Section A - Chapter 4
Water Quality Issues Related to Multiple Watersheds in the Neuse River Basin

4.1 Introduction

Parts 4.2 through 4.7 review the status of specific recommendations made for multiple watersheds in the 1998 Neuse River Basinwide Water Quality Plan. Current status and future recommendations are provided for each recommendation.

Parts 4.8 through 4.16 introduce new multiple watershed issues. These water quality issues were identified by DWQ regional and central office staff and by workshop participants. Recommendations are presented to help address these water quality issues.

Parts 4.17 through 4.21 discuss water quality problems that were commonly noted during the most recent use support assessment. Specific waters where these problems were observed are described in Section B. Current status and future recommendations are discussed for each water quality problem.

4.2 Neuse River Nutrient Sensitive Waters (NSW) Strategy

4.2.1 Introduction

Eutrophication became a water quality concern in the lower Neuse River basin in the late 1970s and early 1980s. Nuisance algal blooms prevalent in the upper estuary prompted investigations by DWQ. These investigations, as well as other studies, indicated that algal growth was being stimulated by excess nutrients entering the estuarine waters of the Neuse River. In 1988, a phosphate detergent ban was put in place and the lower Neuse River basin received the supplemental classification of nutrient sensitive waters (NSW). As part of this early NSW strategy, new and expanding NPDES discharges, as well as existing facilities with design flows greater than 0.05 MGD, were given a quarterly average phosphorus limit of 2 mg/l. Phosphorus loading was greatly reduced, and algal blooms in the river and freshwater portions of the estuary were reduced as a result of this action.

The 1993 Neuse River Basinwide Water Quality Plan recognized that eutrophication continued to be a water quality problem in the estuary below New Bern. Extensive fish kills in 1995 prompted further study of the problem. Low dissolved oxygen levels associated with algal blooms were determined to be a probable cause of many of the fish kills. Researchers also determined that the toxic dinoflagellate, *Pfiesteria piscida*, may have been responsible for many of the fish kills.

The algal blooms and correspondingly high levels of chlorophyll *a* prompted DWQ to place the Neuse River estuary on the 1994, 1996, 1998 and 2000 303(d) list of impaired waters. It was determined that control of nitrogen was needed to reduce the extent and duration of algal blooms.

In 1996, the NC Senate Select Committee on River Water Quality and Fish Kills sponsored a workshop with numerous scientists familiar with the Neuse River water quality problems. The group reached consensus that a 30 percent reduction in total nitrogen entering the estuary was a good starting goal. In 1996, the 30 percent reductions were put into law (Session Laws 1995, Section 572). The state funded the Neuse Modeling and Monitoring (MODMON) to quantitatively assess the interactions and pathways between nutrients, phytoplankton and dissolved oxygen in the estuary. A TMDL was developed to address the nitrogen overloading to the estuary. While the Neuse River estuary remains impaired, there have been reductions in nitrogen loading. The following sections discuss the TMDL and the current NSW strategy. For the complete NSW rules, visit http://h2o.enr.state.nc.us/admin/rules/#redbook. For the approved TMDL, visit http://h2o.enr.state.nc.us/tmdl/approved_TMDLS.htm.

4.2.2 Neuse River TMDL for Total Nitrogen

Current Status

The first phase of the TMDL for total nitrogen to the Neuse River estuary was conditionally approved by EPA in 1999. The second phase incorporates the latest tools from the Neuse River Modeling and Monitoring Project (MODMON) (page 72). This TMDL will address chlorophyll *a* as its endpoint but will seek to manage total nitrogen, which is the nutrient that has the best potential to limit excessive growth of algae, and thus, chlorophyll *a* in the estuary. Specifically, the TMDL target is to have less than 10 percent of chlorophyll *a* samples collected in the estuary over a specific time period to be over 40 µg/l. The TMDL will assess the amount of total nitrogen load reduction that is necessary to comply with this criterion. The draft of the second phase of the TMDL was completed in July 2001. The TMDL was approved by the EPA in March 2002.

2002 Recommendations

DWQ will use an adaptive management approach to implement the Neuse River estuary total nitrogen TMDL. Continued monitoring and model updates (page 72) will be used to evaluate the effectiveness of the TMDL and to make adjustments in the implementation strategy as needed to stem the eutrophication of the Neuse River estuary. The second phase of the TMDL model results and recent estuary monitoring indicate that the 30 percent total nitrogen load reduction from the 1991-1995 baseline is currently sufficient.

It is important that North Carolina does a conscientious job of achieving the 30 percent reduction. The Neuse River basin NSW strategies (discussed below) are scheduled to be fully implemented by 2003, and every effort should be made to meet that goal. Based on the range of results seen in the TMDL modeling, more than a 30 percent total nitrogen reduction may be needed in the future. This will be more evident as the adaptive management strategy proceeds. Specifically, the Neuse River should be monitored to determine if the 30 percent total nitrogen load reduction is achieved, and the estuary should be monitored to determine if the chlorophyll *a* criterion is met. This observed data may then be used in subsequent modeling efforts (presumably updates to existing estuary models) to update the expected reduction needed.

By making use of additional data and updating the models and analyses, DWQ and MODMON will be able to reduce the prediction uncertainty to narrow the range of total nitrogen load reduction that may be required. It is also important to note that no matter where the reduction

target is set in this phase of the TMDL, the estuary will not be removed from the list of impaired waters until it meets its designated uses.

Reductions in nutrient inputs may take time to appear in measured loading, due to year-to-year variability in precipitation and flow. It may take more than five years to discern a 30 percent decrease in load.

4.2.3 Protection and Maintenance of Existing Forested Riparian Areas

Current Status
The purpose of the riparian buffer rule is to maintain the nutrient removal function of natural riparian areas along stream corridors. The riparian area that is to be maintained extends 50 feet from intermittent and perennial streams, lakes, ponds, sounds and estuaries, and oceans. This 50-foot area would consist of 30 feet of virtually undisturbed natural vegetation and 20 feet of grass, vegetation or trees that could be harvested to some extent. This rule does not apply to land uses in existence prior to the rule. DWQ received some funding to help staff the Raleigh and Washington Regional Offices to enforce the buffer rule.

2002 Recommendations
Because the buffer rule does not require existing land uses to establish or reestablish buffers, the rule will only help to prevent future increases in nitrogen reaching surface waters. DWQ will continue to enforce this rule to maintain existing nutrient removal functions of riparian buffers. It is also recommended that local governments in high growth areas adopt more stringent buffer rules that protect ephemeral streams as well. Local governments and individuals should also identify areas where buffers can be reestablished.

4.2.4 Wastewater Discharge Requirements

Current Status
The purpose of this rule was to set minimum nutrient control requirements for discharges to surface waters in the Neuse River basin. The Lower Neuse Basin Association (LNBA) (page 220) was formed with the goal of meeting the requirements of the rule as a community. To date, and with great effort and expenditure, the discharges have realized a 30 percent reduction of nitrogen into waters of the Neuse River basin while expanding in capacity. The point source dischargers have improved treatment operations, reduced flow and initiated reuse projects, and started formation of a compliance group.

Most or all of the large dischargers have evaluated their existing treatment facilities and undertaken or completed measures to improve their nutrient removal capabilities. These projects include process improvements at Raleigh and low-cost optimization under the LNBA project (Kinston-Peachtree and Northside, Benson, Contentnea MSD and LaGrange). New Bern is currently constructing a new 4.7 MGD facility designed for biological nutrient removal. As part of its current plant expansion, Goldsboro is constructing a wetlands treatment system to provide effluent polishing for a portion of its discharge.

Some facilities are choosing to reduce discharge flows, either in addition to or in lieu of treatment plant improvements, as a means of lowering nutrient discharges. Weyerhaeuser has

reduced its flows by over 6 MGD (30 percent) since 1995. Several municipal permittees are actively pursuing reuse projects to divert their direct discharges away from the river. Among these are Raleigh, Cary, Goldsboro, Johnston County and New Bern.

Approximately 40 permittees expressed interest in joining a group compliance association as provided under the rule, and formation of the association is well underway. The dischargers are working toward creation of the association as a nonprofit corporation, and they have begun drafting an organization and bylaws. DWQ and the permittees have drafted a Memorandum of Agreement and an NPDES permit for the new association.

The summary below focuses on the 30 Neuse dischargers with the largest nitrogen allocations. Of the 108 facilities subject to the wastewater discharge rule, this group accounts for most of the allocation, hence, the potential nutrient impacts by point sources on the estuary.

- Three facilities (Raleigh, Goldsboro and Weyerhaeuser's New Bern mill) represent nearly half of the total point source allocation.
- In contrast, half of all the facilities covered under the rule account for only 1 percent of the total allocation combined.
- The top 30 facilities account for 95 percent of the point source allocation; this group is very nearly the same as the "large" discharger group defined in the rule.

Table A-30 shows that by the end of 2001 the group had already reduced its nitrogen discharges by nearly half (48 percent) from 1995 levels. This resulted in an equivalent 43 percent reduction at the estuary. Because they account for most of the point source nitrogen load to the estuary, the combined reductions for all dischargers in 2001 is already well beyond the mandated 30 percent.

Table A-30 Total Nitrogen Reductions by LNBA Members by 2002

Dischargers	% TN Reduction Since 1995		% of Permit Flow Discharged	% of TN Limit Discharged	% of Allocation to Estuary
	At Outfall	At Estuary			
Top 30	48.3	42.6	48.1	72.9	84.1
Upstream	34.9	34.9	39.7	48.4	48.4
Downstream	49.7	43.0	48.6	76.8	84.7

However, rapid growth in many areas causes corresponding increases in wastewater flows and nitrogen loading. Facilities that need to expand face the prospect of building highly advanced treatment facilities or purchasing additional allocation, or both. Either choice can be very expensive.

2002 Recommendations

Although the point sources have lowered their nitrogen load to the estuary below the allowable cap, the results show that the dischargers still must take additional steps in coming years to fully meet the intent of the rule.

Table A-30 also shows that the top 30 facilities discharged almost half (48 percent) of their permitted flows in 2001 but a greater portion (73 percent) of the permitted nitrogen. This indicates that treatment capabilities will require further improvement for the dischargers to meet nitrogen limits once flows reach the permitted levels. Consistent with this finding, the 2001 data show that approximately one third of the top 30 exceeded their future limits for nitrogen in that year.

Performance will improve somewhat as plant improvements, reuse systems and other projects already underway are completed. Further, most of these facilities plan to join the group compliance association, and individual performance will be less of an issue as the association's members work together to achieve the necessary reductions as a group.

4.2.5 Basinwide Stormwater Requirements

Current Status

With the goal of reducing nutrients from urbanized areas, the following cities and counties in the Neuse River basin are required to develop stormwater control programs: Cary, Durham, Garner, Goldsboro, Havelock, Kinston, New Bern, Raleigh, Smithfield, Wilson; and Durham, Johnston, Orange, Wake and Wayne counties. The program must include review of stormwater management plans for new development, protection of riparian buffers (see above), public education, removal of illegal discharges, and identification of stormwater retrofits. The stormwater management plans include limits on total nitrogen export and limits on peak flows. All programs have been approved by the Environmental Management Commission and are currently in place.

All local governments covered under the Neuse Stormwater Rule have adopted and are implementing programs to review new development activities to control stormwater runoff and resulting nitrogen inputs. New development must utilize appropriate design and BMPs to limit nitrogen loading to 3.6 pounds/acre/year. Since this program has only been in place a short period of time, the annual report only covers an eight-month window. Over this time, a number of local governments reported that minimal or no new development activities subject to the Neuse NSW rule were implemented in their jurisdictional areas. In part, this occurred because a number of development projects had already been approved locally prior to implementation of their stormwater programs and were not subject to the rules. Based on the estimates supplied in the initial reports for development subject to the Neuse stormwater rules, new development nitrogen loading was reduced by around 5,130 pounds (3,149 from BMPs installed and 2,161 from payments to the Wetland Restoration Program). NCWRP (page 203) is working with local communities to identify and implement restoration projects in the affected areas. Data submitted were variable and sometimes incomplete, so these numbers should be viewed as preliminary.

A large number of public education programs have been implemented in the various communities. These programs have included workshops, development of web sites, newsletters, brochures, storm drain stenciling, participation at school programs such as science fairs, field days, development of environmental fact sheets, and implementation of demonstration projects for stormwater control. A number of communities have also partnered with other agencies such as the NC Cooperative Extension Service and local Soil and Water Conservation Districts. A

number of communities in the basin have also joined together to fund a mass media effort for public education.

All of the communities covered by these regulations have developed ordinances and programs locally that provide adequate authority for removal of illegal discharges. A number of communities have reported responses in this program that have removed pollution sources from the storm drainage system and from local waterbodies. Programs have either established or are developing databases to track these efforts.

Local governments have targeted a good number of viable retrofit sites in their jurisdictional areas. These sites will be made available to groups that may have funding to implement the retrofit activities for nitrogen reduction. In addition to the targeted retrofits, a few local governments reported activities completed or under way that have worked to reduce existing nitrogen loading. Major examples center on programs to buy out properties in floodplain areas and restore these areas to natural conditions for water quality improvements.

2002 Recommendations
DWQ will continue to assist local governments in developing stormwater programs and in identifying funding sources. It is recommended that local governments in the Neuse River basin identify funding sources to implement stormwater retrofits in developed areas that would further reduce nutrient delivery to the estuary. Local governments must also submit annual reports to DWQ so progress in the implementation of the basinwide stormwater rules can be tracked and evaluated.

4.2.6 Agricultural Nitrogen Reduction Strategy

Current Status
The agricultural rule provides each farmer with the option of becoming part of a collective local strategy for implementing best management practices on their land or to implement standard best management practices as specified in the rule.

Under the first option, the local strategy would be coordinated by a group of agency representatives and farmers who would target practices where cost-effective reductions could be achieved. A multiagency basin oversight committee (BOC) will oversee the local strategies and the methods for accounting for nutrient reductions.

The BOC is made up of eight individuals appointed by the Secretary of the Department of Environment and Natural Resources (NCDENR). BOC membership includes federal and state agencies, institutions and interest groups designated in the rule. The BOC includes representatives from DWQ, Division of Soil and Water Conservation (DSWC), Natural Resources Conservation Service (USDA-NRCS), North Carolina Department of Agriculture (NCDA), North Carolina Cooperative Extension Service (NCCES), agricultural community, scientific community and environmental community. Responsibilities of the BOC include developing a method to track and account for net nitrogen reductions from agricultural operations in the basin, approving local nitrogen reduction strategies, and presenting annual reports to the EMC on the progress toward reaching the goal.

The BOC and 17 Local Advisory Committees (LACs) were established to implement the Neuse agricultural rule and to assist farmers to comply with the rule. Representatives from DSWC, NCDA, local NRCS and NCCES, and local farmers make up the LACs. Each of the 17 county-level LACs is made up of seven or more individuals representing local agricultural agencies and farmers. Responsibilities of LACs include conducting farmer sign-up, establishing county agricultural baseline, developing local nitrogen reduction strategy, and preparing annual progress report.

Community meetings about the Neuse agricultural rule were held in 17 counties in the basin with assistance from the NCCES. A fact sheet about the rule was developed and distributed to all counties within the basin. Both agricultural and mass media publications targeting farmers in the Neuse River basin carried announcements about the sign-up process. The LACs successfully conducted a sign-up process for farmers between 1998 to 1999 with assistance from DSWC. Approximately 800,000 acres of cropland (of the estimated 1,000,000) in the Neuse River basin representing about 3,400 farmers were enrolled in the local option between 1998 to 1999.

The Nitrogen Loss Evaluation Worksheet (NLEW) was developed to meet the requirement of a scientifically valid accountability method for nitrogen reduction. The NLEW tool was developed to serve a five-fold purpose:

1. Estimate nitrogen loading from agricultural sources into the Neuse River during the baseline period of 1991-1995.
2. Distribute goals for nitrogen reduction to local entities.
3. Facilitate local BMP planning and implementation.
4. Track implemented BMPs.
5. Account for reduction in nitrogen losses due to the implementation of BMPs throughout the basin.

In March 2000, the EMC approved the accountability process of which NLEW is the critical part. Two major training sessions were provided in central locations for the upper and lower basin. Over 200 county agency staff and farmer LAC members attended.

The county agricultural baseline has been developed using the NLEW tool. The baseline has been reported to and examined by the BOC and reported to the EMC. To verify the county baseline numbers, a statistical sampling project in the Neuse River basin was funded. The primary results of this study were reported to BOC in February 2002. Early information indicates that the baseline figures are high. The BOC will compare this statistical analysis and work with LACs to make any needed adjustments to county baseline estimates.

NLEW is also used to calculate the local nitrogen reduction strategy. This strategy is a consensus determination by the LAC. It is based on the types and amount of the approved BMPs that they believe can be implemented before the deadline that would collectively produce the required 30 percent reduction from their baseline number. The LACs determined which practices would be most acceptable to participating farmers and to predict the number of acres to which they felt these practices could be applied. Table A-31 summarizes the BMP implementation goals from the approved local nitrogen reduction strategy.

Table A-31 BMP Implementation Goals for all 17 Neuse Basin LACs to Achieve 30 Percent Reduction in Agriculture Nitrogen

BMPs	Acreage (ac)
20' vegetated buffer	1,100
30' vegetated buffer	700
20' forested buffer	270
50' riparian buffer	2,000
Cover Crop	5,200
Nutrient management	280,000
Water control structure	42,000

The LACs have submitted their first annual report. Based on an incomplete progress report, Table A-32 presents BMPs that have already been installed.

Table A-32 Progress Reported by LACs as of March 5, 2002 Towards Meeting the Neuse Basin BMP Implementation Goal

BMPs	Acreage (ac)	Percent Towards Goal
20' vegetated buffer	125	11%
30' vegetated buffer	460	66%
20' forested buffer	0	0%
50' riparian buffer	870	44%
Cover Crop	0	0%
Nutrient management	35,000	13%
Water control structure	12,000	29%

2002 Recommendations

DWQ and the other designated agencies will continue to implement the agricultural component of the Neuse River basin NSW strategy. DWQ will continue to work with all agencies and interest groups involved to reduce nitrogen loading from agricultural lands in the Neuse River basin.

4.2.7 Nutrient Management

Current Status

This rule affects landowners, leasees and commercial applicators that apply nutrients to 50 acres or more of residential, agricultural, commercial, recreational or industrial land. Each person has the option of successfully completing nutrient management training or developing nutrient management plans for the lands where they apply fertilizer.

Nutrient management training for agricultural producers has been scheduled in every county in the basin. Over 1,250 agricultural producers were trained in 2001. Two nutrient management training sessions for turf grass operations (aiming for commercial applicators) were conducted in June 2002. Over 200 commercial applicators registered for the training as well. Two nutrient management training sessions for container nursery operations will be held at the end of 2002. Table A-33 lists locations and attendance of nutrient management training sessions held thus far.

Table A-33 Number of Nutrient Training Sessions and Attendance by County

County	Number of Sessions	Total Attendance
Beaufort	1	20
Carteret	1	50
Craven	1	65
Durham	1	20
Franklin	1	60
Granville	1	50
Green	2	125
Johnston	1	65
Jones	1	60
Lenoir	2	100
Nash	1	60
Orange	1	25
Pamlico	1	50
Person	1	75
Pitt	1	60
Wilson	1	65
Wake	1	50
Wayne	4	250
Total	23	1,250

2002 Recommendations

DWQ will continue to work with NCCES to provide training. It is recommended that DWQ work with local governments and industry to provide nutrient management training to homeowners and other interested parties.

4.2.8 Neuse River Modeling and Monitoring (MODMON) Project

Current Status

The Neuse Estuary Eutrophication Model (NEEM) and the Neuse Estuary Bayesian Ecological Response Model (Neu-BERN) are two models that have been developed through the MODMON

project. Predictions from these models will be used for development and implementation of the Neuse River estuary total nitrogen TMDL.

2002 Recommendations
Because an adaptive management strategy will be used in implementing the Neuse River estuary TMDL, DWQ recommends continuation of MODMON so changes in water quality can be assessed and adjustments to the implementation strategy can continue to be made.

4.3 Use Restoration Waters (URW) Approach

Current Status
DWQ has developed a conceptual strategy to manage watersheds with nonpoint source impairments as determined through the use support designations. In July 1998, the state Environmental Management Commission approved the Use Restoration Waters (URW) Program concept which will target all NPS impaired waters in the state using a two-part approach. As envisioned, this concept will apply to all watersheds that are impaired. The program will catalyze voluntary efforts of stakeholder groups in impaired watersheds to restore those waters by providing various incentives and other support. Simultaneously, the program will develop a set of mandatory requirements for NPS pollution categories for locations where local groups choose not to take responsibility for restoring their waters. This URW concept offers local governments an opportunity to implement site-specific projects at the local level as an incentive ("the carrot"). If the EMC is not satisfied with the progress made towards use restoration by local committees, impairment based rules will become mandatory in those watersheds ("the stick"). These mandatory requirements may not be tailored to specific watersheds, but may apply more generically across the state or region.

2002 Recommendations
With more than 400 impaired waters on stream segments in the state, it is not realistic for DWQ to attempt to develop watershed specific restoration strategies for nonpoint source pollution. By involving the stakeholders in these watersheds, DWQ can catalyze large-scale restoration of impaired waters. One of the major implementation challenges of this new program will be educating public officials and stakeholders at the local level as to the nature and solutions to their impairments. To address this challenge, the state plans to develop a GIS-based program to help present information at a scale that is useful to local land management officials. Other incentives that the state might provide include seed grants and technical assistance, as well as retaining the authority to mandate regulations on stakeholders who are not willing to participate.

In cases where incentives and support do not result in effective watershed restoration strategies, mandatory management requirements would be implemented in the watershed. This is not the state’s preferred alternative, as it would add to state monitoring and enforcement workload. However, in areas where it is necessary, DWQ plans to implement such requirements. In the management area, DWQ would be assisted by regulatory staff from the Division of Coastal Management, Division of Environmental Health, Division of Land Resources and the Division of Marine Fisheries to insure compliance.

4.4 Implement Wetlands and Riparian Restoration Plans

Current Status

For the Neuse River Basin, the North Carolina Wetlands Restoration Program (page 203) has integrated information normally found separately in NCWRP Watershed Restoration Plans into this Basinwide Water Quality Plan. This river basin is the first for which NCWRP has integrated the Watershed Restoration Plan directly into a DWQ Basinwide Water Quality Plan. A separate version of the Watershed Restoration Plan for the Neuse will be available online at the NCWRP website by the fall of 2002. These plans identify Targeted Local Watersheds within which NCWRP will focus restoration efforts. NCWRP will be restoring more than 20 acres of wetlands and more than 20,000 linear feet of stream channel in the upper Neuse basin over the next three years.

2002 Recommendations

DWQ will continue to integrate NCWRP restoration planning efforts into the basinwide process. An overview of the program is presented on page 203, as well as Table C-2 listing all the Targeted Local Watersheds selected by the NCWRP, arranged by DWQ subbasins. This section also includes a description of the NCWRP Local Watershed Planning initiative. The NCWRP will continue to use a comprehensive, integrated watershed approach in the identification of high-priority local watersheds in North Carolina's river basins. Also, the NCWRP hopes to expand their Local Watershed Planning efforts into more areas of the state as additional compensatory mitigation resources become available.

4.5 Target Existing Funding Sources to Impaired Waters

Current Status

The Unified Watershed Assessment (UWA) was developed in 1998 and targeted the upper Neuse and Contentnea Creek watersheds among other watersheds in the state. NCWRP, Clean Water Act Section 319, Clean Water Management Trust Fund and agricultural cost share financial resources have targeted waters in these watersheds. Currently, waters on the 303(d) list are the primary targets for these financial resources. A summary of monies spent and descriptions of projects are presented in Section C.

2002 Recommendations

DWQ continues to recommend targeting of funds toward impaired streams. DWQ also encourages targeting of monetary resources where water quality impacts are noted but the waters have not degraded to the point of being impaired. A small amount of effort and funding can result in great water quality improvements in these waters and potentially prevent these waters from becoming impaired. These waters and noted impacts are specifically described in each subbasin chapter in Section B.

4.6 Biological Criteria for Assessment of Aquatic Life

4.6.1 Introduction

DWQ strives to properly evaluate the health of aquatic biological communities throughout the state. Swamp stream systems, small streams and estuarine waters have presented unique challenges for benthic macroinvertebrate evaluation, while nonwadeable waters and trout streams have done the same for fish community evaluations. This section discusses some of these challenges. Refer to Appendix II for further information.

4.6.2 Assessing Benthic Macroinvertebrates in Swamp Streams

Current Status
Extensive evaluation, conducted by DWQ, of swamp streams across eastern North Carolina suggests that different criteria must be used to assess the condition of water quality in these systems. Swamp streams are characterized by seasonally interrupted flows, lower dissolved oxygen and often lower pH. They also may have very complex braided channels and dark-colored water. Since 1995, benthic macroinvertebrates swamp sampling methods have been used at over 100 sites in the coastal plain of North Carolina, including more than 20 reference sites. Preliminary investigations indicate that there are at least five unique swamp ecoregions in the NC coastal plain, and each of these may require different biocriteria. The lowest "natural" diversity has been found in low-gradient streams (especially in the outer coastal plain) and in areas with poorly drained soils.

DWQ has developed draft biological criteria that may be used in the future to assign bioclassifications to these streams (as is currently done for other streams and rivers across the state). However, validation of the swamp criteria will require collecting data for several years from swamp stream reference sites. The criteria will remain in draft form until DWQ is better able to evaluate such things as: year-to-year variation at reference swamp sites, effects of flow interruption, variation among reference swamp sites, and the effect of small changes in pH on the benthic macroinvertebrate community. Other factors, such as whether the habitat evaluation can be improved and the role fisheries data should play in the evaluation, must also be resolved.

2002 Recommendations
While it may be difficult to assign use support ratings to these swamp streams, these data will be used to evaluate changes in a particular stream between dates or to evaluate effects of different land uses on water quality within a relatively uniform ecoregion.

4.6.3 Assessing Benthic Macroinvertebrate Communities in Small Streams

Current Status
The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for flowing freshwater streams. The benthic macroinvertebrate database is being evaluated, and a study to systematically look at small reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in such small streams.

2002 Recommendations
DWQ will use this monitoring information to identify potential impacts to these waters even though a use support rating is not assigned. DWQ will continue to develop criteria to assess water quality in small streams.

4.6.4 Assessing Fish Communities

Current Status
Fish communities in most wadeable streams can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures. The data are evaluated using the North Carolina Index of Biotic Integrity (NCIBI) (NCDENR-DWQ, 2001). The NCIBI uses a cumulative assessment of twelve parameters or metrics. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score.

2002 Recommendations
In order to obtain data from nonwadeable coastal plain streams (that are difficult to evaluate using benthic macroinvertebrates), a fish community boat sampling method is being developed with the goal of expanding the geographic area that can be evaluated using fisheries data. This project may take many years to complete.

DWQ will continue to use this monitoring information to identify potential impacts to these waters even though a use support rating is not assigned.

4.7 DWQ Stormwater Programs

There are many different stormwater programs administered by DWQ. One or more of these programs affects many communities in the Neuse River basin. The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. Those programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include NPDES Phase I and II, coastal county stormwater requirements, HQW/ORW stormwater requirements, Neuse River basin NSW stormwater requirements (page 64) and requirements associated with the Water Supply Watershed Program. Local governments that are or may be affected by these programs are presented in Table A-34.

4.7.1 NPDES Phase I

Introduction
Phase I of the EPA stormwater program started with Amendments to the Clean Water Act (CWA) in 1990. Phase I required NPDES permit coverage to address stormwater runoff from medium and large stormwater sewer systems serving populations of 100,000 or more people. Phase I also had requirements for ten categories of industrial sources to be covered under stormwater permits. Industrial activities which require permitting are defined in categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment,

storage or disposal facilities. Construction sites disturbing greater than five acres are also required to obtain an NPDES stormwater permit under Phase I of the EPA stormwater program.

Current Status
Currently, Durham and Raleigh have NPDES Phase I stormwater permits and have developed stormwater programs. There are currently 15 individual stormwater permits issued to facilities in the Neuse River basin. There are 429 facilities that have general permit coverage in the Neuse River basin. These facilities are mapped in each subbasin chapter in Section B and listed in Appendix I.

2002 Recommendations
DWQ recommends continued implementation of the current stormwater programs as well as implementation of the Phase II requirements. Just over 100 stream miles in the Neuse River basin are impaired at least in part because of runoff from urbanized areas. Development and implementation of local programs that go beyond the minimum requirements will be needed to restore aquatic life to these streams.

4.7.2 NPDES Phase II

Introduction
The Phase II stormwater program is an extension of the Phase I program that will include permit coverage for smaller municipalities and cover construction activities down to one acre. The local governments permitted under Phase II will be required to develop and implement a comprehensive stormwater management program that includes six minimum measures.

1) Public education and outreach on stormwater impacts.
2) Public involvement/participation.
3) Illicit discharge detection and elimination.
4) Construction site stormwater runoff control.
5) Post-construction stormwater management for new development and redevelopment.
6) Pollution prevention/good housekeeping for municipal operations.

Construction sites greater than one acre will also be required to obtain an NPDES stormwater permit under Phase II of the EPA stormwater program in addition to erosion and sedimentation control approvals.

Current Status
Ten municipalities and four counties (Table A-34) in the basin are automatically required (1990 US Census designated Urban Areas) to obtain a NPDES stormwater permit under the Phase II rules. Results of the 2000 US Census may expand coverage of automatically designated areas. These local governments will be required to submit applications for NPDES stormwater permits by March 2003. DWQ is currently developing criteria that will be used to determine whether other municipalities should be required to obtain a NPDES permit and how the program will be implemented. DWQ is also working to finalize state rules to implement the Phase II stormwater rules as required by the EPA.

2002 Recommendations
DWQ recommends that the local governments that will be permitted under Phase II proceed with permit applications and develop programs that can go beyond the six minimum measures. Just over 100 stream miles in the Neuse River basin are impaired at least in part because of runoff from urbanized areas. Implementation of Phase II as well as the other stormwater programs should help to reduce future impacts to streams in the basin. Local governments to the extent possible should identify sites for preservation or restoration. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government stormwater programs.

4.7.3 Neuse River Basin NSW Stormwater Requirements

Introduction
Because of the water quality problems in the Neuse estuary related to nutrient overloading, communities in the Neuse River basin (Table A-34) are required to develop stormwater programs to reduce nutrient delivery to surface waters. The program must include review of stormwater management plans for new development, public education, removal of illegal discharges, and identification of stormwater retrofits. The stormwater management plans include limits on total nitrogen export and limits on peak flows.

Current Status
All programs have been approved by the Environmental Management Commission and are currently in place. All local governments covered under the Neuse Stormwater Rule have adopted and are implementing programs to review new development activities to control stormwater runoff and resulting nitrogen inputs.

2002 Recommendations
Refer to page 64 for more information on this program and recommendations. Communities should integrate the NSW stormwater requirements with other stormwater programs, to the extent possible, in order to be more efficient and gain the most water quality benefits for protection of public health and aquatic life.

4.7.4 State Stormwater Program

Introduction
The State Stormwater Management Program was established in the late 1980s under the authority of the North Carolina Environmental Management Commission (EMC) and North Carolina General Statute 143-214.7. This program, codified in 15A NCAC 2H .1000, affects development activities that require either an Erosion and Sediment Control Plan (for disturbances of one or more acres) or a CAMA major permit within one of the twenty coastal counties and/or development draining to Outstanding Resource Waters (ORW) or High Quality Waters (HQW).

The State Stormwater Management Program requires developments to protect these sensitive waters by maintaining a low density of impervious surfaces, maintaining vegetative buffers, and transporting runoff through vegetative conveyances. Low density development thresholds vary from 12-30 percent built-upon area (impervious surface) depending on the classification of the receiving stream. If low density design criteria cannot be met, then high density development

requires the installation of structural best management practices (BMP's) to collect and treat stormwater runoff from the project. High density BMP's must control the runoff from the 1 or 1.5-inch storm event (depending on the receiving stream classification) and remove 85 percent of the total suspended solids.

Current Status
Table A-34 shows the four coastal counties in the Neuse River basin where permits may be required under the state stormwater management program under CAMA or ORW stormwater rules. All development requiring an Erosion and Sediment Control Plan (for disturbances of one or more acres) must obtain a stormwater permit.

2002 Recommendations
DWQ will continue implementing the state stormwater program with the other NCDENR agencies and local governments. Local governments should develop local land use plans that minimize impervious surfaces in sensitive areas. Communities should integrate state stormwater program requirements, to the extent possible, with other stormwater programs in order to be more efficient and gain the most water quality benefits for protection of public health and aquatic life.

4.7.5 Water Supply Watershed Stormwater Rules

Introduction
The purpose of the Water Supply Watershed Protection Program is to provide a proactive drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills and residual application sites to control the impacts of point and nonpoint sources of pollution. The program attempts to minimize the impacts of stormwater runoff by utilizing low density development or stormwater treatment in high density areas.

Current Status
All communities in the Neuse River basin in water supply watersheds have EMC approved water supply watershed protection ordinances. Refer to page 44 for more information on classified water supply waters and watersheds in the Neuse River basin.

2002 Recommendations
DWQ recommends continued implementation of local water supply protection ordinances to ensure safe and economical treatment of drinking water. Communities should also integrate water supply protection ordinances with other stormwater programs, to the extent possible, in order to be more efficient and gain the most water quality benefits for both drinking water and aquatic life.

Table A-34 Communities in the Neuse River with Stormwater Requirements

Local Government	NPDES Phase I	NPDES Phase II*	Neuse NSW Stormwater Rules	Coastal Stormwater Rules	State Stormwater Program	Water Supply Watershed Stormwater Requirements
Municipalities						
Apex		X				X
Cary		X	X			X
Clayton						X
Creedmoor						X
Durham	X	X	X			X
Garner		X	X			X
Goldsboro		X	X			X
Havelock		X	X	X		
Kinston			X			
New Bern		X	X	X		
Princeton						X
Raleigh	X	X	X			X
Rolesville						X
Roxboro						X
Selma						X
Smithfield		X	X			X
Stem						X
Wake Forest						X
Wilson		X	X			X
Counties						
Beaufort				X		
Carteret				X	X	
Craven				X		
Durham		X	X			X
Franklin						X
Granville						X
Johnston			X			X
Nash		X				X
Orange		X	X			X
Pamlico				X		
Person						X
Wake		X	X			X
Wayne		X	X			X
Wilson						X

* More local governments may be designated once designation criteria are developed in addition to those that may be automatically designated based on 2000 Census.

4.8 Protection and Restoration of Streams in Urbanized and Developing Watersheds

4.8.1 Introduction

Urbanization often has greater hydrologic effects than any other land use, as native vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and driveways. Urbanization results in increased surface runoff and correspondingly earlier and higher peak flows after storms. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge streams and increases suspended sediment. Scouring also destroys the variety of habitat in streams leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999). Most of the impacts are in terms of habitat degradation (page 89), but runoff from developed and developing areas can also carry toxic pollutants to a stream (NCDENR-DWQ, November 2001). For these streams to support aquatic life, good water quality and aquatic habitat must be maintained.

4.8.2 Current Status

Currently, in the Neuse River basin, there are over 100 miles of streams in urban areas that are impaired by stormwater runoff and the resultant combination of toxicity and habitat degradation. Streams around the high growth areas of the basin are, and will increasingly be, impacted by urban stormwater runoff as land use changes from agriculture and forest uses to urban and suburban land uses.

4.8.3 2002 Recommendations

<u>Maintain Riparian Buffers</u>

The presence of intact riparian buffers and/or wetlands in urban areas can lessen these impacts, and restoration of these watershed features should be considered where feasible; however, the amount of impervious cover should be limited as much as possible. Wide streets, huge cul-de-sacs, long driveways and sidewalks lining both sides of the street are all features of urban development that create excess impervious cover and consume natural areas.

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as riprap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks lining a bank absorb the sun's heat and warm the water. Some fish require cooler water temperatures as well as the higher levels of dissolved oxygen cooler water provides. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive (WNCT, 1999).

Preserving the natural streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife. To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

Protect Headwater Streams

Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. However, impairment of headwater streams can (and does) impact the larger stream or river.

Headwater areas are found from the mountains to the coast along all river systems and drain all of the land in a river basin. Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed.

For a more detailed description of watershed hydrology, please refer to EPA's Watershed Academy website: http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

Reduce Impacts of Future Development

Areas adjacent to the high growth areas of the basin are at risk of having impaired biological communities. These biological communities are important to maintaining the ecological integrity in the Neuse River basin. These streams will be important as sources of benthic macroinvertebrates and fishes for reestablishment of biological communities in nearby streams that are recovering from past impacts or are being restored.

Proactive planning efforts at the local level are needed to assure that development is done in a manner that minimizes impacts to water quality. These planning efforts must find a balance among water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin.

Action should be taken at the local level to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box (below), refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection and the Center for Watershed Protection website at www.cwp.org. Additional public education is also needed in the Neuse River basin in order for citizens to understand the value of urban

planning and stormwater management. DWQ recently developed a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. To obtain a free copy, call (919) 733-5083, ext. 558.

To prevent further impairment to aquatic life in streams in urbanizing watersheds local governments should:

1. Identify waters that are threatened by development.
2. Protect streams beyond existing buffer regulations.
3. Implement stormwater BMPs during and after development.
4. Develop land use plans that minimize disturbance in sensitive areas of watersheds.
5. Minimize impervious surfaces including roads and parking lots.
6. Develop public outreach programs to educate citizens about stormwater runoff.

Establish Long–Term Restoration Plans for Impaired Streams

Many streams in existing urban areas have been impaired for a very long time. Because of the large amounts of established structures, it is generally considered to be too expensive to undertake a stream restoration project in many urban watersheds. These streams are important to ecosystem health, water quality in the basin, and to the quality of life in general. The following steps can be incorporated into a long-term redevelopment plan that will eventually provide opportunity for a stream restoration project.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking and narrower slots).
- Place sidewalks on only one side of residential streets.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.
- Minimize floodplain development.
- Protect and restore wetland/bog areas.

1. Maintain good water quality and aquatic habitat of nearby unimpacted watersheds. Streams in these watersheds will be needed to establish reference conditions and as a source of aquatic life for repopulating restored streams.
2. Identify urban watersheds and encourage community groups, local business and industry to become involved in the long-term planning, fund raising and eventual restoration projects.
3. Target streamside properties that can be purchased or put into easement as the existing structures are removed to provide space for restoration of riparian areas.
4. When streamside properties are redeveloped, structures and parking lots should be sited to provide as much space as possible for restoration of stream channels and riparian areas.
5. Minimize impervious surfaces during redevelopment with the goal of having less impervious surface than was previously on the site.
6. Install BMPs that can hold and treat stormwater runoff from the site during and after redevelopment.
7. When enough stream reach has restoration opportunity, proceed with restoration projects.

Although this process may take many years before urban stream water quality and aquatic habitat are restored, the end product will be an important feature of urban areas.

4.9 Shellfish Harvesting in Class SA Waters

Introduction

The 1997 Neuse River basin use support assessment rated approved shellfish harvesting waters as fully supporting (FS), conditionally approved waters as fully supporting but threatened (ST), and prohibited waters as partially supporting (PS) (page 52). In the 1997 assessment, there were 295,112 acres rated FS and 3,588 acres rated partially supporting (PS). Class SA acres were reported by the nine Division of Environmental Health Shellfish Sanitation and Recreational Water Quality Section (DEH SSRWQ) (page 52) growing areas (e.g., F2: Merrimon, 1,475 acres).

Current Status

DWQ and DEH SSRWQ are developing the database and expertise necessary to assess shellfish harvesting use support using a frequency of closure based approach. This database will allow DWQ to better assess the extent and duration of closures in Class SA waters. These tools are not available for use support determinations in Class SA waters for the 2002 Neuse River basin assessment. DWQ believed it important to identify frequency of closures in these waters, so an interim methodology was used based on existing databases and GIS shapefiles. There will likely be changes in reported acreages in future assessments using the permanent methods and tools that define areas and closure frequency.

For the 2002 Neuse River basin assessment, DWQ used an interim frequency of closures based method to assign use support ratings to Class SA waters. DWQ worked with DEH SSRWQ to determine the number of days and acreages that identified conditionally approved-open Class SA waters were closed to shellfish harvesting in the Neuse River basin during the assessment period (September 1, 1995 to August 31, 2000). For the one growing area with conditionally approved-open (CAO) Class SA waters, DEH SSRWQ and DWQ staff defined subareas (within the larger conditionally approved-open area) that were opened and closed at the same time. The number of days these conditionally approved-open waters were closed was determined using proclamation summary sheets and the original proclamations. The number of days that approved areas in the growing area were closed due to preemptive closures because of named storms was not counted. Refer to Table A-35 for a summary of Class SA waters use support ratings.

Table A-35 Interim Frequency of Closure Based Use Support Ratings

Percent of Time Closed within Basin Data Window	DEH SS Growing Area Classification	DWQ Use Support Rating
N/A	Approved*	Supporting
Closed ≤10 percent of data window	Portion of conditionally approved-open waters closed ≤10 percent	Supporting
Closed >10 percent of data window	Portion of conditionally approved-open waters closed >10 percent of data window	Impaired
N/A	Conditionally approved-closed waters and Prohibited/Restricted**	Impaired

* **Approved waters are closed only during extreme meteorological events (hurricanes).**

** CAC and P/R waters are rarely opened to shellfish harvesting.

2002 Recommendations
DWQ will continue to develop the tools necessary to make use support decisions in Class SA waters using a frequency of closures methodology. Refer to Appendix III for more information. Class SA waters are closed to shellfish harvesting because of bacterial contamination (page 92) or the presence of stormwater outfalls. BMPs for reducing bacterial delivery to shellfish harvesting waters are presented on page 92.

4.10 Impacted Streams in Agricultural Areas

Introduction
Impacts to streams from agricultural activities can include excessive nutrient loading, pesticide and herbicide contamination, bacterial contamination and sedimentation. In the coastal plain, many agricultural areas are ditched, thereby increasing the delivery of the contaminants to surface waters.

Current Status
There are over 115 stream miles that are currently impaired in areas where agriculture is the predominant land use, and biologists have noted impacts to streams related to nutrient loading and sedimentation. There has been a loss of approximately 180,000 acres of cultivated cropland in the Neuse River basin since 1982 (page 22). Much of this land has been converted into more intensive uses, such as urban and suburban areas.

2002 Recommendations
DWQ will identify streams where agricultural land use may be impacting water quality and aquatic habitat. This information will be related to local Division of Soil and Water Conservation (DSWC) and NRCS staff to investigate the agricultural impacts in these watersheds and to recommend BMPs to reduce impacts. DWQ recommends that funding and technical support for agricultural BMPs be continued. Refer to Appendix VI for agricultural nonpoint source agency contact information.

4.11 Confined Animal Operations

Introduction
Confined animal operations in North Carolina result in increased production efficiency, improved production economics, and a better industry support system. However, high animal concentration and accompanying high nutrient import into eastern NC counties also impose a serious environmental threat to water quality.

Current Status
Some portion of nitrogen in swine waste is emitted to the air as ammonia from hog houses, lagoons and sprayfields. The contribution of atmospheric deposition to nutrient budgets in natural systems has not been fully appreciated until recently. In a June 2000 report, *Deposition of Air Pollutants to the Great Waters – 3rd Report to Congress 2000 (1)*, the USEPA presented estimates for selected waterbodies of the portion of the total nitrogen (N) load that was due to atmospheric inputs. With the range varying between 5 and 38 percent, that for the Albemarle-

Pamlico Sounds was one of the highest at 38 percent. There is much uncertainty in calculating emissions from animal waste lagoons.

2002 Recommendations
DWQ recommends that the agricultural community work to research and implement best management practices to address the atmospheric deposition. See also page 64 for more information on the Neuse River basin NSW strategy.

4.12 Water Quality Problems Resulting from Hurricanes

Introduction
The Natural Resources Conservation Services' (NRCS) Emergency Watershed Protection (EWP) is responsible for emergency de-snagging (removal of piles of woody debris from stream and river channels) activities. The EWP program is intended to respond to watersheds impacted by natural disasters such as hurricanes, floods and fire. The purpose of the program is to restore watershed functions to predisaster conditions. Areas selected for debris removal are based on the amount and location of debris and the increased risk of flooding to improved property (including cropland) or public safety (primarily roads and bridges). Location maps and a description of all proposed work are sent to appropriate federal and state agencies for review and comment prior to contracting the work. The programs' intent is to consider environmental concerns.

Current Status
The activity of debris removal of is great interest to DWQ as the excessive removal of debris can impact the aquatic habitat and aquatic life within a stream reach. The decision to remove debris is made considering topography, proximity of improved property subject to damage, location of culverts, bridges and other restrictions, comparison of costs and benefits, and potential environmental impacts. NRCS, along with other state and federal agencies, are in the process of developing guidelines for debris removal that will improve the decision-making process with regard to eligibility and damage thresholds, as well as improving the standards and specifications for removing woody debris in a manner that leaves enough to provide suitable habitat. Debris removal under EWP is not intended to remove all debris from stream channels, only that which causes or may cause an increased risk of flooding or streambank erosion.

Woody debris is the predominant habitat for benthic macroinvertebrates in larger, slower-moving coastal stream and wetland systems. Therefore, removal of these snags removes the habitat available for aquatic life. If care is not taken in properly removing woody debris, the streambanks and streambed can be altered as well as causing moderate to severe habitat degradation.

2002 Recommendations
DWQ is aware of the need to remove obstructions to water flow, including snags, near bridges or other structures in emergency situations because of safety concerns, to reduce economic loss in the event of natural disasters, and to reduce the risk of flooding. NRCS has recently adopted an Interagency Coordination and Implementation Plan for the EWP program that allows for a direct and ongoing role for several agencies to play in the implementation process. The method in which snags are removed, the amount of debris that is removed, and the sites selected should all be chosen following a thorough review by the various agencies responsible for the

implementation of the EWP program. Local governments that receive additional funding for this type of activity should also implement the same management strategies as outlined in the EWP implementation plan to reduce impacts to water quality, aquatic habitat and aquatic life.

4.13 Addressing Waters on the State's 303(d) List

Introduction

Section 303(d) of the federal Clean Water Act requires states to develop a 303(d) list of waters not meeting water quality standards or which have impaired uses. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

Current Status

There are approximately 2,387 impaired stream miles on the 2000 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each of these waters during an 8 to 13-year time frame will require the focus of much of the water quality program's resources. Therefore, it will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters.

2002 Recommendations

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a priority. The waters in the Neuse River basin that are on this list are presented in the individual subbasin descriptions in Section B. For information on listing requirements and approaches, refer to Appendix IV.

4.14 Sedimentation Pollution Control

Introduction

One of most commonly noted types of habitat degradation (page 89) in the Neuse River basin was as a result of sediment entering streams from adjacent land uses. The Sedimentation Pollution Control Act (SPCA) is administered by the NC Division of Land Resources. The Division of Land Resources (DLR) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced.

Current Status

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit. An erosion and sediment control plan must also be developed for these sites under the SPCA. Site disturbances of less than one acre are required to use BMPs, but a plan is not required.

Forestry activities in North Carolina are subject to regulation under the SPCA. However, a forestry operation in the Neuse River basin may be exempt from the permitting requirements if compliance with performance standards outlined in *Forest Practice Guidelines Related to Water Quality* (15NCAC 1I .201-.209) and General Statutes regarding stream obstruction (77-13 and 77-14) are maintained. Forestry activities in the Neuse River basin must also adhere to the riparian buffer protection rules (page 64). Extensive information regarding these performance standards and rules as they apply to forestry operations can be found on the NC Division of Forest Resources website at http://www.dfr.state.nc.us/managing/water_qual.htm.

Major Causes of Sedimentation in the Neuse River Basin

- Land clearing activities (construction and preparing land for planting crops)
- Streambank erosion
- Channelization

For agricultural activities which are not subject to the SPCA, sediment controls are carried out on a voluntary basis through programs administered by several different agencies. As part of the Neuse River NSW strategy (page 64), agriculture operations are required to address nutrients using BMPs. Many of these BMPs will also reduce sediment delivery into adjacent waters. (See Appendix VI for further information.)

In February 1999, the NC Sedimentation Control Commission adopted significant changes for strengthening the Erosion and Sedimentation Control Program. The following rule changes were filed as temporary rules, subject to approval by the Rules Review Commission and the NC General Assembly:

- Allows state and local erosion and sediment control programs to require a pre-construction conference when one is deemed necessary.
- Reduces the number of days allowed for establishment of ground cover from 30 working days to 15 working days and from 120 calendar days to 90 calendar days. (Stabilization must now be complete in 15 working days or 90 calendar days, whichever period is shorter.)
- Provides that no person may initiate a land-disturbing activity until notifying the agency that issued the plan approval of the date the activity will begin.
- Allows assessment penalties for significant violations upon initial issuance of a Notice of Violation (NOV).

Additionally, during its 1999 session, the NC General Assembly passed House Bill 1098 to strengthen the Sediment Pollution Control Act of 1973 (SPCA). The bill made the following changes to the Act:

- Increases the maximum civil penalty for violating the SPCA from $500 to $5000 per day.
- Provides that a person may be assessed a civil penalty from the date a violation is detected if the deadline stated in the Notice of Violation is not met.
- Provides that approval of an erosion control plan is conditioned on compliance with federal and state water quality laws, regulations and rules.
- Provides that any erosion control plan that involves using ditches for the purpose of de-watering or lowering the water table must be forwarded to the Director of DWQ.

- Amends the General Statutes governing licensing of general contractors to provide that the State Licensing Board for General Contractors shall test applicants' knowledge of requirements of the SPCA and rules adopted pursuant to the Act.
- Removes a cap on the percentage of administrative costs that may be recovered through plan review fees.

For information on North Carolina's Erosion and Sedimentation Control Program or to report erosion and sedimentation problems, visit the new website at http://www.dlr.enr.state.nc.us/ or you may call the NC Division of Land Resources, Land Quality Section at (919) 733-4574.

2002 Recommendations
DWQ will continue to work cooperatively with DLR and other agencies that administers sediment control and instream mining programs in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation present in the Neuse River basin. Public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life.

Funding is available for cost sharing with local governments that set up new erosion and sedimentation control programs or conduct their own training workshops. The Sediment Control Commission will provide 40 percent of the cost of starting a new local erosion and sedimentation control program for up to 18 months. Two municipalities or a municipality and county can develop a program together and split the match. It is recommended that local governments draft and implement local erosion and sedimentation control programs.

Funding is also available through numerous federal and state programs for farmers to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams (refer to Section C, Part 1.4.3). EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines some of these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198 or visit the website at http://www.epa.gov/OWOW/watershed/wacademy/fund.html. Local contacts for various state and local agencies are listed in Appendix VI.

4.15 Habitat Degradation

Introduction
Instream habitat degradation is identified in the use support summary (Appendix III) where there is a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surfaces. A watershed in which most of the riparian vegetation has been removed from streams or channelization has

occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Sedimentation is the process by which eroded soil is deposited into waters. Sediment that accumulates on the bottom of streams and rivers smothers fish habitat vital to reproduction and impacts aquatic insects that fish feed upon. Sediment filling rivers and streams decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998). Suspended sediment can decrease primary productivity (photosynthesis) by shading sunlight from aquatic plants, affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency, and therefore, reduced growth by some species, respiratory impairment, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, June 1999). Suspended sediment also increases the cost of treating municipal drinking water.

Some Best Management Practices

Agriculture

- No till or conservation tillage practices
- Strip cropping and contour farming
- Leaving natural buffer areas around small streams and rivers

Construction

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

Forestry

- Controlling runoff from logging roads
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

Bank erosion can add large amounts of sediment to a stream. High flows after rain events can remove soil from the streambank and deposits further downstream. During very high flow events entire streambanks can be eroded into streams. There are many places along the Neuse River where large portions of the riverbank fell as a result of high flows during and following Hurricane Floyd. When these banks began to fail, tons of sediment were washed into the river along with trees and other debris. Streambank erosion from smaller rain events is also common along many urban stream corridors.

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred (McGarvey, 1996). Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996). Channelization also increases the efficiency that bacteria reach shellfish harvesting waters.

Lack of riparian areas can cause reductions in bank stability, nutrient and sediment removal efficiency and increases stream temperatures because of reduced shading. Aquatic habitat can be adversely affected because of the resultant higher temperatures and increased sediment.

Loss of pools and riffles results in loss of the two major aquatic habitat types in streams. High sediment loads can fill pools and bury riffles. For aquatic life to be supported, pools and riffles need to be present and stable in streams for long periods of time.

Loss of woody habitat from streams causes reductions in important aquatic habitat and processing of organic matter. Woody material from surrounding riparian areas provides aquatic habitat for many benthic macroinvertebrate species. Woody material forms debris dams that can be stable for many years in streams. These debris dams hold organic material in the stream longer and increases processing efficiency.

Streambed scour directly removes benthic macroinvertebrates from woody material and large rocks.

2002 Recommendations

Determining the cause and quantifying amounts of habitat degradation is very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and perhaps even more resources to restore the stream. DWQ is working to develop a reliable habitat assessment methodology.

Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation will need to be addressed to further improve water quality in North Carolina's streams and rivers.

Erosion and sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. In fact, planning to minimize the (1) amount and (2) time the land is exposed can prevent substantial amounts of erosion. Land clearing activities that contribute to sedimentation in the Neuse River basin include: construction of homes and subdivisions as well as commercial and public buildings; plowing soil to plant crops; site preparation and harvest on timberlands; and road projects. Refer to (page 87) for information on North Carolina's Sedimentation Pollution Control Act.

Restoration or recovery of channelized streams may occur through natural processes or artificially induced ones. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

4.16 Bacterial Contamination

Introduction
Fecal coliform bacteria are used as an indicator of contamination from warm-blooded animals. Waters containing high amounts of fecal coliform bacteria may also be carrying other more harmful bacteria and microorganisms that have the potential to cause disease. Bacteria can reach surface waters from point sources such as untreated or poorly treated wastewater and from nonpoint sources such as waste deposited on the ground from domesticated animals and wildlife. Waterfowl can also deposit bacteria directly into surface waters.

Increasing the sources of fecal coliform bacteria in watersheds such as more domesticated animals or failing septic systems will potentially increase the amount of bacteria that reach surface waters. Land-disturbing activities and increases in impervious surfaces in a watershed will also increase the efficiency of delivery (via runoff) of fecal coliform bacteria to surface waters. Drainage ditches also increase the efficiency of delivery of bacteria to surface waters.

Current Status
Many areas in the coastal region of the basin are impaired because of shellfish harvesting area closures. The closures are from bacterial contamination. There are also many waters that have high levels of fecal coliform bacteria associated mostly with stormwater runoff in urban areas. DWQ is currently developing TMDLs (see Appendix IV) for waters that are on the 303(d) list of impaired waters.

2002 Recommendations
Refer to page 84 for more information on efforts to evaluate the extent of bacterial contamination in coastal waters. DWQ will continue to monitor and report fecal coliform bacteria levels in monitored waters. DWQ will continue to develop TMDLs for waters that are impaired because of fecal coliform bacteria contamination.

4.17 Algal Blooms

Algal blooms have been a problem in lakes, reservoirs and estuaries that are overloaded with nutrients. Some algal blooms can be noxious and harmful if toxins are inhaled or body contact is made. Many types of algal blooms cause dissolved oxygen to be elevated during photosynthesis. When these algae die off or respire at night, dissolved oxygen can become very low. Many times low dissolved oxygen caused by algal die off can cause fish kills. In 2001, over 600,000 fish died in 37 reported kill events. Not all fish kill events are associated with algal blooms.

2002 Recommendations
Continued implementation of the Neuse River basin NSW strategy (page 64) will help to reduce the potential for fish kills in the Neuse River estuary.

4.18 Low Dissolved Oxygen

Maintaining an adequate amount of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. A number of factors influence DO concentrations

including water temperature, depth and turbulence. Additionally, in the Neuse River basin, a large floodplain drainage system and flow management from upstream impoundments also influence DO. The dissolved oxygen water quality standard for Class C waters is "not less than a daily average of 5.0 mg/l with a minimum instantaneous value of not less than 4.0 mg/l". Swamp waters (Class C Sw) "may have lower values if caused by natural conditions" (NCDENR-DWQ, August 1, 2000).

Oxygen-consuming wastes such as decomposing organic matter and some chemicals can reduce dissolved oxygen levels in surface water through biological activity and chemical reactions. NPDES permits for wastewater discharges set limits on certain parameters in order to control the effects that oxygen depletion can have in receiving waters.

2002 Recommendations

For more information about oxygen-consuming wastes and what DWQ does to limit water quality impacts from these wastes, refer to *A Citizen's Guide to Water Quality Management in North Carolina*. This document is available online at http://h2o.enr.state.nc.us/basinwide/ or by calling (919) 733-5083.

4.19 Fish Tissue Contamination

4.19.1 Introduction

The NC Department of Health and Human Services (NCDHHS) has developed guidelines to advise people to what fish are safe to eat. DWQ considers uses of waters with a consumption advisory for one or more species of fish to be impaired. Elevated methylmercury levels have been found in shark, swordfish, king mackerel, tilefish, largemouth bass, bowfin (or blackfish), and chain pickerel (or jack). As of April 2002, these fish are under an advisory.

The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water and into biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway of mercury in the environment is through the atmosphere. Mercury that has been emitted from industrial and municipal stacks into the ambient air can circulate across the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also commonly found in wastewater. However, mercury in wastewater is typically not at levels that could be solely responsible for elevated levels in fish.

The NC Department of Health and Human Services issues fish consumption advisories for those fish species which have median and/or average methylmercury levels at 0.4 mg/kg or greater. These fish include shark, swordfish, king mackerel, tilefish as well as largemouth bass, bowfin (or blackfish) and chain pickerel (or jack) south and east of Interstate 85. As a result of these advisories, DWQ considers all waters in the Neuse River basin to be impaired in the fish consumption use support category. Refer to Appendix III for more information regarding use support ratings and assessment methodology.

4.19.2 Current Status

Specific Fish Consumption Advisories
Fish is an excellent source of protein and other nutrients. However, several varieties of saltwater and NC freshwater fish may contain high levels of mercury, which may pose a risk to human health. These guidelines will help you make healthy food choices.

Women of Childbearing Age (15-44 years), Pregnant Women, Nursing Women and Children under 15:

- Do not eat shark, swordfish, tilefish or king mackerel; or blackfish (bowfin), largemouth bass or jack fish (chain pickerel) caught in North Carolina waters south and east of Interstate 85. These fish are all high in mercury.
- Eat up to two meals* per week of other fish.

Other Women, Men and Children 15 years and older:

- Eat no more than one meal* per week of shark, swordfish, tilefish or king mackerel; or blackfish (bowfin), largemouth bass or jack fish (chain pickerel) caught in North Carolina waters south and east of Interstate 85. These fish are all high in mercury.
- Eat up to four meals* per week of other fish.

* A "meal" is 6 ounces of cooked fish for adults and children 15 years and older, and 2 ounces of cooked fish for younger children.

DWQ Mercury Workgroup
DWQ is committed to characterizing methylmercury exposure levels and determining if NPDES sources need to be controlled. DWQ formed an internal Mercury Workgroup to improve communication from all programs which directly affect mercury issues (i.e., Pretreatment, Environmental Sciences, Basinwide Planning, etc.). The workgroup meets as needed to share information and determine next steps in addressing mercury issues associated with the aquatic environment.

4.19.3 2002 Recommendations

Improved Ambient Sampling Techniques
DWQ aims to stay abreast of new technology and sampling techniques to ensure that water quality data are accurate, precise and of highest value. In 2000, DWQ started training water quality sampling staff on the new EPA Method 1631 technique. Current monitoring using a higher detection limit (EPA Method 245.1) has consistently yielded non-detected values, and DWQ aims to use the 1631 method to allow detection levels three orders of magnitude lower than EPA Method 245.1.

Regional Mercury Study
In an effort to better manage state waters that may have methylmercury issues, DWQ initiated a study through EPA 104(b)(3) funds. The study aims to provide information that may be used in water quality standard and TMDL development. The study goals include:

- determining levels of ambient mercury in the surface water system;
- estimating site-specific total mercury: methylmercury translators to evaluate water quality criteria;
- develop site-specific water to fish bioaccumulation factors; and
- determine levels of mercury in treatment plant effluent.

DWQ aims to complete this study in 2003, and results will be available to the public. For more information, contact the DWQ Planning Branch Modeling/TMDL Supervisor at (919) 733-5083.

DWQ will continue to host an internal workgroup to stay abreast of current mercury issues. The public has voiced concerns that DWQ should be working on the ecological components and consequences of mercury bioavailability to biota in these areas and the biogeochemical cycling and production of methylmercury from associated wetlands along these streams. Though the workgroup does not have a mandate to conduct research into mercury, the workgroup will better communicate its purpose and accomplishments to the public through periodic updates on the DWQ website.

DWQ will also provide interested members of the public with an overview of the new ambient monitoring sampling technique to gather feedback and insights on how DWQ can best accomplish its data collecting goals.

DWQ will continue to monitor concentrations of various contaminants in fish tissue across the state and will work to identify and reduce wastewater contributions of mercury to surface waters. The Division of Air Quality (DAQ) evaluates mercury levels in rainwater on a regular basis through the EPA Mercury Deposition Network. EPA continues to focus on nationwide mercury reductions from stack emissions and through pollution prevention efforts. Pollution prevention efforts are being investigated on a state and federal level to reduce mercury emissions.