavior?

Baseline: Currently 51% of the watershed falls within smaller Water Supply watersheds, which require 30-foot or 100-foot setbacks for new impervious surfaces depending on development intensity, but which apply to fewer waters (perennial streams only vs. intermittent and perennial under this rule) than the

proposed rule, are less protective in regard to vegetation modifications, and are potentially more permissive regarding structures.

In addition, some local governments have enacted more restrictive buffer protection ordinances than the minimum Water Supply standards of their own initiative.

Finally, NPDES stormwater Phase II requirements will be in place before this rule would take effect. Phase II imposes a 30-foot setback on impervious surfaces associated with development activities adjacent to perennial and intermittent waters, and will apply to virtually all jurisdictions in the watershed.

Behavior Changes: This rule would preclude people from undertaking most new activities within 50 feet of waterways throughout the watershed. It would allow certain named activities, such as road crossings, utilities, and water dependent structures, and would require mitigation for some of these. Local governments would implement the rule on all lands except state and federal, where the Division would instead. A variance process is included for hardship cases, with major variances requiring Commission approval.

This rule would place more stringent controls than any of the above regulations on the first 30 feet adjacent to waters, mandating that vegetation in this zone remain largely undisturbed. Grading and vegetation disturbance would be allowed in the landward 20 feet provided areas are revegetated promptly. Unlike other buffer regulations, maintenance of diffuse flow to buffers would be required, the rule would apply across all land uses, it would apply these controls to a greater proportion of streams by including intermittent streams, it would require establishment of vegetated buffers during a change of land use, and it would require mitigation for activities deemed necessary.

The parties most affected by the proposed rule would be those whose business involves new activities within the buffer. Primarily these are developers, including state road-building development, and forest harvesting operations. Parties engaged in these activities would be required to avoid unnecessary impacts, minimize necessary impacts, and mitigate for them through buffer restoration or other equivalent offsetting measures. A land use not addressed by other buffer rules that would be significantly affected by this rule would be managed forest lands, which would face restrictions on forest harvesting activities that go beyond any current regulatory mandate.

Table 6.2 below summarizes current buffer protection regulations.

Table 6.1: Protection of Existing Riparian Buffers Rule Timeline

Activity	Assumed Date*	Elapsed Time After Effective Date
Effective Date	9/1/2008	0 months
Submit Local Program to DWQ.	3/1/2009	6 months
DWQ requests EMC approval.	9/1/2009	1 year
EMC approval		
LGs adopt and implement programs.	11/1/2009	14 months
LGs submit annual reports summarizing implementation activities.		

*Based on effective date of September 1, 2008.

Step 4: Identify Impact

The succeeding rule, Mitigation for Riparian Buffers, .0268, provides the specifics of the mitigation process requirements, but since this rule establishes the requirements to mitigate, we include mitigation costs in this chapter in addition to the costs associated with protecting existing buffers.

4-A. Regulated Parties: There are two types of regulated parties. *Landowners* would need to comply with the rule's activity restrictions, answering to local governments, and *local governments* would need to comply with the implementation/administration requirements, answering to the Division. We discuss the two parties separately.

RP.0 Party Description

Name of Party	**Property Owners**
Description	Land owners along perennial and intermittent streams, lakes and ponds in the Jordan Reservoir watershed, irrespective of land use. Affected parties would include farmers, developers, commercial and industrial land owners, public land managers, forestry interests, and residential property owners with existing vegetation alongside affected waterbodies. Ditches and manmade conveyances other than modified natural streams are exempt from this rule.
General Baseline	Please see the description in Step 3.2 above.

Table 6.2: Buffer Protection: Local Buffer Programs in the Jordan Watershed

Local Government	Affected Waters	Setbacks (each side)		Restrictions in Setbacks
		Low Density	High Density	
WS-II	Perennial	30[1] (up to 12% built-upon	100[1] (12%- 30% built-upon	See note 4 on next page
WSII-Critical Area		(up to 6% built-upon area)	(6%- 24% built-upon area)[3]	
Counties that are part of WSII Watersheds: Alamance, Caswell, Chatham & Orange				
Cities or Towns that are part of WSII Watersheds: Carrboro, Green Level & Mebane				
WS-III	Perennial	30[1] (up to 24% built-upon area)[3]	100[1] (24%- 50% built-upon	See note 4 on next page
WSIII-Critical Area		(up to 12% upon area)[2]	(12%- 30% built-upon area)	
Counties that are part of WSIII Watersheds: Forsyth, Guilford & Rockingham				
Cities or Towns that are part of WSIII Watersheds: Greensboro, Kernersville, Oak Ridge, Reidsville, Stokesdale & Summerfield				
WS-IV	Perennial	30[1] (up to 24% built-upon area)[3]	100[1] (24%- 70% built-upon	See note 4 on next page
WSIV-Critical Area		(up to 24% built-upon area)[3]	(24%- 50% built-upon area)	
Counties that are part of WSIV Watersheds: Alamance, Chatham, Durham, Guilford, Orange & Wake				
Cities or Towns that are part of WSIV Watersheds: Alamance (barely), Apex, Burlington (barely), Carrboro (barely), Cary, Chapel Hill, Durham, Greensboro (barely), Morrisville (barely), Pittsboro, Pleasant Garden, Sedalia, Whitsett				

(Table 6.2 continues on next page with local government program listings).

Table 6.2: Buffer Protection: Local Buffer Programs in the Jordan Watershed (cont.)

NPDES Stormwater Phase II		Perennial & Intermittent USDA & USGS maps	30'		When surface waters are not present in accordance with the provision of 15A NCAC 0233(3)(a) or Section 11(a) of Senate Bill 1566
Town of Apex		Perennial & Intermittent, Ponds & Lakes	-50' for Intermittent[1], -100' for Perennial[1], -50' for lakes and ponds, -100' for lakes and pond that joins with a perennial stream		Opinion or written statement from DWQ
City of Burlington		Perennial, WS Reservoirs	50' from top of bank. (up to 6% max. built-upon or 1 du / 2 acres)	100' from top of bank. (6% - 24% max. built -upon area 1.5 du / acre)	Within an approved, planned, cluster development.
		Water Supply Reservoirs	100' "natural" buffer from normal pool elevation		
		Unmapped streams where regulatory flood elevations or floodways have not been provided (FEMA)	Average width of the streambed plus 15'-30' (measured from stream centerline), depending upon the area of drainage		
			Town tries to maintain at least 15-foot undisturbed buffer on projects permitted through their local erosion and Sediment Control Program		
Town of Carrboro	Inside University Lake Waters	a Intermittent flowing directly and indirectly into University Lake	50' from edge of floodplain (center of stream if no floodplain demarcated) plus and addition dist. equal to: 4 x slope x 100		Crossing by a street, bikeway, sidewalk, water or sewer line or pump station or water dependent structure with provisions. Other exceptions include replacement of single family residence[5]
		b -Intermittent flowing into creeks and tributaries	50' perpendicularly from steam centerline		
		c -Intermittent flowing directly into University Lake	100' perpendicularly from centerline		
		d -Intermittent flowing into streams which flow directly into University	50' from centerline		
		e University Lake	100' perpendicularly from high water mark or floodplain boundary (whichever is farthest) plus an additional dist. equal to: 4 x slope x 100		
		f Streams outside of the University Lake Watershed[6]	50' or 5 times the avg. width of the stream as it flows through the property in question, whichever is larger[1]		
		g Streams outside of the University Lake Watershed[7]	15' or 5 times the avg. width of the stream as it flow through the property in question, whichever is larger[1]		
Town of Chapel Hill		Perennial & Intermittent Streams[8] and Perennial Water Bodies within Chapel Hill's Resource Conservation District (RCD)	50' to 150', depending on when the lot was created.		Exceptions include exist. single-family home expansions outside the regulatory flood plain.
Town of Cary		Perennial, Intermittent, and some connected Ephemeral	50' to all soil survey indicated streams 100' to USGS indicated streams		Opinion or written statement from DWQ
			Within Watershed Protection Overlay District: 30' min.	100' min	
City of Durham		Perennial & Intermittent	-Minimum of 50' -150' for perennial and 100' for intermittent for streams that are located in Durham's Watershed Protection Overlay "Jordan District A" as defined in Article 4.11.2(A) of Durham's Unified Development Ordinance (UDO): -100' for perennial streams in "Jordan District B" and 50' for intermittent (100' for high density option)		Crossing by street driveway, railroads, recreational features, intakes, docks, utilities, bridges, stormwater control, septic system drainfield repair, sanitary sewer lines, and trails allowed with provisions.
Durham County		Perennial & Intermittent	At least 50'		
Town of Greensboro		Water Supply Lakes, Ponds, and Perennial Streams (in corporation limits) (Lakes Mackintosh, Randleman, Higgins, Brandt, & Townsend)	Low Density11	High Density[11]	See note 10 below
			30'	100'	
		Perennial Streams and Drainage Channels draining an area equal to or greater than 50 acres	50'		
Orange County		Compare to Town of Carrboro. a-d: Replace "University Lake" with "University Lake, Cane Creek, and Upper Eno Watershed". e: Water Supply reservoirs within University Lake, Cane Creek, and Upper Eno Watersheds	Orange County's Setbacks are comparable to the Town of Carrboro's Setbacks (a-e). A portion of Orange County lies in the Neuse River Basin and has different buffer rules for this area. All non-Neuse buffers have a minimum of 65'.		
		Designated Trout Waters	25' from top of bank		
Wake County[9]		Water Supply Impoundments	30' for 5-25 acres of drainage area 50' for 25+ acres of drainage area		See note 12 below
		Perennial streams on USGS topographic. map	100'		
		Non-perennial watercourse, channels, ditches or similar physiographic features	30' for 5-25 acres of drainage area 50' for 25+ acres of drainage area		

[1]Beginning at the most landward limit of the top of bank or the rooted herbaceous vegetation, measured horizontally on a line perpendicular to the surface water

[2]One dwelling unit (u) of single family detached development per acre (40,000 square foot lot excluding roadway right-of-way) or 12% built-upon on area for all other residential and non-residential development in the watershed outside of the critical area

[3]Two dwelling units (du) of single family detached development per acre (20,000 square foot lot excluding roadway right-of-way) or 24% built-upon on area for all other residential and non-residential development; or three dwelling units per acre or 36% built-upon area for projects without curb and gutter street systems in the protected area outside of the critical area

[4]Exceptions include water dependent structures, flag poles, signs and security lights that result in only diminimus increases in impervious area, and public projects such as road crossings and green when no alternative exists.

[5]If such home replaces a home that had been located within such buffer within six months prior to the effective date of Section 15-254 of the Town of Carrboro Land Use Ordinance.

[6]Drainage areas smaller than one square mile (640 acres) in area, and where there are no mapped regulatory floodplains, but larger than 50 acres in area

[7]Drainage areas smaller than 50 acres in size

[8]Intermittent buffers required on lots created after January 2003.

[9]Neuse River Basin applies for lands within the Neuse River and Cape Fear River Basins. IN the event of conflict with other applicable regulations, the more restrictive regulation governs.

[10]Some silviculture activity, ongoing agricultural actives, water dependent structures, road crossings, driveway crossings, railroad crossings, bridges, airport facilities utility crossings, stream restorati project, scientific studies, stream gauging, and passive recreation facilities such as boardwalks, trails, pathways, historic preservation and archeological actives where no practical alternative exist; stream crossing associated with timber harvesting, periodic mowing and removal of plant products, grading and timber harvesting, stormwater mngmt. facilities and ponds, corridors for the construc and management of utility lines, and stream restoration projects with provisions. (See 30-7-1.8 (L) of Greensboro's Zoning, Planning and Development Ordinance.)

[11]Densities vary depending which Watershed class the water is in (WS-III or WS-IV). See above.

[12]Archaeological act ivies, bridges, dam maintenance activities, drainage ditches, roadside ditches, stormwater outfall, drainage of a pond, sing-family dwelling driveways, utility lines, pedestrian bike equestrian, public and private recreation trails, railroad crossings, removal of previous fill or debris, public and private road crossings, scientific studies and stream gauging, stormwater managemer ponds, stream restoration, stream bank stabilization, temporary in-stream sediment and erosion control measures, vegetation management, water-dependent structures, and wetland restoration. Most of these exceptions have restrictions, and are only allowed if there is no other alternative

RP.1 Annual Capital Costs/Savings (ACS/S) (Landowners)

(a) Cost Baseline	Existing local Water Supply setback programs do not result in capital expenses beyond erosion control measures to parties undertaking activities within setbacks. The state Erosion and Sedimentation Control program, implemented by the Division of Land Resources, also requires such measures, as well as prompt revegetation of disturbed areas, for all activities disturbing more than one acre.
(b) Description	*Existing Developed Lands:* Based on Division experience implementing the Neuse and Tar-Pamlico buffer rules, we find that for the great majority of developed lands, including agriculturally developed lands, land use patterns are established, and a rule that allows ongoing uses of the buffer to continue while protecting existing vegetated buffers presents no significant new costs. In our experience, minor incursions associated with occasional property improvements present no significant new costs. Landowners would likely take steps to revegetate areas they disturb regardless of this rule's requirement. Also, the rule includes a lengthy table of uses that exempts many types of minor incursions, further limiting the likelihood of new costs. It also exempts land disturbance in the outer 20 feet, or Zone 2, of the buffer provided that the area is promptly revegetated. The vast majority of buffers on agricultural lands are long-term in nature and only likely to be put back into service under very favorable economic conditions. The trend by agriculture since the initiation of cost share funding for buffers by state and federal agriculture cost share programs in the 1990's has generally been net increases in buffer acres. Also, while our analysis does not attempt economic forecasting, trends to date appear to have moved further away from favorable conditions for converting buffers to cropland, a relatively expensive activity. *New Development:* We identify two types of potential costs to new development (exclusive of DOT road-building, addressed below): opportunity costs of setting aside riparian areas into buffers and capital costs involving a) establishing diffuse flow of stormwater runoff from developed lands into protected buffers, as required by the rule, and b) mitigating unavoidable buffer impacts. Opportunity costs are addressed in the "other costs" section below. Capital costs for providing diffuse flow would come from installing flow-spreading devices called level spreaders at stormwater outfalls. This would be necessary where stormwater is collected on site and cannot be discharged into an existing ditch or pipe because either none exists or an existing one cannot accommodate the flow increase. Also, some development acres would be lot area adjacent and draining to buffers in a diffuse manner, which would not require flow diffusion. Thus, level spreaders would be needed on a portion of new development acres, which we estimated as three-quarters based on Neuse and Tar-Pamlico local government input. Capital costs tied to mitigation result from unavoidable impacts as part of development, which would be approved by local governments as "allowable with mitigation".

(b) Description (continued)

DOT Road-Building: Staff with the NC Department of Transportation have projected the extent of the agency's road-building activities in the watershed for the foreseeable future. They have identified three types of costs: capital, operational, and planning. Capital costs include mitigation costs to offset buffer losses resulting from road crossings, and stormwater devices for flow diffusion and management needed to meet buffer protection aspects of this rule. These requirements are separate from and in addition to stormwater requirements the agency faces in the Jordan State and Federal Entities Stormwater rule, .0271.

Forest Harvesting: The rule restricts timber harvest in the first 30 feet of buffer, or Zone 1, to half of existing trees, with a minimum return frequency of 15 years. Staff with the Division of Forest Resources has identified capital and opportunity costs stemming from this restriction. Capital costs would be the increase in logging costs resulting from using selective removal methods.

(c) Quantify $

The parties facing significant capital costs from this rule are *New Development*, *DOT*, and *Forest Harvesting* activities. We sum those costs as follows:

Table 6.3: Buffer Protection & Mitigation: Capital Costs to Landowners

	Buffer Costs to All Landowners: DOT, Forestry, New Development					
Type of Cost	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	**$727,493**	**$3,029,910**	**$3,029,910**	**$3,029,910**	**$3,029,910**	**$12,847,133**
Operation & Maintenance	$3,905	$34,011	$64,118	$94,224	$124,330	$320,588
Planning	$45,496	$107,652	$107,652	$107,652	$107,652	$476,105
Regulatory Transaction	$0	$0	$0	$0	$0	$0
Opportunity	$0	$1,003,853	$1,003,853	$1,003,853	$1,003,853	$4,015,412
Total	**$776,894**	**$4,175,427**	**$4,205,533**	**$4,235,639**	**$4,265,745**	**$17,659,238**

(d) Quantification Method

Existing Developed Lands: N/A.

New Development: We estimated the capital cost to development of installing *level spreaders* to protect buffers at **$249,000/yr**, applicable in years 2 through 5, since local buffer implementation would begin in year 2. This value is the product of acres new development and per-acre installation cost, using the following steps:

- Assumed a level spreader unit-cost of $6.50 / linear foot level spreader,
- Converted that cost to $130 / drainage acre assuming 50 feet of level spreader per BMP and 2.5 acres drainage area per BMP.
- Estimated average annual new development acres during the first 5 years from yearly new development acres estimated in the New Development rule calculations; result = 2,550 ac/yr.
- Assumed that 75% of new development acres, or 1,913 acres, would be routed through level spreaders.
- Multiplied 1,913 ac/yr by $130/ac, = approximately $249,000/yr.

(d) Quantification Method (continued)

We estimated the capital cost to new development associated with *mitigating* unavoidable buffer impacts at **$1,870,000/yr**, applicable in years 2 through 5, since local buffer implementation would begin in year 2. This value is the product of acres of buffer impacted per year, the per-acre offset fee proposed in the Mitigation Fees Rule .0272, and the acreage multipliers proposed in the Mitigation Rule .0268, using the following steps:

- Fraction of 2,550 ac/yr new development that is buffer = 10%
- Fraction of buffer permitted for impact and mitigation = 10% = 26 ac/yr
- Offset fee proposed in Rule .0272 = $30,492/ac
- Weighted multiplier (per .0268) mitigation ratio of 2.4 [3.0*(30 ft./50 ft) + 1.5*(20 ft/50 ft)], assumes all impact acres are equally distributed across zones 1 and 2 of buffer
- Product of the above factors = $1,870,000/yr.

DOT Road-Building: DOT staff developed buffer protection and mitigation cost projections based on the current 2004-2010 DOT Transportation Improvement Plan for the state, their key planning document that contains the most current road-building projections. DOT staff used these steps for estimating *protection* costs:

- Intersected proposed roads for next 30 years and USGS streams GIS layers to identify anticipated number of crossings, and annualized the number;
- Identified the types of stormwater practices to be used and frequency for each relative to crossings;
- Quantified per-BMP construction costs based on their practice to date;
- Multiplied costs by numbers of BMPs.

They used these additional steps for *mitigation* costs:

- Estimated acreage of a typical buffer impact;
- Multiplied by the number of projected annual impacts obtained above;
- Multiplied by $.70/ft^2, the buffer offset fee to the NC EEP proposed in Rule .0272, to arrive at a total annual capital cost for mitigation; and
- We added a final step, applying the weighted multiplier (per .0268) mitigation ratio of 2.4 [3.0*(30 ft./50 ft) + 1.5*(20 ft/50 ft)], assumes all impact acres are equally distributed across zones 1 and 2 of buffer

DOT's portion of the total costs shown in Table 6.3 above is provided below in Table 6.4. Calculations assume a constant rate of implementation throughout the five years.

Table 6.4: Buffer Protection & Mitigation: DOT Total Capital Costs

	5-Year DOT-Estimated Costs		
Type of Cost	Buffer Protection	Buffer Mitigation	Total
Capital	$568,700	$3,068,762	$3,637,462
Operation & Maintenance	$58,575	$0	$58,575
Planning	$227,480	$0	$227,480
Regulatory Transaction	$0	$0	$0
Opportunity	$0	$0	$0
Other Costs	$0	$0	$0
Total	**$854,755**	**$3,068,762**	**$3,923,517**

(d) Quantification Method (continued)

Thus, annual costs would be one-fifth of the total for each category except o&m, where costs would increase incrementally as BMPs are added each year, starting with a year 1 o&m cost of approximately $4,000. DOT would incur costs in all 5 years, since buffer requirements on state entities would go into effect as of rule effective date.

Table 6.5: Buffer Protection & Mitigation: DOT Annual Capital Costs

Type of Cost	Total DOT Annual Buffer Costs (Protection + Mitigation)					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	**$727,492**	**$727,492**	**$727,492**	**$727,492**	**$727,492**	**$3,637,462**
Operation & Maintenance	$3,905	$7,810	$11,715	$15,620	$19,525	$58,575
Planning	$45,496	$45,496	$45,496	$45,496	$45,496	$227,480
Regulatory Transaction	$0	$0	$0	$0	$0	$0
Opportunity	$0	$0	$0	$0	$0	$0
Other Costs						
Total	**$776,893**	**$780,798**	**$784,703**	**$788,608**	**$792,513**	**$3,923,517**

(d) Quantification Method (continued)

Forest Harvesting: DFR staff used the following sequence of calculations to estimate anticipated capital costs in the form of increased logging costs.

Table 6.6: Buffer Protection: Forestry Capital Costs

Tons Sawtimber Taken from Jordan W'shed/Yr	1,032,000
(Published totals for Jordan counties[1], adjusted for area in Jordan watershed)	
% of Jordan W'shed in Harvestable Forest	53%
(Based on w'shed model[2] landcovers and conserved lands data from NC NHP[3])	
Stream Miles in Harvestable Forest	2,324
(Avg. 2 methods - drainage density[4] & DWQ calc using Cp. Fear Basin Plan data)	
% of W'shed in Harvestable Forest in Zone 1	2.8%
(Ac. conversion assuming 60 ft2 buffer (Zone 1 x 2 sides) per linear ft. of stream)	
Tons Sawtimber Taken from Harvestable Zone 1/Yr	28,874
(2.8% x tons/yr for w'shed)	
Increased Unit Cost of Logging due to Rule ($/Ton)	$6.50
(DFR+industry-estimated 50% increase in $13 per-ton logging cost)	
Annual Capital Increase in Harvest Cost ($/Yr)	**$ 187,682**
(Product of zone 1 tonnage and increased unit cost)	
Total Capital Increase in Harvest Cost, Years 1-5 ($)	**$ 750,729**
(Cost would begin with year 2 when local programs start)	

(e) Assumptions

We assume no costs associated with buffer protection on existing developed lands, including agriculturally developed.

We assume that all parties would meet mitigation requirements by paying the offset fee to NC EEP or a like-priced alternative. This should be a conservative, higher cost assumption considering that in practice, parties would likely use alternatives to the EEP payment only if they were less expensive.

New Development:

- Unit-cost value for level spreaders: the NC Stormwater BMP Manual considers costs too site-specific to generalize. We used the midpoint, $6.50/l.f., of a value range provided in the Neuse SET tool, $3 - $10/l.f.

(e) Assumptions (continued)	▪ We assume a 2.5-acre drainage area per 50-foot level spreader. The NC Stormwater BMP Manual puts a 5-acre ceiling on drainage area per BMP. ▪ We assume an average pace of development in the watershed during the first five years of rule implementation of 2,550 acres per year. We projected this acreage in the existing and new development rule calculations. Please see those chapters for details. ▪ Some development acres would be routed into ditches following existing drainage patterns. We assume 75% of new development would be routed through level spreaders, based on an informal poll of a few local governments implementing Neuse and Tar-Pamlico stormwater rules. ▪ We assume that 5% of buffers on new development lands would be permitted for impact and mitigation each year. This estimate is based on our experience in the other basins and recognizes that some permitted impacts do not require mitigation. ▪ We assume that all developers who obtain approval to mitigate buffer impacts would use the offset fee payment option proposed in Rule .0272. Again based on our experience in other basins, this option has proven to be the choice in the great majority of cases. *DOT Road-Building:* ▪ We understand that the 2004-2010 DOT Transportation Improvement Plan provides a representative sample of the types and numbers of projects that would be subject to this rule. Many of the actual projects currently in the TIP, which is updated constantly, would likely be vested and not subject to this rule's requirements, but we assume the TIP provides a good estimate of the pace and nature of road-building overall, notwithstanding reduced costs in early rule years. To the extent that projects during the first years of implementation would be determined to have vested status, our cost estimates are conservative ***overestimates*** of actual costs. ▪ We assume that the streams data layer used by DOT accurately estimates the extent of streams falling under this rule. Based on experience implementing the Neuse and Tar-Pamlico buffer rules, we believe it underrepresents to some degree perennial and intermittent streams subject to this rule. To that extent, our cost projections ***underestimate*** actual costs. *Forest Harvesting:* ▪ We assume county-wide timber harvest tonnages apply proportionally to area within the watershed. ▪ DFR staff and industry personnel estimated a 50% increase in unit-cost of logging within Zone 1 of the buffer.

(f) Data Sources	**Forestry Cost References** 1 Brown, Mark J, 2002. *Forest Statistics for North Carolina, 2002*. USDA-Forest Service Southern Research Station, Resource Bulletin SRS-88. Page 66, Table 37. 2 Tetra Tech. B. Everett Jordan Lake TMDL Watershed Model Development. Revised Draft, November 2003. 3 NC Natural Heritage Program. Conserved Lands GIS Data Layers provided to DWQ staff. 4 Bruton, JG 2004. *Headwater catchments: estimating surface drainage extent across North Carolina and correlations between land use, near stream, and water quality indicators in the Piedmont physiographic region* [dissertation]. North Carolina State University, Raleigh, NC. 92 pp. 5 Lakel, W.A. III, WM Aust, A Dolloff, and EP Sharp, 2006. Commercial Timber Value of Streamside Management Zones in Managed Pine and Hardwood Stands. Pp. 407-408. *In:* Connor, Kristina F. ed.2006. Proceedings of the 13th Biennial Southern Silvicultural Research Conference. USDA-Forest Service, Southern Research Station. General Technical Report SRS-92.

RP.2 Annual Operating Costs/Savings (AOC/S) (Landowners)

(a) Cost Baseline	Existing Water Supply and other buffer programs do not result in operating costs to landowners since they: apply only to new development activities, which are short-term in nature; they do not require maintenance of stormwater flows; and do not require mitigation that might entail O&M on restoration work. We consider any erosion control expenses as capital since they would be short-term in nature.
(b) Description	*Existing Developed Lands:* No operating costs, consistent with the logic for capital costs. *New Development and DOT Road-Building:* Periodic operation and maintenance costs for level spreaders that provide diffuse flow into protected buffers. *Forest Harvesting:* No new operating costs identified associated with harvesting restrictions. Capital and opportunity costs only.
(c) Quantify $	**Table 6.7: Buffer Protection: Landowner Operation and Maintenance Costs**

	Buffer Costs to All Landowners: DOT, Forestry, New Development					
Type of Cost	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Total**
Capital	$727,492	$3,029,910	$3,029,910	$3,029,910	$3,029,910	$12,847,133
Operation & Maintenance	**$3,905**	**$34,011**	**$64,118**	**$94,224**	**$124,330**	**$320,588**
Planning	$45,496	$107,652	$107,652	$107,652	$107,652	$476,105
Regulatory Transaction	$0	$0	$0	$0	$0	$0
Opportunity	$0	$1,003,853	$1,003,853	$1,003,853	$1,003,853	$4,015,412
Total	**$776,893**	**$4,175,427**	**$4,205,533**	**$4,235,639**	**$4,265,745**	**$17,659,238**

(d) Quantification Method	*New Development:* We estimated the annual *incremental* cost to development of maintaining level spreaders at **$26,000/yr**, applicable in years 2 through 5, since local program implementation would begin in year 2. This value is the product of acres new development and per-acre maintenance cost, using the following steps: ▪ Assumed a level spreader unit maintenance cost of $34 / level spreader, ▪ Converted that cost to $14/ drainage acre assuming a 2.5-acre drainage area. ▪ Estimated average annual new development acres during the first 5 years from yearly new development acres estimated in the New Development rule calculations; result = 2,550 ac/yr. ▪ Assumed that 75% of new development acres, or 1,913 acres, would be routed through level spreaders. ▪ Multiplied 1,913 ac/yr by $14/ac, = approximately $26,000/yr. We assume that the other capital cost to new development, buffer mitigation, would not entail associated operation and maintenance costs because those are incorporated in the single offset rate to NC EEP that we used in the capital cost calculation. *DOT Road-Building:* DOT staff estimated an annual *incremental* cost of maintaining level spreaders of **$3,900/yr**, applicable in all 5 years since the buffer protections for state and federal entities would be in place as of effective date of this rule. DOT staff quantified per-BMP maintenance costs for the several BMPs the anticipated using, all based on their implementation experience, and multiplied those per-BMP costs by the projected number of BMPs needed / year.
(e) Assumptions	*New Development:* ▪ Most of these assumptions were made initially in the capital cost calculations, and supporting reasoning was provided there. ▪ Using the annual O&M value of $137 we calculated for a filter strip / level spreader combined BMP in the stormwater rule chapters, we assumed the level spreader alone would incur one-fourth of that total cost, or $37, based on an estimate of relative areas and recognizing similar maintenance needs.
(f) Data Sources	None.

RP.3 Annual Planning Costs/Savings (APC/S) (Land Owners)

(a) Cost Baseline	Existing Water Supply and other buffer programs result in planning costs to new development associated with planning site designs to avoid and minimize buffer impacts.
(b) Description	Since new development activities currently and under incoming Phase II regulations is required to plan site designs to avoid and minimize buffer impacts, we anticipate new planning costs associated only with designing practices to maintain diffuse flow into protected buffers, not currently a requirement. This cost would occur to both developers and DOT road-building activities.

(c) Quantify $	**Table 6.8: Buffer Protection: Landowner Planning Costs**

	Buffer Costs to All Landowners: DOT, Forestry, New Development					
Type of Cost	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Total**
Capital	$727,492	$3,029,910	$3,029,910	$3,029,910	$3,029,910	$12,847,133
Operation & Maintenance	$3,905	$34,011	$64,118	$94,224	$124,330	$320,588
Planning	**$45,496**	**$107,652**	**$107,652**	**$107,652**	**$107,652**	**$476,105**
Regulatory Transaction	$0	$0	$0	$0	$0	$0
Opportunity	$0	$1,003,853	$1,003,853	$1,003,853	$1,003,853	$4,015,412
Total	**$776,893**	**$4,175,427**	**$4,205,533**	**$4,235,639**	**$4,265,745**	**$17,659,238**

(d) Quantification Method	For both DOT and development, a percentage of construction cost was used, as is frequently done to estimate planning costs. Please see Assumptions for details.
(e) Assumptions	*DOT* assumed their planning costs as 40% of construction costs based on their experience. We assumed planning costs for *new development* as 25% of construction costs, as we did for the new development rule, based on sources identified in that chapter.
(f) Data Sources	See references for planning costs in new and existing development chapters.

RP.4 Regulatory Transaction Costs/Savings (RTC/S) (Land Owners)

(a) Cost Baseline	Existing Water Supply and other buffer programs impose varying permitting costs on developers.
(b) Description	Developers and DOT would be required to obtain stormwater permits for their activities under their respective, proposed stormwater rules in this nutrient strategy. The buffer protection and mitigation requirements of this rule would be incorporated into those permitting processes. Regulatory costs for those permits are quantified in the chapters addressing those rules. The requirements of this rule would not result in increases to those costs. Forest harvesting requirements do not involve new permitting. Selective harvest in the buffer requires that loggers have a certified forest management plan or specified alternative, but this is not expected to involve new regulatory costs.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.5 Other Costs/Savings (OtC/S) (Land Owners)

(a) Cost Baseline	Existing Water Supply and other buffer programs result in opportunity costs to developers. Water Supply ordinances include a 30-foot vegetated setback adjacent to low-density projects and a 100- foot vegetated setback adjacent to high-density projects. Thus, some are less stringent and some more stringent than this rule in terms of setback distance. However, they apply only to perennial waters, perhaps half of the stream mileage covered by this rule. Existing floodplain regulations may result in opportunity costs to developers, prohibiting them from improving portions or all of riparian zones.
(b) Description	*Existing Developed Lands:* For the same reasons given in the capital costs description, we anticipate no opportunity costs from this rule in existing developed settings. *New Development:* Considering the following factors, we anticipate that opportunity costs would vary from none to significant amounts among developments: ▪ A portion of new development lands would face more stringent restrictions under this rule than under existing local buffer ordinances, as described in the baseline above. ▪ At the same time, many developers will have the ability to purchase land and plan developments with foreknowledge of buffer restrictions, minimizing loss of developable land.
(b) Description (continued)	▪ Many developers will have the ability to sell their developments or parcels within them at higher prices using conserved buffers as value-added amenities, and thus recoup the opportunity costs of the foregone land use. Studies have shown that housing prices are significantly higher for parcels located next to a buffer[1]. Developers may be prohibited from using portions or all of buffer zones due to floodplain restrictions. ▪ The variance process in this rule is intended to address developments where an unreasonably high opportunity cost results from protecting the buffer. Overall, we found that opportunity costs associated with new development are not quantifiable. *DOT Road-Building:* DOT staff did not identify opportunity costs related to their activities. *Forest Harvesting:* DFR staff identified opportunity costs associated with lost timber harvest resulting from the Zone 1 restrictions. They estimated a per-acre value for this unharvested timber and converted it to an annual cost.

(c) Quantify $

Table 6.9: Buffer Protection: Landowner Opportunity Costs

	Buffer Costs to All Landowners: DOT, Forestry, New Development					
Type of Cost	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**Total**
Capital	$727,492	$3,029,910	$3,029,910	$3,029,910	$3,029,910	$12,847,133
Operation & Maintenance	$3,905	$34,011	$64,118	$94,224	$124,330	$320,588
Planning	$45,496	$107,652	$107,652	$107,652	$107,652	$476,105
Regulatory Transaction	$0	$0	$0	$0	$0	$0
Opportunity	**$0**	**$1,003,853**	**$1,003,853**	**$1,003,853**	**$1,003,853**	**$4,015,412**
Total	**$776,893**	**$4,175,427**	**$4,205,533**	**$4,235,639**	**$4,265,745**	**$17,659,238**

(d) Quantification Method

DFR staff used the following method to estimate opportunity costs.

Table 6. 10: Buffer Protection: Opportunity Cost to Landowners of Unharvested Timber

Unit Value of Residual Timber in Harvestable Zone 1 ($/Ac)[5]	$891
Opportunity Cost for Single Harvest of Jordan Watershed	$15,057,795
(Product of unit cost increase and 16,900 harvestable zone 1 acres)	
Annual Opportunity Cost	**$1,003,853**
(Pro-rated annual cost based on 15-year thinning or harvest cycle for all lands)	

These costs would begin in year 2, when local buffer programs would be implemented.

(e) Assumptions

This analysis assumes that since a fifteen-year return period is allowed in the rule, that on whole, all buffer zones in the watershed would be harvested once over the course of 15 years, and thus that one-fifteenth of watershed buffer zones would be harvested in any given year.

(f) Data Sources

1 Schueler, T.R., 1995. Site Planning for Urban Stream Protection. Center for Watershed Protection. Metropolitan Washington Council of Governments.

5 Lakel, W.A. III, WM Aust, A Dolloff, and EP Sharp, 2006. Commercial Timber Value of Streamside Management Zones in Managed Pine and Hardwood Stands. Pp. 407-408. *In:* Connor, Kristina F. ed.2006. Proceedings of the 13th Biennial Southern Silvicultural Research Conference. USDA-Forest Service, Southern Research Station. General Technical Report SRS-92.

RP.0 Party Description (Local Governments)

Name of Party	**Local Governments**
Description	As *regulated* parties, all counties and incorporated municipalities in the watershed would be required to comply with the provisions of this rule on lands that they control. The local governments are the counties of Alamance, Caswell, Chatham, Durham, Guilford, Orange, Rockingham, and Wake, and the following municipalities: Alamance, Apex, Burlington, Carrboro, Cary, Chapel Hill, Durham, Elon, Gibsonville, Graham, Green Level, Greensboro, Haw River, Kernersville, Mebane, Morrisville, Oak, Ridge, Pittsboro, Pleasant Garden, Reidsville, Sedalia, Stokesdale, Summerfield, and Whitsett.
General Baseline	We would expect that local governments control riparian zones primarily along greenways and also some acreage in parks. These areas would largely be in some form of open space.
Assumptions	N/A
Data Sources	N/A

RP.1 Annual Capital Costs/Savings (ACS/S) (Local Governments)

(a) Cost Baseline	We would expect that local governments manage vegetation in these areas on some periodic basis and would generally continue to use these areas in the same manner.
(b) Description	We do not anticipate any new activities or associated costs to local governments as *regulated* parties under this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.2 Annual Operating Costs/Savings (AOC/S) (Local Governments)

(a) Cost Baseline	We would expect that local governments manage vegetation in these areas on some periodic basis and would generally continue to use these areas in the same manner.
(b) Description	We do not anticipate any new activities or associated costs to local governments as *regulated* parties under this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.3 Annual Planning Costs/Savings (APC/S) (Local Governments)

(a) Cost Baseline	We would expect that local governments manage vegetation in these areas on some periodic basis and would generally continue to use these areas in the same manner.

(b) Description	We do not anticipate any new activities or associated costs to local governments as *regulated* parties under this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.4 Regulatory Transaction Costs/Savings (RTC/S) (Local Governments)

(a) Cost Baseline	We would expect that local governments manage vegetation in these areas on some periodic basis and would generally continue to use these areas in the same manner.
(b) Description	We do not anticipate any new activities or associated costs to local governments as *regulated* parties under this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

4-B. Implementing Agencies.

IA.0 Party Description (Local governments)

Name of Party	**Local Governments**
Description	All counties and incorporated municipalities in the watershed would be required to implement the provisions of this rule, which would involve enacting and implementing buffer protection ordinances. The local governments are the counties of Alamance, Caswell, Chatham, Durham, Guilford, Orange, Rockingham, and Wake, and the following municipalities: Alamance, Apex, Burlington, Carrboro, Cary, Chapel Hill, Durham, Elon, Gibsonville, Graham, Green Level, Greensboro, Haw River, Kernersville, Mebane, Morrisville, Oak, Ridge, Pittsboro, Pleasant Garden, Reidsville, Sedalia, Stokesdale, Summerfield, and Whitsett.
General Baseline	Please see the Baseline description in Section 3.2 above and related Table 6.2 detailing local buffer programs.
Assumptions	N/A
Data Sources	N/A

IA.1 Regulatory Development Costs/Savings (RDC/S) (Local governments)

(a) Cost Baseline	All eight counties contain significant area in water supply watersheds. Sixteen of the twenty-six municipalities have significant area within Water Supply watersheds. Before this rule would become effective, eighteen of the twenty-six municipalities will have implemented Phase II stormwater programs involving development setbacks. In addition, several major municipalities currently implement more involved buffer rules than required by Water Supply. Altogether, we assume only two municipalities – Alamance and Ossippee - will implement neither water supply nor Phase II requirements.
(b) Description	Local governments will need to develop new ordinances to carry out this rule. However, this rule is readily transferable into ordinance with little modification.
(c) Quantify $	$48,000
(d) Quantification Method	We assumed the 16 smallest municipalities (under 10,000 population) may need to contract assistance in preparing ordinances. We assumed 80 hours of contract time per local government given the minimal text modification needs, and a pay rate of $36/hr. We did not obtain input from local governments on this cost. Other factors could influence this cost. One scenario could involve sharing of ordinance text among local governments with similar ordinance frameworks. Another is the potential for the Division to utilize grant funds to contract development of model ordinances. Either of these could greatly reduce or eliminate this cost.
(e) Assumptions	We assume that all 8 counties and the municipalities over 10,000 have planners who would absorb the rule development costs, leaving the 16 smallest municipalities that would face new costs.
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S) (Local governments)

(a) Cost Baseline	Please see the baseline description for permitting, section IA.3 below.
(b) Description	This rule would not impose specific monitoring requirements outside of inspections, which are covered below. Recordkeeping would be needed to track development projects and enforcement cases. We incorporate those costs into one set of estimates for permitting, inspections and enforcement below.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings (PC/S) (Local governments)

(a) Cost Baseline	All eight counties contain significant area in water supply watersheds. Sixteen of the twenty-six municipalities have significant area within Water Supply watersheds. Before this rule would become effective, eighteen of the twenty-six municipalities will have implemented Phase II stormwater programs involving development setbacks. In addition, several major municipalities currently implement more involved buffer rules than required by Water Supply. Altogether, we assume only two municipalities – Alamance and Ossippee - will implement neither water supply nor Phase II requirements.
(b) Description	Local governments would implement permitting programs under the new development stormwater rule, and would review for buffer requirements at the same time. Because the two activities are integrated, we address both in this chapter. The following estimate would cover costs of permitting, inspections, and enforcement for both stormwater and buffers.
(c) Quantify $	$375,000/yr for years two through five.
(d) Quantification Method	We estimated that five municipalities would each require one full-time position to implement both buffer and new development stormwater requirements. We priced the position as a stormwater engineer at a total cost of $75,000/yr.
(e) Assumptions	We assumed that most municipalities and counties implementing Phase II or Water Supply or both would likely not require new staffing. Exceptions would be relatively small towns (between 2,000 and 15,000 population) in high growth areas. We identified five of these. We assumed that larger cities and counties, including in high-growth areas, are already implementing sizable stormwater and buffer programs and would be better able to absorb the requirements of these rules without adding staff. We did not survey local governments on this subject, and we did not seek municipal growth projections.
(f) Data Sources	N/A

IA.4 Inspection and Enforcement Costs/Savings (IEC/S) (Local governments)

(a) Cost Baseline	Please see the baseline description for permitting, section IA.3 above.
(b) Description	Local governments would need to inspect and monitor permitted development projects and enforcement cases for compliance with stormwater and buffer protection or mitigation requirements. They would need to track these projects and maintain records on them.
(c) Quantify $	$0
(d) Quantification Method	We estimated the costs under permitting above to cover compliance and enforcement as well.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.0 Party Description (Division of Water Quality)

Name of Party	Division of Water Quality

Description	The Division would implement this rule directly for activities on state and federal lands, beginning as of rule effective date. For all lands under local jurisdiction, the Division would review and approve local program proposals, including ordinances, review annual implementation reports submitted by local governments, and perform any compliance oversight on local programs.
General Baseline	The Division oversees local water supply watershed programs in the watershed, which include both stormwater permitting and riparian setbacks for new development. The Division will soon implement Phase II permitting for post-construction stormwater in most jurisdictions that are not required to do so themselves. The Division issues, renews, and monitors compliance with NPDES discharge permits and state and federal non-discharge permits.
Assumptions	N/A
Data Sources	N/A

IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff develop and coordinate watershed restoration initiatives and conduct point source and nonpoint source permitting, compliance and enforcement activities.
(b) Description	Rule development involves staff time to: research rule components; plan and coordinate the rulemaking process; develop and revise rule language; research and document fiscal impacts; conduct/participate in stakeholder meetings; plan and conduct public workshops/meetings/hearings; present information to the Commission and agencies; and file and process rules, forms, etc.
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost to the Division. No new funds are requested. Tasks would be integrated into existing workloads.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff develop and coordinate watershed restoration initiatives and conduct point source and nonpoint source permitting, compliance and enforcement activities.
(b) Description	
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost to the Division. No new funds are requested. Tasks would be integrated into existing workloads.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings (PC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff develop and coordinate watershed restoration initiatives and conduct point source and nonpoint source permitting, compliance and enforcement activities.
(b) Description	
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost to the Division. No new funds are requested. Tasks would be integrated into existing workloads.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.4 Inspection and Enforcement Costs/Savings (IEC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff develop and coordinate watershed restoration initiatives and conduct point source and nonpoint source permitting, compliance and enforcement activities.
(b) Description	
(c) Quantify $	$0
(d) Quantification Method	This cost represents an opportunity cost to the Division. No new funds are requested. Tasks would be integrated into existing workloads.
(e) Assumptions	N/A
(f) Data Sources	N/A

Table 6.11: Protection and Mitigation of Existing Riparian Buffers Cost Summary

Type of Cost	DOT - State Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$727,492	$727,492	$727,492	$727,492	$727,492	**$3,637,462**
Operation & Maintenance	$3,905	$7,810	$11,715	$15,620	$19,525	**$58,575**
Planning	$45,496	$45,496	$45,496	$45,496	$45,496	**$227,480**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**
Total	**$776,893**	**$780,798**	**$784,703**	**$788,608**	**$792,513**	**$3,923,517**

Type of Cost	Local Costs					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$0	$0	$0	$0	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**
Planning	$0	$0	$0	$0	$0	**$0**
Regulatory Transaction	$48,000	$0	$0	$0	$0	**$48,000**
Opportunity	$0	$0	$0	$0	$0	**$0**
Other (Permitting/Inspecting)	$0	$375,000	$375,000	$375,000	$375,000	**$1,500,000**
Total	**$48,000**	**$375,000**	**$375,000**	**$375,000**	**$375,000**	**$1,548,000**

Type of Cost	Forestry and Developers - Private					
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Capital	$0	$2,302,418	$2,302,418	$2,302,418	$2,302,418	**$9,209,671**
Operation & Maintenance	$0	$26,201	$52,403	$78,604	$104,805	**$262,013**
Planning	$0	$62,156	$62,156	$62,156	$62,156	**$248,625**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**
Opportunity	$0	$1,003,853	$1,003,853	$1,003,853	$1,003,853	**$4,015,412**
Total	**$0**	**$3,394,628**	**$3,420,829**	**$3,447,031**	**$3,473,232**	**$13,735,720**

Chapter 7: Mitigation for Riparian Buffers

Step 1: Basic Information

1.1 Rule Reference No.	.0268
1.2 Analyst	Rich Gannon, Environmental Supervisor
1.3 Office	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 ext. 356
1.5 Comments on Agency Contact	None
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Mitigation for Riparian Buffers
1.7 Citation	15A NCAC 2B .0268
1.8 Brief Description of the Proposed Rule	Details the mitigation requirements, options and process for persons who have received local government or Division authorization for buffer activities designated "allowable with mitigation" under the riparian buffer protection rule, .0267. This Rule details three mitigation options, 1) Payment to the riparian buffer restoration fund administered by NC Environment Enhancement Program (NC EEP), 2) Donation of property, or 3) Restoration or enhancement of a non-forested riparian buffer.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint. Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Jordan Reservoir, and more than four-fifths of phosphorus inputs. Protection and restoration of riparian buffers, and mitigation for buffer impacts would serve a valuable role in stemming nonpoint loading increases and achieving load reductions when land use changes.

3.2 How does the Proposed Rule Change Behavior?

Baseline: Currently 51% of the watershed falls within smaller Water Supply watersheds, which require 30-foot or 100-foot setbacks for new impervious surfaces depending on development intensity, but which apply to fewer waters (perennial streams only vs. intermittent and perennial under this rule), are less protective than the proposed rule in regard to vegetation modifications, are potentially more permissive regarding structures, and do not require mitigation for allowable impacts.

In addition, some local governments have enacted more restrictive buffer protection ordinances than the minimum Water Supply standards of their own initiative.

Finally, NPDES stormwater Phase II requirements will be in place before this rule would take effect. Phase II imposes a 30-foot setback on impervious surfaces associated with development activities adjacent to perennial and intermittent waters, and will apply to virtually all jurisdictions in the watershed. However, it does not require mitigation for allowable buffer impacts either.

Behavior Changes: This rule does not require behavior change. Instead it would provide the mitigation requirements, options and process for persons who have received local government or Division authorization for buffer activities designated "allowable with mitigation" under the riparian buffer protection rule, .0267. The protection rule establishes the requirement to mitigate buffer impacts, and defines which impacts require mitigation, thus it requires the behavior change. This rule delineates the nature of that behavior change. It details three mitigation options, 1) Payment to the riparian buffer restoration fund administered by NC Environment Enhancement Program (NC EEP), 2) Donation of property, or 3) Restoration or enhancement of a non-forested riparian buffer.

Step 4: Identify Impact

Because the rule Protection of Existing Riparian Buffers, Rule .0267, establishes the requirement to mitigate, whereas this rule defines the process as described above, the costs to affected parties of doing mitigation are accounted for in the preceding Protection chapter, Chapter 6.

Chapter 8: Options for Offsetting Nutrient Loads

Step 1: Basic Information

1.1 Rule Reference No.	.0269
1.2 Analyst	Rich Gannon, Environmental Supervisor
1.3 Office	NC Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 ext. 356
1.5 Comments on Agency Contact	None
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Options for Offsetting Nutrient Loads
1.7 Citation	15A NCAC 2B .0269
1.87 Brief Description of the Proposed Rule	This rule provides the option to pursue alternative sources of loading reduction to persons subject to any of the three stormwater rules - new development, existing development, or state and federal entities - as well as to point sources and agriculture. These individuals may substitute such reductions for the in-lieu fee offset option of the North Carolina Ecosystem Enhancement Program (NC EEP) provided in some of those rules and for any part of loading reductions required in the existing development rule. Minimum onsite reduction criteria are defined for potential buyers and reduction credit criteria are established for potential sellers. Proposals would require Division approval.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint. Reductions vary in cost-effectiveness across and within source types. We expect that under the proposed set of rules some sources would find achieving reductions in settings within their direct control very costly to potentially cost-prohibitive. This proposed rule would provide the means by which such sources could seek more cost-effective solutions to their reduction needs by paying for other sources to obtain reductions

for them. Such arrangements could reduce overall costs of compliance with the set of rules while achieving equivalent environmental benefit.

3.2 How does the Proposed Rule Change Behavior?

No change in behavior is required. Parties may volunteer to utilize the option provided by this rule. "Sellers" would obtain excessive reductions relative to rule requirements and offer the excess to potential "buyers", who are motivated by high internal reduction costs to seek alternatives. A range of designs is possible for pricing, enabling, approving, tracking and monitoring transactions. This proposed rule currently identifies fundamental components for any structure that is developed.

Step 4: Identify Impact

Because this rule does not require any behavior change but rather provides potential alternatives to behaviors mandated in other rules, there are no new costs associated with this rule. Instead the purpose of this rule is to facilitate potential cost-reducing behaviors. Because of the numerous potential types of interactions and cost-reducing scenarios, we do not attempt to estimate the benefits this rule may provide.

Chapter 9: Wastewater Discharge Requirements

Step 1: Basic Information

1.1 Rule Reference No.	.0270
1.2 Analyst (Your Name and Title):	Michael E. Templeton, Environmental Engineer
1.3 Office (Your Organizational Location)	Division of Water Quality Point Source Branch 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 x541
1.5 Comments on Agency Contact	None
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Wastewater Discharge Requirements
1.7 Citation	15A NCAC 2B .0270
1.8 Brief Description of the Proposed Rule	This rule requires point source wastewater dischargers in the B. Everett Jordan Reservoir watershed to reduce their collective nutrient contributions to the reservoir by 2009 (total phosphorus, TP) and 2016 (total nitrogen, TN). The rule regulates the dischargers through a system of nutrient allocations similar to that in the Neuse River basin (T15A NCAC 02B .0234). The resulting mass permit limits are equivalent to 3.0 – 5.3 mg/L TN and 0.23 – 0.66 mg/L TP. By comparison, limits for Neuse River basin dischargers are equivalent to 3.7 – 5.5 mg/L TN and equal to 2.0 mg/L TP.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of nutrient reduction responsibilities across all sources, both point and nonpoint.

Point sources account for one third to one half of all nitrogen inputs to the Jordan Reservoir and slightly less than one fifth of all phosphorus inputs. The proposed rule would require wastewater dischargers to meet nitrogen and phosphorus limits that achieve the reductions necessary to protect water quality in each subwatershed. Nitrogen limits for the majority of the affected dischargers (Haw and Lower New Hope) would be similar to the default limits already required under the Clean Water Responsibility and Environmentally Sound Policy Act of 1997; those for

the Upper New Hope dischargers are only slightly above the limits of today's treatment technologies. All phosphorus limits are significantly lower than those required under the Act.

3.2 How does the Proposed Rule Change Behavior?

The wastewater discharge rule would establish a point source strategy in the Jordan watershed similar to that already found in the Neuse River Basin. It provides for the initial distribution of the allowable nutrient allocations (Wasteload Allocations) among the 48 existing dischargers in the reservoir's three subwatersheds. The rule directly affects the 15 facilities that are permitted to discharge 100,000 gpd (0.1 MGD) or greater; these facilities account for 98-99% of the point source nutrient contribution to the reservoir. It requires these dischargers to meet nitrogen and phosphorus discharge limits based on their individual allocations. The rule also establishes nutrient control requirements for existing and future point sources in the watershed.

Phosphorus Limits. The proposed rule calls for annual mass limits on Total Phosphorus (TP) for the affected facilities, effective one year after its adoption. All of the affected facilities already have phosphorus limits and perform some degree of phosphorus removal. The rule would require them to provide additional treatment to meet reduced limits. Most will likely achieve this through operational improvements (e.g., increased chemical feed rates). Because these are *mass* limits and the facilities are operating at less than their full capacities, the required level of treatment will be less stringent initially than when the plant reach their design flow rates. (See box below.)

Nitrogen Limits. The rule calls for annual mass limits on Total Nitrogen (TN) for the affected facilities, effective in 2016. Three of the 15 affected facilities already have nitrogen limits and have constructed treatment facilities to meet those limits. Two of these must eventually make some improvements to meet the new, more stringent nitrogen limits. The remaining 12 facilities must make substantial improvements to their treatment facilities in order to meet the proposed nitrogen limits by 2016. Of these, nine are already required to make essentially the same improvements under the Clean Water Responsibility Act. However, the EMC deferred those limits pending the results of the nutrient modeling efforts in the watershed, and the facilities will now be subject to the limits in this proposed rule.

Upon adoption of the rule, existing dischargers with permitted flows of 0.1 MGD or greater must optimize their operations in order to minimize nitrogen discharges until substantial improvements are completed. The Jordan Partners are already required to optimize while they pursue alternative discharge limits under the CWRA.

The rule includes requirements for new or expanding facilities. As in the Neuse, the strategy does not reserve allocations for these facilities. It allows a new or expanding discharge only if (1) no other feasible option to the discharge exists, (2) the proponent offsets its added nutrient load by obtaining allocations either from other existing point sources or from nonpoint sources (i.e., no net increase), and (3) the new treatment system is designed to meet annual mass limits no greater that the equivalent of 3.0 mg/L TN and 0.18 mg/L TP at the facility's permitted flow.

The rule allows a degree of flexibility for dischargers in reducing their nutrient contributions to the reservoir. It includes a group compliance option in which interested dischargers in each subwatershed can form an association and work collectively to meet their combined nutrient limits.

The rule allows the transfer of nutrient allocation ("trading") among dischargers, provided that the transfers do not cross subwatershed boundaries and do not cause localized water quality problems in the receiving streams. The rule specifically provides that, when one facility connects to another and eliminates its direct discharge, its nutrient allocations are transferred in full to the remaining facility.

Table 9.1: Wastewater Discharger Rule Timeline

Activity	Assumed Date*	Elapsed Time After Effective Date
Effective Date	9/1/2008	0 months
Exist. dischargers with flows greater than or equal to 0.1 MGD submit report to DWQ documenting findings, proposed actions, and expected results for optimization of nutrient reduction.	3/1/2009	6 months
Existing dischargers with flow equal to or greater than 0.1 MGD ubject to total phosphorous limits.	9/1/2009	1 year
Dischargers submit a report to DWQ documenting the measures taken and results for nutrient reduction.	9/1/2009	1 Year
Existing dischargers with flows greater than or equal to 0.1 MGD subject to total nitrogen permit limits.	1/1/2016	88 months (7 years and 4 months)
The Director establishes more stringent limits for nitrogen or phosphorus if necessary to protect water quality standards in localized areas.		

*Based on effective date of September 1, 2008.

Mass Limits

All of the nutrient discharge limits established in this rule are *mass* limits. A mass limit is equivalent to
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Flow (MGD) x Concentration (mg/L) x Conversion Factors = Mass (pounds)

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The concentration equivalent to a mass limit is a useful measure of the treatment level required to meet the limit. Many of the affected Jordan facilities currently operate at 50-60% of their permitted flo
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Step 4: Identify Impact

4-A. Regulated Parties

RP.0 Party Description (Wastewater dischargers)

Name of Party	Wastewater Dischargers
Description	Wastewater Dischargers affected by this rule are those existing and future wastewater treatment facilities (point sources) that receive nutrient-bearing wastewater, discharge to surface waters within the Jordan Reservoir watershed, and are subject to requirements for individually issued NPDES permits.
General Baseline	The Wastewater Dischargers include 48 facilities of various types – municipal (publicly owned), 100% domestic (privately owned), and commercial/ industrial facilities. Permitted flows range from 0.003 to 40 MGD. The 15 "large" facilities – those with a permitted flow of 0.1 MGD or greater – account for 98-99% of all point source nutrient contributions to the reservoir and

	are the most directly affected by the proposed rule. Each of the three subwatersheds includes at least one affected facility. Table 9.3 lists the affected facilities in each subwatershed. The eleven largest facilities are potentially subject to nutrient limits in the Clean Water Responsibility Act, as described in Section RP.1 below. The Division does not believe that limits for smaller dischargers are warranted at this time. These facilities account for only 1-2% of the point source nutrient contribution, and nutrient controls would be far less cost-effective than improvements at the larger facilities. However, any small discharger requesting an increase in its permitted flow would become subject to nutrient limits as an expanding facility. NOTE "Permitted flow" is defined as the maximum flow limit in a facility's permit as of 12/31/2001, the end of the baseline period for the nutrient modeling. However, several facilities have expanded their facilities since that time, received approval to expand, or made substantial progress toward expansion. In order to reflect these considerable efforts already underway, the rule lists them as exceptions and specifies the flow values to be used for their permitted flows.
Assumptions	The Division assumes that certain types of dischargers are unlikely to cause a significant net increase in nutrient loads to surface waters and do not merit regulation under this rule: commercial operations (e.g., non-contact cooling waters, boiler or cooling tower blowdown), water treatment plants, and groundwater remediation sites. The DWQ is not aware of specific plans for new discharges in the watershed.
Data Sources	The proposed rule. The state and federal statutes governing discharges of wastewater (NCGS 143-215.1 (including the Clean Water Responsibility Act), federal Clean Water Act). The related state and federal regulations (15A NCAC 02H .0100, 02B .0200, and Chapter 40 of the Code of Federal Regulations).

Table 9.2: Existing Wastewater Treatment Facilities With Permitted Flows ≥ 0.1 MGD

Owner		Facility Type	NPDES	Flow [1]
Upper New Hope Arm				
City of Durham	South Durham WRF	Major Municipal	NC0047597	20.0
Orange Water & Sewer Authority (OWASA)	Mason Farm WWTP	Major Municipal	NC0025241	14.5 [2]
Durham County	Triangle WWTP	Major Municipal	NC0026051	12.0 [2]
Aqua NC [3]	Chatham Water Reclamation	100% Domestic	NC0056413	0.35 [2]
Lower New Hope Arm				
Fearrington Utilities, Inc.	Fearrington Utilities WWTP	100% Domestic	NC0043559	0.5 [2]
Haw River Arm				
City of Greensboro	T.Z. Osborne WWTP	Major Municipal	NC0047384	40.0 [2]
City of Greensboro	North Buffalo Creek WWTP	Major Municipal	NC0024325	16.0
City of Burlington	Eastside WWTP	Major Municipal	NC0023868	12.0
City of Burlington	Southside WWTP	Major Municipal	NC0023876	12.0
City of Reidsville	Reidsville WWTP	Major Municipal	NC0024881	7.5
City of Graham	Graham WWTP	Major Municipal	NC0021211	3.5
City of Mebane	Mebane WWTP	Major Municipal	NC0021474	2.5
Town of Pittsboro	Pittsboro WWTP	Minor Municipal	NC0020354	2.25 [2]
Quarterstone Farm Assoc.	Quarterstone Farm WWTP	100% Domestic	NC0066966	0.20 [2]
Glen Raven, Inc.	Altamahaw Division plant	Industrial	NC0003913	0.15

Footnotes

1 Maximum permitted flows as of 2001 (baseline year), except as noted. Nutrient wasteload allocations (WLAs) for each subwatershed are divided in proportion to these flows.

2 The rule specifies alternate values for "Permitted Flows" in order to reflect permitted increases since 2001 and anticipated increases already under consideration.

3 Formerly owned by Whippoorwill LLC and known as the Carolina Meadows WWTP.

RP.1 Annual Capital Costs/Savings (ACS/S) (Wastewater Dischargers)

(a) Cost Baseline	Treatment Facilities. All dischargers currently own and operate wastewater treatment plants and bear the costs of construction, operation, and maintenance of the facilities; disposal of biosolids and other residuals; and permitting and other regulatory activities. Discharge Permits. The facilities discharge treated wastewater to surface waters within the Jordan Reservoir watershed subject to the terms and conditions of National Pollutant Discharge Elimination System (NPDES) permits administered by the Division of Water Quality. The permits include discharge limitations for flow and for pollutants of concern, monitoring and reporting requirements, and other site-specific and standard permit conditions. Permits are issued for a maximum of five years. Dischargers must submit design documents and receive an Authorization to Construct (ATC) permit from DWQ prior to constructing or substantially modifying treatment plants or their component units. Nutrient Limits. The affected facilities listed in Table 9.2 are already subject to Total Phosphorus limits (a 2.0 mg/L concentration limit for most) and have phosphorus treatment capability.

	Facilities with permitted flows of 0.5 MGD and greater are subject to the requirements of the Clean Water Responsibility Act of 1997, which specifies default mass nutrient limits (equivalent to 5.5 mg/L TN and 2.0 mg/L TP at permitted flow) for all such discharges to Nutrient Sensitive Waters. The DWQ has not applied these limits in all cases pending the outcome of nutrient response modeling for the Jordan watershed. However, the three largest facilities in the Upper New Hope subwatershed are subject to annual mass limits for Total Nitrogen and two of these have mass limits for Total Phosphorus, consistent with the Act.
(b) Description	Owners of the 15 affected treatment facilities will have to expend capital resources in order to upgrade those facilities to meet the nutrient discharge limits prescribed in the rule. The nutrient limits differ among the three subwatersheds according to each area's water quality protection needs and the resulting WLAs. Table 9.3 lists the collective nutrient allocations for "large" and "small" facilities in each subwatershed. It also shows the equivalent concentrations for each mass allocation, providing a relative measure of the treatment level the facilities must achieve before reaching their design flows. The construction and operation of treatment processes for nitrogen and phosphorus removal are somewhat independent of each other. Thus, cost estimates for meeting TN and TP limits can be calculated separately. Discharge limits for existing dischargers will be implemented in two steps: 1. Phosphorus limits – effective January 1, 2009 (the first calendar year following rulemaking). 2. Nitrogen limits – effective January 1, 2016. Due to the length of the compliance schedule, <u>cost estimates are presented for Years 1-5 (2009-2013) and for Years 6-8 (2014-2016)</u> in order to provide a more complete picture of the resulting costs. The cost estimates assume that planning & design for capital improvements will be completed in Years 1-2 and construction will follow in Years 6-7 (to ensure that the new systems will be in operation throughout 2016). The estimates include operation and maintenance (O&M) costs for all years; costs in Years 3-5 and Year 8 consist of O&M costs only. Because several of the affected dischargers must now make capital improvements already required under the CWRA but previously deferred, <u>the estimates include two sets of cost figures: one for all nutrient-related requirements and the other for those incremental improvements that go beyond the requirements of the Act.</u> Any <u>new discharger</u> must provide nutrient treatment upon startup of its treatment facilities. Any person proposing a new discharge will be required to acquire sufficient nitrogen and phosphorus allocations from existing dischargers or, alternately, from the nonpoint source load. The latter alternative is conducted through the Ecosystem Enhancement Program at a rate of $22/pound of nitrogen allocation and $2.20/pound of phosphorus allocation or as set forth in 15A NCAC 02B .0240.
(c) Quantify $	Tables 9.4 and 9.5 summarize the estimated 2009-2016 capital costs for treatment plant improvements required to comply with the proposed rule.

	The estimates cover this extended period in order to include the full implementation period and provide a more complete picture of the resulting costs. Table 9.4 shows the total costs for all nutrient-related improvements, including those required under the Clean Water Restoration Act of 1997. Table 9.5 shows only the incremental cost of nutrient controls beyond those specified in the Act. New Dischargers. The DWQ is not aware of plans for any new discharges in the watershed. However, the rule does not prohibit such a discharge. Any person proposing a new discharge of domestic wastewater would have to acquire nitrogen and phosphorus allocations (no more than the mass equivalent to 3.0 mg/L TN and 0.18 mg/L TP at design flow) and pay for additional treatment processes to meet the resulting permit limits. The current rate for allocations from the Ecosystem Enhancement Program (EEP) is 200% x $11/lb TN, or $22/lb, and $11/0.1 lb TP (pending review of proposed revisions by the NC General Assembly). Assuming best available technology for a new 0.5 MGD plant, allocation costs would be: 3.0 mg/L TN x 0.5 MGD x 8.34 lb/gal x 365 d/yr x $22/lb x 30 yr = $3,014,000 TN allocation 0.18 mg/L TP x 0.5 MGD x 8.34 lb/gal x 365 d/yr x $11/0.1 lb x 30 yr = $904,000 TP allocation Using the methods described below, the incremental capital costs for nutrient removal would be approximately $5.7 million (2006 dollars). The total capital costs associated with nutrient reduction would then total $9.6 million (or $19.20/gallon).
(d) Quantification Method	Cost Estimate Methods: Chesapeake Bay Watershed Cost estimates for the Regulated Parties are based primarily upon the methodologies and estimates reported in 2002 for 540 wastewater treatment plants in the Chesapeake Bay watershed. Many of those plants will be subject to annual mass nutrient limits equivalent to 3.0 mg/L TN and 0.1 mg/L TP by 2010. The Chesapeake Bay task force assumed that most dischargers would make incremental improvements in order to meet the new nutrient limits by 2010. Four tiers of nutrient treatment were identified, ranging from "none" to full 2010 compliance (Table 9.6), and the plant improvements most likely to be used reach each tier were selected (Table 9.7). The team then calculated, for each facility, the capital costs and the associated operations & maintenance (O&M) costs for each tier. Table 9.8 shows how the Chesapeake tiers correspond to the nutrient targets for the Jordan Reservoir point sources. The Chesapeake treatment facilities were divided according to facility type and size, because different types of facilities can require different treatment processes (hence, differing costs) to meet the same nutrient targets; and economies of scale also affect the costs for plants of different sizes. The groups were large municipal facilities (those ≥ 0.5 MGD), large industrial facilities (also ≥ 0.5 MGD), and smaller facilities. Nitrogen and phosphorus treatment generally require different treatment units and also have separate O&M needs, so the costs for nitrogen and

	phosphorus treatment improvements were estimated separately. The Chesapeake estimates are based on cost data from actual project bids as well as detailed cost estimates that had already been prepared for the affected facilities. Where detailed estimates were not available, a task force used the larger collection of cost data to generate cost curves for large facilities and small, TN and TP improvements, capital and O&M costs. It calculated capital and O&M cost estimates for each facility and for each tier. All cost data (and cost curves) were standardized to July 2000 dollars using the Engineering News-Record Building Cost Index ($CCI_{July\ 2000}$ = 6400, $CCI_{July\ 2006}$ = 7763). *Total Phosphorus.* Municipal treatment systems can generally reduce total phosphorus to approximately 0.5 mg/L using chemical addition and gravity settling. They must supplement these with other treatment processes to consistently reach TP concentrations down to 0.1 mg/L. For simplicity's sake, the capital cost estimate presented here assume that all facilities with limits equivalent to less than 0.5 mg/L TP will supplement chemical treatment with low-pressure membrane filtration. Given the relative expense of filtration technology at this time, the estimates should also be sufficient for any facility preferring to install biological phosphorus removal instead. Most or all large dischargers in the Haw River Arm already use chemical addition and will be able to meet their target of 0.66 mg/L TP by increasing chemical feed rates. They will not have to make capital improvements to the systems but will face increased operating expenses due to additional chemical use and sludge disposal costs. Dischargers in the Upper and Lower New Hope Arms will also be able to meet the new phosphorus limits initially without capital improvements. They will likely have to complete capital improvements within the next 5-10 years in order to meet their more stringent TP limits (targets of 0.23 and 0.37 mg/L TP, respectively). Capital cost estimates for these facilities are based on supplementing the existing chemical feed processes with low-pressure microfiltration. *Total Nitrogen.* Municipal treatment facilities can generally reduce total nitrogen to approximately 8 mg/L by adding anoxic cells to their existing biological systems; to 5 mg/L by adding secondary anoxic units with methanol feed; and to 3 mg/L by supplementing these with deep-bed denitrification filters, also with methanol feed. All affected facilities in the Haw River and Lower New Hope Arms will have to expend capital resources for plant in order to meet their new limits (equivalent to 5.29 and 5.35 mg/L TN, respectively). Three of four facilities in the Upper New Hope Arm already have the ability to denitrify with anoxic units. Two of these have deep-bed filters necessary to meet their new limits (equivalent to 3.04 mg/L TN). The two remaining facilities must still make improvements to meet their limits. <u>Cost Estimate Methods: Jordan Reservoir Watershed</u> As shown in Table 9.8, the treatment levels in the Chesapeake Bay tiers correspond well to the targets in the Jordan Reservoir watershed. The capital cost estimates in Tables 9.4 and 9.5 take into account the existing nutrient treatment capabilities of the affected facilities and the level of nutrient treatment required to meet the proposed limits. The Chesapeake cost curves were then used to estimate the costs for necessary treatment improvements at the Jordan facilities, individually and then collectively.

	The Chesapeake Bay report notes that its estimates are based on actual cost data from past projects and should be useful on a watershed scale. But it also warns that, because of the many site-specific factors involved, its estimates for most facilities are order-of-magnitude estimates with an accuracy of -30 to +50% and should not be confused with detailed budgetary estimates for those individual facilities. Thus, these cost estimates do not include figures for individual dischargers in the Jordan watershed. The capital cost estimates are for fixed capital costs that will occur once during the first ten years of implementation of the proposed rule.
(e) Assumptions	The capital costs for wastewater dischargers are based primarily on the Chesapeake Bay report as described above. The Division of Water Quality assumes that the overall approach and assumptions used in that project are reasonable and applicable to the Jordan Reservoir dischargers. The assumptions described in the report are incorporated into this fiscal note.
(f) Data Sources	*"Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed,"* Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task Force, 2002. Available for download at *http://www.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf* Clean Water Responsibility and Environmentally Sound Policy Act, or "HB515," S.L. 1997-458, codified at NCGS 143.215-1(c). 15A NCAC 02B .0240 Nutrient Offset Payments (current offset payment rates are in effect in 2007 while proposed rule revisions are under review)

Table 9.3: Nutrient Wasteload Allocations

DISCHARGER SUBCATEGORIES		TOTAL NITROGEN		TOTAL PHOSPHORUS	
		Wasteload Allocation	Equiv. Conc.	Allocation	Conc.
		(lb/yr)	(mg/L)	(lb/yr)	(mg/L)
Upper New Hope Arm					
Permitted Flows ≥ 0.1 MGD	4	332,467	3.04	22,498	0.23
Permitted Flows < 0.1 MGD	5	3,613	12.0	608	2.0
Lower New Hope Arm					
Permitted Flows ≥ 0.1 MGD	1	6,836	5.35	498	0.37
Permitted Flows < 0.1 MGD	0	0	N/A	0	N/A
Haw River Arm					
Permitted Flows ≥ 0.1 MGD	10	881,757	5.29	104,004	0.66
Permitted Flows < 0.1 MGD	28	13,370	12.0	1,996	2.0

Table 9.4: Estimated Costs For Total Nitrogen and Total Phosphorus Reductions - Full Cost by Regulated Party and by Discharge Location

		PLANNING		CAPITAL		O&M		TOTAL		
SOURCES	**#**	**Years 1-5**	**Years 6-8**	**Years 1-5**	**Years 6-8**	**Years 1-5**	**Years 6-8**	**Years 1-5**	**Years 6-8**	**Years 1-8**
Regulated Parties										
Local Governments	11	$48,964,000	$0	$0	$197,974,000	$6,275,000	$14,603,000	$55,239,000	$212,577,000	$267,816,000
Private	4	$1,621,000	$0	$0	$6,556,000	$290,000	$668,000	$1,911,000	$7,224,000	$9,135,000
Total	15	$50,585,000	$0	$0	$204,530,000	$6,565,000	$15,271,000	$57,150,000	$219,801,000	$276,951,000
Discharge Location										
Upper New Hope	4	$11,638,000	$0	$0	$47,056,000	$2,120,000	$8,875,000	$13,758,000	$55,931,000	$69,689,000
Lower New Hope	1	$799,000	$0	$0	$3,230,000	$75,000	$281,000	$874,000	$3,511,000	$4,385,000
Haw River	10	$38,148,000	$0	$0	$154,244,000	$4,370,000	$6,115,000	$42,518,000	$160,359,000	$202,877,000
Total	15	$50,585,000	$0	$0	$204,530,000	$6,565,000	$15,271,000	$57,150,000	$219,801,000	$276,951,000

Table 9.5: Estimated Costs For Total Nitrogen and Total Phosphorus Reductions - Incremental Costs (Beyond CWRA) by Regulated Party and by Discharge Location

		PLANNING		CAPITAL		O&M		TOTAL		
Dischargers	**#**	**Years 1-5**	**Years 6-8**	**Years 1-5**	**Years 6-8**	**Years 1-5**	**Years 6-8**	**Years 1-5**	**Years 6-8**	**Years 1-8**
Regulated Parties										
Local Governments	11	$11,102,000	$0	$0	$44,888,000	$6,275,000	$14,603,000	$17,377,000	$59,491,000	$76,868,000
Private	4	$896,000	$0	$0	$3,622,000	$290,000	$668,000	$1,186,000	$4,290,000	$5,476,000
Total	15	$11,998,000	$0	$0	$48,510,000	$6,565,000	$15,271,000	$18,563,000	$63,781,000	$82,344,000
Discharge Location										
Upper New Hope	4	$11,638,000	$0	$0	$47,056,000	$2,120,000	$8,875,000	$13,758,000	$55,931,000	$69,689,000
Lower New Hope	1	$206,000	$0	$0	$834,000	$75,000	$281,000	$281,000	$1,115,000	$1,396,000
Haw River	10	$154,000	$0	$0	$620,000	$4,370,000	$6,115,000	$4,524,000	$6,735,000	$11,259,000
Total	15	$11,998,000	$0	$0	$48,510,000	$6,565,000	$15,271,000	$18,563,000	$63,781,000	$82,344,000

Table 9.6: Tiers Used For Chesapeake Bay Point Source Cost Estimates *

Point Source Category	Tier 2	Tier 3	Tier 4
Municipal WWTPs ≥0.5 MGD	TN = 8.0 mg/L TP = 1.0 mg/L Or permit limit if less	TN = 5.0 mg/L TP = 0.5 mg/L Or permit limit if less	TN = 3.0 mg/L TP = 0.1 mg/L
Municipal WWTPs <0.5 MGD	TN and TP = 2000 concentrations	TN and TP = 2000 concentrations	TN = 8.0 mg/L TP = 2.0 mg/L Or 2000 conc. if less

* Concentrations are annual average values, equivalent to annual mass limits at permitted flows.

Table 9.7: Treatment Technologies Assumed Necessary To Reach Each Tier

Nutrient	Tier 2	Tier 3	Tier 4
Total Nitrogen	Nitrification, basic denitrification	Improved nitrification, clarification, secondary anoxic zone	Deep-bed denitrification filters
Total Phosphorus	Chemical precipitation	Chemical precipitation	Metal salt addition with microfiltration

Table 9.8: Equivalence of Jordan Limits and Chesapeake Treatment Tiers

Nutrient	Tier 2	Tier 3	Tier 4
Upper New Hope		Existing TN & TP (Durham) Existing TP (Durham Co.)	Existing TN (Durham Co.) TP, 2009 TN, 2016
Lower New Hope		TP, 2009 TN, 2016	
Haw River	TP, 2009	TN, 2016	
Dischargers ≥ 0.5 MGD to NSWs **	TP = 2 mg/L, 2003	TN = 5.5 mg/L, 2003	
Chesapeake Bay watershed			TN & TP, 2010

** Default limits from the Clean Water Responsibility Act (1997); concentrations are the basis for annual mass limits.

RP.2 Annual Operating Costs/Savings (AOC/S) (Wastewater dischargers)

(a) Cost Baseline	All dischargers currently own and operate wastewater treatment plants and bear the costs of facility operation and maintenance (O&M). The affected facilities (Table 9.2) are already subject to Total Phosphorus limits (a 2.0 mg/L concentration limit for most) and operate treatment systems installed to meet those limits. Three of the four largest facilities in the Upper New Hope subwatershed are subject to annual mass limits for Total Nitrogen and have undertaken facility improvements to meet those limits. The remaining facilities in the Jordan watershed are not designed to remove nitrogen. However, in part because their wastewater flows are less than design flows, they may be able to achieve some nitrogen removal through innovative operation of the facilities (optimization).
(b) Description	Operation and maintenance costs will vary depending on the type and size of treatment system and the improvements required to meet new nutrient limits. All of the affected facilities are subject to permit limits on total phosphorus, and most use chemical addition and gravity settling to remove phosphorus and meet those limits. These same treatment practices can typically treat to approximately 0.5 mg/L TP if chemical feed rates are increased. The higher feed rates, in turn, result in increased sludge production and related disposal costs. Supplemental treatment is required to meet lower limits. Capital cost estimates for such cases are based on the use of membrane filtration with chemical treatment. The O&M costs for improved phosphorus removal include those for increased chemical use, increased sludge production, and (if membranes are used) membrane maintenance and replacement. Most wastewater treatment facilities in the watershed are already required to nitrify the wastewater (converting ammonia to nitrate nitrogen). Several of the affected facilities also provide denitrification (converting nitrates to nitrogen gas) to complete the nitrogen removal process necessary to meet either permit limits (Upper New Hope Arm) or the optimization requirements under the CWRA (1997). The added O&M costs for improved nitrogen removal can include those for methanol, added solids production, energy, and maintenance (annual cost assumed to be 2% of the capital cost).
(c) Quantify $	Tables 9.4 and 9.5 summarize the estimated 2009-2016 operations and maintenance costs associated with treatment plant improvements required to comply with the proposed rule. The estimates cover this extended period in order to include the full implementation period and provide a more complete picture of the resulting costs. Table 9.4 shows the <u>total</u> costs for these improvements, including those required under the Clean Water Restoration Act of 1997. Table 9.5 shows only the <u>incremental</u> cost of nutrient controls beyond those specified in the Act. <u>New Dischargers.</u> The same method indicates that nutrient-related O&M costs would be approximately $254,000/year (half being for the assumed membrane filtration unit).

(d) Quantification Method	As with capital costs, the O&M cost estimates for affected dischargers are based primarily upon estimates reported in 2002 for 540 wastewater treatment plants in the Chesapeake Bay watershed. The Jordan estimates are derived from cost curves in the Chesapeake report, based on the process improvements needed for each facility to meet new nutrient discharge limits.
(e) Assumptions	The O&M costs are based on the Chesapeake Bay report cited below. The assumptions described in the report are incorporated into this fiscal note.
(f) Data Sources	"*Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed*," Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task Force, 2002. Available for download at *http://www.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf*

RP.3 Annual Planning Costs/Savings (APC/S) (Wastewater dischargers)

(a) Cost Baseline	The proposed rule does not require annual planning costs. However, there are design costs associated with the process improvements required for nutrient removal. Consistent with the Chesapeake Bay project, an allowance equal to 30% of the capital cost estimates is made for "program implementation," including engineering, construction management, and legal, bonding, and administrative fees.
(b) Description	N/A
(c) Quantify $	N/A
(d) Quantification Method	N/A
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.4 Regulatory Transaction Costs/Savings (RTC/S) (Wastewater dischargers)

(a) Cost Baseline	Existing regulations require that owners of wastewater treatment facilities obtain NPDES permits for their wastewater discharges from the Division and operate in accordance with those permits. Existing regulations also require owners to obtain an "authorization to construct" permit from the Division prior to constructing or modifying any wastewater treatment units.
(b) Description	The proposed rule does not affect the requirements or costs for NPDES permit coverage. The proposed rule will require most treatment facility owners to obtain at least one ATC permit for nutrient-related treatment plant improvements. However, there is no fee for ATC permits at this time.
(c) Quantify $	N/A
(d) Quantification Method	N/A
(e) Assumptions	Existing wastewater treatment facilities will require modification to meet the new nitrogen and phosphorus limits.
(f) Data Sources	NCGS §143-215.1 (a), 15A NCAC 2H .0105

RP.5 Opportunity Costs/Savings (OpC/S) (Wastewater dischargers)

(a) Cost Baseline	Owners of the affected wastewater treatment facilities already hold NPDES permits and operate according to the terms and conditions of the permits. Most are not presently subject to discharge limitations for Total Nitrogen. All operate at less than design capacity, many at approximately half of design flows, and so have some opportunity to use that "surplus" capacity for nutrient removal while it is available.
(b) Description	Experience in the Neuse River basin indicates that treatment plants operating well below their design capacity can often use operational changes or low-cost plant modifications to achieve some degree of Total Nitrogen removal.[1] This approach becomes less effective as flows approach the design level, and the owner must eventually make substantial changes in the treatment plant to employ biological nutrient removal processes. However, it potentially provides an owner the opportunity to meet the TN limit at relatively low cost while planning and design for the eventual plant upgrades are completed.
(c) Quantify $	Unable to quantify.
(d) Quantification Method	N/A
(e) Assumptions	All wastewater discharge facilities discharging in the Jordan Reservoir watershed are potentially subject to the proposed rules.
(f) Data Sources	[1] *"Nitrogen Reduction In Wastewater Discharge: A Successful Program By The Lower Neuse Basin Association,"* Morris V. Brookhart, P.E., 2001.

RP.6 Other Costs/Savings (OtC/S) (Wastewater dischargers)

(a) Cost Baseline	Owners of the affected wastewater treatment facilities already hold NPDES permits and operate the facilities according to the terms and conditions of the permits. Those terms and conditions include requirements for the monitoring and reporting of the discharge. Existing standards already require that the affected treatment plants be staffed with operators adequately qualified to operate their nutrient treatment processes.
(b) Description	The proposed rule will result in increased monitoring requirements and costs for some facilities. It may also result in increases in pretreatment costs for industrial contributors of nutrients to municipal WWTPs.

(c) Quantify $	Unable to quantify. The resulting costs will depend on: ▪ the size of each facility, ▪ the design and complexity of the existing treatment units, ▪ the rating of the existing facility, ▪ the waste characteristics of the industrial contributors, and ▪ the existing compliance record and the experience of the owners. Increased costs may include added compliance costs in the short-term and increasing the pretreatment levels required for industrial contributors.
(d) Quantification Method	N/A
(e) Assumptions	All wastewater discharge facilities discharging in the Jordan Reservoir watershed are potentially subject to the proposed rules.
(f) Data Sources	Fiscal Analysis: Neuse River Nutrient Sensitive Waters (NSW) Management Strategy, 1997.

Summary Table - Regulated Parties:
Table 9.9: All Nutrient-Related Costs (Including CWRA Requirements)

	Costs/ Savings	**Local Governments**		**Private - Domestic**		**Private - Industrial**	
		Total: Years 1-5	**Total: Years 6-8**	**Total: Years 1-5**	**Total: Years 6-8**	**Total: Years 1-5**	**Total: Years 6-8**
RP.1	Capital	$0	$197,974,000	$0	$6,018,000	$0	$538,000
RP.2	Operating	$6,275,000	$14,603,000[1]	$220,000	$603,000[1]	$70,000	$65,000[1]
RP.3	Planning	$48,964,000[2]	$0	$1,489,000[2]	$0	$132,000[2]	$0
RP.4	Regulatory Transaction	Unable to quantify		Unable to quantify		Unable to quantify	
RP.5	Opportunity	Unable to quantify		Unable to quantify		Unable to quantify	
RP.6	Other	Unable to quantify		Unable to quantify		Unable to quantify	
	Subtotals	$55,239,000	$212,577,000	$1,709,000	$6,621,000	$202,000	$603,000
					Total	$276,951,000	

Table 9.10: Incremental Costs (Beyond CWRA Requirements)

	Costs/ Savings	Local Governments		Private - Domestic		Private - Industrial	
		Total: Years 1-5	Total: Years 6-8	Total: Years 1-5	Total: Years 6-8	Total: Years 1-5	Total: Years 6-8
RP.1	Capital	$0	$44,888,000	$0	$3,622,000	$0	$0
RP.2	Operating	$6,275,000	$14,603,000[1]	$220,000	$603,000[1]	$70,000	$65,000[1]
RP.3	Planning	$11,102,000[2]	$0	$896,000[2]	$0	$0	$0
RP.4	Regulatory Transaction	Unable to quantify		Unable to quantify		Unable to quantify	
RP.5	Opportunity	Unable to quantify		Unable to quantify		Unable to quantify	
RP.6	Other	Unable to quantify		Unable to quantify		Unable to quantify	
	Subtotals	$17,377,000	$59,491,000	$1,116,000	$4,225,000	$70,000	$65,000
					Total	$82,344,000	

[1] Estimated O&M Costs beyond Year 8: Loc. Gov't: $12.1MM/yr; Domestic: $515K/yr; Industrial: $37K/yr.
[2] Planning and design costs for capital improvements to be constructed in Years 6-7.

Note: Although some scenarios were included to describe the costs for new treatment plants, it was not possible to predict potential additional wastewater treatment plants or flows.

4-B. Implementing Agencies

IA.0 Party Description

Name of Party	NC Division of Water Quality (DWQ) - Surface Water Protection Section, Construction Grants & Loans Section
Description	The Surface Water Protection (SWP) Section administers various water quality programs. These include the NPDES and ATC permit programs for wastewater treatment and disposal systems. The proposed rule potentially affects both regional and central office. Central office staff would conduct technical reviews of the treatment plant optimization plans and permit applications, incorporate new nutrient control requirements into the affected permits, and develop policy, as necessary; in order to ensure proper implementation of the proposed rule. Regional office staff would assist with the technical reviews and would provide compliance oversight, conduct on-site investigations to develop permit recommendations, etc. The Construction Grants and Loans (CG&L) Section administers the Authorization to Construct permits program for facilities discharging to surface waters. CG&L staff would conduct technical reviews of the engineering design and plans and specifications for any plant improvements required to meet nutrient limits and would issue ATC permits for the construction of those improvements.
General Baseline	DWQ currently administers the wastewater permitting programs for NPDES discharges and for land application of treated wastewater. These programs require wastewater treatment plant owners and operators obtain permits prior to initiating construction of treatment systems or disposal of treated wastewater (including

	sewer line construction). Existing staff currently review and issue permits for wastewater treatment and disposal.
Assumptions	N/A
Data Sources	Review of current wastewater permitting programs.

IA.1 Regulatory Development Costs/Savings (RDC/S)

(a) Cost Baseline	DWQ staff administer permit and other programs and conduct rulemaking as a regular part of its program activities.
(b) Description	Development and implementation of the proposed rule do not represent significant additional workload to the Division. All such activities would be undertaken by existing staff, therefore, DWQ would have no additional costs.
(c) Quantify $	None
(d) Quantification Method	N/A
(e) Assumptions	The existing staffing levels are sufficient to handle the workload associated with development and implementation of the rules.
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S)

(a) Cost Baseline	The Surface Water Protection Section currently monitors permit compliance and maintains records of its permitting and compliance monitoring activities under existing standard operating procedures.
(b) Description	The proposed rule will not cause any discernible increase in the Division's monitoring and recordkeeping workload.
(c) Quantify $	The proposed rule will not cause an increase in the Division's monitoring and recordkeeping costs.
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs/ Savings (PC/S)

(a) Cost Baseline	The Surface Water Protection Section currently issues NPDES permits in the basin under existing standard operating procedures. At times, the Section must apply more stringent limits in a permit in order to protect surface water quality. Such cases can represent considerable workload for Section staff, as they must document the rationale for the new limits and defend the permit against formal or informal challenges.

(b) Description	The proposed rule will establish a uniform system of discharge standards calculated to protect water quality in the Jordan Reservoir. This will result in consistent treatment of the dischargers and will relieve the Section of the need to develop protective permit limits on a case-by-case basis. Thus, it will likely reduce the staff time necessary to depend its nutrient-related permitting actions in the watershed.
(c) Quantify $	The proposed rule will likely reduce the amount of time SWP Section staff must spend to develop and implement protective nutrient limits in its NPDES permits in the Jordan Reservoir watershed and to defend those permits. This will not result in a discernible cost savings for the Division, because staff will re-direct its attention and address other priority needs within the NPDES program.
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.4 Inspection/ Enforcement Costs/Savings (IEC/S)

(a) Cost Baseline	The Water Quality Section currently inspect point sources and enforce NPDES permit in the basin under existing work plans. There will be no new inspection and enforcement costs associated with this proposed rule.
(b) Description	N/A
(c) Quantify $	N/A
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.5 Other Costs/Savings (OtC/S)

(a) Cost Baseline	Technical assistance associated with the proposed rule would be provided to local governments by existing staff. Therefore, there will be no new costs associated with this proposed rule.
(b) Description	N/A
(c) Quantify $	N/A
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

Table 9.11: Wastewater Discharge Cost Summary

Type of Cost	State Costs						
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	5-Yr Total	Full (7-Yr) Costs
Capital	$0	$0	$0	$0	$0	**$0**	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**	**$0**
Planning	$0	$0	$0	$0	$0	**$0**	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Type of Cost	Municipal / Local Government Costs						
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	5-Yr Total	Full (7-Yr) Costs
Capital	$0	$0	$0	$0	$0	**$0**	**$197,974,000**
Operation & Maintenance	$1,255,265	$1,255,265	$1,255,265	$1,255,265	$1,255,265	**$6,276,327**	**$8,785,000**
Planning	$24,482,224	$24,482,224	$0	$0	$0	**$48,964,449**	**$48,964,000**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**	**$0**
Total	**$25,737,490**	**$25,737,490**	**$1,255,265**	**$1,255,265**	**$1,255,265**	**$55,240,775**	**$255,723,000**

Type of Cost	Industrial & Domestic - Private Costs						
	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	5-Yr Total	Full (7-Yr) Costs
Capital	$0	$0	$0	$0	$0	**$0**	**$6,556,000**
Operation & Maintenance	$58,000	$58,000	$58,000	$58,000	$58,000	**$290,000**	**$406,000**
Planning	$810,000	$810,000	$0	$0	$0	**$1,620,000**	**$1,620,000**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**	**$0**
Opportunity	$0	$0	$0	$0	$0	**$0**	
Total	**$868,000**	**$868,000**	**$58,000**	**$58,000**	**$58,000**	**$1,910,000**	**$8,582,000**

Chapter 10: Stormwater Requirements for State and Federal Entities

Step 1: Basic Information

1.1 Rule Reference No.	.0266
1.2 Analyst	Rich Gannon, Environmental Supervisor
1.3 Office (Your Organizational Location)	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 ext 356
1.5 Comments on Agency Contact	DOT calculations – portions and data provided by Matt Lauffer, PE, Hydraulics Unit, NCDOT, (919) 250-4100
1.6 Title of the Proposed Rule	Jordan Water Supply Nutrient Strategy: Stormwater Requirements for State and Federal Entities
1.7 Citation	15A NCAC 2B .0271
1.8 Brief Description of the Proposed Rule	Provisions of the new and existing development stormwater rules, .0265 and .0266, are applied to state and federal entities, primarily the NC Department of Transportation (DOT) and five state universities. The Division would function as implementing agency. These parties would be required to achieve nutrient loading reductions in stormwater runoff from existing developed lands under their control toward the strategy percentage goals. They would also be required to obtain permits from the Division for new development, demonstrating that stormwater discharges from development projects would achieve export rate targets equating to the strategy percentage goals. The DOT would also implement programs to identify and remove illicit discharges to its stormwater system and conduct nutrient management education of its staff and contractors who apply fertilizer.
1.8 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Jordan Reservoir, and more than four-fifths of phosphorus inputs. Developed land uses comprise at least one-third of nonpoint inputs to the lake. State and federal lands comprise approximately 17% of developed lands, making them a substantial contributor to reservoir nutrient inputs.

3.2 How does the Proposed Rule Change Behavior?

We separate our discussion throughout this chapter into **DOT** and **universities**. The following table gives the make-up of state and federal landholdings in the watershed:

Table 10.1: State and Federal Stormwater: State/Federal Acreage in Jordan Watershed

Entity	Acres	% State/Fed
DOT	25,547	76%
Universities + Other	7,867	24%
Universities	5,678	17%
"Other" Total	2,189	7%
"Other" developed	594	2%

- DOT Area provided by NCDOT, Hydraulics Unit.
- Universities and Other acreages obtained in GIS data layers from the NC Natural Heritage Program – see Appendix B, Table B- 4.

Based on the information in Table 10.1, we chose not to estimate costs for "Other" state/federal lands – lands other than DOT and the universities. They comprise only 7% of all state/federal land and 1% of all developed land, with the developed portion equating to only 2% of all state/federal land. The other 5% is comprised of state parks and other passive recreational cultural or historic sites, all of which we would expect to load nutrients at very low levels. Thus we assumed that these "other" lands represent an insignificant portion of nutrient loads to the watershed. We did not estimate costs for them and do not discuss them further here.

This rule would require all State and Federal Entities in the Jordan Reservoir watershed to install structural and potentially non-structural stormwater treatment practices on new development projects and existing developed areas. For new development, they would obtain permits from the Division project-by-project, demonstrating that stormwater runoff meets export rate targets equating to the strategy percentage goals. Stormwater designs would also reduce peak flow rates to protect receiving waters. For existing development they would obtain approval from the Division for and implement programs involving load-reducing activities on existing developed lands at a meaningful annual rate toward the strategy goals. The DOT would also implement programs to identify and remove illicit discharges to its stormwater system and conduct nutrient management education/training of its staff and contractors who apply fertilizer.

DOT Baseline: DOT holds a Phase I NPDES Stormwater permit. The permit does *not* require water quality treatment on new development projects, thus costs associated with the new development requirements of this rule would be new. For existing development, the NPDES permit requires illicit discharge removal and nutrient management education/training programs, and it commits DOT to 'retrofitting' a total of 70 stormwater practices onto its developed lands

statewide over the 5-year permit duration that began April 2005. The two agencies have not begun to define terms of the next permit cycle, but a similar retrofit component is likely. However, the permit states that retrofits should not be used for compliance with other Division stormwater regulations. Thus for these calculations, we do not recognize reduction credit based on DOT implementing some portion of its statewide retrofit requirements in the Jordan watershed. The other two programs would entirely satisfy the illicit discharges and nutrient management training components of the existing development portion of this rule.

Universities Baseline: Five state universities have landholdings in the Jordan watershed. The Division is requiring universities to obtain Phase II NPDES Stormwater permits on a prioritized basis. North Carolina State University has obtained a permit, and one is currently being drafted for the University of North Carolina at Chapel Hill. The other three universities in the watershed – NC Central University, UNC-Greensboro, and NCA&T State University - have not yet been designated, but likely will be in the future. For these calculations we assume that all five universities will have NPDES stormwater permits in place when the requirements of this rule become effective. These NPDES permits require post-construction stormwater treatment for new development, addressing the new development requirements of this rule to the same extent as described for local governments in this section of Chapter 4. For existing development, NPDES permits (other than DOT's) do not require permittees to retrofit existing developed lands, thus the existing development costs of this rule to universities would be new.

Table 10.2: State and Federal Stormwater: DOT Implementation Timeline

	Date*	te
Effective Date	9/1/2008	0 months
NCDOT submits the stormwater management plan for DWQ	3/1/2010	18 months
DWQ requests EMC approval of plan	1/1/2011	28 months
EMC approval		
NCDOT implement approved stormwater management plan.	5/1/2011	32 months
Entities submit annual reports to DWQ.		

*Based on effective date of September 1, 2008.

Table 10.3: State and Federal Stormwater: Universities Implementation Timeline

Effective Date - DWQ begins permitting new dvlp. activities	9/1/2008	0 months
Entities submit loading reduction programs to DWQ.	9/1/2011	36 months
DWQ requests EMC approval of load reduction programs.	7/1/2012	46 months
EMC approval		
Entities to implement programs on negotiated timeframe.	9/1/2012	48 months or 2 months following EMC approval
Entities submit annual reports to DWQ.		

*Based on effective date of September 1, 2008.

Step 4: Identify Impacts

4-A. Regulated Parties

RP.0 Party Description (State and Federal Entities)

Name of Party	State and Federal entities
Description	As detailed in Section 3.2 above, the entities we address in these calculations are NC DOT and the following universities: ▪ North Carolina Agricultural and Technical State University ▪ North Carolina Central University ▪ North Carolina State University ▪ University of North Carolina at Chapel Hill ▪ University of North Carolina at Greensboro
General Baseline	Please see Section 3.2 above for a description of the parties, their acreages, regulations to which they are currently subject, and the net additional requirements imposed by this rule. We provide fairly detailed cost estimates for DOT in the following sections, however for the universities we offer simplified cost estimates for several reasons. The acreage held by the five universities in the watershed, about 5,700 acres, equates to approximately 2.8% of existing developed lands, a relatively small proportion. The reasoning we applied to local governments to project new development – based in population growth statistics and proportions of existing land uses - does not transfer well to the universities. We suspect that the character of new development in the form of land consumption may vary substantially among them. Given their small overall fraction of landholdings, the likely varying nature of both existing and new development among them, and time constraints on this analysis, we chose not to conduct a full evaluation of their loading. Instead we assumed proportional loading by the universities to that of all existing and new development based on their percentage of landholdings. We apply those percentages to the cost figures in Chapters 4 and 5 to estimate costs to the universities. We provide those figures here separately, but do not repeat them in subsequent sections. We also combine them here with the DOT estimates to give summary values for state and federal entities. The remainder of the chapter focuses on DOT costs.

Table 10.4: State and Federal Stormwater: Summary of Costs to Universities

	Total	Capital	O&M	Planning	Regul'y Transx'n	Other
2009	**$ 16,053**	$ 12,583	$ 2,229	$ 1,233	$ 7	$ -
2010	**$ 16,314**	$ 12,788	$ 2,266	$ 1,253	$ 7	$ -
2011	**$ 16,579**	$ 12,996	$ 2,303	$ 1,274	$ 7	$ -
2012	**$ 16,849**	$ 13,207	$ 2,340	$ 1,295	$ 7	$ -
2013	**$ 658,771**	$ 581,147	$ 8,130	$ 68,273	$ 2,127	$ (906)
5-Yr Total:	**$ 724,567**	**$ 632,722**	**$ 17,267**	**$ 73,328**	**$ 2,155**	**$ (906)**
Existing Dev Full Cost	**$ 20,634,283**	**$ 17,031,843**	**$ 1,951,229**	**$ 2,008,724**	**$ 63,574**	**$ (421,088)**

Table 10.5: State and Federal Stormwater: Summary of Costs to Affected Parties (DOT + Universities)

	Capital	O&M	Planning	Reg Transx'n	Total
2009	$ 12,583	$ 2,229	$ 1,233	$ 7	$ 16,053
2010	$ 12,788	$ 2,266	$ 1,253	$ 7	$ 16,314
2011	$ 2,487,834	$ 79,781	$ 690,822	$ 7	$ 3,258,444
2012	$ 3,229,345	$ 157,396	$ 954,342	$ 7	$ 4,341,091
2013	$ 3,797,286	$ 176,864	$ 1,021,321	$ 2,127	$ 4,997,597
5-Yr Total	**$ 9,539,837**	**$ 418,536**	**$ 2,668,972**	**$ 2,155**	**$ 12,629,499**
Full Exist Dev Cost	**$ 69,037,993**	**$ 8,311,529**	**$ 14,793,160**	**$ 63,574**	**$ 92,206,256**
Potential Range of Total Full Exist Dev Cost				**$78,000,000 - $616,000,000**	

Assumptions

As detailed in Section 3.2 above, we make the following general assumptions:

- We assume that "other" state and federal entities, which together occupy 2% of all state/federal lands in the watershed, represent an insignificant portion of nutrient loads to the watershed. We did not estimate costs for them and do not discuss them further here.
- We assume that retrofit requirements in DOT's current NPDES stormwater permit would not be applicable toward reduction credit under this rule.
- We assume that all five state universities in the watershed will have NPDES stormwater permits in place when the requirements of this rule become effective.

As described in the General Baseline above, to simplify cost estimates to universities we assume proportional existing and new development loading to all existing and new development in the watershed.

Data Sources

- DOT acreage provided by NCDOT, Hydraulics Unit.
- Universities and Other acreages obtained in GIS data layers from the NC Natural Heritage Program – see Appendix B, Table B- 4.
- NPDES Stormwater permitting status provided by DWQ Stormwater Unit.

RP.1 Annual Capital Costs/Savings (DOT)

(a) Cost Baseline	As described in Section 3.2 above, DOT is currently regulated under a Phase I NPDES Stormwater permit. The permit does not require treatment of new

development runoff and the existing development retrofitting requirements may not be applied toward satisfying existing reduction needs of this rule, thus all retrofitting costs of this rule would be new costs.

(b) Description

All new development treatment costs would be new. DOT estimated the number of new outfalls per year requiring treatment, the associated BMP needs, and applied per-BMP costs based on their experience to date complying with their NPDES permit.

All costs to meet the existing development portion of the rule would be new costs. DOT staff developed a high-end cost estimate based on treating every stormwater outfall on every mile of road in the watershed, equating to a total of approximately 15,000 stormwater BMPs. We developed two alternative estimates. The lower figure is based on an assumption of utilizing the NC Ecosystem Enhancement Program to perform restoration work that achieves the entire load reduction need. The middle figure estimates the number of BMPs needed to achieve the DOT load reduction target assuming that BMPs would treat co-mingled DOT and non-DOT runoff, making the most cost-effective use of installed BMPs. The total number of BMPs via this approach would be approximately 3,700. We estimate the annual load reduction target using an averaged roadway export rate applied to DOT acres in the watershed. The annual, 5-year, and full existing development costs in Table 10.6 below are based on the middle, co-mingled drainage estimate. We also provide the low and high estimates as a range in the bottom line of the table.

(c) Quantify $

Table 10.6: State and Federal Stormwater: DOT Capital Costs

	Capital	O&M	Planning	Reg Transx'n	Total
2009	$ -	**$ -**	**$ -**	$ -	$ -
2010	$ -	**$ -**	$ -	$ -	$ -
2011	**$ 2,474,838**	$ 77,478	$ 689,548	$ -	$ 3,241,864
2012	**$ 3,216,138**	$ 155,056	$ 953,048	$ -	$ 4,324,242
2013	**$ 3,216,138**	$ 168,734	$ 953,048	$ -	$ 4,337,920
5-Yr Total	**$ 8,907,115**	$ 401,268	$ 2,595,644	$ -	$ 11,904,027
Full Exist Dev Cost	**$ 52,006,150**	**$ 6,360,300**	**$ 12,784,436**	**$ -**	**$ 71,150,886**
Potential Range of Total Full Exist Dev Cost				**$58,000,000 - $595,000,000**	

(d) Quantification Method

New Development: DOT staff estimated costs using the following approach:

- New roads: Projected an annualized rate of new road (7 miles) and new bridge construction (2.3 projects) watershed-wide using the most current version of the NC DOT Transportation Improvement Plan. At an assumed 4 discharge points per mile, estimated 28 new discharge points per year.
- BMP construction costs: Projected the percent of outfalls requiring each type of stormwater practice and the number of each practice needed per outfall, separately for each subwatershed and in total. Applied per-BMP construction costs to the estimated number of each practice to yield total construction costs.
- Land purchase costs: divided projected miles of construction and numbers of bridge projects among rural and urban land in each subwatershed based on TIP-projected road locations, estimated per-acre purchase cost for urban and rural, and applied those to the acres needed for BMPs.
- O&M costs: Multiplied per-BMP maintenance costs based on experience by the projected numbers of BMPs, calculated cumulative cost values year-by-year with additional BMP implementation.

- Planning costs: Assumed 40% of construction costs.

Existing Development: DOT staff provided a conservative cost estimate assuming treatment of all road miles in the watershed: 3,730 miles, 4 discharge points per mile, a BMP at every discharge point for a total of approximately 15,000 BMPs. The total cost via this method of approximately $595 million was considered a worst-case scenario that could be avoided.

We developed two alternative scenarios, one assuming offset payments to the NC EEP to achieve the entire mass load reduction and one assuming treatment of full, co-mingled DOT and non-DOT drainage areas to meet the mass load reduction. Our final numbers reflect the second, more costly scenario, which we consider a middle ground, recognizing the potential that EEP would not be able to complete restoration work at rates needed to fully satisfy this DOT target as well as satisfying offsets from other sources. To the extent that EEP offsets could be used by DOT, actual costs may be ***lower*** than the second scenario and closer to the first.

Reduction Need: We calculated the mass load reduction need as follows:

Export Rate: The DOT contracted runoff characterization studies from its primary routes with Drs. Jy Wu and Craig Allan of UNC-Charlotte. We applied average export rates derived from those studies to all DOT road acres in the watershed:

- TN 3.17 lb N/ac-yr
- TP 0.53 lb P/ac-yr

Those calculations yielded the following table of mass load reduction needs from baseline for existing DOT roads.

Table 10.7: State and Federal Stormwater: DOT Baseline Loads and Reduction Needs

	UNH	LNH	Haw	Totals
Exist ROW (Ac)	4,821	1,489	19,238	25,547
TN				
Base TN Load (lb/yr)	15,281	4,720	60,984	80,985
TN Reduc Goal (%)	35%	0%	8%	
TN Reduc Need (lb/yr)	**5,348**	**-**	**4,879**	**10,227**
TP				
Base TP (lb/yr)	2,555	789	10,196	13,540
TP Reduc Goal (%)	5%	0%	5%	
TP Reduc Need (lb/yr)	**128**	**-**	**510**	**638**
DOT Urb/Rural Split	50/50	15/85	15/85	
DOT Wgtd Land Cost ($/Ac)	$ 90,000	$ 41,000	$ 41,000	
DOT Wgtd Land Cost ($/Ac)		$50,246		

Scenario 1, Offset Payment to EEP: We applied the offset rate formulas for TN and TP contained in Rule 15A NCAC 2B .0240, effective March 2006, to the mass load reduction needs shown in Table 10.7. While this rule is currently being reevaluated by the General Assembly, the Division believes the rates provided in this rule are reasonable estimates of costs that may be incurred by EEP to offset nutrient loads in the watershed. The resulting, rounded costs to achieve the entire existing development reduction were:

	▪ TN: $57.7 million ▪ TP: $47.9 million The offset amount paid would be the greater of these two values, since one set of restoration activities would achieve the reduction targets for both nutrients with the higher value achieving both targets. The offset formula in Rule .0240 includes a land cost factor for the BMP footprint acres, which requires land cost values. DOT staff provided estimates of rural and urban land costs in the watershed and proportional acres of each, which we converted to a weighted average for use in the formula as shown in Table 10.7. *Scenario 2, Treating Co-Mingled Drainage:* This scenario assumes that DOT would accept runoff from surrounding, non-DOT lands instead of keeping it separate from its road runoff and passing it through. DOT would install BMPs to treat this combined runoff to meet its mass load reduction needs. In practice, DOT may need to sell the reductions it achieves on runoff from land under local governments' jurisdictions to those local governments as trading credit and use the payments to fund additional BMPs until it meets its targets entirely based on DOT runoff. In either scenario, net costs to DOT would be the same except to the extent that it could sell credit at higher rates than it costs to DOT, in which case their net costs would be less than the direct calculation provided here. We calculated these costs as follows and as shown in Table 10.8: ▪ *BMP Input Loading Rate:* We calculated a watershed average export rate from all lands - developed, agricultural, and forest - equaling 5.0 lb N/ac-yr. This was based on agriculture and forest rates estimated by the watershed model and the existing developed land rate we calculated in the existing development rule chapter. ▪ *Number of BMPs Needed:* We identified a suite of five BMPs that DOT may use (expanded from the two of these that the DOT estimate assumed), projected proportions of use based on cost-effectiveness, and estimated the number of each needed to achieve the reduction mass load using the same process as the existing and new development chapters. ▪ *Costs:* We applied per-BMP construction, planning, and operation and maintenance costs provided by DOT to the numbers of BMPs needed to estimate total costs for each category. We assumed a 30-year compliance period and divided total costs by that number to yield annual costs. For O&M we calculated year one costs and compounded by the same number of additional BMPs each year to arrive at total annual and cumulative O&M costs.

Table 10.8: State and Federal Stormwater: DOT Existing Development Reduction Cost Calculations

	Assumed DOT Per-BMP Construction Cost ($/BMP)** & 2	Per-BMP DOT Capital Cost** & 2	DOT:New Dev Capital Cost Ratio	Assumed DOT Total Capital Cost ($)	DOT Planning Cost @ 40% Construx'n ($)	DOT:New Dev O&M Cost Ratio	Assumed DOT Per-BMP Annual O&M ($/BMP-Yr)	Annual O&M Increment ($/yr)	Annual O&M @ Compliance ($/yr)
Stormwater Wetland	$58,979	$233,502		$19,928,394	$2,013,459		$1,511	$4,298	$128,928
Bioretention[1]	$29,647	$31,366	3.0	$4,637,606	$1,753,388	3.88	$684	$3,372	$101,157
Wet Detention	$291,588	$368,207		$4,294,773	$1,360,435		$4,052	$1,576	$47,267
Extended Dry Detention	$63,446	$92,902		$3,389,808	$926,009		$3,645	$4,433	$132,990
Grassed Swale[1]	$4,919	$5,775	2.4	$19,755,569	$6,731,145	0	$0	$0	$0
Filter Strip/Level Spreader	$20,451	$95,300		$0	$0		$531	$0	$0
			Totals	$52,006,150	$12,784,436		Totals	$13,678	$410,342
		Avg	2.7						

1 - DOT costs available.

[2]DOT BMP sizes and costs adjusted to DWQ BMP footprint acreage.

** BMP costs other than bioret, grass swale based on avg DOT:DWQ cap cost ratio for bioretention and grass swale of 2.7:1.

(e) Assumptions	▪ We assumed that the export rates derived from Wu and Allan for primary routes reflect those from all DOT roads in the watershed. These rates are below those estimated using other methods such as the Tar-Pamlico Export Method described in the existing and new development chapters. This assumption results in lesser reduction needs and may ***underestimate*** costs. ▪ We assumed the set of BMPs and BMP proportions shown in Table 10.8. Varying either can yield significant changes to costs in ***either direction***. Due to time constraints, we did not obtain full DOT input on these factors. ▪ DOT provided per-BMP cost data for two BMPs. We assumed these estimates to be accurate. We calculated a ratio of these DOT estimates to our costs for the same BMPs for the other development rules, and applied that adjustment factor to our costs for the remaining three BMPs to approximate DOT costs for them. That ratio was 2.7:1. We would expect DOT costs to be some amount greater due to the nature of linear projects and traffic management needs on existing roadway projects. Streamlining of costs may occur through implementation. In that case, actual costs would be ***lower*** than these estimates. ▪ We assumed no trading gains on DOT's part. This would appear likely given the apparent relative cost-ineffectiveness of retrofitting roadway projects.
(f) Data Sources	Wu, J.S. and C.J. Allan, 2001. *Sampling and Testing of Stormwater Runoff from North Carolina Highways: Final Report*. UNC-Charlotte, Dept of Civil Engineering, Charlotte, NC, July 2001.

RP.2 Annual Operating Costs/Savings (State & Federal Stormwater: DOT)

(a) Cost Baseline	Please see the description in Section 3.2 above.
(b) Description	Please see the capital costs section above.

(c) Quantify $

Table 10.9: State and Federal Stormwater: DOT Maintenance Costs

	Capital	O&M	Planning	Reg Transx'n	Total
2009	$ -	**$ -**	**$ -**	$ -	$ -
2010	$ -	**$ -**	$ -	$ -	$ -
2011	$ 2,474,838	**$ 77,478**	$ 689,548	$ -	$ 3,241,864
2012	$ 3,216,138	**$ 155,056**	$ 953,048	$ -	$ 4,324,242
2013	$ 3,216,138	**$ 168,734**	$ 953,048	$ -	$ 4,337,920
5-Yr Total	$ 8,907,115	**$ 401,268**	$ 2,595,644	$ -	$ 11,904,027
Full Exist Dev Cost	**$ 52,006,150**	**$ 6,360,300**	**$ 12,784,436**	**$ -**	**$ 71,150,886**
Potential Range of Total Full Exist Dev Cost				**$58,000,000 - $595,000,000**	

(d) Quantification Method: See Capital Costs Section. O&M costs are based on DOT costs to date for retrofits under its NPDES Stormwater permit.

(e) Assumptions: See Capital Costs Section.

(f) Data Sources: See Capital Costs Section.

RP.3 Annual Planning Costs/Savings (State & Federal Stormwater: DOT)

(a) Cost Baseline: Please see Section 3.2 above.

(b) Description: Please see the Capital Costs section above.

(c) Quantify $

Table 10.10: State and Federal Stormwater: DOT Planning Costs

	Capital	O&M	Planning	Reg Transx'n	Total
2009	$ -	**$ -**	**$ -**	$ -	$ -
2010	$ -	**$ -**	$ -	$ -	$ -
2011	$ 2,474,838	$ 77,478	**$ 689,548**	$ -	$ 3,241,864
2012	$ 3,216,138	$ 155,056	**$ 953,048**	$ -	$ 4,324,242
2013	$ 3,216,138	$ 168,734	**$ 953,048**	$ -	$ 4,337,920
5-Yr Total	$ 8,907,115	$ 401,268	**$ 2,595,644**	$ -	$ 11,904,027
Full Exist Dev Cost	**$ 52,006,150**	**$ 6,360,300**	**$ 12,784,436**	**$ -**	**$ 71,150,886**
Potential Range of Total Full Exist Dev Cost				**$58,000,000 - $595,000,000**	

(d) Quantification Method: See Capital Costs Section. DOT staff assumed planning costs at 40% of construction costs.

(e) Assumptions: See Capital Costs Section.

(f) Data Sources: See Capital Costs Section.

RP.4 Regulatory Transaction Costs/Savings (State & Federal Stormwater: DOT)

(a) Cost Baseline: Please see Section 3.2 above.

(b) Description: We assumed that these costs would be absorbed into existing staff workloads.

(c) Quantify $: $0

(d) Quantification Method: N/A

(e) Assumptions: We assumed that these costs would be absorbed into existing staff workloads.

(f) Data Sources: N/A

4-B. Implementing Agencies:

Name of Party	DWQ
Description	The set of activities required by this rule would be absorbed into the workloads of existing Division staff. Division staff would administer the permitting process for new development activities on a project-by-project basis, and would conduct compliance monitoring and enforcement on permitted systems. Division staff would also review and approve proposed DOT and university programs for existing development, as well as conducting compliance monitoring and enforcement. Compliance tasks would include contacts with state entities, BMP site inspections, and obtaining and reviewing annual reports.
General Baseline	N/A
Assumptions	N/A
Data Sources	N/A

Table 10.11: State and Federal Stormwater Costs Summary

	State Costs						
Type of Cost	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**5-Year Total**	**Full (30-Yr)Total**
Capital	$12,580	$12,790	$1.9m - $13m	$1.9m - $13m	$2.5m - $14m	**$6.4m -$40m**	**$75m - $413m**
Operation & Maintenance	$2,230	$2,270	$2.3k - $215k	$2.3k - $428k	$8.1k - $647k	**$17k -$1.3m**	**$2.0m-$100m**
Planning	$1,230	$1,250	$1.2k - $3.3m	$1.2k - $3.3m	$68k - $3.4m	**$73k - $10m**	**$2.0m - $102m**
Regulatory Transaction	$7	$7	$7	$7	$2,127	**$2,155**	**$4,310**
Other	$0	$0	$0	$0	$0	**$0**	**$0**
Total	**$16,050**	**$16,320**	**$1.9m - $17m**	**$1.9m - $17m**	**$2.6m - $18m**	**$6.5m - $52m**	**$78m - $616m**

	Local Costs						
Type of Cost	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**5-yr Total**	**Full (30-Yr)Total**
Capital	$0	$0	$0	$0	$0	**$0**	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**	**$0**
Planning	$0	$0	$0	$0	$0	**$0**	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**	**$0**
Other	$0	$0	$0	$0	$0	**$0**	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

	Private Costs						
Type of Cost	**Yr 1**	**Yr 2**	**Yr 3**	**Yr 4**	**Yr 5**	**5-yr Total**	**Full Total**
Capital	$0	$0	$0	$0	$0	**$0**	**$0**
Operation & Maintenance	$0	$0	$0	$0	$0	**$0**	**$0**
Planning	$0	$0	$0	$0	$0	**$0**	**$0**
Regulatory Transaction	$0	$0	$0	$0	$0	**$0**	**$0**
Other	$0	$0	$0	$0	$0	**$0**	**$0**
Total	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Chapter 11: Riparian Buffer Mitigation Fees

Step 1: Basic Information

1.1 Rule Reference No.	.0272
1.2 Analyst	Rich Gannon, Environmental Supervisor
1.3 Office	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 ext. 356
1.5 Comments on Agency Contact	none
1.6 Title of the Proposed Rule	Riparian Buffer Mitigation Fees
1.7 Citation	15A NCAC 2B .0272
1.8 Brief Description of the Proposed Rule	This rule establishes a mitigation fee payment rate to the NC Ecosystem Enhancement Program for offsetting buffer impacts that are approved under the buffer protection rule .0267. This rule is not exclusive to the Jordan nutrient strategy. It is intended to facilitate uniform future changes in this fee across basins.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint. Protection and restoration of riparian buffers, and mitigation for buffer impacts would serve a valuable role in stemming nonpoint loading increases and achieving load reductions when land use changes.

Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Jordan Reservoir, and more than four-fifths of phosphorus inputs. Protection and restoration of riparian buffers would serve a valuable role in stemming nonpoint loading increases and achieving reductions in that loading.

3.2 How does the Proposed Rule Change Behavior?

This rule does not require behavior change. It simply establishes the fee rate for one option that would be available to persons who obtain approval to impact riparian buffers and mitigate those impacts under the riparian buffer protection rule, .0267. The protection rule establishes the

requirement to mitigate buffer impacts, and defines which impacts require mitigation, thus it requires the behavior change. The buffer mitigation rule, .0268, delineates the nature of that behavior change. It details three mitigation options, 1) Payment to the riparian buffer restoration fund administered by NC Environment Enhancement Program (NC EEP), 2) Donation of property, or 3) Restoration or enhancement of a non-forested riparian buffer. This rule sets the fee rate for the first option, payment to EEP.

Step 4: Identify Impact

This rule does not impose any new costs to affected parties. Buffer mitigation costs are accounted for in the riparian buffer protection chapter, Chapter 6. Those costs are estimated using the offset fee established in this rule.

Chapter 12: Cape Fear River Basin

Step 1: Basic Information

1.1 Rule Reference No.	.0311
1.2 Analyst	Elizabeth Kountis, Environmental Specialist
1.3 Office (Your Organizational Location)	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 733-5083 ext. 369
1.5 Comments on Agency Contact	Deborah Gore, Environmental Engineer, Point Source Branch, ext. 593 – pre-treatment facility evaluation , Raleigh Regional Office, 919-791-4200 – facility screening
1.6 Title of the Proposed Rule	Cape Fear River Basin
1.7 Citation	15A NCAC 2B .0311
1.8 Brief Description of the Proposed Rule	The basin's Schedule of Classifications, is revised to recognize the reclassification of a portion of the Jordan watershed to WS-V. Areas that already have classifications would retain their classification. Areas that are unclassified would become WS-V.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

The proposed rule would reclassify those portions of the Jordan Reservoir watershed not currently classified as some form of Water Supply to WS-V. In addition, it would designate the entire watershed of Jordan Reservoir as a Critical Water Supply Watershed under Chapter 143-214.5(b). These actions would clarify Division authority to require local governments to enact and implement ordinances to carry out rules in this strategy.

3.2 How does the Proposed Rule Change Behavior?

This rule does not dictate behavior changes. It serves to clarify authority to impose other rules in the strategy. Division staff has evaluated the effect of reclassifying the balance of the watershed to the least protective Water Supply class, WS-V. This action would impose more stringent aesthetic and human health standards on these waters. Staff evaluated domestic and industrial treatment and pre-treatment facilities and has found no significant improvements or associated new costs would be necessitated by these standards.

Appendix A: **Draft Rules**

Copies of the draft rules are available on the web at:

http://h2o.enr.state.nc.us/nps/JordanNutrientStrategy.htm

Appendix B: References, Notes and Assumptions For Stormwater Rules: Existing Development, New Development, and State & Federal

References

1	Ada Wossink and Bill Hunt. An Evaluation of Cost and Benefits of Structural Best Management Practices in North Carolina. 2003
2	NCDENR. Updated Draft Manual of Stormwater Management Practices. July 2005.
3	A. Moran and B. Hunt. BMP Cost Estimate Study. February 2004.
4	Tetra Tech. Upper Neuse Site Evaluation Tool (SET) Training. August 18, 2005.
5	Tetra Tech. Town of Cary Town Center Area Stormwater Management Plan Final Report. March 2005.
6	B. Hunt, BMP Costs and Removal Amounts. Attachment 10 in Report of Proceedings on the Proposed Changes to 15A NCAC 02B .0240, The Nutrient Offset Payments Rule, Surface Water Protection Section, NC Division of Water Quality, January 2006.
7	RTI. A Review of Highway Nutrient Runoff Studies. June 2006.
8	http://quickfacts.census.gov/qfd/index.html. 4 September 2006.
9	NCDENR. 2005 Cape Fear River Basinwide Water Quality Plan. 2005.
10	Input from local governments in the form of email and telephone conversations. Summer/Fall 2006.
11	New Development target-setting calculations data. August 2006.
12	15A NCAC 02B .0240
13	Tetra Tech. B. Everett Jordan Lake TMDL Watershed Model Development. Revised Draft, November 2003.
14	NCDENR. Watershed Planning in the Albemarle-Pamlico Estuarine System. Annual Average Nutrient Budgets. Report No. 92-10. August 1992.
15	DEM, 1996. Export Coefficients Revisited. NC Division of Environmental Management, Planning Branch. October 1996. 6pp.
16	Tar Pamlico River Basin Nutrient Export Calculation Worksheet, Piedmont. http://h2o.enr.state.nc.us/nps/tarpam.htm
17	DWQ, 1999. Percent Impervious Cover by Land Use, Synthesis of Literature Values for Use in Sugar Creek TMDLs Literature Review. NC Division of Water Quality, Planning Branch. 9 April 1999.
18	Bruton JG. 2004. Headwater catchments: estimating surface drainage extent across North Carolina and correlations between land use, near stream, and water quality indicators in the Piedmont physiographic region [dissertation]. Raleigh (NC): North Carolina State University. 92 p.
19	DWQ, 1998. Comparison of Selected P Loading Coefficients. NC Division of Water Quality, Planning Branch. June 1998.
20	https://ncosp.osp.state.nc.us:8080/CompensationCalc/CompCalc.jsp 26 September 2006.
21	http://www.cityofknoxville.org/engineering/bmp_manual/ST-08.pdf. 25 September 2006.
22	http://www.dnrec.state.de.us/water2000/Sections/Watershed/ws/PDF/Appendix%20F_IB_Costs.pdf. 25 September 2006.

Notes and Assumptions

1	Moran and Hunt (2004), Reference 3, studied sand filters, wet ponds, wetlands, and bioretention cell capital and maintenance costs. They found that costs vary with the surface area of the BMP which varies with the size of the drainage area to the BMP (which they refer to as a "watershed"). The drainage area provided in this analysis for these four BMP types is in the range of the drainage area acreage used in their calculations.
2	Land costs vary widely between rural and urban settings and between communities. We used data provided by the City and County of Durham. We adjusted their taxable value upward based on their assessment that on average taxable value represents 85% of actual cost. For bioretention, sand filters, and wetlands we retained land costs that are embedded in formulas in Reference 1, as they could not be removed from those estimates. Thus, our calculation double-counts land cost for those practices, likely overestimating as a result.
3	Though permeable pavement is an option in the draft NC BMP manual, it does not achieve nutrient reduction in the Jordan watershed, and so cost data are not provided for this BMP. Permeable pavement is more effective in sandier soils found near the coast. Rooftop management is not credited in this analysis.
4	Performances of manufactured BMP devices differ significantly. Some BMPs are manufactured to be inserted into pipes, pipe outfalls, or catchment basins to catch or treat materials in stormwater. Others chemically or biologically treat materials in water. There is a large variety of BMPs on the market. Therefore, cost data associated with manufactured BMPs has not been included in this analysis.
5	To obtain acres of county and municipal residential land, we separate residential land use categories in the Tetratech watershed model among these 2 types at the one acre lot size and larger as county and less than one acre as muni. Thus, RMH, RHH, and RVH lands are considered municipal and RVL, RLL, and RML
6	The draft DENR NC BMP manual says that the drainage area for infiltration devices should be 5 acres or less. This analysis assumes the average value for the drainage acreage, 2.5 acres. A device designed to treat the first inch of rainfall would have the following volume: Volume=9,075ft^3=(2.5 acres)x(1 inch)/(12 inches/foot)x(43,560 ft^2/acre) The manual says that costs for infiltration devices vary significantly. Using the manual in the method and the volume previously calculated, an infiltration basin's capital cost (Cost=13.2V$^{.69}$) would be $7,104. An infiltration trench's capital cost (Cost=33.7V$^{.63}$) would be $10,497. This analysis assumes the average of these two capital costs, $8,800. Neither the BMP manual nor the SET manual provide maintenance costs. The BMP manual says that the costs include mowing, sediment removal and other tasks. The BMP manual estimates the cost for mowing a buffer to be $9/acre, and this value has been applied to the maintenance of infiltration basins. The BMP manual estimates 4 feet as an average depth for a device. If a 9,075 ft^3 device is 4 feet deep then it has 2,269 ft2 or .052 acres of surface area.
8	The draft DENR NC BMP manual does not credit infiltration devices for phosphorus removal. Infiltration devices can remove 40-70% of nitrogen, but each one requires DWQ approval. This analysis assumes that infiltration devices achieve a 55% TN removal efficiency.
9	The draft DENR NC BMP manual says that the filter strip width should be 100ft/acre of drainage (width is perpendicular to flow) and be at least 50 feet long. The level spreader is 10 feet long and 300 ft wide. The BMP manual also says that drainage areas in excess of 5 acres are difficult to manage even when using a filter strip. This analysis assumes a 2.5 acre drainage area. Therefore, the BMP footprint is 12,500 ft^2 or 0.287 acres. The manual also says that the capital cost of the filter strip is $0.35/ft^2 for seed or $0.80/ft^2 for sod. The SET manual, Reference 4, says that the capital cost is $0.30/ft^2 for seed or $0.70/ft^2 for sod. This analysis assumes the average of the BMP manual, $0.58/ft^2, for capital cost. The BMP manual says that the capital and maintenance costs for the level spreader is too site-specific to generalize. The SET manual estimates $3-10/linear-foot for installation/capital costs. The average, $6.50/linear-foot is used in this analysis. The BMP manual says that maintenance costs of the level spreader and filter strip combined is $385/acre. This figure was used for maintenance cost.
10	Planning costs estimated by NC EEP for revisions to the Division's Offset Payments Rule (Reference 6) were 18-47% of construction cost, with 24% as median value. Support calculations for the Cary Stormwater Management Plan (Reference 5) estimate design costs as 25% of construction costs. Based on these two sources, we assumed planning costs at 25% of construction costs. This incorporates staffing needed to implement the rule. We conducted a separate check on this estimate by polling several larger local governments on anticipated staffing needs. Total cost via this exercise was $2.2 million/yr, reasonably consistent with our above estimate totaling $1.9 million/yr.
11	The regulatory transactions costs are assumed to be $25/BMP. The regulatory costs using this figure are 0.2% of the total cost of the project. Data from a proposed stormwater control project on Alamance Community College have permitting costs at 0.2% of the total cost of the project. Therefore, $25/BMP is assumed to be a realistic value.
12	
13	DOT's load is 3.17 lb TN/acre-yr, 0.53 lb TP/acre-yr, Reference 7. These loading rates are for primary roads. Loading data for secondary roads are not available. Secondary roads are assumed to load at the same rate as primary roads.
14	The required reductions to meet the baseline load requirements are set for four types of entities, 1.) Agriculture, 2.) NCDOT, 3.) Non-NCDOT State and Federal Entities, and 4.) Local Governments. Agriculture's load is determined directly from the watershed model, using the pasture and row-crop data provided. Research has shown NCDOT's loading rates for both TN and TP (lb/acre-year), and NCDOT has estimated that they control 25,547 acres in the Jordan watershed. NCDOT's required load is determined from this data. The remainder of the requirement is split between Non-NCDOT entities and local governments. DWQ has determined the number of Non-NCDOT acres in the watershed by comparing a variety of GIS layers. Developed Non-NCDOT land is found to control 4% of the developed watershed, excluding NCDOT and agricultural acres. Local governments control the remaining 96%. CORPS of Engineers' land surrounding the lake has been excluded from this percentage analysis. There are likely other lands that are not developed in the remaining land, however this analysis assumes that the majority of the remaining land is developed in order to simplify the analysis. -Non-NCDOT's Required Reduction=[(Total Reduction Required)-(NCDOT's Required Reduction)](4%) -Existing Development's Required Reduction=[(Total Reduction Required)-(NCDOT's Required Reduction)](96%)
15	We set proportions of BMPs used based primarily on cost-effectiveness. We also surveyed several local governments, and adjusted the cost-effectiveness weighting somewhat based on that input, which was highly variable.
16	The percentages of land of each county that fall within the watershed were estimated by visual comparison to a map. The total acres in the TMDL document (Reference 9) is 1,686 mi^2. This estimate is 1,687 mi^2.
17	Non-Residential loading rates include office, city and barren loading data.
18	"Redevelopment" new development that does not increase imperviousness from the previous land use has the option to either achieve at least the percentage loading reduction goals stated in Rule 15A NCAC 2B .0262 as applied to nitrogen and phosphorus loading from the previous development for the entire project site, or to meet the loading rate targets for new development. The local governments surveyed do not feel that there is a lot of development that does not increase imperviousness. Therefore, this analysis does not account for this option in this calculation.
19	The existing development rule does not specify the number of years that local governments will have to achieve the reduction goals (they propose a compliance timeframe based on feasibility studies they conduct). For these calculations, we assume a uniform 30-year compliance time period. We also assume a uniform BMP lifespan of 30 years.
20	Existing dev *transition* period: For N loading rates from developed lands, we relied on published values developed for the Albemarle-Pamlico region (References 14 and 15), supplemented by values estimated by the Tar-Pamlico export method, Piedmont version (Reference 16). Where these sources overlapped, they were very consistent. For P input rates, we used the Tar-Pamlico export method, which was very consistent with References 14 and 15 and a study done in the Randleman Lake watershed (Reference 19). We did not use field-scale loading rates produced by the Jordan watershed model, as they reflect generated loads as opposed to loads delivered to surface waters. In all cases, we weighted combined values by acres of each land use type from the watershed model. For average residential rate, we aggregated county and municipal values (see Average EC's). For residential and commercial/industrial loading rates after compliance with WSW or Phase II regulations, we calculated weighted rates that also reflected WSW impervious caps and the use of one BMP. For the BMP, we used a weighted average efficiency of all BMPs that achieve 85% TSS removal as required by these two regulations. For transition years 2002-2011, we assumed half of all development would fall in a WSW or Phase II community given that 50% of Jordan watershed is occupied by WSWs and that in the later years of this period additional areas would be subject to Phase II requirements. For transition period BMP input rates, we used an average untreated export rate from municipal residential and all non-residential land uses. We excluded the county residential rate from this average, assuming that retrofits would not be targeted to these low-loading areas based on cost-effectiveness considerations.

21	The agriculture loading rate is determined directly from the watershed model's pasture and row crop records. Agriculture will account for compliance with the rules differently than the stormwater rules due to the nature of their loads. As in the Neuse and the Tar-Pamlico River basins, the agriculture community will use the Nitrogen Loss Evaluation Worksheet (NLEW) to determine if they have achieved the required nitrogen reductions in each arm. A working group associated with the Tar Pamlico agricultural rule determined that phosphorus can not be accounted for quantitatively. The Phosphorus Loss Assessment Tool (PLAT) developed for the Tar-Pamlico River Basin can not be applied at a watershed scale. There is no other tool for phosphorus accounting.
22	Equations from the Wossink and Hunt report, Reference 1, were used to determine capital costs, maintenance costs, and BMP surface area: -Wetland, install $\$=3{,}852(\text{Drainage Acres})^{.484}$ -Bioretention, install $\$=[10{,}162(\text{Drainage Acres})^{1.088}+2{,}861*(\text{Drainage Acres})^{.435}]/2$ (This is an average of clay and sandy soil costs.) -Sand Filter, install $\$=47{,}888(\text{Drainage Acres})^{.882}$ -Wet Pond, install $\$=13{,}909(\text{Drainage Acres})^{.672}$ -Wetland, Annual Maintenance $\$=[4{,}502(\text{Drainage Acres})^{.153}]/20$ -Bioretention, Annual Maintenance $\$=[3{,}437(\text{Drainage Acres})^{.152}]/20$ -Sand Filter, Annual Maintenance $\$=[10{,}556(\text{Drainage Acres})^{.534}]/20$ -Wet Pond, Annual Maintenance $\$=[9{,}202(\text{Drainage Acres})^{.269}]/20$ The following surface area acreage equations are found in Reference 1. However, following discussions with local governments, DWQ learned that these footprint acres do not take the full size of the BMP into account (slopes, etc). This analysis assumes that the BMP footprint estimated by these equations should be increased by 15%: -Wetland Surface Area=.02(Drainage Acres), Piedmont equation used -Bioretention Surface Area=.025(Drainage Acres), Piedmont equation used -Sand Filter Surface Area=.017(Drainage Acres), Piedmont equation used
23	Extended Dry Detention Cost Equations: The NCDENR draft BMP manual says that the construction cost of dry extended detention basins is: Construction Cost = $(7.47)(\text{Volume})^{.78}$ [Volume in cubic feet] The NCDENR draft BMP manual also says that the maintenance costs are 3-5% of the construction cost. The maintenance costs are assumed to be 4% of the construction cost. The SET manual estimates construction costs to be: Construction Cost = $(8.16)(\text{Volume})^{.69}$ [Volume in acre-feet] The SET equation is based on Maryland and Virginia data in 1996 dollars. However, the two sources provide cost estimate equations that are similar in magnitude. The NCDENR values are used in this analysis.
24	Extended Dry Detention Volume Estimation: The cost is a function of volume. The NCDENR draft BMP manual says that the maximum depth is 10 feet. The depth of a dry extended detention basin is assumed to be 5 feet for this analysis. The NCDENR draft BMP manual says that extended dry detention basins can treat up to 75 drainage acres. This BMP is typically used where it can be hidden because it is not aesthetically pleasing. The drainage area for an extended dry detention basin is assumed to be 25 acres for this analysis because the full drainage area will probably not be used regularly. The NCDENR draft BMP manual, the SET tool, nor the Cary Stormwater Management Plan provide BMP surface area information. The SET estimates volumes to be 0.2-53 acre-feet. Cary's document estimates that at 31% imperviousness, the peak flow is 0.353 cfs: $(.353\text{ft}^3/\text{sec})\text{x}(1\text{acre}/43560\text{ft}^2)\text{x}(60\text{sec}/\text{min})\text{x}(60\text{min}/\text{hour})\text{x}(24\text{hours})=0.700165\text{acre-feet}=30{,}499.2\text{ft}^3$. (In the range recommended by the SET.) For a 5 feet deep BMP: Surface area=.700165acre-feet/5feet=0.140033acres
25	BMP cost-effectiveness divides lifetime (30 yrs) total cost by lifetime removal.
26	We use weighted average N and P cost-effectiveness rates taken from our calculations of BMP costs, reductions, and projected proportions used. Our averages are $430/lb P and $28/lb N. The phosphorus offset rate agrees very closely with the rate adopted by the EMC in January 2006 in Rule 15A NCAC B .0240, which is currently under legislative review.
27	Parties subject to the stormwater rules who over-treat for one nutrient by treating for the other nutrient can trade over-treated pounds and generate revenue. The over-treated nutrient is determined by the relative amounts of TN and TP that have to be reduced.
28	BMPs remove TN and TP simultaneously, but not at the same rate. The higher cost to remove is the total cost incurred.
29	We estimated new residential ac/yr by dividing annual population growth (people/yr) by the product of # people/house and # houses/ac. We obtained NC Census whole-county population growth data to date and projections through 2020 and converted to annual watershed pop growth using county land area proportions in the watershed. This assumes even population distribution across each county, introducing some error. People/house: we used NC Census value of 2.49. House/acre avgs differ widely between city and county. For city, we used the following provided by Durham City/County: 242,582 population/(2.49 people/house)/18,365 residential acres = 5.3 houses/ac. By contrast, Guilford County provided complete permitting data on residential lots and acres for the year July 2005-June 2006; the county's 58 cases averaged 1.0 houses/acre. Lacking data with which to project relative proportions of new development falling in city vs county but believing these two values approximate central tendency for the two cases, we averaged them for a final conversion factor of 3.15 houses/acre. A simple sensitivity analysis on this value showed that plausible variations in the city/county range (+/- .5 house/ac) varied the final cost of this rule by only 3.8-5.4%.
30	The draft NC DENR NC BMP manual says that the base capital cost of a grassed swale is $0.50/ft^2 of the footprint for residential. It does not provide a cost for non-residential, and so this analysis uses the residential figure. The manual also says that the total capital cost is 130% of the base capital cost. The manual also says that the minimum bottom width for a grass swale is 2 feet and the minimum length is 100 feet per drainage acre. We assumed a 5 foot width. Therefore, the footprint for a one acre drainage area is 500 ft$^{2.}$ or .011 acres. The manual does not give maintenance costs for the grassed swale. However, the manual says that maintenance for maintenance (mowing) a buffer is $9/acre. This cost was applied to mowing grassed swales. However, grass swales are likely to be mowed muchmore often than buffers. This analysis assumes that a grass swale is mowed 8 times a year (approximately twice each season), and
31	Timeframes used in this fiscal analysis: The baseline period ends December 31, 2001. These rules are projected to become effective mid-2008. To simplify, we use the first five full years after effective date, 2009-2013, in this analysis. We assume timely implementation following rule requirements; delays would result in lower costs during the first 5 years than we estimate.
32	The rule requires 50-ft buffers. The BMP manual assumes a buffer length of 200' (stream frontage). Therefore, the BMP footprint is 10,000 ft^2 or 0.23 acres. The draft DENR NC BMP manual says that maintenance is $9/acre and that the capital costs are $600-950/acre. This analysis assumes the average capital cost, $775/acre. The BMP manual shows that a buffer of this size can treat up to 5 acres.
33	Landowners will not incur maintenance costs for the buffer maintenance and protection rule. Based on experience from the Neuse and Tar-Pamlico River basins, landowners only choose to alter buffers if their land is eroding, in which case they would address the situation outside of the buffer rule's requirements. There may be costs associated with restricted forest harvesting activities. DWQ will consult with the forestry community to determine and quantify these costs.
34	The annual maintenance costs in literature will last for several years. The number of years that they have to be maintained, and the associated cost, is dependent on when they are installed. For instance, BMPs that are installed in 2013 will have to be maintained in years 2013, 2014, 2015, 2016,2017, 2018 etc. BMPs that are installed in 2015 will have to be maintained in 2015, 2016, 2017, 2018 etc, but they will not have to be maintained in 2013 or 2014. The fiscal analysis is required to estimate the costs within the first five years of rule implementation (2009-2013). During this timeframe, retrofits are only required in 2013. As per request by local governments, DWQ has tried to estimate the full cost of the rule.
35	Installing enough BMPs to treat the required TN load will over treat the TP load.

36	We assume that essentially all new development will fall into either a WSW (51% of Jordan watershed) or within a Phase II UA (local programs) or fall under state Phase II post-construction permitting. To determine the fraction of that development that exceeds those regulations' 24% BUA threshold for requiring treatment, we used Durham's land use composition, assigned impervious percents to each land use type, and totaled the acres exceeding 24% impervious. Based on that, 23% of all new residential development must install one BMP to meet existing regulations (for calculations see Table B-6). We thus deducted one averaged-efficiency BMP worth of load from 23% of new, untreated residential loading to obtain the residential load that we then compared to the allowed residential load for this rule. We similarly deducted one BMP worth of load from 100% of new commercial/industrial development, since all of that development would exceed 24% BUA.
37	Developers have the option of paying a per-pound offset fee in lieu of meeting full reductions on-site. However, recent legislative activity has made the future of this option uncertain. For this reason, this calculation will assume the worst-case scenario in which local governments will not have an offset fee option, and will have to achieve the full reduction on-site.
38	Local governments provided data on their land uses. In addition, we used a previous land use survey done by DWQ staff of Neuse and Tar local governments (Reference 15). We combined results from these 10 local governments into an average ratio of commercial/industrial-to-residential development.
39	The weighted average loading rate between residential and non-residential land after using one BMP is equal to the Area-Weighted Average Loading Rate of Residential and Non-Residential (lb/acre-year) minus the Average Pounds Removed Per BMP (lb/acre-year).
40	The allowed loading rates are the rates that are allowed under the new development rules. The values used in this analysis for TN and TP represent the area-weighted loading average for the watershed's three arms.
41	The Required Reduction (lb_{Excess}/year) is equal to the pounds excess per acre per year multiplied by the acres in the watershed. The watershed is comprised of both residential and non-residential land.
42	The total cost to achieve the required reduction is equal to the number of pounds of reduction (lb/year) required multiplied by the weighted average cost per pound ($/lb) to reduce the nutrient. The weighted average cost per pound ($/lb) to reduce the nutrient is determined by sum of multiplying the cost per pound ($/lb) to reduce the nutrient as previously determined for each BMP (and discussed in Note 25) by the % likelihood that the local governments will use each BMP method.
43	This takes a conservative approach that may over-estimate costs to local governments by assuming that nutrient trading for new development will be difficult and that it will not be a popular method. Therefore, nutrient trading for new development does not generate revenue for local governments in this analysis.
44	The number of acres of new residential development is determined by determining the growth in the watershed (# people/year), dividing this number by the number of people per house (2.49 people/house) as found from Reference 8, then multiplying by the number of houses per acre (2 houses/acre). The new development rule will come into effect in mid-2011. The average acres of new residential development for 2012 and 2013 are used in this analysis. These acres were calculated for the existing development rule.
45	The ratio of non-residential to residential acres is based on a staff survey of Jordan local governments, both city and county, requesting proportions of new development in different land use types. Results were variable. We used Durham City/County data because it appeared to be the most representative: values were the most central, it included both city and county, and it was cumulative. Durham values totaled 18,365 acres residential and 20,831 acres non-residential.
46	The cost associated with buying land for new devleopment for the purpose of installing buffers is accounted for under the new development rule.
47	Retrofitted BMPs may have a smaller drainage area than BMPs installed on new developments due to topography. The difference between retrofit BMPs and new development BMPs in the Jordan watershed can not be determined at this time. This analysis assumes that retrofitted BMPs will have a drainage area that is 10% smaller than the drainage area of a similar BMP on new development.
48	BMPs installed on new development will be paid for by developers but will be maintained by either local governments or property owners.
49	The average "pounds per acres per year" (lb/acre-yr) removed by each BMP on new developed lands is found by multiplying each BMP option's pounds removed per year (lb/year) by its percent likelihood that the local government will use it, and then summing these values to determine the average pounds removed per year (lb/year). Then, find the average acres per BMP by multiplying each BMP option's drainage acres by the percent likelihood that the local government will use it, and then sum these values to determine the average drainage area for BMPs. The last step is to divide the average pounds removed per year (lb/year) by the average drainage acre per BMP (acres) to get the average pounds removed per acre by BMPs in the Jordan watershed (lb/acre-year).
50	We calculated cost-effectiveness values for each BMP individually as lifetime total BMP cost divided by lifetime total pounds nutrient removed. We then produced a weighted average value across all BMPs using the percent likelihood that local governments would use each BMP type (based largely on cost-effectiveness but influenced by local gov't input). Our cost per pound removed estimates on new development are higher than those on existing development because the latter has higher nutrient input rates, allowing greater pounds removed for a given BMP % efficiency and associated cost.
51	BMP will remove nutrients for many years once they are installed. However, the number of years is unknown. This analysis assumes that BMPs remove
52	Based on input from local governments from the Neuse and Tar-Pamlico River basins who are already subject to nutrient reduction rules as well as input from several local governments in the Jordan watershed who will be subject to these rules, this analysis assumes that counties will not need new staff for the buffer and new development rules. Municialities, Existing Development: -Up to 10,000 people, 0.25 person contracted -10,000-50,000 people, 1 person hired (Haw arm), 2 people hired (Upper New Hope Arm) -50,000+, 2 people hired, Exceptions: Cary has only 1 b/c no reductions & not much in watershed, Durham said that they need 18 people. This calculation uses engineers' salaries to estimate cost. Durham has been estimated at the rate of 12 engineers Counties, existing development: -All counties hire one person Municipalities, Buffers & new development: -Municipalities 20,000-50,000 use 0.5 hired person, over 50,000 use 1 hired person
53	One full time engineer will cost $75,000 with salary, vacation, retirement, insurance, etc per reference 20. Contracted employees are assumed to cost twice that
54	In order to not require further reductions from lands that had been put into permanent easement, DWQ conducted an analysis of all of the conserved lands in the Jordan watershed (Reference 11). DWQ worked with the NC Heritage Program to identify conserved lands from a variety of GIS layers including Managed Areas (MAREA), Lands Managed for Conservation and Open Space (LMCOS), and other data layers appearing in State Property Office (SSO) data that were specifically listed as being under permanent easement or established as land trusts.
55	DWQ has determined the number of acres of land controlled by Non-NCDOT State and Federal entities using a variety of GIS layers represents ~2001 conditions. The amount of future growth for these entities, which consist largely of universities, can not be predicted. At least one of the major universities in the watershed, UNC, claims that, "Carolina is amidst the largest construction boom the campus has ever witnessed" on their website, http://constructionwatch.unc.edu/ (17 October 2006). Other universities are believed to be growing as well. This analysis assumes that the rate of development of universities (acres/year) is proportional to the increase in population of the universities (people/year). This student increase is unknown, but is assumed to be similar to the population growth of the watershed 1.1%[8,9].
56	Existing dev *baseline:* For BMP input loading rates, we use the weighted average of rates from existing developed lands *as calculated by Tt watershed model,* because we then compare the resulting BMP reductions to annual mass load reduction targets that are taken from the watershed model based on those loading rates. This contrasts with the existing dev *transition* period and new dev calculations (see Note 20).
57	New development BMP input loading rate is an area-weighted average of all developed land uses of sufficient density to require treatment to meet the watershed average new d loading targets after meeting Phase II or WSW regulations. These land uses we identified as muni residential and commercial/industrial. The input rate reflects that prior treatment. For untreated N rates, we used published values developed for the Albemarle-Pamlico region (References 14 and 15), supplemented by values estimated by the Tar-Pamlico export method, Piedmont version (Reference 16). Where these sources overlapped, they were very consistent. For untreated P rates, we used the Tar-Pamlico export method, which was very consistent with References 14 and 15 and a study done in the Randleman Lake watershed (Reference 19). We did not use field-scale loading rates produced by the Jordan watershed model, as they reflect generated loads as opposed to loads delivered to surface waters. In all cases, we weighted combined values by acres of each land use type from the watershed model. PhII/WSW treatment reflects one BMP, a weighted average efficiency of all BMPs that achieve 85% TSS removal as required by these two regulations. We assumed half of all this development would fall in a WSW or Phase II community.

58	Because we determined that meeting the nitrogen reduction requirements necessitated a greater number of BMPs (and greater costs) than that needed to meet phosphorus, we used the total number of nitrogen BMPs needed in this calculation.
59	New development Phase II-treated load: For residential, we assigned percent impervious values to Durham land use data to allow us to estimate the fraction of new residential development that would exceed 24% impervious, the treatment threshold for Phase II and most WSW classes. We reduced the resulting fraction (23%) of the residential load by one BMP worth of nutrient removal. We used an average of all BMPs' N and P efficiencies that meet an 85% TSS removal, the requirement of Phase II and WSW. We summed the result with the other, unreduced 77% of residential load for the load to compare against the target load for residential. For commercial/industrial, we used the same process but assumed half of all development would be treated for Phase II or WSW, reducing that half by one BMP's treatment efficiency.

Table B-1: Existing Development: Note 1 Data

Bioretention (acres of drainage area)	Wetlands (acres of drainage area)	Wet Ponds (acres of drainage area)	Sand Filters (acres of drainage area)
0.60	10.00	0.37	1.25
0.40	70.00	1.25	1.00
0.30	8.00	8.00	1.00
0.50	25.00	15.00	1.00
6.00	5.00	15.00	0.50
1.30	38.00	20.00	1.00
1.20	1.50	20.00	2.50
1.00	131.00	35.00	2.00
1.15	28.00	50.00	1.50
0.77	5.00	70.00	
0.25	48.00		
0.02	65.00		
5.00	200.00		
0.02	1.80		
	0.50		
	4.50		
1.32	**40.08**	**23.46**	**1.31**

Table B-2: Existing Development: Notes 2 & 38 Data

Durham City and County Land Cost Data

Description	Percent of Land in County/City	True Land Value(Note 2) ($/acre)	True Land Value, Percent-Weighted(Note 2) ($/acre)	Acres	Residential (Acres)	Non-Residential (Acres)	Notes
Commercial	4%	$251,632	$10,254	1,807		1,807	
Office	2%	$135,232	$2,334	765		765	
Industrial	8%	$80,802	$6,582	3,612		3,612	
Road Right-of-way*	11%	$0	$0	4,666		4,666	
High Density Residential	1%	$393,249	$3,817	430	430		
Med Density Residential	4%	$165,791	$6,172	1,651	1,651		
Low Density Residential	15%	$98,217	$14,609	6,595	6,595		
Very Low Density Residential	1%	$769,373	$7,067	407	407		
PUB-US Govt- nearly all Corps land	11%	$14,698	$1,657	4,999			Corps land not considered developed.
Duke University	6%	$58,315	$3,698	2,812	1,406	1,406	Half residential, half non-residential
NCCU, Durham Tech	0%	$41,361	$114	122		122	
Other land owned by NC	0%	$22,568	$75	148		148	
open space - no retrofitting	0%	$21,710	$35	71		71	
City, county, churches	7%	$27,394	$1,862	3,014		3,014	
Utilities	1%	$25,386	$289	505		505	
Agriculture, sometimes w/ res	7%	$139,625	$10,254	3,256	1,628	1,628	Half residential, half non-residential
Unknown	0%	$0	$0	143			Unknown land is not counted
Residential Open Space	7%	$8,837	$630	3,161	3,161		
Vacant	14%	$60,777	$8,463	6,174	3,087	3,087	Half residential, half non-residential
		Average:	**$77,912**	**44,338**	**18,365**	**20,831**	

Durham City/County Data

For every 1 ac residential land: **1.13** acres non-residential land is developed.

2005 Census estimated Durham County population was: 242,582 people

At 18,365 residential acres, #people / residential ac was: 13.2 People/Acre$_{residential}$

From Ref. 15, Ratio Comm/Ind : Resid'l **0.67**

From Ref. 15, No. Local Gov'ts Surveyed 9

Averaged Ratio Acres Comm/Ind : Resid'l **0.72**

Table B-3: Existing Development: Note 11 Data

Alamance Community College (ACC) Data (Upcoming Project: One bioretention lagoon with hydraulic dissipaters and drains, re-routing two streams, 100-ft buffers, erosion control on a 21-acre site)		
16.8%	$222,000	Project design
0.2%	$3,000	Permitting
9.5%	$126,000	Land acquisition
68.6%	$908,000	Clearing, grubbing, excavation, channel structures, erosion control, planting, culverts, fencing
1.1%	$15,000	Construction administration
3.8%	$50,000	Construction contingency
	$1,324,000	Total

Jordan Watershed Data				
% from Jordan Calculations	Averages from New & Existing Development Calculations	Jordan Categories	ACC Categories	% from ACC Calculations
86.8%	$43,296	Capital	1. Land Acquisition 2. Clearing, grubbing, etc	78.1%
13.1%	$6,534	Planning	1. Project Design 2. Construction Administration 3. Construction Contingency	21.7%
0.1%	$25	Regulation	1. Permitting	0.2%
	$49,855	Total		

Table B-4: Existing Development: Note 14 Data

Category	COMPLEXNAM	Acres
University Land		5,678
	UNC-CH MASON FARM,TOTTEN GRD,FINELY,	998
	UNC-CH HORACE WOULDIAMS AIRPORT	925
	UNC-CHAPEL HILL	876
	UNC-CH F O BLOOD RESEARCH LABS ETC	700
	A & T FARM AT MCCONNELL RD-FRANKLIN BLVD	568
	NCSU HOPE VALLEY FOREST	318
	U N C AT GREENSBORO	211
	UNC-CH MASON FARM	190
	A & T STATE UNIVERSITY	180
	UNC-GEN CTR FOR PUBLIC TV/SEAA CENTER	106
	NORTH CAROLINA CENTRAL UNIVERSITY	101
	UNC-CH COMPREHENSIVE LIVING & LEARNING CENTER	79
	UNCG AND NCA&T/OLD NC SCHOOL FOR THE DEAF PROPERTY	78
	UNC-GEN CHAPEL HILL TV TRANSMITTER TOWER SITE	67
	UNC-CH AIRPORT RD PHYSICAL PLANT	61
	UNC-G/UNC-GEN CANE CRK OBSERVATORY SITE	61
	UNC-CH ANIMAL CARE FACILITY	56
	UNC-G PINEY LAKE	39
	UNC-CH SEISMOLOGICAL STUDIES STATION	29
	UNC CHAPEL HILL PARK AND RIDE FACILITY	14
	UNC HOSPITAL WAREHOUSE	8
	UNC-GENERAL ADMINISTRATION	7
	UNC-CH UNIVERSITY OF NORTH CAROLINA HOSPITALS	2
	NCCU OLD CHANCELLOR'S RESIDENCE	2
	UNC-CH SMITH CEMETERY	0
Other land		2,189
	ENR HAW SLOPES STATE NATURAL AREA	1,216
	Guilford Court House National Monument	215
	PRK HAW RIVER STATE PARK	209
	CORR GUILFORD CORRECTIONAL CENTER/CAMP BURTON/4440	184
	CCPS NATIONAL GUARD FIELD EXERCISE SITE	98
	HAW RIVER STATE PARK	92
	CR LEIGH FARM	47
	CUL RES HISTORIC ALAMANCE BATTLEGROUND	38
	CUL RES CHARLOTTE HAWKINGS BROWN MEMORIAL	36
	CCPS GREENSBORO NATIONAL GUARD ARMORY	14
	FIRST FLIGHT VENTURE CENTER	10
	DMV NEW OFFICE COMPLEX	9
	FR PITTSBORO HDQRS TOWER SITE	5
	BURLINGTON NATIONAL GUARD ARMORY	5
	DMV GREENSBORO DISTRICT OFFICE	5
	DMV GRAHAM DISTRICT OFFICE	3
	FR ALAMANCE COUNTY FORESTRY HEADQUARTERS	3
	CCPS CANE MOUNTAIN MICROWAVE TOWER	1
Grand Total		7,867

Table B-5: Existing Development: Note 36 Data

Note 36: Percent Impervious in Watershed

Durham City and County Data[10] Land Use Description	Percent of Land in County/City[10]	%Impervious[17]	**Description of % Impervious Determination**
Commercial	4%	85%	Commercial land use
Office	2%	83%	Average of commercial and industrial
Industrial	8%	80%	Industrial land use
Road Right-of-way*	11%	30%	Assumed 30% based on BPJ
High Density Residential	1%	50%	<1/4 acre
Med Density Residential	4%	30%	1/4-1/2 acre
Low Density Residential	15%	20%	1/2-2 acre
Very Low Density Residential	1%	8%	>2 acre
PUB-US Govt- nearly all Corps land	11%	8%	Assumed open space land use
Duke University	6%	50%	Assumed institutional land use. There are many universities in the watershed, not just in Durham.
NCCU, Durham Tech	0%		0% of watershed
Other land owned by NC	0%		0% of watershed
open space - no retrofitting	0%		0% of watershed
City, county, churches	7%	50%	Assumed institutional land use
Utilities	1%	50%	Assumed institutional land use
Agriculture, sometimes w/ res	7%	8%	Assumed open space land use
Unknown	0%		0% of watershed
Residential Open Space	7%	8%	Assumed open space land use
Vacant	14%	40%	Assumed equal to the average of all uses above.
	100%		**Average $\%_{Imperviousness}$ of Watershed**

57%	Percent of the acres in the watershed are over 24% (Subject to Phase II)

Table B-6: Phase II Requirements in the Jordan Watershed

Assuming These Acreages in the Tar-Pamlico Export Method:				
	33	%	=%Impervious in Right of Way	
(1) Type of Land Cover	(2) Lot area (ac)	(3) Right-of-way area (ac)	(4) Community areas (ac)	(5) Sum of Columns (2), (3), and (4)
TOTAL	7.0	1.0	1.5	
Transportation			0.2	
Roof impervious			0.0	
Managed pervious			0.3	
Wooded pervious			1.0	

BMP = Wetland
Area Taken Up by BMP is 0

Average Lot Size (Acres)	Jordan, Fraction Impervious	Pre-BMP TN Export (lb/ac/yr)	One BMP TN Export (lb/ac/yr)	Two BMPs TN Export (lb/ac/yr)			
0.02	0.77	14.3	8.6	5.2			Jordan Requires 3 BMPs, over 3.7 with 2 BMPs
0.03	0.64	11.5	6.9	4.1			
0.04	0.57	9.9	5.9	3.6		Jordan Requires 2 BMPs, over 3.7 with 1 BMP	
0.05	0.52	8.8	5.3	3.2	Phase II Requires 1 BMP, over 24% imp.		
0.10	0.39	6.6	3.8	2.3			
0.11	0.37	6.1	3.7	2.2		Jordan Requires 1 BMP, over 3.7 with 0 BMPs	
0.12	0.36	5.9	3.5	2.1			
0.18	0.30	5.0	3.0	1.8			
0.25	0.27	4.4	2.6	1.6			
0.30	0.25	4.1	2.5	1.5			
0.37	0.23	3.8	2.3	1.4			
0.50	0.21	3.5	2.1	1.2			
0.75	0.18	3.1	1.8	1.1			
0.88	0.17	2.9	1.8	1.1			
1.00	0.16	2.8	1.7	1.0			

	Maximum Loading	
	TN (lb/acre-year)	TP (lb/acre-year)
Area-Weighted Average	**3.7**	1.35
Haw Arm	3.8	1.43
Upper New Hope	2.2	0.82
Lower New Hope	4.4	0.78

Appendix C: **Definition of Terms**

Unless defined differently in the text, terms and acronyms used in this document have the following meanings.

ACSP	Agriculture Cost Share Program
BAR	Barren Land
BMP	Best Management Practice
CES	Cooperative Extension Service
Cit	City
Commission	EMC
CWRA	Clean Water Responsibility And Environmentally Sound Policy Act, S.L. 1997-458
DA	Department of Agriculture
DENR	Department of Environment and Natural Resources
Department	DENR
Division	DWQ
DOT	Department of Transportation
DWQ	Division of Water Quality
EEP	Ecosystem Enhancement Program
EMC	Environmental Management Commission
FLUX	A loading model used for Jordan Lake in conjunction with the lake response model
FOR	Forest
GIS	Geographical Information System
GPD	Gallons per day
GWLF	Generalized Watershed Loading Function - The watershed model used for Jordan Lake in conjunction with the FLUX and lake response model
LAC	Local Advisory Committee
LG	Local Government
LNH	Lower New Hope
mg/L	Milligrams per liter
MGD	Million Gallons per Day
NCACSP	North Carolina Agricultural Cost Share Program
NCCES	North Carolina Cooperative Extension Service
NCDA	North Carolina Department of Agriculture
NCDENR	North Carolina Department of Environment and Natural Resources
NCDOT	North Carolina Department of Transportation
NCDWQ	North Carolina Division of Water Quality
NCEEP	North Carolina Ecosystem Enhancement Program
NCSWCD	North Carolina Soil and Water Conservation District
NLEW	Nitrogen Loss Evaluation Worksheet (permit type for point source discharge)
NPDES	National Pollutant Discharge Elimination System -
NPS	Nonpoint Source
NSW	Nutrient Sensitive Water
O&M	Operation and Maintenance
OFF	Offices
OWASA	Orange (County) Water and Sewer Authority
PAS	Pasture
PLAT	Phosphorus Los Assessment Tool
RHH	Residential, High Density
RLL	Residential, Low Density
RMH	Residential, Medium High Density
RML	Residential, Medium Low Density
RoW	Right of Way
ROW	Row Crops
RVH	Residential, Very High Density
RVL	Residential, Very Low Density
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorous
UGR	Urban Greenways
UNH	Upper New Hope
WAT	Water
WET	Wetlands
WOC	Watershed Oversight Committee
WWTP	Wastewater Treatment Plant