Chapter 36
Jordan Reservoir and Haw River Watershed NSW Strategy

36.1 Introduction and Overview

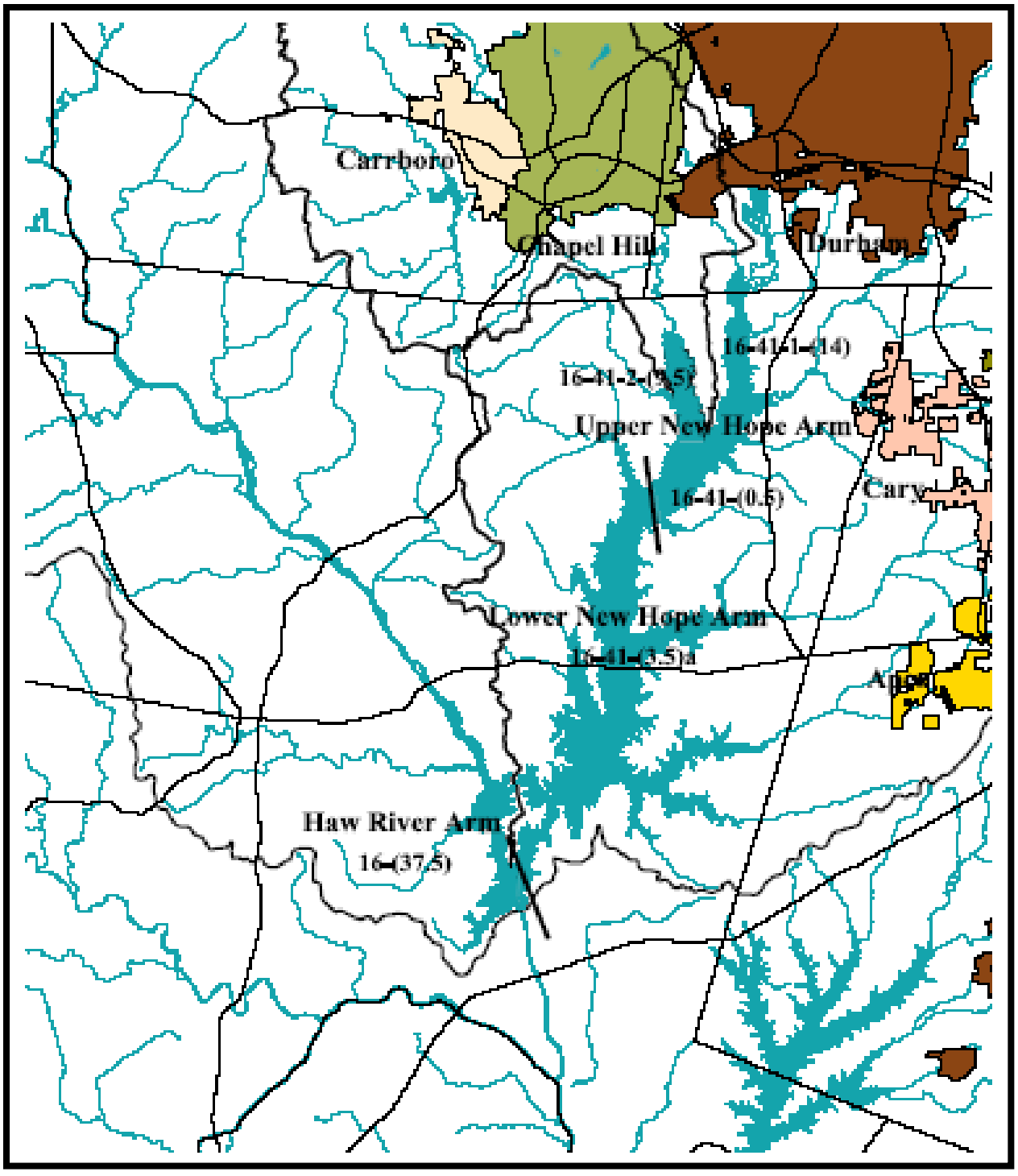
In 1983, all waters in the Haw River watershed (subbasins 03-06-01 to 03-06-06) including Jordan Reservoir received a supplemental classification of nutrient sensitive water (NSW) to acknowledge that Jordan Reservoir could have water quality problems associated with excessive nutrient inputs from both wastewater discharges and runoff from the various land uses in the watershed. The supplemental classification required that a NSW strategy be put in place to protect the reservoir from water quality problems associated with nutrient enrichment.

Total phosphorus (TP) limits of 2 mg/l were required for NPDES permitted facilities with flow greater than 0.005 MGD. In 2000, all subject dischargers were meeting this limit. In addition, discharges located upstream of the Upper New Hope Arm of Jordan Reservoir received TP limits of 0.5 mg/l during the months from April to October. However, nuisance algal blooms and chlorophyll *a* levels exceeding water quality standards continue to be observed.

The Upper New Hope Arm of B. Everett Jordan Reservoir was placed on the 2002 303(d) list of Impaired waters based on results of the nutrient response model developed as described in Section 36.2 below. The listing of the Upper New Hope Arm is consistent with EPA rules that require water quality models to be utilized as a basis for 303(d) listing. The 303(d) listing of the Upper New Hope Arm of the reservoir results in the need for a TMDL for this portion of the lake. Thus, the Jordan Reservoir nutrient management strategy was developed in order to meet requirements of both the Clean Water Responsibility Act and the federal rules and guidance regarding TMDLs. The Lower New Hope Arm and Haw River Arm are currently Impaired as well (Chapter 5). Refer to Figure 43 for identification of the arms discussed here.

The following sections describe 1) the Jordan stakeholder process, 2) Clean Water Responsibility Act, 3) the modeling performed to support the nutrient management strategy, 4) the development of loading targets and 5) the nutrient management strategy that have occurred throughout the development of the models and the nutrient management strategy. For more information on use support assessments used to identify impairment of the reservoir, refer to Chapter 5 and Appendix X.

Figure 43 Jordan Reservoir Segments



36.1 Jordan Reservoir Stakeholder Processes

Two stakeholder processes occurred during the development of this strategy. The first process was through the efforts of the Project Partners. During the initial development of the data review technical memorandum and the nutrient response model, the Project Partners held regular meetings with DWQ staff. At major completion steps, the Project Partners convened greater stakeholder meetings to share and discuss results of the data review and the modeling.

DWQ staff, the Triangle J Council of Governments, and the Piedmont Triad Council of Governments initialized a more formal stakeholder process to carry a greater group of stakeholders forward through the development of management targets and the management strategy. A USEPA 104(b)(3) grant, in the amount of $29,730, and administered by the Division of Water Quality, was used to support this stakeholder process. A total of 21 stakeholder meetings were held between May 2003 and December 2004 to discuss TMDL development, modeling issues, target setting, and management strategy development. The councils of governments prepared a stakeholder report that includes descriptions of the meetings, stakeholder comments and concerns, and recommendations. The Triangle J Council of Governments also continues to maintain a project website, with links to presentations and handouts posted regularly. Materials can be downloaded from this website at http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#Jordan.

36.2 The Clean Water Responsibility Act of 1997 (House Bill 515, Senate Bill 1366)

The Clean Water Responsibility Act of 1997 (often referred to as HB515) included legislation to further address water quality problems in NSW waters. The act set total nitrogen (TN) and total phosphorus (TP) NPDES permit limits for facilities discharging greater than 0.5 MGD into the Jordan Reservoir/Haw River watershed. A five-year compliance period for limits of 5.5 mg/l of TN and 2 mg/l of TP was established for qualifying facilities. Amendments to the act approved in 1998 (referred to as Senate Bill 1366) provided a compliance extension to the nutrient limits, with conditions. Those wastewater facilities granted a compliance extension by the Environmental Management Commission were required to develop a calibrated nutrient response model, evaluate and optimize the operation of all facilities to reduce nutrient loading, and evaluate methods to reduce nutrient mass loading to NSW waters. The municipalities of Greensboro, Mebane, Reidsville, Graham, Pittsboro and Burlington; and the Orange Water and Sewer Authority (OWASA) were granted the compliance extension by the Environmental Management Commission in April 1999. This collective group of facilities will be referred to as the Project Partners in subsequent sections of this chapter. Facilities that did not seek compliance extensions are the City of Durham/Durham South WWTP and Durham County/Triangle WWTP.

The CWRA provided a timeline for progress towards a site-specific nutrient management strategy should facilities and/or municipalities choose to seek the compliance extension. This established timeline is as follows:

- Two years for the collection of data needed to prepare a calibrated nutrient response model.
- A maximum of one year to prepare the calibrated nutrient response model.
- The amount of time, if any, that is required for the Commission to develop a nutrient management strategy and to adopt rules or to modify discharge permits to establish maximum mass loads or concentration limits based on the calibrated nutrient response model.
- A maximum of three years to plan, design, finance and construct a facility that will comply with those maximum mass loads and concentration limits.

If the Commission finds that additional time is needed to complete the construction of a facility, the Commission may further extend the compliance date by a maximum of two additional years.

Each municipality developed optimization plans and submitted them to the Water Quality Committee. Plans for nutrient response model development began in 1999 when the project partners, through the local councils of governments, released a request for proposals for both a data review document and nutrient response model development. Screening level and detailed nutrient response models were developed by Tetra Tech, Inc., the consultant to the project partners. The total cost to the project partners for the development of the data review document and the models was $370,000. The combined hydrodynamic and water quality model was approved by the Water Quality Committee in July 2002. DWQ began work to develop a nutrient management strategy following this approval.

36.3 Nutrient Response and Watershed Loading Modeling

Both the Projects Partners, with the addition of the municipalities of Apex and Cary, and the DWQ funded the development of numerous modeling tools to use for the development of the nutrient management strategy. Four modeling tools were developed by the Project Partners as part of meeting the requirements of the Clean Water Responsibility Act. These tools included a screening level nutrient response model using the BATHTUB modeling framework, a combined hydrodynamic and water quality model, and a nutrient fate and transport model for all major wastewater dischargers in the watershed. Hydrodynamic models simulate water circulation and movement, and nutrient response models simulate the nitrogen and phosphorus cycles, and algal response. The consultants, Tetra Tech, Inc., utilized the Environmental Fluid Dynamics Code (EFDC) framework to construct the reservoir hydrodynamic model, and the Water Quality Analysis Simulation Program (WASP) to link to the hydrodynamic model and simulate reservoir nutrient response (i.e., the water quality model). The models were run for the time period from 1997 through 2001. The Jordan Reservoir Nutrient Response Model results were summarized to provide information regarding the average chlorophyll *a* levels in the reservoir and the likelihood of chlorophyll *a* standard violations in various portions of the reservoir. An example of model output is provided below in Figure 44. Detailed model output is provided in the modeling reports available on the Modeling and TMDL Unit website at h2o.enr.state.nc.us/tmdl.

The Project Partners also funded the development of a nutrient fate and transport model to predict the fraction of wastewater that reaches Jordan Reservoir. The model demonstrates that a smaller fraction of wastewater discharged from facilities located farther upstream in watershed actually reaches Jordan Reservoir. This is contrary to facilities located nearer to the reservoir

that have substantially greater delivery to the reservoir. The fraction of nutrients delivered to the lake from each of the major dischargers varies depending upon the location of the effluent discharge. For example, 43 percent of the nitrogen load and 42 percent of the phosphorus load from the City of Greensboro North Buffalo WWTP reach Jordan Reservoir. In contrast, 96 percent of the nitrogen load and 97 percent of the phosphorus load from the Durham County Triangle WWTP reach Jordan Reservoir. Specific delivery rates for each facility are provided in the nutrient management strategy and TMDL document.

After approval from the Water Quality Committee, DWQ funded an update of the hydrodynamic and nutrient response model developed by the Project Partners. An additional model year, 2001, was added to the calibration and model summaries. This year had the largest amount of measured data of the five years ultimately modeled. DWQ also funded the development of a screening level watershed loading model in order to capture loading from nonpoint sources in the watershed. The watershed loading model was constructed using the Generalized Watershed Loading Function (GWLF) model. The watershed loading model was combined with the previously developed fate and transport model to provide a better analysis of the point and nonpoint source nutrient load contributions to Jordan Reservoir.

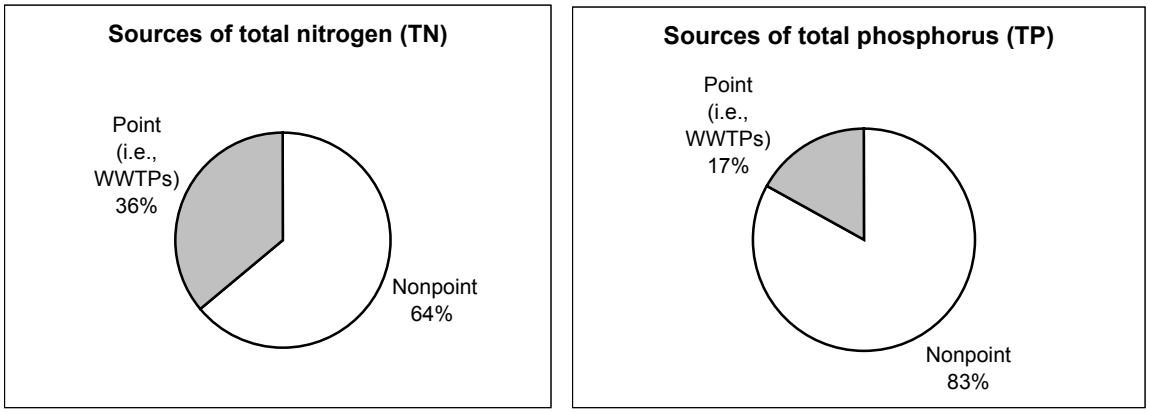


Figure 44 Sources of Nutrient Loads to Jordan Reservoir (1997-2000)

Modeling reports are available electronically from the Triangle J Council of Governments http://h2o.enr.state.nc.us/tmdl/SpecialStudies.htm#Jordan and the DWQ Modeling and TMDL Unit (http://h2o.enr.state.nc.us/tmdl).

36.4 TMDL and Management Targets

Management targets are those nutrient loads associated with chlorophyll *a* standard compliance. The nutrient response model is used to determine nutrient loads likely to produce compliance in all parts of the lake. For Jordan Reservoir, the loads would primarily derive from the Morgan, New Hope and Northeast Creeks, and the Haw River. Nutrient loading targets were determined for three different parts of the reservoir, the Upper New Hope Arm, the Lower New Hope Arm, and the Haw River Arm. Together, these three parts of the reservoir include all of the main body of Jordan Reservoir, with the exception of coves. These three parts were selected based on hydrology, frequency of standard violations, and the locations of reservoir tributaries.

The federal rules for Impaired waters and TMDLs require targets to consider seasonal variation and critical conditions. Thus, targets are based on the summer and early fall seasons to consider those times when predicted algal growth is most likely to result in standard violations. Consistent with use support methodology, the nutrient loading targets were then determined based on a standard violation frequency of less than 10 percent during the summer and early fall. The federal rules for Impaired waters also require targets to have a margin of safety. Per EPA guidance (1999), the margin of safety is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody. For this TMDL, DWQ has elected to use an explicit margin of safety determined by adjusting the TMDL target from a 10 percent standard violation frequency to an 8 percent standard violation frequency.

Reduction targets were evaluated in terms of nitrogen and phoshorus loads. Multiple combinations of nitrogen and phosphorus loading scenarios that resulted in an 8 percent standard violation frequency were considered. Ultimately, three different targets were selected for Jordan Reservoir, corresponding to three different hydrologic areas of the lake. These targets are summarized in Table 39 by percentage reduction:

Table 39 Nutrient Load Reduction Targets from 1997-2001 Baseline

Area	Total Nitrogen (TN) Percent Reduction	Total Phosphorus (TP) Percent Reduction
Upper New Hope Arm (above SR 1008)	35%	5%
Middle and Lower New Hope Arm (from SR 1008 to the narrows)	0% (a)	0% (a)
Haw River Arm	8%	5%
(a) Provides a loading cap equal to 1997-2001 baseline nutrient loads.		

36.5 Point Source Management Strategies

There are numerous factors considered in the point source allocation strategy. These include the distance from the reservoir and the amount and type of waste discharged. Further weighting of the amount of wasteload allocations for each facility was evaluated using the actual annual average flow during the 1997-2001 period, the permitted flow during the 1997-2001 period, and the permitted flow in 2004. The final allocations are based on the permitted flow in 2004. The result of the allocation strategy is presented below for the Upper New Hope and Haw River arms of the reservoir. Detailed discussions can be found in the TMDL document.

36.5.1 Upper New Hope Arm of Jordan Reservoir

Converting the wasteload allocation from the lake to the load at the effluent pipe yields a total allowable end of pipe nitrogen load of 444,088 lbs/year and phosphorus load of 34,270 lbs/year for all facilities. All of the available loading was allocated to the existing facilities. Therefore, there will be no new nitrogen or phosphorus bearing loads permitted in this watershed. There are five facilities discharging greater than 100,000 gallons per day in the Upper New Hope Arm, as shown in Table 40. These facilities account for 99.8 percent of the total permitted flow from

point sources. The discharge allocations for these five facilities provide equivalent concentrations for each facility. For nitrogen, this equivalent concentration is 3.05 mg/l, and for phosphorus this equivalent is 0.23 mg/l. Therefore, the five large facilities will receive annual mass load limits as shown in Table 40.

Table 40 Wasteload Allocations for Facilities Great Than 100,000 Gallons Per Day

Permittee	Facility	Permitted Flow (MGD)	Percent of Total Flow	Wasteload Allocation (lbs/yr)	
				TN	TP
City of Durham	South Durham WRF	20.0	42.1	185,648	14,154
Orange Water & Sewer Authority	Mason Farm WWTP	14.5	30.5	134,595	10,262
Durham County	Triangle WWTP	12.0	25.3	111,389	8,492
Fearrington Utilities	Fearrington Utilities WWTP	0.5	1.1	4,461	354
Whippoorwill LLC	Carolina Meadows WWTP	0.35	0.7	3,249	248
	Total for large facilities	*47.4*	*99.7%*	*439,342*	*33,510*

36.5.2 Haw River Arm of Jordan Reservoir

Converting the wasteload allocation from the lake to the load at the effluent pipe yields a total allowable end of pipe nitrogen load of 1,570,890 lbs/year and phosphorus load of 195,510 lbs/year. All of the available loading was allocated to the existing facilities. Therefore, there will be no new nitrogen or phosphorus bearing loads permitted in this watershed. There are ten facilities discharging greater than 100,000 gallons per day in the Haw River Arm, as shown in Table 41. These facilities account for 99.3 percent of the total permitted flow from point sources. The discharge allocations for these ten facilities provide equivalent treatment levels for each facility. For nitrogen, this equivalent treatment level is 5.3 mg/l, and for phosphorus this equivalent is 0.67 mg/l. Therefore, the ten large facilities will receive annual mass load limits as shown in Table 41.

Special Permitting Options. There are two permitting options available to provide existing facilities flexibility with target compliance. One option is a bubble permit, which allows multiple facilities owned by the same permittee to pool the mass loading limits. This will only be an option for the cities of Greensboro and Burlington. Another option is a group compliance option, which allows multiple facilities owned by various permittees to pool the mass loading limits for compliance purposes. The group compliance option provides the interested permittees the ability to meet to the total mass limit even if an individual facility does not meet the individual mass limit. This option also provides the ability for a new discharge with nitrogen or phosphorus bearing loads to purchase loading from the existing compliance group members, if they choose to sell. Both options are provided in the TMDL document.

Table 41 Wasteload Allocations for Facilities Greater Than 100,000 Gallons Per Day

Permittee	Facility	Permitted Flow (MGD)	Percent of Total Flow	Wasteload allocation (lbs/yr)	
				TN	TP
City of Greensboro	T.Z. Osborne WWTP	40.0	41.5	645,834	81,222
City of Greensboro	North Buffalo Creek WWTP	16.0	16.6	258,333	32,489
City of Burlington	Eastside WWTP	12.0	12.4	193,750	24,367
City of Burlington	Southside WWTP	12.0	12.4	193,750	24,367
City of Reidsville	Reidsville WWTP	7.5	7.8	121,094	15,229
City of Graham	Graham WWTP	3.5	3.6	56,510	7,107
City of Mebane	Mebane WWTP	2.5	2.6	40,365	5,076
Town of Pittsboro	Pittsboro WWTP	2.0	2.1	32,292	4,061
Quarterstone Farm Homeowners Association	Quarterstone Farm WWTP	0.2	0.2	3,229	406
Glen Raven Inc.	Altamahaw Division plant	0.15	0.2	2,422	305
	Total for large facilities	*95.85*	*99.4%*	*1,547,580*	*194,630*

36.6 Nonpoint Source Management Strategies

36.6.1 Introduction and Overview

The comprehensive stakeholder process yielded five potential nonpoint source management scenarios covering the spectrum of possibilities between completely voluntary and regulation of all significant nutrient sources. Recognizing that point sources would be regulated, equity concerns led the stakeholders to favor some form of mandatory measures for all significant source types.

The NPS management strategy proposed by DWQ staff builds from concepts implemented in the Neuse and Tar-Pamlico River basins. All of the following elements would apply in the subwatersheds of both the Upper New Hope and Haw River arms, while only the riparian buffer protection and new development controls – would apply in the Lower New Hope subwatershed. The proposed strategy contains the following provisions. It should be noted that these provisions will be subject to change during the rule-making process that is expected to run from September 2005 to July of 2007.

- All **agricultural** operations would collectively meet N and P export performance goals as implemented by local committees.
- **Stormwater:**
  - All local governments would achieve stormwater N and P export performance goals from all new and existing development. This would entail establishing loading caps for all new development that would be tailored to each arm of the lake. For existing development, rules would be developed to ensure achievement N and P reduction targets through phased retrofitting.

- Local governments required to meet NPDES Phase II stormwater requirements of S1210 would have the option of adopting the

- DWQ would protect existing **riparian buffers on the lake and all perennial and intermittent streams in the watershed.**.
- Persons who apply fertilizers to lands in the lake's watershed would complete **nutrient management** training and a written plan for those lands. Stakeholders suggested pursuing a tax on fertilizer would fund the implementation of this rule, however, this would require approval of the general assembly, and is beyond the scope of the EMC's authority
- DWQ would work with DEH to develop programs to reduce N and P loading from **on-site wastewater** (the EMC has no control over this management area).
- DWQ would refine existing **wastewater land application** permitting programs as needed.
- DWQ would consult with DFR and forest industry to ensure that **forestry** does its part in meeting forest practice guidelines and minimizing nutrient loading to the lake (EMC has no control over this management area).
- DWQ would craft rules to allow for a **trading** program among point sources, between point and nonpoint sources, and among nonpoint sources.
- Local governments and agricultural committees would provide annual reports to the EMC. The EMC would reexamine the management strategy every five years.

Table 42 presents the loading goals that have been calculated based on the percentage reductions established for each subwatershed. The following sections describe the agriculture, urban stormwater, buffer protection, nutrient management, and land application proposals in more detail. Proposed requirements in the agriculture and development sections refer back to these numeric loading goals.

Table 42 Loading Goals by Subwatershed

Subwatershed	Nitrogen Reduction Goal / Load Goal		Phosphorus Reduction Goal / Load Goal	
Upper New Hope	35%	4.1 lb/ac-yr	5%	1.1 lb/ac-yr
Haw	8%	5.6 lb/ac-yr	5%	1.5 lb/ac-yr
Lower New Hope	0%	4.8 lb/ac-yr	0%	0.8 lb/ac-yr

36.6.2 Agriculture Strategy

Applicable Subwatersheds: Upper New Hope River and Haw River.
What: Achieve and maintain net annual N and P loads from agricultural lands, in lb/ac-yr, equal to or less than the targets allocated to an arm's subwatershed.

Who Administers: Local committees and a watershed oversight committee.

Who is Affected: All agricultural operations lying wholly or partly within the lake watershed, including animal operations, crop-farming, pasture and horticulture.

How: Local committees would be responsible for registering all producers, drafting strategies to achieve load targets, and submitting annual progress reports. A watershed oversight committee would develop a site evaluation tool to account for loading, review and approve local strategies, and provide reports to the EMC. Individual producers could comply automatically by implementing standard BMPs or they could contribute as needed to their collective local strategy and rely on it to comply.

When: Relative to rule effective date, producers register within one year, accounting tool completed in two years, strategies developed in three years, targets reached in five years. If a local committee did not meet its goal in five years, then producers in that area would be subject to additional implementation needs as determined by the EMC.

36.6.3 Urban Stormwater Strategy

Applicable Subwatersheds: Upper New Hope River and Haw River subject to all elements. Lower New Hope River - subject to new development and redevelopment elements; existing development element would not apply, and NPDES Phase II would apply only to local governments dictated by S1210.

What: A stormwater rule to address N and P loading from new development, redevelopment and existing development. The rule would require new development and redevelopment activities to achieve and maintain net annual N and P loads, in lb/ac-yr, equal to or less than the targets allocated to an arm's watershed. Redevelopment would have the option of meeting the subwatershed's percentage reduction targets relative to the previous development. Off-site trading options would be provided. The rule would also require retrofitting of existing development. Phase II communities would have the option of incorporating this nutrient stormwater rule into their programs to avoid having to administer two rules.

Who Administers: All local governments wholly or partly within an arm's subwatershed except as stated above.

Who is Affected: All new development and redevelopment projects, and existing development.

How: Local governments would adopt stormwater programs. A watershed oversight committee would be established, responsible for developing a site evaluation tool for load accounting by all local governments and for presenting the tool to the EMC. For existing development, local governments would analyze their jurisdictions within a subwatershed to determine stormwater BMPs needed for existing development to meet the loading targets allocated to that subwatershed. They would prioritize BMP installations, develop implementation schedules, then implement retrofits.

When: New development and redevelopment permitting would begin upon adoption of local ordinances within stormwater rule timeframes. Local governments would set retrofit implementation schedules for existing development within five years, then provide annual implementation reports to the EMC. The EMC would reexamine the retrofit approach every five years. Based on input from public review of the draft strategy, the stormwater rule may contain provisions for feasibility studies during the first years immediately following the effective date of the rules.

36.6.4 Buffer Protection Strategy

Applicable Subwatersheds: All.

What: Existing vegetated riparian buffers would be protected and maintained on both sides of perennial and intermittent streams, lakes and ponds.

Who Administers: DWQ. DWQ may delegate programs to interested, qualified local governments.

Who is Affected: Potentially all owners of property with riparian buffers.

How: 50 feet of riparian area would be protected on each side of waterbodies. The first 30 feet adjacent to the water, or Zone 1, would remain undisturbed with the exception of certain activities. The outer 20 feet, or Zone 2, may be graded but would need to be revegetated, with certain additional uses allowed. Specific activities would be identified in the rule as "exempt", "allowable", or "allowable with mitigation". Examples of "exempt" activities would include driveway and utility crossings of certain sizes through zone 1, and grading and revegetating in Zone 2. "Allowable" and "allowable with mitigation" activities would require review by DWQ staff and would include activities such as new ponds in drainage ways and road crossings. Mitigation options would be defined. Footprints of existing uses within the buffer such as cropland, buildings, commercial facilities, lawns, utility lines, and on-site wastewater systems would be exempt. A newly vegetated buffer would not be required unless the existing use of the riparian area changes.

When: Upon rule effective date.

36.6.5 Nutrient Application Management Strategy

Applicable Subwatersheds: All.

What: Completion of training and continuing education in nutrient management, completion and implementation of a written nutrient management plan addressing both N and P for all lands where nutrients are applied.

Who Administers: Not yet determined.

Who is Affected: All persons who apply fertilizer or biosolids to, or manage, ten or more acres of cropland; golf courses; recreational lands; rights-of-way; residential, commercial or industrial lawns and gardens; and other turfgrass areas. Cropland with a certified animal waste management plan would be exempt.

How: Revenue from a tax on fertilizer would fund implementation of the rule.

When: Upon rule effective date, persons affected would be required to complete initial training and plans within five years. Persons who become subject after the effective date would be given a shorter time period to comply. Biosolids applicators would be given until 2010 to begin

implementation of plans addressing both N and P. All persons would be required to comply with continuing education requirements on a periodic basis.

36.6.6 Wastewater Land Application Strategy

DWQ would refine its existing permitting program as needed for the entire Jordan Lake watershed. Changes may include requiring all non-discharge systems within a certain distance of the lake or mainstems of the Haw River or New Hope River tributaries to meet reclaimed water effluent standards, with the exception of individual single family homes. New and existing industrial non-discharger facilities may be required to establish vegetated buffers compliant with the riparian buffer rule.

36.6.7 Proposed Rule-making Schedule for the Nutrient Management Strategy.

Below is a tentative rule-making schedule beginning with submitting draft rules to the Water Quality Committee (WQC) in October 2005, and ending with review by the General Assembly.

October 2005	Draft rules submitted by DWQ to WQC for review and approval to bring to the EMC in November.
November 2005	Draft rules submitted to EMC for approval to go to public hearings.
April 2006	Publish fiscal note and announcement of public hearings for proposed rules.
April – May 2006	Hold hearing and receive public comments.
June – July 2006	Hearing officer deliberations on public comments.
September 2006	EMC adoption of rules.
October – December 2006	Seek approval of rules from RRC. (Note: If the RRC approves the rules, and has not received more than 10 written objections, then the rules become effective the following month.)
December 2006	Send rules to the General Assembly for review and approval.
April – September 2007	Effective date of rule will vary depending on action taken by the General Assembly.