CATAWBA RIVER BASINWIDE WATER QUALITY MANAGEMENT PLAN

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FORWARD

The Catawba River Basin is unique in a number of respects, and these unique features offer some special challenges in protecting the quality of its waters. Despite the relatively pristine conditions of its headwaters, which includes the Linville River, one of just four state-designated Natural and Scenic Rivers in North Carolina, the Catawba Basin is the most densely populated river basin in the state. The basin has over a million residents and encompasses the state's largest city, Charlotte.

The river mainstem is almost entirely impounded by a series of seven hydropower reservoirs running from Lakes James, located at the foot of the Blue Ridge Mountains, to Lake Wylie, which straddles the state line with South Carolina. The reservoirs, by virtue of their location in this highly populated region, have become a tremendous recreational and water supply resource. Yet the water quality of these and five other reservoirs in the basin may be jeopardized by the surrounding growth pressures. Three of the twelve reservoirs in the basin are considered threatened, primarily from excessive nutrient loading from both wastewater treatment plants and stormwater runoff. Without careful monitoring and protection, water quality impacts may not be seen by many until the problems become severe enough to alter uses in the main bodies of the lakes. For example, water quality standard violations for chlorophyll *a* have begun to be observed in the main body of Lake Wylie with more severe conditions occurring in the Crowders Creek and Catawba Creek arms of the lake. A nutrient management strategy has been recommended in order to prevent degradation of the main body of Lake Wylie and to begin to restore uses to the tributary arms. Studies are currently underway to determine the need for additional protection in several of the basin's other reservoirs.

In regard to the basin's nearly 3100 miles of free-flowing rivers and streams, 16% are considered impaired with 90% of the impairment attributed to nonpoint sources of pollution. Agricultural runoff, construction activities and urban stormwater are the primary nonpoint sources of pollution, and sediment is by far the most widespread cause of impairment. In addition to the nonpoint pollution sources, the basin has nearly 550 permitted dischargers. A small number of these facilities have problems with toxicity and color, but of larger importance is the fact that the waste assimilative capacity, for oxygen-consuming wastes, of a growing number of streams is becoming exhausted. This is necessitating recommending more stringent waste limits for discharges in order to protect water quality standards and sustained use of the basin's waters.

A major challenge facing those with a stake in the basin is how to protect the quality of its water resources in the face of strong growth pressures. This plan does not purport to have all the answers, but it does begin to lay the groundwork for addressing them. Through analyses of extensive data collected over the past 5 to 10 years, it identifies and addresses eight major water quality issues in the basin:

1) Nutrient inputs to lakes from both point and nonpoint sources
2) Sedimentation in streams and lakes from urban runoff, construction and agriculture
3) Lack of assimilative capacity for oxygen-consuming wastes in streams and lake coves from wastewater treatment plant discharges
4) Stream water quality impairment from urban stormwater runoff
5) Health concerns associated with fecal coliform bacteria
6) Toxicity from heavy metals and its impacts on aquatic life and water supplies
7) Discharges of colored effluent from wastewater treatment plants
8) Enforcement of water quality regulations and compliance with discharge permits

Solving these problems is beyond the capabilities of any one agency or group. State and federal government regulatory programs will play an important part; but much of the responsibility will rest with industry, agriculture, local governments and the public. Those who live, work and recreate in the basin have the most at stake. It is hoped that this plan will provide a framework for cooperative efforts between the various stakeholders in the basin toward a common goal of protecting the basin's water resources.

EXECUTIVE SUMMARY

NORTH CAROLINA'S BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT - PURPOSE OF CATAWBA BASINWIDE PLAN

Basinwide management is a new watershed-based water quality management initiative being implemented by the North Carolina Division of Environmental Management (DEM). The *Catawba River Basinwide Water Quality Management Plan* (Catawba Plan) is the fourth in a series of basinwide water quality management plans that will be prepared by DEM for all seventeen of the state's major river basins by 1998. The plan will be used as a guide by DEM in carrying out its water quality program duties and responsibilities in the Catawba River Basin. It can also provide a framework for cooperative efforts with local interests to protect the water resources of the basin.

The draft plans are circulated for public review and comment and are presented at public meetings in each basin. The plan for a given basin is completed and approved prior to the scheduled date for basinwide permit renewals in that basin. Each plan is then to be evaluated, based on follow-up water quality monitoring, and updated at five year intervals. The Catawba Basinwide Plan was approved in February of 1995 and will be updated in 1999. Basinwide permitting of NPDES (National Pollutant Discharge Elimination System) wastewater treatment facilities is scheduled to commence in April 1995.

BASINWIDE GOALS

The primary goals of DEM's basinwide program are to 1) identify and restore full use to impaired waters, 2) identify and protect highly valued resource waters, and 3) manage problem pollutants throughout the basin so as to protect water quality standards while accommodating population increases and reasonable economic growth.

In addition, DEM is applying this approach to each of the major river basins in the state as a means of better identifying water quality problems; developing appropriate management strategies; maintaining and protecting water quality and aquatic habitat; assuring equitable distribution of waste assimilative capacity for dischargers; and improving public awareness and involvement in management of the state's surface waters.

CATAWBA BASIN OVERVIEW

The Catawba River Basin, along with the nearby Broad River basin in North Carolina, forms the headwaters of the Santee-Cooper River system which flows through South Carolina to the Atlantic Ocean. The Catawba is the eighth largest river basin in North Carolina covering 3279 square miles in the southwestern region of the state. The Catawba River rises from the eastern slope of the Blue Ridge Mountains at elevations in excess of 3,000 feet and flows eastward, then southward to Lake Wylie which straddles the North Carolina-South Carolina state line (Figure 1). The headwaters of the Catawba River are formed by swift-flowing, cold water streams originating in the steep terrain of the mountains in Avery, Burke, Caldwell and McDowell Counties. Many of these streams exhibit good to excellent water quality and are classified as trout waters. Below Lake Wylie in South Carolina, the Catawba flows through Fishing Creek Reservoir and Wateree Lake before becoming the Wateree River. The Wateree, joined by the Congaree River, flows into Lake Marion, and the entire river system eventually drains to the Atlantic Ocean.

One of the most important headwater streams is the Linville River. The Linville is one of only four rivers in the state designated by the General Assembly as a state Scenic River under the state's Natural and Scenic Rivers Program (a program administered the North Carolina Division of Parks

FINAL CATAWBA BASIN PLAN

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and Recreation). The Linville flows through Linville Gorge Wilderness Area, a section of the Pisgah National Forest, and into Lake James, the first of a series of hydroelectric dams that segment the mainstem of the Catawba River into a series of impoundments. These impoundments, commonly referred to as the Catawba Chain Lakes include Lake James, Rhodhiss Lake, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake and Lake Wylie. As the basin enters the piedmont region from the mountains, land use shifts from forest to agriculture and urban uses.

The largest tributary to the Catawba River is the South Fork Catawba River which flows into Lake Wylie near the state line. It originates in the South Mountain area in southern Burke County. Its two major headwater tributaries are Jacob Fork and Henry Fork. There are 3,083 miles of freshwater streams in the basin and over 60,000 acres of impoundments. The basin is subdivided into nine subbasins represented in Figure 1 by six-digit subbasin codes (03-08-30 through 03-08-38). The subbasins are often referred to throughout the plan by their last two digits (e.g., 03-08-30 equals subbasin 30).

The population of the basin, based on 1990 census data, was estimated at 1,033,400. Municipalities with a population of 5,000 or more in the Catawba basin include Belmont, Charlotte, Conover, Hickory, Lincolnton, Mooresville, Morganton, Mt. Holly and Newton. The Catawba basin is the most densely populated river basin in the state with an overall population density of 312 persons per square mile versus a statewide average of 127 persons per square mile. The percent population growth over the past ten years (1980 to 1990) was 16.5% versus a statewide percentage increase of 12.7%. The basin encompasses all or part of the following 14 counties: Alexander, Avery, Burke, Caldwell, Catawba, Cleveland, Gaston, Iredell, Lincoln, McDowell, Mecklenburg, Union, Watauga and Wilkes.

Land cover, based on a 1982 assessment by the Soil Conservation Service is dominated by forest (54%), agriculture (20%) and urban/built-up areas (16%), which jointly comprise 90% of the land/water surface area in the entire basin. The remaining basin is comprised of open water (4%), rural transportation (3%) and minor development (3%). North Carolina is in the process of obtaining statewide land cover data through the Center for Geographic Information and Analysis (CGIA).

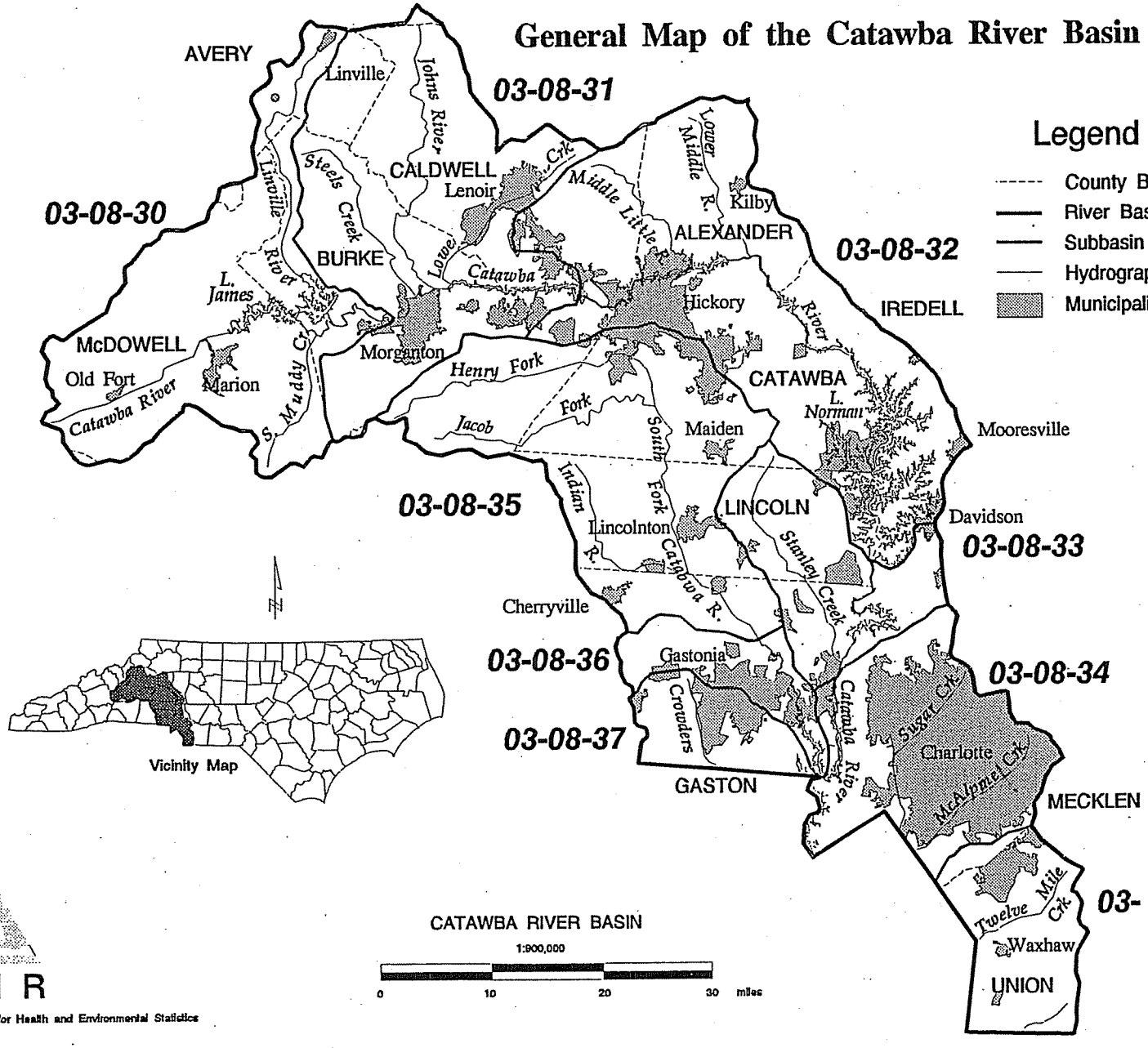
There are a total of 545 NPDES (National Pollutant Discharge Elimination System) dischargers in the basin, 39 of which are major facilities, 165 are purely domestic, 45 are municipalities and 64 are industries. The total permitted flow for all facilities is 203 million gallons per day (MGD). In addition to the discharge facilities, there are 94 swine, cattle, dairy, chicken and poultry operations in the basin that have registered with the Division of Environmental Management (DEM) as concentrated animal feeding operations under 15A NCAC 2H .0217.

ASSESSMENT OF WATER QUALITY IN THE CATAWBA RIVER BASIN

An assessment of water quality data collected by DEM and others revealed that in the forested upper region of the basin, most of the streams feeding the Catawba River have good water quality. As the river continues into the piedmont, nonpoint runoff from agricultural operations, urban runoff, and other sources has caused nutrient enrichment, sedimentation and fecal coliform problems in the streams and rivers as well as in the tributary arms of many lakes in the mid and lower basin. Urban stormwater runoff is of particular concern in the lower basin in and around Mecklenburg and Gaston counties. Impacts from point source dischargers have also been documented. Biochemical oxygen demand, nutrients and localized toxicity and color impacts are the chief point source concerns.

One type of monitoring data used to assess water quality and identify long-trends is benthic macroinvertebrate sampling. Benthic macroinvertebrates are bottom-dwelling aquatic organisms

General Map of the Catawba River Basin



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that can be seen with the naked eye (mostly aquatic insect larvae). An analysis of the benthic macroinvertebrate database for the entire basin shows that a total of 180 benthos sites (287 samples) have been sampled in the Catawba River basin since 1983. Twenty of the 45 benthos sites in the 1992 basinwide assessment have long-term data for analysis of changes in water quality. Of these sites, 12 (60%) showed long term improvements in water quality, 7 (35%), showed no change, and one site (Clark Creek) had a decline in water quality from 1984 to 1985, with no change since 1985.

Another important method for assessing surface water quality is to determine whether the quality is sufficient to support the uses for which the waterbody has been classified by the state. The word *uses*, depending on the classification of the waters, refers to activities such as swimming, fishing and water supply. DEM has collected extensive chemical and biological water quality monitoring data throughout the Catawba basin as summarized above. All data for a particular stream segment have been assessed to determine the overall *use support* rating; that is, whether the waters are *fully supporting*, *partially supporting* or *not supporting* their uses. A fourth rating, *support-threatened,* applies where all uses are currently being supported but that water quality conditions are marginal. Streams referred to as *impaired* are those rated as either partially supporting or not supporting their uses. Use support ratings in the Catawba basin, described more fully in Chapter 4, are summarized below for freshwater streams and lakes. A list of impaired streams along with recommended management strategies is presented in Table 6.1 in Chapter 6.

Freshwater Streams and Rivers

Of the 3042 miles of freshwater streams and rivers in the Catawba basin, use support ratings were determined for 90% or 2737 miles with the following breakdown: 52% were rated fully supporting, 22% support-threatened, 12% partially supporting, four percent not supporting, and 10% nonevaluated. Thus a total of 16% are considered impaired. In general, those subbasins upstream on the Catawba mainstem above from Mt. Island Lake dam (subbasins 30, 31, 32 and 33) those subbasins upstream from and including Long Creek on the Sourth Fork Catawba River (subbasins 35 and 36) had a majority of their streams which were either supporting or support-threatened. A higher percentage of impaired streams were found in the lower South Fork, Catawba Creek, Crowders Creek and Sugar Creek subbasins (subbasins 34, 37 and 38).

Probable causes and sources of impairment have been determined for about 90% of the impaired streams. Sediment was the most widespread cause of impairment (376 miles), followed by fecal coliform bacteria (51 miles), turbidity (26 miles) and metals (16 miles). In regard to fecal coliform bacteria, bacteria levels at 26 of the 39 ambient sampling locations were found to exceed the state standard of 200 MPN in over 10% of the samples. Further, at 18 stations, over 25% of the samples exceeded the state standard.

Lakes

Twelve lakes in the Catawba Basin, totaling 46,985 acres, have been monitored and assigned use support ratings (see Table 4.7, Chapter 4). Of these 12, nine are fully supporting their uses, and three are support-threatened: Lake Hickory, Lake Wylie and Maiden Lake. The main cause of use support impairment is high chlorophyll *a* levels which result from algae blooms brought on by excessive nutrient loadings. Nutrients come from both point source discharges and nonpoint sources including urban and agricultural lands. The tributary arms of the lakes are most susceptible to pollution impacts not only from nutrients but from sediment and biochemical oxygen-demanding (BOD) wastes, as well. These areas should be monitored periodically because they will exhibit problems before the main body of the lake.

MAJOR WATER QUALITY ISSUES AND RECOMMENDED MANAGEMENT STRATEGIES

Several water quality issues emerge as being of particular importance in light of factors such as the degree of water quality degradation, the value of the resources being impacted and the number of users affected. Those issues considered most significant on a basinwide scale are presented below along with recommended management or research actions. These include: oxygen-consuming wastes, nutrients, toxicants, sedimentation, color, urban stormwater and fecal coliform bacteria.

A. MANAGEMENT OF OXYGEN-CONSUMING WASTES FROM DISCHARGE FACILITIES

The Division of Environmental Management has the responsibility of ensuring that the waste limits in NPDES discharge permits are established so as to protect dissolved oxygen standards in receiving waters. In the past, these limits have been established on a case-by-case basis, but followup studies that have examined the cumulative affects of multiple discharges on receiving streams have found that this approach sometimes results in overallocating the waste assimilative capacity of the receiving waters. Under the basinwide approach, efforts are being made, as resources allow, to establish strategies called total maximum daily loads (TMDLs) which would apply to multiple dischargers on streams or watershed areas within the basin. TMDLs include recommended permit limits designed to protect water quality standards and provide additional capacity for future expansions or new facilities. TMDLs for BOD have been established for the following streams:

- Lyle Creek Watershed
- Sugar Creek Watershed
- South Fork Catawba River
- Crowders, McGills and Abernethy Creeks
- Six Mile Creek Watershed

The strategies for each of these water bodies are presented in Section 6.3 of Chapter 6. These TMDLs are based on predictive computer modeling that takes into account such factors as water quality data, stream flow and physical conditions, waste loading and waste assimilative capacity. Appendix III summarizes the modeling methodology.

In addition to setting TMDLs for stream protection, TMDLs are also recommended for protection of the transitional environment between free flowing streams and lake waters in the tribuary arms of major lakes along the mainstem of the Catawba River (Lake James, Lake Hickory, Rhodhiss Lake, Lookout Shoals Lake, Lake Norman, Mountain Island Lake and Lake Wylie). This is a potentially sensitive area to loading of oxygen demanding wastes. As stream waters slow and deepen as they enter a lake, the rate at which oxygen enters the water is reduced. This means that a concentration of oxygen demanding waste that was acceptable in a free flowing stream may result in dissolved oxygen levels below the state standard in the transitional areas.

Accordingly, it is recommended that all new and expanding dischargers of oxygen consuming wastes that discharge to the lakes along the mainstem of the Catawba River (except Lake Wylie - see Nutrients, below) or are predicted to increase oxygen demanding waste loading to the lakes, should meet a minimum treatment limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N. These limits will help to protect dissolved oxygen water quality standards in the Catawba River chain of lakes and will allow for continued growth in the region.

B. NUTRIENTS

Control of nutrients is necessary to avoid the development of nuisance algae conditions in the state's waterways. Point source controls typically include NPDES permit limitations on total phosphorus (TP) and total nitrogen (TN). Nonpoint controls of nutrients generally include best management practices (BMPs) to control nutrient loading from areas such as agricultural land, urban areas, construction sites and forestry activities.

Assimilative capacity for nutrients varies greatly in the Catawba Basin as the waters flow from stream to lake to stream. A 1992 report by DEM and South Carolina Department of Health and Environmental Control (92-04) described the nutrient assimilative capacity of Lake Wylie as exhausted. Rhodhiss Lake and Lake Hickory are eutrophic lakes, but their short retention time appears to mitigate the effect of algal growth. Ongoing and planned studies will further detail the assimilative capacity for nutrients of Lake James, Rhodhiss Lake, Lake Hickory, Lookout Shoals Lake, and Mountain Island Lake.

Updating the Lake Wylie Nutrient Management Strategy

The 1992 Lake Wylie Report (92-04) documented eutrophic conditions in Lake Wylie and several of its major tributaries. To address eutrophication in Lake Wylie, the State adopted a point and non-point nutrient control strategy for the Lake Wylie watershed. For point sources, it required state-of-the-art nutrient removal for all new or expanding wastewater discharges in the vicinity of the lake. In addition, the nutrient management strategy required existing facilities on tributaries to the three most highly eutrophic arms of the lake (South Fork Catawba River, Catawba Creek and Crowders Creek) to meet state-of-the-art nutrient removal. For nonpoint sources, this strategy included targeting of funds from the state's Agricultural Cost Share Program for the Reduction of Nonpoint Source Pollution for implementation of best management practices on agricultural lands to highly impacted watersheds of Lake Wylie.

In conjunction with the Catawba River basinwide planning effort, the existing Lake Wylie management strategy was reexamined in light of current water quality data and in order to assess the strategy's consistency with the State's stated goal of managing problem pollutants while accommodating reasonable economic growth. The Lake Wylie nutrient management strategy, presented below, is designed to reduce and eventually prevent the occurrence of eutrophication-related water quality standard violations in Lake Wylie and is consistent with the general results and conclusions of the 1992 Lake Wylie report. For the purposes of this document, the Lake Wylie Nutrient Management Area is considered to be Lake Wylie and its tributaries including the Catawba River and its tributaries below Mountain Island Dam and the South Fork Catawba River below its confluence with Long Creek.

Point Source Strategy - Lake Wylie

Entire Lake Management Area:

- No new discharges should be allowed to the lake mainstem or its tributaries, unless an evaluation of engineering alternatives shows that it is the most environmentally sound and economically feasible alternative.
- Existing discharges to the lake mainstem and tributaries should be encouraged to be removed when alternatives become available. Incentives should be established to encourage the privately owned facilities to transfer their wastes to larger municipal WWTPs which have a greater resource base to consistently operate the state-of-art treatment facilities required to protect water quality in the above listed sensitive areas.

- All industrial dischargers will be handled on a case-by-case basis because best available technology (BAT) is not clearly defined for them as a group. It is recommended that industries reduce TP and TN to BAT levels.

New/Expanding Non-industrial Dischargers to Lake Wylie (except Catawba and Crowders Creek arms)

- $\geq$ 1 MGD: Recommended limits are 1 mg/l TP and 6 mg/l TN (summertime)
- < 1 MGD but > 0.05 MGD: Recommended limits are 2 mg/l TP

Catawba Creek (>0.05 MGD):

- By 2006, all dischargers should be required to meet limits of 0.5 mg/l TP, 4mg/l summertime TN and 8 mg/l wintertime TN.

Crowders Creek (> 1 MGD):

- By 2001, all facilities should meet limits of 1 mg/l TP and 6 mg/l TN

Nonpoint sources - Lake Wylie

All tributaries to Lake Wylie should be given priority by the Division of Soil and Water Conservation for cost share funds for use in implementation of best management practices (BMPs). When possible, resources should be targeted toward implementation of BMPs in the Catawba Creek, Crowders Creek and the South Fork Catawba River watersheds since a significant amount of the nutrients reaching these streams is from non-point sources. Since the South Fork Catawba River provides by far the largest nutrient load of any tributary to Lake Wylie, the South Fork should be considered the highest priority for implementation of BMPs.

Rhodhiss Lake, Lake Hickory and Mountain Island Lake

Specific management plans for addressing point and/or non-point source pollution to Rhodhiss Lake, Lake Hickory and Mountain Island Lake will be developed after completion of studies now underway by DEM, the US Geological Survey, Mecklenburg County and others.

C. TOXIC SUBSTANCES

Toxic substances routinely regulated by DEM include metals, organics, chlorine and ammonia. Point source dischargers will be allocated chemical specific toxic substance limits and monitoring requirements based on a mass balance technique. Whole effluent toxicity limits are also assigned to all major dischargers and any discharger of complex wastewater. Where clusters of discharges and other pollution sources exits, concerns about the interaction of toxicants from different facilities are addressed by calculating a total maximum daily load (TMDL) for these streams. This method involves determining the total dilution available downstream of a number of pollution sources that are believed to contribute to a threat to water quality, and allocating pollutant loads to sources so as to prevent instream violations of water quality standards. TMDL strategies are presented in Section 6.5.2 of Chapter 6 for portions of Clark Creek and the South Fork Catawba River.

All new and expanding dischargers are required to dechlorinate their effluent if chlorine is used for disinfection. If a chlorine standard is developed for North Carolina, chlorine limits may be assigned to all dischargers in the State that use chlorine for disinfection.

Strategies being implemented through the industrial and urban NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters. Industries are being required to prevent contamination of stormwater runoff from their sites through practices such as covering stockpiles of toxic materials that could pose a threat to water quality, and where necessary, implementing other best management practices to control the water quality of runoff.

D. SEDIMENTATION

Sediment is the most widespread cause of water quality use support impairment in the Catawba River Basin as it is throughout most of the state. Significant sources include agricultural activities, road construction, urban development and timber harvesting. There are 19 programs administered by various local, state and federal agencies which have been developed to control sediment from these activities (Table 6.3 of Chapter 6). Without these programs, sediment-related water quality impacts would undoubtedly be much worse. However, despite the combined efforts of all of the above program there were still 376 miles of streams in the Catawba Basin found to be impaired by sediment, thus pointing to the need for continued overall improvements in sediment control. Most the programs referenced above and listed in Chapter 6 are the responsibility of agencies other than DEM. DEM is using the basinwide approach to draw attention to this issue to work more closely with the responsible agencies to find ways of improving sediment control. Possibilities for improvement may include the following measures:

- More effective implementation and maintenance of sediment control measures by contractors, farmers and other land owners
- Better enforcement of existing regulations
- More widespread adoption of sediment control programs by local governments
- Public education
- Possible strengthening of sediment control laws and regulations including limiting the area of disturbed land on a given site and providing a more stringent time period for reestablishing vegetation on denuded areas than currently required.

All or portions of the following streams (followed by their respective subbasin numbers) have been identified as being impaired or threatened by sediments and should receive high priority as sediment control programs are implemented: Linville River (03-08-30), South Fork Catawba (03-08-35), Lower Creek (03-08-31), Long Creek (03-08-36), Lower Little River (03-08-32), Twelve Mile Creek (03-08-38), Clark Creek (03-08-35), and Waxhaw Creek (03-08-38).

F. COLOR

Color is rarely the result of one specific chemical, rather a mixture of many dissolved and/or suspended constituents contribute to color. Because color is perceived differently by different people and in different lighting conditions, no general definition of color impairment can be specified by a simple set of criteria. DEM has identified the need to develop a color monitoring protocol that will allow specific analyses of color in waters of the state. Because textile industries are a significant source of color to waters of the Catawba and other river basins, DEM intends to work with the North Carolina Textile Manufacturing Association on developing appropriate methodologies for color analysis. This work will be followed with a monitoring program with the goal of developing treatment strategies for facilities that are a significant source of colored effluent. Two subbasins that make up the South Fork Catawba River watershed (03-07-35 and 03-07-36) will be targeted in a pilot study to address color.

G. URBAN STORMWATER

DEM has identified 111 miles of streams in the Catawba River Basin as being impaired by urban stormwater, many of which are in the Charlotte-Mecklenburg area. DEM administers several programs aimed at controlling urban stormwater runoff. These include: 1) NPDES stormwater permit requirements for industrial activities and for municipalities greater than 100,000 in population (which includes Charlotte) and 2) programs for the

control of development activities near High Quality Waters (HQW) and Outstanding Resource Waters (ORW) and activities within designated Water Supply (WS) watersheds. However, because of the widespread occurrence of stormwater runoff impacts throughout this rapidly urbanizing basin, it is recommended that smaller municipalities begin efforts to identify sources of stormwater runoff and take corrective actions such as eliminating illicit discharges to stormwater systems. Several strategies for addressing urban stormwater are summarized briefly in Section 6.8 of Chapter 6. It should be noted that the City of Charlotte is the first municipality in the southeast to have obtained an NPDES stormwater permit.

H. FECAL COLIFORM BACTERIA

Fecal coliforms are bacteria typically associated with the intestinal tract of warm-blooded animals and are widely used as an indicator of the potential presence of pathogenic, or disease-causing, bacteria and viruses. They enter surface waters from improperly treated discharges of domestic wastewater and from nonpoint source runoff. Common nonpoint sources of fecal coliforms include leaking or failing septic systems, leaking sewer lines or pump station overflows, runoff from livestock operations and wildlife.

Of the 39 ambient water quality monitoring stations in the Catawba basin, fecal coliform measurements exceeded the state standard of 200 MPN at least 10% of the time at 27 stations, and more than 25% of the time at 18 stations. In light of this information, local health departments are encouraged to sample waters in their jurisdictions, particularly in and around known swimming areas and to alert citizens to potential health hazards from water contact if bacterial levels are found to be too high.

I. ENFORCEMENT AND TREATMENT PLANT OPERATOR TRAINING

NCDEM is aggressively improving permit compliance through such methods as better screening of effluent violations, streamlining enforcement actions and imposing automatic penalties. At the same time, NCDEM's training and certification program for wastewater treatment plant operators is being expanded and improved in order to reduce problems associated with operator errors and to improve plant operations and efficiency.

In summary, basinwide management is a planning process that seeks to maximize water quality protection through the use of existing programs and regulations while providing a framework for long-term planning and economic growth. The Catawba River Basinwide Water Quality Management Plan summarizes water quality information for the basin, identifying the major causes and sources of pollution, and recommends actions needed help achieve the goals of balanced growth and environmental protection in the Catawba Basin. Achieving these goals will require the concerted efforts of all stakeholder interests in the basin.

TABLE OF CONTENTS

Chapter	Title	Page
EXECUTIVE SUMMARY		ii
TABLE OF CONTENTS		x
1.	INTRODUCTION	1 - 1
1.1	Purpose of this Document	1 - 1
1.2	Guide to Use of this Document	1 - 2
1.3	North Carolina's Basinwide Management Approach	1 - 3
1.4	Basinwide Responsibilities within the NCDEM Water Quality Section	1 - 7
1.5	State and Federal Legislative Authorities for NC's Water Quality Program	1 - 9
2.	GENERAL BASIN DESCRIPTION WITH WATER QUALITY CLASSIFICATIONS AND STANDARDS	2 - 1
2.1	Catawba River Basin Overview	2 - 1
2.2	Major Lakes in the Catawba River Basin	2 - 4
2.3	Land Use, Population and Growth Trends	2 - 6
2.3.1	General Land Cover/Land Use Patterns	2 - 6
2.3.2	Population and Growth Trends in the Basin	2 - 8
2.4	Registered Animal Operations	2 - 12
2.5	Surface Water Classifications and Water Quality Standards	2 - 12
2.5.1	Program Overview	2 - 12
2.5.2	Statewide Classifications and Water Quality Standards	2 - 13
2.5.3	Surface Water Classifications in the Catawba Basin	2 - 14
3.	CAUSES & SOURCES OF WATER POLLUTION IN THE CATAWBA BASIN	3 - 1
3.1	Introduction	3 - 1
3.2	Defining *Causes* of Pollution	3 - 1
3.2.1	Oxygen Consuming Wastes	3 - 1
3.2.2	Nutrients	3 - 5
3.2.3	Toxic Substances	3 - 7
3.2.4	Sediment	3 - 9
3.2.5	Fecal Coliform Bacteria	3 - 9
3.2.6	Color	3 - 11
3.3	Point Sources of Pollution	3 - 11
3.3.1	Defining Point Sources	3 - 11
3.3.2	Point Source Discharges in the Catawba	3 - 11
3.4	Nonpoint Sources of Pollution	3- 18
3.4.1	Agriculture	3 - 18
3.4.2	Urban	3 - 18
3.4.3	Construction	3 - 19
3.4.4	Forestry	3 - 19
3.4.5	Mining	3 - 19
3.4.6	Onsite Wastewater Disposal	3 - 19
3.4.7	Solid Waste Disposal	3 - 20

TABLE OF CONTENTS (Continued)

Chapter	Title	Page
4.	WATER QUALITY AND USE SUPPORT RATINGS IN THE CATAWBA RIVER BASIN	4 - 1
4.1	Introduction	4 - 1
4.2	Water Quality Monitoring Programs	4 - 1
4.2.1	Benthic Macroinvertebrate Monitoring	4 - 1
4.2.2	Fisheries Monitoring	4 - 2
4.2.3	Lake Assessment Program	4 - 3
4.2.4	Aquatic Toxicity Monitoring	4 - 4
4.2.5	Chemical/Physical Characterizations	4 - 4
4.2.6	Sediment Oxygen Demand	4 - 5
4.2.7	Ambient Monitoring System	4 - 5
4.3	Ambient Water Quality Summary for the Catawba River Mainstem and Tributary Stations	4 - 7
4.3.1	Summary of AMS for the Catawba River Mainstem Stations	4 - 8
4.3.2	Summary of AMS for the Catawba River Mainstem Stations	4 - 10
4.3.3	Summary of AMS Data for the South Fork Catawba Watershed	4 - 15
4.4	Narrative Water Quality Summaries by Subbasin	4 - 18
4.4.1	Subbasin 30 - Catawba Basin Headwaters (upstream of Morganton)	4 - 18
4.4.2	Subbasin 31 - Upper Catawba Basin (Rhodhiss Lake)	4 - 20
4.4.3	Subbasin 32 - Mid Catawba Basin (Rhodhiss Lake to Lake Norman Dam)	4 - 22
4.4.4	Subbasin 33 - Lower Catawba (Mountain Island Lake and Dutchman's Creek	4 - 24
4.4.5	Subbasin 34 - Catawba River (Catawba arm of Lake Wylie and Charlotte)	4 - 24
4.4.6	Subbasin 35 - Upper South Fork Catawba River	4 - 28
4.4.7	Subbasin 36 - Lower South Fork Catawba River	4 - 30
4.4.8	Subbasin 37 - Crowders and Catawba Creeks	4 - 30
4.4.9	Subbasin 38 - Waxhaw Creek	4 - 33
4.5	Use Support: Definitions and Methodology	4 - 35
4.5.1	Introduction to Use Support	4 - 35
4.6	Use Support Ratings for the Catawba Basin	4 - 35
4.6.1	Freshwater Streams and Rivers	4 - 35
4.6.2	Lakes	4 - 43
5.	EXISTING POINT AND NONPOINT SOURCE POLLUTION CONTROL PROGRAMS	5 - 1
5.1	Introduction	5 - 1
5.2	North Carolina's Point Source Control Program	5 - 1
5.2.1	Introduction	5 - 1
5.2.2	NPDES Permits Review and Processing	5 - 1
5.2.3	Establishing Discharger Permit Effluent Limitations/Wasteload Allocations	5- 2
5.2.4	Compliance Monitoring and Enforcement	5- 3
5.2.5	Aquatic Toxicity Testing	5- 3
5.2.6	Pretreatment Program	5- 4

TABLE OF CONTENTS (Continued)

Chapter	Title	Page
	5.2.7 Operator Certification and Training Program	5- 5
	5.2.8 Nondischarge and Regionalized Wastewater Treatment Alternatives	5- 5
5.3	Nonpoint Source Control Programs	5 - 5
	5.3.1 Agricultural Nonpoint Source Control Programs	5 - 8
	5.3.2 NPS Programs for Urban and Developed Lands	5 - 12
	5.3.3 Construction-Sedimentation and Erosion Control NPS Program	5 - 15
	5.3.4 On-Site Wastewater Disposal Sanitary-Sewage Systems NPS Program	5 - 15
	5.3.5 Solid Waste Disposal NPS Programs	5 - 16
	5.3.6 Forestry NPS Programs	5 - 17
	5.3.7 Mining NPS Program	5 - 18
	5.3.8 Wetlands Regulatory NPS Programs	5 - 18
	5.3.9 Hydrologic Modification	5 - 20
5.4	Integrating Point and Nonpoint Source Pollution Control Strategies	5 - 21
6.	MAJOR WATER QUALITY CONCERNS, GOALS AND RECOMMENDED MANAGEMENT STRATEGIES FOR THE CATAWBA RIVER BASIN	6 - 1
6.1	Basinwide Management Goals	6 - 1
6.2	Major Water Quality Concerns and Priority Issues	6 - 1
	6.2.1 Identifying and Restoring Impaired Waters	6 - 1
	6.2.2 Identification and Protection of High Resource Value or Biologically Sensitive Waters	6 - 4
	6.2.3 Managing Problem Pollutants in order to Protect Waters Currently Supporting their Uses	6 - 5
6.3	Recommended Management Strategies for Oxygen-Demanding Wastes	6 - 5
	6.3.1 Catawba River Mainstream Watersheds (Subbasins 03-08-33 to 03-08-33)	6 - 6
	6.3.2 Sugar Creek Watershed (Subbasin 34)	6 - 8
	6.3.3 South Fork Catawba River Watersheds (Subbasins 03-08-35 and 03-08-36	6 - 9
	6.3.4 Catawba Creek and Crowders Creek Watersheds (Subbasin 37)	6 - 9
	6.3.5 Union County Watersheds (Subbasin 38)	6 - 10
6.4	Management Strategies for Nutrients	6 - 10
	6.4.1 Lake Wylie Management Strategy	6 - 11
	6.4.2 Mountain Island Lake	6 - 16
	6.4.3 Rhodhiss Lake and Lake Hickory	6 - 16
6.5	Toxic Substances	6 - 17
	6.5.1 Assimilative Capacity	6 - 17
	6.5.2 Control Strategies	6 - 17
6.6	Management Strategies for Controlling Sedimentation	6 - 18
6.7	Management Strategies for Controlling Color	6 - 19
6.8	Management Strategies for Stormwater Control	6 - 20
	6.8.1 HQW, ORW and Water Supply Areas	6 - 21
	6.8.2 NPDES Stormwater Management	6 - 21
	6.8.3 Recommendations for Controlling Stormwater Impacts by Local Governments Not Subject to NPDES Stormwater Requirements	6 - 22

APPENDICES ..... *A - I* - 1

I NORTH CAROLINA'S SURFACE WATER CLASSIFICATIONS AND WATER QUALITY STANDARDS ..... *A - I* - 1

- Summary of North Carolina's Water Quality Classifications and Standards
- Anti-Degradation Policy and High Quality Waters (15A NCAC 2B .0201)
- Outstanding Resource Waters (15A NCAC 2B .0216)

II WATER QUALITY DATA COLLECTED BY DEM ..... *A - II* - 1

- Benthic Macroinvertebrate Sampling
- Fisheries Studies
- Lakes Assessment Procedure

III MODELING INFORMATION ..... *A - III* - 1

IV USE SUPPORT DATA INTERPRETATION AND ASSESSMENT METHODS .. *A - IV* - 1

V PUBLIC WORKSHOP SUMMARY ..... *A - V* - 1

VI FACT SHEET FOR CITY OF CHARLOTTE NPDES STORMWATER PERMIT . *A - VI* - 1

GLOSSARY ..... *G* - 1

LIST OF FIGURES

Figure	Title	Page
1	General Map of the Catawba River Basin	iii
1.1	Basinwide Management Plan Schedule (1994 to 1999)	*1* - 1
1.2	Major Steps and Information Transfers Involved in the Development of a Basinwide Management Plan	*1* - 5
1.3	Organizational Structure of the DEM Water Quality Section	*1* - 8
2.1	General Map of the Catawba River Basin	*2* - 2
2.2	River Basins and Physiographic Regions of North Carolina	*2* - 3
2.3	Map of Catawba River Chain Lakes in North Carolina	*2* - 4
2.4	Comparison of Selected Land Cover Types (% cover) between 1982 and 1992)	*2* - 7
2.5	1990 Population Density by Census Block Group	*2* - 10
2.6	Population Growth Increases by Subbasin Between 1970 and 1990	*2* - 11
2.7	Wilson Creek Outstanding Resource Waters (ORW)	*2* - 17
2.8	Henry and Jacobs Forks Outstanding Resource Waters (ORW)	*2* - 18
2.9	Upper and Steels Creek Outstanding Resource Waters (ORW)	*2* - 19
3.1	Comparison of Total BOD Loading and Effluent Flows from NPDES Dischargers in the Catawba River Basin Between the Mid 1970's and 1993	*3* - 3
3.2	Comparison Between Mid-1970s and 1993 Loading of Biochemical Oxygen Demand (BOD) from Municipal Wastewater Treatment Plants in the Catawba Basin	*3* - 4
3.3	Comparison Between Mid-1970s and 1993 Loading of Flow from Municipal Wastewater Treatment Plants in the Catawba Basin	*3* - 4
3.4	Schematic Diagram of Lake Wylie Showing Nutrient Loadings and Predicted Chlorophyll *a* Concentrations in the 4 Major Arms and the Mainstem of the Lake	*3* - 6
3.5a	Distribution Map of Dischargers in the Upper Catawba River Basin	*3* - 14
3.5b	Distribution Map of Dischargers in the Lower Catawba River Basin	*3* - 15
4.1	Explanation of Box and Whisker Plots	*4* - 6
4.2	Ambient Monitoring Stations (AMS) on the Catawba River Mainstem and Larger Tributaries	*4* - 8

LIST OF FIGURES (continued)

Figure	Title	Page
4.3	Dissolved Oxygen Data Trends on the Catawba River from 4 AMS Stations near Old Fort	4 - 9
4.4	Total Phosphorus Trends on the Catawba River from 4 AMS Stations near Old Fort	4 - 9
4.5	Fecal Coliform Levels at AMS Mainstem Stations on the Catawba River	4 - 10
4.6	Dissolved Oxygen at Tributary AMS Stations	4 - 11
4.7	pH at Tributary AMS Stations of the Catawba River	4 - 11
4.8	Long-term pH Readings at 2 AMS Stations on Wilson Creek	4 - 12
4.9	Total Phosphorus (mg/l) at Tributary AMS Stations of the Catawba River	4 - 12
4.10	Nitrite/Nitrate Nitrogen at Tributary AMS Stations of the Catawba River	4 - 13
4.11	Ammonia-Nitrogen at Tributary AMS Stations of the Catawba River	4 - 13
4.12	Dissolved oxygen data for Charlotte area, period of record, Catawba	4 - 14
4.13	Total Phosphorus (mg/l) at AMS Stations on the South Fork Catawba River and Jacobs and Henry Forks	4 - 15
4.14	Nitrite/Nitrate Nitrogen (mg/l) at AMS Stations on the South Fork Catawba River and Jacobs and Henry Forks	4 - 16
4.15	Ammonia-Nitrogen (mg/l) at AMS Stations on the South Fork Catawba River and Jacobs and Henry Forks	4 - 16
4.16	Total Phosphorus (mg/l) at AMS Stations on the South Fork Catawba River	4 - 17
4.17	Ammonia-Nitrogen (mg/l) at AMS Stations on the South Fork Catawba River	4 - 17
4.18	Water Quality Monitoring Stations in Subbasin 03-08-30, Catawba River Headwaters	4 - 20
4.19	Water Quality Monitoring Stations in Subbasin 03-08-31, Upper Catawba River (Rhodhiss Lake)	4 - 21
4.20	Water Quality Monitoring Stations in Subbasin 03-08-32, (Mid Catawba River)	4 -22
4.21	Water Quality Monitoring Stations in Subbasin 03-08-33	4 -25
4.22	Water Quality Monitoring Stations in Subbasin 03-08-34, (Lower Catawba River)	4 - 26
4.23	Water Quality Monitoring Stations in Subbasin 03-08-35	4 - 29

LIST OF FIGURES (continued)

Figure	Title	Page
4.24	Water Quality Monitoring Stations in Subbasin 03-08-36	*4* - 31
4.25	Water Quality Monitoring Stations in Subbasin 03-08-37	*4* - 32
4.26	Water Quality Monitoring Stations in Subbasin 03-08-38 - Waxhaw Creek	*4* - 34
4.27	Use Support Map for the Upper Catawba River Basin	*4* - 39
4.28	Use Support Map for the Lower Catawba River Basin	*4* - 40
4.29	Bar Graph Showing Freshwater Use Support Distribution of Subbasin	*4* - 41
6.1	Schematic Diagram of Lake Wylie Showing Nutrient Loadings and Predicted Chlorophyll a Concentrations in the 4 Major Arms and the Mainstem of the Lake Under the 1995 Lake Wylie Nutrient Management Strategy	*6* - 14
6.1	Schematic Diagram of Lake Wylie Showing Nutrient Loadings and Predicted Chlorophyll a Concentrations in the 4 Major Arms and the Mainstem of the Lake Under the 1995 Lake Wylie Nutrient Management Strategy with Mt. Holly and Belmont Expanded by 2.0 MGD	*6* - 15

LIST OF TABLES

Table	Title	Page
1.1	Basinwide Permitting and Planning Schedule for North Carolina's 17 Major River Basins (1993 through 1999)	*1* - 4
1.2	Subbasin NPDES Permit Schedule for Catawba Basin	*1* - 6
2.1	Statistics on Major Lakes in the Catawba River Basin	*2* - 5
2.2	Land Cover in the Catawba Basin by 8 Digit USGS Hydrologic Units (USDA Natural Resources Conservation Service - 1992 NRI)	*2* - 6
2.3	Description of Land Cover Types (1982 NRI - USDA SCS)	*2* - 8
2.4	Catawba Subbasin Population (1970, 80 and 90) and Land Area Summaries	*2* - 9
2.5	Registered Animal Operations in the Catawba River Basin	*2* - 13
2.6	Waters in the Catawba Basin Classified in Whole or Part as WS, HQW or ORW	*2* - 16
3.1	Summary of Major/Minor Dischargers and Permitted/Actual Flows by Subbasin	*3* - 12
3.2	Summary of NPDES Dischargers in the Catawba Basin	*3* - 13
3.3	Major NPDES Dischargers in the Catawba River Basin	*3* - 16
3.4	NPDES Facilities with Pretreatment Programs and Significant Industrial Users	*3* - 17
4.1	Ambient Monitoring System Parameters	*4* - 5
4.2	Ambient Monitoring System Stations within the Catawba River Basin	*4* - 7
4.3	Catawba River Basin Monitored Freshwater Segments (1988-1992)	*4* - 36
4.4	Use Support Ratings for Freshwater Streams by Subbasin	*4* - 41
4.5	Sources for Use Support Impairments in Freshwaters in the Catawba Basin	*4* - 42
4.6	Major Causes of Use Support Impairment in Freshwaters in the Catawba Basin	*4* - 42
4.7	Lakes Use Support Status and Causes and Sources of Impairment	*4* - 44
5.1	Examples of Nonpoint Source Programs	*5* - 7
6.1	Management Strategies for Monitored Impaired Streams in the Catawba Basin	*6* - 3
6.2	Comparison of Nutrient Reduction Strategies for Lake Wylie (1992 and 1995)	6 - 13
6.3	State and Federal Sediment Control-related Programs	*6* - 18
6.4	Highlights of Charlotte's NPDES Municipal Stormwater Management Programs	*6* - 22

CHAPTER 1
INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose of the Catawba River Basinwide Water Quality Management Plan (Catawba River Plan) is to report to citizens, policy makers and the regulated community on

- the current status of surface water quality in the basin,
- major water quality concerns and issues,
- projected trends in development and water quality,
- the long-range water quality goals for the basin, and
- recommended point and nonpoint source management options.

The Catawba River Plan presents strategies for management of point sources and nonpoint sources of pollution. Section 1.2 provides an overview of the plan format to assist in use and understanding of the document. The Catawba River Plan is the fourth in a series of basinwide water quality management plans that are being prepared by the Water Quality Section of the North Carolina Division of Environmental Management (DEM). Plans will be prepared for all seventeen of the state's major river basins by 1998 as shown in Figure 1.1. An introduction to the basinwide management approach and a statewide basinwide permitting schedule are presented in Section 1.3.

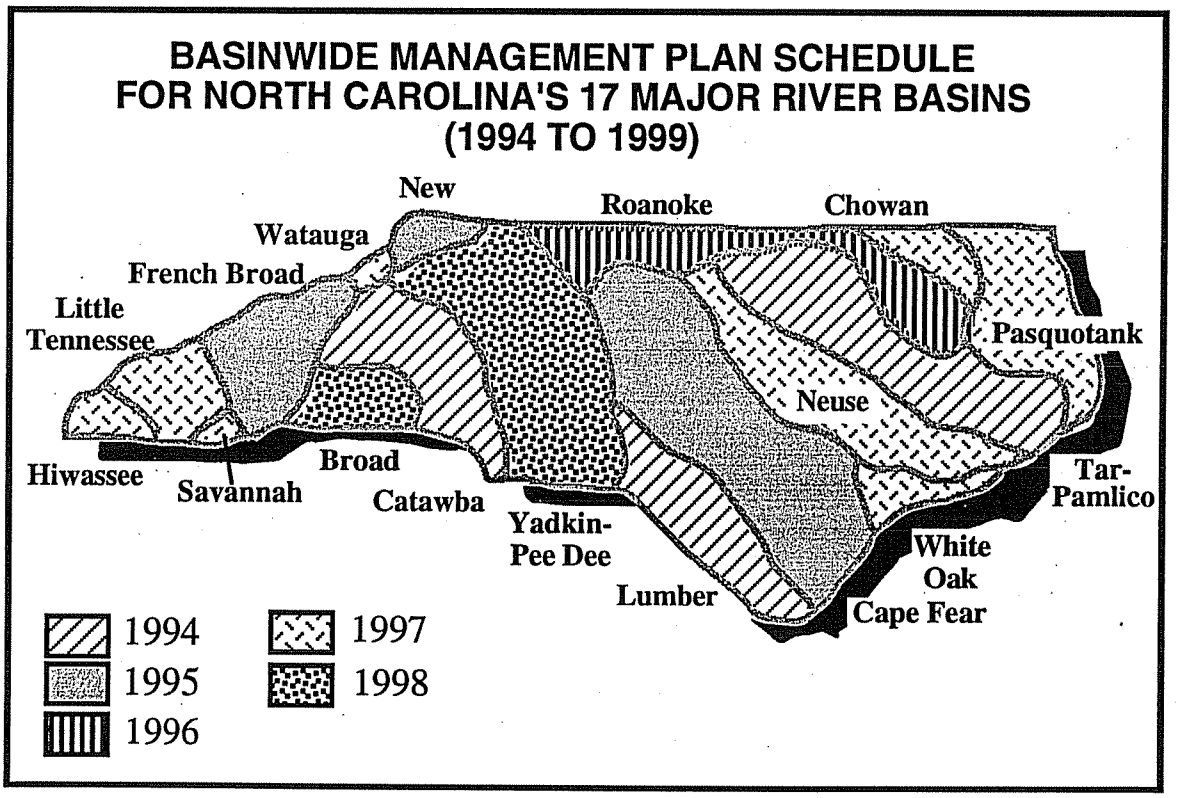


Figure 1.1 Basinwide Management Plan Schedule (1994 to 1999)

1.2 GUIDE TO USE OF THIS DOCUMENT

CHAPTER 1: Introduction - Provides a non-technical description of the purpose of this plan, the basinwide water quality management approach and how this approach will be administered through DEM's Water Quality Section. The description of the basinwide management approach is based primarily on a 54-page document entitled *North Carolina's Basinwide Approach to Water Quality Management: Program Description - Final Report/August 1991* (Creager and Baker, 1991).

CHAPTER 2: General Basin Description - Physical features, population densities, land cover and water uses in the Catawba River basin are summarized in five sections. Section 2.1 provides an overview of the major features of the Catawba River basin such as location, rainfall, population, physiography and so on. Section 2.2 describes the major lakes in the basin. Section 2.3 presents a summary of land cover, population and growth trends within the basin. Land cover is based on results of a 1982 National Resources Inventory conducted by the US Department of Agriculture Natural Resources Conservation Service (formerly Soil Conservation Service). Population growth trends and densities by subbasin are based on 1970, 1980 and 1990 census data. The information is presented through a series of maps and tables. Section 2.4 briefly summarizes registered animal operations in the basin. Section 2.5 discusses major water uses in the basin and introduces DEM's program of water quality standards and classifications.

CHAPTER 3: Causes and Sources of Water Pollution in the Catawba River Basin - Chapter 3 discusses the causes and probable sources of surface water degradation in the Catawba River basin. It describes both point and nonpoint sources of pollution as well as a number of important causes of water quality impacts including sediment, biochemical oxygen demand (BOD), toxic substances, nutrients, color, fecal coliform bacteria and others. It also discusses pollutant loading in the basin and identifies water quality problem areas.

CHAPTER 4: Water Quality Status in the Catawba River Basin - Data generated by DEM on water quality and biological communities are reviewed and interpreted in this chapter in order to assess current conditions and the status of surface waters within the Catawba River basin. Section 4.2 describes the various types of water quality monitoring conducted by DEM. Section 4.3 presents ambient water quality data for monitoring stations on the mainstem of the river and for a number of its major tributaries. Section 4.4 summarizes water quality in each of the eight subbasins in the basin based on the biological indicators and sampling methods described in Section 4.2. This information is then used to generate a summary of use support ratings for those surface waters that have been monitored or evaluated (Sections 4.5 and 4.6).

CHAPTER 5: Existing Point and Nonpoint Source Pollution Control Programs - Chapter 5 summarizes the existing point and nonpoint source control programs available to address water quality problems. These programs represent the management tools available for addressing the priority water quality concerns and issues that are identified in Chapter 6. Chapter 5 also describes the concept of Total Maximum Daily Loads (TMDLs). TMDLs represent management strategies aimed at controlling point and nonpoint source pollutants on various water bodies within the basin.

CHAPTER 6: Basinwide Goals, Major Water Quality Concerns and Recommended Management Strategies - Water quality issues identified in chapters 2, 3 and 4 are evaluated and prioritized based on use-support ratings, degree of impairment, and the sensitivity of the aquatic resources being affected. Recommended management strategies, or TMDLs, are then presented that describe how the available water quality management tools and strategies described in Chapter 5 will be applied in the Catawba River basin. Strategies are listed for addressing nutrients, biochemical oxygen demand, sedimentation, fecal coliform bacteria, urban stormwater, color and toxicity.

1.3 NORTH CAROLINA'S BASINWIDE MANAGEMENT APPROACH

Introduction - Basinwide water quality management is a watershed-based management approach being implemented by DEM which features basinwide permitting, integrating of existing point and nonpoint source control programs, and preparing basinwide management plan reports.

DEM is applying this approach to each of the seventeen major river basins in the state as a means of better identifying water quality problems, developing appropriate management strategies, maintaining and protecting water quality and aquatic habitat;, and assuring equitable distribution of waste assimilative capacity for dischargers. Other important benefits of the basinwide approach include improved efficiency, increased cost-effectiveness, better consistency and equitability, and improved public awareness and involvement in management of the state's surface waters.

A basinwide management plan document is prepared for each basin. The plans are circulated for public review and are presented at public meetings in each river basin. The management plan for a given basin is completed and approved preceding the scheduled date for basinwide permit renewals in that basin. The plans are then to be evaluated, based on followup water quality monitoring, and updated at five year intervals thereafter.

DEM began formulating the idea of basinwide management in the late 1980s, established a basin permitting schedule and began basinwide monitoring activities in 1990, and published a basinwide program description in August 1991. Basinwide management entails coordinating and integrating, by major river basin, DEM's Water quality program activities. These activities, which are discussed further in Section 1.4, include permitting, monitoring, modeling, nonpoint source assessments, planning and enforcement.

Water Quality Program Benefits - Several benefits of basinwide planning and management to North Carolina's Water quality program include: (1) *improved program efficiency,* (2) *increased effectiveness*, (3) better *consistency and equitability* and (4) *increased public awareness of the state's water quality protection programs.* First, by reducing the area of the state covered each year, monitoring, modeling, and permitting efforts can be focused. As a result, *efficiency increases* and more can be achieved for a given level of funding and resource allocation. Second, the basinwide approach is in consonance with basic ecological principles of watershed management, leading to *more effective* water quality assessment and management. Linkages between aquatic and terrestrial systems are addressed (e.g., contributions from nonpoint sources) and all inputs to aquatic systems, and potential interactive, synergistic and cumulative effects, are considered. Third, the basinwide plans will provide a focus for management decisions. By clearly defining the program's long-term goals and approaches, these plans will encourage *consistent* decision-making on permits and water quality improvement strategies. Consistency, together with greater attention to long-range planning, in turn will promote a *more equitable* distribution of assimilative capacity, explicitly addressing the trade-offs among pollutant sources (point and nonpoint) and allowances for economic growth.

Basinwide management will also promote integrating point and nonpoint source pollution assessment and controls. Once waste loadings from both point and nonpoint sources are established, management strategies can be developed to prevent overloading of the receiving waters and to allow for a reasonable margin of safety to ensure compliance with water quality standards.

Basinwide Planning Schedule - The following table presents the overall basin schedule for all 17 major river basins in the state. Included are the dates for permit reissuance and the dates by which management plans are to be completed for each basin.

Table 1.1 Basinwide Permitting and Planning Schedule for North Carolina's 17 Major River Basins (1993 through 1999).

Basin	Discharge Permits to be Issued	Target Date for Basin Plan Approval	Basin	Discharge Permits to be Issued	Target Date for Basin Plan Approval
Neuse	4/93	2/93 (approved)	Roanoke	1/97	7/96
			White Oak	6/97	1/97
Lumber	11/94	5/94 (approved)	Savannah	8/97	4/97
			Watauga	9/97	4/97
Tar-Pamlico	1/95	12/94 (approved)	Little Tennessee	10/97	5/97
Catawba	**4/95**	**2/95** (approved)	Hiwassee	12/97	5/97
French Broad	8/95	5/95			
New	11/95	6/95	Chowan	1/98	8/97
			Pasquotank	1/98	8/97
Cape Fear	1/96	9/95	Neuse (2nd cycle)	4/98	11/97
			Yadkin-Pee Dee	7/98	1/98
			Broad	11/98	6/98

The number of plans to be developed each year varies from one to six and is based on the total number of permits to be issued each year. For example, the Cape Fear basin, the state's largest, has about as many dischargers as all six of the small basins in 1997. This has been done in order to balance the permit processing workload from year to year. In years where more than one basin is scheduled to be evaluated, an effort has been made to group at least some of the basins geographically in order to minimize travel time and cost for field studies and public meetings.

The earliest basin plans may not achieve all of the long-term objectives for basinwide management outlined above. However, subsequent updates of the plans, every 5 years, will incorporate additional data and new assessment tools (e.g., basinwide water quality modeling) and management strategies (e.g., for reducing nonpoint source contributions) as they become available.

Basinwide Plan Preparation, Review and Public Involvement - Preparation of an individual basinwide management plan is a five year process which is broken down into 15 steps in Figure 1.2 and is broadly described below.

Year **Activity**

~~1 to 3~~ ~~Water Quality Data Collection/Identification of Goals and Issues (steps 1 through 7)~~: Year 1 entails identifying sampling needs and canvassing for information. It also entails coordinating with other agencies, the academic community and local interest groups to begin establishing goals and objectives and identifying and prioritizing problems and issues. Biomonitoring, fish community and tissue analyses, special studies and other water quality sampling activities are conducted in Years 2 and 3 by DEM's Environmental Sciences Branch (ESB). These studies provide information for assessing water quality status and trends throughout the basin and provide data for computer modeling.

3 to 4 Data Assessment and Model Preparation (steps 7 to 9): Modeling priorities are identified early in this phase and are refined through assessment of water quality data from the ESB. Data from special studies are then used by DEM's Technical Support Branch (TSB) to prepare models for estimating potential impacts of waste loading from point and nonpoint sources using the TMDL approach. Preliminary water quality control strategies are developed, based on modeling, with input from local governments, the regulated community and citizens groups during this period.

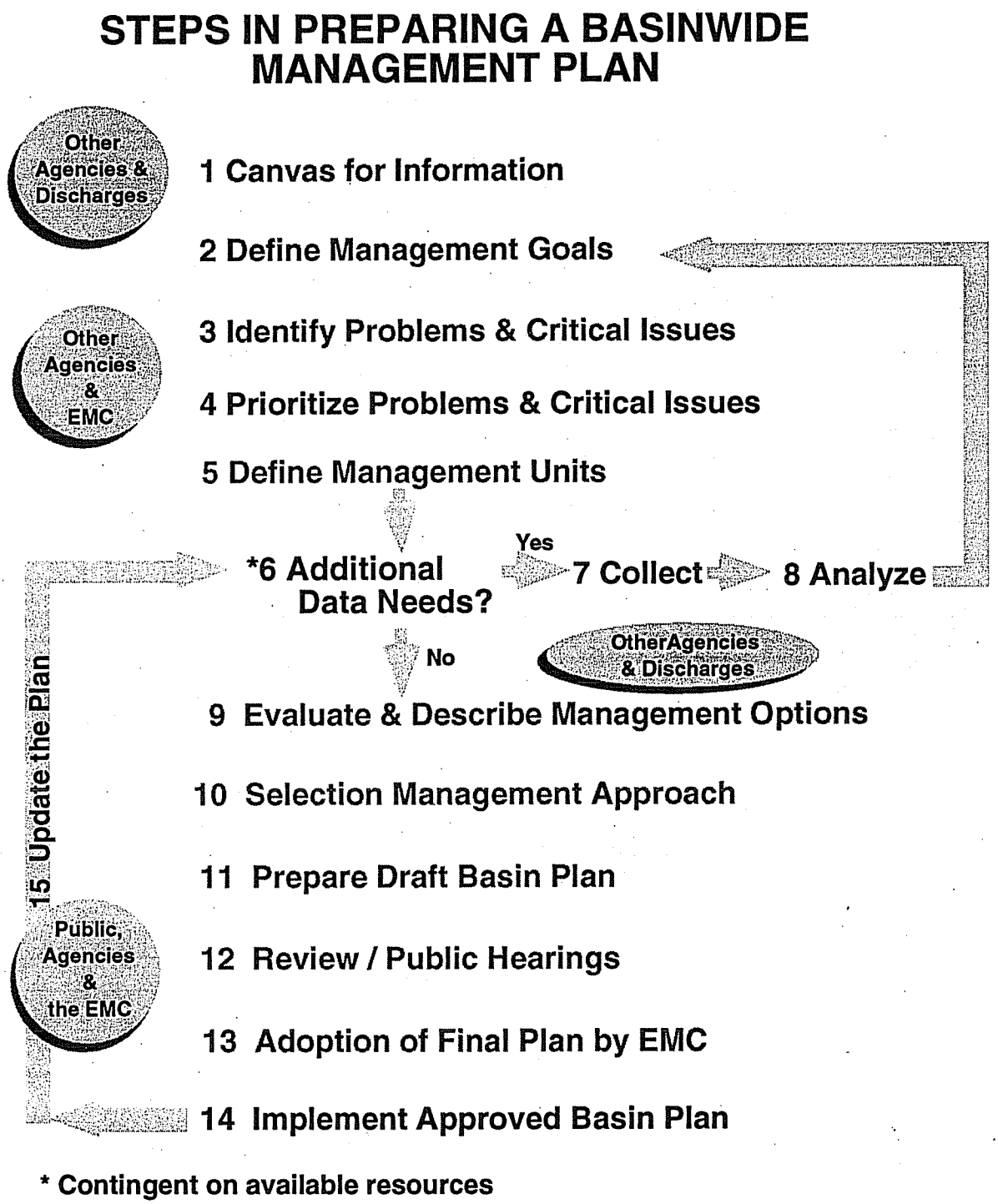


Figure 1.2 Major steps and information transfers involved in the development of a basinwide management plan.

4 Preparation of Draft Basinwide Plan (Steps 9, 10 and 11): The draft plan, which is prepared by DEM's Planning Branch, is due for completion by the end of year 4. It is based on support documents prepared by ESB (water quality data) and TSB (modeling data and recommended pollution control strategies). Preliminary findings are presented at informal meetings through the year with local governments and interested groups, and comments are incorporated into the draft.

5 Public Review and Approval of Plan (Steps 12, 13 and 14): During the beginning of year 5, the draft plan, after approval of the Environmental Management Commission (EMC), is circulated for review, and public meetings are held. Revisions are made to the document, based on public comments, and the final document is submitted to the EMC for approval midway through year 5. Basinwide permitting begins at the end of year 5.

Each basinwide management plan includes six chapters: (1) An introduction describing the purpose and format of the plan, Water Quality Section responsibilities and enabling legislation; (2) a general basin description including land use, population trends, physiographic regions, and classifications and standards; (3) an overview of existing pollutant sources and loads within a basin and a more generic description of causes and sources of point and nonpoint source pollution for the lay person; (4) an assessment of the status of water quality and biological communities in the basin including use-support rating and 305(b) information (see Section 1.5); (5) a description of the TMDL approach and the state's NPDES and nonpoint source control programs; and (6) priority water quality issues and recommended control strategies, including TMDLs. This process is discussed in more detail in the basinwide program description document.

Implementation - The implementation of basinwide planning and management will occur in phases. Permitting activities and associated routine support activities (field sampling, modeling, wasteload allocation calculations, etc.) have already been rescheduled by major river basin. All National Pollutant Discharge Elimination System (NPDES) permit renewals within a basin occur within a prescribed time period after completion of the final basin plan, and will be repeated at five year intervals. The NPDES permit renewal schedule drives the schedule for developing and updating the basinwide management plans.

In large river basins, permits are to be issued by subbasin. Permitting in the Catawba River basin will occur during time intervals between April, 1995 and October, 1996 (Table 1.2). Permits in subbasins 30, 31, 32 and 35 will be issued from April through July of 1995. Permits in subbasins 33, 34, 36, 37 and 38 will be issued from July 1996 through October 1996.

Table 1.2 Subbasin NPDES Permit Schedule for Catawba Basin

Subbasin No.	Month/Year	Subbasin No.	Month/Year
03-08-30	April, 1995	**03-08-35**	July, 1995
03-08-31	May, 1995	**03-08-36**	September, 1996
03-08-32	June, 1995	**03-08-37**	September, 1996
03-08-33	July, 1996	**03-08-38**	October, 1996
03-08-34	August, 1996		

1.4 BASINWIDE RESPONSIBILITIES WITHIN THE DEM WATER QUALITY SECTION

The Water Quality Section is the lead state agency for the regulation and protection of the state's surface waters. It is one of five sections located within the Division of Environmental Management. The other sections are Groundwater, Air Quality, Construction Loans and Grants and the Laboratory.

The primary responsibilities of the Water Quality Section are to maintain or restore an aquatic environment of sufficient quality to protect the existing and best intended uses of North Carolina's surface waters and to ensure compliance with state and federal water quality standards. The Section receives both state and federal allocations and also receives funding through the collection of permit fees. Policy guidance is provided by the Environmental Management Commission. The Water Quality Section is comprised of over 200 staff members in the central and seven regional offices (Figure 1.3). The major areas of responsibility are water quality monitoring, permitting, planning, modeling (wasteload allocations) and compliance oversight.

The Central office is divided into four branches, with each branch being subdivided into two units. The Planning Branch is responsible for developing water quality standards and classifications, program planning and evaluation, and implementation of new water quality protection programs. The *Water Quality Planning and Assessment Unit* handles surface water reclassifications, development of water quality standards, coordination of the state's nonpoint source program and development of the stormwater runoff program. The *Basinwide Assessment Unit* administers implementation of the water supply watershed and basinwide management programs. It also coordinates EPA water quality planning grants, state environmental policy act responsibilities and development of wetlands rules and regulations.

The Operations Branch is responsible for permit compliance tracking, the pretreatment program and the operator training and certification program. The *Facility Assessment Unit* includes both the permit compliance and pretreatment programs. The *Operator Training and Certification Unit* rates the complexity of operation of wastewater treatment plants and provides formal training for operators commensurate with the plant operating needs.

The Technical Support Branch is responsible for processing of discharge and nondischarge permits as well for preparing TMDLs and wasteload allocations for dischargers. The *Instream Assessment Unit* provides primary computer modeling support and is responsible for coordinating development of TMDLs and individual NPDES wasteload allocations. The *Permits and Engineering Unit* handles reviews and processing of permit applications for both discharging and nondischarging wastewater treatment systems.

The Environmental Sciences Branch is responsible for water quality monitoring, toxicity testing, biological laboratory certifications and the wetlands 401 Water Quality Certification program. The branch is divided into the Ecosystems Analysis Unit and the Aquatic Survey and Toxicology Unit Some of the major functions of the *Ecosystems Analysis Unit* include biological and chemical water quality monitoring and evaluation, evaluating reclassification requests, algal analyses, benthic macroinvertebrate monitoring (biomonitoring), fish tissue and fish communities studies and wetlands assessment and certification. Major functions of the *Aquatic Survey and Toxicology Unit* include effluent toxicity testing, chemical toxicity evaluations, toxicity reduction evaluations (TRE), biological lab certification, biocide evaluations and related special studies, intensive surveys, special studies, dye studies, time-of-travel studies, long term biochemical and sediment oxygen demand, chemical water quality monitoring and lakes assessments.

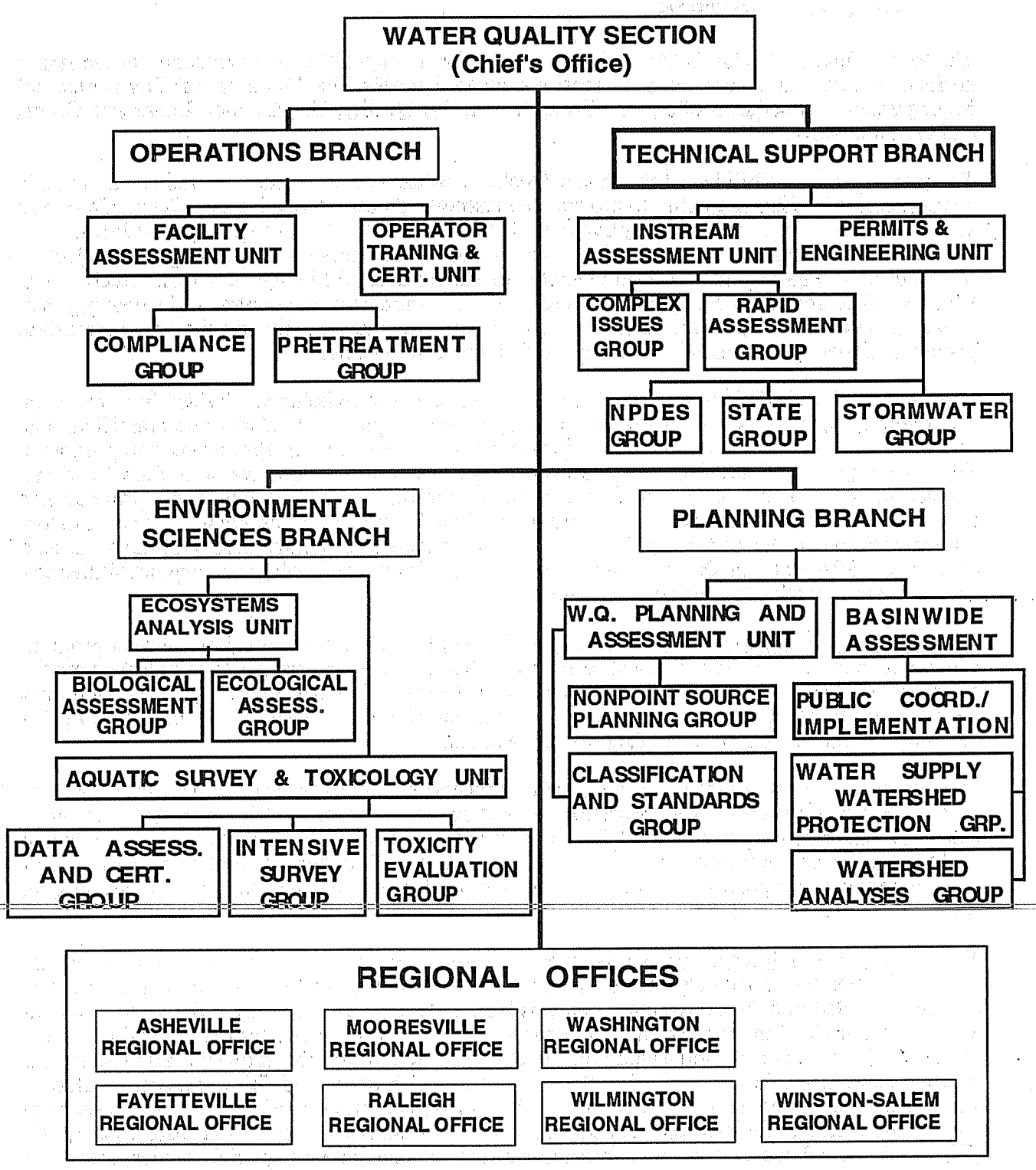


Figure 1.3 Organizational Structure of the DEM Water Quality Section (July, 1995)

The seven Regional Offices carry out activities such as wetland reviews, compliance evaluations, permit reviews and facility inspections for both discharging and nondischarging systems, ambient water quality monitoring, state environmental policy act reviews, stream reclassification reviews, pretreatment program support and operator training and certification assistance. In addition, they respond to water quality emergencies such as oil spills and fish kills, investigate complaints and provide information to the public.

Although the basic structure and major responsibilities within the Water Quality Section will remain unchanged, implementation of a basinwide approach to water quality management will require some modification of and additions to the tasks currently conducted by each branch and the regional offices. The goal of basinwide planning is to broaden the scope of management activities from a stream reach to the entire basin. Accomplishing this goal will require more complex water quality modeling, data interpretation, and database management within the water quality program. For example, more sophisticated methods of quantitatively estimating nonpoint source pollutant loads will need to be developed and applied. In addition, these quantitative estimates of nonpoint source loads will have to be integrated with information on point sources to determine the total loading to the system.

Planning for future growth and the possibility of incorporating "agency banking" (see Section 5.3) into the Water Quality Section's management objectives will require model projections of various potential scenarios to allocate the remaining assimilative capacity and fairly distribute control requirements. Finally, the link between water quality data and model projections for the multiple stream reaches within a basin, and the overlay of other relevant types of information, such as land use, will require expanded use of geographic information systems (GIS) with coordination and support from this state's Center for Geographic Information Analysis (CGIA).

1.5 STATE AND FEDERAL LEGISLATIVE AUTHORITIES FOR NORTH CAROLINA'S WATER QUALITY PROGRAM

Authorities for some of the programs and responsibilities carried out by the Water Quality Section are derived from a number of federal and state legislative mandates outlined below.

Federal Authorities - The major federal authorities for the state's water quality program are found in various sections of the Clean Water Act (CWA).

- **Section 301** - Prohibits the discharge of pollutants into surface waters unless permitted by EPA (see Section 402, below).
- **Section 303(c)** - States are responsible for reviewing, establishing and revising water quality standards for all surface waters.
- **Section 303(d)** - Each state shall identify those waters within its boundaries for which the effluent limits required by section 301(b)(1) A and B are not stringent enough to protect any water quality standards applicable to such waters.
- **Section 305(b)** - Each state is required to submit a biennial report to the EPA describing the status of surface waters in that state.
- **Section 319** - Each state is required to develop and implement a nonpoint source pollution management program.
- **Section 402** - Establishes the National Pollutant Discharge Elimination System (NPDES) permitting program. Allows for delegation of permitting authority to qualifying states (includes North Carolina).
- **Section 404/401** - Section 404 prohibits the discharge of fill materials into navigable waters and adjoining unless permitted by the US Army Corps of Engineers. Section 401 requires the Corps to receive a state Water Quality Certification prior to issuance of a 404 permit.

State Authorities - The following authorities are derived from the following North Carolina state statutes.

- **G.S. 143-214.1** - Directs and empowers the NC Environmental Management Commission (EMC) to develop a water quality standards and classifications program.
  G.S. 143-214.2 - Prohibits the discharge of wastes to surface waters of the state without a permit.
- **G.S. 143-214.5** - Provides for establishment of the state Water Supply Watershed Protection Program.
- **G.S. 143-214.7** - Directs the EMC to establish a Stormwater Runoff Program.
- **G.S. 143-215** - Authorizes and directs the EMC to establish effluent standards and limitations.
- **G.S. 143-215.1** - Outlines methods for control of sources of water pollution (NPDES and nondischarge permits, statutory notice requirements, public hearing requirements, appeals, etc.).
- **G.S. 143-215.1** - Empowers the EMC to issue *special orders* to any person whom it finds responsible for causing or contributing to any pollution of the waters of the state within the area for which standards have been established.
- **G.S. 143-215.3(a)** - Outlines additional powers of the EMC including provisions for adopting rules, charging permit fees, delegating authority, investigating fish kills and investigating violations of rules, standards or limitations adopted by the EMC.
- **G.S. 143-215.6A, 143-215.6B and 143-215.6C** - Includes enforcement provisions for violations of various rules, classifications, standards, limitations, provisions or management practices established pursuant to G.S. 143-214.1, 143-214.2, 143-214.5, 143-215, 143-215.1, 143-215.2. 6A describes enforcement procedures for civil penalties. 6B outlines enforcement procedures for criminal penalties. 6C outlines provisions for injunctive relief.
- **G.S. 143-215.75** - Outlines the state's Oil Pollution and Hazardous Substances Control Program.

REFERENCES CITED: CHAPTER 1

Creager, C.S., and J. P. Baker, 1991, North Carolina's Basinwide Approach to Water Quality Management: Program Description, DEM Water Quality Section, Raleigh, NC.

CHAPTER 2

GENERAL BASIN DESCRIPTION WITH WATER QUALITY STANDARDS AND CLASSIFICATIONS

2.1 CATAWBA RIVER BASIN OVERVIEW

The Catawba River Basin is the eighth largest river in the state covering 3279 square miles in the south central portion of western North Carolina. The Catawba River rises from the eastern slope of the Blue Ridge Mountains and flows eastward, then southward, to the North Carolina-South Carolina line (Figure 2.1). The headwaters of the Catawba River are formed by swift-flowing, cold water streams originating in the steep terrain of the mountains in Avery, Burke, Caldwell and McDowell Counties. Many of these streams exhibit good to excellent water quality and are classified as trout waters. While the topography of the upper river basin is characterized by mountains, with elevations in excess of 3000 feet above mean sea level, the lower basin has rolling terrain and land use shifts from forest to agriculture and urban uses.

The mainstem of the Catawba River is unlike almost any other in the state because it composed largely of a series of impoundments. Lake James is the first of a series of seven hydroelectric dams that segment the mainstem of the river. These impoundments, commonly referred to as the Catawba Chain Lakes include, from upstream to downstream, Lake James, Rhodhiss Lake, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake and Lake Wylie. Lake Wylie, the most downstream impoundment on the Catawba in North Carolina, straddles the state line between and North and South Carolina. Waters leaving Lake Wylie in South Carolina flow generally southeastward through several more impoundments including Fishing Creek Reservoir, Wateree Lake and Lake Marion before emptying into the Atlantic Ocean.

The largest tributary to the Catawba River in North Carolina is the South Fork Catawba River which flows into Lake Wylie. It originates in the South Mountain area in southern Burke County. Its two major headwater tributaries are Jacob Fork and Henry Fork. One of the most important headwater streams is the Linville River. The Linville is one of only four rivers in the state designated by the General Assembly as a state Scenic River under the state's Natural and Scenic Rivers Program administered the NC Division of Parks and Recreation. The Linville flows through the Pisgah National Forest Wilderness area and into Lake James.

There are 3,083 miles of freshwater streams in the Catawba basin in North Carolina and over 60,000 acres of impoundments. The basin is subdivided into nine subbasins represented in Figure 2.1 by six digit subbasin codes (03-08-30 through 03-08-38). Throughout the document the individual subbasins will often be referred to by the last two numbers in their respective six digit codes (i.e., 03-08-30 equals subbasin 30).

The population of the basin, based on 1990 census data, was estimated at 1,033,347. Municipalities with a population of 5,000 or more in the Catawba basin include Belmont, Charlotte, Conover, Hickory, Lincolnton, Mooresville, Morganton, Mt. Holly and Newton. The overall population density of the basin is 312 persons per square mile versus a statewide average of 127 persons per square mile. The percent population growth over the past ten years (1980 to 1990) was 16.5 % versus a statewide percentage increase of 12.7%. The basin encompasses all or part of the following 14 counties (with approximate percentage of the county in the basin shown in parentheses): Alexander (60%), Avery (50%), Burke (100%), Caldwell (70%), Catawba (100%), Cleveland (<5%), Gaston (>95%), Iredell (15%), Lincoln (95%), McDowell (75%), Mecklenburg (70%), Union (25%), Watauga (<5%) and Wilkes (<5%).

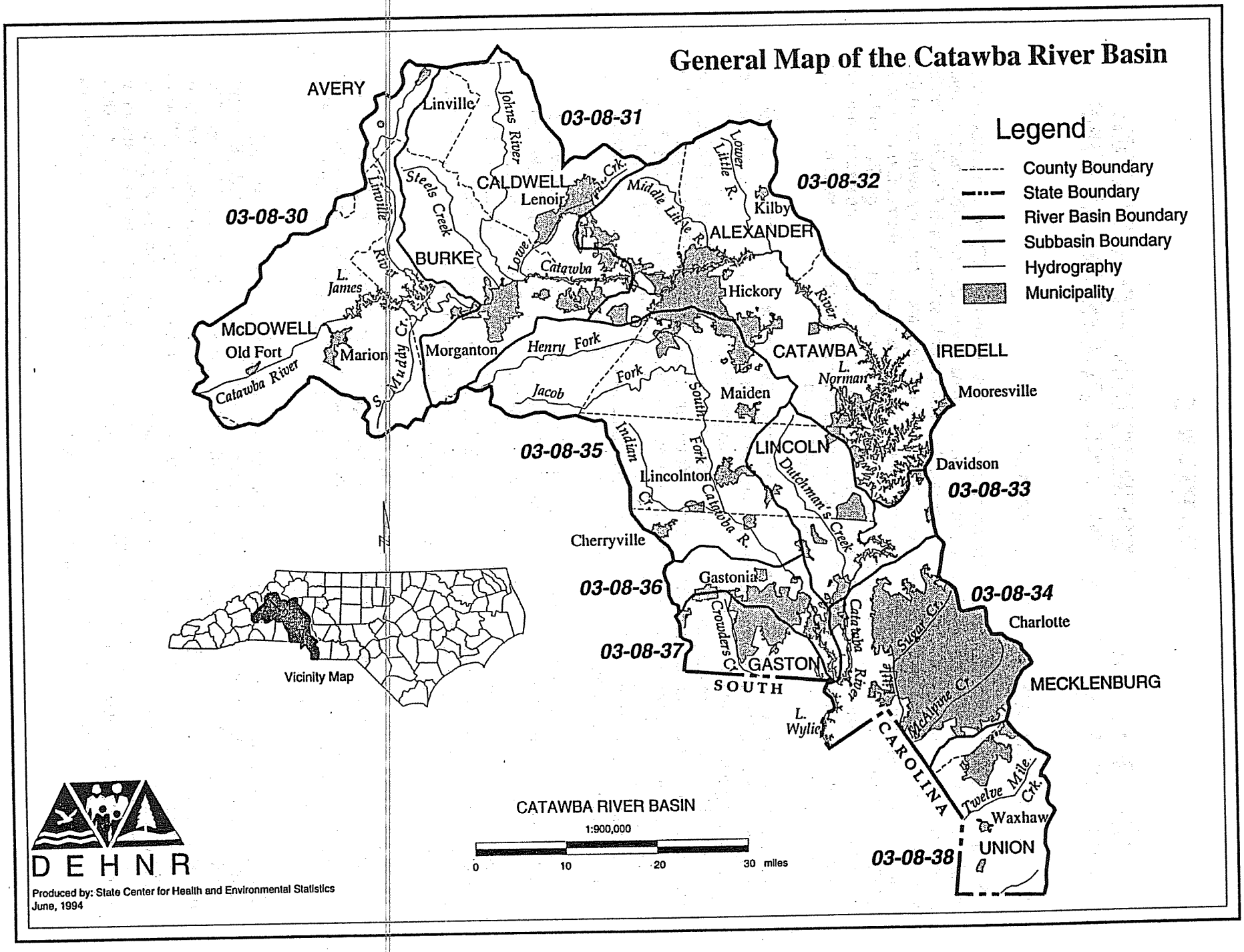


Figure 2.1 General Map of the Catawba River Basin

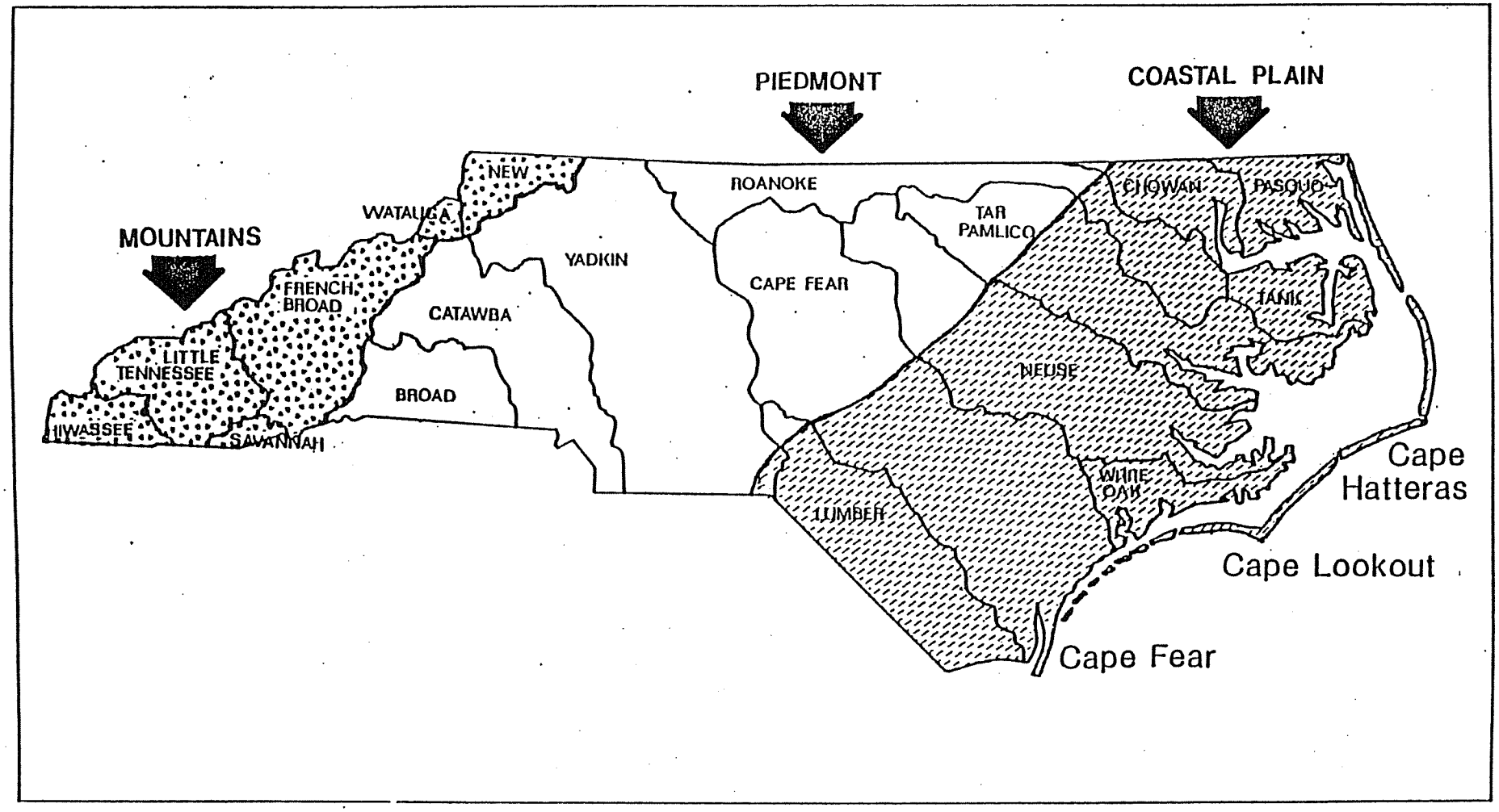


Figure 2.2 River Basins and Physiographic Regions of North Carolina

Average rainfall in the basin ranges from about 45 inches per year in the lower portion near Charlotte to more than 50 inches per year in the headwaters. The average July temperature ranges from about 80°F at Charlotte to about 71°F in the headwaters with the average January temperature ranging from 45°F near Charlotte to 36°F in the upper basin. The evapotranspiration rate ranges from 42 inches per year near Charlotte to 38 inches in the headwaters.

Land cover, based on a 1982 assessment by the Natural Resources Conservation Service is dominated by forest (45%), urban/built-up areas (23%) and agriculture (16%) which jointly comprise 84% of the land/water surface area in the entire basin. The remaining basin area is comprised of other cover types such as open water, rural transportation and minor development.

2.2 MAJOR LAKES IN THE CATAWBA RIVER BASIN

As noted above, one of the most prominent hydrologic features of the Catawba River basin is the series of hydropower impoundments along the river's length that are widely referred to as the Catawba chain lakes (Figure 2.3). From a water quality standpoint, the water quality of each

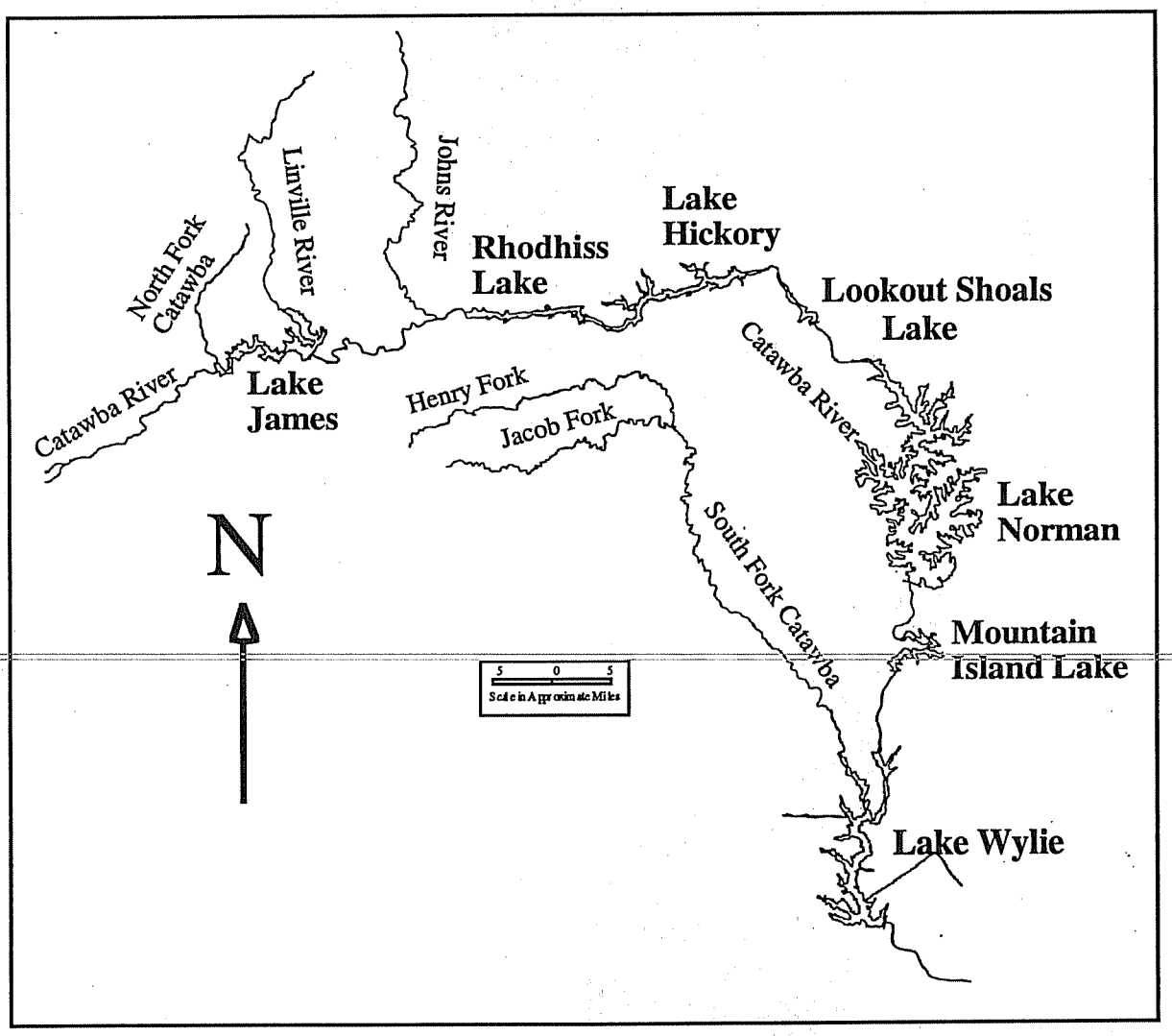


Figure 2.3 Catawba River Chain Lakes

impoundment is influenced by discharge from the upstream reservoir as well as inputs from the surrounding watershed. The most upstream impoundment located on the Catawba River is Lake James which has exhibited the highest water quality of all of the lakes in the Catawba chain.

The next three impoundments in the chain are Rhodhiss Lake, Lake Hickory and Lookout Shoals Lake. Enriched conditions found at some of these reservoirs may be caused by nutrient loading from agricultural runoff, urban stormwater and municipal dischargers. Although nutrient concentrations in these reservoirs are sufficient to support substantial algal populations, short water retention times and limited light availability generally keep algae from reaching higher levels (NC Department of Environment, Health and Natural Resources, 1992).

Lake Norman is located on the Catawba River below lookout Shoals Lake and has historically exhibited good water quality. Water released from Lake Norman forms Mountain Island Lake which is moderately productive. The final impoundment on the Catawba River in North Carolina is Lake Wylie. It is experiencing localized sedimentation and nutrient enrichment problems.

All seven of the Catawba chain lakes, as well as Little River Dam Lake, are owned by Duke Power Company and were created to generate electricity. All of the chain lakes were completed between 1904 and 1928 except Lake Norman, which was completed in 1967. In addition to power generation, the lakes have become popular recreational areas, and some are used for water supply purposes and for waterfront home development (Table 2.1).

Table 2.1 Statistics on Major Lakes in the Catawba River Basin

Lake	Surface Area (Acres)	Mean Depth (Feet)	Max. Depth (Feet)	Shore Length (Miles)	Retent. Time (Days)	Trophic Level	Elev. MSL (Feet)	Watershed Area (Sq. Mi.)	Major Uses
Catawba Chain Lakes (Upstream to downstream order)									
Lake James:	6,510	46	118	145	208	Oligo	1194	380	Hydro, Rec
Rhodhiss Lake:	3,515	20	52	90	21	Meso	995	1,090	Hydro, Rec
Lake Hickory:	4,100	33	85	105	33	Eutro	931	1,310	Hydro, Rec, WS
Lookout Shoals:	1,270	30	69	39	7	Eutro	835	1,449	Hydro, Rec
Lake Norman:	32,510	33	118	520	239	Oligo	760	1,790	Hydro, Rec, WS
Mt. Island Lake:	3,234	16	52	61	12	Oligo	648	1,859	Hydro, Rec, WS
Lake Wylie:	12,450	23	69	327	39	Eutro	569	3,020	Hydro, Rec
Other Major Lakes (Not on Catawba River)									
Lake Tahoma	161					Oligo			Rec (was Hydro)
Little River Dam	162					Eutro		25	Rec (was Hydro)
Maiden Lake	14					Eutro		20	WS
Bessemer City	15					Meso		0.4	WS
Newton City Lake	17					Oligo			WS

The five other lakes in the Catawba basin included in Table 2.1 include Little River Dam Lake, Lake Tahoma, Maiden Lake, Bessemer City Lake and Newton City Lake. Little River Dam is no longer used for hydropower purposes but has become a local fishing spot. It is located on a tributary to Lake Hickory. Lake Tahoma, located on Buck Creek, a tributary to the Catawba River upstream from Lake James, was originally created in the 1920s for hydropower purposes. It is now a recreational lake owned by Lake Tahoma, Incorporated, a corporation of property owners living around the lake. The last three lakes are small water supply reservoirs that serve the municipalities of Maiden, Bessemer City and Newton.

2.3 LAND USE, POPULATION AND GROWTH TRENDS

2.3.1 General Land Cover/Land Use Patterns

Land cover information in this section is derived from the US Department of Agriculture, Natural Resources Conservation Service's (NRCS) National Resources Inventories (NRI) of 1982 and 1992. The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. It is considered accurate to the 8-digit hydrologic unit scale established by the US Geological Survey (NRCS, 1993). Several state agencies including the NC Department of Transportation and the Department of Environment, Health and Natural Resources are working with the state's Center for Geographic Information and Analysis (CGIA) to develop statewide land use coverage based on recent satellite imagery. However, until these other land coverages become available, the NRI data is the most recent comprehensive data for the basin as a whole.

Table 2.2 summarizes acreages and percent cover of land cover for the basin as a whole and for the

Table 2.2 Land Cover in the Catawba River Basin by 8-Digit USGS Hydrologic Units for 1982 and 1992 (USDA, Natural Resources Conservation Service - 1982 and 1992 NRI)

1982	Upper Catawba 03050101		S Fork Cataw. 03050102		Lower Catawba 03050103		TOTAL	
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	ACRES (1000s)	% of TOTAL
Cult. Crop	86.8	6.2	69.5	15.4	37.3	16.4	193.6	9.3
Uncult. Crop	43.3	3.1	10.4	2.3	2.8	1.2	56.5	2.7
Pasture	93.2	6.6	53.2	11.8	14.1	6.2	160.5	7.7
Forest	737.1	52.5	179.7	39.9	69.6	30.7	986.4	47.4
Urban/built-up	196.9	14.0	59.4	13.2	94.7	41.7	351.0	16.9
Other	246.6	17.6	78.1	17.3	8.5	3.7	333.2	16.0
Totals	1403.9	100.0	450.3	100.0	227.0	100.0	2081.2	100.0
% of Total Basin		67.5		21.6		10.9		100.0
SUBBASINS	30 to 33 and 37		35 and 36		34 and 38		All	

1992	Upper Catawba 03050101		S Fork Cataw. 03050102		Lower Catawba 03050103		TOTAL	
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	ACRES (1000s)	% of TOTAL
Cult. Crop	50.9	3.6	38.1	8.5	31.6	13.9	120.6	5.8
Uncult. Crop	48.3	3.4	12.8	2.8	2.3	1.0	63.4	3.0
Pasture	82.7	5.9	56.6	12.6	13.7	6.0	153.0	7.4
Forest	693.9	49.4	177.4	39.4	59.6	26.3	930.9	44.7
Urban/built-up	281.3	20.0	78.7	17.5	114.1	50.3	474.1	22.8
Other	246.8	17.6	86.7	19.3	5.7	2.5	339.2	16.3
Totals	1403.9	100.0	450.3	100.0	227.0	100.0	2081.2	100.0
% of Total Basin		67.5		21.6		10.9		100.0
SUBBASINS	30 to 33 and 37		35 and 36		34 and 38			

three major watershed areas within the basin.

Land cover in the basin for 1992, as presented in Table 2.2, is dominated by forest land (45%), urban/built-up (23%) agriculture (16% - cultivated and cultivated cropland and pastureland) which jointly comprise roughly 84% of the land/water surface area in the entire basin. The remaining 16% of land cover in the Other category includes transportation corridors, open water and minor lands. It is significant that the percentage of land cover in this basin in the urban/built-up category exceeds the percentage in agriculture. In general, the percentage of land cover in urban/built-up is highest in the lower portion of the basin in correlation with population density figures, especially in subbasins 34, 37 and 38. Forest land cover would be expected to dominate the upper basin (subbasins 30, 31 and 35).

Changes in land cover percentages between 1982 and 1992 are presented in Figure 2.4. The developing nature of the basin is evidenced by the increase in the percentage of urban/built-up lands and the decreases in agricultural and forest lands. Cover types are described in Table 2.3.

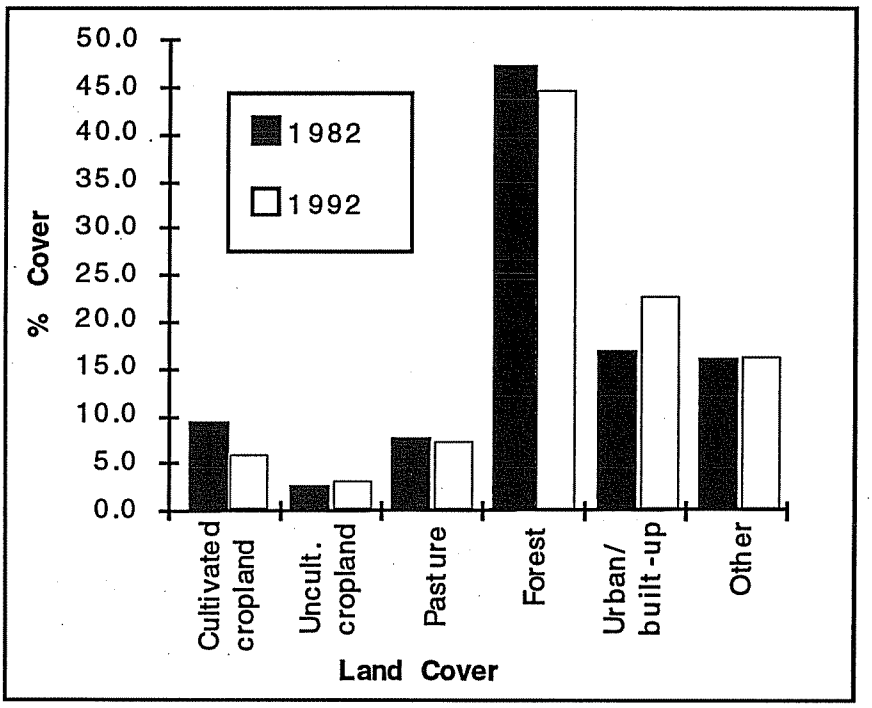


Figure 2.4 Comparison of Selected Land Cover Types (% cover) Between 1982 and 1992

2.3.2 Population and Growth Trends in the Basin

The Catawba River basin has an estimated population of 1,033,347 based on 1990 census data. Table 2.4 presents census data for 1970, 1980 and 1990 for each of the subbasins. It also includes land areas and population densities (persons/square mile) by subbasin based on the *land area* (excludes open water) for each subbasin. Most the population is located in the lower portion of the basin (Mecklenburg and Gaston Counties) as depicted in the population density map (Figure 2.5). Other population centers include Marion, Morganton, Lenoir, Hickory Lincolnton and Davidson. The percentage increase in population for the entire basin was 40% from 1970 to 1990 and was 16.5% for the 10-year period from 1980 to 1990. This latter figure compares to a statewide increase of 12.7% over the same 10-year period. Population growth rates by subbasin, are presented in Figure 2.6. Subbasin 38 (Union County area) had a 20-year growth of over 100%.

Table 2.3 Description of Land Cover Types (1982 NRI - USDA NRCS)

Land Cover Type (No.)	Land Cover Description
1) Cultivated Cropland	Land used for the production of adapted crops for harvest, including row crops, small-grain crops, hay crops, nursery crops, orchard crops, and other specialty crops. The land may be used continuously for these crops or they may be grown in rotation with grasses and legumes.
2) Uncultivated Cropland	Summer fallow, aquaculture in crop rotation, or other cropland not planted (may include cropland in USDA set-aside or similar short-term program).
3) Pastureland	Land used primarily for production of introduced or native forage plants for livestock grazing. This category includes land that has a vegetative cover of grasses, legumes, and /or forbs, regardless of whether or not it is being grazed by livestock.
4) Forest Land	Land at least 10 percent stocked by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover and not currently developed for nonforest use. Ten percent stocked, when viewed from a vertical direction, is a canopy cover of leaves and branches of 25 percent or greater. The minimum area for classification of forest land is 1 acre, and the area must be at least 1,000 feet wide.
5) Urban and Built-up Land	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Highways, railroads, and other transportation facilities are considered part of this category if surrounded by other urban and built-up areas. Tracts of less than 10 acres that do not meet this category's definitions (e.g., small parks or water bodies) but are completely surrounded by urban and built-up lands are placed in this category.
6) Other	Minor Land - Lands not classified into one of the other categories. Rural Transportation - Consists of all highways, roads, railroads, and associated rights-of-way outside Urban and Built-up areas; private roads to farmsteads, logging roads; and other private roads (but not field lanes). Small Water Areas - Water bodies less than 40 acres in size and streams less than one-half mile wide. Census Water - Large water bodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width.

Table 2.4 Catawba Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

SUBBASIN	POPULATION (Number of Persons)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
							Total Land and Water Area		Water Area	Land Area
	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-08-30	36,369	42,671	42,702	70	82	82	336,659	526	10	516
03-08-31	77,096	88,648	92,541	133	153	160	372,006	581	3	578
03-08-32	101,842	126,998	151,979	157	196	234	451,872	706	59	647
03-08-33	30,127	39,067	47,301	139	180	218	141,101	220	4	216
03-08-34	281,144	348,562	435,725	885	1,098	1,372	207,501	324	7	317
03-08-35	87,074	101,427	110,523	155	181	197	357,843	559	1	558
03-08-36	52,676	59,851	61,697	520	591	609	66,438	104	3	101
03-08-37	62,379	59,586	64,977	594	567	618	67,872	106	1	105
03-08-38	10,714	20,121	25,902	60	112	145	114,669	179	1	178
Totals	739,421	886,931	1,033,347	301	351	403	2,115,200	3,305	89	3,216

Note: Population, land area and water area were derived from 1970, 1980 and 1990 census data.

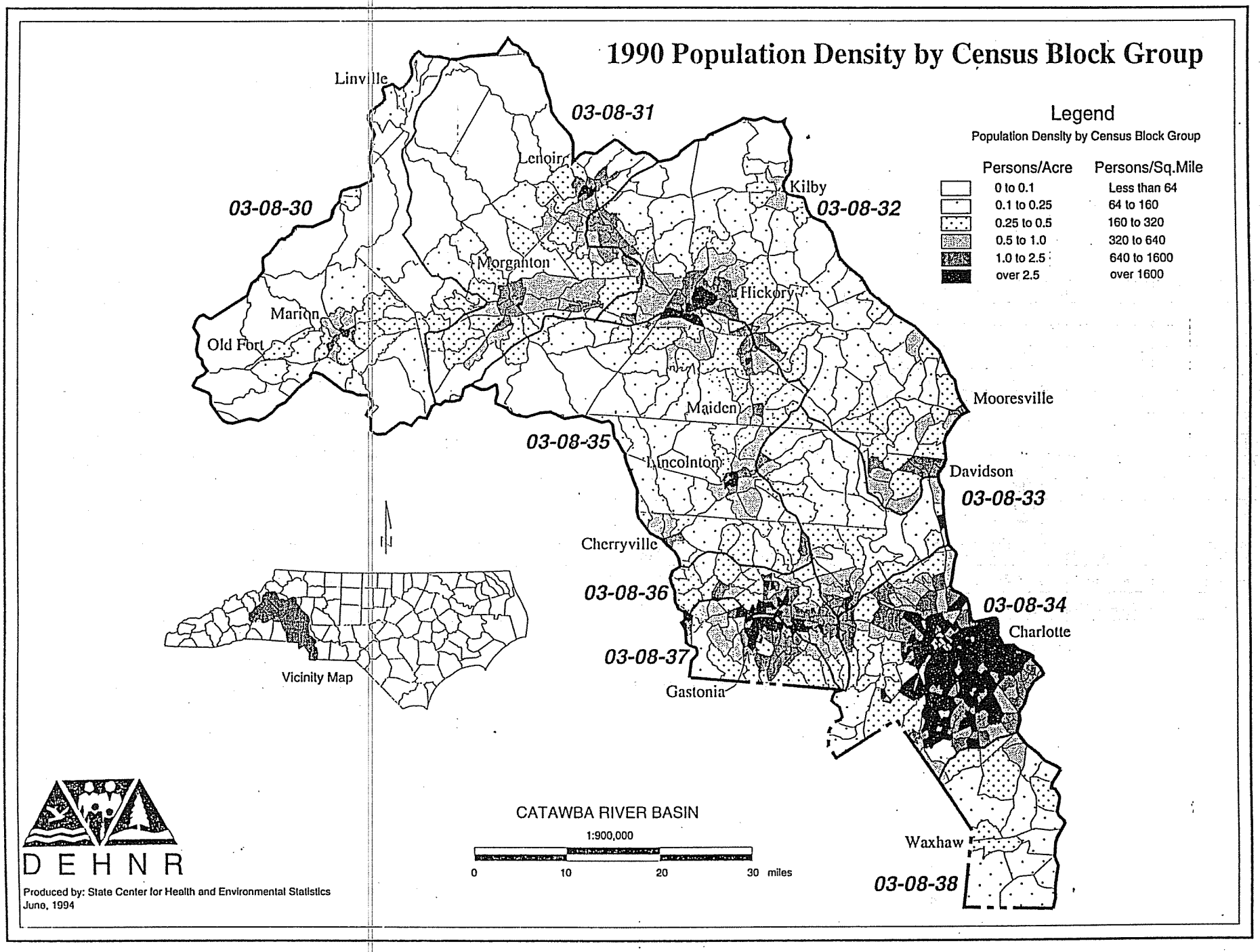


Figure 2.5 1990 Population Density by Census Block Group

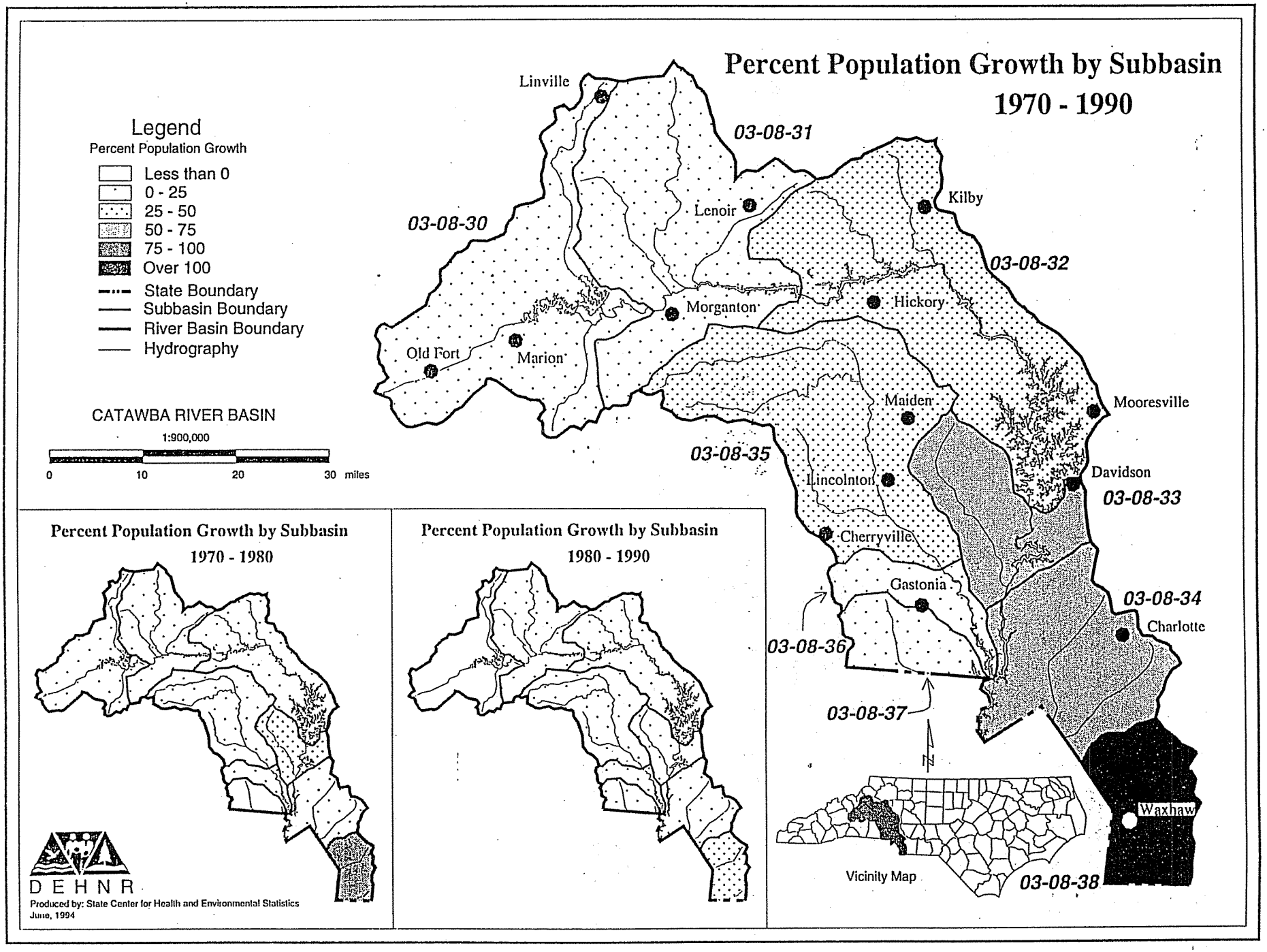


Figure 2.6 Population Growth Increases by Subbasin (1970 to 1990)

In using these data, it should be noted that some of the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, an estimate has to be made on the percentage of the population that is located in the subbasin. This is done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it the subbasin. Use of this method necessitates assuming that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups change each ten years so comparisons between years must be considered approximate.

Figure 2.5 shows population densities by census block group based on 1990 census data. The population density categories are based on persons/acre. An average family unit size is close to 2.5 persons. Therefore, a density of 2.5 persons/acre (1600 persons/square mile) is very roughly equivalent to one house per acre. The lowest density category of less than 0.1 person/acre is equivalent to less than 64 persons/square mile. The highest population densities are generally located in the lower portion of the basin in Mecklenburg and Gaston Counties (subbasins 34 and 37). Other areas with population densities greater than 1 person/acre occur around the municipalities of Cherryville, Davidson, Hickory, Lenoir, Lincolnton, Maiden, Marion, Mooresville and Morganton. The only subbasin with a population density of less than the state average (127 persons/square mile) is subbasin 30 (Lakes James watershed). Subbasin 34 (Charlotte area) has a population density of 1,372 persons/square mile.

Figure 2.6 displays percent population growth by subbasin for the time period from 1970 to 1990. During that twenty year period, subbasin 38 experienced a population increase of over 100%. Subbasins 33 and 34 had population growth increases in the 50 to 75% range. Subbasins 32 and 35 were in the 25 to 50% range and subbasins 30 and 31 were in the 0 to 25% range.

2.4 REGISTERED ANIMAL OPERATIONS

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for properly managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds with a liquid waste system. The deadline for submittal of registrations to DEM for existing facilities was December 31, 1993. Table 2.5 summarizes the number of registered intensive livestock operations and animals, by type and subbasin, for those registrations received for the basin through May 1994.

Table 2.5 Registered Animal Operations in the Catawba River Basin

TYPE OF OPERATION	SUBBASINS									TOTALS
	30	31	32	33	34	35	36	37	38	
CATTLE										
Operations		1	4	3	4	7	2		1	21
Animals		75	460	715	428	930	300		140	2,908
CHICKENS										
Operations										0
Animals										0
DAIRY										
Operations	2	1	14	5	3	24	6	2	1	57
Animals	210	235	3,628	790	446	6,677	2,240	395	185	14,621
POULTRY										
Operations						1				1
Animals						48,000				48,000
SWINE										
Operations		1	6	1		6	1		5	15
Animals		2,800	2,885	300		3,800	200		11,614	9,985
TOTALS										
Operations	2	3	24	9	7	38	9	2	7	94
Animals	210	3,110	6,973	1,805	874	59,407	2,740	395	11,939	75,514

2.5 SURFACE WATER CLASSIFICATIONS AND WATER QUALITY STANDARDS

2.5.1 Program Overview

Clean water is critical to the health, economic well-being and the quality of life of those residing or working in the Catawba River basin. Most water users throughout the basin rely on surface water for basic needs such as water supply and/or wastewater disposal. In addition, many businesses and residents of the Catawba Basin rely directly or indirectly on clean lakes, rivers and streams to meet their recreational needs and for a source of living. Water-oriented real estate and building industries, and those businesses that serve the recreational needs of the basin such as fishing, boating and vacationing are just some examples. To these groups and the public they serve, it is important that the waters support viable fisheries and shellfish resources. In addition, full enjoyment of boating, swimming and residing along the water requires the waters to be relatively

safe (low risk of contracting water-borne disease) and aesthetically desirable (free of objectionable colors, odors and smells). Yet maintaining clean water becomes increasingly difficult and more expensive as the population grows, as land develops and as competition for its resources heighten. In order to assure that water quality throughout the basin is maintained at levels that support the various uses presented above as well as aquatic life, North Carolina has established a water quality classification and standards program pursuant to G.S. 143-214.1. Classifications and standards are developed pursuant to 15A NCAC 2B.0100 - Procedures for Assignment of Water Quality Standards.

Waters were classified for their "best usage" in North Carolina beginning in the early 1950's, with classification and water quality standards for all the state's river basins adopted by 1963. The effort to accomplish this included identification of water bodies (which included all named water bodies on USGS 7.5 minute topographic maps), studies of river basins to document sources of pollution and appropriate best uses, and formal adoption of standards/classifications following public hearings.

The Water Quality Standards program in North Carolina has evolved over time and has been modified to be consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters and the protection of unique and special pristine waters with outstanding resource values. Classifications and standards have been broadly interpreted to provide protection of uses from both point and nonpoint source pollution. Stormwater rules to protect uses and standards of coastal water are an example of North Carolina's water quality authorities.

2.5.2 Statewide Classifications and Water Quality Standards

Appendix I summarizes the state's primary and supplemental classifications including, for each classification, the best usage, key numeric standards, stormwater controls and other requirements as appropriate. This information is derived from 15A NCAC 2B 0.200 - Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina.

Primary Classifications

Under this system, all surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water body (e.g., aquatic life support and swimming). Primary freshwater classifications include the following: *C*, *B* and *WS* (Water Supply) *I* through *WS V*. The WS freshwater classifications may also include a *CA* designation which stands for *critical area*. The critical area is an area in close proximity to a water supply intake and/or the shoreline of the reservoir in which it is located. Primary saltwater classifications include *SC*, *SB* and *SA*. SC and SB are saltwater counterparts to the freshwater C and B classifications. SA is a classification assigned to waters used for shellfish harvesting. SA, WS-I and WS-II are also, by definition, considered to be High Quality Waters, discussed below.

Supplemental Classifications

In addition to primary classifications, surface waters may be assigned a supplemental classification. The supplemental classifications include *HQW* (High Quality Waters), *ORW* (Outstanding Resource Waters), *NSW* (Nutrient Sensitive Waters), *Tr* (Trout Waters) and *Sw* (Swamp Waters). Most of these have been developed in order to afford special protection to sensitive or highly valued resource waters. Therefore, while all surface waters are assigned a primary classification, they may also have one or more supplemental classifications. For example, many surface waters in the upper Catawba basin are supplementally classified as trout (Tr) waters. Therefore, a typical freshwater stream in the mountains might have a C Tr classification where C is the primary classification followed by the Tr supplemental classification.

Water Quality Standards

Each primary and supplemental classification is assigned a set of water quality *standards* that establish the level of water quality that must be maintained in the water body to support the uses associated with each classification. Some of the standards, particularly for HQW and ORW waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. These strategies are summarized in Appendix I and are discussed briefly below. Tables 1 and 2 in Appendix 1 summarize the state's freshwater and saltwater numeric standards. The standards for C and SC waters establish the basic protection level for all state surface waters. With the exception of Sw, all of the other primary and supplemental classifications have more stringent standards than for C and SC and therefore require higher levels of protection.

Special HQW protection management strategies are presented in 15A NCAC 2B.0201(d), which is included in its entirety in Appendix I under Antidegradation Policy. These measures are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new facilities and facilities which expand beyond their currently permitted loadings address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances. For oxygen-consuming wastes, for example, effluent limitations for new or expanding facilities are as follows: BOD_5 = 5 mg/l; NH_3-N = 2 mg/l; DO = 6 mg/l (except for those expanding discharges which expand with no increase in permitted pollutant loading).

For nonpoint source pollution, development activities which require an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or local erosion and sedimentation control program approved in accordance with 15A NCAC 4B .0218, and which drain to and are within one mile of high quality waters will be required to control runoff from the one-inch design storm using either a low density or high density option described in the rules.

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0216 (most of which is included in Appendix I). At a minimum, no new discharges or expansions are permitted, and stormwater controls for most new development are required.

2.5.3 Surface Water Classifications in the Catawba Basin

The Catawba Basin has examples of all of the freshwater classifications and supplemental classifications presented above except swamp waters. A complete listing of these classifications can be found in a DEM publication entitled "Classifications and Water Quality Standards Assigned to the Waters of the Catawba River Basin". Trout waters, WS-I, WS-II, HQWs, and ORWs are generally limited to tributaries of the upper Catawba River and upper South Fork Catawba River. Table 2.6 summarizes those waters in the basin that are classified in whole or part as WS, HQW or ORW. Figures 2.7 through 2.9 show ORW streams in the basin.

REFERENCES

North Carolina Environmental Management Commission, Amended Effective February 1, 1993, Procedures for Assignment of Water Quality Standards (15 NCAC 2B .0100), and Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina (15A NCAC 2B .0200), Raleigh, NC.

North Carolina Department of Environment, Health, and Natural Resources, 1992, North Carolina Lake Assessment Report, Report No. 92-02, Division of Environmental Management, Water Quality Section, Raleigh, NC.

Table 2.6 Waters in the Catawba Basin Classified in Whole or Part as WS, HQW or ORW

WATER BODY	WS Classification	HQW	ORW
Armstrong Creek	II	•	
Buck Creek	II		
Catawba River (at Morganton)	IV		
Clear Creek	I	•	
Henry Fork	I		•
Hoyle Creek	IV		
Indian Creek	II		
Jacob Fork	III		•
Jarrett Creek		•	
Jem Branch	I		
Johns River			
Lake Hickory	IV		
Lake Norman	IV		
Lake Rhodhiss	IV		
Lake Wylie	IV		
Linville River		•	
Long Creek	II		
Long Creek (Arrowood Lake)	II		
Mackey Creek	II	•	
Maiden Lake	II		
Mountain Island Lake	IV		
Mulberry Creek		•	
So. Fork Catawba River	IV		
Steels Creek		•	•
Upper Creek		•	•
Warrior Fork	III		
Wilson Creek and Tribs			•

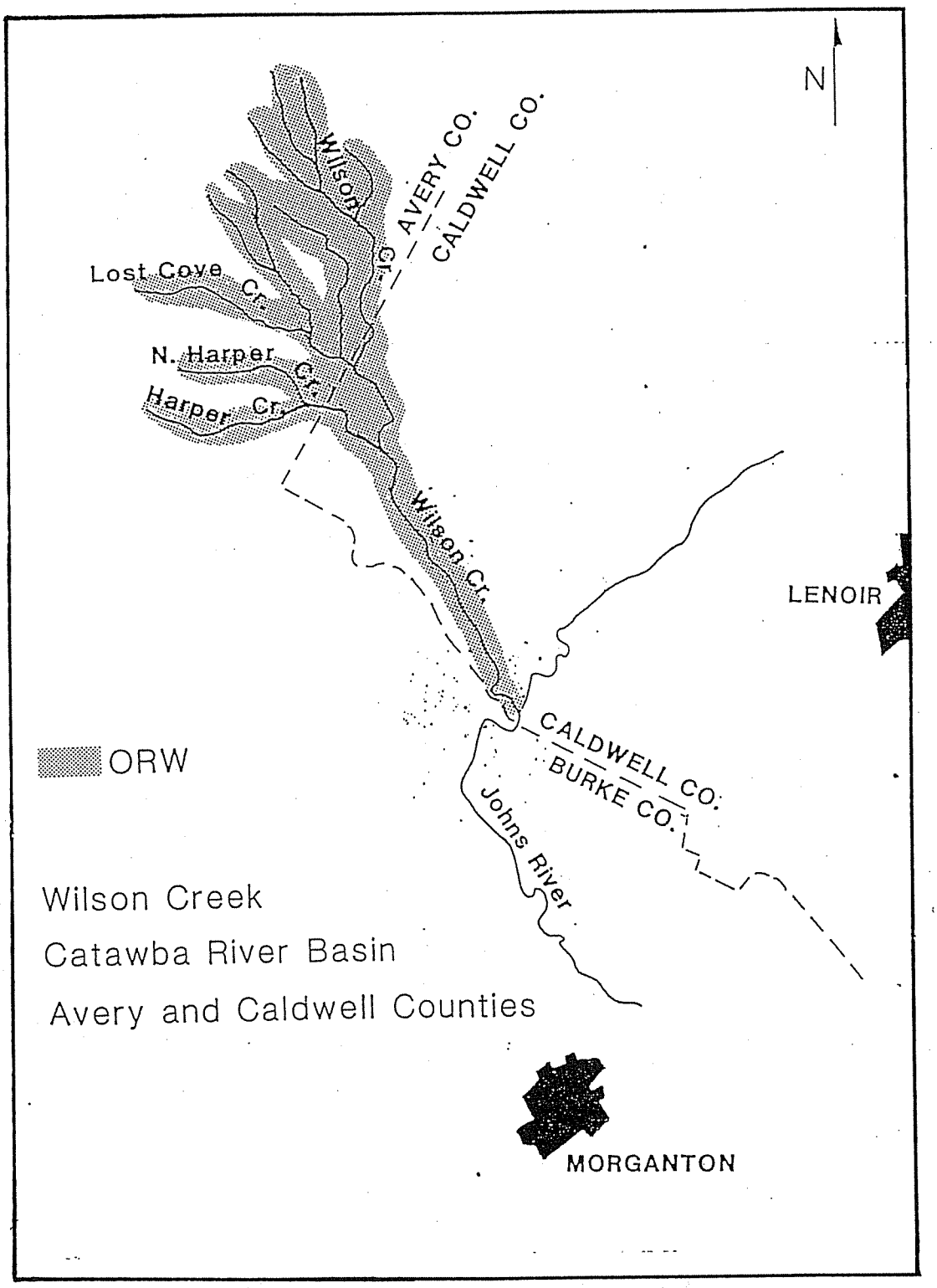


Figure 2.7 Wilson Creek Outstanding Resource Waters (ORW)

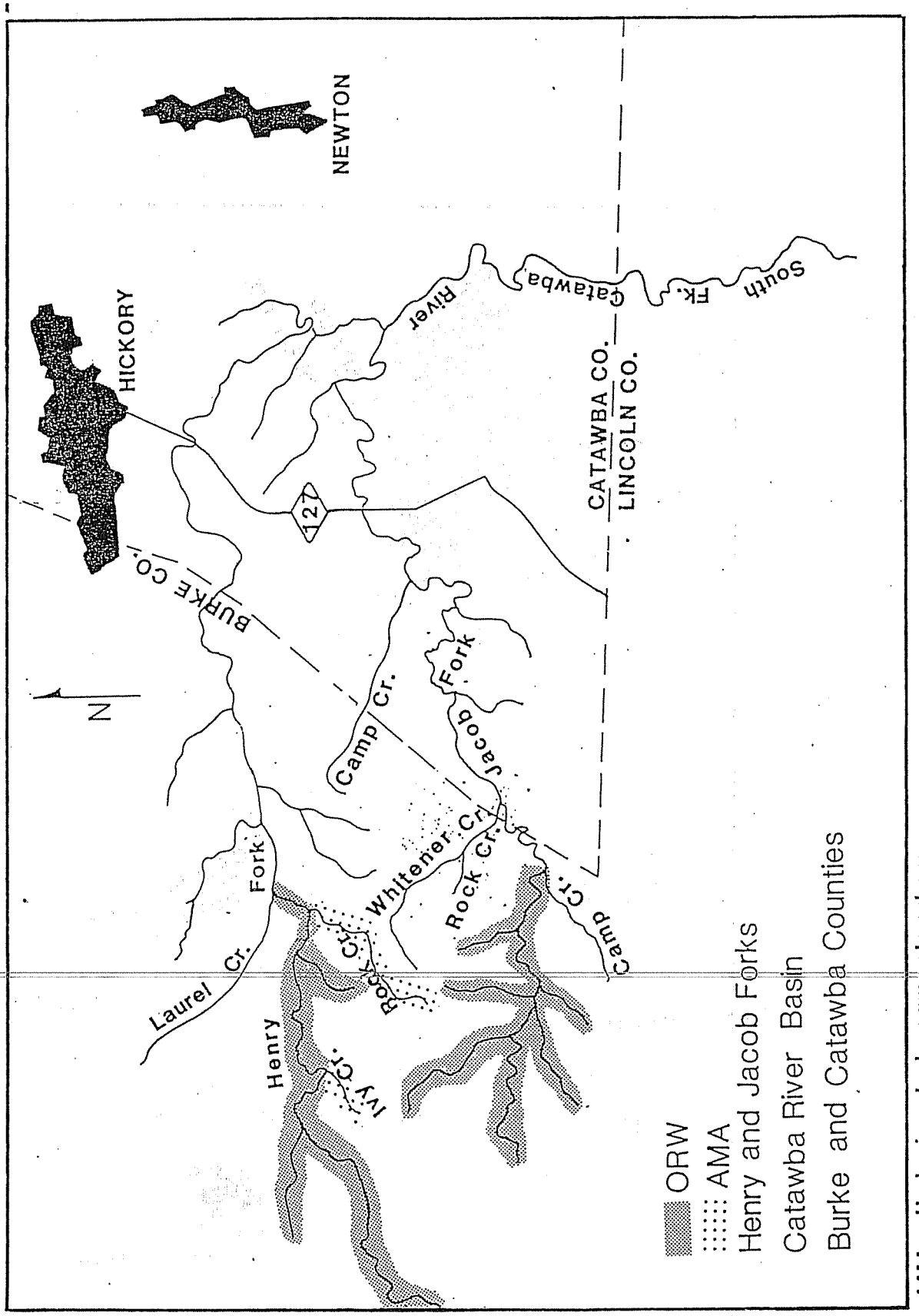


Figure 2.8 Henry and Jacob Forks Outstanding Resource Waters (ORW)

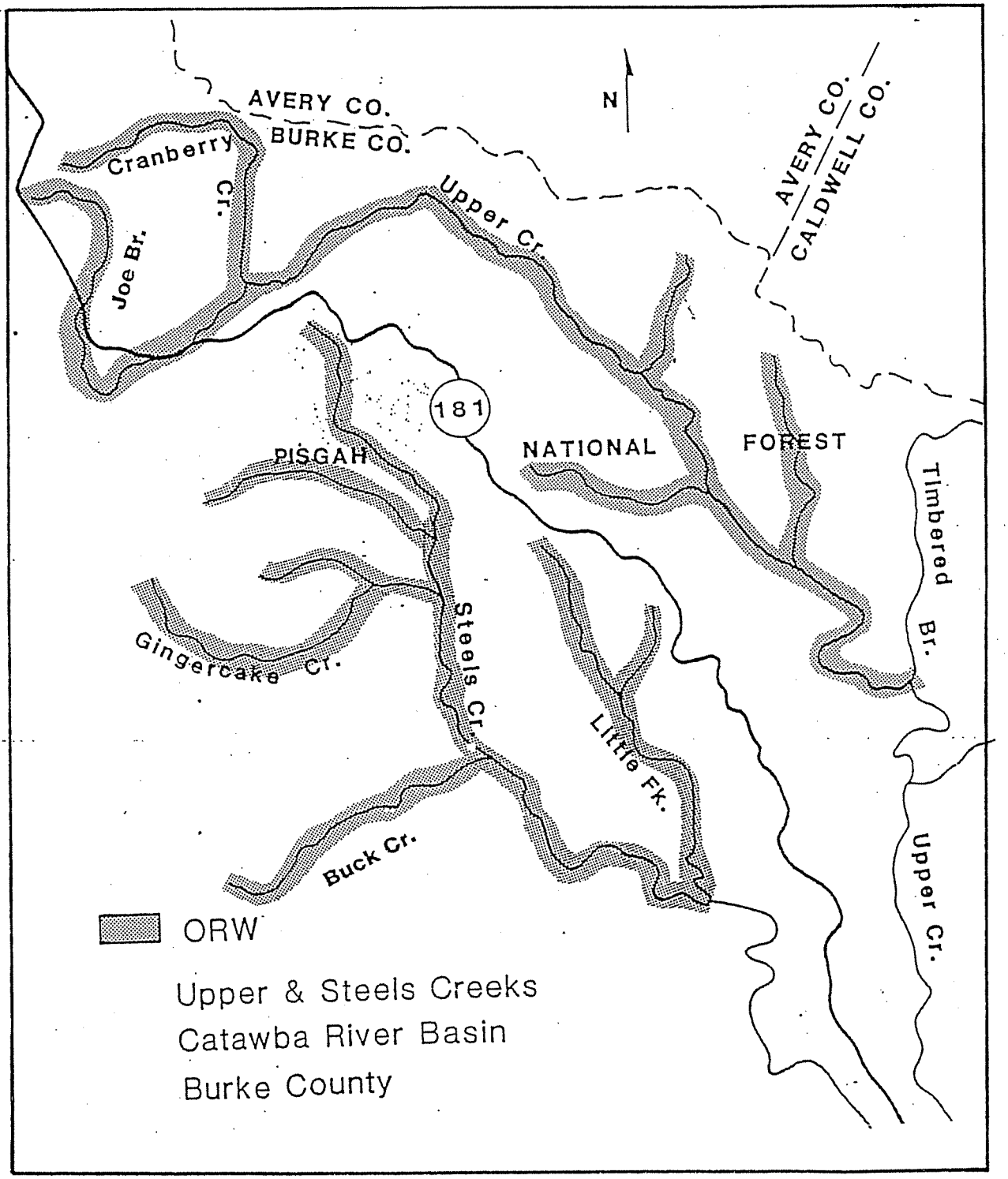


Figure 2.9. Upper and Steels Creek Outstanding Resources Waters (ORW)

CHAPTER 3

CAUSES AND SOURCES OF WATER POLLUTION IN THE CATAWBA RIVER BASIN

3.1 INTRODUCTION

Water pollution is caused by a number of substances including sediment, nutrients, bacteria, oxygen-demanding wastes, metals, color and toxic substances. *Sources* of these pollution-causing substances are divided into broad categories called *point* sources and *nonpoint* sources. Point sources are typically piped discharges from wastewater treatment plants and large urban and industrial stormwater systems. Nonpoint sources can include stormwater runoff from small urban areas (population less than 100,000), forestry, mining, agricultural lands and others. **Section 3.2** identifies and describes the major causes of pollution in the Catawba basin. **Sections 3.3** and **3.4** describe point and nonpoint source pollution in the basin.

3.2 DEFINING CAUSES OF POLLUTION

The term *causes* of pollution refers to the substances which enter surface waters from point and nonpoint sources and result in water quality degradation. The major causes of pollution discussed throughout the basin plan include *biochemical oxygen demand (BOD)*, *nutrients*, *sediment*, *toxicants* (such as heavy metals, chlorine and ammonia), *color* and *fecal coliform bacteria*. Each of the following descriptions indicates whether the cause is point or nonpoint source-related (or both).

3.2.1 Oxygen-Consuming Wastes

Oxygen-consuming wastes are substances such as decomposing organic matter or chemicals which remove dissolved oxygen from the water column. Raw domestic wastewater contains high concentrations of oxygen-consuming wastes that need to be removed from the wastewater before it can be discharged into a waterway. Maintaining a sufficient level of dissolved oxygen in the water is critical to most forms of aquatic life. Understanding oxygen-consuming wastes and their impact on water quality is enhanced by some basic knowledge of the factors which affect dissolved oxygen concentrations in the water.

The concentration of dissolved oxygen (DO) in a water body is one indicator of the general health of an aquatic ecosystem. A lack of sufficient DO in the water will threaten aquatic life. The United States Environmental Protection Agency (EPA) states that 3.0 milligrams per liter (mg/l) is the threshold DO concentration needed for many species' survival (EPA, 1986). Higher concentrations are needed to promote propagation and growth of a diversity of aquatic life in North Carolina's surface waters. North Carolina has adopted a water quality standard of 5.0 mg/l to protect the majority of its surface waters. Exceptions to this standard exist for waters supplementally classified as *trout waters* and those supplementally classified as *swamp* (not found in the Catawba Basin). Trout waters have a DO standard of 6.0 mg/l due to the higher sensitivity of trout to low DO levels. Swamp waters often have naturally low levels of DO, and aquatic life typically found in these waters is adapted to the lower DO levels. Sluggish swamp waters in the coastal plain portion of the state may have natural DO levels of 3.0 to 4.0 mg/l or less at times. Therefore, the DO standard for swamp waters may be less than 5.0 mg/l if that lower level is judged to be the result of natural conditions. Many of the freshwater streams in the Coastal Plain portion of the basin are swamp waters.

DO concentrations are affected by a number of factors. Higher DO is produced by turbulent actions which mix air and water such as waves, rapids and water falls. This process is referred to as reaeration. In addition, lower water temperature generally allows for retention of higher DO concentrations.

Aquatic plant life, including algae, can also produce DO, although this effect is generally temporary and usually occurs nears the surface. Oxygen is produced by algae and other plants in the presence of sunlight through a process called *photosynthesis*. At night, however, photosynthesis and DO production stop and DO is consumed by plants through a process called *respiration*. During the summer months, this daily cycle of daytime oxygen production and nighttime depletion often results in supersaturation of the surface water by oxygen during the afternoon hours on bright, sunny days, and low DO concentrations during the late night and early morning hours.

Another cause of DO depletion is the decomposition of organic matter such as leaves, dead plants and animals, and organic waste matter that may be washed or discharged into the water. Human and household wastes are high in organic waste matter, and bacterial decomposition can rapidly deplete DO levels unless these wastes are adequately treated at a wastewater treatment plant to remove much of the organic component. In addition, some chemicals may react with and bind up DO, and high water temperatures reduce the ability of water to retain DO. Therefore, in general, lowest DO concentrations usually occur during the warmest summer months and particularly during low flow periods. Low DO levels often occur in warm, slow-moving waters that receive a high input of effluent from wastewater treatment plants during low flow conditions. Water depth is also a factor. In deep slow moving waters such as reservoirs or estuaries, DO concentrations may be very high near the surface due to wind action and plant (algae) photosynthesis but may be entirely depleted (anoxic) at the bottom.

Biochemical oxygen demand, or BOD, is a technical term that describes the overall demand on DO from the various oxygen-depleting processes presented above. BOD can be further subdivided into two broad categories: *carbonaceous* biochemical oxygen demand (CBOD) and *nitrogenous* biochemical oxygen demand or NBOD (largely comprised of ammonia (NH_3)). CBOD accounts for the DO consumed by organic substances breaking down. NBOD refers to the bacterial conversion of ammonia to nitrite and nitrate which also uses dissolved oxygen. NPDES permits administered by DEM typically have limits for BOD_5 in each point source permit.

A large portion of the organic material discharged into the water from a wastewater treatment plant is readily decomposed as the oxygen-consuming decay process may begin to occur within a matter of hours. As this decay process occurs in a moving water column, the area of greatest impact may be several miles below the point of discharge. This area can be often be identified by a marked reduction in instream dissolved oxygen concentrations and is commonly referred to as the *sag zone*. Frequently, DO concentrations will gradually rise downstream of the sag zone as the amount of readily decomposed organic matter is reduced. However, a significant portion of the organic matter in wastewater treatment plant effluent may take days to decompose. A commonly used measure of BOD is called BOD_5 where the "5" stands for five days. BOD_5 is a standard waste limit in most discharge permits. A limit of 30 mg/l of BOD_5 is the highest concentration allowed by federal and state regulations for municipal and domestic wastewater treatment plants. However limits less than 30 mg/l and sometimes as low as 5 mg/l are becoming more common in order to maintain DO standards in the receiving waters.

Oxygen Consuming Wastes in the Catawba Basin

The total daily loading of biochemical oxygen demanding wastes (BOD) from NPDES (National Pollutant Discharge Elimination System) municipal dischargers in the Catawba River Basin in 1993 is estimated to be significantly lower than it was 20 years ago despite a large increase in the total volume of treated wastewater. As noted in Figure 3.1a, the total loading of BOD has decreased

from approximately 6.3 tons per day in the mid-1970s to approximately 4.2 tons per day in 1993 while the total daily volume of effluent discharged increased by 58% from 72 MGD in the mid 1970s to 114 MGD in 1993 (Figure 3.1b). This reduction in BOD loading is attributed to more stringent point source pollution control requirements mandated by the federal Clean Water Act and implemented through the state's NPDES program.

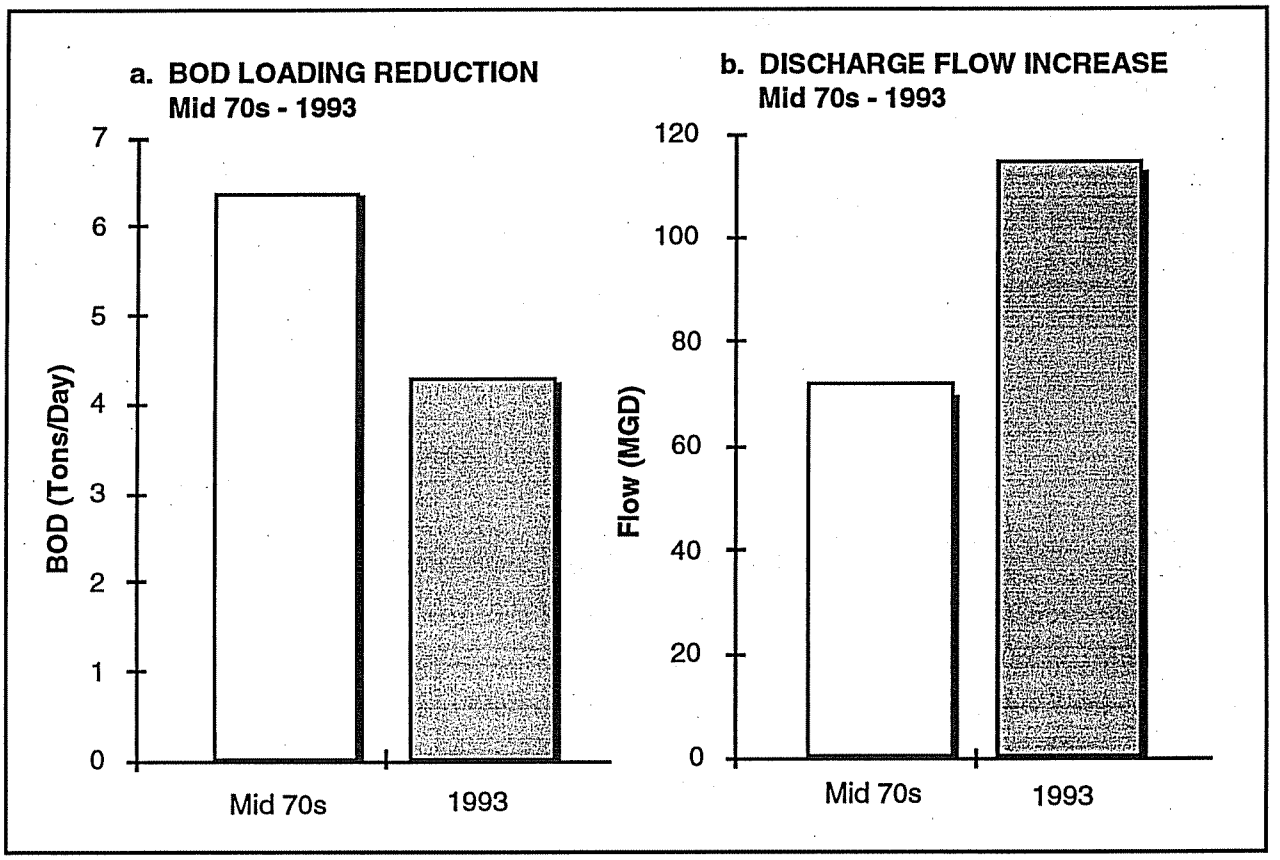


Figure 3.1 Comparison of (a) Total BOD Loading and (b) Effluent Flows from Municipal NPDES dischargers in the Catawba River Basin Between Mid-1970s and 1993

Comparisons of BOD loadings and flows from municipal wastewater treatment facilities in the basin are presented in Figures 3.2 and 3.3. For municipalities or municipal sewer authorities that operate more than one facility, such as Gastonia and the Charlotte-Mecklenburg Utility Department, the flows and loadings are combined. These numbers are based on actual loadings and flows through 1993.

In general, while water quality standards for dissolved oxygen are being met throughout most of the basin, modeling studies have indicated that the BOD assimilative capacity is either limited or has been exhausted in some waters in the basin. Also, treatment of BOD will need to continue to improve in order to maintain water quality standards in the face of future plant expansions. In addition, the tributary arms of many lakes in the basin are susceptible to impacts from loadings of BOD. Recommended strategies for addressing BOD are presented in Section 6.3 of Chapter 6.

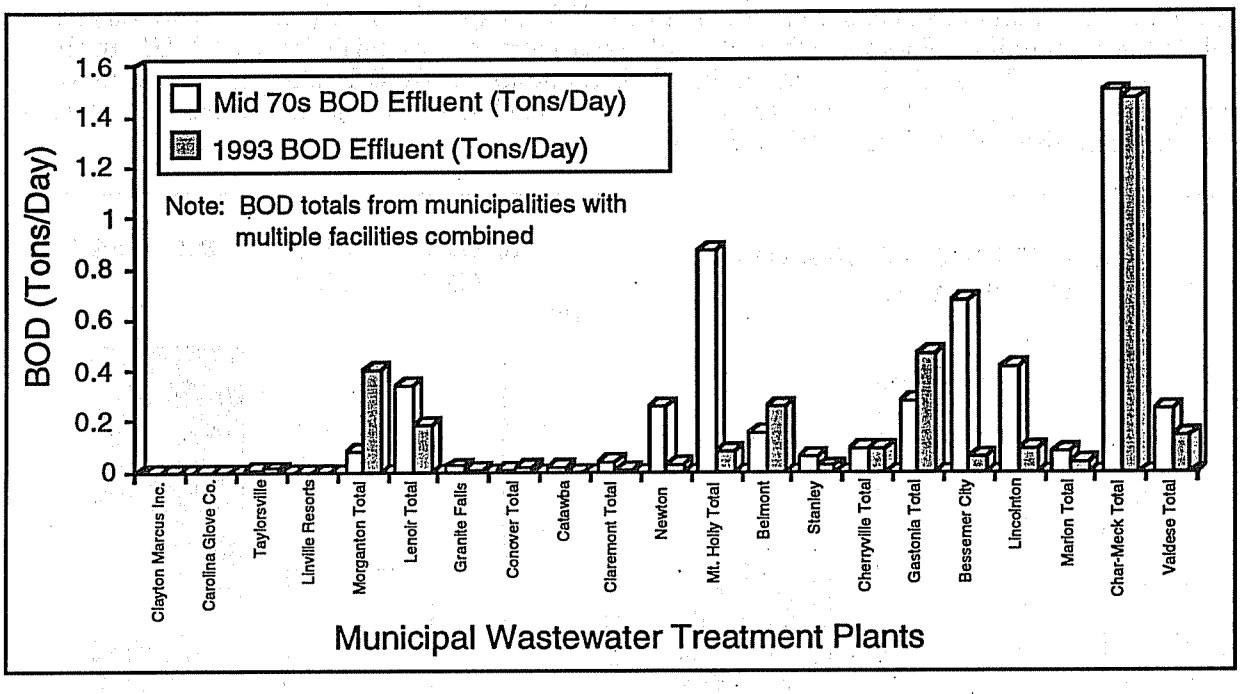


Figure 3.2 Comparison Between Mid-1970s and 1993 Loading of Biochemical Oxygen Demand (BOD) from Municipal Wastewater Treatment Plants in the Catawba Basin

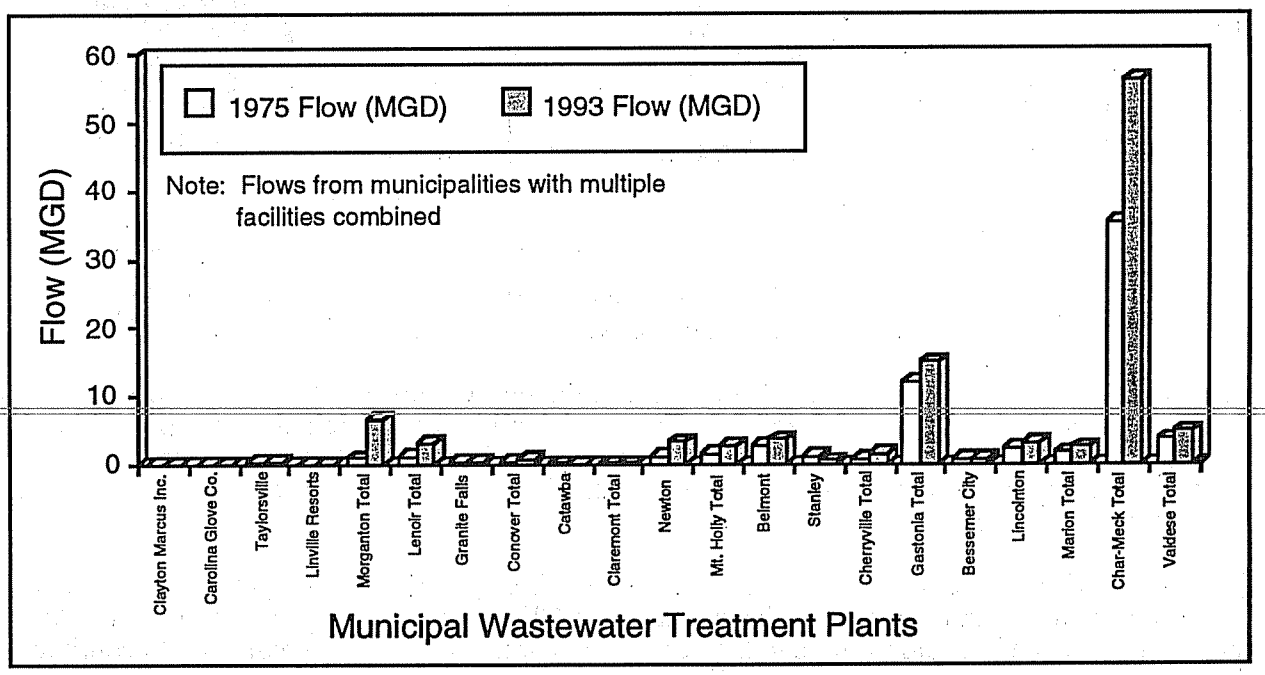


Figure 3.3 Comparison Between Mid-1970s and 1993 Daily Effluent Flow from Municipal Wastewater Treatment Plants in the Catawba Basin

3.2.2 Nutrients

The term *nutrients* in this document refers to the substances phosphorus and nitrogen, two common components of fertilizers, animal and human wastes, vegetation and some industrial processes. Nutrients in surface waters come from both point and nonpoint sources. While nutrients can be beneficial to aquatic life in small amounts, in overabundance and under favorable conditions, they can stimulate the occurrence of algal blooms and excessive plant growth in quiet waters such as ponds, lakes, reservoirs and estuaries.

Algae blooms, through respiration and decomposition, deplete the water column of dissolved oxygen and can contribute to serious water quality problems. Nutrient overenrichment and the resultant problems of low DO are called *eutrophication.* In addition to problems with low DO, the blooms are aesthetically undesirable, impair recreational use, impede commercial fishing and pose difficulties in water treatment at water supply reservoirs. Excessive growth of larger plants, or macrophytes, such as milfoil, alligator weed and Hydrilla, can also be a problem. These plants, in overabundance, can reduce or eliminate swimming, boating and fishing in infested waters.

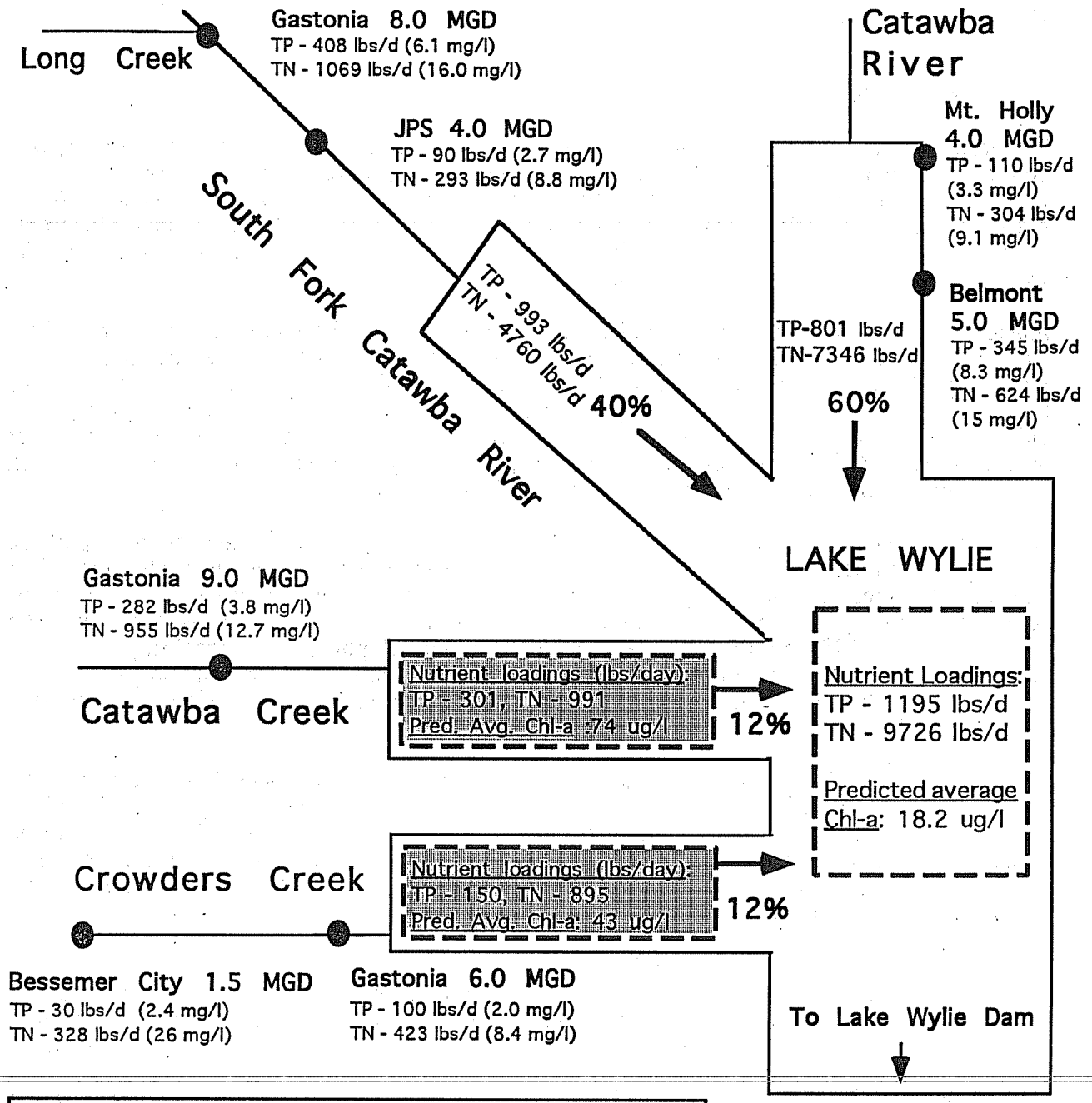
Agricultural runoff and wastewater treatment plants along with forestry and atmospheric deposition are the main sources of nutrients. Nutrients in nonpoint source runoff come mostly from fertilizer and animal wastes. Nutrients in point source discharges are from human wastes, food residues, some cleaning agents and industrial processes. A statewide phosphorus detergent ban implemented in 1988 significantly reduced the amount of phosphorus reaching and being discharged into surface waters from wastewater treatment plants. A report was prepared by the North Carolina Department of Environment, Health, and Natural Resources in 1991 to evaluate the effects of the ban. (NCDEHNR, 1991).

At this time, North Carolina has no numeric instream standards for total phosphorus (TP) and total nitrogen (TN), but analysis is underway, and standards or instream criteria may be developed for these parameters in the future. In addition, the State has a standard of 40 ug/l (micrograms per liter or parts per billion) for chlorophyll *a* Chlorophyll *a* is a constituent of most algae (it gives algae its green color). A chlorophyll *a* reading above the 40 ug/l standard is indicative of excessive algal growth and portends bloom conditions.

Nutrients in the Catawba Basin

Nutrients, especially phosphorus, are a potential water quality problem throughout much of the river basin because of their potential impacts on the many lakes found in the basin. Of particular concern are the impacts in the headwater tributaries of these lakes. Table 4.7 in Chapter 4 identifies three lakes as being threatened by nutrients based on observed high chlorophyll *a* levels: Lake Hickory, Lake Wylie and Maiden Lake. Discussions of nutrient-related concerns for these lakes are presented in Sections 4.4.3, 4.4.5 and 4.4.6. Ambient water quality data for nitrogen and phosphorus are presented in Section 4.3 of Chapter 4 (Figures 4.4, 4.9, 4.10, 4.11, and 4.13 through 4.17).

A special water quality study was conducted jointly by DEM and the South Carolina Department of Health and Environmental Control regarding nutrient loadings to Lake Wylie. The resulting 1992 report (North Carolina Department of Environment, Health, and Natural Resources, 1992) found that the lake's assimilative capacity for nutrients was exhausted in the tributary arms from Catawba Creek and Crowders Creek and nearly exhausted in the mainstem below the confluence of the Catawba River and South Fork Catawba arms. Figure 3.4 is a schematic representation of the lake which indicates the phosphorus and nitrogen loads entering the lake from the four main tributary arms: Catawba River, South Fork Catawba River, Catawba Creek and Crowders Creek. Also shown are the contributions of nutrients from seven major wastewater treatment plants. See Section 4.4.5 of Chapter 4 for a more detailed review of Lake Wylie Report findings.



Legend/Explanation of terms

- Major NPDES Discharger locations with facility name and avg. 93-94 daily nutrient loads for total nitrogen (TN) and phosphorus (TP).
- Nutrient sensitive lake areas where the state standard of 40 ug/l for chlorophyll-a is predicted to occur at some time during the growing season. Standard violations were observed twice in a 1989-90 study.
- Areas where predicted average Chl-a concentrations exceed the state standard of 40 ug/l and where chronic algal bloom conditions have been observed.

Note: Daily nutrient loadings in the 4 lake arms are based on 89-90 measured background levels plus actual average 93-94 loadings from dischargers. Nutrient loading in the main lake is based on percentages of the lake arm loadings that are thought to reach the lake based on a field-calibrated in-lake nutrient transport model.

Figure 3.4 Schematic Diagram of Lake Wylie Showing Nutrient Loadings and Predicted Chlorophyll-a Concentrations in the 4 Major Arms and the Mainstem of the Lake

In each of the tributary arms to the lake, pounds per day of total phosphorus (TP) and total nitrogen (TN) are shown. For example, the TP for the South Fork Catawba River is 993 lbs/day. This number is derived by adding together background nutrient loadings from the 1989-90 study (with 89-90 nutrient loadings from the nearby major discharges subtracted out) with the 93-94 average daily loadings from the depicted wastewater treatment plants. The percentages shown in bold type and accompanied by an arrow indicate the percentage of the nutrients in each tributary arm that are estimated to reach the mainstem of the lake taking into consideration uptake of the nutrients by algae and other factors that would limit in-lake transport. As an example, 60% of the nutrients in the Catawba River arm of the lake are estimated to reach the nutrient sensitive mainstem segment of the lake. These percentages are based on a field-calibrated in-lake nutrient transport model run by DEM. The TP and TN values in the Lake Wylie portion of the diagram represent the combined nutrient loads transported from all four lake arms to the mainstem.

The areas of the lake enclosed by the dashed-line boxes are nutrient sensitive areas of concern. In each box is the predicted average chlorophyll *a* concentration over that segment of the lake during the growing season (April through October). As this is an average over the entire segment, chlorophyll *a* concentrations both above and below this value are expected. Hotspots with concentrations above the 40 ug/l state standard for chlorophyll *a* can be anticipated in the mainstem segment of the lake even though the predicted average concentration is 18.2 ug/l. In the Crowders and Catawba Creeks arms, the predicted average chlorophyll *a* concentrations are 43 and 74 ug/l, respectively. Both of these averages are above the state standard and have been shaded for emphasis.

Relative point source contributions of nutrients are summarized below:

	Major municipal	Industrial	Minor domestic
Total Phosphorus	86%	11%	3%
Total Nitrogen	73%	26%	1%

Recommended nutrient reduction strategies for point and nonpoint sources to Lake Wylie are presented in Section 6.4.1 of Chapter 6.

Ongoing and planned studies will further detail the assimilative capacity for nutrients in Rhodhiss Lake, Lake Hickory, Lookout Shoals Lake and Mountain Island Lake.

3.2.3 Toxic Substances

Regulation 15A NCAC 2B. 0202(36) defines a toxicant as "any substance or combination of substances ... which after discharge and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, has the potential to cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions or suppression in reproduction or growth) or physical deformities in such organisms or their offspring or other adverse health effects". Toxic substances frequently encountered in water quality management include *chlorine*, *ammonia*, *organics* (hydrocarbons, pesticides, herbicides), and *heavy metals*. These materials are toxic to different organisms in varying amounts, and the effects may be evident immediately or may only be manifested after long-term exposure or accumulation in living tissue.

North Carolina has adopted standards and *action levels* for several toxic substances. These are contained in 15A NCAC 2B .0200. Usually, limits are not assigned for parameters which have action levels unless monitoring indicates that the parameter may be causing toxicity or federal guidelines exist for a given discharger for an action level substance. This process of determining

action levels exists because these toxic substances are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics and/or associated waste characteristics. Water quality based limits may also be assigned to a given NPDES permit if data indicate that a substance is present for which there is a federal criterion but no water quality standard.

Whole effluent toxicity (WET) testing is required on a quarterly basis for major dischargers and any discharger containing complex (industrial) wastewater. This test shows whether the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity. If the effluent is found to be toxic, further testing is done to determine the specific cause. This followup testing is called a *toxicity reduction evaluation* (TRE). WET testing is discussed in Sections 4.2.5 and 5.2.5 of Chapters 4 and 5 respectively.

Each of the substances below can be toxic in sufficient quantity.

Metals

Municipal and industrial dischargers along with urban runoff are the main sources of metals contamination in surface water. North Carolina has stream standards for many heavy metals, but the most common ones in municipal permits are cadmium, chromium, copper, nickel, lead, mercury, silver and zinc. Each of these, with the exception of silver, is also monitored through the ambient network along with aluminum and arsenic. Point source discharges of metals are controlled through the NPDES permit process. Mass balance models (Appendix III) are employed to determine appropriate limits. Municipalities with significant industrial users discharging wastes to their treatment facilities limit the heavy metals coming to them from their industries through their *pretreatment program.* Source reduction and wastewater recycling at WWTPs also reduces the amount of metals being discharged to a stream. Nonpoint sources of pollution are controlled through best management practices. The new urban stormwater NPDES program described in Chapter 5 should help address nonpoint source metals loading in the Charlotte area.

Chlorine

Chlorine is commonly used as a disinfectant at NPDES discharge facilities which have a domestic (i.e., human) waste component. These discharges are a major source of chlorine in the State's surface waters. Chlorine dissipates fairly rapidly once it enters the water, but its toxic effects can have a significant impact on sensitive aquatic life such as trout and mussels. At this time, no standard exists for chlorine, but one may be adopted in the near future and an action level has been established. In the meantime, all new and expanding dischargers are required to dechlorinate their effluent if chlorine is used for disinfection. If a chlorine standard is developed for North Carolina, chlorine limits may be assigned to all dischargers in the State that use chlorine for disinfection.

Ammonia (NH_3)

Point source dischargers are one of the major sources of ammonia. In addition, decaying organisms which may come from nonpoint source runoff and bacterial decomposition of animal waste products also contribute to the level of ammonia in a waterbody. At this time, there is no numeric standard for ammonia in North Carolina. However, DEM has agreed to address ammonia toxicity through an interim set of instream criteria of 1.0 mg/l in the summer (April - October) and 1.8 mg/l in the winter (November - March). These interim criteria are under review, and the State may adopt a standard in the near future.

<u>Ammonia (NH3) in the Catawba River Basin</u>

Ammonia has been identified as a cause of stream use impairment in two streams in the basin in subbasin 34: Little Sugar Creek at Pineville and McAlpine Creek (Table 4.3 in Chapter 4). Instream ammonia-nitrogen data at ambient monitoring stations are presented in Section 4.3 (Figures 4.11, 4.15 and 4.17). Because ammonia is an oxygen-demanding waste, in addition to

being a potential toxicant, management strategies for controlling ammonia are presented in Section 6.3 of Chapter 6.

3.2.4 Sediment

Sediment is the most widespread cause of nonpoint source pollution in the state. It impacts streams in several ways. Eroded sediment may gradually fill lakes and navigable waters and may increase drinking water treatment cost. Sediment may clog the gills of fish, eliminate the available habitat of organisms which serve as food for fish, or even completely cover shellfish beds. Sediment also serves as a carrier for other pollutants including nutrients (especially phosphorus), toxic metals and pesticides. Most sediment-related impacts are associated with nonpoint source pollution.

North Carolina does not have a numeric water quality standard for suspended solids, however all discharges must meet federal effluent guideline values at a minimum (e.g. 30 mg/l for domestic discharges). Also, most point source BOD limitations usually require treatment to a degree that removes sediments to a level below federal guidelines requirements. Discharges to high quality waters (HQW) must meet a total suspended solids (TSS) limit of 10 mg/l for trout waters and primary nursery areas and 20 mg/l for all other HQWs. In addition, the state has adopted a numerical instream turbidity standard for point and nonpoint source pollution. Nonpoint sources are considered to be in compliance with the standard if approved best management practices (BMPs) have been implemented.

Sedimentation in the Catawba River Basin

Sediment is the most widespread cause of freshwater stream impairment in the Catawba River Basin. Use support information presented in Section 4.5 of Chapter 4 indicates that 376 miles of streams are impaired as a result of sedimentation. Freshwater stream impairment from sedimentation is distributed as follows:

Subbasin No.:	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**
Stream Miles Impaired by Sediment:	15	50	77	23	110	51		11	42

Section 6.6 of Chapter 6 discusses strategies for controlling sediment.

3.2.5 Fecal Coliform Bacteria

Fecal coliforms are bacteria typically associated with the intestinal tract of warm-blooded animals and are widely used as an indicator of the potential presence of pathogenic, or disease-causing, bacteria and viruses. They enter surface waters from improperly treated discharges of domestic wastewater and from nonpoint source runoff. Common nonpoint sources of fecal coliforms include leaking or failing septic systems, leaking sewer lines or pump station overflows, runoff from livestock operations and wildlife.

Fecal coliforms are used as indicators of waterborne pathogenic organisms (which cause such diseases as typhoid fever, dysentery, and cholera) because they are easier and less costly to detect than the actual pathogens. Fecal coliform water quality standards have been established in order to ensure safe use of waters for water supplies, recreation and shellfish harvesting. The current State standard for fecal coliforms is 200 MF/100 ml for all waters except SA waters. MF is an abbreviation for the Membrane Filter procedure for determining fecal coliform concentrations. This procedure entails pouring a 100 ml water sample through a membrane filter. The filter is then placed on a cultured medium and incubated for a specified period of time. The number of colonies of bacteria that grow on the medium is then compared to the standard of 200 colonies per 100 ml.

Fecal coliforms in treatment plant effluent are controlled through disinfection methods including chlorination (sometimes followed by dechlorination), ozonation or ultraviolet light radiation

Fecal Coliform Bacteria in the Catawba River Basin

Of the 39 ambient water quality monitoring stations in the Catawba basin, fecal coliform measurements exceeded the state standard at least 10% of the time at 27 stations, and more than 25% of the time at 18 stations. According to Table 4.6 in Chapter 4, there are 50 miles of streams in subbasins 31, 34 and 35 considered to be use-impaired due to levels of fecal coliform bacteria above state standards. Use-impairment by fecal coliforms is based on ambient water quality data collected by DEM. Streams that are use-impaired, based on monitored data, are identified in Table 4.3 (see Fecal under Problem Parameter Column).

3.2.6 Color

Color in wastewater is generally associated with industrial wastewater or with municipal plants that receive certain industrial wastes, especially from textile manufacturers, that use dyes to color their fabrics, and from pulp and paper mills. For colored wastes, 15A NCAC 2B .0211(b)3(F) states that the point sources shall discharge only such amounts as will not render the waters injurious to public health, secondary recreation, or aquatic life and wildlife or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses. NPDES permit requirements regarding color are included on a case-by-case basis since no numeric standard exists for color, and because a discharger may have high color values but no visual impact instream due to dilution or the particular color of the effluent. Color monitoring is included in the NPDES permit where it has been perceived to be a problem instream.

Color in the Catawba River Basin

While no streams in the basin have been identified as use-impaired due to color, color has been identified as a concern in the South Fork Catawba River and several of its tributaries. Section 6.7 in Chapter 6 discusses ongoing efforts to study color and to address the issue in the Catawba Basin. It also lists facilities in subbasins 35 and 37 that are required to monitor for color.

3.3 POINT SOURCES OF POLLUTION

3.3.1 Defining *Point* Sources

Point sources refers to discharges that enter surface waters through a pipe, ditch or other well-defined points of discharge. The term most commonly refers to discharges associated with wastewater treatment plant facilities. These include *municipal* (city and county) and *industrial* wastewater treatment plants as well as small *domestic* discharging treatment systems that may serve schools, commercial offices, residential subdivisions and individual homes. In addition, discharges from *stormwater systems* at industrial sites are now considered point source discharges and are being regulated under new urban stormwater runoff regulations being required by the U.S. Environmental Protection Agency (EPA). The urban stormwater runoff program is discussed in more detail in Chapter 5 and Section 6.8 in Chapter 6. The primary substances and compounds associated with point source pollution are oxygen-demanding wastes, nutrients, color and toxic substances including chlorine, ammonia and metals.

Point source discharges are not allowed in North Carolina without a permit from the state. Discharge permits are issued under the National Pollutant Discharge Elimination System (NPDES) program delegated to North Carolina from EPA. The amount or loading of specific pollutants that may be allowed to be discharged into surface waters are defined in the NPDES permit and are called *effluent limits*. Under the NPDES permitting program, each NPDES discharger is assigned either *major* or *minor* status. Major facilities are large with greater flows. For municipalities, all dischargers with a flow of greater than 1 million gallons per day (MGD) are classified as major.

Most point source discharges, other than urban and industrial stormwater discharges, are continuous and do not occur only during storm events as do nonpoint sources. They generally have the most impact on a stream during low flow conditions when the percentage of stream flow composed of treated effluent is greatest. Permit limits are generally set to protect the stream during low flow conditions. The standard low flow used for determining point source impacts is called the *7Q10*. This is the lowest flow which occurs over seven consecutive days and which has an average recurrence of once in ten years.

Information is collected on NPDES permitted discharges in several ways. The major method of collection is facility self-monitoring data which are submitted monthly to the DEM by each individual permittee. NPDES facilities are required to monitor for all pollutants for which they have limits as well as other pollutants which may be present in their wastewater. All domestic wastewater dischargers are required to monitor flow, dissolved oxygen, temperature, fecal coliform, BOD, ammonia, and chlorine (if they use it as a disinfectant). In addition, facilities with industrial sources may have to monitor for chemical specific toxicants and/or whole effluent toxicity (see Section 3.2.3); and all dischargers with design flows greater than 50,000 gallons per day (GPD) monitor for total phosphorus and total nitrogen. Minimum NPDES monitoring requirements are provided in 15A NCAC 2B .0500.

Other methods of collecting point source information include effluent sampling by DEM during inspections and special studies. The regional offices may collect data at a given facility if they believe there may be an operational problem or as a routine compliance check. In addition, the DEM may collect effluent data during intensive surveys of segments of streams, and extensive discharger data have been collected during onsite toxicity tests.

3.3.2 Point Source Discharges in the Catawba

In the Catawba River Basin, there are 545 permitted NPDES dischargers, 32 of which have pretreatment programs. Table 3.1 summarizes the number of dischargers and their total permitted and actual 1993 flows for each subbasin. Table 3.2 summarizes this information for the entire basin by broad categories of dischargers including majors, minors, domestic, municipal, industrial (process and nonprocess) and stormwater.

A distribution map of the discharge facilities is shown in Figure 3.5a and b (upper and lower basin). Table 3.3 lists the major dischargers in the basin along with the NPDES number, permitted flow, receiving stream and category (e.g., municipal, industrial). Location numbers are provided in the table for each major discharger that correlate with numbered locations shown in Figure 3.5 (a and b).

Of the total 545 dischargers, 39 are major facilities, 165 are domestic, 45 are municipalities and 64 are industries. The total permitted flow for all facilities is 203 million gallons per day (MGD). The reason that the average actual flow was so much higher than the permitted flow is because some industrial discharges, such as those for cooling water, stormwater or nonprocess wastewater, do not have a total flow limit specified in their permit although they have reported total flow anyway. A more meaningful comparison is the difference between the permitted and actual flows for municipal dischargers. In this case, the actual flows are 70% of the permitted flows.

Thirty-two of the municipal facilities in the basin have pretreatment programs that serve 258 industrial users (Table 3.4). Under these pretreatment programs, regulated industries that discharge their wastes to the municipal plants are required to pretreat their wastes. This is done in order to minimize potential toxicity problems both at the plant in the receiving waters into which the municipality discharges. See Section 5.2.6 in Chapter 5 for more information on pretreatment.

Table 3.1 Summary of Major/Minor Dischargers and Permitted and Actual Flows by Subbasin

CATEGORIES	SUBBASINS									TOTALS
	30	31	32	33	34	35	36	37	38	
Total Facilities	53	53	107	31	152	57	39	42	11	545
Total w/o Stmwtr & Gen Permits	35	20	58	11	48	28	22	23	9	254
Total Permitted Flow (MGD)	10.59	19.89	14.10	7.78	79.81	22.30	26.66	18.35	3.46	202.96
# of Facilities Reporting	29	19	49	8	41	23	19	16	6	210
Total Avg. Flow 1993 (MGD)	6.98	17.84	161.96	51.08	65.07	13.40	244.45	12.00	0.24	573.01
Major Dischargers	3	4	7	3	6	6	5	5	0	39
Total Permitted Flow (MGD)	6.20	19.58	8.24	7.00	78.57	21.00	23.30	17.62	0.00	181.50
# of Facilities Reporting	3	4	7	3	5	6	5	5	0	38
Total Avg. Flow 1993 (MGD)	4.07	17.05	156.70	51.04	59.21	12.39	242.21	11.15	0.00	553.83
Minor Dischargers	50	49	100	28	146	51	34	37	11	506
Total Permitted Flow (MGD)	4.39	0.26	5.87	0.78	1.24	1.30	3.36	0.73	3.46	21.41
# of Facilities Reporting	26	15	42	5	36	17	14	11	6	172
Total Avg. Flow 1993 (MGD)	2.90	0.78	5.26	0.04	5.86	1.01	2.24	0.85	0.24	19.18
100% Domestic Wastewater	24	18	41	11	27	13	5	16	10	165
Total Permitted Flow (MGD)	0.81	0.19	1.44	0.59	1.09	0.36	0.11	0.33	3.46	8.39
# of Facilities Reporting	17	12	27	3	16	8	2	8	6	99
Total Avg. Flow 1993 (MGD)	0.23	0.06	0.16	0.01	0.17	0.04	0.04	0.05	0.24	1.02
Municipal Facilities	3	4	11	2	4	11	7	3	0	45
Total Permitted Flow (MGD)	4.10	19.64	11.22	7.00	74.67	20.83	9.80	16.50	0.00	163.76
# of Facilities Reporting	4	4	11	2	4	10	7	3	0	45
Total Avg. Flow 1993 (MGD)	2.91	13.48	6.20	4.74	57.79	12.24	6.07	10.46	0.00	113.88
Major Process Industrial	2	1	5	0	1	1	3	2	0	15
Total Permitted Flow (MGD)	3.20	0.00	1.04	0.00	3.90	1.00	15.30	1.12	0.00	25.55
# of Facilities Reporting	2	1	5	0	1	1	4	2	0	16
Total Avg. Flow 1993 (MGD)	1.70	3.62	152.45	0.00	1.42	0.74	237.00	0.69	0.00	397.62
Minor Process Industrial	5	3	4	3	24	3	4	3	0	49
Total Permitted Flow (MGD)	3.26	0.01	0.40	0.19	0.15	0.01	0.04	0.33	0.00	4.38
# of Facilities Reporting	3	1	4	2	19	2	4	3	0	38
Total Avg. Flow 1993 (MGD)	0.11	0.01	2.39	0.03	5.45	0.08	0.87	0.79	0.00	9.72
Nonprocess Industrial	8	11	10	6	19	11	11	9	0	85
Total Permitted Flow (MGD)	2.43	0.00	0.00	0.00	0.00	0.11	1.41	0.07	0.00	4.02
# of Facilities Reporting	3	1	2	1	1	2	2	0	0	12
Total Avg. Flow 1993 (MGD)	2.03	0.68	0.50	46.30	0.24	0.31	0.47	0.00	0.00	50.51
Stormwater Facilities	8	16	34	9	77	18	9	9	1	181
Total Avg. Flow 1993 (MGD)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Table 3.2 Summary of NPDES Discharge Permits in the Catawba Basin

Permit Category	No. of Facilities	% of Facilities	Permitted Flow (MGD)	Average 1993 Flow (MGD)	% of Permitted Flow
Total NPDES	545	100.0	202.96	573.01	282.3
Majors	39	7.2	181.50	553.83	305.1
Minors	506	92.8	21.41	19.18	89.6
Nonprocess	85	15.6	4.02	50.51	1,255.2
Domestic	165	30.3	8.39	1.02	12.1
Municipal	45	8.3	163.76	113.88	69.5
Major Process Industrial	15	2.8	25.55	397.62	1,556.1
Minor Process Industrial	49	9.0	4.38	9.72	221.9
Stormwater	181	33.2	0	0	0.0

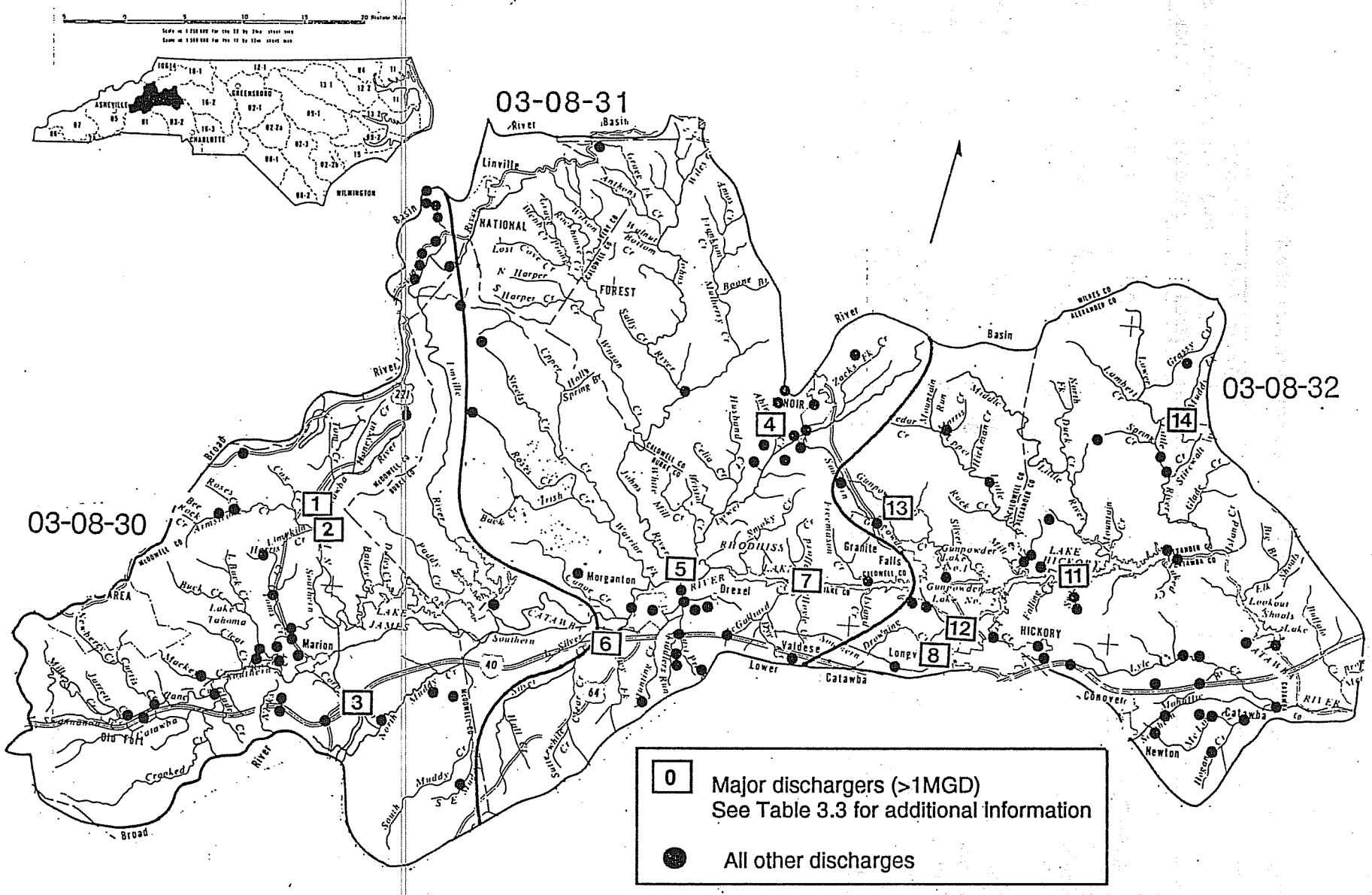


Figure 3.5a Distribution Map of Dischargers in the Upper Catawba River Basin

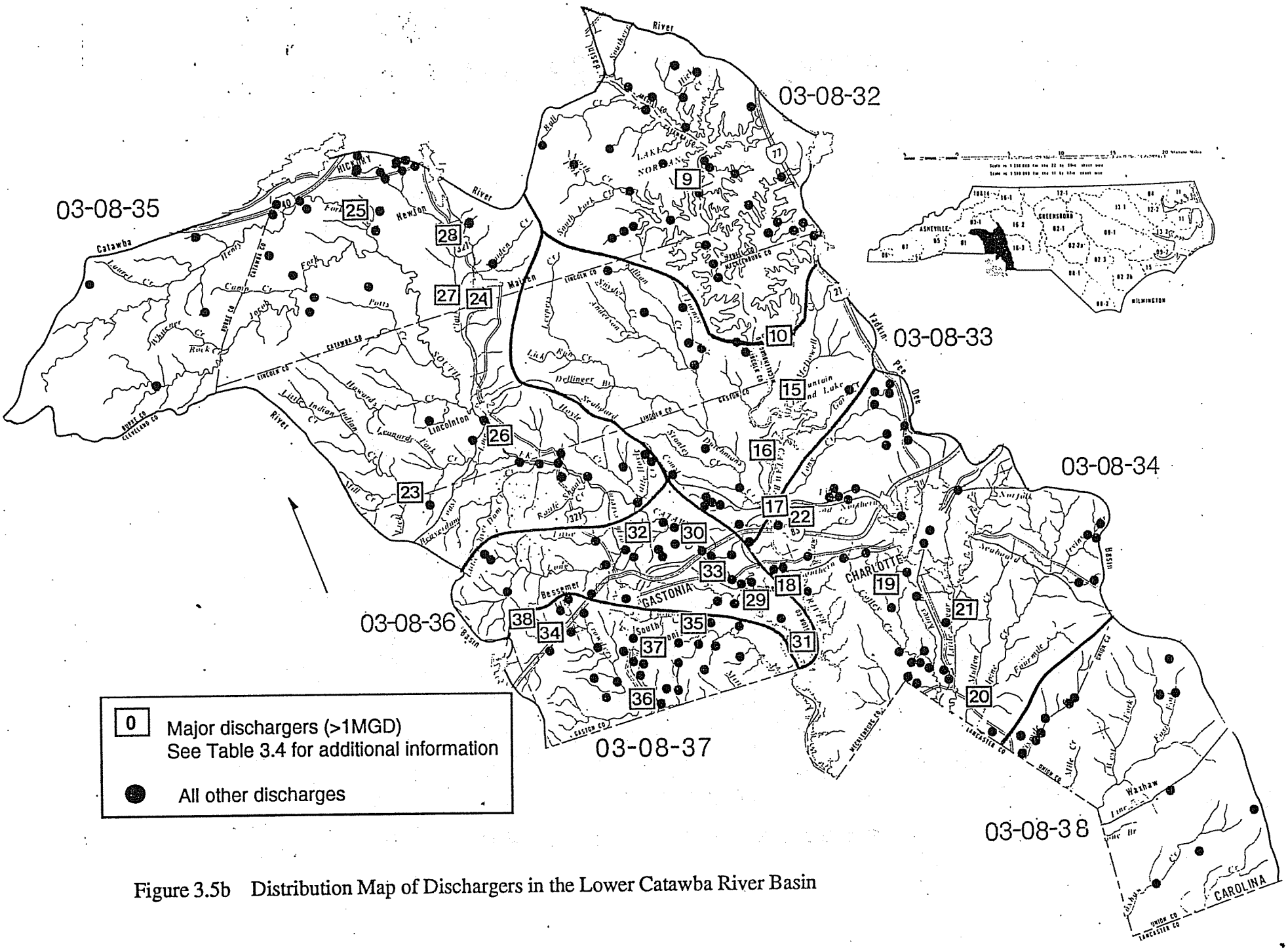


Figure 3.5b Distribution Map of Dischargers in the Lower Catawba River Basin

Table 3.3 Major NPDES Discharges in the Catawba River Basin

Map#	Name	NPDES No.	Subbasin	Type	Permitted Flow (MGD)
1	BAXTER HEALTHCARE CORP.	NC0006564	30	NON-MUNIC.	1.20
2	COATS AMERICAN INC.	NC0004243	30	NON-MUNIC.	2.00
3	MARION CORPENING CREEK WWTP	NC0031879	30	MUNICIPAL	3.00
4	LENOIR (LOWER CREEK WWTP)	NC0023981	31	MUNICIPAL	4.08
5	MORGANTON WWTP, CITY OF	NC0026573	31	MUNICIPAL	8.00
6	SIGRI GREAT LAKES CARBON CORP.	NC0005258	31	NON-MUNIC.	0.00
7	VALDESE, TOWN-LK RHODHISS WWTP	NC0041696	31	MUNICIPAL	7.50
8	ARLENE HOSIERY MILL, INC.	NC0007927	32	NON-MUNIC.	0.01
9	DUKE POWER CO., MARSHALL S.E.	NC0004987	32	NON-MUNIC.	0.00
10	DUKE POWER CO., MCGUIRE S.E.	NC0024392	32	NON-MUNIC.	0.00
11	HICKORY NORTHEAST WWTP	NC0020401	32	MUNICIPAL	6.00
12	HUFFMAN FINISHING COMPANY	NC0025135	32	NON-MUNIC.	0.25
13	LENOIR-GUNPOWDER CRK WWTP	NC0023736	32	MUNICIPAL	1.20
14	SCHNEIDER MILLS INC.	NC0034860	32	NON-MUNIC.	0.78
15	CMUD-MCDOWELL CREEK WWTP	NC0036277	33	MUNICIPAL	3.00
16	DUKE POWER CO., RIVERBEND S.E.	NC0004961	33	NON-MUNIC.	0.00
17	MOUNT HOLLY WWTP, CITY OF	NC0021156	33	MUNICIPAL	4.00
18	BELMONT, CITY OF WWTP	NC0021181	34	MUNICIPAL	5.00
19	CMUD-IRWIN CREEK	NC0024945	34	MUNICIPAL	15.00
20	CMUD-MCALPINE	NC0024970	34	MUNICIPAL	40.00
21	CMUD-SUGAR CREEK WWTP	NC0024937	34	MUNICIPAL	14.67
22	SANDOZ CHEMICALS CORPORATION	NC0004375	34	NON-MUNIC.	3.90
23	CHERRYVILLE WWTP, TOWN OF	NC0044440	35	MUNICIPAL	2.00
24	DELTA MILLS, INC.	NC0006190	35	NON-MUNIC.	1.00
25	HICKORY WWTP, CITY OF	NC0040797	35	MUNICIPAL	6.00
26	LINCOLNTON WWTP, TOWN OF	NC0025496	35	MUNICIPAL	6.00
27	MAIDEN WWTP, TOWN OF	NC0039594	35	MUNICIPAL	1.00
28	NEWTON (TOWN OF)-CLARK CREEK	NC0036196	35	MUNICIPAL	5.00
29	CRAMERTON AUTOMOTIVE PRODUCTS	NC0006033	36	NON-MUNIC.	4.00
30	CROMPTON & KNOWLES CORP-LOWELL	NC0005274	36	NON-MUNIC.	0.30
31	DUKE POWER CO., ALLEN S.E.	NC0004979	36	NON-MUNIC.	10.00
32	GASTONIA LONG CREEK WWTP	NC0020184	36	MUNICIPAL	8.00
33	PHARR YARNS INDUSTRIAL WWTP	NC0004812	36	NON-MUNIC.	1.00
34	BESSEMER CITY WWTP, TOWN OF	NC0020826	37	MUNICIPAL	1.50
35	GASTONIA CATAWBA CREEK WWTP	NC0020192	37	MUNICIPAL	9.00
36	GASTONIA-CROWDERS CREEK WWTP	NC0074268	37	MUNICIPAL	6.00
37	HOMELITE - TEXTRON	NC0005231	37	NON-MUNIC.	0.50
38	LITHIUM CORPORATION - CHEMICAL	NC0005177	37	NON-MUNIC.	0.62

Table 3.4 NPDES Facilities with a Pretreatment Program and their Significant Industrial Users

basin	Facility Name	NPDES OR ND Num	WWTP SIUs	REGION
30830	MARION (CORPENING CK)	NC0031879	4	ARO
	OLD FORT	NC0021229	5	ARO
			9	
30831	LENOIR (LOWER CK)	NC0023981	9	ARO
	MORGANTON	NC0026573	7	ARO
	VALDESE	NC0041696	11	ARO
			27	
30832	CLAREMONT (NORTH)	NC0032662	0	MRO
	CLAREMONT (SOUTH)	NC0026549	0	MRO
	CONOVER (NORTHEAST)	NC0024252	1	MRO
	CONOVER - SE	NC0024279	1	MRO
	HICKORY NE	NC0020401	7	MRO
	LENOIR (GUNPOWDER CK)	NC0023736	0	ARO
	TROUTMAN	NC0026832	0	MRO
			9	
30833	CMUD (MCDOWELL CK)	NC0036277	4	MRO
	MOUNT HOLLY	NC0021156	7	MRO
			11	
30834	BELMONT	NC0021181	5	MRO
	CMUD (IRWIN CK)	NC0024945	44	MRO
	CMUD (MCALPINE)	NC0024970	40	MRO
	CMUD (SUGAR CK)	NC0024937	34	MRO
			123	
30835	CHERRYVILLE	NC0044440	2	MRO
	CONOVER (SOUTHWEST)	NC0024261	0	MRO
	HICKORY - HENRY FK.	NC0040797	17	MRO
	LINCOLN COUNTY (HOYLE CK)	NC0041815	1	MRO
	LINCOLNTON	NC0025496	11	MRO
	MAIDEN	NC0039594	1	MRO
	NEWTON (CLARK CK)	NC0036196	13	MRO
	STANLEY	NC0020036	1	MRO
			46	
30836	GASTONIA (CROWDERS)	NC0074268	5	MRO
	GASTONIA (LONG)	NC0020184	12	MRO
	RANLO	NC0021318	1	MRO
			18	
30837	BESSEMER CITY	NC0020826	4	MRO
	GASTONIA (CATAWBA)	NC0020192	7	MRO
	KING'S MOUNTAIN (MCGILL CK)	NC0020745	4	MRO
			15	

ARO: Asheville Regional Office, MRO: Mooresville Regional Office

3.4 NONPOINT SOURCES OF POLLUTION

Nonpoint source (NPS) refers to runoff that enters surface waters through stormwater or snowmelt. There are many types of land use activities that can serve as sources of nonpoint source pollution including land development, construction, crop production, animal feeding lots, failing septic systems, landfills, roads and parking lots. As noted above, stormwater from large urban areas (>100,000 people) and from certain industrial sites is technically considered a point source since NPDES permits are required for piped discharges of stormwater from these areas. However, a discussion of urban runoff will be included in this section.

Sediment and nutrients are major pollution-causing substances associated with nonpoint source pollution. Others include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters. Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur at random intervals depending on rainfall events. Below is a brief description of major areas of nonpoint sources of concern in the Catawba Basin.

3.4.1 Agriculture

There are a number of activities associated with agriculture that may serve as sources of water pollution. Land clearing and plowing render soils susceptible to erosion which in turn can cause stream sedimentation. Pesticides and fertilizers (including chemical fertilizers and animal wastes) can be washed from fields or improperly designed storage or disposal sites. Concentrated animal feed lot operations can be a significant source of both BOD and nutrients. The untreated discharge from a large operation would be comparable to the nutrient load in the discharge from a secondary waste treatment plant serving a small town. Animal wastes can also be a source of bacterial contamination of surface waters. Construction of drainage ditches on poorly drained soils enhances the movement of stormwater into surface waters.

In the Catawba Basin, 245 (or 50%) of the miles of freshwater streams estimated to be impaired from nonpoint sources of pollution are attributed to agriculture. The highest number of impaired stream miles in any subbasin attributed to agriculture is 74 miles in subbasin 35 (upper South Fork Catawba). In other subbasins, the number of stream miles estimated to be impaired by agriculture ranges from 10 miles in subbasin 37 (Crowders Creek watershed in Gaston County) to 63 miles in subbasin 32 (mid Catawba basin). This information is derived from the table in Section 4.5 of Chapter 4 entitled Probable Sources of Use Support Impairment. The prime cause of freshwater stream impairment associated with agriculture is sedimentation.

Another important water quality concern associated with agriculture in the Catawba basin is nutrient runoff. Nutrient-related problems are not always evident in the receiving stream adjoining a farm but may manifest themselves in a downstream impoundment, sluggish creek or estuary many miles away. Chapter 5 discusses agricultural nonpoint source control programs. Recommended management strategies for reducing nutrients and sediment runoff are found in Sections 6.4 and 6.6 respectively, in Chapter 6.

3.4.2 Urban

Runoff from urbanized areas, as a rule, is more localized but generally more severe than agricultural runoff. The rate and volume of runoff in urban areas is much greater due both to the high concentration of impervious surface areas and to storm drainage systems that rapidly transport stormwater to nearby surface waters. These drainage systems, including curb and guttered roadways, also allow urban pollutants to reach surface waters quickly and with little or no filtering. These pollutants include lawn care products such as pesticides and fertilizers; automobile-related pollutants such as fuel, lubricants, abraded tire and brake linings; lawn and household wastes

(often dumped in storm sewers); and fecal coliform bacteria (from animals and failing septic systems). Many urban streams are rated as biologically poor. The population density map in Chapter 2 is a good indicator of where urban development and potential urban stream impacts are likely to occur. Based on Table 4.5 in Chapter 4, there are 111 miles of streams that are impaired due to urban runoff.

3.4.3 Construction

Construction activities that entail excavation, grading or filling, such as road construction or land clearing for development, can produce large amounts of sediment if not properly controlled. As a pollution source, construction activities are temporary in nature but the impacts, discussed under the section on sediment, above, can be long lasting.

Construction activity tends to be concentrated in the more rapidly developing areas of the basin such as subbasins 32 through 35 and 38. However, road construction is widespread and often involves stream crossings in remote or undeveloped areas of the basin. In addition, resort development in relatively undeveloped areas can be devastating to previously unimpacted streams. Based on Table 4.5 in Chapter 4, there are 137 miles of streams impaired due to construction activity.

3.4.4 Forestry

Forestry, a major industry in North Carolina, can impact water quality in a number of ways. Ditching and draining of naturally forested low-lying lands in order to create pine or hardwood plantations can change the hydrology of an area and significantly increase the rate and flow of stormwater runoff. Clearing of trees through timber harvesting and construction of logging roads can produce sedimentation. Removing riparian vegetation along stream banks can cause water temperature to rise substantially, and improperly applied pesticides can result in toxicity problems. Timber harvesting occurs throughout much of the upper basin and is often done at the onset of clearing for site development. Based on Table 4.5 in Chapter 4, there are 34 miles of streams impaired due to forestry activities.

3.4.5 Mining

Mining is a common activity in the Piedmont and Mountain regions and can produce high localized levels of stream sedimentation. Sediment may be washed from mining sites or it may enter streams from the wash water used to rinse some mined products. In addition, abandoned gold mined lands are suspected of being the sources of mercury in stream waters because of its historic use for the amalgamation of gold. The most prevalent type of mining activity in the Catawba River basin is for sand and gravel. Fourteen miles of streams have been impaired by mining activities in subbasin 38 (Waxhaw Creek subbasin) according to Table 4.5 in Chapter 4.

3.4.6 Onsite Wastewater Disposal

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. These systems can provide safe and adequate treatment of wastewater; however, improperly placed, constructed or maintained septic systems can serve as a significant source of pathogenic bacteria and nutrients. These pollutants may enter surface waters both through or over the soil. They may also be discharged directly to surface waters through *straight pipes* (i.e., direct pipe connections between the septic system and surface waters). These types of discharges, if unable to be eliminated, must be permitted under the NPDES program and be capable of meeting effluent limitations specified to protect the receiving stream water quality which includes a requirement for disinfection.

Onsite wastewater disposal is most prevalent in rural portions of the basin and at the fringes of urban areas. Nutrients from failing septic systems also contribute to eutrophication problems in some impoundments and coastal waters.

3.4.7 Solid Waste Disposal

Solid wastes may include household wastes, commercial or industrial wastes, refuse or demolition waste, infectious wastes or hazardous wastes. Improper disposal of these types of wastes can serve as a source of a wide array of pollutants. The major water quality concern associated with modern solid waste facilities is controlling the leachate and stabilizing the soils used for covering many disposal facilities. Properly designed, constructed and operated facilities should not significantly effect water quality.

REFERENCES CITED - CHAPTER 3

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Walker, W.W., Jr. 1985. "Empirical Methods for Predicting Eutrophication in Impoundments, Report 4, Phase III: Applications Manual." Technical Report E-18-9, Prepared by William W. Walker, Jr., Environmental Engineer, Concord, Massachusetts for the U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

CHAPTER 4

WATER QUALITY IN THE CATAWBA RIVER BASIN

4.1 INTRODUCTION

This chapter provides a detailed overview of water quality and use support ratings in the Catawba River Basin.

Water Quality Monitoring and Assessment

- **Section 4.2** presents a summary of water quality monitoring programs conducted by the Environmental Sciences Branch of the Division of Environmental Management's (DEM's) Water Quality Section including consideration of information reported by researchers and other agencies within the Catawba River Basin. Seven monitoring programs are described.
- **Section 4.3** summarizes water quality based on analyses of chemical water quality data from ambient monitoring stations along the mainstem of the river and tributary stations.
- **Section 4.4** presents a narrative summary of water quality findings for each of the nine subbasins based on all of the monitoring approaches described in Section 4.2 Also included are subbasin maps which show the locations of monitoring sites.

Use-Support Ratings

- **Section 4.5** provides a brief introduction to the use-support concept. Using this approach, water quality for specific surface waters in the basin is assigned one of four ratings: fully supporting, fully supporting but threatened, partially supporting or not supporting uses. A detailed description of the methodology for developing use-support ratings is presented in Appendix III.
- **Section 4.6** presents the use support ratings for most of streams and lakes in the Catawba basin through a series of tables and figures along with a color-coded use support map of the basin.

4.2 WATER QUALITY MONITORING PROGRAMS

DEM's monitoring program integrates biological, chemical, and physical data assessment to provide information for basinwide planning. Below is a list of the seven major monitoring programs, each of which is briefly described in the following text.

- Benthic macroinvertebrate monitoring (Section 4.2.2 and Appendix II),
- Fish population and tissue monitoring(Section 4.2.3 and Appendix II),
- Lakes assessment (including phytoplankton monitoring) (Section 4.2.4 and Appendix II),
- Aquatic toxicity monitoring (Section 4.2.5),
- Special chemical/physical water quality investigations (Section 4.2.6),
- Sediment oxygen demand monitoring (Section 4.2.7), and
- Ambient water quality monitoring (covering the period 1988-1992) (Section 4.2.8).

4.2.1 Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven

to be a reliable water quality indicator, as these organisms are relatively immobile and sensitive to subtle changes in water quality. Since many organisms in a community have life cycles of six months to one year, the effects of short term pollution (such as an oil or chemical spill) will generally not be overcome until the following generation appears. The benthic community also responds to and shows the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign five bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the pollution-intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPTs). Likewise, ratings can be assigned with a Biotic Index (Appendix II). This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification. Higher taxa richness values are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is poorly assessed by a taxa richness analysis. Different criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina.

4.2.2 Fisheries Monitoring

To the public, the condition of the fishery is one of the most meaningful indicators of ecological integrity. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web will affect the abundance, species composition, and condition of the fish population. Two types of fisheries monitoring are conducted by DEM and described briefly below. The first involves assessing the overall health of the fish community. This information can be used as an indicator of the quality of the water the fish inhabit. The second involves analyzing fish tissues to determine whether they are accumulating chemicals. This information is also useful as an indicator of water quality and can be used to determine whether human consumption of these fish poses a potential health risk.

Fish Community Assessment

The North Carolina Index of Biotic Integrity (NCIBI) is a modification of Karr's IBI (1981) which was developed as a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The index incorporates information about species richness and composition, trophic composition, fish abundance and fish condition. At this time there is no Index of Biotic Integrity calculated for fish populations in lakes.

The NCIBI summarizes the effects of all classes of factors influencing aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While any change in a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicates additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

Fish Tissue Analysis

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Therefore, by analyzing fish tissue, determinations about what chemicals are in the water can be made. Contamination of aquatic resources, including freshwater, estuarine, and marine fish and shellfish species has been documented for heavy metals, pesticides, and other complex organic compounds. Once these contaminants reach surface waters, they may be available for bioaccumulation either directly or through aquatic food webs and may accumulate in fish and shellfish tissues. Thus results from fish tissue monitoring can serve as an

important indicator of further contamination of sediments and surface water. Fish tissue analysis results are also used as indicators for human health concerns, fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem.

In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with Federal Food and Drug Administration (FDA) action levels and U.S. Environmental Protection Agency (EPA) recommended screening values for contaminants.

The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue parameters accompanied by their FDA criteria are presented in Appendix II. At present, the FDA has only developed metals criteria for mercury. Individual parameters which appear to be of potential human health concern are evaluated by the N.C. Division of Epidemiology by request of the Water Quality Section.

4.2.3 Lakes Assessment Program (including Phytoplankton)

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lakes Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed. Data are used to determine the trophic state of each lake; a relative measure of nutrient enrichment and productivity, and whether the designated uses of the lake have been threatened or impaired by pollution.

Phytoplankton and Algal Bloom Program

Phytoplankton are microscopic algae found in the water column of lakes, rivers, streams, and estuaries. Phytoplankton populations respond to nutrient availability and other environmental factors such as light, temperature, pH, salinity, water velocity, and grazing by organisms in higher trophic levels. These algae may be useful as indicators of eutrophication and are often collected with ambient water quality samples from lakes. Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of algae may discolor the water or form visible mats on top of the water. Blooms may be unsightly and deleterious to water quality causing fish kills, anoxia, or taste and odor problems. The Algal Bloom Program was initiated in 1984 to document suspected algal blooms with quantitative biovolume and density estimates. Usually, an algal sample with a biovolume larger than 5000 mm^3/m^3, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 µg/l (the North Carolina state standard) constitutes a bloom. These values are referred to as bloom threshold values. Bloom samples are collected often as a result of complaint investigations, fish kills, or during routine monitoring if a bloom is detected.

Algal Growth Potential Tests

Three of the 11 lakes sampled in the Catawba River Basin have historical data for Algal Growth Potential Tests (AGPT). These are Lake Hickory, Lake Wylie and Lake Rhodhiss. The objective of the AGPT is to assess a waterbody's potential for supporting algal biomass and to determine whether algal growth is limited by nitrogen, by phosphorus, or co-limited by both nutrients. When AGPT control growth rates are $\geq$ 5.0 mg/l, sufficient quantities of biologically available algal growth limiting constituents are present to support algal growth in excess of levels equivalent to 57 µg/l chlorophyll *a* (Raschke, 1989). A waterbody may be protected from nuisance algal blooms if an AGPT value is consistently less than 5 mg/l.

Duke Power Company Lakes Data

In addition to the monitoring efforts of the Division of Environmental Management, Duke Power Company has maintained surveillance of the eleven-impoundment, Catawba River system since 1959. The initial monitoring program included monthly temperature and dissolved oxygen from Lake Wateree in South Carolina to Lake James near the River's headwaters. Data collection was expanded in 1974 to include routine measurements of twenty-four physico-chemical variables at least semiannually. Duke Power's long term program on all the Catawba lakes has been designed to monitor changes in the main channel as well as immediately downstream of the hydroelectric facilities. Lake Norman, Mountain Island Lake, and Lake Wylie, comprising the most extensively developed sources of hydroelectric power on the Catawba River, have been monitored more intensively to address environmental commitments associated with steam generating activities. In addition to physico-chemical measurements, these lakes have also been monitored intensively for plankton, benthos, and fish populations. Duke Power has conducted many site specific environmental programs, but the present program on all of the Catawba Lakes includes a continuation of the historical semiannual data as well as quarterly forebay sampling to address trophic indices. Duke Power is presently conducting water quality monitoring on the following lakes in the Catawba River Basin:

Lake	Number of Sites	
Lake James:	7	
Lake Rhodhiss:	4	
Lake Hickory:	3	
Lookout Shoals:	2	
Lake Norman:	12	
Mt. Island Lake:	9	
Lake Wylie:	5	(in N.C., including South Fork Catawba River)

Specific water quality information collected by Duke Power on the Catawba River lakes can obtained by calling: **Chris Sekerak** (875-5303), **Ron Santini** (875-5229) or **Jon Knight** (875-54I7).

4.2.4 Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. Other facilities may be tested by DEM's Aquatic Toxicology Laboratory. The Aquatic Toxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update of this information to regional offices and DEM administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

4.2.5 Chemical/Physical Characterizations

Water quality simulation models are often used for the purpose of constructing wasteload allocations. These models must adequately predict water body responses to different waste loads so that appropriate effluent limits can be included as requirements in National Pollutant Discharge Elimination System (NPDES) permits. Where large financial expenditures or the protection of water quality is at risk, models should be calibrated and verified with actual in-stream field data. Because sufficient historical data are often lacking, intensive water quality surveys are required to provide the field data necessary to accomplish model calibration and verification. Intensive water quality surveys are performed on water bodies below existing or proposed wastewater dischargers and usually consist of a time-of-travel dye study, flow measurements, physical and chemical

samples, long-term biochemical oxygen demand (BOD_{lt}) analysis, water body channel geometry, and effluent characterization analysis.

4.2.6 Sediment Oxygen Demand

If oxygen depletion is suspected due to the characteristics of benthic sediments then sediment oxygen demand (SOD) studies may be performed. Each stream reach is divided into a series of model segments. The number of stream segments that must be evaluated with an intensive survey depends on the individual study and the spatial resolution desired. Intensive surveys and SOD evaluations are reported as a series of field data tables and summaries of laboratory analysis reports. For the purposes of this report, intensive surveys and SOD studies that have been performed within each subbasin will be listed in table format accompanied by a brief summary of surveys that have been performed within the last five years.

4.2.7 Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine (saltwater) water quality monitoring stations (about 380 statewide) strategically located for the collection of physical and chemical water quality data. The type of water quality data, or parameters, that are collected is determined by the waterbody's freshwater or saltwater classification and corresponding water quality standards. Table 4.1 summarizes the types of water quality data collection conducted at ambient stations. AMS data for the Catawba Basin are summarized Section 4.3. The presentation of data involves the use of graphs that utilize box and whisker plots. Box and whisker plots are explained in Figure 4.1.

Table 4.1. Ambient Monitoring System Parameters

<u>C and SC WATERS</u> (minimum monthly coverage for all stream stations)

- dissolved oxygen,
- pH,
- conductivity,
- temperature,
- salinity (SC),
- secchi disk (where appropriate),
- nutrients: total phosphorus, ammonia, total Kjeldahl nitrogen, nitrate+nitrite,
- total suspended solids,
- turbidity,
- hardness,
- fecal coliforms,
- metals: aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, zinc

<u>NUTRIENT-SENSITIVE WATERS</u>

- Chlorophyll *a* (where appropriate)

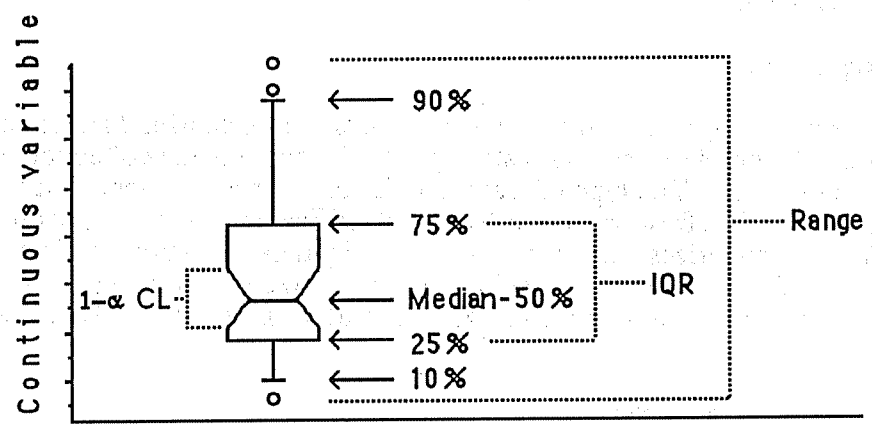
<u>WATER SUPPLY</u>

- chloride,
- total coliforms,
- manganese,
- total dissolved solids

PLUS any additional parameters of concern for individual station locations

Box and Whisker Plots

Box and whisker plot are useful for comparing sets of data comprised of a single variable by the visualization of selected order statistics. After the data have been ordered from low to high, the 10th, 25th, 50th, 75th, and 90th percentiles are calculated for plot construction. Box and whisker plots display the following important information: 1) the interquartile range (IQR) which measures the distribution and variability of the bulk of the data (located between the 25th and 75th percentiles), 2) the desired confidence interval (1-a CL) for measuring the statistical significance of the median (50th percentile), 3) indication of skew from comparing the symmetry of the box above and below the median, 4) the range of the data from the lowest to highest values, and 5) the extreme values below the 10th percentile and above the 90th percentile (depicted as dots).



Visual comparison of confidence level notches about the medians of two or more boxplots can be used to roughly perform hypothesis testing. If the boxplots represent data from samples assumed to be independent, then overlapping notches indicate no significant difference in the samples at a prescribed level of confidence. Formal tests should subsequently be performed to verify preliminary conclusions based on visual inspection of the plots.

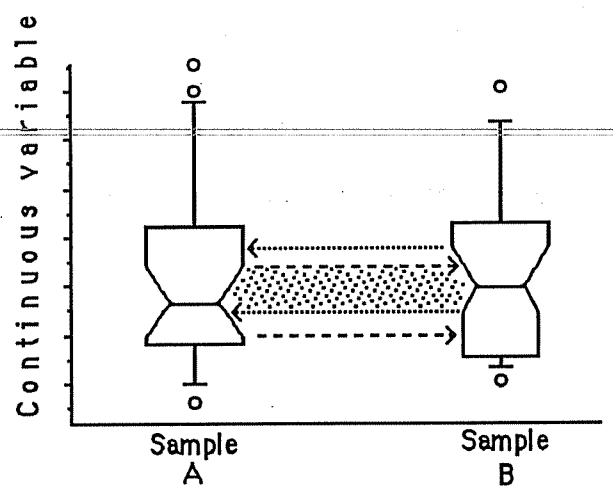


Figure 4.1 Explanation of Box and Whisker Plots

4.3 AMBIENT WATER QUALITY SUMMARY FOR THE CATAWBA RIVER MAINSTEM AND TRIBUTARY STATIONS.

AMS stations for the basin are listed in Table 4.2 below. The lower portion of the table are stations that were discontinued during this five-year basin period. The data for most of these stations stopped in 1991. There are a total of 39 stations within the basin and five discontinued stations. Of these stations, 11 are on the mainstem of the Catawba River and six are on the mainstem of the South Fork Catawba River (Figure 4.2).

Table 4.2 Ambient Monitoring System Stations within the Catawba River Basin.

STORET	1°Number	2° Number	Station Name	County	Subbasin
C0009000	**0213649985**	**CTB00M**	**CATAWBA RIVER AT SR 1273 NEAR OLD FORT, NC**	**McDowell**	**030830**
C0145000	**0213734850**	**CTB004D**	**CATAWBA RIVER AT SR 1240 NEAR GREENLEE, NC**	**McDowell**	**030830**
C0160000	**02137513**	**CTB005**	**CATAWBA RIVER AT I-40 NEAR OLD FORT, NC**	**McDowell**	**030830**
C0250000	**02137727**	**CTB008**	**CATAWBA RIVER AT SR 1221 NEAR PLEASANT GARDENS, NC**	**McDowell**	**030830**
C1210000	**02139036**	**CTB028A**	**CATAWBA RIVER AT SR 1147 NEAR GLEN ALPINE, NC**	**Burke**	**030830**
C2030000	**02141461**	**CTB040A**	**LAKE RHODHISS AT SR 1001 NEAR BATON, NC**	**Burke**	**030831**
C2600000	**02141840**	**CTB056A**	**LAKE HICKORY AT NC HWY 127 NEAR HICKORY, NC**	**Catawba**	**030832**
C3420000	**0214253319**	**CTB079A**	**CATAWBA RIVER AT SR 1004 NEAR MOORESVILLE, NC**	**Iredell**	**030832**
C3699000	**0214266050**	**CTB086B**	**MOUNTAIN ISLAND LAKE ABOVE GAR CREEK NEAR CROFT, NC**	**Gaston**	**030833**
C3900000	**02142808**	**CTB090**	**CATAWBA RIVER AT NC HWY 27 NEAR THRIFT, NC**	**Mecklenburg**	**030833**
C4220000	**02142938**	**CTB103**	**CATAWBA RIVER AT SOUTH BELMONT, NC**	**Mecklenburg**	**030834**
C7500000	**02145531**	**CTB178**	**LAKE WYLIE AT NC HWY 49 NEAR OAK GROVE, NC**	**Mecklenburg**	**030834**
C0550000	02138133	CTB013A	NORTH FORK CATAWBA RIVER AR SR 1552 NEAR HANKINS, NC	McDowell	030830
C1000000	02138500	CTB023A	LINVILLE RIVER AT NC HWY 126 NEAR NEBO, NC	Burke	030830
C1750000	02141245	CTB0341A	LOWER CREEK AT SR 1501 NEAR MORGANTON, NC	Burke	030831
C3860000	0214272204	CTB089A	DUTCHMAN'S CREEK AT SR 1918 AT MOUNTAIN ISLAND, NC	Gaston	030833
C1370000	02140304	CTB0311A	WILSON CREEK AT US HWY 221 NEAR GRAGG, NC	Avery	030831
C1385000	0214031250	CTB0314A	WILSON CREEK AT SR 1358 AT EDGEMONT, NC	Caldwell	030831
C2818000	02142000	CTB058J	LOWER LITTLE RIVER @ SR1313 NR ALL HEALING SPRINGS, NC	Alexander	030832
C4040000	02142900	CTB094	LONG CREEK AT SR 2042 NEAR PAW CREEK, NC	Mecklenburg	030834
C8896500	02146300	CTB202H	IRWIN CREEK AT IRWIN CREEK WWTP NEAR CHARLOTTE, NC	Mecklenburg	030834
C9050000	02146381	CTB208	SUGAR CREEK AT NC HWY 51 AT PINEVILLE, NC	Mecklenburg	030834
C9210000	02146530	CTB213D	LITTLE SUGAR CREEK @ NC HWY 51 @ PINEVILLE, NC	Mecklenburg	030834
C9370000	02146600	CTB219	MCALPINE CREEK AT SARDIS ROAD NEAR CHARLOTTE, NC	Mecklenburg	030834
C9680000	0214676115	CTB226H	MCALPINE CREEK AT SC SR 2964 NEAR CAMP COX, SC	SC-Lancaster	030834
C9790000	02146800	CTB230	SUGAR CREEK AT SC HWY 160 NEAR FORT MILL, SC	SC-Lancaster	030834
C9819500	02146900	CTB230D	TWELVE MILE CREEK AT NC HWY 16 NEAR WAXAHAW, NC	Union	030838
C9920000	02147126	CTB231B	WAXHAW CREEK AT SR 1103 NEAR JACKSON	Union	030838
C4300000	02143000	CTB107	HENRY FORK AT SR 1124 NEAR HENRY RIVER, NC	Catawba	030835
C4360000	02143027	CTB1110	HENRY FORK AT SR 1143 NEAR BROOKFORD, NC	Catawba	030835
C4370000	02143040	CTB1101A	JACOB FORK AT SR 1924 AT RAMSEY, NC	Burke	030835
C4380000	02143069	CTB110A	SOUTH FORK CATAWBA RIVER AT NC HWY 10 NR STARTOWN, NC	Catawba	030835
C6500000	02145112	CTB165	SOUTH FORK CATAWBA RIVER AT NC HWY 7 MCADENVILLE, NC	Gaston	030836
C7000000	02145442	CTB174	SOUTH FORK CATAWBA RIVER AT SR 2524 NR S BELMONT, NC	Gaston	030836
C4800000	02143260	CTB124	CLARK CREEK AT NORTH GROVE ST AT LINCOLNTON, NC	Lincoln	030835
C5170000	02143500	CTB131H	INDIAN CREEK AT SR 1252 NEAR LABORATORY, NC	Lincoln	030835
C5900000	02144000	CTB146	LONG CREEK AT SR 1456 NEAR BESSEMER CITY, NC	Gaston	030836
C7400000	02145524	CTB177	CATAWBA CREEK AT SR 2302 AT THE NC-SC STATE LINE	Gaston	030837
C8640000	02145633	CTB198	CROWDERS CREEK AT SR 2424 AT NC-SC LINE	Gaston	030837
C8660000	02145640	CTB198A	CROWDERS CREEK AT RIDGE ROAD NEAR BOWLING GREEN, SC	SC-York	030837
Stations discontinued within the five-year basin, cycle					
C1190000	0213875850		HIGH SHOALS CREEK AT DYSARTSVILLE	McDowell	030830
C1380000	0214042720		NORTH HARPER CREEK AT USFS #58 NEAR KAWANA	Avery	030831
C3500180	0214253830		NORWOOD CREEK AT SR 1328 NEAR EAST MONBO	Iredell	030832
C9638500	02146750		MCAPLINE CREEK BELOW MCCULLEN CREEK NR PINEVILLE	Mecklenburg	030834

For this review the stations are divided into the Catawba River Mainstem stations, Catawba River tributaries and the South Fork Catawba River Basin (subbasins 35, 36 and 37).

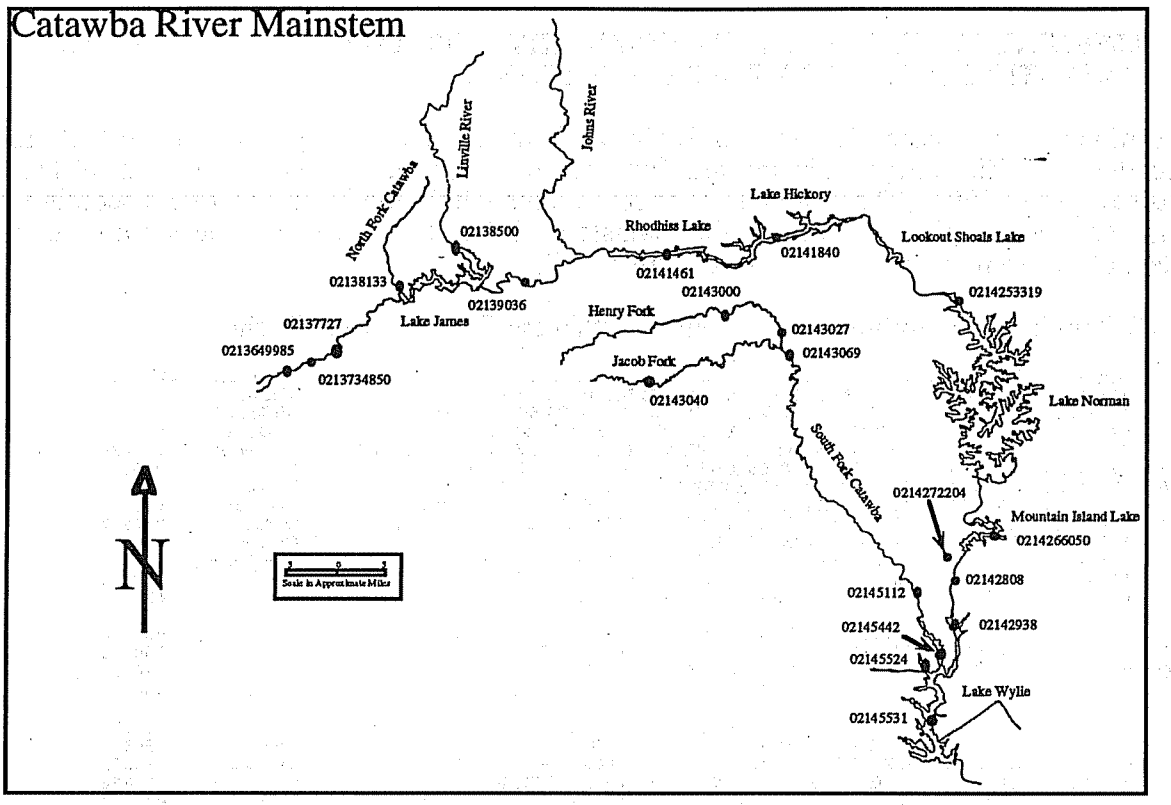


Figure 4.2 AMS Stations on the Catawba River Mainstem and Larger Tributaries.

4.3.1 Summary of AMS data for Catawba River Mainstem Stations

Adequate dissolved oxygen levels were found throughout the mainstem sites on the Catawba River. pH data were generally within DEM criteria with all median values between six and seven Standard Units. The lake stations were found to be more variable in pH with higher medians likely due to increased productivity at those locations. Nutrients in the mainstem are slightly higher entering the chain lakes, lower near Mountain Island Lake and higher again near the South Carolina border.

Long-term data were examined in response to water quality concerns in the Old Fort area upstream from Lake James (Stations 0213649985, 0213734850, 02137513, 02137727). In summer 1987, the low drops in dissolved oxygen during summer months of 1970, 1981, 1983 and 1986 were no longer found through the summer of 1993 (Figure 4.3). A notable decrease in total phosphorus can be seen in the long-term data during 1988 at the time of the Phosphate ban in the state (Figure 4.4). Metals data were examined and it was noted that copper levels were generally higher in the Old Fort area (02137513). Fecal coliform bacteria were at their consistently highest level near Old Fort. The median numbers at this station roughly coincided with the state standard of 200 MF/100 ml (figure 4.5)

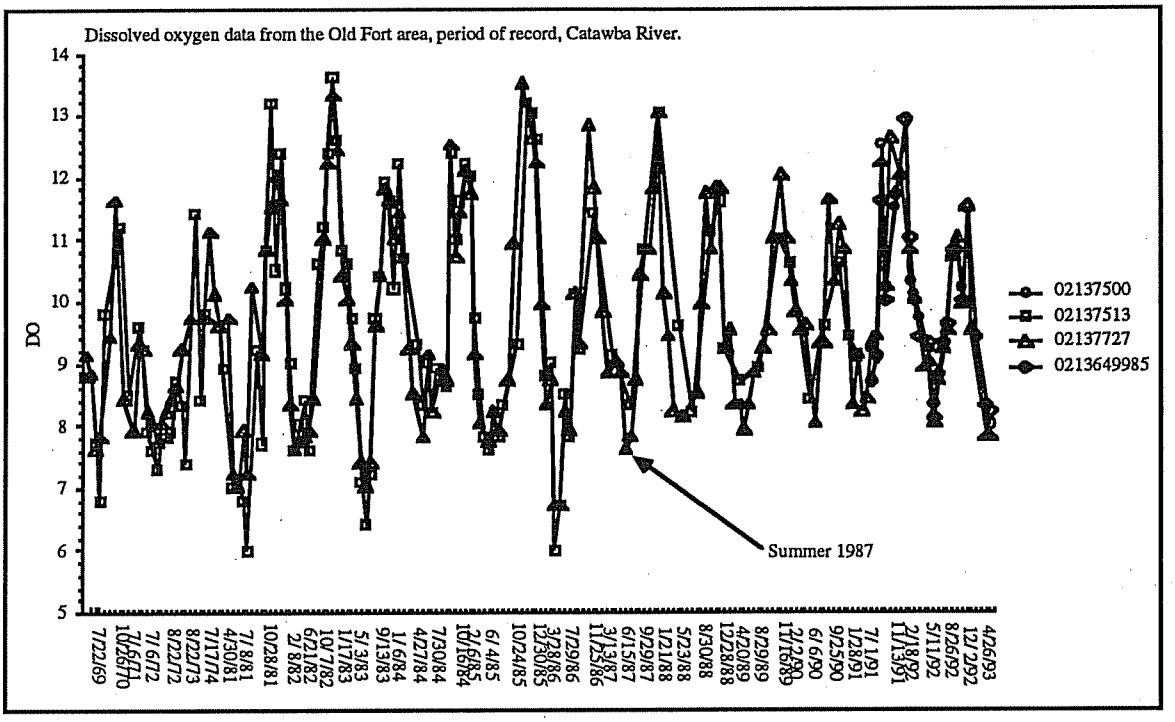


Figure 4.3 Dissolved Oxygen Data Trends in Catawba River from 4 AMS Stations near Old Fort

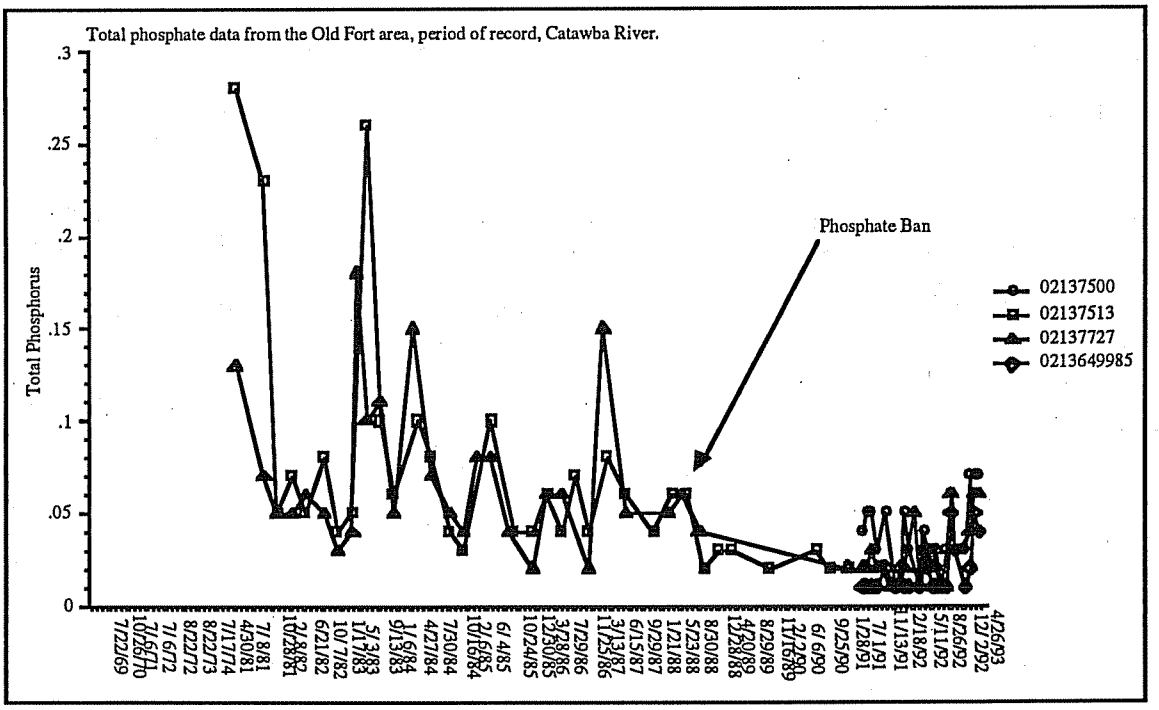


Figure 4.4 Total Phosphorus Trends in Catawba River from 4 AMS Stations near Old Fort

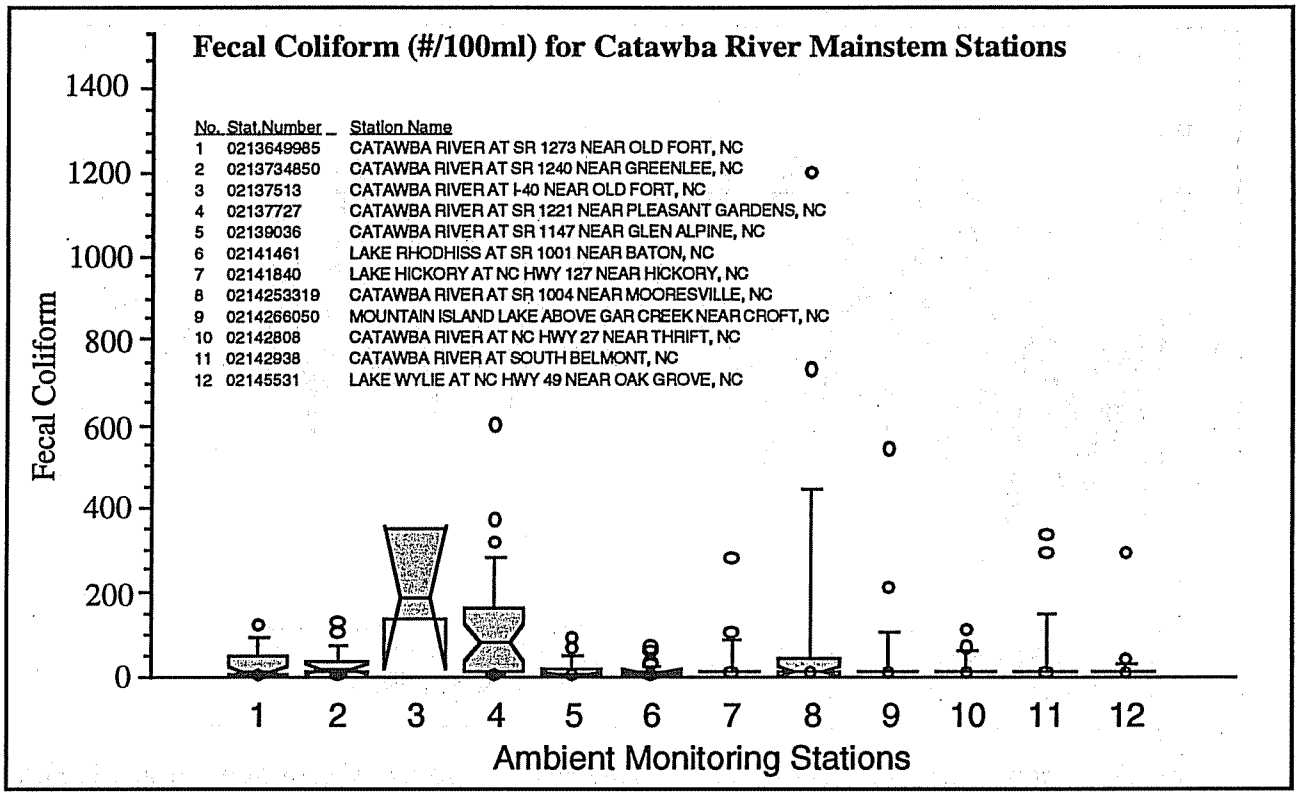


Figure 4.5 Fecal Coliforms at Catawba River Mainstem Stations

4.3.1 Summary of AMS data for Catawba River Tributary Stations

Adequate dissolved oxygen (DO) levels were found in the major tributaries of the Catawba River as in the mainstem (Linville River, North Fork Catawba, Lower Creek, Dutchman's Creek, and Catawba Creek). High pH samples were found in Catawba Creek and the North Fork Catawba station (not shown). Catawba Creek also had a high distribution of total phosphorus compared to the other major tributaries. Dutchman's Creek recorded two exceptionally high readings of total phosphorus. The nitrogen parameters show an elevated level at the Lower Creek and Catawba Creek stations. Metals data, in particular copper, are elevated in the lower tributaries (Dutchman's Creek and Catawba Creek).

AMS data for a number of the smaller tributaries are presented in the following figures. Dissolved oxygen in the smaller tributary stations tends to be lower in Sugar, Little Sugar and McAlpine Creeks (Charlotte area) (Figure 4.6). However, only a few samples were recorded below the DEM criterion. High pH levels were found in Irwin Creek (Figure 4.7). Low pH values were examined in more detail for the Wilson Creek stations (02140304 and 0214031250). The data show a slight increase in pH over the 1980's, although during the spring of 1990 and fall/winter of 1992 there were some precipitous drops in pH over several months Figure 4.7. The stations on tributaries in the upper subbasins (30 and 31) all recorded low pH distributions. Nutrient levels are elevated in all of the Charlotte-area Catawba River tributaries (Figures 4.8 - 4.10).

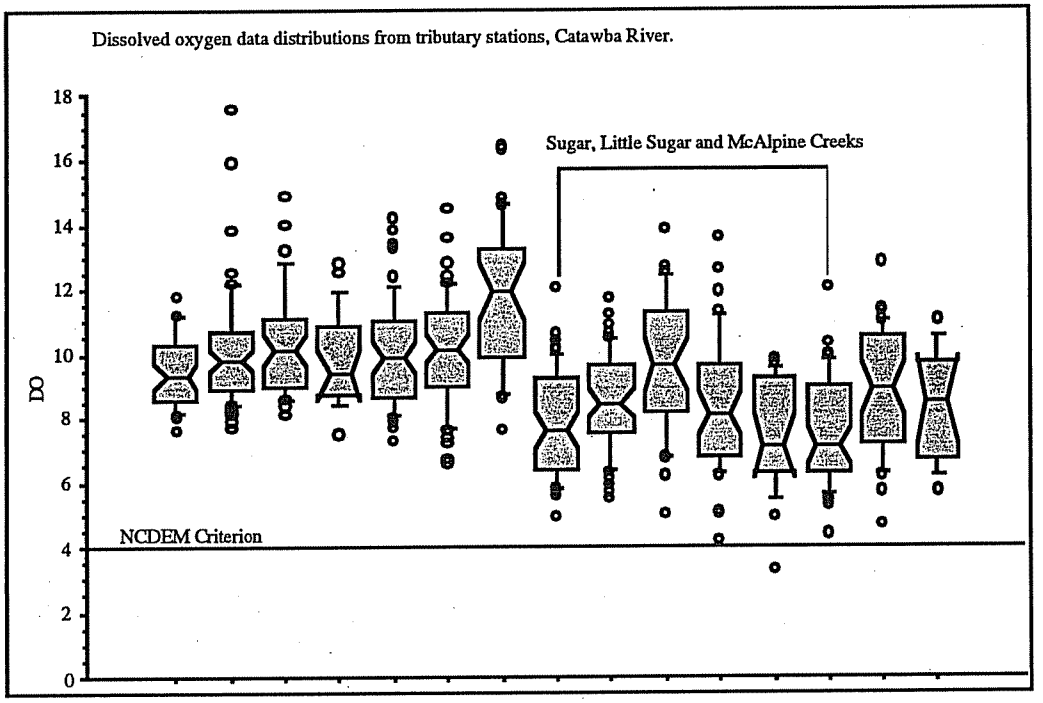


Figure 4.6 Dissolved Oxygen (mg/l) at Tributary AMS Stations of the Catawba River

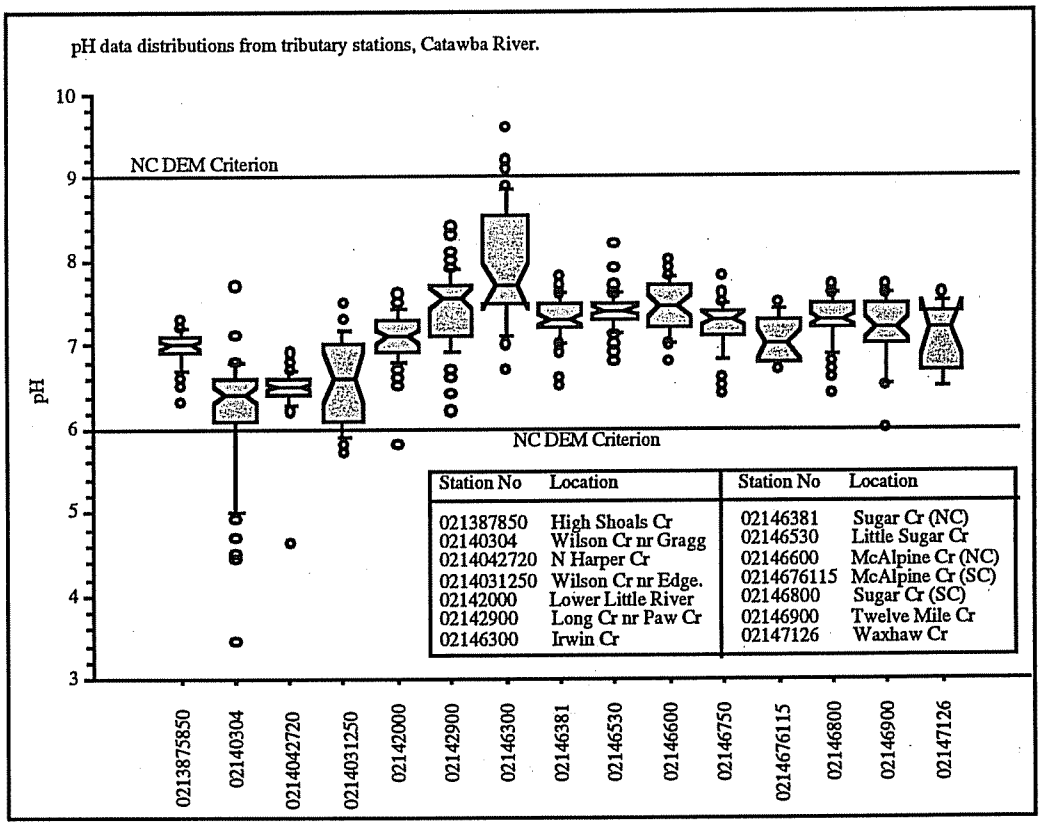


Figure 4.7 pH at Tributary AMS Stations of the Catawba River

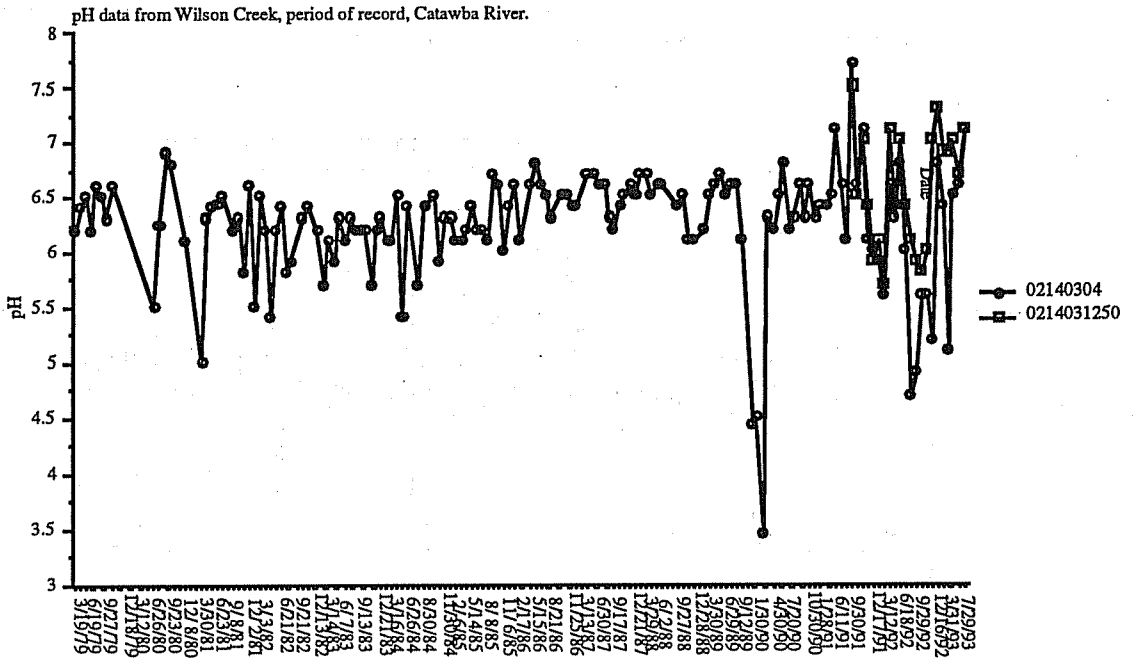


Figure 4.8 Long-term pH Readings at 2 AMS Stations on Wilson Creek

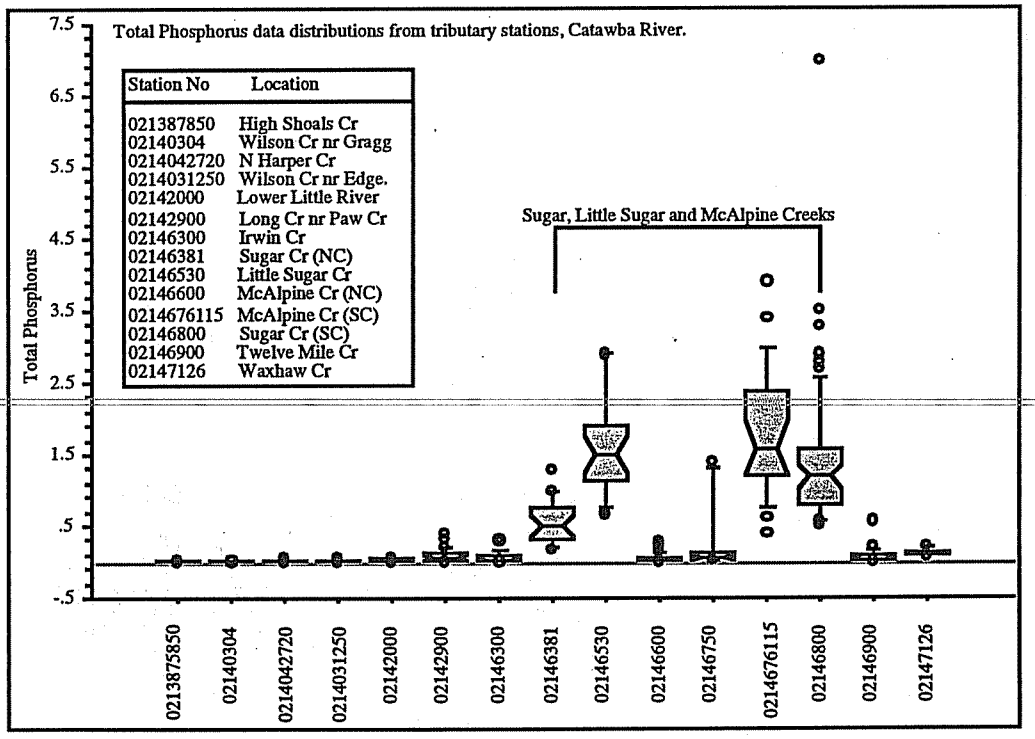


Figure 4.9 Total Phosphorus (mg/l) at Tributary AMS Stations of the Catawba River

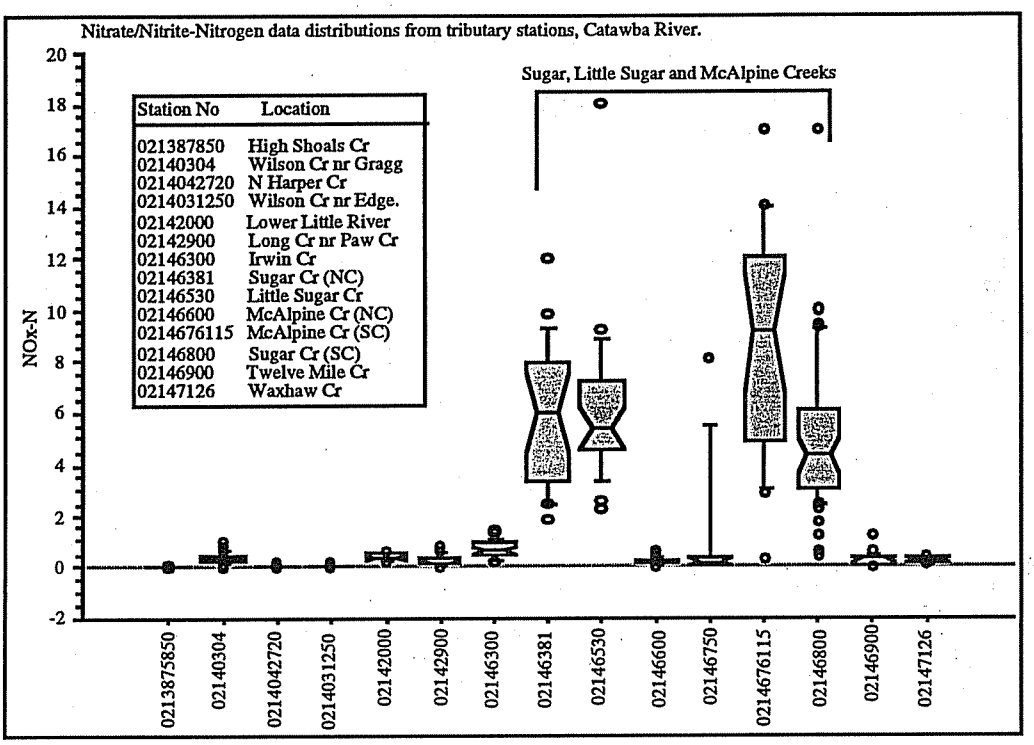


Figure 4.10 Nitrate/Nitrate-Nitrogen (mg/l) at Tributary AMS Stations of the Catawba River

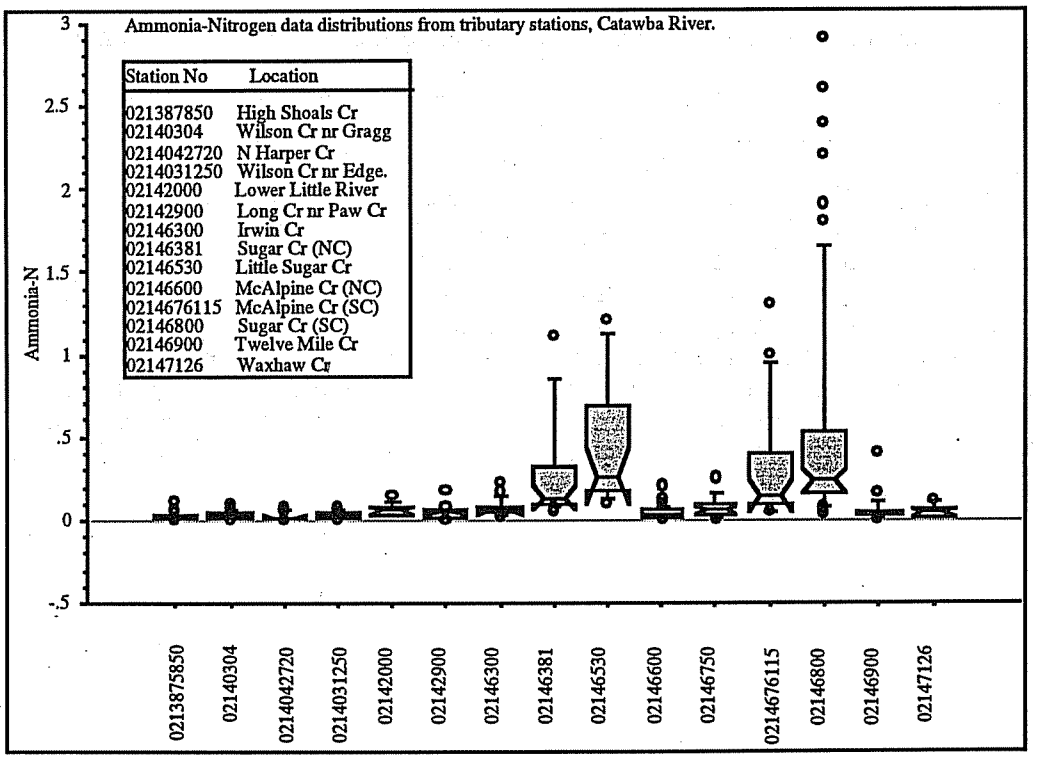


Figure 4.11 Ammonia-Nitrogen at Tributary AMS Stations of the Catawba River

Finally, creeks in the Charlotte area were chosen to examine effects of the Charlotte wastewater treatment plants and urban impacts. Stations on Irwin Creek (02146300), Sugar Creek (02146381, 02146800), Little Sugar Creek (02146530) and McAlpine Creek (02146600, 0214676115). Dissolved oxygen shows a general increasing trend from the lower levels in the 1970's (Figure 4.12) although summertime levels still occasionally fall below the state standard of 5 mg/l. Total phosphorus data reflects the effect of the 1988 phosphate ban . However, the phosphorus levels are beginning to raise again in 1992 and early 1993. Nitrate/nitrite-nitrogen exhibits a definite downstream trend. The levels of nitrate/nitrite-nitrogen show large differences in the most downstream stations McAlpine Creek at Camp Cox, SC (0214676115) and Sugar Creek at Fort Mill, SC (02146800). A recent trend in the recent data shows an increase in nitrate/nitrite-nitrogen as does the phosphorus data.

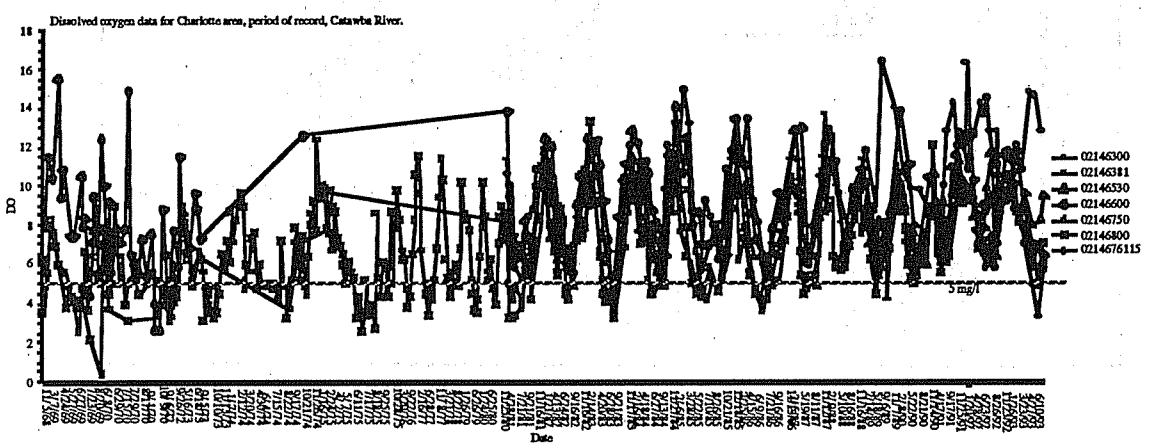


Figure 4.12 Dissolved oxygen data for Charlotte area, period of record, Catawba River.

Despite a dramatic decrease in fecal coliform levels over the past 20 years, largely as a result of disinfection of wastewater treatment plant effluent, recent fecal coliform data collected by both DEM and the South Carolina Department of Health and Environmental Control (SCDHEC) have revealed levels in the Sugar Creek watershed above the states' standard of 200/100 ml. SCDHEC conducted an intensive 30-day study in the watershed from June 7, 1993 to July 6, 1993 (SCDHEC, 1994). The study area included Little Sugar Creek, McAlpine Creek and Steele Creek. Data were collected from fourteen sampling locations, five of which were in North Carolina with nine in South Carolina. During the 30-day sampling program, all fourteen sites failed to meet applicable South Carolina fecal coliform standards. These standards are very similar to those use in North Carolina. The study also revealed violations of North Carolina and South Carolina dissolved oxygen water quality standards on McAlpine Creek (both above the McAlpine WWTP in North Carolina and below the plant in South Carolina) and Steele Creek (in South Carolina not far below the state line).

4.3.3 Summary of AMS Data for the South Fork Catawba Watershed

Dissolved oxygen and pH in the South Fork Catawba River area are adequate in all stations. Nutrient data in the South Fork Catawba mainstem tend to be high in the downstream Henry Fork station (02143027) and remains relatively high in the mainstem to a peak at the McAdenville station (02145112), Figures 4.13 - 4.15. Clark (02133260) and Indian (02143500) Creek stations have high distributions of nutrients and even the lowest of the tributary stations at Long (02144000) Creek is high compared to the mainstem (Figures 4.16 and 4.17).

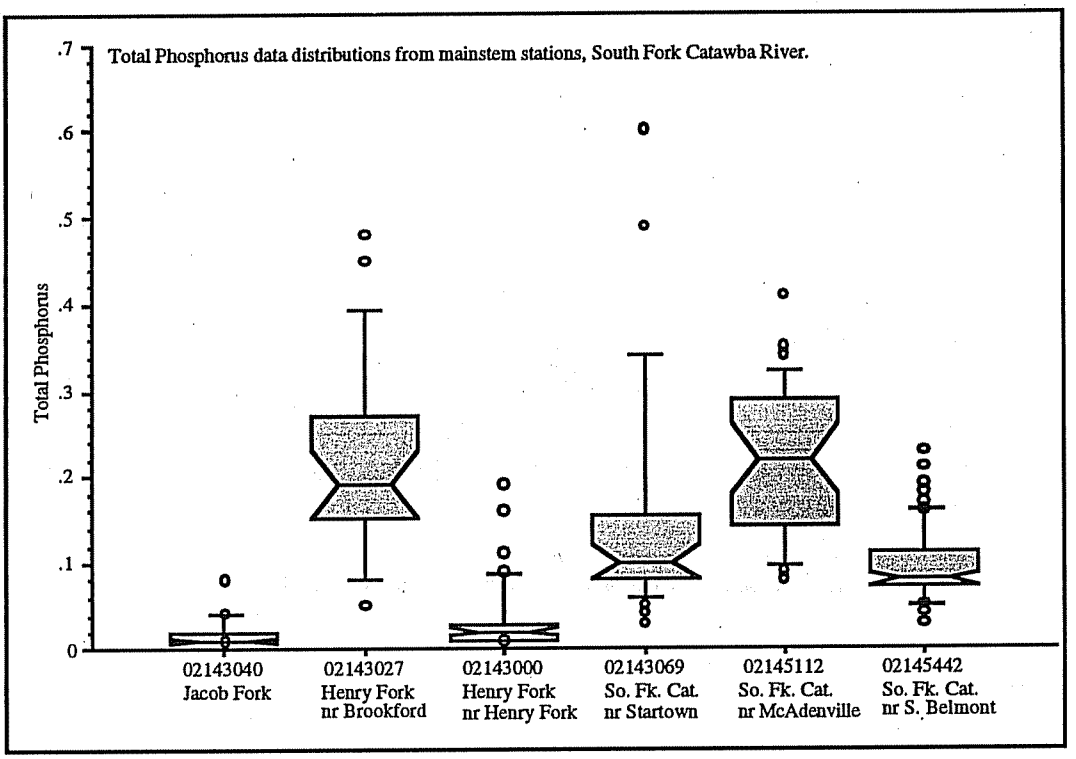


Figure 4.13 Total Phosphorus (mg/l) at AMS Stations on the South Fork Catawba River and Jacob and Henry Forks

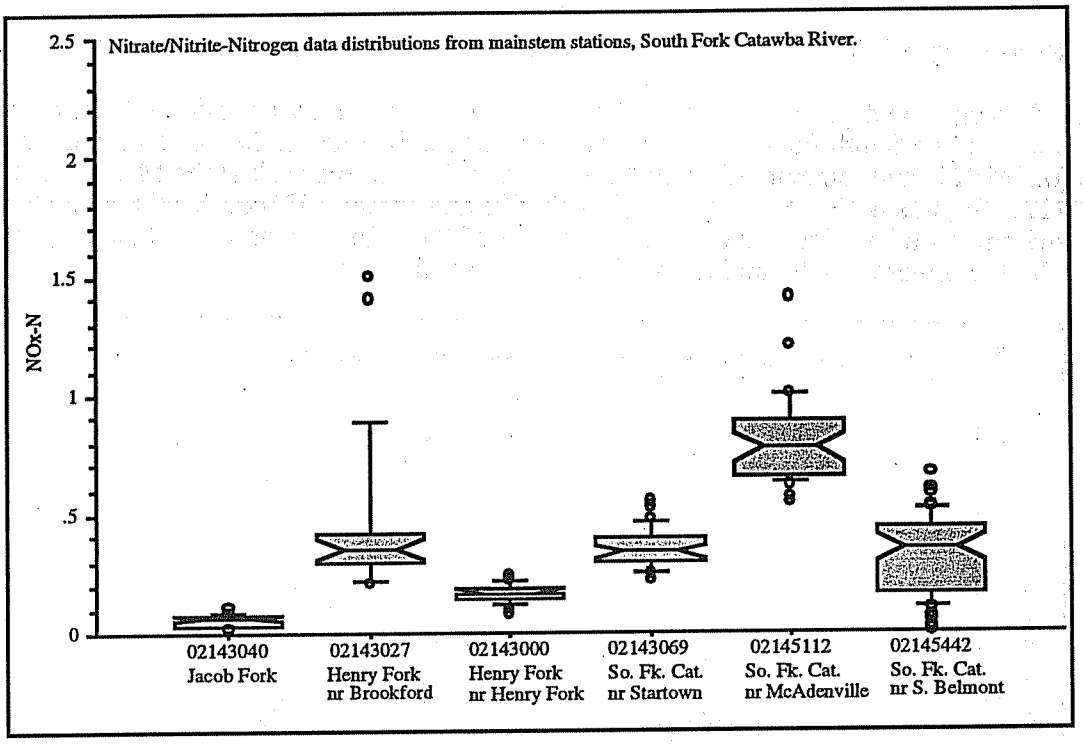


Figure 4.14 Nitrate/Nitrite-Nitrogen (mg/l) at AMS Stations on the South Fork Catawba River and Jacob and Henry Forks

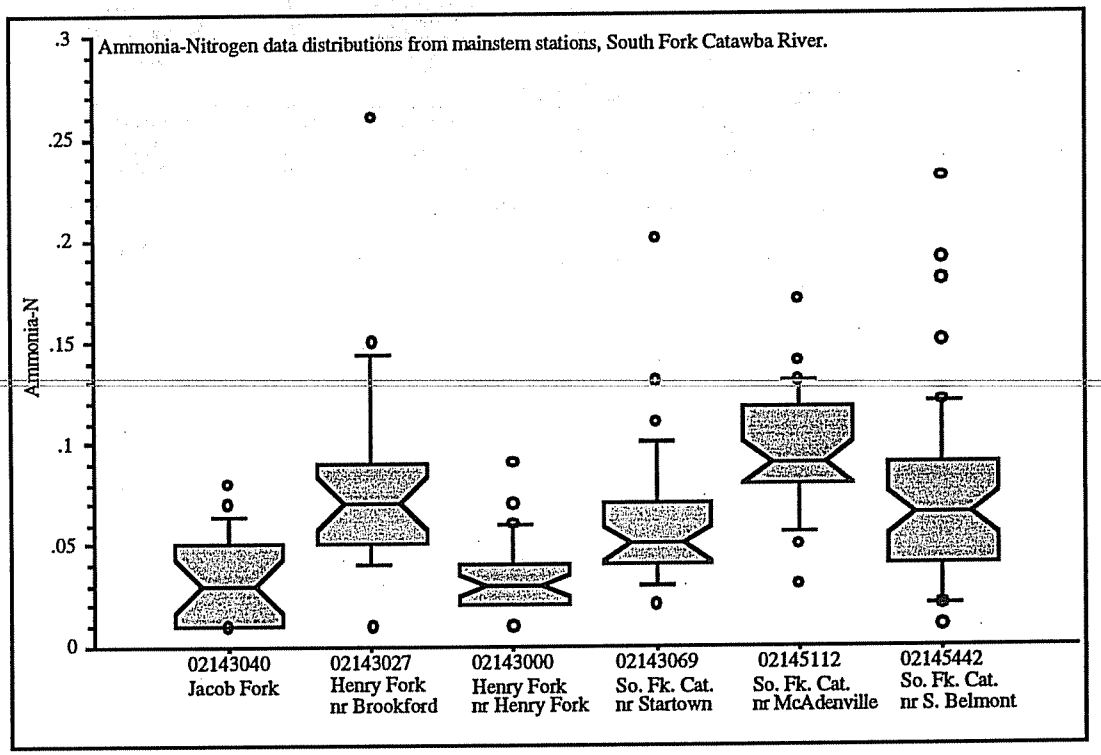


Figure 4.15 Ammonia-Nitrogen (mg/l) at AMS Stations on the South Fork Catawba River and Jacob and Henry Forks.

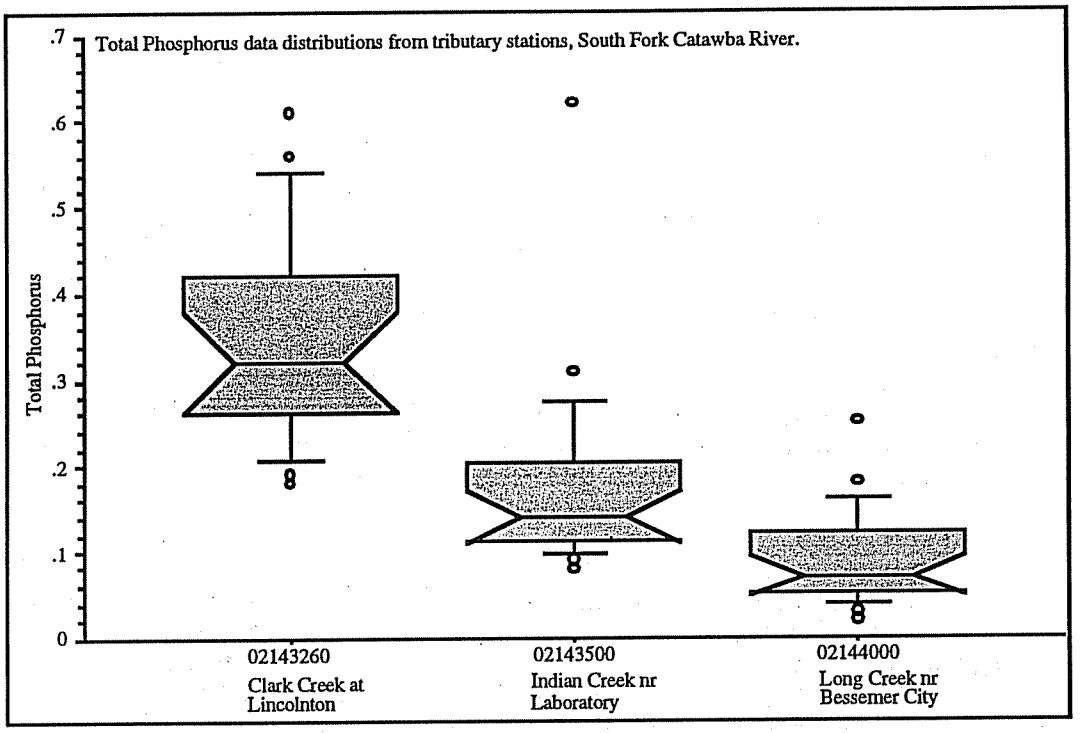


Figure 4.16 Total Phosphorus (mg/l) at Tributary Stations on the South Fork Catawba River

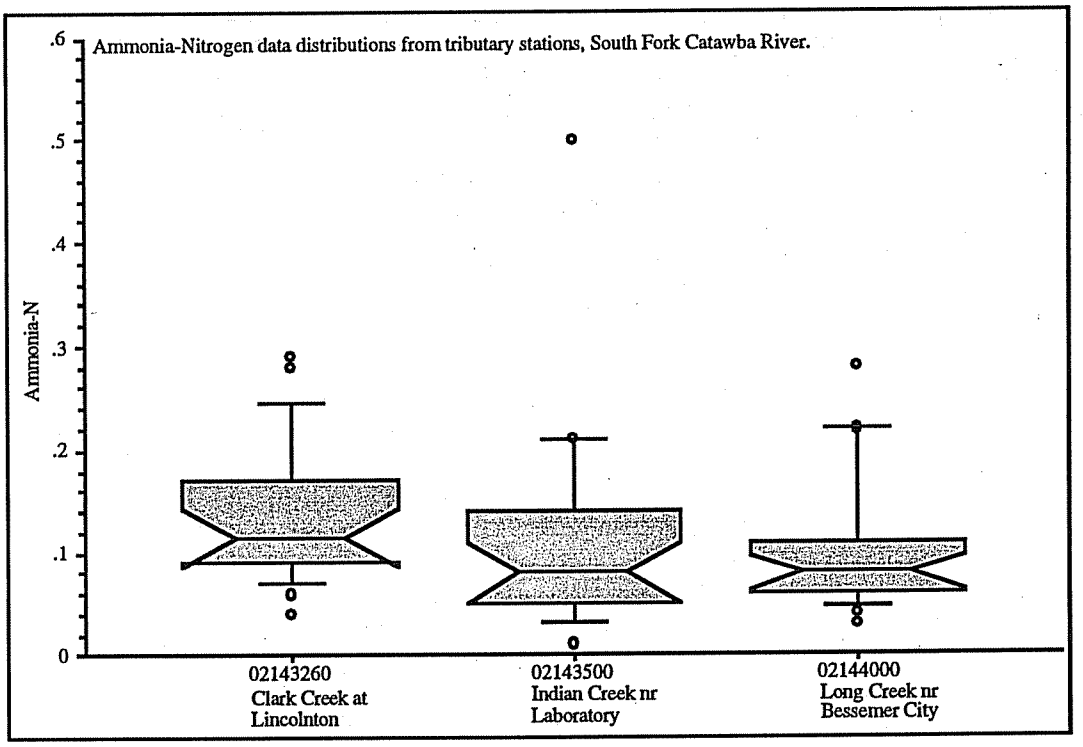


Figure 4.17 Ammonia-Nitrogen (mg/l) at Tributary Stations on the South Fork Catawba River

4.4 NARRATIVE WATER QUALITY SUMMARIES BY SUBBASIN

4.4.1 Subbasin 30 - Catawba Basin Headwaters (upstream from Morganton)

Description

Catawba subbasin 30 contains the headwater reaches of the Catawba River from its source near Old Fort to near the confluence with Silver Creek in Burke county. This is approximately a 25 river mile reach of the upper Catawba River and includes the entire watershed of Lake James. Approximately one half of the land use within this subbasin is contained within the Pisgah National Forest. This portion of the watershed is, therefore, protected from most land disturbing activities and has a limited number of point source discharges. The Catawba River flows generally eastward with major tributaries, such as the North Fork Catawba and the Linville Rivers, flowing south from mountainous headwaters. These streams are typically swift-flowing, cold-water stream systems capable of supporting trout populations. Several other smaller tributaries, such as Crooked and Muddy Creeks, flow north to the Catawba River from less mountainous and more developed catchments.

Overview of Water Quality

Fish and benthic macroinvertebrate community investigations have been conducted at 35 monitoring locations within subbasin 30 since 1983 (Figure 4.18). These investigations were conducted to assess the effects of both point and nonpoint sources of pollution. Ambient monitoring system information is currently being collected from seven active locations in the headwater area and five of these locations are on the mainstem of the Catawba River. These data generally indicate good water quality, with very few violations of water quality standards. However, data collected prior to 1988 at the Catawba River at I-40 and the Catawba River at Pleasant Gardens, noted consistent violations in several parameters including copper, zinc, and nitrate-N, with high total phosphorus values. Fecal coliform concentrations were also very high. Better water quality and biological integrity has been noted at these two ambient locations since 1988. Ambient chemistry data has shown higher dissolved oxygen values in the summer in the Old Fort area, as well as a notable decrease in total phosphorus values beginning in 1988, at the time of the phosphate ban in the state. Benthos ratings for the Catawba River below Old Fort have improved from Fair in 1985 to Excellent in 1992. Improvements in water quality are a likely response to the Old Fort Finishing plant ceasing discharge and improvements to effluent quality at the Old Fort WWTP, which discharges to Curtis Creek. The Pleasant Gardens site has improved from Good-Fair to Good, but this station had elevated levels of turbidity and suspended solids, especially during times of high flow, suggesting nonpoint source runoff may affect this portion of the Catawba River.

The tributaries of the upper Catawba River flowing south, such as the North Fork Catawba River and the Linville River, are often swift-flowing, cold-water streams originating in the steep terrain of the mountains. The majority of benthic macroinvertebrate investigations within this area have noted Good or Excellent bioclassifications. Some enrichment in streams below trout farming facilities was indicated by benthos sampling. Several tributary catchments, totaling 20.1 stream miles, flowing south from the Blue Ridge Parkway have been reclassified as High Quality Waters (upper Jarrett and Lost Cove Creeks, Mackey Creek and tributaries, Armstrong Creek, and the Linville River below Linville Falls), based either on an Excellent bioclassification or designation as native or special native trout waters. A benthos site on the Linville River just above where it enters Lake James, has consistently been rated Excellent since 1983. Good/Fair water quality conditions were noted in the upper Linville River due to nonpoint sources of runoff.

Several other smaller tributaries, such as Crooked, Corpening and North and South Muddy Creeks, flow north to the Catawba River from less mountainous and more developed catchments.

Catawba River Basin
030830

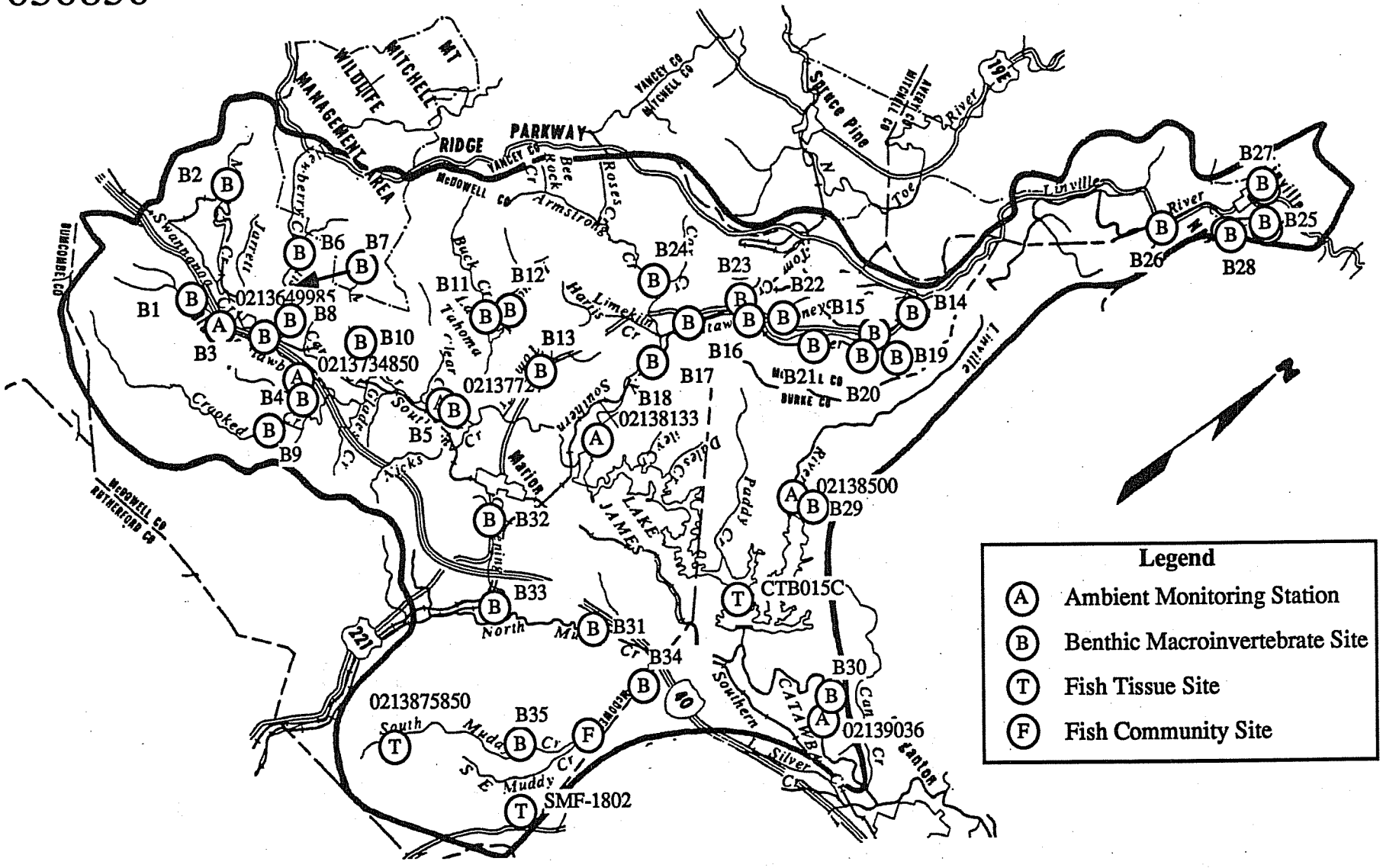


Figure 4.18 Water Quality Monitoring Stations in Subbasin 03-08-30, Catawba River Headwaters

The Marion WWTP was found, in 1990, to impact Corpening Creek as the benthos rating changed from Fair upstream to Poor downstream. Crooked Creek and North Muddy Creek received Good bioclassifications in 1992, while South Muddy Creek was rated Good-Fair.

Fish tissue samples have been collected from two locations in the subbasin (High Shoals Creek and Lake James near Bridgewater). Metal samples from High Shoals Creek were all lower than FDA and EPA criteria and organic results were all lower than detection levels. A total of nine samples were collected from the Lake James location. All metals were lower than FDA criteria. One sample contained dieldrin.

Assessments have been made of Lake Tahoma and Lake James. Lake Tahoma, which is privately owned, has a phytoplankton population dominated by oligotrophic indicators, suggesting that this lake fully meets it designated uses. Lake James, which is owned by Duke Power Company, is the most upstream of the major impoundments of the Catawba chain lakes system. The catchment is primarily forested and characterized by rolling hills. Water quality and phytoplankton data from Lake James have indicated that the lake is fully meeting all of its designated uses.

Potential ORW/HQW Streams

Based on DEM surveys in 1992, the following stream segments may be eligible for HQW designation:

1. Mill Creek above Graphite (above RR bridge).
2. Little Buck Creek (all)
3. Armstrong Creek above the confluence with Three-mile Creek. Presently only a small headwater section has received special designation.
4. Toms Creek was rated Excellent, but was sediment impacted.

4.4.2 Subbasin 31 - Upper Catawba Basin (Rhodhiss Lake)

Description

Catawba subbasin 31 is located in the mountain ecoregion, and contains the cities of Morganton, Lenoir, Drexel and Granite Falls (Figure 4.19). The Catawba River (including Lake Rhodhiss) flows generally eastward, with major tributaries flowing south, especially Warrior Fork and the Johns River. Portions of these stream's headwater tributaries are designated as HQW because they are native trout waters. Portions of this catchment are within the Pisgah National Forest, including Wilson Creek, and have received ORW designation. The Johns River catchment also contains some high quality areas, but this area has widespread agricultural land use, especially cultivation of ornamental shrubs and trees.

Overview of Water Quality

Benthos data indicate very good water quality in areas within the Warrior Fork and Johns River watersheds. Portions of these watersheds are within the Pisgah National Forest. Both Upper Creek in the Warrior Fork watershed, and Wilson Creek in the Johns River watershed have received Excellent bioclassifications since 1983.

Point source discharges in the Lenoir area appear to have impacted water quality in Lower Creek. This creek received a Fair benthos rating and a Fair-Good NCIBI (fish) rating. Fecal coliform bacteria exceeded the state criterion 8 times (36%) at the Lower Creek ambient monitoring station.

Benthos collections indicated sedimentation problems in Silver Creek, Canoe Creek, McGalliard Creek and Bailey Fork. Good-Fair bioclassifications were assigned to them. Fish community assessment of Canoe Creek indicated a NCIBI score of Fair, while McGalliard Creek received a Poor-Fair NCIBI rating.

Catawba River Basin
030831

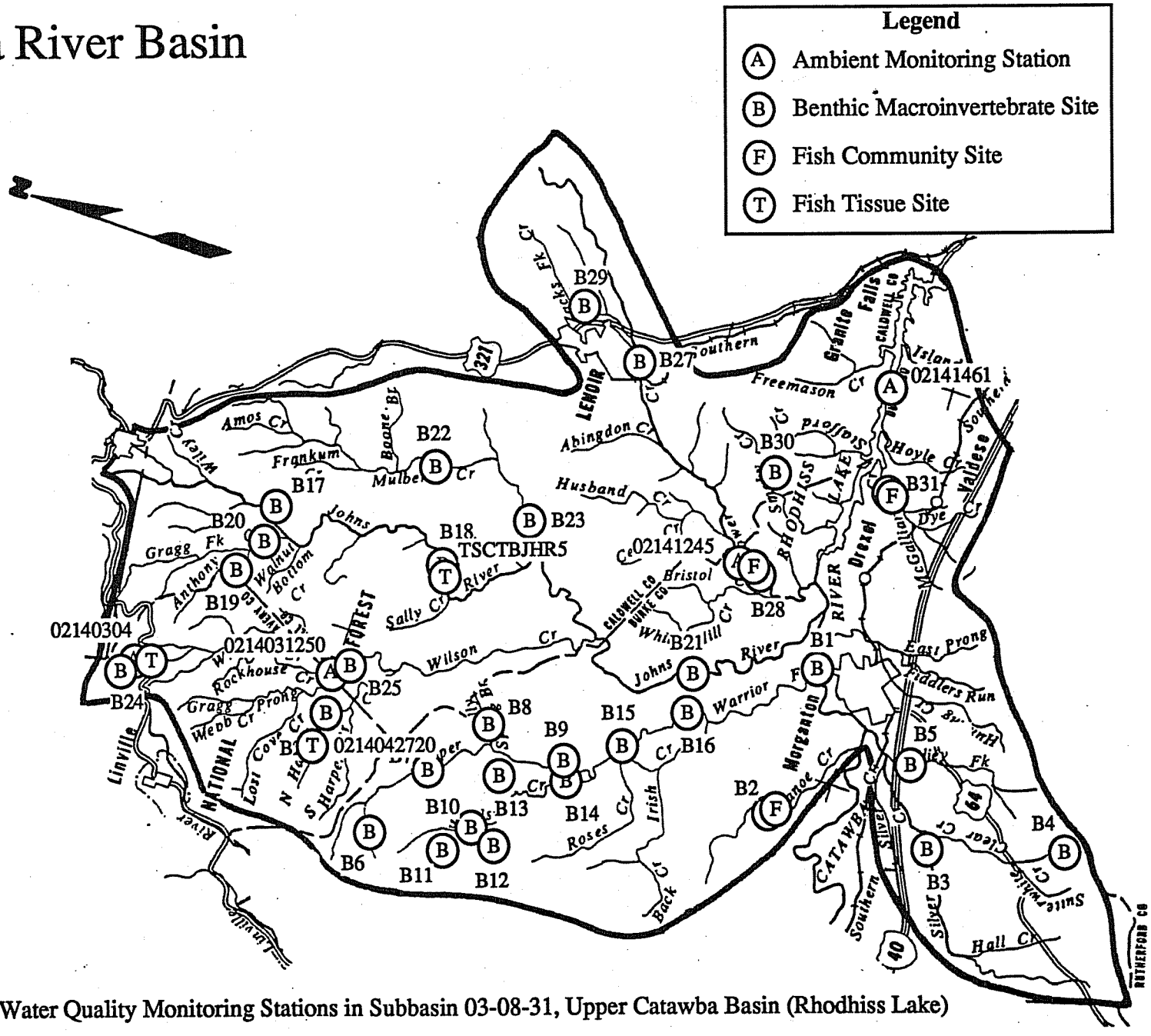


Figure 4.19 Water Quality Monitoring Stations in Subbasin 03-08-31, Upper Catawba Basin (Rhodhiss Lake)

Lake Rhodhiss has a surface water classification of WS-IV B CA and a trophic state index of eutrophic. Algal bloom conditions in the lake were present in April 1990 and November 1991.

4.4.3 Subbasin 32 - Mid Catawba Basin (Rhodhiss Lake to Lake Norman Dam)

Description

Catawba subbasin 32 is located in the Upper Piedmont ecoregion (Figure 4.20). Highly erodable soils and moderate gradients contribute to the large amounts of sediment into the Little Rivers (Upper, Middle and Lower) and their tributaries. This subbasin contains portions of the cities of Hickory, Conover, and Newton, although most dischargers in these cities are located in subbasin 35. The Catawba River has been dammed to form a series of four lakes, (Lake Hickory, Lookout Shoals Lake, and Lake Norman). A fourth lake, Little River Dam Lake, is located northwest of Lake Hickory on Upper Little River.

Overview of Water Quality

Benthic macroinvertebrates were sampled at eight basin assessment sites in 1992. Ratings were mainly Good (Upper, Middle and Lower Little River sites and Lyle Creek), or Good-Fair (Duck Creek, an upstream site on Muddy Creek and Elk Shoals Creek). Another benthos site on Muddy Fork below Schneider Mills was rated Fair. Most of these stream sites contained large amounts of sand. A long term benthos monitoring site located on Lower Little River at SR 1313 has improved from Fair to Good-Fair. Older benthic studies found discharges from Huffman Finishing to Huffman Branch and the Troutman WWTP to Big Branch were highly toxic, resulting in greatly diminished macroinvertebrate biodiversity and Poor bioclassifications. Muddy Fork, (Schneider Mills) was rated Good-fair at an upstream site and Fair below the discharge.

Fish community structure sampling NCIBI ratings in 1993 ranged from Good at Lyle Creek, to Fair at sites on Middle Little River, Duck Creek and Elk Shoals Creek, to Poor, at an upstream site on the Lower Little River. Comparing sites sampled by both fish and benthos, fish data produced lower ratings for two out of five sites. This may suggest that sediment may be the major pollutant. Results of fish tissue monitoring from four sites indicated minor accumulations of metals, (copper, zinc, chromium, and mercury). However, levels were not above FDA action levels.

Four lakes were monitored within this subbasin (Lake Hickory, Lookout Shoals Lake, Lake Norman and Little River Dam Lake). Trophic states range from eutrophic, (Lake Hickory and Lookout Shoals Lake), to mesotrophic, (Little River Dam Lake), to oligotrophic, (Lake Norman). Chlorophyll *a* levels higher than the state standard of 40 µg/l were detected in Lake Hickory.

Chemical monitoring was conducted at four ambient stations in the basin. Two of these stations, (Lake Hickory at NC Hwy 127 and Catawba River at SR 1004), are on the Catawba River. One fecal coliform and three iron measurements at these two sites were higher than the state criteria. One turbidity measurement at the Catawba River at SR 1400 site was higher than the state action level criteria. Maximum fecal coliforms, iron, and mercury were higher at Little Lower River at SR 1313 than the state action level for these parameters. Of the parameters monitored at Norwood Creek at SR 1328, three sample readings for iron and one for copper exceeded the state action level.

The Western Piedmont Council of Governments (WPCOG) has two ongoing studies which involve both Lake Hickory and Lookout Shoals. In 1992 the WPCOG and the Tennessee Valley Authority (TVA) initiated a study to monitor the health of largemouth bass in both reservoirs. Results of the study showed that a majority of the fish contained Protocephalus ambloplites (bass tapeworm), an internal parasite. It was determined that the parasite has had no major effect on the fish and, for the most part, the fish are in good health (Brown, 1993). Testing for fecal coliform bacteria has also been conducted by the WPCOG. Fecal coliform bacteria values were within the limits for North Carolina water quality standards.

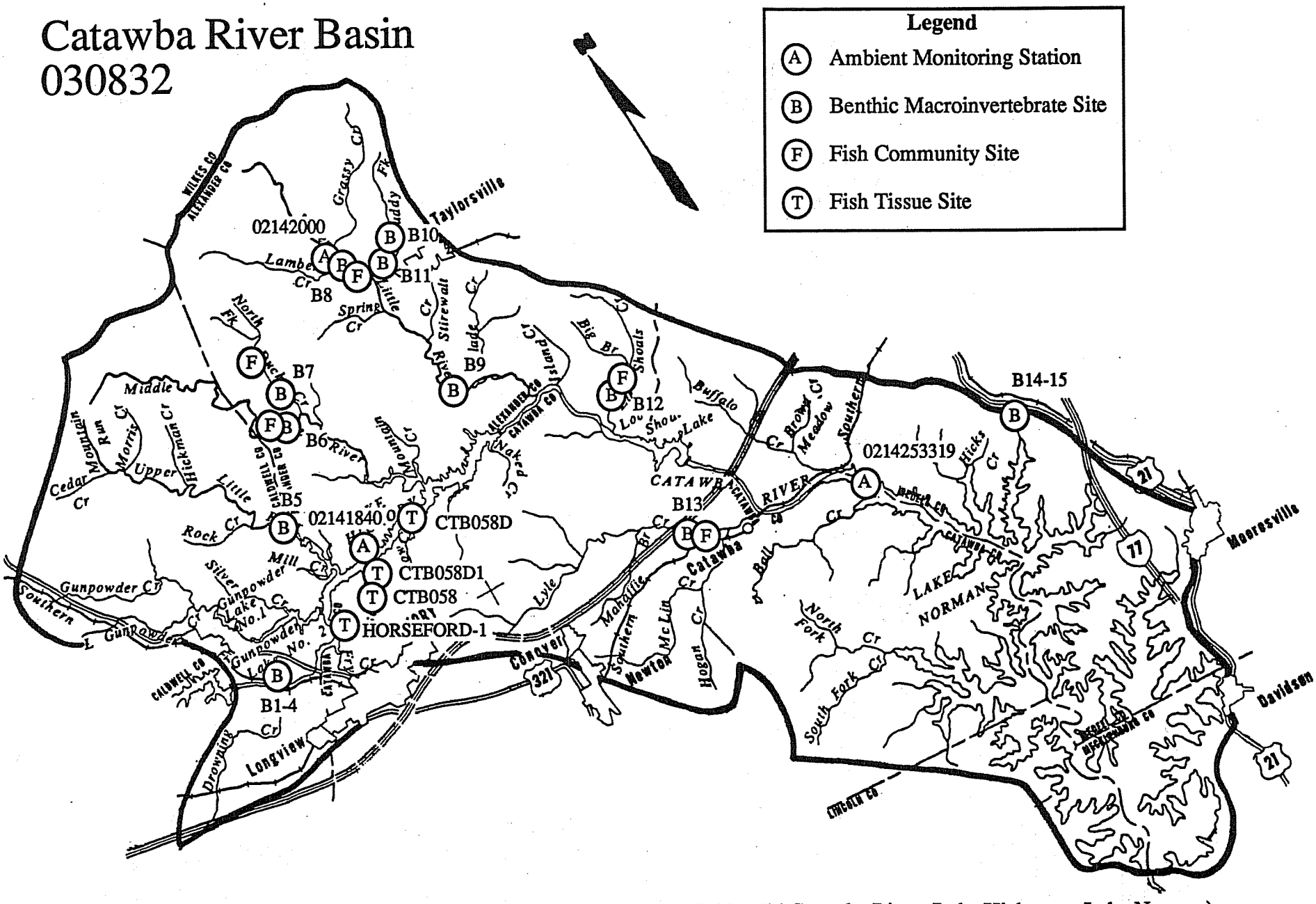


Figure 4.20 Water Quality Monitoring Stations in Subbasin 03-08-32, Mid Catawba River (Lake Hickory to Lake Norman)

4.4.4 Subbasin 33 - Lower Catawba (Mountain Island Lake and Dutchman's Creek)

Description

This subbasin is located in the inner Piedmont ecoregion of the state. Impoundment of the Catawba River in this area forms Mountain Island Lake (Figure 4.21). The Dutchman's Creek watershed is the largest in this subbasin. Streams in this subbasin are often sandy, low gradient streams with predominately silt and clay substrates. Land use is primarily agricultural, with recreational and residential use near the lakes.

Overview of Water Quality

Water quality ratings from benthos data collected in 1992 were Excellent (Killian Creek and Dutchman's Creek) or Good (Gar Creek). Older benthos data indicated Good-Fair and Fair water quality for McDowell Creek, and Excellent water quality for Leepers Creek. Fish community structure sampling indicated Good water quality for Leepers Creek, Fair-Good water quality for Dutchman's Creek, and Good water quality for Killian Creek.

Mountain Island Lake is the only large lake in this subbasin. The whole lake TSIs for 1982 and 1986 suggest the lake was mesotrophic. However, the 1992 TSI demonstrated the lake to be oligotrophic. During 1992, a powdery surface algal bloom was observed within the McDowell Creek Cove. The lake is currently under study by the Mecklenburg County Department of Environmental Protection and DEM. An increase in algal blooms in McDowell Creek Cove has raised concerns about water quality in the lake and impacts from increasing watershed development. The lake receives treated effluent from the McDowell Creek wastewater treatment plant via McDowell Creek. The study will attempt to identify potential sources of point and non-point pollution in McDowell Creek and McDowell Creek Cove from May through October 1993 and 1994.

4.4.5 Subbasin 34 - Catawba River (Catawba arm of Lake Wylie and Charlotte Area Watersheds)

Description

This subbasin is located in the inner Piedmont ecoregion and includes the city of Charlotte (Figure 4.22). The major tributary within this subbasin is Sugar Creek (262 square miles at Fort Mill, S.C.), but it also includes parts of Lake Wylie. This is the most heavily developed portion of the Catawba River basin, with urban, residential and agricultural land use.

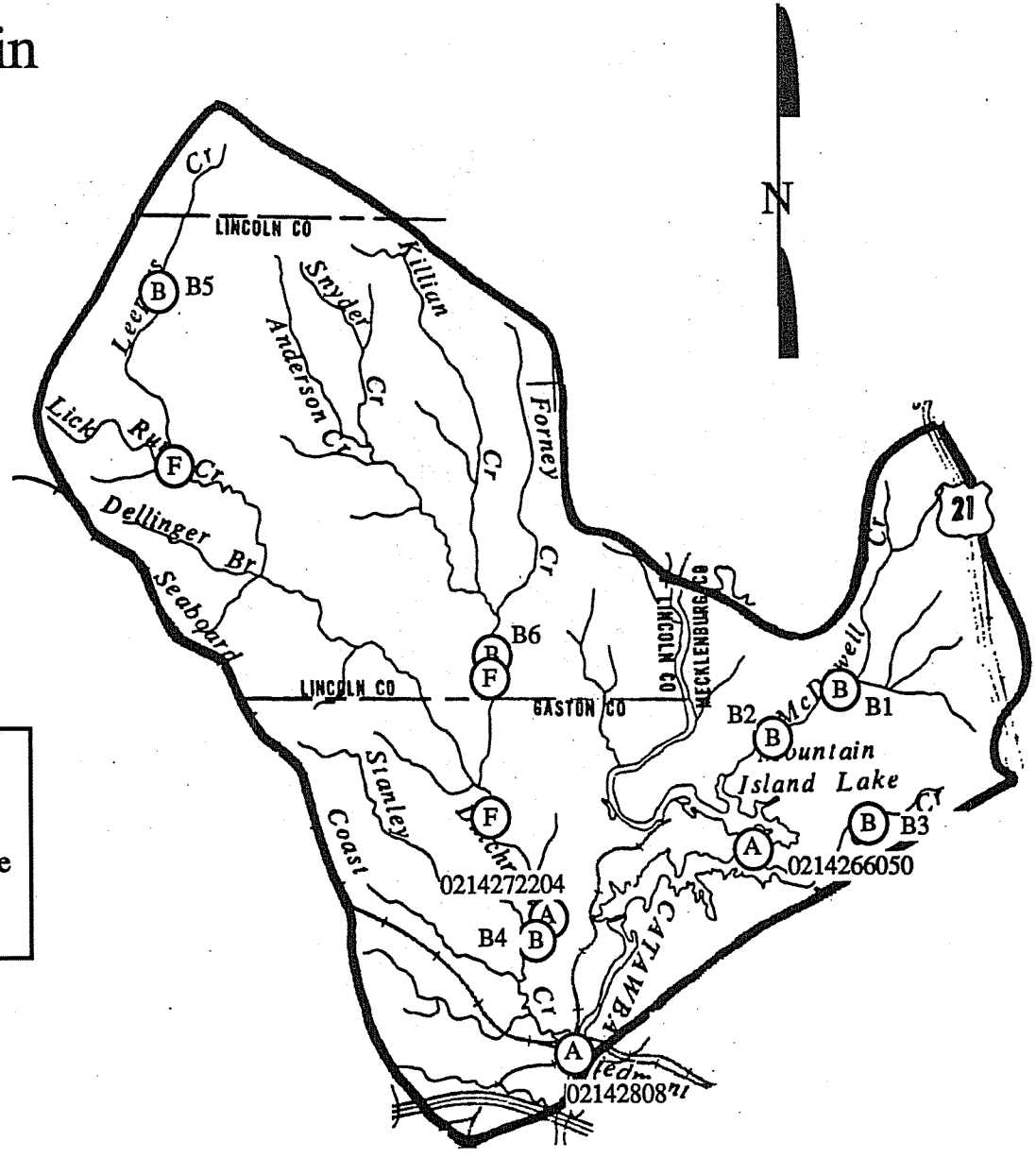
Overview of Water Quality

Historical data indicate that Sugar Creek was one of the most severely polluted streams in North Carolina. Fisheries collections in the 1960's and 1970's usually recorded "no fish" in Sugar Creek. Both urban runoff and several large wastewater treatment plants contributed to these problems. While this area is still characterized by Fair to Poor water quality, there have been significant improvements in water quality, especially between 1988 and 1992.

There are currently over 50 permitted dischargers in this subbasin and attempts to improve water quality have focused on wastewater treatment facilities. The three largest dischargers are the Charlotte/Mecklenburg Utilities Department (CMUD) wastewater plants, which are permitted to discharge about 70 million gallons/day into Sugar Creek and its tributaries. All CMUD wastewater plants have undergone upgrades during the last 5 years. Some success from these upgrades can be seen through self-monitoring effluent toxicity data, water chemistry from ambient sites, and DEM's collection of fish and benthic macroinvertebrates.

Summer benthic macroinvertebrate collections from Sugar Creek near Fort Mill (near the NC/SC border) should measure the effects of this reduction in toxicity, as well as integrating the effects of

Catawba River Basin
030833



Legend

- (A) Ambient Monitoring Station
- (B) Benthic Macroinvertebrate Site
- (F) Fish Community Site

Figure 4.21 Water Quality Monitoring Stations in Subbasin 03-08-33, Mt. Island Lake and Dutchman's Creek

Catawba River Basin
030834

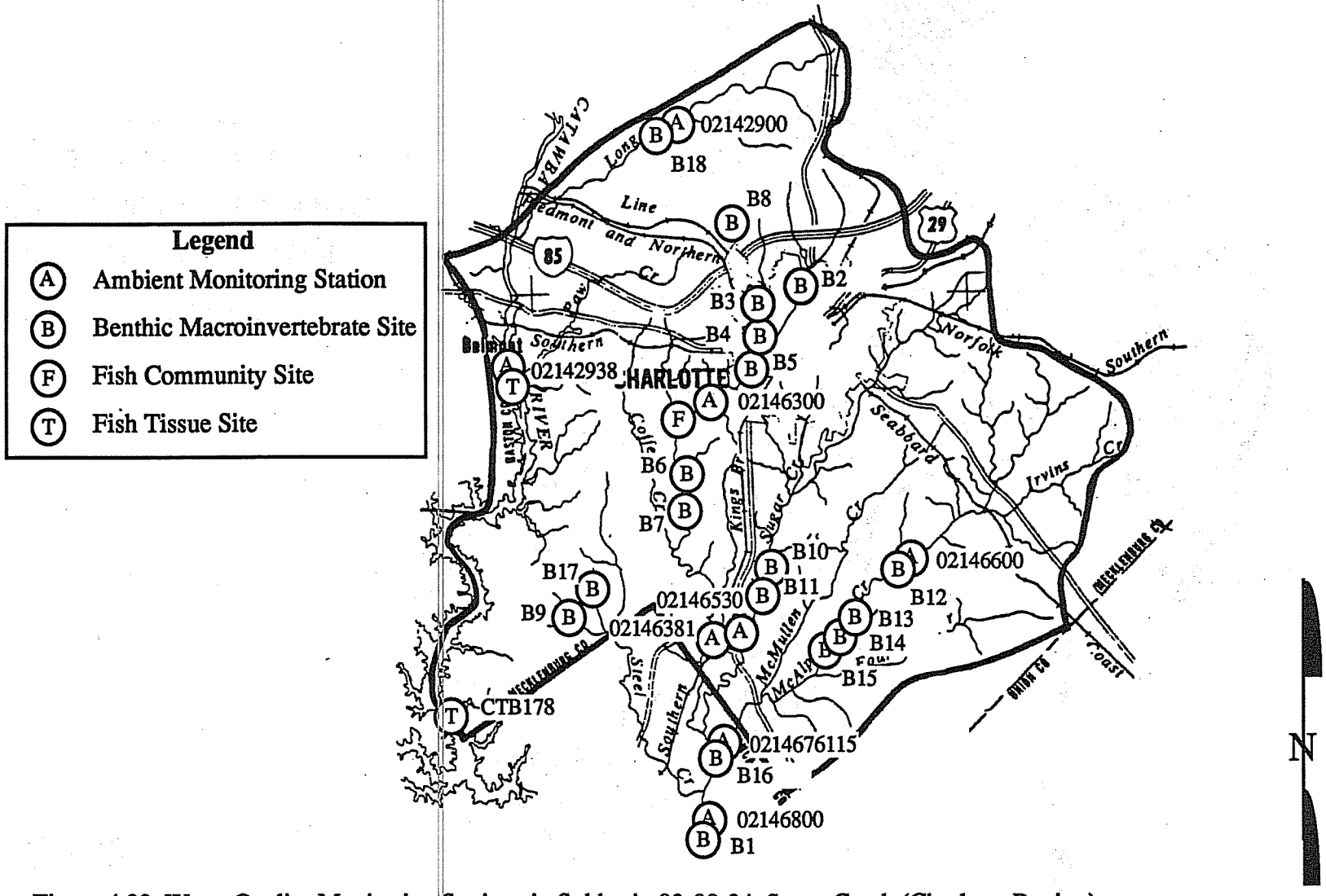


Figure 4.22 Water Quality Monitoring Stations in Subbasin 03-08-34, Sugar Creek (Charlotte Region)

other point and nonpoint-source problems. Benthos samples at this site consistently indicated a Poor rating between 1983 and 1988, but it improved to Fair in 1990/1991, and to Good-Fair in 1992. A site on lower McAlpine Creek also improved from Poor in 1987 to Fair in 1992. These changes were associated with decreased concentrations of copper, zinc and total phosphorus. Despite findings of occasional dissolved oxygen concentration measurements below state standards, as noted above in Section 4.3.2, overall dissolved oxygen concentrations have steadily increased in Sugar Creek at Fort Mill, averaging 6.1 mg/l in the 1970's, 6.9 mg/l in the 1980's and 7.7 mg/l from 1990-1992. Elevated fecal coliform concentrations in this area are of concern, again as noted in Section 4.3.2, although these concentrations are vastly improved since the 1970s.

Invertebrate samples at other locations indicated Fair or Poor ratings for other streams in the Sugar Creek catchment. Fair ratings are most likely to be found in the less developed headwater areas. Recent fisheries collections were limited to a single sample from the middle section of Sugar Creek (SR 1156). This fish collection produced a Poor rating with four species of fish, but this is probably an improvement over earlier "no fish" collections. Benthos samples from this site also produced a Poor rating in 1992.

Lake Wylie was the subject of a special study conducted jointly by the North Carolina Department of Environment, Health, and Natural Resources (NCDEHNR) and the South Carolina Department of Health and Environmental Control (SCDHEC) from April 1989 to September 1990 to identify nutrient loading patterns in the watershed, the assimilative capacity of the lake, and to identify control strategies to protect the lake as a water source for North and South Carolina. Lake Wylie is threatened by eutrophic conditions, especially in the embayments and tributary arms where algal blooms and fish kills have been observed. Nutrient loading in the lake has been linked to both point and nonpoint source loading, with high nutrient levels in several tributaries: South Fork Catawba River, Catawba Creek and Crowders Creek. The Catawba Creek arm of the lake consistently demonstrated eutrophic conditions, and both Catawba Creek and Crowders Creek demonstrated algal blooms, elevated nutrient concentrations, and violations of the North Carolina chlorophyll *a* water quality standard (greater than 40 µg/l in lakes). Modeling analysis results indicated that control of both point and non-point sources would be needed to reduce nutrient loading to the lake.

The designated uses of Lake Wylie are threatened within the embayments and tributary arms by eutrophic conditions which have led to algal blooms and fish kills. Because Lake Wylie serves as a water supply in both North and South Carolina and exhibits symptoms of water quality degradation, a joint study was conducted by DEM and the South Carolina Department of Health and Environmental Control (SCDHEC) (Water Quality Investigation of Lake Wylie, April 1989 - September 1990, DEM Report No. 92-04) to identify nutrient loading patterns in the watershed and the assimilative capacity of the lake. Control strategies to protect the water quality of the lake were also determined.

The South Fork Catawba River, Catawba Creek, and Crowders Creek were found to be major contributors of nutrients into Lake Wylie. The heavy sediment load of the South Fork Catawba River, which frequently visually appears as a mud line in the lake arm, carries large amounts of nutrients into the lake. The Catawba Creek arm of the lake consistently demonstrated eutrophic conditions, and both Catawba Creek and Crowders Creek demonstrated algal blooms, elevated nutrient concentrations, and violations of the North Carolina chlorophyll a water quality standard (greater than 40 µg/l in lakes). Modeling analysis results indicated that control of both point and non-point sources would be needed to reduce nutrient loading to the lake. Point source controls would require state-of-art nutrient removal technology improvements for new and existing discharges into the lake to meet limits of 1.0 mg/l total phosphorus and 6.0 mg/l monthly average year round. Non-point sources would be targeted through agricultural cost share funds for implementation of best management practices (BMPs), with the South Fork Catawba River watershed receiving the highest priority.

4.4.6 Subbasin 35 - Upper South Fork Catawba River

Description
This subbasin is located in the inner Piedmont ecoregion of the state and includes the South Fork Catawba River and its tributaries (Figure 4.23). Two of these tributaries, Jacob Fork and Henry Fork, drain sections of the South Mountains State Park. Other major tributaries include Clark Creek and Indian Creek. Land use in this subbasin is primarily agriculture and urban.

Overview of Water Quality
The upper reaches of Jacob Fork and Henry Fork have Excellent water quality and have been designated ORW. Jacob Fork and Henry Fork are classified using mountain ecoregion criteria, but they exhibit characteristics of both mountain and piedmont streams. The lower reaches of these streams generally have Good water quality. These areas of the streams receive nonpoint source runoff and effluent from permitted dischargers. The Hickory WWTP, on the lower end of Henry Fork, is the largest of the dischargers. The Hickory facility has been cited and fined for noncompliance with their whole effluent toxicity limit. Ambient water chemistry data for Henry Fork indicate higher nutrient levels and slightly lower DO levels below the WWTP outfall.

Bioclassifications for the South Fork Catawba River near Startown have been Good-Fair to Fair for the past few years. This site appears to be affected by upstream dischargers to varying degrees depending on stream flow. Nutrient levels here are below those for Henry Fork near Brookford, but higher than those recorded for Henry Fork near Henry River.

Point source dischargers seem to be a major problem in some of the Clark Creek watershed. However, there is a gradual downstream recovery and no negative effects of the water from Clark Creek entering the South Fork Catawba were found in 1984. Fish and macroinvertebrate data from Clark Creek near Lincolnton indicate a Fair rating.

Indian Creek flows into the South Fork Catawba River below Lincolnton. Long term macroinvertebrate data from SR 1252 indicate an improvement in water quality for the stream from Fair in 1983 to Good in 1992. Water chemistry data also indicate some improvement at this location with a slight decrease in nutrient levels. These improvements are believed to be due to better operation of the upstream Cherryville WWTP.

The only lake sampled in this subbasin is Lake Maiden, an impoundment of Maiden Creek, which is a tributary of Clark Creek. The lake is currently classified WS-II CA. Nutrient levels are moderate in the lake, and phytoplankton blooms were documented in 1990, but not in 1992.

Eleven facilities in this subbasin currently monitor effluent toxicity as per permit requirements. At least two others will be recommended for monitoring requirements in their next permit renewal. None of the facilities in this subbasin have obtained regulatory relief for toxicity limits through a special or judicial order.

POTENTIAL HQW/ORW STREAMS
Carpenter Creek received an Excellent bioclassification in 1984 and may qualify for HQW/ORW designation.

Catawba River Basin
030835

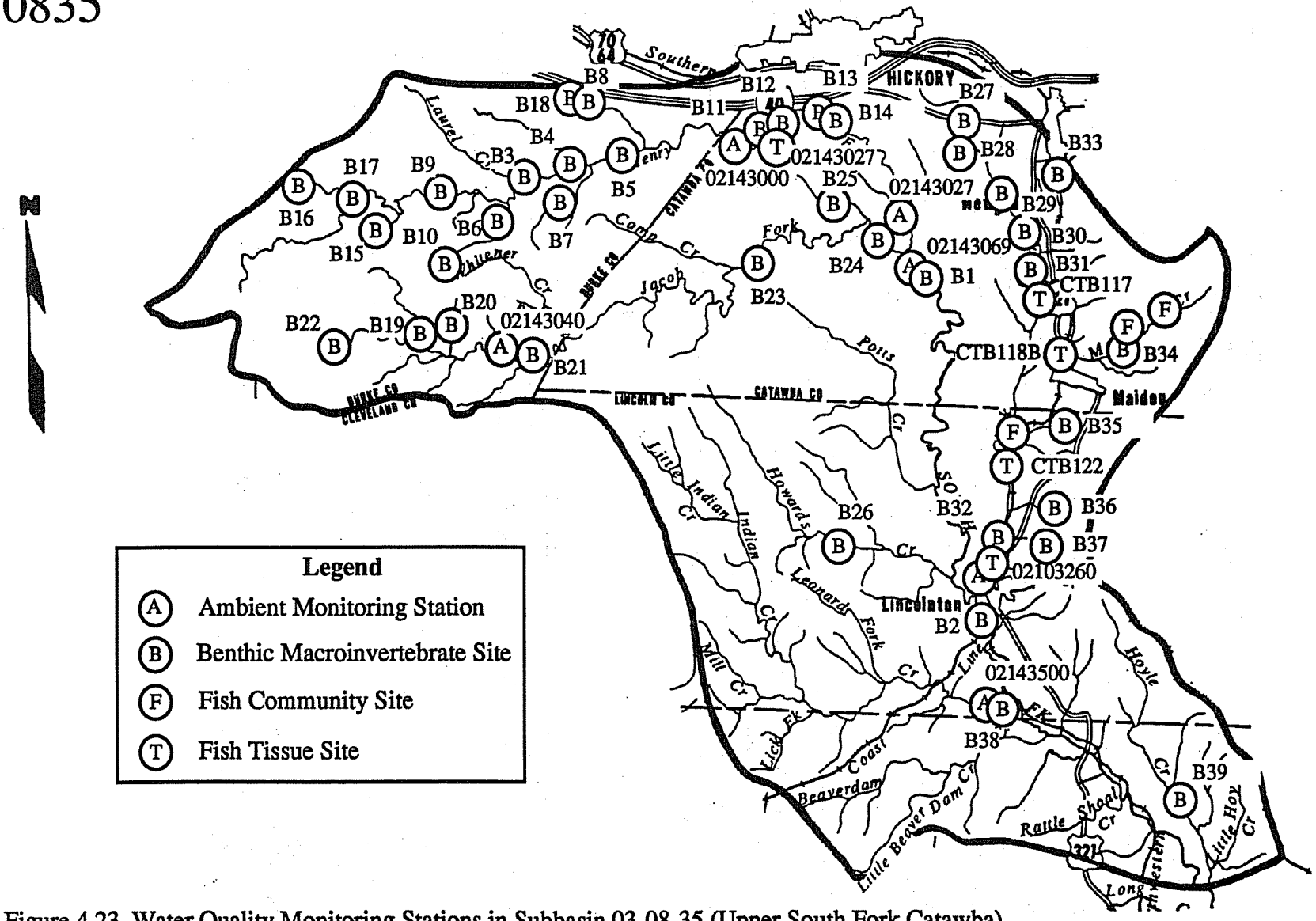


Figure 4.23 Water Quality Monitoring Stations in Subbasin 03-08-35 (Upper South Fork Catawba)

4.4.7 Subbasin 36 - Lower South Fork Catawba River

DESCRIPTION
Catawba subbasin 36 is located in the Piedmont ecoregion, and includes Gastonia and parts of Bessemer City (Figure 4.24). This small subbasin includes Long Creek and the lower portion of the South Fork Catawba River. Most streams are very sandy due to erosion problems throughout the area.

OVERVIEW OF WATER QUALITY
There are many dischargers in this highly industrialized area, and most are located near the South Fork Catawba River. Long Creek is primarily affected by agricultural runoff and attempts are being made to control erosion in the Long Creek catchment. Fecal coliform counts in the Long Creek catchment have exceeded North Carolina criteria in eighteen out of twenty observations between 1991 and 1993. Long Creek near Bessemer City was given a Good-Fair bioclassification based on benthos data between 1984 and 1992. Fish community sampling occurred in 1993 and indicated a NCIBI rating of Poor-Fair. The lower fish rating suggests sediment problems in Long Creek. Long Creek below the Gastonia WWTP received a Fair bioclassification in 1990, based on benthos data.

The South Fork Catawba River has shown improved water quality according to benthos data. Benthos samples collected near McAdenville resulted in bioclassifications changing from Poor to Good-Fair between 1983 and 1992. Fish tissue samples collected in the South Fork of the Catawba near Cramerton showed dieldrin, DDE, and heptachlor epoxide exceeding EPA screening values. Fish tissue metals samples collected near Belmont from 1984 to 1986 showed no exceedances in FDA or EPA criteria. Bessemer City Lake was the only lake sampled within this subbasin and results have indicated good water quality. Bessemer City Lake is currently classified as WS-II CA.

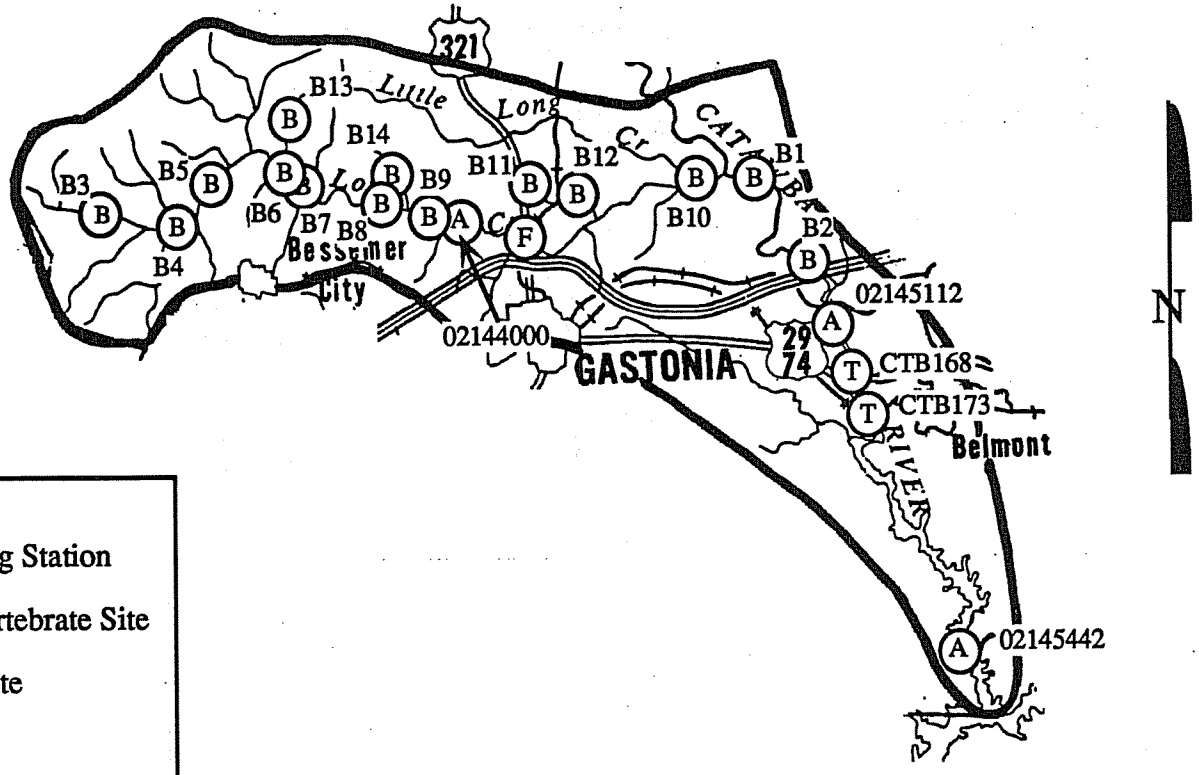
4.4.8 Subbasin 37 - Crowders and Catawba Creeks

Description
Catawba subbasin 37 is the smallest in the basin (Figure 4.25). It is located in the Piedmont ecoregion, and includes portions of Bessemer City and Gastonia. Crowders Creek and Catawba Creek are the principle streams. This heavily developed area includes many permitted dischargers.

Overview of Water Quality
Catawba Creek is severely affected by the Gastonia WWTP (Poor bioclassification), with no improvement seen between surveys in 1985 and 1990. Phosphorous concentrations in Catawba Creek were sufficient enough to cause blooms in Lake Wylie and any increase in nitrogen in this drainage will lead to higher algal growth according to Algal Growth Potential Tests (AGPT).

Dischargers in the Crowders Creek drainage cause Poor or Fair ratings in McGill Creek, Abernathy Creek, several unnamed tributaries, and Crowders Creek itself. Because of the many dischargers, it is often difficult to examine the effects of individual dischargers. Lower Crowders Creek improved from Poor in 1988 (after a spill) to Fair in 1989, based on benthos data.

Catawba River Basin
030836



Legend

- (A) Ambient Monitoring Station
- (B) Benthic Macroinvertebrate Site
- (F) Fish Community Site
- (T) Fish Tissue Site

Figure 4.24 Water Quality Monitoring Stations in Subbasin 03-08-36 (Lower South Fork Catawba and Long Creek)

Catawba River Basin
030837

Legend

- (A) Ambient Monitoring Station
- (B) Benthic Macroinvertebrate Site
- (T) Fish Tissue Site

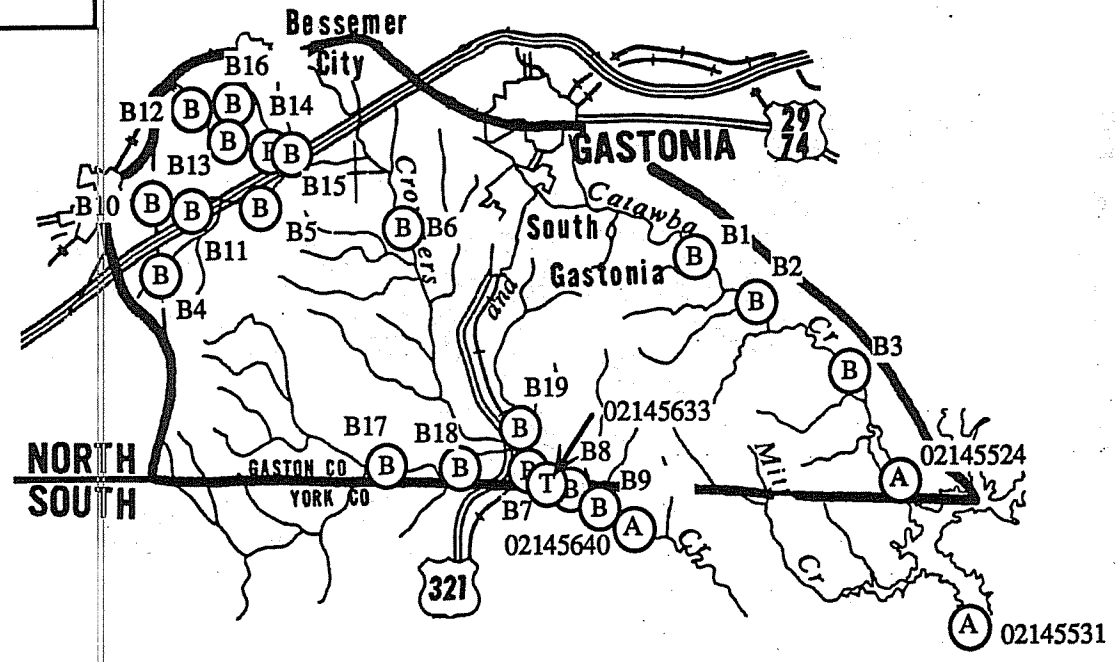


Figure 4.25 Water Quality Monitoring Stations in Subbasin 03-08-37 (Crowders and Catawba Creeks)

4.4.9 Subbasin 38 - Waxhaw Creek

Description

Catawba subbasin 38 is located in the Piedmont ecoregion of North Carolina, and includes portions of two geologic regions: the Charlotte Belt and the Carolina Slate Belt (Figure 4.26). This small subbasin includes Sixmile Creek, Waxhaw Creek, and Twelvemile Creek. These streams have very low flows during summer drought periods.

Overview of Water Quality

Nonpoint source runoff (agriculture) is the principle source of water quality degradation in this subbasin, although low flow conditions during the summer also limit the diversity of stream fauna. Three benthic macroinvertebrate sites have indicated Good-Fair bioclassifications for Twelvemile, Sixmile and Waxhaw Creeks.

Water chemistry data was collected on both Twelvemile Creek and Waxhaw Creek. Values for fecal coliforms were exceeded six times or in 30% of the samples collected from Twelvemile Creek. Turbidity violations in Twelvemile and Waxhaw Creeks were detected in nine and 31% of the samples, respectively. Elevated levels of total phosphorus were found in both creeks, most likely because of non-point source contributions. Both creeks contained concentrations of copper and iron greater than the action levels, although these elements are naturally occurring in piedmont soils.

Potential HQW/ORW Streams

Although streams in this subbasin support some unusual mussels, DEM sampling has not identified any ORW/HQW sites. Waxhaw Creek has been suggested as critical habitat for the Carolina Heelsplitter (*Lasmigona decorata*), a federally and state-listed endangered mussel species.

Catawba River Basin
030838

Legend

- (A) Ambient Monitoring Station
- (B) Benthic Macroinvertebrate Site

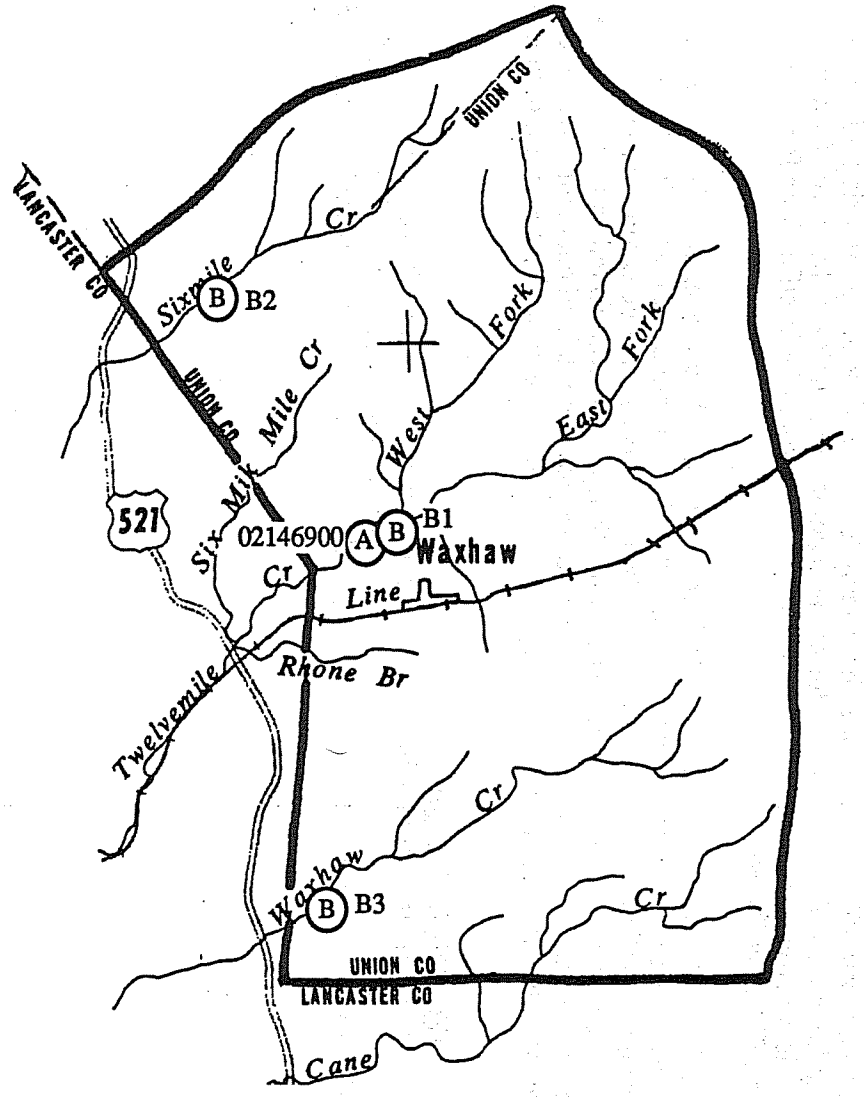


Figure 4.26 Water Quality Monitoring Stations in Subbasin 03-08-37, Waxhaw Creek (Union County region)

4.5 USE-SUPPORT: DEFINITIONS AND METHODOLOGY

4.5.1 Introduction to Use Support

Determining the *use support* status of a waterbody, that is how well a waterbody supports its designated uses, is another important method of interpreting water quality data and assessing water quality. Use support assessments are presented in Section 4.6 using figures, tables and maps for freshwater streams and lakes within the Catawba River Basin. The methodology used in determining use support is presented in Appendix IV.

Surface waters (e.g. streams, lakes and impoundments) are rated as either *fully supporting* (S), *support-threatened* (ST), *partially supporting* (PS), or *nonsupporting* (NS). The terms refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are being fully supported, partially supported or are not supported based on assessment of water quality. The support-threatened category for freshwater rivers and streams refers to those waters classified as Good-Fair based on water quality data, in contrast to Excellent or Good which are considered fully supporting. An overall support rating, however, does include both fully supporting and support-threatened waters. Streams which had no data to determine their use support were listed as non-evaluated (NE).

For the purposes of this document, the term *impaired* refers to waters that are rated either partially supporting or not supporting their uses based on specific criteria discussed more fully below. There must be a specified degree of degradation before a stream is considered impaired. This differs from the word impacted, which can refer to any noticeable or measurable change in water quality, good or bad.

4.6 USE SUPPORT RATINGS FOR THE CATAWBA BASIN

Use support ratings and background information for all monitored stream segments are presented in Table 4.3. Ratings for all monitored and evaluated surface waters are presented on color coded maps in Figures 4.27 and 4.28.

4.6.1 Freshwater Streams and Rivers

Of the 3042 miles of freshwater streams and rivers in the Catawba basin, use support ratings were determined for 90% or 2737 miles with the following breakdown: 52% were rated fully supporting, 22% support-threatened, 12% partially supporting, four percent not supporting, and 10% nonevaluated. Table 4.4 and Figure 4.29 present the use support determinations by subbasin. In general, subbasins 30, 31, 32, 33, 35 and 36 had a majority of their streams which were either supporting or support-threatened. While subbasins 34, 37 and 38 had a larger percentage of streams which were partially supporting or not supporting.

Probable causes and sources of impairment were determined for about 90% of the impaired streams with the information summarized in Table 4.5 and 4.6. When a stream segment had more than one cause or source listed, the total stream segment information was added to each cause or source. This means that the miles of stream impaired by the combination of all sources or all causes may be more than the total miles of partially and not supporting streams presented in Table 4.5 Where the sources of impairment could not be identified, no mileage for that segment was entered into the table. Sediment was the most widespread cause of impairment, followed by fecal coliform bacteria, turbidity, and metals.

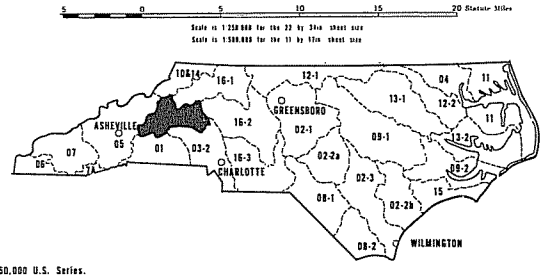
Catawba #1

Supporting

Supporting - threatened

Partially Supporting

Not Supporting



Adapted from U.S.G.S.[A.M.S.] 1:250,000 U.S. Series.

CATAWBA RIVER BASIN (UPPER) 03-1

Catawba River Basin #1

Figure 4.27 Use Support Map for the Upper Catawba River Basin

N.C. Department of Environmental, Health, and Natural Resources

Division of Environmental Management Water Quality Section

Catawba #2

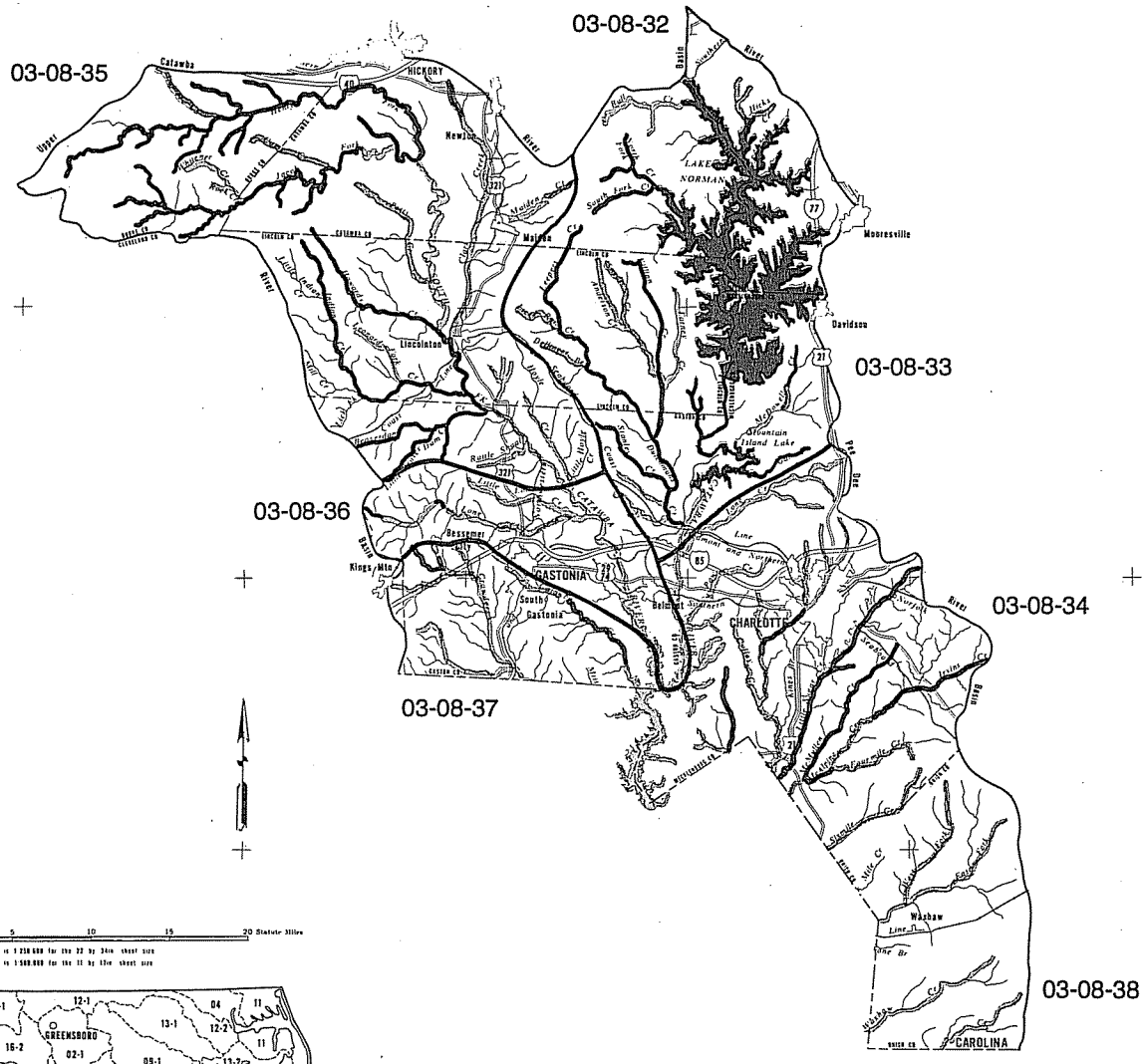

03-08-35
03-08-32
03-08-33
03-08-36
03-08-37
03-08-34
03-08-38
HICKORY
Newton
Lincolnton
Mooresville
Davidson
GASTONIA
CHARLOTTE
CAROLINA
LAKE NORMAN
Mountain Island Lake
Catawba
Upper
Yadkin
River
Kings Mtn
Bessemer City
South Gastonia
Belmont
Waxhaw
Line Br
Sugar Creek
Little Sugar Creek
Irwin Cr
Long Cr
Mill Cr
Steele Cr
Reedy Cr
Rocky Cr
Clarke Cr
Dutchman Cr
Fishing Cr
Beaverdam Cr
Leeper Cr
Jacob Fork
Lyle Cr
Mallard Cr
Duck Cr
Little Duck Cr
Long Cr
Crowder Cr
Mill Cr
Little Mill Cr
Sugar Cr
Little Sugar Cr
Dutch

Table 4.3 Monitored Stream Segments in the Catawba River Basin (1988-1992) (1 of 3)

Station Number	Station Location	WQ Class.	Index No.	Miles	Chem Rating 89-93	Biological Rating 88	89	90	91	92	Problem Param.	Overall Rating	Source
SUBBASIN 30													
0213649985	Catawba River at SR-1273	C Tr	11-(1)	7.5	S							S	
	Mill Cr at Graphite ab RR bridge, McDowell	C Tr	.	8.2						E		S	
0213734850	Catawba Rv at 1234	C	11-(8)b	1.0	S			G		E		S	
02137513	Catawba R at I-40 near Old Fort, McDowell Co	C	11-(8)c	1.3	NS						Hg(30)	NS	
02137727	Catawba River near Pleasant Gardens, SR-122	C	11-(8)d	13.7	PS	G-F		E		G	Fecal(14.3)	S	P
	Catawba Cr be Newberry Cr, McDowell	C Tr	11-10a	5.0						G		S	
	Crooked Cr, SR 1135, McDowell	C	11-12	15.6						G		S	NP
	Mackey Cr, SR 1453, Mcdowell	C HQW	11-15-(2)	0.3						E		S	NP,P
	Buck CrNC 80, ab Lake Tahoma McDowell	WS-II B Tr	11-19-(1)a	5.4						G		S	
	Little Buck Creek SR 1436McDowell Co.	WS-II B Tr	11-19-11	3.8					E	E		S	
	Toms Cr, SR 1434 McDowell Co.	C	11-21-(2)	5.5						E		S	P
	North Fork Catawba River at Linville Caverns	C Tr	11-24-(1)a	3.5					G			S	NP
	North Fork Catawba at NC 221, McDowell Co	C Tr	11-24-(1)b	3.3					G			S	
	North Fork Catawba at SR-1573, McDowell Co	C Tr	11-24-(1)c	5.4					G			S	
	North Fork Catawba at SR-1560, McDowell Co	C Tr	11-24-(1)d	3.0					E	E		S	
	Laurel Branch at NC 221, McDowell	C Tr	11-24-3	2.3					G			S	NP
	Pond Branch at SR-1560, McDowell Co.	C Tr	11-24-4	2.3					G			S	NP
	Stillhouse Br, SR 1560, McDowell	C Tr	11-24-6	2.2					G			S	NP
	Honeycutt Creek at SR 1568 McDowell	C Tr	11-24-8	4.7					G			S	
	Pepper Creek at NC 221	C Tr	11-24-10	3.9					G			S	NP
02138133	N. Fk Cataw SR 1552 nr Hankins, McDowell	C	11-24-(13)	6.6	S							S	NP
	Armstrong Cr, end of FS Rd, McDowell	WS-II Tr	11-24-14-(1.	8.7						E		S	
	Linville River nr Brier Knob	C Tr	11-29-(1)a	3.7			G-F					ST	NP
	Linville River NC 221, Avery Co.	C Tr	11-29-(1)b	34.6			G-F			G		S	NP,P
	W. Fork Linville River at SR-1349, Avery Co.	C Tr	11-29-4	3.6			G					S	
	Granmother Creek at SR,1511 Avery	B Tr	11-29-5-(1)	4.0			G					S	
02138500	Linville River near Nebo, NC Hwy 126	WS-V B HV	11-29-(23)	0.7	S		E	E	E	E		S	NP
02139036	Catawba River near Glen Alpine, SR-1147	WS-IV	11-(31)	10.8	S	G						S	
	Copernig Creek at SR-1819	C	11-32-1-4a	4.2				F				PS	NP
	Copernig Creek at SR-1794	C	11-32-1-4b	0.5				P				NS	NP
	North Muddy Creek at SR-1750	WS-IV	11-32-1-(10.	2.2						G		S	NP
0213875850	High Shoals Creek at Dysartsville	C	11-32-2-6	2.6	NS						Hg(27.3)	NS	
	S Muddy Cr, SR 1764 McDowell	WS-IV	11-32-2-(8.5	4.8						G-F	Sed	ST	NP
SUBBASIN 31													
	Catawba R, NC 181 Burke	WS-IV	11-(32.7)	3.8						G		S	
	Canoe Cr SR 1250, Burke	WS-IV	11-33-(2)	5.3						G-F	Sed	ST	NP
	Silver Cr SR 1149, Burke	C	11-34-(0.5)	13.7						G-F	Sed	ST	NP
	Clear Cr., ab Hospital Res., Burke Co.	C HQW	11-34-6-(1)	2.0					G		Sed	S	NP
	Bailey Fk, SR 1102, Burke	WS-IV	11-34-8-(3)	2.0						G-F	Sed	ST	NP
	Upper Creek at NC 181, Burke Co.	WS-III Tr C	11-35-2-(1)a	1.5		E						S	NP
	Upper Cr at Grntn Jeep Tr., Burke Co.	WS-III Tr C	11-35-2-(1)b	8.1		G	G					S	
	Timbered Branch at USFS Rd 928, Burke Co.	WS-III Tr H	11-35-2-9	2.3		G-F						ST	
	Upper Creek Ab Optimists Park, Burke Co.	WS-III B T	11-35-2-(10)	3.9		E						S	NP
	Steels Cr, Little Frk USFS Rd 128	WS-III Tr C	11-35-2-12-(	5.8		E		E				S	
	Gingercake Creek at USFS Rd 496, Burke Co.	WS-III Tr C	11-35-2-12-3	2.5		E		E				S	
	Buck Creek at USFS Rd.	WS-III Tr C	11-35-2-12-4	2.3				E				S	
	Steels Creek Above NC 181, Burke Co.	WS-III B T	11-35-2-12-(	2.8		G		E				S	
	Little Fork at USFS Rd 128, Burke Co	WS-III Tr C	11-35-2-12-6	3.1		E						S	

Table 4.3 Monitored Stream Segments in the Catawba River Basin (1988-1992) (2 of 3)

Station Number	Station Location	WQ Class.	Index No.	Miles	Chem Rating 89-93	Biological Rating 88	89	90	91	92	Problem Param.	Overall Rating	Source
	Upper Creek at SR-1407,	WS-III B T	11-35-2-(13)	1.6		G						S	
	Upper Creek at SR 1439	WS-III B T	11-35-2-(13)	3.9		G						S	
	Johns River at SR -1367, Caldwell	B	11-38-(9)	10.2			G			E		S	NP
	Anthony Cr, Avery/Caldwell Co.,ab Gragg	C Tr	11-38-10-3a	1.8			G-F					ST	NP
	Anthony Creek, SR 1362, Caldwell	C Tr	11-38-10-3b	2.8			G					S	NP
	Johns River, SR 1356 Caldwell Co	C	11-38-(28)	22.3			G			E		S	NP
	Mulberry Cr, SR 1368, Caldwell	B HQW	11-38-32-(11	2.4			E					S	
	Mulberry Cr, SR 1310, Caldwell	C	11-38-32-(15	5.3			G					S	
02140304	Wilson Cr nr Gragg, US 221, Avery	B Tr ORW	11-38-34a	0.6	PS	E		E			pH(25)	S	
0214031250	Wilson Cr at SR1358, Edgemont, NC, Cald.	B Tr ORW	11-38-34b	22.5	PS		E		E		pH(20)	S	
0214042720	N. Harper Cr near Kawana, USFS #58	C Tr ORW	11-38-34-14	6.1	PS						Hg(20)	PS	
	Johns River at SR-1438,Burke Co.	C HQW	11-38-(34.5)	4.8			E					S	
02141245	Lower Creek near Morganton, SR-1501	WS-IV	11-39-(6.5)	6.6	NS			F		F	Fecal, Sed	PS	NP,P
	Smokey Cr, SR 1515 Burke Co	WS-IV	11-41-(1)	7.4						G	Sed	S	NP
	McGilliard Cr, Church St, Burke Co	WS-IV	11-44-(0.5)	4.3						G-F	Sed	ST	NP
SUBBASIN 32													
	Upper Little R, SR 1744, Caldwell	WS-IV	11-58-(5.5)	7.9						G		S	NP
	Middle Little R, SR 1153, Alexander	C	11-62	21.5						G		S	
	Duck Cr, NC 127, Alexander	C	11-62-2-(4)	4.6						G-F	Sed	ST	NP
02142000	Lower Little R at Sr1313 nr All Healing Sprgs	C	11-69a	8.2	NS	G-F					Fecal,Sed	ST	NP
	Lower Little River at Sr-1131	C	11-69b	15.8						G	Sed	S	NP
	Muddy Fk, ab Schneider Mills Alexander	C	11-69-4a	5.5						G-F	Sed	ST	NP
	Muddy Fk, be Schn. Mills, NC 16, Alexander	C	11-69-4b	1.6						F	Sed	PS	NP,P
	Elk Shoal Cr, SR 1605, Alexander	WS-IV	11-73-(1.5)	4.8						G-F	Sed	ST	NP
	Lyle Cr, NC 64/70, Catawba Co	WS-IV	11-76-(3.5)	6.4						G	Sed	S	NP
0214253830	Norwood Creek near East Monbo, SR-1328	WS-IV CA	11-82-(3)	0.6	S						Sed	S	NP
SUBBASIN 33													
	McDowell Creek at SR-2136, Mecklenburg	WS-IV	11-115-(1.5)	5.0				F			Sed	PS	
	McDowell Creek at SR-2128, Mecklenburg	WS-IV	11-115-(1.5)	3.0				G-F			Sed	ST	
	Gar Cr, SR 2074, Mecklenburg	WS-IV	11-116-(1)	3.5						G		S	
02142808	Catawba R, Near Thrift/NC-27,Meck.	WS-IV CA	11-(117)	5.9	S							S	
0214272204	Dutchmans Cr at Mt. Island, SR-1918	WS-IV	11-119-(0.5)	7.2	PS	E				E	Turb,Fecal	S	NP
	Killian Cr, SR 1511, Lincoln Co	C	11-119-2-(0.	14.7						F		S	NP,P
SUBBASIN 34													
02142900	Long Creek near Paw Creek, SR-2042	WS-IV	11-120-(2.5)	8.4	PS		G-F				Fecal,Turb	ST	
	Sugar Cr bel. WWTP, SR 1156, Meck.	C	11-137a	0.2						P	Sed	NS	NP
02146381	Sugar Creek at NC HWY 51 at Pineville, NC	C	11-137b	11.9	PS						Fecal, Sed	PS	NP, P
02146800	Sugar Creek near Fort Mill, SC Hwy 160	C	11-137c	8.8	NS	P		F	F	G-F	Fecal,Turb,Se	ST	NP
	Irwin Cr at NC 21/SR 2523, Meck.	C	11-137-1a	7.3				G-F				ST	NP,P
02146300	Irwin Cr nr Charlotte & ab WWTP, Meck.	C	11-137-1b	4.5	NS					P	Fecal,Turb(12	NS	NP
	Stewart Creek at SR 2050, Mecklenburg	C	11-137-1-2	0.6				F				PS	NP
	McCullough Br at NC 51, Mecklenburg Co.	C	11-137-7	2.6				P				NS	P
02146530	Little Sugar Creek at Pineville, US Hwy 51	C	11-137-8b	4.6	NS					P	Fecal,NH3,Se	NS	NP
02146600	McAlpine Creek at SR 3356	C	11-137-9a	8.3	NS						Fecal,Turb,Se	NS	NP
02146750	McAlpine Creekat NC 51, Meck	C	11-137-9b	6.3	S					F	Sed	PS	NP
0214676115	McAlpine Cr at Dorman Rd, SC (SR 2964)	C	11-137-9d	1.1	NS					F	Fecal,NH3,Se	PS	NP
	Walker Branch at NC 49, Mecklenburg Co.	C	11-137-10-1	3.2				G-F				ST	
SUBBASIN 35													
02143069	S Fork Cataw R near Startown, NC Hwy 10	WS-IV	11-129-(0.5)	16.5	NS	G-F		F		G-F	Fecal,Turb, Se	ST	NP

Table 4.3 Monitored Stream Segments in the Catawba River Basin (1988-1992) (3 of 3)

Station Number	Station Location	WQ Class.	Index No.	Miles	Chem Rating 89-93	Biological Rating 88	89	90	91	92	Problem Param.	Overall Rating	Source
	Henry Fork, be He Cr, and SR 1922	C ORW	11-129-1-(2)	7.2		E						S	NP
	He Cr, source to Morganton Water Supply	WS-I ORW	11-129-1-4-(	2.6		E						S	NP
	Ivy Creek, source to Henry Fork,SR-1919	C Tr +	11-129-1-6	2.1		G						S	NP
	Long Branch at SR-1917	C ORW	11-129-1-8	3.6		E						S	NP
	Rock Creek SR 1915, Burke	C +	11-129-1-12	4.8		G						S	NP
	Henry Fork , NC 18 Burke Co	C	11-129-1-(2)	14.7		E						S	
02143000	Henry Fk nr Henry R, SR-1124, Catawba Co	C	11-129-1-(12	10.2	PS		G			G	Fecal(19)	S	
02143027	Henry Fk, SR1143 nr Brookford, Cataw Co	C	11-129-1-(12	8.0	NS						Fecal,Turb	NS	NP
	Jacob Fork at SR1904 Burke and In Park	WS-III Tr C	11-129-2-(1)	7.8				E				S	
	Shinny Creek at In Park, Burke Co.	WS-III Tr C	11-129-2-3	3.5				E				S	NP
02143040	Jacob fork at Sr 1924 at Ramsey, NC	WS-III ORW	11-129-2-(4)	6.6	S			E		E		S	
	Howard Cr SR 1200 Lincoln Co	WS-IV	11-129-4	13.3						G		S	NP
	Clark Cr SR 1149 Catawba	C	11-129-5-(0.	2.7						G-F		ST	NP
	Clark Creek at SR-2014, Catawba Co.	C	11-129-5-(0.	3.6				F				PS	NP
	Clark Creek at SR-2012, Catawba Co.	WS-IV	11-129-5-(4.	1.0				F				PS	NP
02143260	Clark Creek at Lincolnton, at Grove Street	WS-IV	11-129-5-(4.	5.5	NS	F				F	Cu,Turb,Fecal	PS	NP, P
02143500	Indian Creek near Laboratory, SR-1252	WS-IV	11-129-8-(5)	8.4	NS			G-F		G	Fecal,Turb, Se	S	P
SUBBASIN 36													
02145112	S Fork Catawba River at McAdenville, NC 7	WS-V	11-129-(15.5	9.3	NS		G-F			G-F	Fecal,Turb	ST	NP
	Long Creek at SR-1408, Gaston Co.	WS-II CA	11-129-16-(2	0.7						G		S	NP
	Long Creek at SR-1405, Gaston Co.	WS-II CA	11-129-16-(2	1.1					G	G-F		ST	NP
	Long Creek at NC 274, Gaston Co.	C	11-129-16-(4	0.4					G-F	G-F		ST	
	Long Creek at SR-1446, Gaston Co.	C	11-129-16-(4	2.8					Goo	G-F		ST	
	Long Creek at SR-1448, Gaston Co.	C	11-129-16-(4	0.5					G	G		S	
02144000	Long Crk Near Bessemer City, NC 1456	C	11-129-16-(4	2.7	NS			G-F			Fecal(90)	ST	
	Long Cr at NC 275	C	11-129-16-(4	0.7					G-F	G-F		ST	
	Long Cr bel WWTP & at SR2003, Gaston	C	11-129-16-(4	7.7				F				PS	NP,P
	Dalls Br, ab Dallas WWTP, Gaston	C	11-129-16-7a	1.1						G-F		ST	NP
	Dallas BR, be Dallas WWTP, SR 2275, Gaston	C	11-129-16-7b	0.8						F		PS	NP
SUBBASIN 37													
	Catawba Creek at SR-2446	C	11-130a	6.1				F			Sed	PS	NP
	Catawba Creek at SR-2439	C	11-130b	2.9				P				NS	NP,P
02145640	Crowders Cr, Bowling Grn, SC <SR2424	C	11-135g	7.2	NS	P	F			G-F	Fecal, Sed	ST	NP
	Crowders Creek at SR-1118, Gaston Co.	C	11-135a	1.8			G-F					ST	NP
	Crowders Creek at SR-1125, Gaston Co.	C	11-135b	1.7			F					PS	NP
	Crowders Creek at SR-1131, Gaston Co.	C	11-135c	4.5			F					PS	NP
	Crowders Creek atNC 321, Gaston Co.	C	11-135e	1.4			F					PS	NP
	Crowders Creek at SR 2424	C	11-135f	1.4			F					PS	P
	McGill Creek above and below WWTP	C	11-135-2	2.4			P					NS	
	Abernathy Cr above Lithium Corp disch	C	11-135-4a	2.2			F					PS	NP
	Abernathy Cr bel Lithium Corp disch	C	11-135-4b	2.2			P					NS	P
	UT to Crowders Creek at SR-2416	C	11-135-8.5	0.4			F					PS	
	S Fk Crowders Cr at SR-1109, Gaston	C	11-135-10-1	4.5			G-F					ST	
SUBBASIN 38													
02146900	Twelvemile Cr nr Waxhaw, NC Hwy 16	C	11-138a	2.8	NS		G-F	G-F			Fecal(30)	ST	NP
	Sixmile Cr,m SR 3445, Mecklenburg	C	11-138-3	9.2							Sed	PS	NP, P
02147126	Waxhaw Creek near Jackson, SR-1103	C	11-139	16.0	NS					G-F	Turb,Cu	ST	NP

Table 4.4 Use Support Ratings for Freshwater Streams by Subbasin

USE SUPPORT STATUS FOR FRESHWATER STREAMS (MILES) (1988-1992)						
Subbasin	S	ST	PS	NS	NE	Total Miles
30830	535.5	65.6	25.1	4.4	18.9	649.5
30831	481.2	79.9	68.8	0.6	54.9	685.4
30832	179.4	188.5	69.3	14.6	32.1	483.9
30833	106.5	21.3	21.7	0	17.9	167.4
30834	0	107.6	39.7	78.3	31.9	257.5
30835	254.1	104.5	70.3	12.1	55.3	496.3
30836	8.3	52.6	8.5	0	0	69.4
30837	0	24.2	21.9	14	21.3	81.4
30838	0	36.3	42.4	0	72.5	151.2
TOTAL	1565	680.5	367.7	124	304.8	3042
PERCENTAGE	52	22	12	4	10	

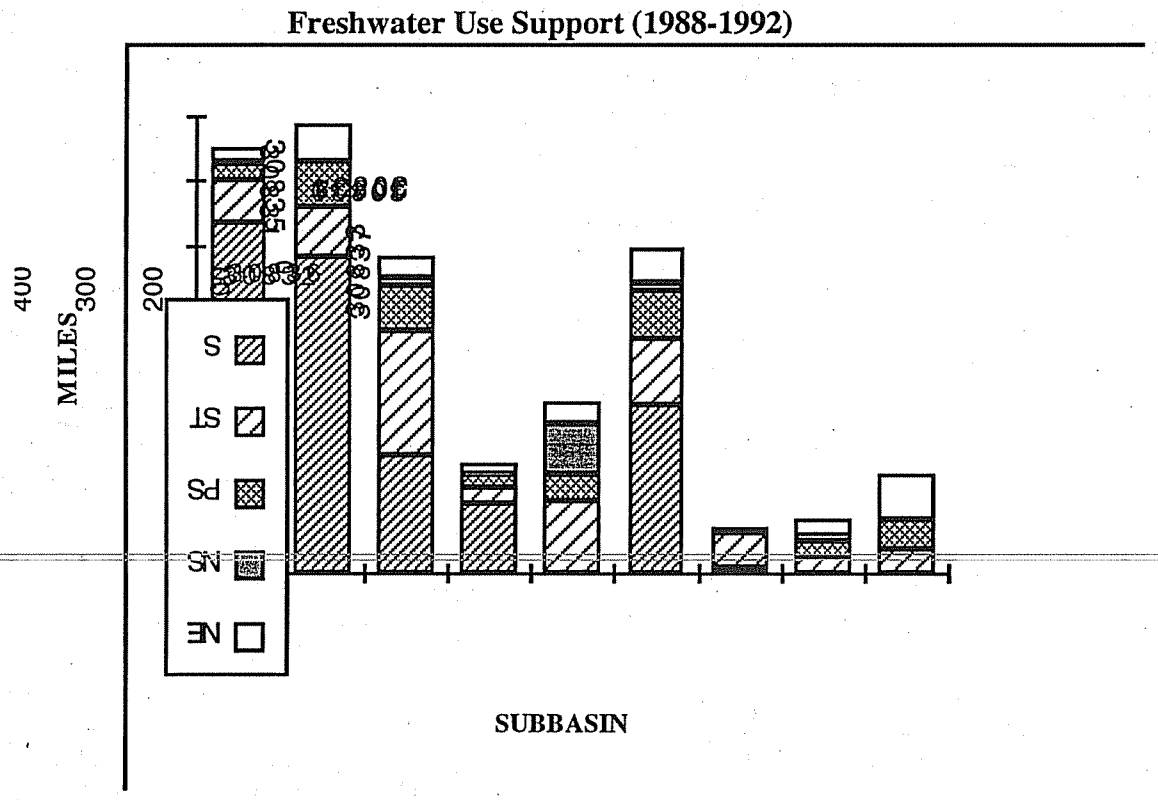


Figure 4.29 Bar Graph Showing Freshwater Use Support Distribution by Subbasin

Table 4.5 Sources of Use Support Impairment in Freshwaters of the Catawba Basin

PROBABLE SOURCES OF USE SUPPORT IMPAIRMENT (MILES)										
Subbasin	Non-Point Source	Point Source	Agriculture	Forestry	Constr.	Urban	Mining	Land Disposal	Unknown	Other
30830	21.7	0	6.1	0	0	4.2	0	0	11.4	0
30831	61.2	6.6	55	17.9	33.6	11.7	0	11.1	0	17.9
30832	71.8	18	63.2	0	8.4	4.2	0	4.2	4.4	0
30833	16.7	0	16.7	0	0	0	0	0	0	0
30834	114.8	11.9	6	0	73.1	64.4	0	10.8	0	8.8
30835	76.7	20.7	73.9	15.8	0	11.9	0	12.1	34.2	0
30836	8.5	7.7	8.5	0	0	0.8	0	0	0	0
30837	27.5	4.3	0	0	0	14	0	13.5	0	0
30838	42.4	9.2	15.4	0	22.4	0	13.8	0	0	0
Total Miles	441.3	78.4	244.8	33.7	137.5	111.2	13.8	51.7	50	26.7
% of PS and NS	90	16	50	7	28	23	3	11	10	5

* **Total Miles** = miles of impaired streams where a probable source has been identified.
** **PS** = Partially supporting; **NS** = Not supporting; PS and NS = Impaired streams.
Total miles of impaired streams (PS+NS) = 492 miles

Table 4.6 Major Causes of Use Support Impairment in Freshwaters in the Catawba Basin

CAUSES OF USE SUPPORT IMPAIRMENT (MILES)					
Subbasin	NH3	Fecal	Sediment	Turbidity	Metals
30830	0	0	14.7	0	3.9
30831	0	6.6	48.8	0	6.1
30832	0	0	77.1	0	0
30833	0	0	21.7	0	0
30834	5.7	30.4	109.7	12.8	0
30835	0	13.5	51.4	13.5	5.5
30836	0	0	0	0	0
30837	0	0	10.6	0	0
30838	0	0	42.4	0	0
Total Miles	5.7	50.5	376.4	26.3	15.5
% of PS and NS	1	10	77	5	3

Information on sources of impairment for stream miles rated partially or not supporting indicated that 441 stream miles were impaired by nonpoint sources, and 78 stream miles were impaired by point sources. Agriculture was the most widespread nonpoint source, followed by construction, and urban runoff. Subbasins 35 and 32 had the highest number of streams thought to be impaired by agriculture and subbasins 34 and 31 had the highest number attributed to construction.

4.6.2 Lakes

Twelve lakes in the Catawba Basin, totaling 46,985 acres, were monitored and assigned use support ratings (Table 4.7). Of these 12, nine are fully supporting their uses, and three are support-threatened. Following is a brief summary of the lakes and their use support information.

Lake James fully supported all designated uses as of 1992. Portions of Lake James include WS-V, B, and C classifications. The lake continues to provide the local area with a valuable resource for recreation and source of water supply. However, controversy currently exists concerning the development of the watershed and potential impacts this development may have on the aesthetic beauty and water quality in the future.

Lake Tahoma fully supported all designated uses as of 1992. Lake Tahoma is currently classified WS-I, B-Tr, and is used for recreation. It was sampled in 1990 and 1992, which showed that nutrients and chlorophyll a were low and the water column was stratified and slightly acidic.

Lake Rhodhiss fully supported all designated uses as of 1992. It is currently classified as WS-IV, B CA, and is used for recreation and for the generation of hydroelectric power. At the time DEM sampled Lake Rhodhiss in 1989 and 1992, the lake was moderately stratified with partial mixing at the shallow upper reaches with more defined stratification at the deeper, lower end of the impoundment. Lake Rhodhiss has a trophic status of eutrophic, and in 1992 the upper end of the lake had elevated nutrient levels. AGPT results from August 1985 indicated that the lake was co-limited by nitrogen and phosphorus. The Town of Valdese and the Morganton wastewater treatment plant and the Town of Lenoir water treatment plant discharge directly into Lake Rhodhiss.

Lake Hickory is support threatened for its overall use as of 1992. It is currently classified as WS-IV, B CA, is used primarily for hydroelectric power, and is also used for recreation and as a water supply source. Results of the most recent sampling in 1992 show some elevated levels of chlorophyll a and total phosphorus (TP). Despite consistent TSI's at eutrophic levels, Lake Hickory is ranked as mesotrophic. This is due to the short retention time of the lake and low estimates of phytoplankton density and biovolume.

Little River Dam Reservoir fully supported all designated uses as of 1992. It is classified as WS-IV, and is used primarily for fishing. From sampling in 1990 to 1992, a decrease in chlorophyll a concentration indicated lower phytoplankton productivity, and significant decreases were also observed in all nutrient levels. There was also a substantial increase in the Secchi disk transparency. Changes observed in the 1992 samples resulted in a trophic status change from eutrophic in 1990, to its current status of mesotrophic.

Lookout Shoals Lake fully supported all designated uses as of 1992. The lakes classification ranges from WS-V from Oxford Dam to Island Creek, to WS-IV, B CA from Lookout Shoals Dam to half-mile upstream of the dam. It is used for generation of hydroelectric power and recreation. Sampled in 1989 and 1992, the past years TSIs of the lake have been borderline between mesotrophic and eutrophic. With its latest TSI of 0.7, Lookout Shoals Lake is currently ranked as eutrophic.

Table 4.7 Lakes Use Support Status and Causes and Sources of Impairment

LAKE NAME	County	SIZE (Acres)	CLASS	Overall Use	Fish Con sump	Aq. Life Second Cont	Swim ming	Drink ing Water	Trophic Status	Problem Parameters
Subbasin 30830										
LAKE JAMES	Burke	6510	WS,B,C	S	S	S	S	S	MESO	
LAKE TAHOMA	MdDowell	161	WS,B-Tr	S	S	S	S	n/a	OLIGO	
Subbasin 30831										
LAKE RHODHISS	Burke/Cald	3515	WS,B-CA	S	S	S	S	S	EUTRO	
Subbasin 30832										
LAKE HICKORY	Alex/Cataw	4100	WS,B-CA	ST	S	ST	S	S	EUTRO	
LAKE NORMAN	Meckl/Linc	32510	WS,B	S	S	S	S	S	OLIGO	
LITTLE RIVER DAM (Icard)	Alexander	162	WS-CA	S	S	S	n/a	S	MESO	
LOOKOUT SHOALS LK.	Cataw/Irede	1270	WS,B	S	S	S	S	S	EUTRO	
Subbasin 30833										
MOUNTAIN ISLAND LK.	Meckl/Gasto	3235	WS,B	S	S	S	S	S	OLIGO	
Subbasin 30834										
LAKE WYLIE (NC)	Meckl/York	6000	WS,B	ST	S	ST	S	S	EUTRO	NUTR.,EUTR.
Subbasin 30835										
MAIDEN LAKE	CATAWBA	23	WS	ST	S	ST	n/a	S	MESO	TURB.,NUTR.
NEWTON CITY LAKE	CATAWBA	17	WS-CA	S	S	S	n/a	S	OLIGO	
Subbasin 30836										
BESSEMER CITY LAKE	GASTON	15	WS	S	S	S	n/a	S	OLIGO	

Lake Norman fully supported all designated uses as of 1992. It is classified as WS-IV, B CA, and is used to power hydroelectric generators at Cowans Ford Dam and to cool the steam that powers the turbines at the Marshall Steam Station and McGuire Nuclear Station. It is also used as a water supply source and for recreation. Lake Norman has a trophic status of oligotrophic as a result of the most recent sampling in 1992.

Mountain Island Lake fully supported all designated uses as of 1992 although recent data collected by Duke Power and Mecklenburg County have shown elevated levels of nutrients entering the lake from McDowell Creek. A study is currently being conducted by DEM and the County to determine the sources. The lake is classified as WS-IV, B, CA and serves as a water supply for the City of Charlotte and as a hydroelectric power source for two power stations. The 1992 TSI showed the lake to be oligotrophic, although previous years TSIs suggested a ranking of mesotrophic.

Lake Wylie is support threatened for its overall use as of 1992 due to conditions related to eutrophication primarily in the Catawba Creek, Crowders Creek and South Fork Catawba River arms. The lake is used for hydroelectric power, recreation, and water supply. DEM has sampled Lake Wylie from 1981 through 1992, and the trophic status has always been eutrophic. High nutrient levels, periodic algal blooms, and fish kills in many of the tributary embayments have been reported. In 1992, the highest nutrient and chlorophyll *a* values were found in the South Fork Catawba River arm. This arm receives discharges from industrial, municipal and private wastewater treatment plants as well as nutrients from nonpoint sources. Nutrient loadings from the Catawba River mainstem arm have been relatively low and water quality standards have been met consistently over the past five years. One algae bloom was observed in 1989.

Maiden Lake is support threatened for its overall use as of 1992. It is classified as WS-II CA and serves as a water supply for the town of Maiden. The lake was sampled in 1990 and 1992, and showed moderate nutrient levels in both sampling years, but chlorophyll *a* concentrations and turbidity levels were low in 1992. This decrease in chlorophyll a concentrations and turbidity levels in 1992 signified decreased algal growth. The trophic status was changed from eutrophic in 1990, to mesotrophic in 1992.

Newton City Lake fully supported all designated uses as of 1992. It is classified as WS-CA. This lake was sampled in 1992, and results indicated a trophic status of oligotrophic.

Bessemer City Lake fully supported all designated uses as of 1992. It is classified as WS-II and serves as the primary water supply for Bessemer City in Gaston County. Chlorophyll *a* measured in 1992 was low indicating minimal phytoplankton activity. Low turbidity measurements and high Secchi readings indicated good water quality. Trophic status changed from mesotrophic in 1990, to oligotrophic in 1992, which is its current status.

REFERENCES

North Carolina Department of Environment, Health and Natural Resources, 1994, *Basinwide Assessment Report for the Catawba River Basin (draft)*, Division of Environmental Management, Water Quality Section, Environmental Sciences Branch.

South Carolina Department of Health and Environmental Control, 1994, *A Special Water Quality Assessment of Sugar Creek, York and Lancaster Counties, South Carolina and Mecklenburg County North Carolina, Bureau of Pollution Control,* Technical Report No. 004094.

CHAPTER 5

EXISTING POINT AND NONPOINT SOURCE POLLUTION CONTROL PROGRAMS

5.1 INTRODUCTION

This chapter summarizes the point and nonpoint source control programs available for addressing water quality problems in the Catawba River basin. **Sections 5.2 and 5.3**, respectively, describe existing point and nonpoint source pollution control programs. Application of these programs to specific water quality problems and water bodies is presented in Chapter 6. **Section 5.4** discusses integration of point and nonpoint source control management strategies and introduces the concept of *total maximum daily loads* (TMDLs).

5.2 NORTH CAROLINA'S POINT SOURCE CONTROL PROGRAM

5.2.1 Introduction

Point source discharges, which are also described in Section 3.3 in Chapter 3, are not allowed in North Carolina without a permit from the state. Discharge permits are issued under the authority of North Carolina General Statute (NCGS) 143.215.1 and the National Pollutant Discharge Elimination System (NPDES) program which was delegated to North Carolina from the US Environmental Protection Agency (EPA). These permits serve as both state and federal permits. NPDES permits contain effluent limitations which establish the maximum level of various wastes, or pollutants, that may be discharged into surface waters. North Carolina has a very comprehensive NPDES program which includes the following major components:

1. permit review (Section 5.2.2),
2. enforcement and compliance (Section 5.2.3),
3. wasteload allocation modeling (Section 5.2.4),
4. pretreatment (Section 5.2.5),
5. aquatic toxicity testing (Section 5.2.6),
6. operator training and certification (Section 5.2.7), and
7. consideration of nondischarge alternatives including regionalization (Section 5.2.8).

Below is a brief summary of key components of North Carolina's NPDES program.

5.2.2 NPDES Permit Review and Processing

Under the basinwide approach, all discharge permits within a given basin are set to expire and be renewed at about the same time. In the Catawba basin, for example, all of the existing permits are to expire and be renewed between April 1995 and October 1996. The permitting schedule for the Catawba Basin is presented in Chapter 1 for each subbasin. Permits are issued with an effective life of not more than five years, thus basin plans are renewed at five-year intervals. New discharge permits issued during an interim period between cycles will be given a shorter expiration period in order to coincide with the next basin permitting cycle.

DEM will not process a permit application until the application is complete. Rules outlining the discharge permit application and processing requirements are contained in Administrative Code Section: 15A NCAC 2H .0100 - Wastewater Discharges to Surface Waters. Under this rule, all applications must include a summary of waste treatment and disposal options that were considered,

and why the proposed system and point of discharge were selected. The summary is required to have sufficient detail to assure that the most environmentally sound alternative was selected from the reasonably cost effective options.

Also, applications for new discharges which propose to discharge wastewater in excess of 500,000 gallons per day or 10 million gallons per day (MGD) of cooling water or any other proposed discharge of 1 MGD or greater to surface waters must include an *assessment* report in addition to the normal permit application. The assessment is to provide sufficient information to describe the impact of the proposed action on the waters in the area. An Environmental Impact Statement or Environmental Assessment, under the NC Environmental Policy Act may also be required for certain publicly funded projects.

Once an application is considered complete, a staff review is initiated and a wasteload allocation is performed in order to establish permitted waste limits (described in the following section). The staff review includes a site inspection. If the Division finds the application acceptable, then notice of intent to issue the permit is published in newspapers having wide circulation in the local area. The public is given a 30-day period in which to comment, and a public hearing may be held if there is significant public interest. Under Basinwide Management, the public notices will al be issued in generally the same time period for particular subbasins. A public hearing would be scheduled for just those applications where significant public interest is indicated. Copies of the Notice of Intent are also sent to a number of state and federal agencies for comment. For example, the Division of Environmental Health reviews the applications for their potential impact on surface water sources of drinking water. Once all comments are received and evaluated, a decision is made by the Director of DEM on whether to issue the permit. The final permit will include recommended waste limits and other special conditions which may be necessary to ensure protection of water quality standards.

5.2.3 Establishing Discharge Permit Effluent Limitations/Wasteload Allocations

As noted above, effluent limitations, or waste limits as they are sometimes called, dictate the amounts of wastes (pollutants), that are allowed to be discharged into surface waters under an NPDES permit. Where a discharge permit is required, an evaluation is conducted to determine the projected impact of the discharge on the receiving waters. This determination, called a wasteload allocation (WLA), is often based on computer modeling which considers such factors as the rate of waste flow, the type of waste to be discharged, and characteristics of the receiving waters (e.g. rate and quantity of flow, waste assimilative capacity, channel configuration, rate of reaeration, water quality classification, etc.). Permit limits that are determined by models are called water quality-based limits. Permits may also be based on federal effluent guidelines established by the USEPA.

Wasteload allocations are performed by DEM using models of varying scope and complexity, depending on the parameter (type of waste) of interest and the characteristics of the receiving waters. Model frameworks, which are discussed in more detail in Appendix III, can range from simple mass balance analyses to 3-dimensional dynamic water quality models. Modeling fits into the basin plan by drawing on the current conditions within the basin and evaluating the effects of various management strategies. In general terms, modeling can be used to determine the fate and transport of pollutants, reduction goals for point and nonpoint sources of environmental contaminants, and to derive effluent limits for NPDES permits. More specifically, models can be used to predict concentrations of a parameter at a given site, such as instream DO or chlorophyll *a* in a lake, and can be used as a tool to determine what is needed to protect instream standards. Uncertainty analysis of water quality models expand the predictive capabilities and the confidence in results, and can produce probabilities that an event would occur under a certain set of circumstances. Waste limits may vary from summer to winter for some parameters, such as nutrients and ammonia, with winter limits being somewhat less stringent than summer limits due to higher instream flows during the winter months.

It should be noted that where point sources are responsible for water quality problems, WLAs offer a solution by yielding appropriate permit limits that offer adequate water quality protection. Where a sole discharge is responsible for the water quality impacts, a simple WLA can be performed and no other discharges need be affected. If the issues are not complex, and a standard WLA analysis was performed, the management practice is to establish limits in accordance with DEM's Standard Operating Procedures (SOP) for Wasteload Allocations manual. The standard procedures have been developed to support State and Federal regulations and guidelines and have been approved by the EPA.

In considering a wasteload for an individual discharge facility, a critical factor is whether the receiving waters have a flow during 7Q10 or 30Q2 conditions in accordance with regulations (15A NCAC 2B .0206). It is DEM's policy not to allow new or expanded discharges into "no flow" streams having a 7Q10 and 30Q2 equal to zero. In addition, existing facilities on such streams will be targeted for removal unless it is determined that there are no reasonable alternatives. If that is the case, and water quality problems are documented, then the facility may be required to meet limits of 5 mg/l BOD_5 and 2 mg/l NH_3N in summer (and 10 mg/l BOD_5 and 4 mg/l NH_3N in winter).

If the water quality issues involve numerous discharges, the Environmental Management Commission, pursuant to NCGS 143-215.1(b)(2), is required to consider the cumulative impacts of all permits in order to prevent violations of water quality standards. Such areas are identified and discussed in Chapter 6. Generally, these are areas where the standard procedures alone do not provide adequate guidance. That is, the standard procedures address mostly single discharges or the relatively simple interaction of several discharges. More complex wasteload allocation procedures outside the realm of the standard procedures are required in developing large watershed or basin scale allocations under the basinwide approach.

5.2.4 Compliance Monitoring and Enforcement

Most dischargers are required to periodically sample the treated effluent from their discharge pipes. Also, many larger and more complex dischargers are required to sample points in the receiving waters both up and downstream from the discharge point. This process is called self-monitoring and it is typically required five days a week for some parameters (Monday through Friday) for major facilities. The sampling results (contained in a daily monitoring report or DMR) are then submitted each month to DEM for compliance evaluations. If the limits are not being met, the state may issue a notice of violation, initiate enforcement action, place the facility on moratorium, and/or enter into a Special Order by Consent (SOC) to ensure compliance. An SOC is a legal commitment entered into by the state and the discharger that establishes a time schedule for bringing the wastewater treatment plant back into compliance. During this time period, interim waste limits may be assigned to the facility until the improvements can be made. These interim limits may be less stringent than those in the permit although they are still required to protect water quality in the receiving waters.

In addition to the DMR data, illegal or improperly treated discharges may be identified in other ways including through third party reports, routine DEM site inspections, and water quality monitoring conducted by DEM staff.

5.2.5 Aquatic Toxicity Testing

There are literally thousands of chemicals or compounds in use today which may enter wastewater systems and eventually be discharged to surface waters. Monitoring the concentration of each of these chemicals individually would be impossible due both to cost/time considerations as well as

the inability of current analytical technique to detect many of them. Even if the existence and potential effects of every constituent of a wastewater were known, the combined effects of these constituents could not be predicted.

North Carolina utilizes an integrated approach to address this problem which relies on chemical specific monitoring, assessment of resident aquatic populations, and analysis of whole effluent toxicity (WET) to control the potential effects of these chemicals and their interactions. Whole effluent toxicity limits allow protection against predicted impacts of toxicants through measurement of those impacts in the laboratory. It is from this same foundation of aquatic toxicity laboratory tests that chemical specific limits and criteria are derived for the majority of chemical toxicants.

Whole effluent toxicity limitations were implemented by North Carolina in February, 1987 through a policy to incorporate these limits in all major and complex minor permits. As of July 1994, there were 548 permitted NPDES discharges in North Carolina required to perform whole effluent toxicity testing, and over 10,000 individual toxicity analyses had been performed across the state. These limitations are developed to protect aquatic life from the discharge of toxic substances in toxic amounts as prescribed by 15 NCAC 2B. 0208 (i.e. so as not to result in chronic toxicity at permitted discharge flow and 7Q10 receiving flow volumes). Since the inception of the aquatic toxicity program a shift in observed WET has been seen from a time when approximately 25% of the facilities tested would be predicted to have been acutely toxic instream to a point now where less than 10% would be considered chronically toxic.

Aquatic toxicity testing, no less than any other complex analytical technique, requires a great deal of quality assurance and quality control to achieve reliable results. In 1988, North Carolina adopted regulations that initiated a program which required all laboratories performing NPDES analyses in North Carolina to be certified by the state as a biological laboratory. As of July 1994, 24 commercial, municipal, and industrial laboratories had achieved this certification in either aquatic toxicity analyses and/or aquatic population survey.

5.2.6 Pretreatment Program

The goal of the pretreatment program is to protect municipal wastewater treatment plants, or publicly-owned treatment works (POTWs), and the environment from the adverse impacts that may occur when hazardous or toxic wastes are discharged into a public sewage system. The pretreatment program is designed to achieve this protection primarily by regulating non-domestic (e.g. industrial) users of POTWs that discharge toxic wastes under the Domestic Sewage Exclusion of the Resource Conservation and Recovery Act (RCRA). In essence, the program requires that businesses and other entities that use or produce toxic wastes pretreat their wastes prior to discharging their wastewater into the sewage collection system of POTW. State-approved pretreatment programs are typically administered by local governments that operate POTWs.

There are four major areas of concern addressed through implementation of a local pretreatment program: 1) interference with POTW operations, 2) pass-through of pollutants to a receiving stream, 3) municipal sludge contamination, and 4) exposure of workers to chemical hazards. Interference may involve any aspect of plant operation from physical obstruction to inhibition of biological activity. The process for developing technically based local pretreatment limits involves determining the maximum amount of each pollutant that can be accepted at the influent, or headworks, of the POTW and still protect the receiving water, the POTW itself, and the POTW's sludge disposal options.

As of 1994, there are approximately 130 approved pretreatment programs, statewide, regulating approximately 1,000 industrial users; with 8 programs in the development stage. In the Catawba River basin, there are 32 POTWs with pretreatment programs regulating 258 industrial users.

5.2.7 Operator Certification and Training Program

Water pollution control systems must be operated by state-certified operators. These systems include: wastewater treatment plants, wastewater collection systems and "non-discharge" ground absorption systems, such as alternative on-site disposal technologies, land application of residuals and spray irrigation facilities. Systems are classified based on system type and complexity and are required to have an appropriately trained and certified operator. The Certification Commission currently certifies operators in four grades of wastewater treatment, four grades of collection system operation, one grade of subsurface operation, and a variety of specialized conditional exams for other technologies. Training and certification programs are also being developed for groundwater remediation.

Training is accomplished in cooperation with the state university and community college system as well as through the professional associations for operators and pollution control professionals. Specialty courses and seminars for operators are also offered by operators' associations and the NC Water Pollution Control Association/American Water Works Association (WPCA/AWWA).

Training and certification of operators is essential to the proper operation and maintenance of pollution control systems. Without proper operation and maintenance, even the most highly designed treatment system will not function efficiently. It is the goal of the Training and Certification Program to provide competent and conscientious professionals that will provide the best wastewater treatment and protect the environment and the public health.

5.2.8 Nondischarge and Regionalized Wastewater Treatment Alternatives

As discussed in section 5.2.2, discharge permit applicants are required to consider other forms or alternatives of wastewater treatment other than discharging into a stream. For some, there may be no other economically feasible alternatives. However, for others, particularly smaller dischargers, there are a number of potentially cost-effective and environmentally sound alternatives. There are several types of non-discharging wastewater treatment systems including spray irrigation, rapid infiltration and trickling systems. Artificial wetlands wastewater systems are also being evaluated in this state. Permit requirements for nondischarging systems are presented in Administrative Code Section 15 NCAC 2H .0200 - Waste Not Discharged to Surface Waters.

Another alternative to a surface water discharge is to tie into an existing wastewater treatment system. Where possible, DEM is encouraging smaller dischargers to connect to large established municipal systems. Regionalization, as this is called, has several advantages. First, large municipal facilities, unlike smaller package type plants, are manned most of the time thereby reducing the potential for plant malfunctions, and where malfunctions do occur, they can be caught and remedied more quickly. Second, these larger facilities can provide a higher level of treatment more economically and more consistently than can smaller plants. Third, the larger plants are monitored daily. And fourth, centralizing the discharges reduces the number of streams receiving effluent. In evaluating future permit expansion requests by regional facilities, DEM will take into consideration the amount of flow accepted by them from the smaller discharges.

In addition to the nondischarging wastewater treatment systems mentioned above, nondischarge permits are also issued for the land application of residual solids (sludge) from wastewater treatment processes.

5.3 NONPOINT SOURCE CONTROL PROGRAMS

Land use control as well as technology-based best management practices (BMPs) are the two most widely used tools for controlling nonpoint source pollution and protecting designated uses of waterbodies. In developing areas, land use control through low density development has often

been selected by municipalities as the preferred method of treatment for urban stormwater because it avoids potential problems with long-term BMP maintenance requirements. In situations where low density development is not feasible or where higher densities are preferred, stormwater control devices (BMPs) are available. These include, but are not limited to stormwater retention and wet detention ponds, vegetated buffer strips along streams, and designated infiltration areas.

Nonpoint source strategies for other categories of pollution (e.g., agriculture, construction, or mining) depend more on the installation of BMPs and waste reduction/management systems. The installation of these BMPs and management systems may be voluntary or required by a set of regulations, depending on the designated management agency. Examples of nonpoint source management approaches that combine land use controls and BMPs include the coastal stormwater regulations and the Water Supply Watershed Protection Program rules.

Once a management strategy is developed for each category of nonpoint source pollution, a schedule can be developed for implementing these strategies for specific geographic areas and waterbodies. It is important to emphasize that management strategies are developed for both highly valued resource waters where a potential for degradation exists and for areas already impacted by nonpoint source pollution.

Regulations or programs are in place which address most categories of nonpoint source pollution (Table 5.1). For example, discharges are not allowed into state waters without a discharge permit from DEM. This includes discharges from septic systems and animal operations. In addition, water quality standards apply to all categories of land-use activities. In the case of the turbidity standard, it is assumed that the standard will be met if proper BMPs are in place, as determined by the appropriate lead nonpoint source agency.

After acceptable BMPs are established and geographic areas or waterbodies are targeted for implementation, steps must then be taken to assure that the chosen management strategies and BMPs are protecting water quality. DEM utilizes both chemical and biological sampling procedures to test the effectiveness of BMPs.

In general, the goals of the nonpoint source management program include the following:

1) Continue to build and improve existing programs,
2) Develop new programs that control nonpoint sources of pollution not addressed by existing programs,
3) Continue to target geographic areas and waterbodies for protection,
4) Integrate the NPS Program with other state programs and management studies (e.g. Albemarle-Pamlico Estuarine Study), and
5) Monitor the effectiveness of BMPs and management strategies, both for surface and groundwater quality.

North Carolina has a variety of statewide programs which are used in the Catawba River Basin and statewide to address nonpoint source pollution. Table 5.1 lists these programs by categories based on the type of activity. Below is a brief overview of existing nonpoint source control efforts for various categories of land use activities.

Table 5.1 Examples of Nonpoint Source Programs

PROGRAM	MANAGEMENT AGENCIES LOCAL	STATE	FEDERAL
AGRICULTURE			
Agriculture Cost Share Program	SWCD	SWCC, DSW	
N.C. Pesticide Law of 1971		NCDA	
Pesticide Disposal Program		NCDA	
Animal Waste Management (15 NCAC 2H .0217)	SWCD	DEM, DSW, CES	NRCS
Laboratory Testing Services		NCDA	
Watershed Protection (PL-566)			NRCS
1985 and 1990 Farm Bills			USDA
- Conservation Reserve Program			
- Conservation Compliance			
- Sodbuster			
- Swampbuster			
- Conservation Easement			
- Wetland Reserve			
- Water Quality Incentive Program			
URBAN			
Water Supply Watershed Protection Program	city, county	DEM	
Coastal Stormwater Program		DEM	
ORW, HQW, NSW Management Strategies		DEM	
Stormwater Control Program	city, county	DEM	EPA
CONSTRUCTION			
Sedimentation and Erosion Control	ordinance	DLR, DOT	
Coastal Area Management Act	ordinance	DCM	
Coastal Stormwater Program		DEM	
ON-SITE WASTEWATER DISPOSAL Sanitary Sewage Systems Program	county	DEH	
SOLID WASTE DISPOSAL			
Resource Conservation and Recovery Act			EPA
Solid Waste Management Act of 1989	city, county	DSWM	
FORESTRY			
Forest Practice Guidelines		DFR	
National Forest Management Act			NFS
Forest Stewardship Program		DFR	
MINING Mining Act of 1971		DLR	
HYDROLOGIC MODIFICATION			
Clean Water Act (Section 404)		DCM, DEM	COE
Rivers and Harbors Act of 1899			COE
Dam Safety Permit		DLR	
WETLANDS			
Clean Water Act (Sections 401 and 404)		DEM	COE
Wetland Reserve Program			USDA

(ABBREVIATIONS: **COE**, US Army Corps of Engineers; **DCM**, Div. of Coastal Mgmt.; **DEM**, Div. of Environ. Mgmt.; **DLR**, Div. of Land Resources; **DFR**, Div. of Forest Resources; **DOT**, Dept. of Transportation; **DSW**, Division of Soil and Water; **DSWM**, Div. of Solid Waste Mgmt.; **NCDA**, NC Dept. of Agric.; **NRCS**, Natural Resources Conservation Service; **SWCC**, Soil and Water Conservation Commission; **SWCD**, Soil and Water Conserv. District; **USDA**, US Dept. of Agric.)

5.3.1 Agricultural Nonpoint Source (NPS) Control Programs

Agricultural BMPs have been developed largely to control the five major agriculturally-related causes of pollution: sediment, nutrients, pesticides, oxygen-demanding substances and bacteria. BMPs vary from site to site and are dependent upon a particular pollutant but include practices such as grassed waterways and vegetated buffers, nondischarging animal waste lagoons, integrated crop and pest management and soil testing. BMPs may be administered through one or more of the agricultural programs described below.

- **North Carolina Agriculture Cost Share Program**
  In 1984, the North Carolina General Assembly budgeted approximately $2 million to assist landowners in 16 counties within the "Nutrient Sensitive Water" (NSW) watersheds including the Upper Neuse River (Falls Lake) to implement BMPs for agricultural and silvicultural activities. These funds were increased in May 1987 to include 17 additional coastal counties by the passage of a General Statute formally creating the *Agriculture Cost Share Program for Nonpoint Source Pollution Control (NCACSP).* In 1989 the NCACSP became a statewide program. The NCACSP will pay a farmer 75 percent of the average cost of implementing approved BMPs and offer technical assistance to the landowners or users which would provide the greatest benefit for water quality protection. The primary purpose of this voluntary program is water quality protection.

  The local Soil and Water Conservation District Boards under the administration of the North Carolina Soil and Water Conservation Commission (SWCC) are responsible for identifying treatment areas, allocating resources, signing contractual agreements with landowners, providing technical assistance for the planning and implementation of BMPs and generally encouraging the use of appropriate BMPs to protect water quality. The criteria for allocating funds to the District is "based on the identified level of agricultural related nonpoint source pollution problems and the respective District's BMP installation goals and available technical services as demonstrated in the Districts annual strategy plan" (NC Administrative Code, Title 15, Chapter 6, Section 6E). This local participation is crucial to the success of the program.

  The DEHNR-Division of Soil and Water Conservation (DSWC) provides staff, administrative and technical support to the SWCC. The DSWC also coordinates the efforts of various associated Program committees and acts as the clearinghouse for District strategy plans, contracts, etc. A legislated Technical Review Committee meets quarterly "to review the progress of the Program" (G.S. 143-215.74B) and to make technical recommendations to the Commission.

  Technical assistance for the implementation of approved BMPs is provided to the Districts through a 50:50 cost share provision for technical positions to be filled at the District level. The USDA-Natural Resources Conservation Service also provides technical assistance.

  The current annual statewide budget to cost share BMPs (75% - NCACSP / 25% landowner) with landowners is approximately $ 6.7 million. The budget to share the cost of providing technical assistance with Districts is approximately $ 1.3 million. Additional support for administration and staff is provided by local governments. In Catawba River Basin districts, approximately $1.55 million in BMP cost share dollars have been spent (see section 6.4.3 in Chapter 6). There is also federal assistance through ASCS for BMP implementation.

- **North Carolina Pesticide Law of 1971**
  In 1971 the General Assembly created and authorized the North Carolina Pesticide Board to regulate the use, application, sale, disposal and registration of pesticides for the protection

of the health, safety, and welfare of the people and for the promotion of a healthy and safe environment. Some of the responsibilities of the Pesticide Board and the North Carolina Department of Agriculture include registering all pesticides prior to distribution and sale in N.C., sampling pesticides to insure that all products are up to guaranteed analysis and unadulterated by any other pesticide, sampling pesticides at time of application to insure that the applicator is following label instructions and certifying the competency of applicators and dealers of restricted use pesticides.

The Pesticide Section of the North Carolina Department of Agriculture conducts mandatory annual inspections of all aircraft used in pesticide application and conducts random inspections of ground application equipment and chemigation (application of pesticides through irrigation systems) systems. These inspections are intended to encourage proper calibration and use of equipment in order to avoid excessive application rates and accidental spills from faulty systems. Stop use orders are issued for noncompliance with the regulations.

Inspections are also required for bulk storage tanks prior to filling. All commercial pesticide storage facilities are required to have an approved Pre-fire Plan. In addition, each large commercial storage facility is required to develop and maintain an Emergency Contingency Plan. This plan describes the actions facility personnel shall take to respond to fires, explosions, spills, or any other sudden or gradual release of pesticides or pesticide contaminated materials to air, soil, or surface waters. The Contingency Plan is designed to minimize hazards to human health and the environment.

Penalties are assessed to careless pesticide applicators. Enforcement of the law is based on where the pesticide is deposited rather than just where it is applied. For example, if a pesticide is found in a stream as a result of wind drift, the applicator is subject to legal action. The Raleigh Office staff of the NCDA Pesticide Section is comprised of 20 employees. There are 10 Inspectors who conduct field-level compliance monitoring and investigation services. The annual budget for pesticide control and analytical work is $1.4 million.

- **NCDA Pesticide Disposal Program**

  In 1976, the North Carolina Pesticide Board adopted regulations governing the disposal of pesticides. These regulations make it illegal in North Carolina to dispose of hazardous waste (which includes certain pesticides) in sanitary landfills. While households and farms which generate less than 220 lbs of hazardous waste and less than 2 lbs of acutely hazardous waste are exempt from federal disposal requirements, the regulations prohibiting the disposal of these wastes in sanitary landfills still applies to them. The option to use commercial hazardous waste disposal companies is too expensive and most companies will not pickup small quantities. As a result of this dilemma, the NCDA created the Pesticide Disposal Program in 1980 through appropriations from the General Assembly.

  The goal of the Program is to provide an available, affordable and environmentally acceptable mechanism in which any homeowner, farmer, or institution can dispose of unwanted or unusable pesticides. It is mandatory, however, that all pesticide products are labeled correctly before NCDA will pick them up. An EPA permitted hazardous waste treatment or disposal facility (TSD) requires proper identification before the products can be disposed.

  The Food and Drug Division of the North Carolina Department of Agriculture administers the Pesticide Disposal Program. The same staff used for enforcing the North Carolina Pesticide Law of 1971 are used in the Disposal Program.

- **Animal Waste Management Regulations**
  On December 10, 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for properly managing and reusing animal wastes from intensive livestock operations. The goal of the rule is for intensive animal operations to operate so that animal waste is not discharged to waters of the state. This means that if criteria are met and no waste is discharged to surface waters, then an individual permit from DEM is not required. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds with a liquid waste system. These operations are deemed permitted if a signed registration and an approved waste management plan certification are submitted to DEM by the appropriate deadlines.

  The deadline for submittal of registrations to DEM for existing facilities was December 31, 1993. Facility plans must be certified by a technical specialist designated by the Soil and Water Conservation Commission and submitted to DEM by December 31, 1997. The standards and specifications of the USDA Natural Resources Conservation Service are the minimum criteria used for plan approval by the local Soil and Water Conservation Districts.

  In the past, DEM inspected intensive animal operations mostly in response to third party complaints. However, with the passage of the above rules, the increasing numbers of these operations and their potential impact on water quality, DEM will be making more routine inspections to make sure that their waste management systems are adequate and are being operated properly. Animal waste management systems that are determined to have an adverse impact on water quality may be required to obtain an approved animal waste management plan or to apply for and receive either an individual nondischarge permit.

  An illegally discharging operation may also be designated as a concentrated animal feeding operation (CAFO) and an NPDES discharge permit could be required.

- **NC Cooperative Extension Service and Agricultural Research Service**
  Crop and animal production programs are administered under the research and education activities of the N.C. Agricultural Research Service (ARS) and the N.C. Cooperative Extension Service (CES). The research and education efforts are broad and include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development and irrigation. Guidelines for most agricultural enterprises have been developed and made available to farmers. A more intensified water quality emphasis is being incorporated in these area and many other projects undertaken by ARS and CES. The local contact that county CES agents have with farmers and homeowners provides an excellent opportunity for dialogue and education in nonpoint source pollution control. This network of contacts can be used to inform people about BMPs and to provide some structure for a general NPS education program.

  The N.C. Agricultural Research Service and the N.C. Cooperative Extension Service conduct broad research and education efforts that include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development, and irrigation. County Cooperative Extension agents work closely with farmers and homeowners, providing an excellent opportunity for dialogue and education in nonpoint source pollution control.

- **Soil, Plant Tissue, and Animal Waste Testing Program**
  These services provide farmers with information necessary to improve crop production efficiency, to manage the soil properly and to protect environmental quality. The Soil,

Plant Tissue and Animal Waste Testing Program is administered by the Agronomic Division of the North Carolina Department of Agriculture. Water and wastewater from lagoons is also tested for irrigation and fertilizer use.

- **Watershed Protection and Flood Prevention Program (PL 83-566)**
  The purpose of the Watershed Protection and Flood Prevention Program is to provide technical and financial assistance in planning, designing, and installing improvement projects for protection and development of small watersheds. The Program is administered by the USDA-Natural Resources Conservation Service in cooperation with the N.C. Division of Soil and Water Conservation, the State Soil and Water Conservation Commission, the U.S. Forest Service, Soil and Water Conservation Districts, and other project sponsors.

  The emphasis of the Program over the past three decades has been to provide flood control. However, legislation has shifted emphasis of PL-566 land treatment projects so that a project proposal must demonstrate off-site water quality benefits in order to have any chance of funding. In the Catawba River Basin, there are a number of land treatment projects underway with more in the planning stages.

- **Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA)**
  There are several provisions authorized by the federal Food Security Act of 1985 (FSA) and re-authorized by the Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA) which offer excellent opportunities for the abatement of agricultural nonpoint source pollution. The FSA and FACTA make the goals of the USDA farm and conservation programs more consistent by encouraging the reduction of soil erosion and production of surplus commodities and the retention of wetlands. At the same time, the provisions can serve as tools to remove from production those areas which critically degrade water quality by contributing to sedimentation. Important water quality-related provisions are known as the Conservation Reserve, Conservation Compliance, Sodbuster, Swampbuster, and Conservation Easement, Wetland Reserve, and Water Quality Incentive Program. These provisions are administered by the USDA.

  Conservation Reserve Program
  The Conservation Reserve Program (CRP) is administered by the USDA Agricultural Stabilization and Conservation Service (ASCS) and the USDA Natural Resources Conservation Service (NRCS). Other cooperating agencies include the NC Cooperative Extension Service, NC Division of Forest Resources and local Soil and Water Conservation Districts. The CRP was established to encourage removing highly erodible land from crop production and to promote planting long-term permanent grasses and tree cover. The ASCS will share up to half of the cost of establishing this protective cover. The intention of the program is to protect the long term ability of the US to produce food and fiber by reducing soil erosion, improving water quality and improving habitat for fish and wildlife. Additional objectives are to curb the production of surplus commodities and to provide farmers with income supports through rental payments over a 10 year contract period for land entered under the CRP.

  Conservation Compliance
  The Conservation Compliance provision of the FSA and FACTA discourages the production of crops on highly erodible cropland where the land is not carefully protected from erosion. Highly erodible land is defined as land where the potential erosion (erodibility index) is equal to eight times or greater than the rate at which the soil can maintain continued productivity. This rate is determined by the Natural Resources Conservation Service.

A farmer had until January 1, 1990 to develop and begin applying a conservation plan on highly erodible land. The plan must be operational by January 1, 1995. If a conservation plan is not developed and implemented, the farmer loses eligibility in price and income supports, crop insurance, FHA loans, Commodity Credit Corporation storage payments, farm storage facility loans, Conservation Reserve Program annual payments, and other programs under which USDA makes commodity-related payments. In other words, Conservation Compliance is an economic disincentive, quasi-regulatory program.

Sodbuster
The Sodbuster provision of the FSA and FACTA is aimed at discouraging the conversion of highly erodible land for agricultural production. It applies to highly erodible land that was not planted in annually tilled crops during the period 1981-85. As with the other provisions of the FSA, the Natural Resources Conservation Service determines if a field is highly erodible. If a highly erodible field is planted in an agricultural commodity without an approved conservation system, the landowner (or farmer) becomes ineligible for certain USDA program benefits.

Swampbuster
The purpose of Swampbuster is to discourage the conversion of wetlands to cropland use. Wetlands are defined as areas that have a predominance of hydric soils that are inundated or saturated by surface water or groundwater at a frequency or duration sufficient to support a prevalence of hydrophytic (water loving) vegetation. It is the responsibility of the Natural Resources Conservation Service to determine if an area is a wetland. Like the other provisions of the FSA and FACTA, a farmer will lose eligibility for certain USDA program benefits on all the land which is farmed if a wetland area is converted to cropland.

Conservation Easement
The Conservation Easement provision encourages producers whose FHA loans are in or near default to place their wetland, highly erodible land, and fragile land in conservation, recreation, or wildlife uses for periods of at least 50 years. The producer benefits by having the FHA loan partially canceled. The environment benefits by reducing the level of soil disturbing activities and the threat of agricultural pollutants.

Wetland Reserve
FACTA established a voluntary program for farmers to grant the federal government a 30-year or perpetual easement to wetlands. Eligible land includes farmed or converted wetlands which could be restored to their highest wetland function and value. The goal is to enroll one million acres by the end of 1995.

Water Quality Incentive Program
FACTA established this cost sharing program to help farmers control pollution problems associated with agricultural activities. A producer could receive up to $3,500 in cost share assistance to implement approved BMPs. The goal is to enroll 10 million acres by 1995.

5.3.2 NPS Programs for Urban and Developed Lands

- **Federal Urban Stormwater Discharge Program / NC NPDES Stormwater Program**
  In 1987, Congress passed the Water Quality Act Amendments to the Clean Water Act requiring the U.S. Environmental Protection Agency (EPA) to develop regulations on permit application requirements for stormwater discharges associated with industrial activities as well as those associated with large and medium municipal separate storm sewer

systems (population greater than 100,000). These regulations became effective in December 1990.

The goal of the stormwater discharge permitting regulations in North Carolina is to prevent pollution of the stormwater runoff by controlling the source(s) of pollutants. Defining the potential pollutant sources and establishing controls of the sources that will reduce and minimize pollutant availability will result in an improvement to the water quality of the receiving streams, consistent with the overall goal of the water quality program.

Authority to administer these regulations has been delegated to the North Carolina Division of Environmental Management (DEM). The NPDES stormwater regulations require that facilities with stormwater point source discharges associated with industrial activity and municipalities defined as either large or medium municipal separate storm sewer systems be permitted.

The municipal permitting requirements are designed to lead to the formation of site-specific stormwater management programs for a municipal area Therefore, the permits issued to municipalities for their municipal separate storm sewer systems will be explicitly written for each individual municipality. Municipal permits of this type in North Carolina are currently required for Charlotte, Durham, Greensboro, Winston-Salem, Fayetteville/Cumberland County and Raleigh. Charlotte's NPDES stormwater permit is discussed in Section 6.8 of Chapter 6, and a copy of the city's permit fact sheet is included in Appendix IV. The municipalities will develop and implement comprehensive stormwater quality management programs to reduce the discharge of pollutants in stormwater to the maximum extent practicable (MEP). MEP will be defined separately for each municipality required to be permitted. Industrial facilities discharging through a municipal separate storm sewer system are required to submit a permit application to the state and receive their own NPDES stormwater permit.

Industrial activities which require permitting are defined in eleven categories in the federal regulations ranging from sawmills and landfills to phosphate manufacturing plants and hazardous waste treatment, storage or disposal facilities. The regulations cover point source discharges that are related to manufacturing, processing, or material storage areas at an industrial facility. Stormwater discharges associated with industrial activities are required to be covered by permits which contain technology-based controls based on Best Available Technology/Best Conventional Pollutant Control Technology considerations or water quality controls, if necessary. Through monitoring and regulating stormwater discharge quality, the goal of the NPDES stormwater program is to reduce the pollutant load in stormwater runoff.

The permitting requirements described here represent Phase I of the stormwater program. EPA and Congress are currently involved in studies to determine the scope of additional stormwater coverage under Phase II of the stormwater program. Further stormwater NPDES coverage could include additional industrial activities or additional municipal areas. If additional areas of coverage are added under the federal stormwater programs, DEM will be responsible for the appropriate permitting of these areas within North Carolina.

- **Water Supply Protection Program**
  Approximately 50 percent of North Carolina's population depends on surface water supplies for drinking, commercial, and industrial uses. Water supplies have become more important in recent years because of increased demand for water, concern over potential contamination by toxic substances, and protection of human health. As a result, the General Assembly passed the Water Supply Watershed Protection Act of 1989 (NCGS 143-214.5). This Act requires all local governments that have land-use jurisdiction within surface water

supply watersheds, or a portion thereof, to be responsible for implementation and enforcement of nonpoint source management requirements related to urban development according to minimum standards adopted by the state. NPS control strategies are included in the rules for urban, agricultural, silvicultural, and Department of Transportation activities. The Water Supply Watershed Protection Rules were adopted by the Environmental Management Commission on February 13, 1992 and became effective on August 3, 1992. See Appendix I for a summary of the management requirements for the five water supply classifications.

The purpose of the Water Supply Protection Program is to encourage communities to work with the state to provide enhanced protection for their water supply from pollution sources. There are five water supply classes that are defined according to existing land use and the amount and types of permitted point source discharges. By classifying a watershed as a water supply watershed, local government having land use jurisdication within the watershed will take steps to control nonpoint sources of pollution at their sources and thereby reduce the potential of pollutants contaminating their drinking water supply. In turn, the state limits the point source discharges that can locate within the watershed and thereby reduces the potential of contamination of the water supply.

This dual approach of state and local government action to preclude potential impacts from stormwater runoff and wastewater discharges is important since only a small fraction of the possible pollutants have water quality standards. As more is learned about the types and effects of pollutants in our drinking waters, the state will proceed to adopt additional water quality standards. One of the effects this would have is that water treatment facilities will be required to remove these pollutants. This could require additional technology and possibly more expensive treatment facilities or operation to ensure safe drinking water. It is therefore very important for the state and local governments to consider the important alternative of preventing pollution from entering their drinking water supplies.

The General Assembly extended the deadline for completing reclassification of existing surface water supply waters to July 1, 1992 in House Bill 873. The bill also established a schedule for local governments' submittal of water supply protection ordinances as follows:

1) July 1, 1993 for municipalities with populations of 5,000 or more,
2) October 1, 1993 for municipalities with smaller populations, and
3) January 1, 1994 for counties.

As of August 1994, 100% of the 38 local governments in the Catawba River basin required to submit a water supply protection ordinance for approval have done so. Statewide, the compliance rate for submittals is 99%.

The Water Supply Protection Program is administered by staff in the Planning Branch of the Water Quality Section in DEM. These staff coordinate with the Division of Community Assistance (NCDCA) who helps local governments develop land-use ordinances, the Division of Environmental Health, which certifies that a proposed reclassification is suitable for a drinking water supply, and DEM staff in NCDEHNR regional offices who are responsible for water quality sampling in the proposed water supply.

- **ORW and HQW Stream Classifications**
  Outstanding Resource Waters (ORW) and High Quality Waters (HQW) have management strategies that address handling of urban stormwater. Controls for urban stormwater, either through development density limitations or stormwater treatment systems, are required by DEM. Some of these controls are outlined in Appendix I. Other NPS

management agencies are expected to place priority on protecting these waters as well. For example, the NC Department of Transportation and the NC Division of Land Resources require more stringent sediment control on construction sites in ORW and HQW areas.

5.3.3 Construction - Sedimentation and Erosion Control NPS Program

In 1973, the North Carolina General Assembly enacted the Sedimentation Pollution Control Act. The Act authorized the establishment of a sediment control program to prevent accelerated erosion and off-site sedimentation caused by land-disturbing activities other than agriculture, forestry, and mining. The Land Quality Section of the Division of Land Resources is responsible for administration and enforcement of the requirements of the Act under the authority of the N.C. Sedimentation Control Commission.

The sediment control program requires, prior to construction, the submission and approval of erosion control plans on all projects disturbing one or more acres. On-site inspections are conducted to determine compliance with the plan and to evaluate the effectiveness of the BMPs which are used. The intent is to offer permanent downstream protection for stream banks and channels from damages caused by increased runoff velocities. If voluntary compliance with the approved plan is not achieved and violations occur, the Land Quality Section will pursue enforcement through civil penalties and injunctive relief. House Bill 448, passed in 1991, authorized the issuance of stop-work orders for violations of the SPCA. This additional enforcement mechanism will help improve the overall performance of the program.

There are a number of local municipal and county erosion and sedimentation control programs in the Catawba River Basin. These local programs are reviewed annually for compliance with the requirements of the Sedimentation Pollution Control Act. The Land Quality Section also conducts educational programs directed toward state and local government officials in order to strengthen the local programs. Persons engaged in land-disturbing activities and interested citizen groups are included in the educational effort.

The Sedimentation Control Commission has delegated to the Division of Highways of the North Carolina Department of Transportation (DOT) the authority to approve erosion and sedimentation control plans for land-disturbing activity conducted by that agency or by other persons under highway contracts with that agency. The DOT sedimentation control program has been reviewed by the Division of Land Resources under the authority of the Sedimentation Control Commission. DOT is required to incorporate more stringent sedimentation controls as specified in the High Quality Water rules. The N.C. Department of Environment, Health, and Natural Resources (NCDEHNR) has established a position to evaluate environmental aspects of DOT highway projects and programs. DOT, in cooperation with DEM, has developed and adopted formal BMPs for protection of surface waters. These BMPs and other efforts are significant improvements in developing a proactive system at DOT toward environmental issues.

Sedimentation control rules remain in effect for High Quality Waters (HQW). These rules require more stringent erosion control measures for projects draining to HQWs.

5.3.4 On-Site Wastewater Disposal - Sanitary Sewage Systems NPS Program

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. More than 52 percent of all housing units in the state are served by septic tank systems or other systems besides public or community sewage systems. A conventional septic system consists of a septic tank, a distribution box or equivalent branching lines, and a series of subsurface absorption lines consisting of tile or perforated pipes laid in a bed of gravel.

All subsurface sanitary sewage systems are under the jurisdiction of the Commission for Health Services (CHS) of the Department of Environment, Health, and Natural Resources. The CHS establishes the rules for on-site sewage systems which are administered by the Division to Environmental Health.

According to GS 130A-335(e) and (f), the rules of the CHS and the rules of the local board of health shall address at least the following: sewage characteristics; design unit; design capacity; design volume; criteria for the design, installation, operation, maintenance, and performance of sanitary sewage collection, treatment, and disposal systems; soil morphology and drainage; topography and landscape position; depth to seasonally high water table, rock, and water impeding formations; proximity to water supply wells, shellfish waters, estuaries, marshes, wetlands, areas subject to frequent flooding, streams, lakes, swamps, and other bodies of surface or groundwaters; density of sanitary sewage collection, treatment, and disposal systems in a geographical area; requirements for issuance, suspension, and revocation of permits; and other factors which affect the effective operation in performance of sanitary sewage collection treatment and disposal systems. The rules also must provide construction requirements, standards for operation, and ownership requirements for each classification of sanitary systems of sewage collection, treatment, and disposal in order to prevent, as far as reasonably possible, any contamination of the land, groundwater, and surface waters. There exists a strict permitting procedure which regulates site selection, system design, and installation of on-site sewage systems. Privately owned subsurface sewage discharging systems are governed by NCDEHNR through local county health departments. Authorized local sanitarians serve as agents of NCDEHNR and assist in implementing the state sewage rules. Local boards of health may adopt by reference the state rules and append to those rules more stringent laws and local criteria which they desire. These amendments, however, must be approved by the state. Only nine counties in the state currently operate under local rules. The 1983 amendments of the state public health laws eliminated the co-mingling of state rules with local rules except by state approval.

5.3.5 Solid Waste Disposal NPS Programs

- **Federal Program**
  The major federal legislation in the area of solid waste management is the Resource Conservation and Recovery Act (RCRA) administered by the U.S. Environmental Protection Agency (EPA). RCRA deals almost entirely with hazardous waste management but it does require that states meet minimum standards for solid waste facilities. EPA does not have permitting authority over solid waste management facilities.

- **State Program**
  States are accorded a major role in solid waste management by RCRA. North Carolina now operates under revisions by the General Assembly to Chapter 130A of the General Statutes. The Division of Solid Waste Management (DSWM) in the Department of Environment Health and Natural Resources is authorized as the single state agency for the management of solid waste. DSWM is responsible for the development of the state's solid waste management plan, has permitting authority over all solid waste management facility siting and operation, inspects permitted facilities, provides technical assistance, investigates complaints, responds to emergencies, monitors ground water quality at facilities, promotes the state's recycling effort, and closes non-conforming sites.

  The Solid Waste Management Act of 1989 established the policies and goals of the state to recycle at least 25 percent of the total waste stream by January 1, 1993. This Act created a Solid Waste Management Trust Fund to promote waste reduction and fund research and demonstration projects to manage solid waste. In 1991, the Solid Waste Management Act of 1989 was amended to broaden the goal to reduce the solid waste stream by 40 percent through source reduction, reuse, recycling, and composting by June 30, 2001.

The state adopted solid waste management rules, effective February 1, 1991, requiring liner, leachate collection, and final cover systems at all new landfills, lateral expansions of existing landfills, and at all active landfills by January 1, 1998. Septage rules and regulations also have been adopted and are administered through a permit program.

- **Local Program**
  Solid waste collection and disposal has long been a municipal function. The operation of solid waste collection and disposal facilities is among the enterprises which municipalities are expressly authorized by statute to operate (G.S. 160A-311 through 160A-321). Municipalities are also authorized to regulate the disposal of solid waste within their corporate limits. Such regulations may specify the location and type of receptacles to be used for collection (G.S. 160A-192).

  Outside municipal limits, counties are authorized to operate solid waste collection and disposal facilities either as a function of county government or through establishment of a special service district (G.S. 153A-292 and 301). Since 1970, county governments have increasingly accepted responsibility for solid waste disposal activities and most disposal facilities in the state are now operated by counties or with county financial assistance.

5.3.6 Forestry NPS Programs

- **Forest Practice Guidelines Related to Water Quality**
  In 1989 the Sedimentation Pollution Control Act (SPCA) was amended to limit the forestry exemption to those operations that adhere to forest practice guidelines. The forestry amendment to the SPCA required the Division of Forest Resources to develop performance standards known as the Forest Practices Guidelines Related to Water Quality.

  Guidelines consist of nine performance standards for activities such as maintaining streamside management zones and applying fertilizer and pesticide applications. These Guidelines are used to determine if a forestry operation will fall under the jurisdiction of the Division of Land Resources which enforces the SPCA. The Guidelines were developed in October 1989 and were put into effect on January 1, 1990. A Memorandum of Agreement was also signed between the Division of Forest Resources and the Division of Land Resources to coordinate their respective activities in the sedimentation control program. DLR has also signed an MOA with DEM.

  Site-disturbing forestry activities are being inspected by local DFR personnel as part of a training, mitigation, and monitoring program. Site inspections are conducted when a problem or potential problem is suspected to exist. Sites not brought into compliance within a reasonable time schedule are referred by DFR to DLR or DEM for appropriate enforcement action.

- **National Forest Management Act (NFMA)**
  The National Forest Management Act was passed in 1976 and applies to all lands owned or administered by the National Forest System. The Act stipulates that land management plans be prepared which consider economic and environmental aspects of forest resources. The Act further states that timber will be harvested from National Forest lands only where soil, slope, or other watershed conditions will not be irreversibly damaged; and where protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of watercourses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat.

- **Forest Stewardship Program**
  The Division of Forest Resources initiated the Forest Stewardship Program in 1991 along with the cooperation and support of several other natural resource and conservation agencies. This program encourages landowners with ten or more acres of forestland to become involved and committed to the wise development, protection and use of all natural forest resources they own or control.

5.3.7 Mining NPS Program

In 1971 the North Carolina General Assembly passed the Mining Act to ensure that the usefulness, productivity, and scenic values of all land and waters involved in mining will receive the greatest practical degree of protection and restoration. The Mining Commission is the rule-making body for the Act and has designated authority to administer and enforce the rules and regulations of the Act to the Mining Program within the Land Quality Section of the NCDEHNR Division of Land Resources.

The Mining program has four major areas of responsibility. First, the Program requires submission and approval of a mining permit application prior to initiating land disturbing activity if the mining operation is one (1) or more acres in surface area. The mining permit application must have a reclamation plan for these operations. Second, the Program conducts on-site inspections to determine compliance with the approved application and whether or not the plan is effective in protecting land and water quality. Third, the program pursues enforcement action through civil penalties, injunctive relief, and/or bond forfeiture to gain compliance when voluntary compliance is not achieved. Finally, the Mining Program conducts educational efforts for mine operators.

5.3.8 Wetlands Regulatory NPS Programs

There are numerous reasons for preserving wetlands, but of special interest within the context of basinwide planning is their role in protecting water quality. Because of their intrinsic characteristics and location within the landscape, wetlands function to protect water quality in a number of ways. These functions include the retention and removal of pollutants, stabilization of shorelines, and storage of flood waters.

Numerous authors have studied the effectiveness of riparian wetland forests for nutrient retention and transformation (Jones et al. 1976; Yates and Sheridan 1983; Brinson et al. 1984; Lowrance et al. 1984; Peterjohn and Correll 1984; Jacobs and Gilliam 1985; Budd et al. 1987; and Groffman et al. 1991). The location of riparian wetlands allows them the opportunity to receive nutrients from the surrounding landscape as well as through overbank flooding. In addition to the storage of nutrients in wetland vegetation, the microbial and chemical processes within wetland soils may function to completely remove nutrients from the system.

Headwater riparian wetlands are the most important wetland in terms of sediment and associated nutrient and toxicant retention. Since small stream comprise most of the total stream length within a watershed (Leopold 1974), these areas intercept the greatest proportion of eroded sediments and associated substances from uplands before these pollutant reach waters downstream. Novitzki (1978) found that approximately 80% of the sediments entering a stream were retained in headwater wetlands.

Wetlands adjacent to streams, rivers and lakes stabilize shorelines and help protect these bodies of water from erosive forces. This function is particularly important in urbanized watersheds where the prevalence of impervious surfaces contributes to greater peak storm flows. Wetland vegetation serves to dissipate erosive forces and anchors the shoreline in place preventing sediments and associated pollutants from entering waterways. Wetlands by their very nature of being "wet" are also vital for water storage. Those wetlands adjacent to surface waters, that have the opportunity

to receive flood waters and surface runoff, are most important to water storage. Wetlands located in headwaters generally desynchronize peaks in tributaries and main channels, and lakes and wetlands with restricted outlets hold back flood waters and attenuate flood peaks (Carter et al. 1978).

Several important state and federal wetland protection programs are described below. In addition to the following wetlands programs, provisions of the 1985 and 1990 Farm Bills, discussed in Section 5.3.1, should also help reduce wetlands impacts. Agriculture conversions should be reduced by the "swampbuster" provision of the 1985 Farm Bill, which encourages farmers not to convert wetlands for agriculture in order not to lose their USDA subsidies, loans, and price supports. Silviculture is exempted from the swampbuster provision and therefore, conversion of wetlands for intensive or managed forestry will not receive the benefits of this incentive device. A Wetland Reserve Program was established by the 1990 Farm Bill with the goal of allowing one million acres of prior-converted wetlands to revert back to wetlands by 1995.

- **Section 10 of the Rivers and Harbors Act of 1899**
  This act, administered by the US Army Corps of Engineers, provides the basis for regulating dredge and fill activities in navigable waters of the United States. Originally, this Act was administered to protect navigation and the navigation capacity of the nation's waters. In 1968, due to growing environmental concerns, the review of permit applications was changed to include factors other than navigation including fish and wildlife conservation, pollution, aesthetics, ecology, and general public interest. Activities which may be covered under the Act include dredging and filling, piers, dams, dikes, marinas, bulkheads, bank stabilization and others.

- **Section 404 of the Clean Water Act**
  The U.S. Army Corps of Engineers administers a national regulatory program under Section 404 of the Clean Water Act aimed at controlling the discharge of dredged or fill material into waters of the United States. Section 404 applies to just the discharge of dredged or fill materials into waters of the United States and does not apply to dredging activities. Waters of the United States refers to navigable waters, their tributaries, and adjacent wetlands. Activities covered under Section 404 include dams, dikes, marinas, bulkheads, utility and power transmission lines and bank stabilization. Although the 404 program does not fully protect wetlands, it is nonetheless the only federal tool at this time for regulating wetland development statewide. State legislation has not been adopted to protect inland freshwater wetlands in North Carolina, as has been done for coastal wetlands, but DEM is in the process of drafting rules which will formalize the wetlands protection measures associated with the 401 Water Quality Certification review process.

- **Section 401 Water Quality Certification (from CWA)**
  The Division of Environmental Management is responsible for the issuance of 401 Water Quality Certifications (as mandated under Section 401 of the Clean Water Act). A 401 certification is required for the discharge of pollutants into surface waters and wetlands for projects that require a section 404 federal permit. The 401 certification indicates that the discharged pollutant will not violate state water quality standards. A federal permit cannot be issued if a 401 certification is denied. The 401 certification process is coordinated with the 404 and CAMA processes in the 20 counties of CAMA jurisdiction.

- **North Carolina Dredge and Fill Act (1969)**
  This act requires permits for "excavation or filling begun in any estuarine waters, tidelands, marshlands, or state-owned lake". This law is currently administered with North Carolina's Coastal Area Management Act (CAMA) (1974).

5.3.9 Hydrologic Modification

Hydrologic modification is defined as channelization, dredging, dam construction, flow regulation and modification, bridge construction, removal of riparian vegetation, streambank modification/destabilization, and dam collapse. By its very nature hydrologic modification is closely tied to wetland issues. It is not surprising then that the U.S. Army Corps of Engineers (Corps) is the agency most involved in issuing permits for land-disturbing activities in wetlands. These permits are issued through Section 404 and the Rivers and Harbors Act discussed above.

In addition to wetland issues, dam construction and the lack of low flow releases into streams can severely impact downstream aquatic resources. Dam construction, repair, modification, and removal are regulated by the NC Division of Land Resources under the Dam Safety Law of 1967. A dam safety permit is required for any dam which is 15 feet or greater in height (from top of dam to lowest point on downstream toe) and the impoundment capacity is 10-acre-feet or greater at the top of the dam. Low-flow release requirements to maintain adequate instream flows are established in permits where appropriate. Instream flows are recommended by the NC Division of Water Resources.

There are several other programs which can affect hydrologic modification. The Forest Practice Guidelines Related to Water Quality requires streamside management zones to be maintained during logging operations. The Water Supply Watershed Protection Program also has requirements to maintain buffers for certain activities. The Conservation Reserve Program encourages the establishment of vegetative filter strips (66-99 feet wide) for farming operations. A significant number of local governments have established greenway programs within urban settings in order to maintain and protect riparian areas.

5.4 INTEGRATING POINT AND NONPOINT SOURCE POLLUTION CONTROLS STRATEGIES

Integrating point and nonpoint source pollution controls and determining the amount and location of the remaining assimilative capacity in a basin are key long-term objectives of basinwide management. The information can be used for a number of purposes including determining if and where new or expanded municipal or industrial wastewater treatment facilities can be allowed; setting the recommended treatment level at these facilities; and identifying where point and nonpoint source pollution controls must be implemented to restore capacity and maintain water quality standards.

The U.S. Environmental Protection Agency (USEPA) has developed a means to help accomplish these objectives called *total maximum daily loads (TMDL)*. The TMDL approach, which is being required by the United States Environmental Protection Agency (USEPA) pursuant to Section 303(d) of the Clean Water Act, is based on the concept of determining the total waste (pollutant) loading, from point and nonpoint sources, that a water body (such as a stream, lake or estuary) can assimilate while still maintaining its designated uses.

A TMDL is a strategy for establishing water quality-based controls on point and nonpoint sources of a given pollutant identified as contributing to a waterbody's impairment. In the Catawba basin, nutrients and biochemical oxygen demand (BOD) are the primary pollutants for which TMDLs are being developed. The TMDL can reflect quantifiable limits to be placed on specific pollution sources or it can be comprised of programmatic strategies (e.g., implementation of nonpoint source best management practices) established to reduce pollutant loadings, in general, throughout the targeted waterbody. The overall goal in establishing the TMDL is to set forth a course of management actions necessary for a waterbody to meet water quality standards.

It should be noted that a targeted water body does not necessarily refer to an entire basin. This is particularly true for the Catawba River Basin. The Catawba River is composed of a chain of impoundments which segment the river into distinct parts when viewed from a water quality standpoint. TMDLs for smaller streams may serve as important elements in a TMDL covering a larger portion of the basin. Nesting of TMDLs in this fashion constitutes a flexible yet comprehensive management approach that allows for specific strategies to be developed for smaller problem areas and yet offers the means to address the large scale problems as well.

As DEM's abilities to quantify and predict the impacts of point and nonpoint source pollution become more sophisticated, the basinwide approach will make more innovative management strategies possible. Possible strategies that might be considered in future Catawba Basinwide Plans or in the plans for basins that come up later in this first five-year cycle include agency banking, pollution trading among permitted dischargers, industrial recruitment mapping and consolidation of wastewater discharges.

Agency banking refers to the concept of holding assimilative capacity in reserve by DEM for future growth and development in the basin. *Pollution trading* involves trading of waste loading and stream assimilative capacity among permitted dischargers, or between point and nonpoint sources, adding flexibility to the permitting system and also using the free market system as an aid to identifying the most cost effective solution to water quality protection. *Industrial recruitment mapping* involves providing specific recommendations on the types of industry and land development best suited to the basin's long-term water quality goals and also an individual basin's ability to assimilate a particular type or quantity of discharge or nonpoint source pollutants. *Consolidation of wastewater discharges*, also referred to as regionalization, entails combining several dischargers into one facility. Input from local authorities, regulated industries, landowners, and other interested parties will be needed to develop these strategies. By accommodating, to the degree possible, local needs and preferences, the probability of the plan's long-term success can be increased.

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CHAPTER 6

BASINWIDE GOALS, MAJOR WATER QUALITY CONCERNS AND RECOMMENDED MANAGEMENT STRATEGIES FOR THE CATAWBA BASIN

6.1 BASINWIDE MANAGEMENT GOALS

The long-range goal of basinwide management is to provide a means of addressing the complex problem of planning for increased development and economic growth while protecting and/or restoring the quality and intended uses of the Catawba Basin's surface waters. In striving towards the long-range goal stated above, DEM's highest priority near-term goals will be as follows:

- identify and restore the most serious water quality problems in the basin (**Section 6.2.1**)
- protect those waters known to be of the highest quality or supporting biological communities of special importance (**Section 6.2.2**)
- manage problem pollutants, particularly biochemical oxygen demand and nutrients, in order to correct existing water quality problems and to ensure protection of those waters currently supporting their uses (**Sections 6.2.3, 6.3, 6.4, 6.5, 6.6, 6.7** and **6.8**).

To achieve these goals, water quality planning must consider the 3000 miles of free-flowing streams in the Catawba Basin as the well as the many lakes and reservoirs created through impoundment of streams. Lakes and reservoirs are common features of the Catawba Basin. They play an important role in the physical, hydrologic and chemical composition of the Catawba waters. The Catawba River in North Carolina is dominated by a series of seven major reservoirs from Lake James through Lake Wylie. Smaller impoundments are also found along the South Fork Catawba River and other tributaries in the basin. These reservoirs provide for a multitude of recreational opportunities and contribute to the diverse biological communities of Catawba Basin. However, these reservoirs also present water quality planning issues that differ in some ways from those of free-flowing streams.

Lakes along the Catawba River interrupt the regular stream flow of water through the mainstem. The relatively slow velocities, increased depths and widths of lakes create an environment that can differ significantly from free-flowing streams in their response to pollution loading. For example, lakes can provide an environment where algae can grow given sufficient nutrient enrichment (e.g. fertilizers). This means that lakes can be more sensitive to nutrient loading than free-flowing streams. Also, because of limited mixing in lake waters, lakes can demonstrate localized problems from pollution loading. On the other hand, the slow velocities and increased retention time of lakes means that lakes can trap nutrients and suspended solids in sediments. Nutrient concentrations and turbidity are typically lower in water flowing out of Catawba river basin lakes than above them.

The controlled nature of flow down the Catawba affects DEM's abilities to develop specific long-term pollution control strategies, or total maximum daily loads (TMDLs), for the major streams within the basin. As the Catawba River changes from river to lake and back to river, the impact on water quality of pollutant constituents changes. The recommended management strategies presented in this chapter have been designed to reflect not only the integration of pollution sources throughout the basin but also the anticipated local responses to pollutant loading.

6.2 MAJOR WATER QUALITY CONCERNS AND PRIORITY ISSUES

6.2.1 Identifying and Restoring Impaired Waters

Impaired waters are those rated in Chapter 4 as partially supporting or not supporting their designated uses based on either evaluated or monitored water quality data described in Section 4.7. A list of those impaired freshwater streams has been compiled in Table 6.1. The table includes the planned water quality management strategies for these waters. Impairment of waters of the Catawba River basin is due to both point and non-point source pollution. This table includes those streams on the state's 303(d) list of impaired waters required by the US Environmental Protection Agency under Section 303(d) of the Clean Water Act.

The list of impaired streams in Table 6.1 cannot be considered a comprehensive list of all water bodies where water quality improvements or protective management strategies are necessary. Some impaired streams may not yet have been identified by DEM. Surface waters where water quality issues exist but specific data have not been obtained to evaluate water quality have been identified by recent public comment, State and Federal agency comment, and other sources. Following are water bodies where DEM recognizes water quality issues in waters not defined as impaired but where protective management strategies are needed: Lake Wylie, Mountain Island Lake, Rhodhiss Lake, Lake Hickory, South Fork Catawba River, Linville River, Sixmile Creek, and Lyle Creek.

Planned Management Strategies fall into two major categories. The first is continuation of ongoing programs that have not yet reached full effectiveness. For example, nonpoint source programs constitute an extremely important set of management strategies and many are in relatively early stages of implementation. These programs, described briefly in Chapter 5 are wide-ranging and are grouped under general nonpoint source categories such as urban development, construction, agriculture, forestry, mining, onsite wastewater treatment and wetlands protection. Agricultural programs such as the NC Agricultural Cost Share Program, which provides farmers with financial assistance to install best management practices (BMPs), and the Farm Bill (Food, Agriculture, Conservation and Trade Act of 1990), which among its provisions reduces government funding subsidies for farming on highly erodible land, are examples of potentially effective ongoing programs which should reduce water quality impacts of certain agricultural activities over the long run.

Another example of an ongoing program is the planned upgrade of wastewater treatment plants (WWTPs) to reduce pollution loading to waters of the Catawba Basin. Many cities, towns, and industries in the Catawba Basin are currently in the process of planning for, designing, or building upgraded treatment facilities with the objective of reducing total pollution loading.

The second category of planned management strategies includes several other initiatives. Where water quality problems have been identified but the source(s) is not evident, investigation of the source(s) will be necessary before any specific actions can be outlined. Water quality monitoring will be an important component of this strategy. An example of ongoing investigations to identify and address water quality issues in the Catawba Basin is the McDowell Creek study. Mecklenburg County and DEM are in the midst of a two year study to monitor and document nutrient loading throughout the McDowell Creek watershed. The study also monitors the impact of nutrients downstream on Mountain Island Lake. Preliminary results of this study have been incorporated

Table 6.1 Management Strategies for Impaired Freshwater Streams in the Catawba Basin

Subbasin	Stream Name	Use Rating	Source	Planned Management Strategy	NPS (319) Priority
30	Corpening Creek	PS/NS	NP	BMP implementation	High
31	Lower Creek	PS	NP, P	BMP targeting for sediment control	High
32	Big Branch	PS to NS	P	Troutman WWTP received toxicity limit.	
	Powder Spring Br.	PS	P	Point source discharge removed	
33	McDowell Creek	PS		McDowell Creek Study	
	UT Fites Creek	NS	P	Point source discharge removed	
34	McCullough Br	PS	P	Charlotte Stormater Prog.	
	Dixon Branch	NS	P	Point source discharge removed	
	Mcintyre Creek	PS	P	Point source discharge removed	
	Walker Branch	PS	P	Point source discharge removed	
	Sugar Creek	PS	NP, P	Upgrade WWTPs, Charlotte Stormater Prog.	High
	Little Sugar Creek	NS	NP	Upgrade WWTPs, Charlotte Stormater Prog.	High
	Irwin Creek	PS	NP, P	Upgrade WWTPs, Charlotte Stormater Prog.	High
	Stewart Creek	PS	NP	Upgrade WWTPs, Charlotte Stormater Prog.	Medium
	Brier Creek	NS	NP	Charlotte Stormater Prog.	High
	McAlpine Creek	PS/NS	NP	Upgrade WWTPs, Charlotte Stormater Prog.	High
	Irvins Creek	NS	NP, P	Upgrade WWTPs, Charlotte Stormater Prog.	High
	Fourmile Creek	PS	NP	Charlotte Stormater Prog.	Medium
	McMullen Creek	NS	NP	Charlotte Stormater Prog.	High
	Steele Creek	NS	NP	Charlotte Stormater Prog.	High
35	Clark Creek	PS to NS	NP	Color Study, Toxicity TMDL	High
	Bills Branch	PS	P	Point source discharge removed	
36	Long Creek	PS	NP, P	Long Creek Watershed Study, WWTP upgrade	High
	Dallas Branch	PS	NP	Long Creek Watershed Study	High
37	Catawba Creek	PS/NS	NP, P	Nutrient removal (Section 6.4)	High
	Crowders Creek	PS/NS	NP, P	Nutrient removal (Section 6.4), QUAL2E	High
	UT Crowders Cr	PS		Nutrient removal (Section 6.4), QUAL2E	
	McGill Creek	NS	P	Investigate sources	
	Abernethy Creek	PS/NS	NP, P	Nutrient removal (Section 6.4), QUAL2E	High
	UT Abernethy Cr	NS	P	Nutrient removal (Section 6.4), QUAL2E	High
	Mill Creek	NS	P	Point source discharge removed	High
	Sixmile Creek	PS	P	Encourage regional WWTP	

DEFINITIONS	
PS	Partially Supporting classified uses
NS	Not Supporting classified uses
NP	Impairment due to Nonpoint Source pollution, though specific sources may not be known.
P	Impairment attributed to Point source pollution
UT	Unnamed tributary
Use Rating	Use support rating - See Section 4.5 and Appendix IV for explanation
Color Study	See Section 6.7 for discussion
QUAL2E	Type of water quality model used to determine oxygen-consuming waste limits for dischargers

into this basin plan and finalized results will be used to update future basinwide planning efforts. A similar multi-agency study is underway on the Long Creek watershed of subbasin 03-08-36. Studies of five reservoirs in the Catawba Basin are also in various stages of completion. Data from these and other future studies will be used to guide the continuous process of updating this basinwide plan on a five year schedule.

The *NPS (319) Priority* column in Table 6.1 indicates DEM's recommended priority rating for nonpoint source management of impaired streams under Section 319 of the federal Clean Water Act. Monitored streams have been prioritized in Table 6.1 for nonpoint source controls which may be implemented through programs such as Section 319, the Agriculture Cost Share Program and the Forest Practice Guidelines Related to Water Quality. A schedule of priority from high to medium has been established to help direct the resources of the programs so that nonpoint sources problems can be addressed and water can be protected from degradation. Funding opportunities under Section 319 do not apply to urban stormwater NPDES program activities.

High priority streams:

- monitored streams that have an overall use support rating of "nonsupporting,"
- monitored streams that have a "partial support" rating but have a predicted loading of one or more pollutants that is high,
- streams that are unusually sensitive as documented by special studies (not included in table)
  - High Quality Waters
  - Outstanding Resource Waters
  - Water Supply I; Water Supply II; Critical Areas of WS-II, WS-III, WS-IV
  - Shellfish Waters (Class SA) closed due to pollutants that have a Significant Shellfish Resource (SSR) as identified by the Division of Environmental Health. (Saltwaters only)

Medium priority streams:

Monitored streams that have an overall use support rating of "partially supporting." Also, in salt waters, shellfish waters (Class SA) that are closed due to pollutants and that do not have a SSR are also considered medium priority streams.

The United States Fish and Wildlife Service has also identified Unique Aquatic Communities (UAC) that the Division could consider as sensitive resource waters for the purpose of prioritizing for 319 grant funding. These areas usually encompass waters which provide habitat for threatened and endangered species.

6.2.2 Identification and Protection of High Resource Value or Biologically Sensitive Waters

Waters considered to be biologically sensitive or of high resource value may be afforded protection through reclassification to HQW (high quality waters), ORW (outstanding resource waters) or WS (water supply), or they may be protected through more stringent permit conditions. Waters eligible for reclassification to HQW or ORW include those approved for designation as native trout waters, critical habitat for threatened or endangered species (as designated by the NC Wildlife Resources Commission), waters having excellent water quality or those used for domestic water supply purposes having a WS I and II primary classification. The HQW, ORW and WS classifications generally require more stringent point and nonpoint source pollution controls than do basic water quality classifications such as C. Lists of streams classified as HQW, ORW or WS are presented in Chapter 2. Protection requirements are presented in Appendix I.

Where waters are known to support state or federally listed endangered or threatened species or species of concern, but where water quality is not Excellent and where no critical habitat has been

designated, consideration will be given during NPDES permitting to minimize impacts to these habitat areas consistent with the requirements of the federal Endangered Species Act and North Carolina's endangered species statutes. The federally endangered Carolina Heelsplitter, a freshwater mollusk, is known to exist in the waters of subbasin 03-08-38. Possible point-source related protection measures may include, but are not limited to: effluent dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, backup power provisions to minimize accidental plant spills, evaluation of nondischarge alternatives and others. The need for special provisions will be determined on a case-by-case basis during review of individual permit applications and take into account the degree of impact and the costs of protection.

In addition, that portion of the Linville River that flows through the Linville Gorge Wilderness Area in Pisgah National Forest above Lake James has been designated as a state Scenic River.

6.2.3 Managing Problem Pollutants to Maintain Water Quality Standards and Existing Uses

In addition to restoring impaired waters, protection of other waters which currently meet their standards and are considered supporting of their uses is a basic responsibility of the state's water quality program and a primary goal of basinwide management. Protecting standards and uses rests on DEM's ability to control the causes and sources of water pollution from point and nonpoint sources. Existing point and nonpoint source programs are outlined in Chapter 5. Oxygen-demanding wastes, or biochemical oxygen demand (BOD), nutrients (in lakes and impoundments), and sediment are the most widespread problem pollutants in the Catawba Basin. Metals, fecal coliform bacteria, and color are other important pollutants requiring management. Point-source oriented control strategies for oxygen-demanding wastes are further addressed in section 6.3. Nutrients are addressed in section 6.4 and toxic substances (including metals, ammonia and chlorine) are addressed in section 6.5. Sediment control is discussed in section 6.6. Color is discussed in section 6.7.

The management strategies outlined below are the results of comprehensive evaluations of all previously summarized data. It is the intention of DEM that the following recommendations serve the public of North Carolina for long-term planning purposes. General nonpoint source management strategies are discussed thoroughly in Chapter 5. Point source controls are implemented through limiting wastewater parameters in NPDES permits.

6.3 RECOMMENDED MANAGEMENT STRATEGIES FOR OXYGEN DEMANDING WASTES

Oxygen demanding wastes are described in Chapter 3. BOD and ammonia nitrogen (NH_3) are generally the types of oxygen-consuming wastes of greatest concern. Therefore, NPDES permits generally limit BOD_5 (or $CBOD_5$) and NH_3 in point source discharge effluents to control the effects of oxygen depletion in receiving waters.

In most surface water systems throughout the State of NC, the lowest concentrations of dissolved oxygen usually occur during summertime conditions when temperature is high and streamflow is low. During these periods point source discharges have their greatest impact, while nonpoint input is generally low. Nonpoint loads are typically delivered at high flow during and after storm events, but may have residual effects on water quality through runoff and sediment oxygen demand. Modeling of oxygen-consuming wastes is typically performed under low flow scenarios, accounts for the residual effects of nonpoint sources and is used to establish appropriate NPDES permit limits. Where the residual BOD is significant, management of nonpoint sources to reduce loading is recommended by implementation of best management practices.

General Recommended Strategies for Expanding and Proposed Dischargers in the Catawba Basin

The transitional environment between free flowing streams and lakes is a potentially sensitive area to loading of oxygen demanding wastes. As stream waters slow and deepen as they enter a lake, the rate at which oxygen enters the water is reduced. This means that a concentration of oxygen demanding waste that was acceptable in a free flowing stream may result in dissolved oxygen levels below the State standard.

The seven major reservoirs that make up the chain of lakes along the Catawba River create many transition zones between streams and lakes. The hundreds of tributaries to the seven major reservoirs create local environments where waters may be relatively sensitive to oxygen demanding wastes. Due to the transitional nature of such waters, the exact allowable amount of oxygen demanding wastes that can be discharged without impairing water quality is difficult to determine. Water quality studies can be conducted on a case-by-case basis to support wasteload allocations. However, due to the widespread occurrence of transitional waters in the Catawba Basin and the high demand on water for the assimilation of oxygen-consuming wastes, a basinwide strategy is recommended. Over the past five years, DEM has implemented a minimum treatment strategy for discharges of oxygen demanding waste in the Lake Norman watershed. It is recommended that this strategy, described below, be extended to all seven major lakes in the Catawba Basin.

not on 303(d)

All new and expanding dischargers of oxygen-consuming wastes that discharge to the Catawba River Chain of Lakes or are predicted to increase oxygen-demanding waste loading to the lakes, (Lake James, Rhodhiss Lake, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake, and Lake Wylie) will be required to meet a minimum of advanced treatment limits. Typical NPDES permit conditions for advanced treatment facilities are 15 mg/l BOD_5 and 4 mg/l NH_3-N. These limits will help to protect water quality standards in the Catawba River chain of lakes and will allow for continued growth in the region.

6.3.1 Catawba River Mainstem Watersheds (Subbasins 03-08-30 to 03-08-33)

Subbasin 03-08-30 (Catawba River Headwaters, Lake James)

Corpening Creek

Corpening Creek has been listed as an impaired stream due to non-point source pollution from agricultural and urban runoff from the City of Marion. In addition, Corpening Creek receives treated wastewater from the 3.0 MGD Marion WWTP via Youngs Fork Creek. Benthic macroinvertebrate studies conducted above and below the Marion WWTP indicate only Fair water quality above the discharge and Fair (1985) or Poor (1990) water quality below the discharge. This suggests that the Marion WWTP was affecting the invertebrate community but that upstream non-point pollution sources play a significant role in the stream impairment.

Over the past three years, the Marion WWTP has averaged less than 5 mg/l BOD5 and less that 1 mg/l NH3-N. These concentrations of oxygen-consuming wastes are well below the facilities secondary treatment based limits. Therefore it is recommended that efforts to address water quality issues in the Corpening Creek watershed be concentrated upon non-point source pollution reduction. Section 6.8 contains several recommendations that the City of Marion should consider in order to begin addressing urban stormwater pollution. Additional information and guidance can be provided by DEM's Water Quality Section.

Lake James

At present Lake James is fully supporting its designated uses and there is no indication that the lake is adversely impacted by the discharge of oxygen-consuming wastes. However, there is

significant development activity in the Lake James watershed. Future development has the potential to increase pollutant loading to Lake James, particularly oxygen demanding wastes, nutrients, and suspended solids. DEM is currently working with the Western Piedmont Council of Governments (WPCOG) and the U.S. Geological Survey (USGS) to develop and implement a water quality study of Lake James to assess water quality conditions in the reservoir for present and possible future conditions. A water quality model and a geographical information system (GIS) are planned to be used to anticipate and plan for water quality impacts of future activities in the Lake James watershed. This study should be completed by the second issuance of the Catawba Basinwide plan in April 2000.

Subbasin 03-08-31 (Johns River, Rhodhiss Lake)

Rhodhiss Lake

The WPCOG and the USGS in conjunction with DEM are presently performing a three-year water quality study of Rhodhiss Lake. The objectives of this study include an effort to estimate the assimilative capacity of Rhodhiss Lake for oxygen demanding wastes. Rhodhiss Lake receives a considerable load of oxygen-consuming wastes from both point and non-point sources. The largest point source contribution are from Valdese and Morganton WWTPs. Each of these facilities is permitted to release over 7 MGD of wastewater receiving only secondary limits. However, significant dilution of these and other sources exists due to the 126 cfs 7Q10 flow of the Catawba River. Existing water quality models of Rhodhiss Lake suggest that oxygen-consuming wastes are less likely to affect dissolved oxygen than increased nutrient loading. Studies underway to evaluate the effects of nutrients on Rhodhiss Lake are discussed in Section 6.4.3.

Subbasin 03-08-32 (Lake Hickory, Lake Norman)

Powder Spring Branch

Powder Spring Branch was listed as impaired due to impacts from the South Iredell High School WWTP to a zero flow stream reach. This facility has since ceased to discharge, and the NPDES permit was rescinded January 17, 1992. Additional monitoring should be done to determine if the stream has improved.

Lake Hickory

The WPCOG and the USGS in conjunction with DEM are presently in the mist of a three year water quality study of Lake Hickory. The objectives of this study include an effort to estimate the assimilative capacity of Lake Hickory for oxygen demanding wastes. Existing water quality models of Lake Hickory suggest that oxygen-consuming wastes are less likely to affect dissolved oxygen than increased nutrient loading. Studies underway to examine the impact of nutrients on Lake Hickory are discussed in Section 6.4.3.

Lyle Creek Watershed Management Strategy

This watershed includes Lyle Creek, Huffman Branch, McLin Creek, Mull Creek, Hagan Fork and all other Lyle Creek Tributaries. In July of 1988, a watershed-wide modeling analysis of the Lyle Creek watershed was conducted by the Technical Support Branch of DEM. This model was developed to address a request for an expansion of the Conover Northeast WWTP from 0.5 MGD to 1.5 MGD. Results of this model indicated that BOD_5 and NH_3 had been over allocated under previous WLA procedures. The watershed model was used to establish NPDES permit limits for the Conover plant that would protect the DO standard and was used to guide general recommendations for future expansion and new facilities in the Lyle Creek watershed. To control oxygen-consuming wastes in Lyle Creek, the strategy below has been used in the WLA procedure since 1988. It is recommended that this strategy be continued as part of the Catawba Basinwide Plan.

Expanding facilities in the Lyle Creek watershed will receive BOD and NH_3 limits that will hold their load of oxygen-consuming wastes constant. This condition will not be used to bring permit limits below summer limits of 8 mg/l BOD_5 and 2 mg/l NH_3 unless other analyses demonstrate the need for lower limits.

All new facilities discharging to the Lyle Creek watershed will receive limits for oxygen-consuming wastes of ultimate summer BOD not greater than 21 mg/l (equivalent to 8 mg/l BOD_5 and 2 mg/l NH_3 for domestic discharges).

Subbasin 33 (Dutchman's Creek, Mountain Island Lake)

Unnamed Tributary to Fites Creek

This stream segment was listed as impaired due to impacts from the Parkdale Mill discharge to a zero flow segment of the stream. This facility has since ceased to discharge, and the NPDES permit was rescinded January 24, 1991. Additional monitoring should be done to determine if the stream has improved.

6.3.2 Sugar Creek Watershed (Subbasin 34)

Sugar Creek Watershed

A water quality study of 32.3 stream miles in the Sugar Creek, Little Sugar Creek, and McAlpine Creek watersheds in Mecklenburg County, North Carolina, and York County South Carolina was performed to calibrate a QUAL2E water quality model. This model was used to predict dissolved oxygen, ammonia, and biochemical oxygen demand at low flow conditions.

The goal of the field study and water quality modeling was to provide a tool to assist with management of wastewater discharge issues in the Sugar Creek watershed. The Sugar Creek watershed receives a significant amount of wastewater from three major municipal discharges operated by the Charlotte-Mecklenburg Utilities Department; Irwin Creek WWTP, Sugar Creek WWTP, and McAlpine Creek WWTP. In addition, the Sugar Creek watershed receives pollutant loading from eight minor discharges and a highly urbanized landscape.

Current permit limits do not protect water quality in the study area. However, each major facility has new permit limits that will apply to any future modification. In May of 1994, McAlpine Creek WWTP began operation of advanced tertiary treatment to meet permit limits of 4 mg/l BOD and 1 mg/l ammonia. Sugar Creek WWTP and Irwin Creek WWTP are scheduled to meet advanced tertiary limits in 1995. These new limits will significantly lower BOD loading to the system and are predicted to prevent DO from dropping below the instream standard during 7Q10 conditions.

Results of the study suggest that the current management plan and new permit limits for the Irwin Creek, Sugar Creek, and McAlpine Creek WWTPs are consistent with the goal of improving water quality in the Sugar Creek watershed. Once the new permit limits are met at the three major WWTPs, the model predicts that the discharge of oxygen-consuming wastes will not result in water quality problems in the Sugar Creek watershed.

Sugar Creek is also impacted by urban stormwater from the Charlotte area. Efforts to control the effect of stormwater discharge from Charlotte are discussed in Section 6.8.2.

6.3.3 South Fork Catawba River Watersheds (Subbasins 03-08-35 and 03-08-36)

Subbasin 35 (South Fork Catawba Headwaters, Clark Creek)

Bills Branch

Bills Branch was listed as impaired due to BOD and TSS loading from the North Carolina Department of Correction Catawba Correctional Center WWTP. This facility has since ceased to discharge, and the NPDES permit was rescinded April 10, 1990. Additional monitoring should be done to determine if the stream has improved.

Subbasin 36 (Long Creek, Lower South Fork Catawba River)

Long Creek

In 1990, the Gaston County Quality of Natural Resources Commission and the North Carolina Cooperative Extension Service , in conjunction with 13 other agencies and companies including DEM, initiated a water quality study of the Long Creek watershed. The objectives of the study were to identify and monitor point and non-point pollution sources and to collect water quality data that would allow for the development of policies and plans to protect natural resources within the watershed. North Carolina Agricultural Cost-Share Program funds will be targeted for BMP implementation for animal waste management systems to address non-point sources of oxygen-consuming wastes.

In addition, DEM has been working with the City of Gastonia to reduce the discharge of oxygen demanding wastes from the Long Creek WWTP, the single largest point source discharge in the watershed. The Long Creek WWTP will be upgraded to an advanced tertiary plant upon expansion. This treatment upgrade means that even as permitted wasteflow is doubled, the facility will be able to reduce the total loading of oxygen-consuming wastes in the watershed.

South Fork Catawba River

A water quality study of 10 miles of the South Fork Catawba River was performed in order to calibrate a QUAL2E water quality model. This model was used to predict dissolved oxygen (DO), ammonia (NH3), and biochemical oxygen demand (BOD) at low flow conditions.

Results of the study suggest that the assimilative capacity for oxygen demanding wastes in the lower South Fork Catawba River is extremely limited. It is recommended that major discharges (Permitted wasteflow greater than 1.0 MGD) to the South Fork below Long Creek should receive advanced tertiary limits upon major modification or expansion. All new discharges to the South Fork Catawba River below Long Creek should also receive advanced tertiary limits.

6.3.4 Catawba Creek and Crowders Creek Watersheds (Subbasin 37)

Crowders, McGill and Abernethy Creeks

A water quality study of 25 stream miles of McGill, Crowders, and Abernethy creeks in Gaston County was performed in order to calibrate a QUAL2E water quality model. This model was used to predict dissolved oxygen (DO), ammonia (NH3), and biochemical oxygen demand (BOD) at low flow conditions. The study was initiated due to high instream waste concentration in Crowders Creek and observations of poor water quality downstream of Crowders Creek in Lake Wylie. Crowders Creek watershed receives a significant amount of wastewater from 19 NPDES discharges, including 2 major municipal discharges (Bessemer City and Gastonia Crowders Creek) and 5 significant industrial discharges.

Results of the study suggest that the recent collection of wastewater by the Gastonia Crowders Creek WWTP from smaller facilities has significantly reduced loading of oxygen demanding wastes to Crowders Creek. This is due to the advanced treatment capabilities of the Gastonia

Crowders Creek WWTP. DO violations are no longer predicted. However, it is recommended that the smaller facilities continue to tie on the Gastonia's WWTP as collection services become available.

6.3.5 Union County Watersheds (Subbasin 38)

The entire Sixmile Creek Watershed in North Carolina has zero 7Q10 flow. However, much of Sixmile Creek does have a positive 30Q2 flow. Existing water quality models cannot accurately predict the effects of discharges to a zero 7Q10 flow stream, yet because of the positive 30Q2 flow, current DEM procedures have allowed for new and expanding facilities to be permitted at advanced tertiary limits. The limit to this procedure is that without a model in place there is no way to estimate at what point such a stream will be impaired by additional wastewater flow. This is a concern in watersheds such as Sixmile Creek where a significant amount of wastewater is discharged to zero 7Q10 streams. It is also a potential concern for nearby Waxhaw Creek which is less developed but which provides habitat for the state and federally endangered Carolina Heelsplitter mussel.

At present there are eight existing and proposed discharges in the Sixmile Creek watershed totaling nearly 3 MGD of wastewater. Dissolved oxygen values of less than the state standard of 5 mg/l have been reported downstream in South Carolina's portion of the Creek. Instream monitoring data from several of the existing WWTPs have also indicated DO values below the state standard.

The most environmentally sound method to address the problem of high wastewater flow in this zero 7Q10 flow watershed is to remove the discharges. A planned expansion of the Charlotte Mecklenburg County Utility Department (CMUD) McAlpine Creek WWTP collection system offers an opportunity to do this. CMUD has proposed a collection system that will tie on at least five of the discharges in Sixmile Creek watershed. Therefore, the following strategy is recommended for the Sixmile Creek watershed.

Sixmile Creek Watershed Management Strategy

All new and expanding facilities will receive summer limits of 5 mg/l BOD5, 2 mg/l NH_3, and 6 mg/l DO per the existing DEM procedure and regulations for zero 7Q10 flow streams. Winter limits for new and expanding facilities will be 10 mg/l BOD_5, 4 mg/l NH_3, and 6 mg/l DO. All facilities will be required to tie on to sewer lines serving a regional facility within 180 days of availability.

6.4 MANAGEMENT STRATEGIES FOR NUTRIENTS

Control of nutrients is necessary to limit algal growth potential, to assure protection of the instream chlorophyll *a* standard, and to avoid the development of nuisance conditions in the state's waterways. Point source controls are typically NPDES permit limitations on total phosphorus (TP) and total nitrogen (TN). Nonpoint controls of nutrients generally include best management practices (BMPs) to control nutrient loading from areas such as agricultural land and urban areas.

Assimilative capacity for nutrients vary greatly in the Catawba Basin as the waters flow from stream to lake to stream. A 1992 report by DEM and South Carolina Department of Health and Environmental Control (92-04) described the assimilative capacity of Lake Wylie as exhausted. Rhodhiss Lake and Lake Hickory are eutrophic lakes, but their short retention time mitigates the effect by somewhat controlling algal growth. Ongoing and planned studies will further detail the assimilative capacity for nutrients of Lake James, Rhodhiss Lake, Lake Hickory, Lookout Shoals Lake, and Mountain Island Lake.

6.4.1 Lake Wylie Management Strategy

The 1992 Lake Wylie Report (92-04) documented eutrophic conditions in Lake Wylie and several of its major tributaries. To address eutrophication in Lake Wylie, the state developed a point and non-point nutrient control strategy for the Lake Wylie watershed. For point sources, it required state-of-the-art nutrient removal for all new or expanding wastewater discharges in the vicinity of the lake. In addition, the nutrient management strategy required existing facilities on tributaries to the three most highly eutrophic arms of the lake (South Fork Catawba River, Catawba Creek and Crowders Creek) to meet stringent nutrient removal requirements. For nonpoint sources, this strategy included targeting of funds from the state's Agricultural Cost Share Program for the Reduction of Nonpoint Source Pollution for implementation of best management practices on agricultural lands to highly impacted watersheds of Lake Wylie.

In conjunction with the Catawba River basinwide planning effort, the existing Lake Wylie management strategy was reexamined using current water quality data to assess the strategy's consistency with the State's stated goal of managing problem pollutants while accommodating reasonable economic growth. The Lake Wylie nutrient management strategy presented below is designed to reduce and eventually prevent the occurrence of eutrophication-related water quality standard violations in Lake Wylie and is consistent with the general results and conclusions of the 1992 Lake Wylie report.

The Lake Wylie Nutrient Management Area

In order to control nutrient loading in Lake Wylie and its major tributaries, both point and non-point source controls need to be implemented. For the purposes of this document, the Lake Wylie Nutrient Management Area is considered to be Lake Wylie and its tributaries including the Catawba River and its tributaries below Mountain Island Dam and the South Fork Catawba River below its confluence with Long Creek. The upper watersheds of the Catawba River, above Mountain Island Lake Dam, and the South Fork Catawba River, above Long Creek, are not included in the management area due to both the distance of these waters from Lake Wylie and the presence of impoundments which trap some nutrients. Because distance from the lake and the presence of impoundments may somewhat mitigate the effects of nutrients released into the upper Lake Wylie watersheds, nutrient management will be focused within the study area as defined above.

Future study will be conducted to reevaluate the extent of the defined management area. Point and non-point sources on the South Fork Catawba River upstream of Long Creek will be further assessed to determine what effect additional control of nutrients in the upper South Fork Catawba River basin may have upon eutrophication in Lake Wylie. Results of this study will be considered during the development of the next Catawba River Basin Plan.

Recommended Point Source Nutrient Reduction Strategies

To reduce nutrient enrichment of Lake Wylie, the following recommendations are made for point source discharges within the Lake Wylie Nutrient Management Area. These recommendations are summarized and compared with those from the 1992 Lake Wylie Report in Table 6.2, below.

Reference is also made to Figures 6.1 and 6.2, below, and Figure 3.4 in Chapter 3. Figures 6.1 and 6.2 depict the average daily nutrient loading and predicted chlorophyll *a* concentrations in the four major tributary arms and the mainstem of Lake Wylie based on the nutrient management strategy described below. The key differences between Figures 6.1 and 6.2 pertain to nutrient loadings in the Catawba River arm and the lake mainstem resulting from possible future expansions and upgrading of the Mt. Holly and Belmont municipal wastewater treatment plants (WWTPs). In Figure 6.1, the nutrient loadings to the lake mainstem area, which are shown enclosed by a dashed box in the figure, would be 1077 lbs/day for total phosphorus (TP) and 9289 lbs/day for total nitrogen (TN). The predicted average chlorophyll *a* concentration would be 17.2

ug/l (compared to the state standard of 40 ug/l). Figure 6.2 shows conditions in which the Mt. Holly and Belmont WWTPs are enlarged. Even though their respective flows would increase by 2.0 MGD, their actual nutrient loadings are reduced because nutrient limits would apply to the plants upon expansion. As a result, the TP and TN loads and the predicted chlorophyll *a* concentrations in the mainstem of the lake are lower in Figure 6.2 than in 6.1.

Finally, a comparison can be made between present and permitted nutrient loadings and chlorophyll *a* concentrations by comparing Figures 6.1 and 6.2 with Figure 3.4 in Chapter 3. Major nutrient loading reductions and predicted chlorophyll *a* concentrations can be seen in the Catawba Creek and Crowders Creeks arms when comparing existing conditions (Figure 3.4) and the recommended permitting strategies contained herein. The reductions in nutrient loadings and chlorophyll *a* in the two other lake arms and the lake mainstem are less dramatic but significant.

New Discharges

It is recommended that no new discharges should be allowed to the lake mainstem or its tributaries, unless an evaluation of engineering alternatives shows that it is the most environmentally sound alternative. For any new discharges that meet this requirement it is recommended that advanced treatment technology be required. It is further recommended that any new facility with a permitted design flow of greater than or equal to 1 MGD should be required to meet monthly average limits of 1.0 mg/l total phosphorus (TP) and 6.0 mg/l total nitrogen (TN), (nitrogen limits to apply for the months April through October only). For new facilities with a permitted design flow of less than 1 MGD but greater than 0.05 MGD (50,000 gallons per day) it is recommended that they meet a total phosphorus limit of 2.0 mg/l.

All industrial discharges will be handled on a case-by-case basis because attainable advanced removal technology cannot be clearly defined for them as a group. The Division will require the industries in the management area to control TP and TN to best available technology levels applicable to their industrial type.

Existing Discharges

Existing discharges to the lake mainstem and tributaries should be encouraged to be removed when alternatives become available. Programs such as the Charlotte-Mecklenburg Utility Department (CMUD) sewer line extension project should continue to be supported.

Upon expansion or major modification, it is recommended that all existing discharges should be required to apply advanced nutrient removal technology. For all expanding facilities with a permitted design flow greater than or equal to 1 MGD, recommended monthly average limits are as follows: 1.0 mg/l TP and 6.0 mg/l TN, (nitrogen limits to apply for the months of April through October only). For expanding facilities with a permitted design flow less than 1 MGD but greater than or equal to 0.05 MGD, the recommended TP limit is 2.0 mg/l. No expansion should be allowed that increases the total nutrient load from the facility unless an evaluation of engineering alternatives shows that it is the most environmentally sound alternative.

All existing industrial discharges will be handled on a case-by-case basis because attainable advanced removal technology can not be clearly defined for them as a group. DEM will require the industries in the management area to reduce TP and TN to best available technology levels.

To reduce nutrient enrichment in the two most eutrophic arms of Lake Wylie, additional recommendations are made for point source discharges to the Catawba Creek and Crowders Creek watersheds. In both watersheds, incentives should be established to encourage the privately owned facilities to tie on to larger municipal WWTPs which have a greater resource base to draw on in order to consistently operate the state-of-art treatment facilities required to protect water quality in the above listed sensitive areas. In addition, specific nutrient management recommendations are presented below.

Table 6.2 Comparison of 1992 and 1995 Point Source Phosphorus Reduction Strategies for Lake Wylie

1992 STRATEGY	1995 STRATEGY
NEW/EXPANDING DISCHARGES TO LAKE WYLIE*	NEW/EXPANDING DISCHARGES TO LAKE WYLIE*
Upon expansion, all facilities must meet BAT limits (defined as 0.5 mg/l TP, 4 mg/l summertime TN and 8 mg/l wintertime TN)	≥ 1 MGD, all new and expanding facilities must meet limits of 1 mg/l (TP) and 6 mg/l (TN - summer only). <1 MGD, but >0.05 MGD, all new and expanding facilities must meet a 2 mg/l TP limit.
INDUSTRIAL DISCHARGES	INDUSTRIAL DISCHARGES
All industrial discharges will be handled on a case-by-case basis because best available technology (BAT) is not clearly defined for them. The Division will require the industries in the management area to reduce TP and TN to BAT levels.	No change
DISCHARGES TO CATAWBA CREEK (>0.05 MGD)	DISCHARGES TO CATAWBA CREEK (>0.05 MGD)
By 1998, all facilities must meet BAT limits (defined as 0.5 mg/l TP, 4 mg/l summertime TN and 8 mg/l wintertime TN)	By 2001, all facilities must meet a 1 mg/l TP limit and 6 mg/l summertime TN limit. By 2006, all facilities must meet a 0.5 mg/l TP limit and TN limits of 4 mg/l in the summertime and 8 mg/l in the wintertime.
DISCHARGES TO CROWDERS CREEK (>1 MGD)	DISCHARGES TO CROWDERS CREEK (>1 MGD)
By 1998, all facilities must meet BAT limits (defined as 0.5 mg/l TP, 4 mg/l summertime TN and 8 mg/l wintertime TN)	By 2001, all facilities must meet limits of 1 mg/l (TP) and 6 mg/l (TN - summer only).
DISCHARGES TO SOUTH FORK CATAWBA RIVER DOWNSTREAM OF LONG CREEK	DISCHARGES TO SOUTH FORK CATAWBA RIVER DOWNSTREAM OF LONG CREEK
By 1998, all facilities must meet BAT limits (defined as 0.5 mg/l TP, 4 mg/l summertime TN and 8 mg/l wintertime TN)	≥ 1 MGD, all new and expanding facilities must meet limits of 1 mg/l (TP) and 6 mg/l (TN - summer only). <1 MGD, but >0.05 MGD, all new and expanding facilities must meet a 2 mg/l TP limit.

*Defined as the Catawba River and its tributaries (unless otherwise noted) from the Mountain Island Lake dam to the Lake Wylie dam.

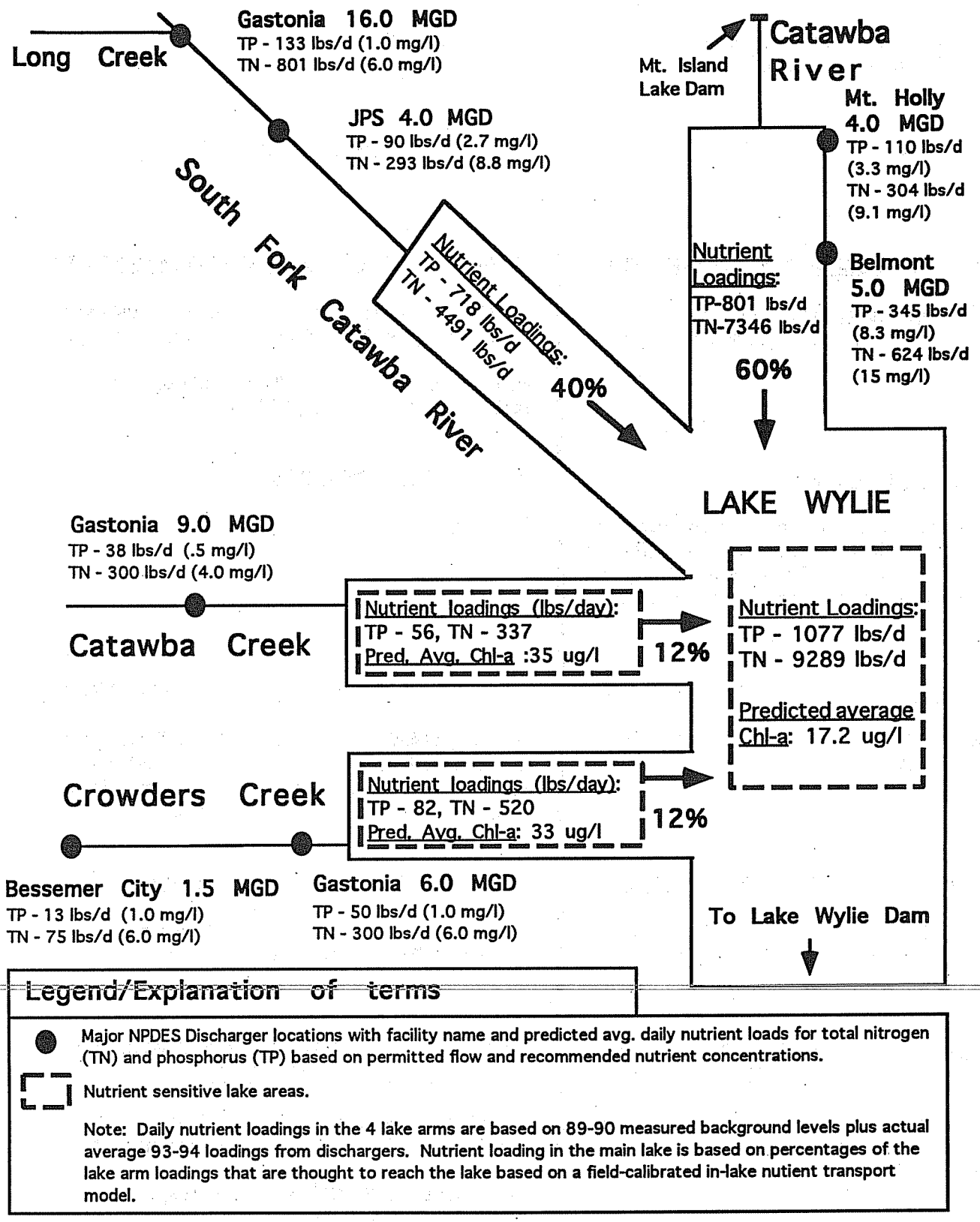


Figure 6.1 Schematic Diagram of Lake Wylie Showing Nutrient Loadings and Predicted Chlorophyll-a Concentrations in the 4 Major Arms and the Mainstem of the Lake Under the 1995 Lake Wylie Nutrient Management Strategy

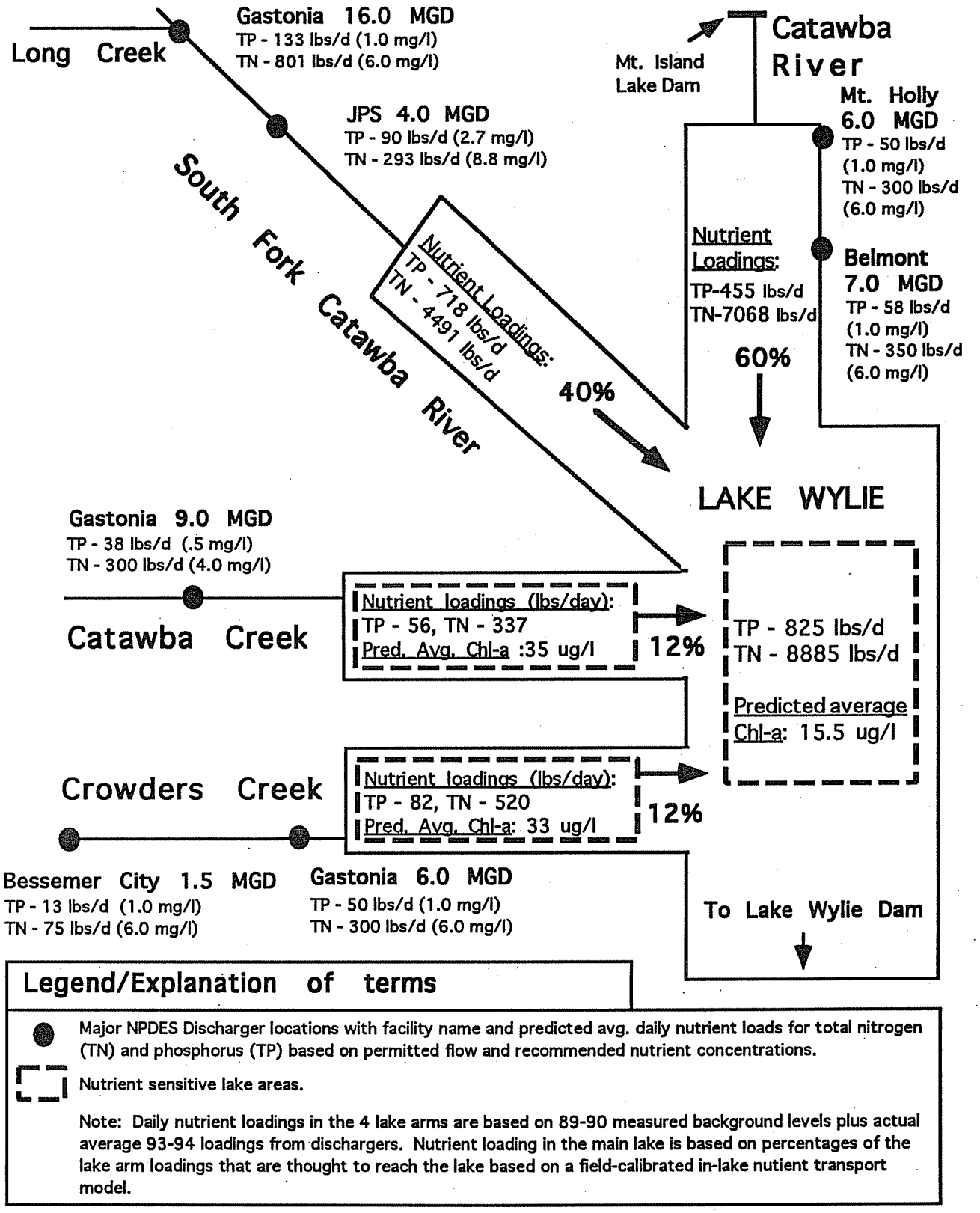


Figure 6.2 Schematic of Lake Wylie Showing Nutrient Loadings and Predicted Chlorophyll-a Concentrations in the 4 Major Arms and the Mainstem of the Lake Under the 1995 Lake Wylie Nutrient Management Strategy with Mt. Holly and Belmont Expanded by 2.0 MGD

Catawba Creek
All existing surface water discharges in these watersheds with a permitted design flow of greater than or equal to 0.05 MGD should be required to apply state-of-art nutrient removal technology. Existing facilities have been notified of this strategy and will be required to meet permit limits of 0.5 mg/l TP and TN limits of 4 mg/l in the summer and 8 mg/l in the winter by 2006. Interim limits of 1.0 mg/l TP and 6.0 mg/l TN (summer) will become effective January 1, 2001. Based on a comparison between Figure 3.4, in Chapter 3, and Figure 6.1, it can be seen that these recommendations would result in reducing the predicted chlorophyll *a* concentration in Catawba creek from 74 ug/l (Figure 3.4) to 35 ug/l (Figure 6.1).

Crowders Creek
By January 1, 2000, it is recommended that all facilities with a permitted design flow of greater than or equal to 1 MGD will be required to meet limits of 1.0 mg/l TP and 6.0 mg/l TN. The nitrogen limits would apply for the months of April through October only. Based on a comparison between Figure 3.4, in Chapter 3, and Figure 6.1, it can be seen that these recommendations would result in reducing the predicted chlorophyll *a* concentration in the creek from 43 ug/l to 33 ug/l.

Non point sources
All tributaries to Lake Wylie should be targeted by the NC Division of Soil and Water Conservation for cost share funds for use in implementation of best management practices (BMPs). When possible, resources should be targeted toward implementation of BMPs in the Catawba Creek, Crowders Creek, and the South Fork Catawba River watersheds since a significant amount of the nutrients reaching these streams is from non-point sources. Since the South Fork Catawba River provides by far the largest nutrient load of any tributary to Lake Wylie, the South Fork should be considered the highest priority for implementation of BMPs.

6.4.2 Mountain Island Lake

DEM and Mecklenburg County are completing a two-year cooperative study of nutrient loading in the McDowell Creek watershed and the eutrophic response in Mountain Island Lake. Preliminary data suggest that the CMUD McDowell Creek WWTP discharge is the largest source of nutrients to the McDowell Creek arm of Mountain Island Lake. This facility will be required to implement nutrient removal upon major modification or expansion.

6.4.3 Rhodhiss Lake and Lake Hickory

The WPCOG and the USGS in conjunction with DEM are presently performing a three-year water quality study of Rhodhiss Lake and Lake Hickory. The objectives of this study include an effort to quantify nutrient loading to the lakes and to evaluate eutrophic response to nutrient enrichment. Both lakes receive significant nutrient loading from point and non-point sources.

When compared to other major lakes in the Catawba river basin, Rhodhiss Lake and Lake Hickory have relatively fast velocities and short retention times (see Table 2.1 in Chapter 2). This suggests that these lakes may be less sensitive to nutrient enrichment than other lakes in the Catawba river basin, as mixing and limited retention time in the reservoirs may limit algal growth. Specific management plans for point and/or non-point source pollution sources to Rhodhiss Lake and Lake Hickory will be developed after completion of the WPCOG, USGS, DEM study and incorporated into the second edition of the Catawba basinwide plan.

6.5 TOXIC SUBSTANCES

6.5.1 Assimilative Capacity

Toxic substances, or toxicants, routinely regulated by DEM include metals, organics, chlorine and ammonia. These are described in Chapter 3.

The assimilative capacity, that is, the amount of wastewater the stream can assimilate under designated flow conditions (7Q10 for aquatic life based standards, average flow for carcinogens), available for toxicants in the Catawba Basin varies from stream to stream. In larger streams where there is more dilution flow, there is more assimilative capacity for toxic dischargers. In areas with little dilution, facilities will receive chemical specific limits which are close to the standard. Toxicants from nonpoint sources typically enter a waterbody during storm events. The waters need to be protected from immediate acute effects and residual chronic effects. A review of the ambient station data in the Catawba Basin indicates that there are no significant problems occurring for measured toxicants within any one subbasin. Most ambient stations where metals data is collected, show levels of copper, zinc and iron above detection and in some cases above the designated action level instream. Action levels are not limited in the effluent unless the facility has a federal guideline limit for the parameter or if the facility is failing toxicity and the cause is known to be the substance regulated by the action level.

6.5.2 Control Strategies

Basinwide Strategies

Point source dischargers will be allocated chemical specific toxic substance limits and monitoring requirements based on a mass balance technique discussed in the Instream Assessment Unit's Standard Operating Procedures manual and in Appendix III of this report. Whole effluent toxicity limits are also assigned to all major dischargers and any discharger of complex wastewater. Where clusters of discharges and other pollution sources exits, concerns about the interaction of toxicants from different facilities are addressed by calculating a total maximum daily load (TMDL) for these streams. This method involves determining the total dilution available downstream of a number of pollution sources that are believed to contribute to a threat to water quality, and allocating pollutant loads from those sources so as to prevent instream violations of water quality standards. Examples of this TMDL strategy for Clark Creek and the South Fork Catawba River are discussed below.

Subbasin 35 - Clark Creek

One four mile segment of Clark Creek receives potentially toxic effluent from three major WWTPs; Newton WWTP, Maiden WWTP and Delta Mills. Benthic macroinvertebrate data collected below the Newton WWTP indicated a decline in bioclassification from 1984 to 1991. The largest of these facilities, Newton WWTP at 5.0 MGD, will be required to meet new limits for cadmium, chromium, nickel, lead, cyanide and toluene during the next permit cycle. In addition, due to the potential interaction of toxic wastes from these three facilities, future wasteload allocations for each facility will include a TMDL analysis for total loading below all three facilities. Copper has not been included in the list of metals recommended for limitations in the upcoming permits primarily because there is no specific standard for it, only an action level, and there is no demonstrated linkage between the elevated copper concentration in the stream and affects on aquatic life in Clark Creek. However, because copper levels above the action level have been observed, DEM will assess the need for recommending copper limits in the discharger permits prior to permit renewal.

Subbasin 36 - South Fork Catawba River

The South Fork Catawba has been identified by EPA as one of fourteen areas nationwide where potential toxicity problems exist. The South Fork is used both as a drinking water supply and for the assimilation of wastewater. To address concerns about potential toxicity, point source

wasteload allocations for each facility discharging to the South Fork from Lincolnton to Lowell will include a TMDL analysis for total loading at the Lowell Gage (120 cfs).

Nonpoint source strategies to be implemented through the industrial NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters. Industries are being required to control runoff from their sites and to cover stockpiles of toxic materials that could pose a threat to water quality.

6.6 MANAGEMENT STRATEGIES FOR CONTROLLING SEDIMENTATION

Sedimentation refers to the deposition of sediment in surface waters. The causes, sources and water quality impacts of sedimentation are described in section 3.2.4 of Chapter 3. It is essentially a widespread nonpoint source-related water quality problem which results from land-disturbing activities. The most significant of these activities include agriculture, construction (e.g., highways, shopping centers and residential subdivisions) urban stormwater, forestry and mining. For each of these types of land-disturbing activities, there are programs being implemented by various government agencies at the state, federal and/or local level to minimize soil loss and protect water quality. These programs are listed in Table 6.3 and are briefly described in Chapter 5.

Table 6.3 State and Federal Sediment Control-related Programs (with Chapter 5 Section References in Parentheses)

- Agricultural Nonpoint Source (NPS) Control Programs (Section 5.3.1)
  - North Carolina Agriculture Cost Share Program
  - NC Cooperative Extension Service and Agricultural Research Service
  - Watershed Protection and Flood Prevention Program (PL 83-566)
  - Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA) (Includes Conservation Reserve Program, Conservation Compliance, Sodbuster, Swampbuster, Conservation Easement, Wetland Reserve and Water Quality Incentive Program)

- Construction, Urban and Developed Lands (Sections 5.3.2 and 5.3.3)
  - Sediment Pollution Control Act (Section 5.3.3)
  - Federal Urban Stormwater Discharge Program
  - Water Supply Protection Program
  - NC Coastal Stormwater Management Regulations
  - Coastal Nonpoint Pollution Control Programs
  - ORW and HQW Stream Classifications

- Forestry NPS Programs (Section 5.3.6)
  - Forest Practice Guidelines Related to Water Quality
  - National Forest Management Act (NFMA)
  - Forest Stewardship Program

- Mining Act (Section 5.3.7)

- Wetlands Regulatory NPS Programs (Section 5.3.8)
  The sediment trapping and soil stabilization properties of wetlands are particularly important to nonpoint source pollution control. Several important state and federal wetland protection programs are listed below.

  - Section 10 of the Rivers and Harbors Act of 1899
  - Section 404 of the Clean Water Act
  - Section 401 Water Quality Certification (from CWA)

DEM's role in sediment control is to work cooperatively with those agencies that administer the sediment control programs in order to maximize the effectiveness of the programs and protect water quality. Where programs are not effective, as evidenced by violation of instream water quality standards (section 3.2.4), and where DEM can identify a source, then appropriate enforcement action can be taken. Generally, this would entail requiring the land owner or responsible party to install acceptable best management practices (BMPs). BMPs vary with the type of activity, but they are generally aimed at minimizing the area of land-disturbing activity and the amount of time the land remains unstabilized; setting up barriers, filters or sediment traps (such as temporary ponds or silt fences) to reduce the amount of sediment reaching surface waters; and recommending land management approaches that minimize soil loss, especially for agriculture.

Some control measures, principally for construction or land development activities of 1 acre or more, are required by law under the state's Sedimentation and Erosion Control Act administered by the NC Division of Land Resources. For activities not subject to the act such as agriculture, sediment controls are carried out on a voluntary basis through programs administered by several different agencies. The NC Agricultural Cost Share Program administered by the NC Division of Soil and Water Conservation provides incentives to farmers to install BMPs by offering to pay up to 75% of the average cost of approved BMPs. A federal Farm Bill program administered by the Soil Conservation Service provides an incentive not to farm on highly erodible land (HEL) by taking away federal subsidies to a farmer that fails to comply with the provision.

The NC Cost Share Program totals are cumulative for an approximate 10-year period. The cost share figures include a wide array of BMPs including conservation tillage, terraces, diversions, critical area plan, sod-based rotation, crop conservation grass, crop conservation trees, filter strip, field border, grass waterway, water control structure and livestock exclusion.

Despite the combined efforts of all of the above programs for construction, forestry, mining and agriculture, there were still 376 miles of streams in the Catawba Basin found to be impaired by sediment, thus pointing to the need for continued overall improvements in sediment control. The following streams have been identified as being impaired or threatened by sediments and so should receive high priority as sediment control programs are implemented. The Linville River, as noted earlier, is one of four state-designated scenic rivers, and Waxhaw Creek provides habitat for a federally-endangered mussell, the Carolina Heelsplitter.

Stream	Subbasin	Stream	Subbasin
Linville River	03-08-30	South Fork Catawba	03-08-35
Lower Creek	03-08-31	Long Creek	03-08-36
Lower Little River	03-08-32	Twelve Mile Creek	03-08-38
Clark Creek	03-08-35	Waxhaw Creek	03-08-38

6.7 MANAGEMENT STRATEGIES FOR CONTROLLING COLOR

The discharge of color is to be regulated such that only such amounts as will not render the waters injurious to public health, secondary recreation, or to aquatic life and the wildlife or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses. However, the practical application of this regulation must take into account the various ways in which color is perceived in the environment. Color in natural waters is rarely the result of one specific chemical, rather a mixture of many dissolved and/or suspended constituents contribute to color. Also, the stream bed and sediments may also contribute to color. Because color is perceived differently by different people and in different lighting conditions, no general definition of color impairment can be specified by a simple set of criteria.

Because textile industries are a significant source of color to waters of the Catawba and other river basins, DEM is working with the industrial and municipal dischargers to develop appropriate methodologies for evaluating color impairment.

The two subbasins that make up the South Fork Catawba River watershed (03-08-35 and 03-08-36) will be targeted in a pilot study to address color. These subbasins were selected for a pilot study because of the relative high concentration of textile discharges in the watershed and public concerns and complaints regarding color. The study will involve color monitoring and development of color control measures for the following facilities in the South Fork Catawba watershed:

FACILITY	STREAM	FACILITY	STREAM
Hickory Henry Fk WWTP	Henry Fork	Gastonia Long Cr WWTP	Long Creek
Newton WWTP	Clark Creek	Cromton & Knowles	S. Fork Catawba
Delta Mills	Clark Creek	Stowe Pharr Mills	S. Fork Catawba
Lincolnton South Fork	S. Fork Catawba	JPS Automotive	S. Fork Catawba
Cherryville WWTP	Indian Creek		

Color monitoring will consist of ADMI monitoring (as cited below). All samples taken should have complete descriptive recordings of the color in the sample container including hue (distinctive characteristics and tint), clarity (clearness of the color sample) and luminance (brightness or glowing quality) of the sample as it looks in the collection container. Descriptions of stream color should also be recorded when color samples are collected. Below is language typically contained in NPDES discharge permits for color monitoring:

> Color samples should be analyzed as follows:
>
> a) at natural pH
> b) free from turbidity (True Color); and
> c) Samples shall be analyzed in accordance with the provisions of Method 2120 E.4. as described in the 18th Edition of Standard Methods for the Examination of Water and Wastewater. Using a narrow-band scanning spectrophotometer to produce a complete spectral curve of the visible spectrum (350-75-nm), calculate and report results in ADMI values for true color values at the sample's ambient pH value. All color data including visual observations should be submitted with the monthly DMRs.
>
> Color Monitoring shall take place instream above the effluent outfall, downstream below the effluent outfall and in the effluent.
> Frequency shall be 3 consecutive days (preferably Tuesday, Wednesday and Thursday) once per month.

In addition to the monitoring, the Division will work with the Office of Waste Reduction to identify possible source reduction methods for the control of color at the facilities listed above. The results of the monitoring program will be used to guide color management decisions throughout the Catawba River basin and to develop a color management strategy for the South Fork Catawba watershed as part of the Catawba basinwide plan update in 1999.

6.8 MANAGEMENT STRATEGIES FOR STORMWATER CONTROL

A number of studies, including the Nationwide Urban Runoff Program (NURP) sponsored by the US Environmental Protection Agency, have shown that urban stormwater runoff, and the pollutants it carries, can be a significant contributor to water quality impairment. The North Carolina Division of Environmental Management (DEM) has identified 111 miles of streams in the

Catawba River Basin as being impaired by urban stormwater. DEM administers a number of programs aimed at controlling urban stormwater runoff. These include: 1) programs for the control of development activities near High Quality Waters (HQW) and Outstanding Resource Waters (ORW) and activities within designated Water Supply (WS) watersheds and 2) NPDES stormwater permit requirements for industrial activities and municipalities greater than 100,000 in population (see Section 5.3.2).

6.8.1 HQW, ORW and Water Supply Watersheds

The Catawba River Basin includes a significant number of streams and lakes that are assigned these sensitive water classifications. As described in other parts of this plan, these waters carry with them specific management strategies to protect their uses, including measures to control stormwater runoff from urban development (Section 2.5.3 and Appendix I). The HQW and ORW requirements are implemented by DEM through it's Mooresville and Asheville Regional Offices. Any development activities subject to the HQW or ORW requirements must submit plans and receive stormwater approvals from these regional offices. The water supply protection requirements are implemented by all local governments that have jurisdiction in a water supply watershed. There are 38 local governments in the Catawba basin that have developed water supply watershed protective ordinances for twenty watersheds in the basin. Development activities covered by water supply protection requirements must be reviewed and approved by the appropriate local government. As part of the Catawba Plan, these programs will continue to focus on protection measures for these sensitive water areas.

6.8.2 NPDES Stormwater Management

Throughout the Catawba Basin various types of industrial activities with point source discharges of stormwater are required to be permitted under the NPDES stormwater program. These include discharges related to manufacturing, processing, materials storage areas and construction activities with greater than five acres of disturbance. All of those areas requiring coverage must develop Stormwater Pollution Prevention Plans (SWPPP) to minimize and control pollutants discharged from their stormwater systems. These SWPPPs are subject to review and modification by the permitted facilities and DEM to assure that management measures are appropriate.

In the Catawba Basin one municipality, the City of Charlotte, is currently covered by the NPDES stormwater requirements. The City of Charlotte's permit became effective on November 1, 1993 and expires on June 30, 1998. This permit covers discharges of stormwater from the city's storm sewer system as it exists today and any additional storm sewer outfalls that may be added. The Stormwater Quality Management Program (SWQMP) developed by the City involves stormwater management to address a wide range of activities within the jurisdictional area of the City of Charlotte. These programs are designed to control the discharge of pollutants from the city's storm sewer system associated with stormwater runoff from commercial, residential, industrial and construction activities. Like the other municipal areas across the state that are covered by this program, the City of Charlotte is responsible for implementing programs to reduce the discharge of pollutants from their municipal storm sewer system to the maximum extent practical. Stormwater management through source reduction and pollution prevention are the major areas of emphasis of all of these programs. Appendix VI of this document contains fact sheet information related to the city's permit. Additional information on the City of Charlotte's Stormwater Permit can be obtained from the Division or from the Charlotte/Mecklenburg Stormwater Services.

The programs associated with the SWQMP are comprehensive programs that will take a number of years to implement fully. For this reason Charlotte, like other municipalities, will implement management activities on a priority basis. The Division recognizes municipal stormwater permits as living documents that will most likely change over the life of the permit to afford the most effective management of stormwater runoff. Annual reports on the progress and effectiveness of

the cities stormwater management programs are part of the NPDES municipal permits and will serve as an assessment tool for DEM and for the cities to make needed adjustments to various parts of their program. In the case of the City of Charlotte, Table 6.4 below outlines some of the highlights of their programs. This is a very generalized summary of Charlotte's program which is a very progressive and comprehensive stormwater management program.

Table 6.4 Highlights of Charlotte's NPDES Municipal Stormwater Management Programs

Commercial and Residential: Charlotte will monitor and evaluate the effectiveness of management practices including maintenance activities, recycling controls, litter controls and other housekeeping programs that impact stormwater management in these areas.
Construction: Charlotte will utilize ongoing training programs to educate people involved in sedimentation and erosion control activities on state-of-the-art control practices and measures.
Industrial: Charlotte is implementing inspection and monitoring programs to identify water quality problems associated with industrial areas including illicit connections programs.
Recycling: Charlotte is enhancing programs, along with the county, for collection of household wastes - used oil, household chemicals, etc. These programs will be implemented in conjunction with educational programs.
Monitoring: Charlotte will utilize various forms of chemical and biological monitoring to locate problem areas for controls and to assess the effectiveness of stormwater management programs.

6.8.3 Recommendations for Controlling Stormwater Impacts by Local Governments Not Subject to NPDES Stormwater Requirements

Other local governments throughout the Catawba basin are encouraged to evaluate the potential impacts of stormwater runoff and develop stormwater management programs for control of these sources of pollutants. In this process a few program areas consistent with existing municipal NPDES programs are recommended as starting points for stormwater management. These include:

- Mapping of the local government's storm sewer system and outfall points, and development of procedures to update this information.
- Evaluating existing land uses in the local government's jurisdictional area to determine where sources of stormwater pollution may exist. In addition, local government activities and programs should be evaluated to determine where existing activities address stormwater management in some way, or could be modified to do so.
- Developing educational programs to alert people to the activities that may contribute pollutants to stormwater runoff and how they can change their practices to minimize or eliminate these problems.
- Developing programs to locate and remove illicit connections (illegal discharge of non-stormwater materials) to the storm sewer system. These often occur in the form of floor drains and similar connections. In practice, stormwater management programs represent an area where local governments can develop their own ideas and activities for controlling sources of pollution.

APPENDIX 1

CONTENTS:

- Summary of North Carolina's Water Quality Classifications and Standards

- Anti-Degradation Policy and High Quality Waters (15A NCAC 2B .0201)

- Outstanding Resource Waters (15A NCAC 2B .0216)

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS

PRIMARY CLASSIFICATIONS	BEST USAGE	NUMERIC STANDARDS	STORMWATER CONTROLS	OTHER REQUIREMENTS
Freshwater:				
Class C (standards apply to all freshwaters, unless preempted by more stringent standard for more protective classification)	Secondary recreation (including swimming on an unorganized or infrequent basis); fish and other aquatic life propagation and survival; agriculture and other uses, except for primary recreation, water supply or other food - related uses	See attached Table 1.; WATER QUALITY STANDARDS FOR FRESHWATER CLASSES; standards listed under "Standards For All Freshwaters" column (aquatic life and human health sections) apply to Class C waters, unless preempted by more protective standard.	Stormwater Disposal Rules apply in the 20 coastal counties as described in 15A NCAC 2H .1000	
Class B	Primary recreation (swimming on an organized or frequent basis) and all uses specified for Class C (and not water supply or other food-related uses)	Same as for Class C	Same as for Class C	Wastewater treatment reliability requirements (dual train design; backup power capability) may apply to protect swimming uses (15A NCAC 2H .0124)
WS-I Water Supply NOTE: Revised water supply classifications and standards effective as of 8/3/92	Water supplies in natural and undeveloped watersheds	See Table 1. under "More Stringent Standards to Support Additional Uses": WS Classes heading; no point sources except groundwater remediation when no alternative exists	Not applicable since watershed is undeveloped	No landfills, sludge/residual or petroleum contaminated soils application allowed in watershed
WS-II Water supply	Water supplies in predominantly undeveloped watersheds	See Table 1. under "More Stringent Standards to Support Additional Uses": WS Classes heading; only general permit wastewater discharges allowed in watershed and groundwater remediation discharges allowed when no alternative exists	Local land management program required as per 15A NCAC 2B .0211(d): 2-acre lots or 6% built-upon area in critical area; 1-acre lots or 12% built-upon area outside of critical area; up to 64% in the critical area and 30% built upon area outside of the critical area allowed with engineered stormwater controls for the 1" storm[1]	Buffers required along perennial waters; no new landfills allowed in the critical area and no new discharging landfills outside of critical area; no new sludge/ residual or petroleum contaminated soils application allowed in the critical area; hazardous material and spill/failure containment plan required; spill containment structures required for new industries in the critical area using, storing or manufacturing hazardous materials
WS-III Water Supply	Water supplies in low to moderately developed watersheds	See Table 1. under "More Stringent Standards to Support Additional Uses": WS Classes heading; general permits allowed througliout watershed, domestic and non-process industrial outside of the critical area, groundwater remediation discharges allowed when no alternative exists	Local land management program required as per 15A NCAC 2B .0211(e): 1-acre lots or 12% built-upon area in critical area; ½-acre lots or 24% built-upon outside of critical area; up to 30% in critical area and 50% built-upon area outside critical area with engineered stormwater controls for the 1" storm[1]	Buffers required along perennial waters; no new landfills allowed in the critical area and no new discharging landfills outside of the critical area; no new sludge/ residual or petroleum contaminated soils application allowed in the critical area; hazardous material and spill/failure containment plan required; spill containment structures required for new industries in the critical area using, storing or manufacturing hazardous materials

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

PRIMARY CLASSIFICATIONS	BEST USAGE	NUMERIC STANDARDS	STORMWATER CONTROLS	OTHER REQUIREMENTS
WS-IV Water Supply	Water supplies in moderately to highly developed watersheds	See Table 1. under "More Stringent Standards to Support Additional Uses": WS Classes heading; general permits, domestic and industrial discharges allowed throughout water supply [2]; groundwater remediation discharges allowed when no alternative exists	Local land management program required as per 15A NCAC 2B .0211(F): ½-acre lots or 24% built-upon area in critical area and protected area [3,4]; up to 50% in critical area and 70% built-upon area outside critical area with engineered stormwater controls for the 1" storm[1]	Buffers required along perennial waters; no new landfills allowed in the critical area; no new sludge/residual or petroleum contaminated soils application allowed in the critical area; hazardous material and spill/failure containment plan required
WS-V Water Supply	River segment	No categorical restrictions on development or wastewater dischargers. Instream water quality standards for water supply waters are applicable.		

NOTE: Please refer to 15A NCAC 2B .0101, .0104, .0202, .0211 and .0301 for more specific requirements for surface water supply protection.

1. If the high density development option is utilized, then wet detention basins are required and local governments will assume ultimate responsibility for the operation and maintenance of these engineered stormwater control structures.
2. New industrial process wastewater discharges in the critical area are allowed but must meet additional treatment requirements.
3. Applies to projects requiring an Erosion/Sedimentation Control Plan.
4. 1/3 acre or 36% built-upon area is allowed for projects without a curb and gutter street system in the protected area.
- Critical area is ½ mile and draining to water supplies from normal pool elevation of reservoirs, or ½ mile and draining to a river intake.
- Protected area is 5 miles and draining to water supplies from normal pool elevation of reservoirs, or 10 miles upstream of and draining to a river intake.
- Agricultural activities are subject to provisions of the Food Security Act of 1985 and the Food, Agriculture, Conservation and Trade Act of 1990. In WS-I watersheds and critical areas of WS-II, WS-III and WS-IV areas, agricultural activities must maintain a 10 foot vegetated buffer or equivalent control, and animal operations >100 animal units must use BMPs as determined by the Soil and Water Conservation Commission.
- Silviculture activities are subject to the provisions of the Forest Practices Guidelines Related to Water Quality (15A NCAC 1I .0101-.0209).
- The Department of Transportation must use BMPs as described in their document, "Best Management Practices for Protection of Surface Waters".

PRIMARY CLASSIFICATIONS	BEST USAGE	NUMERIC STANDARDS	STORMWATER CONTROLS	OTHER REQUIREMENTS
Saltwater:				
Class SC	Saltwaters protected for secondary recreation, aquatic life propagation and survival and other uses as described for Class C	See attached Table 2.; WATER QUALITY STANDARDS FOR SALTWATER CLASSES; standards listed under "Standards For All Tidal Saltwaters" column (aquatic life and human health sections) apply to Class SC waters, unless preempted by more protective standard.	Stormwater Disposal Rules (15A NCAC 2H .1000) apply to all waters in the 20 coastal counties; low density option: 30% built-upon area or 1/3 acre lots, or structural stormwater controls with higher density, as specified	
Class SB	Saltwaters protected for primary recreation and all Class SC uses (similar to Class B)	Same as Class SC except no floating solids, settleable solids or sludge deposits attributable to sewage, industrial or other wastes	Same as Class SC	Reliability requirements same as for Class B
Class SA	Shellfishing and all Class SC and SB uses	Same as for Class SC, except fecal coliform = 14 colonies per 100 ml of water; all [illegible]her [illegible]s = [illegible]0 ml	Same as for Class SC, except low density option = 25% built-upon area	No domestic discharges and only nonprocess industrial discharges, such as seafood packing house or cooling water [illegible]

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STADARDS (continued)

Supplemental Classifications are added to the primary classifications as appropriate (Examples include Class C-NSW, Class SA-ORW, Class B-Trout, etc.) and impose additional requirements.

SUPPLEMENTAL CLASSIFICATIONS	BEST USAGE	NUMERIC STANDARDS	STORMWATER CONTROLS	OTHER REQUIREMENTS
High Quality Waters (HQW) (categories: (1) waters rated as Excellent by DEM; (2) Primary Nursey Areas; (3) Native or Special Native Trout Waters; (4) Critical Habitat Areas; (5) WS-I and WS-II water supplies; (6) SA waters)	Waters with quality higher than the standards (EPA's Tier II waters; the minimum standards for Class C and SC define Tier I); see Standards and Stream Classifications Rules (15A NCAC 2B .0100) for detailed description (15A NCAC 2B .0101(e)(5))	For new or expanded discharges, advanced treatment requirements are: BOD_5=5 mg/l; NH_3-N= 2 mg/l; DO=6 mg/l	Projects requiring Erosion/ Sedimentation Control Plan and are within 1 mile and draining to HQW waters: 1-acre lots or 12% built-upon area, or higher density with engineered structural controls (wet detention ponds); WS-I, WS-II and 20 coastal counties exempt since stormwater control requirements already apply	Other treatment requirements may apply, dependent upon type of discharge and characteristics of receiving waters (see pp. 1 and 2 of Section .0200 Rules: 15A: NCAC 2B .0201(d) of Antidegradation Policy)
Outstanding Resource Waters (ORW)	Unique and special waters having exceptional water quality and being of exceptional state or national ecological or recreational significance; must meet other certain conditions and have 1 or more of 5 outstanding resource value criteria as described in Rule 2B .0216	Water quality must clearly maintain and protect uses, including outstanding resource values; management strategies must include at a minimum: no new or expanded discharges to freshwater ORWs; some discharges may be allowed in coastal areas	Same as for High Quality Waters for Freshwater ORWs; for Saltwater ORWs, development activities within a 575' buffer must comply with the low density option of Stormwater Disposal Rules (generally, 25% built-upon area around SA waters and 30% around other waters)	Other management strategy components as described in Rule .0216
Trout Waters (Tr)	Protected for natural trout propagation and survival of stocked trout;	More protective standards for cadmium, total residual chlorine, chlorophyll-a, dissolved oxygen, turbidity and toluene to protect these sensitive species (see Table 1. under "Trout" heading)		
Nutrient Sensitive Waters (NSW)	Waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation	No increase of nutrients over background levels		Nutrient management strategies developed on a case-by-case basis
Swamp Waters (Sw)	Waters with low velocities and other characteristics different from other waterbodies (generally, low pH, DO, high organic content)	pH as low as 4.3 and DO less than 5 mg/l allowed if due to natural conditions		

TABLE 1. WATER QUALITY STANDARDS FOR FRESHWATER CLASSES

Parameters	Standards For All Freshwater		More Stringent Standards To Support Additional Uses	
	Aquatic Life	Human Health	WS Classes	Trout
Arsenic (ug/l)	50			
Barium (mg/l)			1.0	
Benzene (ug/l)		71.4	1.19	
Beryllium (ng/l)		117	6.8	
Cadmium (ug/l)	2.0			0.4
Carbon tetrachloride (ug/l)		4.42	0.254	
Chloride (mg/l)	230 (AL)		250	
Chlorinated benzenes (ug/l)			488	
Chlorine, total residual (ug/l)	17 (AL)			17
Chlorophyll a, corrected (ug/l)	40 (N)			15 (N)
Chromium, total (ug/l)	50			
Coliform, total (MFTCC/100ml)			50 (N)(2)	
Coliform, fecal (MFTCC/100ml)		200 (N)		
Copper (ug/l)	7 (AL)			
Cyanide (ug/l)	5.0			
Dioxin (ng/l)		0.000014	0.000013	
Dissolved gases	(N)			
Dissolved oxygen (mg/l)	5.0 (Sw)(1)			6.0
Fluoride (mg/l)	1.8			
Hardness, total (mg/l)			100	
Hexachlorobutadiene (ug/l)		49.7	0.445	
Iron (mg/l)	1.0 (AL)			
Lead (ug/l)	25 (N)			
Manganese (ug/l)			200	
MBAS (ug/l) (Methylene-Blue-Active Substances)	500			
Mercury (ug/l)	0.012			
Nickel (ug/l)	88		25	
Nitrate nitrogen (mg/l)			10	
Pesticides				
Aldrin (ng/l)	2.0	0.136	0.127	
Chlordane (ng/l)	4.0	0.588	0.575	
DDT (ng/l)	1.0	0.591	0.588	
Demeton (ng/l)	100			
Dieldrin (ng/l)	2.0	0.144	0.135	
Endosulfan (ng/l)	50			
Endrin (ng/l)	2.0			
Guthion (ng/l)	10			
Heptachlor (ng/l)	4.0	0.214	0.208	
Lindane (ng/l)	10			
Methoxychlor (ng/l)	30			
Mirex (ng/l)	1.0			
Parathion (ng/l)	13			
Toxaphene (ng/l)	0.2			
2,4-D (ug/l)			100	
2,4,5-TP (Silvex) (ug/l)			10	
pH (units)	6.0-9.0 (Sw)			
Phenolic compounds (ug/l)		(N)	1.0 (N)	
Polychlorinated biphenyls (ng/l)	1.0	0.079		
Polynuclear aromatic hydrocarbons (ng/l)		31.1	2.8	
Radioactive substances		(N)		
Selenium (ug/l)	5			
Silver (ug/l)	0.06 (AL)			
Solids, total dissolved (mg/l)			500	
Solids, suspended	(N)			
Sulfates (mg/l)			250	
Temperature	(N)			
Tetrachloroethane (1,1,2,2) (ug/l)		10.8	0.172	
Tetrachloroethylene (ug/l)			0.8	
Toluene (ug/l)	11			0.36
Toxic Substances	(N)			
Trialkyltin (ug/l)	0.008			
Trichloroethylene (ug/l)		92.4	3.08	
Turbidity (NTU)	50; 25 (N)			10 (N)
Vinyl chloride (ug/l)		525	2	
Zinc (ug/l)	50 (AL)			

Note:
- (N) See 2B .0211 (b), (c), (d), or (e) for narrative description of limits.
- (AL) Values represent action levels as specified in .0211 (b)(4).
- (Sw) Designated swamp waters may have a pH as low as 4.3 and dissolved oxygen less than 5.0 mg/l if due to natural conditions.
- (1) An instantaneous reading may be as low as 4.0 ug/l but the daily average must be 5.0 ug/l or more.
- (2) Applies only to unfiltered water supplies.

TABLE 2. WATER QUALITY STANDARD FOR SALTWATER CLASSES

Parameters	Standards For All Tidal Saltwaters		More Stringent Standards To Support Additional Uses
	Aquatic Life	Human Health	Class SA
Arsenic (ug/l)	50		
Benzene (ug/l)		71.4	
Beryllium (ng/l)		117	
Cadmium (ug/l)	5.0		
Carbon tetrachloride (ug/l)		4.42	
Chlorophyll a (ug/l)	40 (N)		
Chromium, total (ug/l)	20		
Coliform, fecal (MFFCC/100ml)		200 (N)	14 (N)
Copper (ug/l)	3 (AL)		
Cyanide (ug/l)	1.0		
Dioxin (ng/l)		0.000014	
Dissolved gases	(N)		
Dissolved oxygen (mg/l)	5.0 (1)		
Hexachlorobutadiene (ug/l)		49.7	
Lead (ug/l)	25 (N)		
Mercury (ug/l)	0.025		
Nickel (ug/l)	8.3		
Phenolic compounds		(N)	
Polychlorinated biphenyls (ng/l)	1.0	0.079	
Polynuclear aromatic hydrocarbons (ng/l)		31.1	
Pesticides (ng/l)			
Aldrin	3.0	0.136	
Chlordane	4.0	0.588	
DDT	1.0	0.591	
Demeton	100		
Dieldrin	2.0	0.144	
Endosulfan	9.0		
Endrin	2.0		
Guthion	10		
Heptachlor	4.0	0.214	
Lindane	4.0		
Methoxychlor	30		
Mirex	1.0		
Parathion	178		
Toxaphene	0.2		
pH (units)	6.8-8.5 (1)		
Radioactive substances		(N)	
Salinity	(N)		
Selenium (ug/l)	71		
Silver (ug/l)	0.1 (AL)		
Solids, suspended	(N)		
Temperature	(N)		
Tetrachloroethane (1,1,2,2) (ug/l)		10.8	
Toxic substances	(N)		
~~Trialkyltin (ug/l)~~	~~0.002~~		
Trichloroethylene (ug/l)		92.4	
Turbidity (NTU)	25 (N)		
Vinyl chloride (ug/l)		525	
Zinc (ug/l)	86 (AL)		

Note: (N) See 2B .0212 (b), (c), or (d) for narrative description of limits.
(AL) Values represent action levels as specified in .0212(b)(4).
(1) Designated swamp waters may have a pH as low as 4.3 and dissolved oxygen less than 5.0 mg/l if due to natural conditions.

HIGH QUALITY WATERS

Excerpt from Classifications and Water Quality Standards Applicable to
Surface Waters of North Carolina
15 NCAC 2B .0200

.0201 ANTIDEGRADATION POLICY

(a) It is the policy of the Environmental Management Commission to maintain, protect, and enhance water quality within the State of North Carolina. Pursuant to this policy, the requirements of 40 CFR 131.12 are hereby incorporated by reference including any subsequent amendments and editions. This material is available for inspection at the Department of Environment, Health, and Natural Resources, Division of Environmental Management, Water Quality Planning Branch, 512 North Salisbury Street, Raleigh, North Carolina. Copies may be obtained from the U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402-9325 at a cost of thirteen dollars ($13.00). These requirements will be implemented in North Carolina as set forth in Paragraphs (b), (c) and (d) of this Rule.

(b) Existing uses, as defined by Rule .0202 of this Section, and the water quality to protect such uses shall be protected by properly classifying surface waters and having standards sufficient to protect these uses. In cases where the Commission or its designee determines that an existing use is not included in the classification of waters, a project which will affect these waters will not be permitted unless the existing uses are protected.

(c) The Commission shall consider the present and anticipated usage of waters with quality higher than the standards, including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of waters with quality higher than the standards below the water quality necessary to maintain existing and anticipated uses of those waters. Waters with quality higher than the standards are defined by Rule .0202 of this Section. The following procedures will be implemented in order to meet these requirements:

(1) Each applicant for an NPDES permit or NPDES permit expansion to discharge treated waste will document an effort to consider non-discharge alternatives pursuant to 15A NCAC 2H .0105(c)(2).

(2) Public Notices for NPDES permits will list parameters that would be water quality limited and state whether or not the discharge will use the entire available load capacity of the receiving waters and may cause more stringent water quality based effluent limitations to be established for dischargers downstream.

(3) The Division may require supplemental documentation from the affected local government that a proposed project or parts of the project are necessary for important economic and social development.

(4) The Commission and Division will work with local governments on a voluntary basis to identify and develop appropriate management strategies or classifications for waters with unused pollutant loading capacity to accommodate future economic growth.

Waters with quality higher than the standards will be identified by the Division on a case-by-case basis through the NPDES permitting and waste load allocation processes (pursuant to the provisions of 15A NCAC 2H .0100). Dischargers affected by the requirements of Paragraphs (c)(1) through (c)(4) of this Rule and the public at large will be notified according to the provisions described herein, and all other appropriate provisions pursuant to 15A NCAC 2H .0109. If an applicant objects to the requirements to protect waters with quality higher than the standards and believes degradation is necessary to accommodate important social and economic development, the applicant can contest these requirements according to the provisions of General Statute 143-215.1(e) and 150B-23.

(d) The Commission shall consider the present and anticipated usage of **High Quality Waters** (HQW), including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of **High Quality Waters** below the water quality necessary to maintain existing and anticipated uses of those waters. **High Quality Waters** are a subset of waters with quality higher than the standards and are as described by 15A NCAC 2B .0101(e)(5). The following procedures will be implemented in order to meet the requirements of this part:

(1) New or expanded wastewater discharges in **High Quality Waters** will comply with the following:

(A) Discharges from new single family residences will be prohibited. Those that must discharge will install a septic tank, dual or recirculating sand filters, disinfection and step aeration.

(B) All new NPDES wastewater discharges (except single family residences) will be required to provide the treatment described below:

(i) Oxygen Consuming Wastes: Effluent limitations will be as follows: BOD_5= 5 mg/l, NH_3-N = 2 mg/l and DO = 6 mg/l. More stringent limitations will be set, if necessary, to ensure that the cumulative pollutant discharge of oxygen-consuming wastes will not cause the DO of the receiving water to drop more than 0.5 mg/l below background levels, and in no case below the standard. Where background information is not readily available, evaluations will assume a percent saturation determined by staff to be generally applicable to that hydroenvironment.

(ii) Total Suspended Solids: Discharges of total suspended solids (TSS) will be limited to effluent concentrations of 10 mg/l for trout waters and PNA's, and to 20 mg/l for all other **High Quality Waters.**

(iii) Disinfection: Alternative methods to chlorination will be required for discharges to trout streams, except that single family residences may use chlorination if other options are not economically feasible. Domestic discharges are prohibited to SA waters.

(iv) Emergency Requirements: Failsafe treatment designs will be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs.

(v) Volume: The total volume of treated wastewater for all discharges combined will not exceed 50 percent of the total instream flow under 7Q10 conditions.

(vi) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations will be set for phosphorus or nitrogen, or both.

(vii) Toxic substances: In cases where complex wastes (those containing or potentially containing toxicants) may be present in a discharge, a safety factor will be applied to any chemical or whole effluent toxicity allocation. The limit for a specific chemical constituent will be allocated at one-half of the normal standard at design conditions. Whole effluent toxicity will be allocated to protect for chronic toxicity at an effluent concentration equal to twice that which is acceptable under design conditions. In all instances there may be no acute toxicity in an effluent concentration of 90 percent as measured by the North Carolina "Pass/Fail Methodology for Determining Acute Toxicity in a Single Effluent Concentration". Ammonia toxicity will be evaluated according to EPA guidelines promulgated in the Ammonia Criteria Development Document (1986); EPA document number 440/5-85-001; NTIS number PB85-227114; July 29, 1985 (50 FR 30784).

(C) All expanded NPDES wastewater discharges in **High Quality Waters** will be required to provide the treatment described in part (1)(B) of this Rule, except for those existing discharges which expand with no increase in permitted pollutant loading.

(2) Development activities which require an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or local erosion and sedimentation control program approved in accordance with 15A NCAC 4B .0218, and which drain to and are within one mile of **High Quality Waters (HQW)** will be required to control runoff from the one inch design storm as follows:

(A) Low Density Option: Developments which limit single family developments to one acre lots and other type developments to 12 percent built-upon area, have no stormwater collection system as defined in 15A NCAC 2H .1002(13), and have built-upon areas at least 30 feet from surface waters will be deemed to comply with this requirement, unless it is determined that additional runoff control measures are required to protect the water quality of **High Quality Waters** necessary to maintain existing and anticipated uses of those waters, in which case more stringent stormwater runoff control measures may be required on a case-by-case basis. Activities conforming to the requirements described in 15A NCAC 2H .1003(a) [except for Subparagraphs (2) and (3) which apply only to waters within the 20

coastal counties as defined in 15A NCAC 2H .1002(9)] will also be deemed to comply with this requirement, except as provided in the preceding sentence.

(B) High Density Option: Higher density developments will be allowed if stormwater control systems utilizing wet detention ponds as described in 15A NCAC 2H .1003(i), (k) and (l) are installed, operated and maintained which control the runoff from all built-upon areas generated from one inch of rainfall, unless it is determined that additional runoff control measures are required to protect the water quality of **High Quality Waters** necessary to maintain existing and anticipated uses of those waters, in which case more stringent stormwater runoff control measures may be required on a case-by-case basis. The size of the control system must take into account the runoff from any pervious surfaces draining to the system.

(C) All waters classified WS-I or WS-II and all waters located in the 20 coastal counties as defined in Rule 15A NCAC 2H .1002(9) are excluded from this requirement since they already have requirements for nonpoint source controls.

If an applicant objects to the requirements to protect high quality waters and believes degradation is necessary to accommodate important social and economic development, the applicant can contest these requirements according to the provisions of G.S. 143-215.1(e) and 150B-23.

(e) Outstanding Resource Waters (ORW) are a special subset of **High Quality Waters** with unique and special characteristics as described in Rule .0216 of this Section. The water quality of waters classified as ORW shall be maintained such that existing uses, including the outstanding resource values of said Outstanding Resource Waters, will be maintained and protected.

OUTSTANDING RESOURCE WATERS

Excerpt from Classifications and Water Quality Standards Applicable to
Surface Waters of North Carolina
15 NCAC 2B .0200

.0216 OUTSTANDING RESOURCE WATERS

(a) General. In addition to the existing classifications, the Commission may classify certain unique and special surface waters of the state as outstanding resource waters (ORW) upon finding that such waters are of exceptional state or national recreational or ecological significance and that the waters have exceptional water quality while meeting the following conditions:

(1) there are no significant impacts from pollution with the water quality rated as excellent based on physical, chemical or biological information;

(2) the characteristics which make these waters unique and special may not be protected by the assigned narrative and numerical water quality standards.

(b) Outstanding Resource Values. In order to be classified as ORW, a water body must exhibit one or more of the following values or uses to demonstrate it is of exceptional state or national recreational or ecological significance:

(1) there are outstanding fish (or commercially important aquatic species) habitat and fisheries;

(2) there is an unusually high level of water-based recreation or the potential for such recreation;

(3) the waters have already received some special designation such as a North Carolina or National Wild and Scenic River, Native or Special Native Trout Waters, National Wildlife Refuge, etc, which do not provide any water quality protection;

(4) the waters represent an important component of a state or national park or forest; or

(5) the waters are of special ecological or scientific significance such as habitat for rare or endangered species or as areas for research and education.

(c) Quality Standards for ORW.

(1) Freshwater: Water quality conditions shall clearly maintain and protect the outstanding resource values of waters classified ORW. Management strategies to protect resource values will be developed on a site specific basis during the proceedings to classify waters as ORW. At a minimum, no new discharges or expansions of existing discharges will be permitted, and stormwater controls for all new development activities requiring an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an appropriate local erosion and sedimentation control program will be required to control stormwater runoff as follows:

(A) Low Density Option: Developments which limit single family developments to one acre lots and other type developments to 12 percent built-upon area, have no stormwater collection system as defined in 15A NCAC 2H .1002(13), and have built-upon areas at least 30 feet from surface water areas will be deemed to comply with this requirement, unless it is determined that additional runoff control measures are required to protect the water quality of Outstanding Resource Waters necessary to maintain existing and anticipated uses of those waters, in which case such additional stormwater runoff control measures may be required on a case-by-case basis.

(B) High Density Development: Higher density developments will be allowed if stormwater control systems utilizing wet detention ponds as described in 15A NCAC 2H .1003(i), (k) and (l) are installed, operated and maintained which control the runoff from all built-upon areas generated from one inch of rainfall, unless it is determined that additional runoff control measures are required to protect the water quality of Outstanding Resource Waters necessary to maintain existing and anticipated uses of those waters, in which case such additional stormwater runoff control measures may be required on a case-by-case basis. The size of the control system must take into account the runoff from any pervious surfaces draining to the system.

(2) Saltwater: Water quality conditions shall clearly maintain and protect the outstanding resource values of waters classified ORW. Management strategies to protect

resource values will be developed on a site-specific basis during the proceedings to classify waters as ORW. At a minimum, new development will comply with the low density options as specified in the Stormwater Runoff Disposal rules [15A NCAC 2H .1003 (a)(2)] within 575 feet of the mean high water line of the designated ORW area. New non-discharge permits will be required to meet reduced loading rates and increased buffer zones, to be determined on a case-by-case basis. No dredge or fill activities will be allowed where significant shellfish or submerged aquatic vegetation bed resources occur, except for maintenance dredging, such as that required to maintain access to existing channels and facilities located within the designated areas or maintenance dredging for activities such as agriculture. A public hearing is mandatory for any proposed permits to discharge to waters classified as ORW.

Additional actions to protect resource values will be considered on a site specific basis during the proceedings to classify waters as ORW and will be specified in Paragraph (e) of this Rule. These actions may include anything within the powers of the commission. The commission will also consider local actions which have been taken to protect a water body in determining the appropriate state protection options. Descriptions of boundaries of waters classified as ORW are included in Paragraph (e) of this Rule and in the Schedule of Classifications (15A NCAC 2B .0302 through .0317) as specified for the appropriate river basin and will also be described on maps maintained by the Division of Environmental Management.

(d) Petition Process. Any person may petition the Commission to classify a surface water of the state as an ORW. The petition shall identify the exceptional resource value to be protected, address how the water body meets the general criteria in Paragraph (a) of this Rule, and the suggested actions to protect the resource values. The Commission may request additional supporting information from the petitioner. The Commission or its designee will initiate public proceedings to classify waters as ORW or will inform the petitioner that the waters do not meet the criteria for ORW with an explanation of the basis for this decision. The petition shall be sent to:

Director
DEHNR/Division of Environmental Management
P.O. Box 29535
Raleigh, North Carolina 27626-0535

The envelope containing the petition shall clearly bear the notation: RULE-MAKING PETITION FOR ORW CLASSIFICATION.

APPENDIX II

CONTENTS:

DEM Water Quality Monitoring Programs:

- **Benthic Macroinvertebrate Sampling**
- **Fisheries Studies**
- **Lakes Assessment**

BENTHIC MACROINVERTEBRATES

Benthic macroinvertebrates, or benthos, are organisms, mostly aquatic insect larvae, that live in and on the bottom substrates of rivers and streams. The use of benthos data has proven to be a reliable monitoring tool as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since many taxa in a community have life cycles of six months to one year, the effects of short term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPT S). Likewise, ratings can be assigned with a "biotic index". This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification. Higher taxa richness values are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is poorly assessed by a taxa richness analysis. Different criteria have been developed for different ecoregions (mountains, piedmont and coastal) within North Carolina.

Classification Criteria by Ecoregion*

A. EPT taxa richness values

	10-sample Qualitative Samples			4-sample EPT samples		
	Mountains	Piedmont	Coastal	Mountains	Piedmont	Coastal
Excellent	>41	>31	>27	>35	>27	>23
Good	32-41	24-31	21-27	28-35	21-27	18-23
Good-Fair	22-31	16-23	14-20	19-27	14-20	12-17
Fair	12-21	8-15	7-13	11-18	7-13	6-11
Poor	0-11	0-7	0-6	0-10	0-6	0-5

B. Biotic Index Values (Range = 0-10)

	Mountains	Piedmont/Coastal
Excellent	<4.18	<5.24
Good	4.17-5.09	5.25-5.95
Good-Fair	5.10-5.91	5.96-6.67
Fair	5.92-7.05	6.68-7.70
Poor	>7.05	>7.71

*These criteria apply to flowing water systems only. Biotic index criteria are only used for full-scale (10-sample) qualitative samples

Table 1 presents a summary of benthic macroinvertebrate samples collected in the Catawba River Basin.

Table 1. Benthic macroinvertebrate collections in the Catawba River basin, 1983-1992.

CTB 30

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba R ab Old Fort, SR 1273, McDowell	3/B-1	11-(1)	04/85	99/49	4.28/2.95	Good
Mill Cr at Graphite ab RR bridge, McDowell	-/B-2	11-7	07/92	85/49	2.39/1.87	Excellent
			02/92	-/39	-/1.76	Good
Catawba R ab Curtis Cr, McDowell	4/B-3	11-(8)	04/85	82/39	4.65/3.24	Good-Fair
Catawba R be Old Fort, McDowell, I-40 or SR 1234	5, N/B-4	11-(8)	07/92	102/41	3.98/2.82	Excellent
			07/90	84/38	4.31/3.47	Good
			07/87	74/30	5.78/4.63	Good-Fair
			04/85	86/28	6.41/4.12	Fair
Catawba R nr Pleasant Gardens, SR 1221, McDowell	A/B-5	11-(8)	07/92	90/42	4.33/3.39	Good
			07/90	77/43	4.36/3.80	Good
			08/88	86/31	5.81/4.91	Good-Fair
			07/88	-/27	-/3.99	Good-Fair
			07/86	78/26	5.93/4.24	Good-Fair
			08/85	73/24	5.58/4.49	Good-Fair
			08/84	63/23	5.04/4.47	Good-Fair
			08/83	70/27	5.69/4.68	Good-Fair
Curtis Cr be Newberry Cr, McDowell	-/B-6	11-10-(6)	02/92	-/42	-/2.21	Good
Curtis Cr ab WWTP, SR 1227, McDowell	1/B-7	11-10-(6)	04/85	97/44	3.88/2.57	Good
Curtis Cr be WWTP, McDowell	2/B-8	11-10-(14)	04/85	56/25	6.00/3.24	Fair
Crooked Cr, SR 1135, McDowell	-/B-9	11-12	07/92	-/33	-/3.29	Good*
Mackey Cr, SR 1453, McDowell	-/B-10	11-15-(2)	02/92	-/45	-/2.07	Excellent*
Buck Cr, NC 80 ab L Tahoma, McDowell	-/B-11	11-19-(1)	02/92	-/42	-/2.30	Good
L Buck Cr, SR 1436	-/B-12	11-19-11	02/92	-/43	-/2.11	Excellent
			07/91	60/37	2.48/2.02	Excellent
Toms Cr, SR 1434, McDowell	-/B-13	11-21-(2)	07/92	75/37	3.28/2.28	Excellent
			02/92	-/49	-/2.38	Excellent*
N Fk Catawba R @ Linville Caverns, McDowell	-/B-14	11-24-(1)	01/91	-/37	-/1.96	Good
N Fk Catawba R, NC 221, McDowell	-/B-15	11-24-(1)	01/91	-/42	-/2.67	Good
N Fk Catawba R, SR 1573, McDowell	-/B-16	11-24-(1)	01/91	-/37	-/2.96	Good
N Fk Catawba R, SR 1560, McDowell	-/B-17	11-24-(1)	07/92	95/41	4.12/3.22	Excellent
			01/91	-/44	-/2.67	Excellent
N Fk Catawba R, be Sevier dischargers, McDowell	-/B-18	11-24-(1)	07/92	88/43	4.00/3.20	Excellent
Laurel Br, NC 221, McDowell	-/B-19	11-24-3	01/91	-/32	-/1.13	Good
Pond Br, SR 1560, McDowell	-/B-20	11-24-4	01/91	-/24	-/1.36	Good
Stillhouse Br, SR 1560, McDowell	-/B-21	11-24-6	01/91	-/25	-/1.45	Good
~~Honeycutt Cr, SR 1568, McDowell~~	~~-/B-22~~	~~11-24-8~~	~~01/91~~	~~-/44~~	~~-/2.73~~	~~Good~~
Pepper Cr, NC 221, McDowell	-/B-23	11-24-10	01/91	-/42	-/2.63	Good
Armstrong Cr, end of FS Rd, McDowell	-/B-24	11-24-14-(1.5)	07/92	-/38	-/2.11	Excellent
Linville R, nr NC 105 nr Brier Kn, Avery	93/B-25	11-29-(1)	11/89	-/27	-/3.54	Good-Fair
Linville R, NC 221, Avery	94/B-26	11-29-(1)	07/92	-/30	-/3.15	Good*
			11/89	-/22	-/4.33	Good-Fair
W Fk Linville R, SR 1349, Avery	91/B-27	11-29-4	11/89	-/39	-/1.90	Good
Grandmother Cr, SR 1511, Avery	92/B-28	11-29-5-(2)	11/89	-/30	-/2.73	Good
Linville R, nr Nebo, NC 126, Burke	B/B-29	11-29-(16)	07/92	108/48	4.19/3.15	Excellent
			07/91	84/43	4.10/3.05	Excellent
			10/90	94/47	3.85/2.78	Excellent
			07/90	104/46	4.32/3.26	Excellent
			04/90	113/54	3.61/2.45	Excellent
			01/90	94/56	3.57/2.53	Excellent
			11/89	100/54	3.47/2.67	Excellent
			08/89	99/46	4.15/2.90	Excellent
			03/89	89/43	3.62/3.08	Excellent
			02/89	113/59	3.88/2.91	Excellent

CTB 30, continued.

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Linville R nr Nebo, cont.			08/87	-/42	-/3.49	Excellent
			07/87	113/48	4.61/3.49	Excellent
			08/85	101/41	5.23/3.70	Good
			08/83	105/45	4.64/3.49	Excellent
Catawba R, Glen Alpine, SR 1147, Burke	O/B-30	11-(31)	08/88	82/35	4.91/3.44	Good
N Muddy Cr, SR 1750 , McDowell	8/B-31	11-32-1-(0.5)	07/92	81/33	5.03/4.38	Good
			04/85	85/35	5.64/4.08	Good-Fair
Corpening Cr (Youngs Fk), SR 1819, McDowell	6/B-32	11-32-1-4	09/90	55/17	6.37/5.51	Fair
			04/85	64/19	6.91/4.95	Fair
Corpening Cr (Youngs Fk), SR 1794, McDowell	7/B-33	11-32-1-4	09/90	44/8	7.53/6.82	Poor
			04/90	58/17	6.82/4.76	Fair
S Muddy Cr, SR 1764, McDowell	-/B-34	11-32-2-(8.5)	07/92	-/27	-/3.90	Good-Fair
High Shoals Cr, SR 1798, McDowell	9/B-35	11-32-2-6	07/86	76/32	4.32/3.07	Good

*These sites showed signs of sediment problems and/or enrichment. They might have received a lower bioclassification with a full-scale survey invertebrate collection or a fisheries survey.

CTB 31

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba R, NC 181, Burke	-/B-1	11-(31)	07/92	76/30	4.93/3.89	Good
Canoe Cr, SR 1250, Burke	-/B-2	11-33-(2)	08/92	-/25	-/3.09	Good-Fair*
Silver Cr, SR 1149, Burke	-/B-3	11-34	08/92	71/29	5.65/4.45	Good-Fair
Clear Cr, ab Hospital Reservoir, Burke	-/B-4	11-34-6-(1)	12/91	-/30	-/2.51	Good
Bailey Fk, SR 1102, Burke	-/B-5	11-34-8-(2)	08/92	-/24	-/3.46	Good-Fair
Upper Cr, NC181 nr Jonas Ridge, Burke	73/B-6	11-35-2-(1)	09/88	-/46	-/2.57	Excellent
Upper Cr, USFS Rd 128 (Raven Cliff Rd), Burke	74/B-7	11-35-2-(1)	03/89	-/44	-/2.62	Good
			10/88	-/34	-/3.00	Good
			09/88	-/26	-/3.68	Good-Fair
Timbered Br, USFS Rd 928, Burke	80/B-8	11-35-2-9	09/88	-/20	-/3.15	Good-Fair
Upper Cr, ab Optimists Park, Burke	75/B-9	11-35-2-(10)	09/88	108/45	4.63/3.22	Excellent
Steels Cr, USFS Rd 128, Burke	78/B-10	11-35-2-12-(1)	05/90	-/48	-/1.79	Excellent
			09/88	-/38	-/2.94	Excellent
Gingercake Cr, USFS Rd 496, Burke	81/B-11	11-35-2-12-3	05/90	-/39	-/1.72	Excellent
			10/88	-/31	-/1.40	Excellent
Buck Cr, USFS Rd, ab Steels Cr, Burke	-/B-12	11-35-2-12-4	05/90	-/40	-/1.59	Excellent
Little Fk, USFS Rd 128, Burke	10/B-13	11-35-2-12-6	09/88	-/38	-/2.61	Excellent
			03/86	102/45	3.23/2.40	Excellent
Steels Cr, ab NC 181, Burke	79/B-14	11-35-2-12-(7)	05/90	-/49	-/2.17	Excellent
			09/88	105/43	4.69/3.39	Good
Upper Cr, SR 1407, Burke	76/B-15	11-35-2-(13)	10/88	-/34	-/3.55	Good
Upper Cr, SR 1439 nr Worry, Burke	77/B-16	11-35-2-(13)	09/88	100/42	4.90/3.69	Good
Johns R, SR 1367, Caldwell	95/B-17	11-38-(1)	03/89	-/45	-/2.28	Good
Johns R, SR 1356, Caldwell	96/B-18	11-38-(9)	08/92	-/43	-/3.12	Excellent
			03/89	-/40	-/2.54	Good
			10/84	108/48	4.16/2.92	Excellent
Anthony Cr, ab Gragg, Caldwell	98/B-19	11-38-10-3	03/89	-/30	2.35	Good-Fair
Anthony Cr (= Gragg Pr), SR 1462, Caldwell	99/B-20	11-38-10	03/89	-/47	2.38	Good
Johns R, SR 1438, Burke	97/B-21	11-38-(28)	03/89	116/63	3.93/2.75	Excellent
			08/83	89/43	4.20/3.48	Excellent
Mulberry Cr, SR 1368, Caldwell	100/B-22	11-38-32-(11)	03/89	-/53	-/2.62	Excellent
Mulberry Cr, SR 1310, Caldwell	101/B-23	11-38-32-(15)	03/89	-/43	-/2.93	Good
Wilson Cr, NC 221, Avery	C1/B-24	11-38-34	07/90	65/32	2.99/1.75	Excellent
			08/88	81/37	3.26/1.67	Excellent
			07/86	67/36	2.62/1.56	Excellent
			08/84	38/20	2.85/1.45	Good
Wilson Cr, SR 1358, Caldwell	C2/B-25	11-38-34	07/91	92/50	3.76/2.67	Excellent
			03/89	-/57	-/2.19	Excellent
			07/86	106/49	3.67/2.55	Excellent
N Harper Cr, USFS Rd 58, Avery	11/B-26	11-38-34-14-2	08/86	90/43	3.54/2.24	Excellent

CTB 31, continued.

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Lower Cr, Harrisburg St, Caldwell	58/B-27	11-39-(0.5)	09/87	65/22	6.23/5.00	Fair
Lower Cr, SR 1501, Burke	D/B-28	11-39-(6.5)	08/92	55/20	6.03/4.89	Fair
			07/90	62/19	6.83/5.49	Fair
			07/87	61/18	7.00/5.06	Fair
			08/84	60/20	6.64/5.20	Fair
Zacks Fk Cr, NC 18A, Caldwell	59/B-29	11-39-1	09/87	55/19	6.22/5.55	Fair
Smoky Cr, SR 1515, Burke	-/B-30	11-41-(1)	08/92	-/30	-/3.23	Good
McGalliard Cr, Church St, Burke	-/B-31	11-44-(0.5)	08/92	66/22	5.80/4.59	Good-Fair

CTB 32

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Huffman Br, #2, be Huffman Finishing, Caldwell	12/B-1	11-(51)-1	10/84	13/0	9.12/-	Poor
Huffman Br, #3, Caldwell	12/B-2	11-(51)-1	10/84	19/1	9.19/-	Poor
Huffman Br, #3A (recovery), Caldwell	12/B-3	11-(51)-1	10/84	20/0	9.13/-	Poor
UT Huffman Br, Caldwell	12/B-4	11-(51)-1	10/84	54/15	-/-	Good?
Upper Little R, SR 1744, Caldwell	-/B-5	11-58	08/92	74/38	4.17/3.53	Good
Middle Little R, SR 1153, Alexander	-/B-6	11-62	08/92	-/32	-/4.20	Good
Duck Cr, NC 127, Alexander	-/B-7	11-62-2-(4)	08/92	-/26	-/3.61	Good-Fair
Lower Little R, SR1313, Alexander	E/B-8	11-69	07/88	88/33	5.13/3.61	Good-Fair
			08/85	53/18	5.97/5.48	Fair
Lower Little R, SR 1131, Alexander	-/B-9	11-69	08/92	70/29	4.85/4.06	Good
Muddy Fk, ab Schneider Mills, Alexander	-/B-10	11-69-4	06/92	70/19	5.73/4.65	Good-Fair
Muddy Fk, be Schneider Mills, NC 16, Alexander	-/B-11	11-69-4	06/92	66/19	6.91/5.07	Fair
Elk Shoal Cr, SR 1605, Alexander	-/B-12	11-73-(1.5)	08/92	-/15	-/5.05	Good-Fair
Lyle Cr, NC 64/70, Catawba	-/B-13	11-76-(3.5)	08/92	63/22	5.83/5.09	Good
Big Br (Rocky Cr), SR 1303, ab Troutman, Iredell	60/B-14	11-83-1-(1)	02/87	-/12	-/4.29	Good-Fair
Big Br (Rocky Cr), SR 1303, be Troutman, Iredell	61/B-15	11-83-1-(1)	02/87	-/0	-	Poor

CTB 33

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
McDowell Cr, SR 2136, Mecklenburg	114/B-1	11-115-1.5	09/90	55/15	6.84/6.02	Fair
McDowell Cr, SR 2128, Mecklenburg	115/B-2	11-115-1.5	09/90	54/17	6.57/5.50	Good-Fair
Gar Cr, SR 2074, Mecklenburg	-/B-3	11-116-(1)	08/92	86/24	5.72/4.68	Good
Dutchmans Cr, SR 1918, Gaston	P/B-4	11-119-(0.5)	08/92	77/33	5.72/4.82	Excellent
			07/88	83/34	5.47/4.73	Excellent
Leepers Cr, NC 150, Lincoln	26/B-5	11-119-1-(1)	06/84	86/30	5.14/4.32	Good
Killian Cr, SR 1511, Lincoln	-/B-6	11-119-2-(0.5)	08/92	-/28	-/5.30	Excellent

CTB 34

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Sugar Cr, SC 160, York Co., SC	F/B-1	11-137	08/92	58/21	6.92/5.77	Good-Fair
			07/91	49/14	6.91/6.24	Fair
			07/90	39/7	7.30/5.88	Fair
			07/88	53/9	8.23/6.81	Poor
			07/86	40/2	8.82/8.61	Poor
			08/84	45/9	8.30/6.49	Poor
			08/83	30/3	8.55/6.45	Poor
Irwin Cr, SR 2523, Mecklenburg	117/B-2	11-137-1	02/90	52/17	6.24/5.22	Good-Fair
Irwin Cr, Statesville Rd, ab landfill, Mecklenburg	55/B-3	11-137-1	10/84	50/13	7.58/6.41	Fair
Irwin Cr, Statesville Rd, be landfill, Mecklenburg	56/B-4	11-137-1	10/84	36/11	7.80/6.16	Fair

CTB 34, continued

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Irwin Cr, West Blvd, Mecklenburg	-/B-5	11-137-1	08/92	55/8	7.89/6.90	Poor
Irwin Cr, ab WWTP, Mecklenburg	21/B-6	11-137-1	11/83	23/2	8.61/7.39	Poor
Irwin Cr, be WWTP, SR 1156, Meck.	-/B-7	11-137-1	08/92	45/4	8.12/7.38	Poor
Stewart Cr, SR 2050, Mecklenburg	116/B-8	11-137-1-2	02/90	37/14	6.31/4.17	Fair
McCullough Br, NC 51, Mecklenburg	118/B-9	11-137-7	02/90	34/5	7.75/7.23	Poor
L Sugar Cr, SR 3657 (Archdale Rd), Mecklenburg	18/B-10	11-137-8	11/83	15/1	8.59/7.60	Poor
L Sugar Cr, NC 51, Mecklenburg	-/B-11	11-137-8	09/92	43/3	8.09/6.66	Poor
McAlpine Cr, Sardis Rd, SR 3356, Mecklenmburg	19/B-12	11-137-8	03/87	45/12	6.40/5.23	Fair
			11/83	61/12	6.92/5.97	Fair
McAlpine Cr, NC 51 ab WWTP, Meck.	-/B-13	11-137-9	08/92	55/9	7.53/6.08	Fair
McAlpine Cr, NC 521 ab WWTP, Meck	67/B-14	11-137-9	03/87	33/5	7.73/5.46	Poor
McAlpine Cr, NC 521 be WWTP, Meck.	20/B-15	11-137-9	11/83	24/3	8.83/6.70	Poor
McAlpine Cr, Dorman Rd, SC	68/B-16	11-137-9	08/92	40/11	7.31/6.68	Fair
			03/87	19/2	8.16/2.91	Poor
Walker Br, NC 49, Mecklenburg	119B-17	11-137-10-1	02/90	68/18	6.47/5.79	Good-Fair
Long Cr, SR 2042, Mecklenburg	17/B-18	11-120-(0.5)	07/89	65/17	6.44/6.02	Good-Fair

CTB 35

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
S Fk Catawba R, NC 10, Catawba	I/B-1	11-129-(0.5)	08/92	75/24	6.20/5.05	Good-Fair
			07/90	56/16	6.57/5.27	Fair
			07/88	67/24	6.25/5.07	Good-Fair
			07/86	49/12	6.59/4.68	Fair
			07/84	67/26	5.28/4.15	Good-Fair
S Fk Catawba R, NC 27, Lincoln	39/B-2	11-129-(3.5)	09/84	77/29	5.58/4.17	Good
Henry Fk, be He Cr, SR 1918, Burke	82/B-3	11-129-1-(1)	04/88	106/53	3.29/2.11	Excellent
Henry Fk, SR 1922, Burke	83/B-4	11-129-1-(2)	04/88	116/62	3.59/2.52	Excellent
Henry Fk, NC 18, Burke	84/B-5	11-129-1-(2)	04/88	127/65	3.84/2.68	Excellent
He Cr, ab water intake, Burke	85/B-6	11-129-1-4-(1)	04/88	-/45	-/2.01	Excellent
Ivy Cr, SR 1919, Burke	86/B-7	11-129-1-6	04/88	-/42	-/2.36	Good
Long Br, SR 1917, Burke	87/B-8	11-129-1-8	04/88	-/46	-/2.87	Excellent
UT Henry Fk, SR 1915, Burke	88/B-9	-	04/88	110/52	3.83/2.33	Good
Rock Cr, SR 1915, Burke	89/B-10	11-129-1-12	04/88	-/43	-/2.84	Good
Henry Fk, SR 1124, Catawba	G/B-11	11-129-1-(12.5)	08/92	74/38	4.58/3.75	Good
			07/89	64/27	4.65/4.22	Good
			07/87	73/25	5.09/4.01	Good-Fair
			07/86	79/28	5.39/3.88	Good-Fair
Henry Fk, SR 1008, be WWTP, Catawba	G/B-12	11-129-1-(12.5)	11/83	27/5	6.87/4.20	Poor
UT Henry Fk A ab Pantasote, SR 1213, Catawba	23/B-13	-	06/85	29/8	6.34/4.23	Fair
UT Henry Fk A be Pantasote, SR 1213, Catawba	24/B-14	-	06/85	31/7	6.24/2.71	Fair
UT Henry Fk B (control), SR 1148, Burke	65/B-15	-	02/87	-/36	-/2.13	Excellent
UT Henry Fk C (ab Neuville), 64 Bypass, Burke	62/B-16	-	02/87	-/0	-/-	Poor
UT Henry Fk C, be discharge, Burke	63/B-17	-	02/87	-/5	-/5.96	Poor
UT Henry Fk C, recovery, I-40, Burke	64/B-18	-	02/87	-/17	-/3.40	Good-Fair
Jacob Fk, S Mts St Pk, Burke	121/B-19	11-129-2-(1)	05/90	-/42	-/2.49	Excellent
Jacob Fk, SR 1904, Burke	122/B-20	11-129-2-(1)	05/90	-/42	-/2.31	Excellent
Jacob Fk, SR 1924, Burke	H/B-21	11-129-2-(1)	08/92	104/48	4.48/3.32	Excellent
			10/90	102/50	3.95/2.60	Excellent
			07/90	92/45	4.77/4.01	Excellent
			05/90	-/48	-/2.56	Excellent
			01/90	86/55	3.41/2.87	Excellent
			07/87	96/35	4.96/3.76	Good
			08/85	75/32	5.14/3.99	Good-Fair

CTB 35, continued.

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Shinny Cr, (S Mts St Pk), Burke	120/B-22	11-129-2-3	05/90	-/41	-/2.13	Excellent
Jacob Fk, NC 27, Catawba	41/B-23	11-129-2-(9.5)	11/83	79/35	**	Good
Jacob Fk, SR 1139, Catawba	42/B-24	11-129-2-(9.5)	11/83	69/23	**	Good-Fair
Hop Cr, SR 1131, Catawba	23/B-25	11-129-2-14	06/85	86/36	4.56/3.44	Good
Howards Cr, SR 1200, Lincoln	-/B-26	11-129-4	08/92	-/25	-/4.33	Good
Clark Cr, SR NC 64, Catawba	27/B-27	11-129-5-0.3	09/84	57/15	6.14/5.15	Good-Fair
Clark Cr, SR 1149, Catawba	28/B-28	11-129-5-0.3	08/92	-/16	-/5.74	Good-Fair
			09/84	60/16	6.6 5/5.81	Good-Fair
Clark Cr, SR 2014, ab Newton WWTP, Catawba	25/B-29	11-129-5-0.3	09/90	50/13	7.16/6.46	Fair
			09/84	59/15	6.79/6.17	Fair
			06/84	59/16	6.25/5.80	Good-Fair
Clark Cr, SR 2012,be Newton WWTP, Catawba	25/B-30	11-129-5-0.3	09/90	40/6	7.11/5.33	Fair
			09/84	64/19	7.11/6.26	Good-Fair
			06/84	46/14	6.51/5.81	Good-Fair
Clark Cr, SR 1274, Catawba	31B-31	11-129-5-(4.5)	09/84	70/16	6.92/6.06	Fair
Clark Cr, SR 1008, Lincoln	J/C8-32	11-129-5-(4.5)	08/92	48/10	6.67/5.63	Fair
			07/88	54/11	6.78/6.11	Fair
			08/85	48/13	7.14/6.25	Fair
			09/84	79/27	6.62/5.40	Good
			11/83	38/9	**	Fair
Cline Cr, SR 1164, Catawba	33/B-33	11-129-5-2	09/84	50/11	7.16/6.21	Fair
Maiden Cr, NC 207, Catawba	34/B-34	11-129-5-7-2-(3)	09/84	86/18	6.55/5.76	Good-Fair
Shady Br, be Maiden, SR 2005, Catawba	35/B-35	11-129-5-7-3	09/84	32/1	8.86/7.37	Poor
Carpenter Cr, NC 321, Lincoln	36/B-36	11-129-5-9	09/84	85/30	4.94/4.61	Excellent
Walker Cr, SR 1405, Lincoln	37/B-37	11-129-5-10	09/84	75/18	7.09/6.11	Good-Fair
Indian Cr, SR 1252, Lincoln	K/B-38	11-129-8-(5)	08/92	79/29	6.06/5.38	Good
			07/90	72/25	6.19/5.44	Good-Fair
			07/87	67/18	6.33/5.52	Good-Fair
			07/86	77/18	6.58/5.40	Good-Fair
		11/83	50/6	6.90/5.36	Fair	
			08/83	51/12	6.39/6.00	Good-Fair
Hoyle Cr, SR 1836, Gaston	46/B-39	11-129-15-(4)	11/83	50/15	6.12/4.88	Good-Fair

CTB 36

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
S Fk Catawba R, SR 2003, Spencer Mtn, Gaston	M/B-1	11-129-(15.5)	08/83	49/19	6.51/5.65	Good-Fair
S Fk Catawba R, NC 7, McAdenville, Gaston	M/B-2	11-129-(15.5)	08/92	63/18	6.70/5.40	Good-Fair
			07/89	62/15	6.32/4.72	Good-Fair
			07/87	65/23	6.50/5.43	Good-Fair
			08/85	55/16	7.02/5.34	Fair
			11/83	37/2	7.82/5.64	Poor
Long Cr 1A, SR 1408, Gaston	-/B-3	11-129-16-(2.3)	04/92	81/29	5.28/4.39	Good
Long Cr 1, SR 1405, Gaston	-/B-4	11-129-16-(2.3)	04/92	-/22	-/5.07	Good-Fair
		04/91	89/29	5.63/4.70	Good	
Long Cr 2A, NC 274, Gaston	-/B-5	11-129-16-(4)	04/92	79/19	5.82/5.22	Good-Fair
		04/91	90/24	6.35/4.92	Good-Fair	
Long Cr 5A, SR 1446, Gaston	-/B-6	11-129-16-(4)	04/92	76/24	6.20/5.40	Good-Fair
			04/91	70/23	5.52/4.68	Good
Long Cr 6, SR 1448, Gaston	-/B-7	11-129-16-(4)	04/92	80/23	5.82/5.15	Good
		04/91	86/30	5.83/5.04	Good	
Long Cr 8A, NC 275, Gaston	-/B-8	11-129-16-(4)	04/92	72/20	6.36/5.47	Good-Fair
		04/91	84/21	6.26/5.17	Good-Fair	
Long Cr, SR 1456, Gaston	L/B-9	11-129-16-(4)	07/90	67/18	6.42/5.39	Good-Fair
			07/87	71/19	6.59/5.61	Good-Fair
			08/84	62/17	6.25/5.44	Good-Fair

CTB 36 continued

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Long Cr, SR 2003 be WWTP, Gaston	102/B-10	11-129-16-(4)	07/90	54/14	7.33/6.30	Fair
			11/83	20/3	8.61/4.93	Poor
Dallas Br, ab Dallas WWTP, Gaston	-/B-11	11-129-16-7	06/92	42/10	6.45/6.11	Good-Fair
Dallas Br, be Dallas WWTP, SR 2275, Gaston	-/B-12	11-129-16-7	06/92	39/8	7.60/6.40	Fair
UT Long Cr 5, SR 1446, Gaston	-/B-13	-	04/91	76/25	5.46/4.39	Good
UT Long Cr 8, SR 1456, Gaston	-/B-14	-	04/91	55/26	4.44/4.25	Good

CTB 37

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba Cr, SR 2446 ab WWTP, Gaston	49/B-1	11-130	07/90	42/10	6.94/6.66	Fair
			05/85	55/16	7.09/6.13	Fair
Catawba Cr, SR 2439 be WWTP, Gaston	50/B-2	11-130	07/90	43/1	8.12/7.40	Poor
			05/85	38/5	8.55/6.07	Poor
Catawba Cr, SR 2435, Gaston	51/B-3	11-130	05/85	43/6	8.44/6.50	Poor
Crowders Cr, SR 1118, Gaston	103/B-4	11-135	09/89	50/14	6.02/4.73	Good-Fair
Crowders Cr, SR 1125, Gaston	104/B-5	11-135	09/89	55/13	7.07/6.11	Fair
Crowders Cr, SR 1131, Gaston	105/B-6	11-135	09/89	46/7	7.69/7.00	Fair
Crowders Cr, NC 321,Gaston	106/B-7	11-135	09/89	46/10	6.81/5.64	Fair
Crowders Cr, SR 2424,Gaston	107/B-8	11-135	09/89	51/15	6.86/5.87	Fair
Crowders Cr, SC 564 York Co., SC	Q-B-9	11-135	08/92	66/18	6.55/5.65	Good-Fair
		09/89	61/15	6.83/6.13	Fair	
			07/88	43/4	8.30/7.50	Poor
McGill Cr, ab WWTP, Gaston	108/B-10	11-135-2	09/89	-/4	-/7.43	Poor
McGill Cr, be WWTP, SR 1300, Gaston	109/B-11	11-135-2	09/89	-/6	-/7.09	Poor
Abernethy Cr, ab UT, SR 1302, Gaston	70/B-12	11-135-4	09/89	-/12	-/4.93	Fair
			06/87	67/13	7.40/5.81	Fair
Abernethy Cr, be UT, Gaston	71/B-13	11-135-4	09/89	-/4	-	Poor
			06/87	43/4	7.78/7.53	Poor
Abernethy Cr, ab Bessemer City WWTP, Gaston	-/B-14	11-135-4	09/89	-/3	-/6.90	Poor
Abernethy Cr, be WWTP, Gaston	110/B-15	11-135-4	09/89	-/1	-/6.57	Poor
UT Abernethy be Lithium, Gaston	72/B-16	-	06/87	25/0	7.90/-	Poor
S Crowders Cr, SR 1103, Gaston	52/B-17	11-135-10-1	05/85	89/31	5.31/4.41	Good-Fair
S Crowders Cr, SR 1109, Gaston	111/B-18	11-135-10-1	09/89	-/16	-/5.56	Good-Fair
UT Crowders Cr, SR 2416, Gaston	112/B-19	-	09/89	-/11	-/6.62	Fair

CTB 38

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Twelvemile Cr, NC 16, Union	S/B-1	11-138	02/90	-/30	-/4.93	Good-Fair
			07/89	71/20	6.25/5.37	Good-Fair
			11/83	50/7	7.15/6.33	Fair
Sixmile Cr, SR 3445, Mecklenburg	69/B-2	11-138-3	03/87	67/22	5.26/3.58	Good-Fair
Waxhaw Cr, SR 1103, Union	54/B-3	11-139	08/92	-/14	-/5.53	Good-Fair
			11/83	38/6	6.82/5.39	Fair

FISHERIES

To the public, the condition of the fishery is one of the most meaningful indicators of water quality. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web will affect the abundance, species composition, and condition of the fish population.

FISH COMMUNITY STRUCTURE METHODS

The North Carolina Index of Biotic Integrity (NCIBI) is a modification of Karr's IBI (1981) which was developed as a method for assessing a streams biological integrity by examining the structure and health of its fish community. The index incorporates information about species richness and composition, trophic composition, fish abundance and fish condition.

The NCIBI summarizes the effects of all classes of factors influencing aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While any change in a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicates additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

The assessment of biological integrity using IBI is provided by the cumulative assessment of 12 parameters, or metrics. The values provided by the metrics are converted into scores on a 1, 3, 5 scale. A score of 5 represents conditions expected for undisturbed streams in the area, while a score of 1 indicates that the conditions vary greatly from those expected in undisturbed streams of the region. The scores for each metric are summed to attain the overall IBI score.

Each metric is designed to contribute unique information to the overall assessment. A discussion of each metric is presented below; some metrics have been grouped together.

1. The total number of species and individuals supported by streams of a given size in a given region decrease with environmental degradation.
2. Darters are sensitive to environmental degradation particularly as a result of their specific reproductive and habitat requirements. Darter habitats are degraded as a result of channelization, siltation, and reduced oxygen levels. Collection of fewer than expected darter species can indicates that some habitat degradation is occurring.
3. Sunfish species are used because they are particularly responsive to degradation of pool habitats and to other aspects of habitat degradation like quality of instream cover.
4. Sucker species are intolerant of habitat and chemical degradation and, because they are long lived, provide a multiyear integrated perspective.
5. Intolerant species are those which are most effected by environmental perturbations and therefore should have disappeared, at least as viable populations, by the time a stream is degraded to a fair rating.
6. Tolerant species are those which are often present in a stream in moderate numbers, but as the stream degrades they tend to dominate.
7. The three trophic composition metrics, proportion of omnivores, insectivores, and piscivores, are used to measure the divergence from expected production and consumption patterns in the fish community that can result from environmental degradation. The main cause for a shift in the trophic composition of the fish community (a greater proportion of omnivores and few insectivores) is nutrient enrichment.

8. The proportion of fish with disease, tumors, fin damage, and skeletal anomalies increases as a stream is degraded. The length distribution metric measures the amount of reproduction which is occurring in the community by looking at the number of age groups, determined by length range, present for each species.

A field methodology for fish collections to be used for NC IBI is included in the standard operating procedures of the NC Division of Environmental Management (NCDEM, 1989). A representative section of stream, 600 feet in length, is selected, measured, and blocked at the upstream and downstream ends with small mesh nets. The stream is then sampled with one or two backpack electrofishing units depending upon stream width. After collection, the fish are examined for sores, lesions, fin damage, and skeletal anomalies and preserved in 10% formalin. Once preserved the fish are identified to species, length recorded, and batch weighed by species.

Streams with larger watersheds or drainage areas can be expected to support more fish species and a larger number of fish. Figures 1 and 2 represent the relative number of species and number of fish that can be expected in the North Carolina river basins.

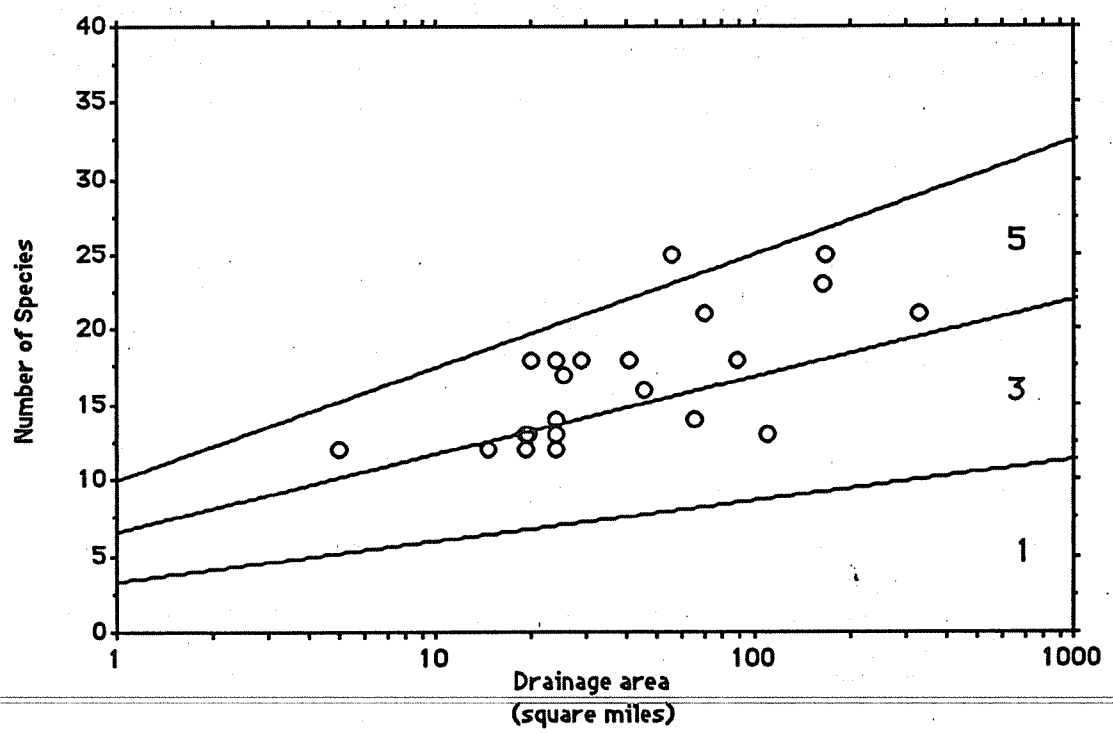


Figure 1. Expectations of the Number of Species based upon Drainage Area Size

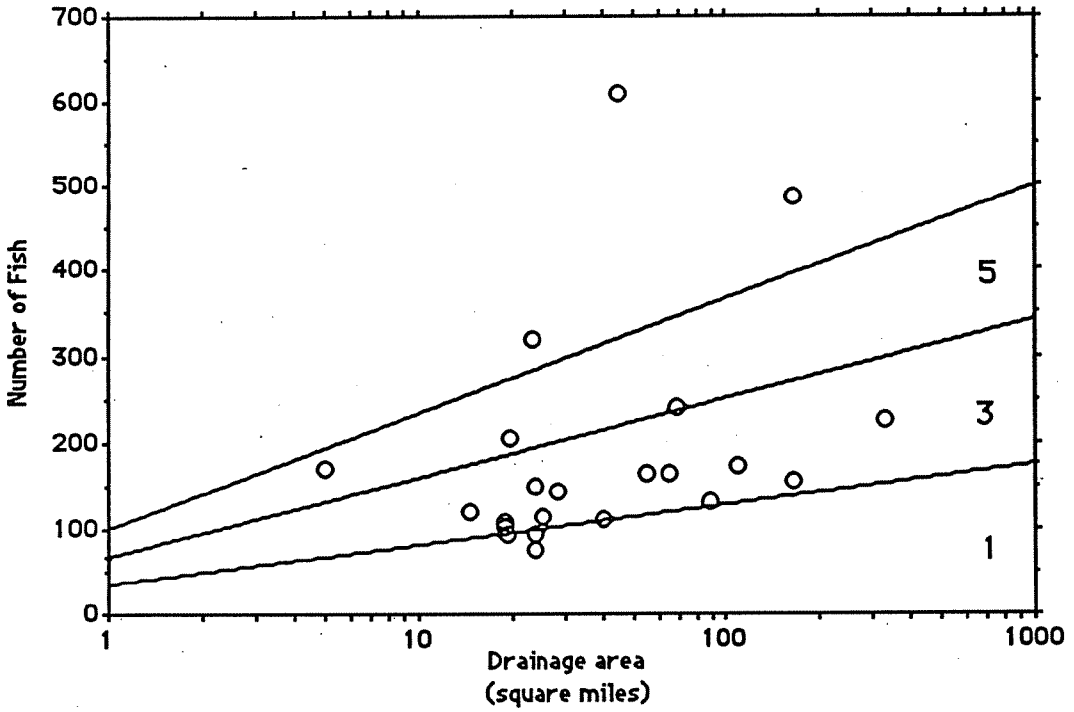


Figure 2. Expectations of the Number of Fish based upon Drainage Area Size

FISH TISSUE

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Therefore, by analyzing fish tissue, determinations about what chemicals are in the water can be made. Once contaminants reach surface waters, they may be available for bioaccumulation either directly or through aquatic food webs and may accumulate in fish and shellfish tissues. Thus results from fish tissue monitoring can serve as an important indicator of further contamination of sediments and surface water. Fish tissue analysis results are also used as indicators for human health concerns and fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem. Contamination of aquatic resources, including freshwater, estuarine, and marine fish and shellfish species have been documented for heavy metals, pesticides, and other complex organic compounds.

In evaluating fish tissue analysis results, several different types of criteria are used. Currently human health concerns related to fish consumption are screened by comparing results with Federal Food and Drug Administration (FDA) action levels. The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue parameters accompanied by their FDA criteria are presented below. Individual parameters which appear to be of potential human health concern are evaluated by the N.C. Division of Epidemiology by request of the Water Quality Section.

Metals

	FDA		FDA
Cadmium	None	Chromium	None
Nickel	None	Lead	None
Copper	None	Arsenic	None
Mercury	1.0 mg/kg	Selenium	None

Synthetic Organics

	FDA		FDA
Aldrin	0.3 mg/kg	o,p DDD	5.0 mg/kg
Dieldrin	0.3 mg/kg	p,p DDD	5.0 mg/kg
Endrin	0.3 mg/kg	o,p DDE	5.0 mg/kg
Methoxychlor	None	p,p DDE	5.0 mg/kg
Alpha BHC	None	o,p DDT	5.0 mg/kg
Gamma BHC	None	p,p DDT	5.0 mg/kg
PCB-1254	2.0 mg/kg	cis-chlordane	3.0 mg/kg
Endosulfan I	None	trans-chlordane	3.0 mg/kg
Endosulfan II	None	Hexachlorobenzene	None

The USEPA is currently developing screening values for target analytes which are formulated from a risk assessment procedure. The EPA screening value for a particular analyte is the concentration of that analyte in edible fish tissue that is associated with a maximum limit of acceptable health risk to the general population or subpopulation of concern.

LAKES ASSESSMENT PROGRAM

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lake Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed. Data are used to determine each lake's trophic status-a relative measure of nutrient enrichment and productivity, and whether the lake's uses have been threatened or impaired by pollution.

Tables presented in each subbasin summarize data used to determine the trophic status and use support status of each lake. These determinations are based on information from the most recent summertime sampling (date listed). The most recent North Carolina Trophic State Index (NCTSI) value is shown, followed by the descriptive trophic state classification (O=oligotrophic, M=mesotrophic, E=eutrophic, H=hypereutrophic, D=dystrophic).

Numerical indices are often used to evaluate the trophic status of lakes. An index was developed specifically for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NRCD 1982). The North Carolina Trophic State Index (NCTSI) is based on total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), Secchi depth (SD in inches), and chlorophyll-a (CHL in µg/l). Lakewide means for these parameters are integrated to produce a NCTSI score for each lake, using the following equations:

$$\text{TON score} = \frac{\text{Log(TON)} + (0.45)}{0.24} \times 0.90$$

$$\text{TP score} = \frac{\text{Log(TP)} + (1.55)}{0.35} \times 0.92$$

$$\text{SD score} = \frac{\text{Log(SD)} - (1.73)}{0.35} \times -0.82$$

$$\text{CHL score} = \frac{\text{Log(CHL)} - (1.00)}{0.43} \times 0.83$$

$$\text{NCTSI} = \text{TON score} + \text{TP score} + \text{SD score} + \text{CHL score}$$

In general, NCTSI scores relate to trophic classifications as follows: less than -2.0 is oligotrophic; -2.0 to 0.0 is mesotrophic; 0.0 to 5.0 is eutrophic; and greater than 5.0 is hypereutrophic. When scores border between classes, best professional judgment is used to assign an appropriate classification. NCTSI scores are also skewed by the highly colored water typical of dystrophic lakes. These acidic, "black-water" lakes are scattered throughout the coastal plain, often located in swampy areas or overlying peat deposits.

APPENDIX III

Modeling Information

APPENDIX III

MODELING INFORMATION

INTRODUCTION

In order to assess the impact of pollutants on surface water quality, the Division must often develop and apply water quality models. A water quality model is a simplified representation of the physical, chemical, and biological processes which occur in a water body. The type of model used is dependent on the purpose for which it is needed, the amount of information that is available or attainable for its development, and the degree of accuracy or reliability that is warranted. In most cases, the Division develops and applies a given model to predict the response of the system to a given set of inputs that reflect various management strategies. For example, water quality models such as QUAL2E or the Division's Level B model are used to predict what the instream dissolved oxygen concentration will be under various sets of NPDES wasteflows and discharge limits. The following sections briefly summarize the types of models used by the Division.

Oxygen-Consuming Waste Models

Several factors are considered when choosing an oxygen-consuming waste model including: the type of system (stream, lake, or estuary), whether one, two, or three dimensions are needed, the temporal resolution needed, and the type of data available. Many of the factors are related. For example, in streams, flow usually occurs in one direction and one can assume that a steady state model will result in adequate predictions. A steady state model is one in which the model inputs do not change over time. However, in open water estuaries, the tide and wind affect which way water moves, and they must often be represented by 2 or 3 dimensional models. In addition, the wind and tide can affect the model reaction rates, and therefore a dynamic model must be used rather than one which is steady state. The last factor, the amount of data available, dictates whether an empirical or calibrated model will be used. An empirical model is used when little water quality information is available for a given water body, and hydraulics and decay rates are estimated through the use of equations. For example, in North Carolina's empirical stream model (referred to as a Level B analysis) velocity is determined through a regression equation developed from North Carolina stream time-of-travel (TOT) studies which includes stream slope and flow estimates as independent variables. Stream slope can be measured from a topographic map, and flow is estimated at a given site by the U.S. Geological Survey. Therefore, the empirical model can be run without TOT information specific to a given stream since parameters are estimated through the use of information which can easily be obtained in the office environment. More information regarding the empirical dissolved oxygen model used by DEM can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Field calibration of a BOD/DO model requires collection of a considerable amount of data. For example, in order to develop hydraulics equations specific to a given stream, TOT studies using rhodamine dye are recommended under at least two flow scenarios including one summer low flow period. In addition, during one summer low flow study, dissolved oxygen, temperature, long term BOD and nitrogen series data are collected. Sediment oxygen demand (SOD) data may also be collected. These data are then used to calibrate reaction rates specific to the stream. QUAL2E is the most commonly used calibrated DO/BOD model for streams in North Carolina. A copy of the model guidance can be obtained from EPA's Environmental Research Lab in Athens, Georgia, and further

information on North Carolina's calibration procedures can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Data collection for an estuary DO model is even more extensive. Since the system is multi-dimensional and not steady-state, many more data are needed. Dye is often injected into a system over a period of time, and the dye cloud is then followed for a period of time which may last for days. In addition, several tide gages may need to be set up. Due to the stratification which occurs in an estuary, depth integrated data must also be collected. Calibrated estuary models which have been used by DEM include WASP, GAEST, and QUAL2E. WASP is also supported by EPA, and a user manual may be obtained from them. You should note that both GAEST and QUAL2E are one dimensional and are not applicable to many of North Carolina's estuaries.

Lakes are rarely modeled for BOD. Tributary arms of lakes are modeled as slow moving streams. Depending on the system, a one, two, or three dimensional model may be used. If a one dimensional model is needed, the modeler may choose the Level B (if little or no data), or QUAL2E. In multidimensional lake systems, WASP will be used.

The calibrated model will be more accurate than the empirical model since it is based on data collected specifically for a given stream in the State. However, it is much more expensive to develop a calibrated model. Not only do a number of staff spend several days to weeks collecting field data (sometimes having to wait months for appropriate conditions), but it also takes the modeling staff several months to develop and document the calibrated model. An empirical model can be developed and applied in a matter of hours. Therefore, due to resource constraints, the majority of the BOD/DO models developed in North Carolina are empirical.

Eutrophication Models

Eutrophication models are used to develop management strategies to control trophic response of a system to nutrient inputs (usually total phosphorus (TP) or total nitrogen (TN)). Nutrient management strategies are typically needed in areas which are sensitive to nutrient inputs due to long residence times, warm temperature, and adequate light penetration. These characteristics are found in deep slow moving streams, ponds, lakes, and estuaries. Modeling and insitu research are used to relate nutrient loading to the trophic response to the system allowing the manager to establish nutrient targets. Models which may be used include the Southeastern Lakes Model (Reckhow, 1987), Walker's Bathtub Model (Walker, 1981), QUAL2E, and WASP.

Once the nutrient targets are known, watershed nutrient budgets are developed to evaluate the relative nutrient loadings from various point and nonpoint sources. Land use data are obtained for the basin, and export coefficients based on literature values are applied to each land use. An export coefficient is an estimate of how may pounds of nutrient will runoff from each acre of land in a given year.

Toxics Modeling

Toxics modeling is done to determine chemical specific limits which will protect to the no chronic level in a completely mixed stream. The standards developed for the State of North Carolina are based on chronic criteria. These chemical specific toxics limits are developed through the use of mass balance models:

$$(Cup)(Qup) + (Cw)(Qw) = (Cd)(Qd)$$ where

Cup = concentration upstream
Qup = flow upstream
Cw = concentration in wastewater (unknown being solved for in WLA)
Qw = wasteflow
Cd = concentration downstream (set = to standard or criteria)
Qd = flow downstream (= Qup + Qw)

When no data are available concerning the upstream concentration, it is assumed to be equal to zero. The upstream flow is the 7Q10 at the discharge point unless the parameter's standard is based on human health concerns, in which case the average flow is used.

REFERENCES CITED - MODELING APPENDIX

Reckhow, K. H., 1987. "A Cross-Sectional Analysis of Trophic State Relationships in Southeastern Lakes." Duke University School of Forestry and Environmental Studies, Durham, N.C.

Walker, W. W., Jr. 1981. "Empirical Methods for Predicting Eutrophication in Impoundments," Technical Report E-81-9, prepared by William W. Walker, Jr., Environmental Engineer, Concord, Mass., for the U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

APPENDIX IV

Use Support Data Interpretation and Assessment Methodology

APPENDIX IV

Interpretation of Data

The assessment of water quality presented below involved evaluation of available water quality data to determine a water body's use support rating. In addition, an effort was made to determine likely causes (e.g., sediment or nutrients) and sources (e.g., agriculture, urban runoff, point sources) of pollution for waters that did not support their designated uses (i.e. those found to be either partially or nonsupporting). These data consisted of biological and chemical ratings, reports of citizen complaints, responses to mailings requesting water quality information, land-use reviews of topographic maps, and best professional judgement (see Data Analysis Methodology section for more details). By including best professional judgments (i.e., perceived water quality problems) in deciding the overall water quality ratings and the potential sources of pollution, a much broader, but less precise, picture of water quality conditions in the basin was developed.

Interpretation of these data compiled by DEM should be done cautiously. The methodology used to acquire the numbers must be understood, as does the purpose for which the numbers were generated. The intent of this use-support assessment was to gain an overall picture of the relative contribution made by different categories of pollution within the Catawba River basin. In order to comply with guidance received from EPA to identify likely sources of pollution for all impaired stream mileage, DEM used the data mentioned above.

The data are not intended to provide precise conclusions about pollutant budgets for specific watersheds. Since the assessment methodology is geared toward general conclusions, it is important to not manipulate the data to support policy decisions beyond the accuracy of these data. For example, according to this report, nonpoint source pollution is thought to be the most widespread source of the impairment of water quality. However, this does not mean that there should be no point source control measures. As discussed in previous sections of this chapter, and in Chapter 6, many stream miles in the basin are impacted by point source dischargers, but the degree of impact has not resulted in a partial or nonsupport rating. What is clear from the plan is that all categories of point and nonpoint source pollution have the potential to cause significant water quality degradation if proper controls and practices are not utilized.

This threat to water quality from all types of activities heightens the need for point and nonpoint source pollution control. It is important to not neglect any source (or potential source) of pollution in developing appropriate management and control strategies. Data exist which document water quality problems from every major pollution category that has been considered in this report. Certainly, the potential for further problems remains high as long as the activity in question continues carelessly. Because of this potential, neglecting one pollution source in an overall control strategy can mask the benefits achieved from controlling all other sources.

Assessment Methodology - Freshwater Bodies

Many types of information were used to make use support assessments and to determine causes and sources of use support impairment. Chemical, physical and biological data as well as wastewater treatment plant self-monitoring data and toxicity data were the primary sources of information used to make use support assessments. Information was also obtained from other agencies, workshops, and pertinent reports.

The most recent water quality chemical data (January 1988 through August 1993) were interpreted for use support utilizing the STAND(ards) program available through the STORET system. The program determines water quality standard violations and computes percentages of the values in

violation based on applicable North Carolina water quality standards. According to EPA guidance, use support determinations based on chemical data are to be made as follows:

Fully Supporting - for any one pollutant, criteria exceeded in ≤ 10% of the measurements,
Partially Supporting - for any one pollutant, criteria exceeded in 11- 25% of the measurements, and
Not Supporting - for any one pollutant, criteria exceeded in > 25% of the measurements.

The following parameters were evaluated in the STAND(ards) program: dissolved oxygen (surface values), temperature, pH, turbidity, fecal coliform bacteria, chlorophyll *a*, ammonia, arsenic, cadmium, chromium, copper, lead, nickel, mercury, zinc, chloride, fluoride and selenium.

Another valuable source of data used for the report was biological rankings from 1983 through 1992 as determined from benthic macroinvertebrate surveys discussed in section 4.2. The most recent report on these surveys (NCDEHNR, DEM 1991) is available from DEM's Environmental Sciences Branch. Data from North Carolina's Biological Monitoring Ambient Network (BMAN), in addition to special macrobenthic studies were ranked on a five point scale. This scale is based on taxa richness for the three pollution intolerant groups of Ephemeroptera, Plecoptera and Trichoptera (EPT).

Collected specimens are identified to the lowest possible taxonomic level. Total species (or taxa) richness values for the EPT groups are calculated and biological classifications assigned to each station (Excellent, Good, Good-fair, Fair or Poor). Higher species richness values are associated with better water quality. For ranking purposes, stations classified as "Poor" with regard to biological data are rated not supporting (NS) and stations classified as "Fair" are rated partially supporting (PS). Stations classified as "Good-Fair" are rated as support-threatened (ST) and those having a Good to Excellent biological classified are rated as supporting their designated uses (S).

Other types of DEM-collected data used to make use support assessments were toxicity data related to discharging facilities, fish tissue and fish community structure data and phytoplankton bloom information. In addition, fish consumption advisories and information from other agencies, workshops held in 1987 and pertinent reports were utilized. In general, stream segments which received a discharge from a facility significantly out of compliance with permit limits or failing their whole effluent toxicity test were rated as support-threatened, unless water quality data indicated otherwise. Streams which had a fish consumption advisory in place were rated as partially supporting. Assessments were made on either a monitored (M) or evaluated (E) basis. A *monitored* basis represents data which are less than five years old. An *evaluated* basis refers to the use of best professional judgment or data older than five years old. Overall ratings were determined for stream segments as follows:

1. *Biological ratings* generally were preferred over any other source of information since they are a direct measurement of aquatic life support.
2. *Chemical ratings* (when biological ratings were unavailable) were preferred over information from older reports or information from workshops.
3. *Workshop "evaluations"* or best professional judgments were preferred over information from older reports.
4. Information from older reports was used when no other information was available.

After overall ratings were assigned, probable sources of pollution (point or nonpoint) for partially supporting and nonsupporting streams were sought. Information on point sources, such as permit compliance records, was reviewed in order to identify major and minor dischargers potentially affecting streams. The Aquatic Toxicology Unit was also consulted to identify facilities known to have toxic effects based on chronic and acute toxicity tests. Information related to nonpoint source

pollution (e.g., agricultural, urban and construction) was obtained from other agencies (federal, state and local), citizens, land-use reviews and best professional judgment.

Causes of use support impairment, such as sedimentation and low dissolved oxygen, were also identified for specific stream segments. For ambient water quality stations, those parameters which exceeded the water quality standard >10% of the time for the review period were included as probable causes. For segments without ambient stations, information from reports, other agencies and best professional judgment were used. In general, facility self-monitoring data and facility aquatic toxicity data were not included in the cause or overall problem parameter column since these data may not reflect instream conditions occurring during the reporting period because they are based on 7Q10 conditions.

Once all monitored and evaluated information was located on water basin maps, remaining "unassessed" streams and segments were evaluated to have the same use-support if they were a direct or indirect tributary to monitored or evaluated segments rated supporting and support-threatened. Partially and nonsupporting segments were not extended. U.S. Geological Survey (USGS) 7.5 minute topographic maps (1:26,000 scale) and orthophotoquads were used to determine probable sources for all impaired streams when other sources, such as WWTP compliance data, were insufficient.

APPENDIX V

SUMMARY OF BASINWIDE PLANNING WORKSHOP

Catawba Basinwide Planning Workshop Summary

Prepared by Greg Jennings, Extension Specialist
North Carolina Cooperative Extension Service, North Carolina State University

The Catawba Basinwide Planning Workshop was conducted May 24, 1994, at the Catawba County Agricultural Resources Center, Newton, with 98 participants representing the following interests:

21 County Government	25 City Government	5 Regional Agencies
6 State Agencies	7 Federal Agencies	5 Business / Industry
5 Farmers / Landowners	13 Private Organizations	11 Cooperative Extension Service

Workshop Objectives:

1. Describe local implications of the Catawba Basinwide Water Quality Management Plan; and
2. Increase public involvement in developing and implementing the Catawba Basinwide Plan.

Workshop Agenda:

9:00 Introduction and Video Presentation - Greg Jennings, CES - NCSU
9:30 Description of DEM Basinwide Water Quality Management Program and Implications for the Catawba River Basin - Alan Clark, DEM
10:30 Discussion Groups to Answer: "Based on your knowledge of water quality in the Catawba River Basin, what are the key issues and how should they be addressed?"
11:15 Presentations by Discussion Group Facilitators
11:45 Summary of Discussion Group Comments and Wrapup - Frank Humenik, CES - NCSU

Workshop participants were randomly divided into 6 discussion groups to respond to the question: "Based on your knowledge of water quality in the Catawba River Basin, what are the key issues and how should they be addressed?" Facilitators summarized key issues and recommended actions in 5-minute presentations to Workshop participants.

Priority Issues Identified by Two or More Discussion Groups:

- **Nonpoint sources of pollution**
- **Point sources of pollution**
- **Development and land use planning**
- **Monitoring to provide a sound basis for regulations**
- **Enforcement of regulations**
- **Economic implications of environmental protection**
- **Coordination of government programs**

Recommended Actions Identified by Two or More Discussion Groups:

- **Increase public education and involvement**
- **Identify and target critical areas**
- **Increase funding for nonpoint source controls, including agriculture**
- **Develop regional approaches to land use and water resource planning**
- **Increase DEM staff to support monitoring and enforcement**
- **Evaluate cost-benefit relationships of regulations**
- **Coordinate local and state government programs to maximize effectiveness**
- **Develop and implement new technologies for point and nonpoint source control**

Below are summarized the priority issues and recommended actions of the 6 discussion groups:

Group 1 Priority Issues (Facilitator: Fred Miller, CES - Catawba County):

1. Nonpoint sources: Sediment, Animal waste, Construction, Timber harvesting, Agriculture
2. Point sources: Industrial discharges, Color, Toxicity, Illegal dumping
3. Enforcement of existing and future regulations (e.g. Water Supply Watershed Rules)
4. Development: Septic systems, Treatment plant malfunctions
5. Water supply planning: Quantity, Quality, Recreation uses
6. Factual, scientific basis for regulation
7. Cost impacts of regulations

Group 1 Recommended Actions:

1. Increase public education: Nonpoint sources, Point sources, Economic impacts
2. Implement NPS controls
3. Identify and target problem areas
4. Consider cost-benefit relationships and funding sources

Group 2 Priority Issues (Facilitator: Frank Humenik, CES - NCSU):

1. Development
2. Scientific basis for regulation
3. Cost-benefit analysis
4. Education
5. Cooperation/coordination among governments

Group 2 Recommended Actions:

1. Coordinate state management planning with local efforts (e.g. Duke Power, COGs)
   - Need consistency among agencies
   - Improve monitoring to provide technically sound basis for regulations
2. Evaluate cost-benefit relationships of regulations
   - Provide equitable distribution of river capacity
   - Provide reasonable timeframe for implementation
3. Increase education & public involvement to build consensus on water quality needs
   - Need political & social acceptance
   - Need grass roots support

Group 3 Priority Issues (Facilitator: Kevin Starr, CES - Lincoln County):

1. Sources of Pollution: Sediment, Nutrients, Sewer systems, Trash, Color, Nonpoint sources
2. Water quality
3. Regulatory impacts
4. Preventive measures
5. Cooperative involvement
6. Competing demands

Group 3 Recommended Actions:

1. Increase education:
   - Schools (begin in elementary)
   - Industry
   - Construction companies
   - Developers
   - Constructive, individual involvement
   - Emphasize prevention through public involvement and education
2. Enforce regulations:
   - Accurately identify and force compliance of responsible parties (including NPS)
   - Enforce through NPDES
   - Regulate land use and development
   - Improve monitoring to support enforcement
   - Monitor small scale sewage treatment systems
   - Need uniformity of regulations & enforcement within basin
3. Network to improve coordination of existing regulatory and non-regulatory programs
4. Set realistic goals using a consensus of water quality needs
5. Provide adequate funding for regulatory and non-regulatory programs

Group 4 Issues (Facilitator: Will Harman, CES - Gaston County):

1. Water quality: Monitoring, Standards, Waste allocation
2. Enforcement: NPDES permits, Data quality
3. Nonpoint source controls: Agriculture, Development, Urban runoff
4. Economic impacts: Costs, Funding sources

Group 4 Recommended Actions:

1. Increase public information and education
2. Target critical areas and polluters
3. Research and develop new technologies
4. Increase DEM staff for enforcement of NPS
5. Publish names of violaters
6. Provide economic incentives for clean water
7. Encourage regional approach to wastewater management
8. Use fines paid by violators to fund monitoring

Group 5 Issues (Facilitator: Martha Burris, CES - Gaston County):

1. Impacts of pollution on wildlife
2. Sedimentation: Agriculture, Construction, Logging
3. Economic development
4. Urban & residential concerns
5. Nutrients: Reservoir impacts, Animal waste management

Group 5 Recommended Actions:

1. Monitor wildlife impacts to determine areas where management practices are needed
2. Map areas impaired by sediment and sources
3. Coordinate and clarify roles of agencies working on sediment control
4. Monitor to obtain data on agricultural sources

5. Target funding to treat agricultural problems
6. Compile regulations affecting agriculture

Group 6 Issues (Facilitator: Greg Jennings, CES - NCSU):

1. Land use: Controlled development, Open space, Natural areas, Growth management
2. Monitoring: Data quality, Scope, Ground water, Value in targeting problems
3. Point sources: Color, SOCs, Cost-effective treatment, New limits, More fines, Toxics
4. Development: Urban runoff, Landfills, Automobiles, Construction, Lake use
5. Agriculture: Animal waste, sediment, nutrients, pesticides
6. Policies & Education: Desirable water quality, Cleanup, Need for basic knowledge, Politics

Group 6 Recommended Actions:

1. Coordinate local government planning for land use without politics
2. Improve monitoring & enforcement
   - Increase DEM staff
   - Monitor near drinking water intakes
   - Monitor in small streams
   - Monitor ground water near potential sources
   - Enforce below construction sites
   - Develop an enforcement guidance document
   - Adopt successful methods from other areas of country
3. Improve regulation of point sources through stricter permits and enforcement
4. Address agricultural problems
   - Increase cost-share, technical assistance, and education for farmers
   - Enforce animal waste rules, including soil and waste analyses
   - Adopt poultry mortality composting
   - Add DEM basin coordinator for agriculture
   - Develop and implement new technologies for addressing problems
5. Increase public awareness and involvement
   - Create community roundtables to identify local solutions
   - Get public involved in setting long-range goals
   - Empower broad-based citizen groups
   - Educate urban residents on impacts of stormwater
   - Use all media to keep public regularly informed
   - Increase school education on basic environmental protection

APPENDIX VI

FACT SHEET:

CITY OF CHARLOTTE NPDES MUNICIPAL STORMWATER PERMIT

DIVISION OF ENVIRONMENTAL MANAGEMENT

FACT SHEET

MUNICIPAL SEPARATE STORM SEWER SYSTEM STORMWATER PERMIT
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
PERMIT TO DISCHARGE STORMWATER

Application No. NCS000240 **Date: August 31 1993**

TABLE OF CONTENTS

Page

Municipal Permit Information 2
Background Information 2
Location of Discharge 2
Receiving Waters 3
Description of Permit Coverage 3
Coverage Under This Permit 3
Scope of Permit Coverage 4
Urban Stormwater Quality 5
Pollutants of Concern 5
Management Alternatives 5
Proposed Discharge Controls and Limits 5
Monitoring and Reporting Requirements 5
Effective Date of Proposed Control Programs 7
Basis for Proposed Stormwater Management Programs 7
General 7
Coverage 9
Permit Conditions 10
Monitoring and Reporting 10
The Administrative Record 11
State Contact 11
Proposed Schedule for Permit Issuance 11
Procedure for the Formulation of Final Determinations 11
Comment Period 11
Public Meeting 12
Appeal Hearing 12
Issuance of a Permit When no Hearing is Held 12

1. MUNICIPAL PERMIT INFORMATION

Background Information

Stormwater is surface water runoff that results from precipitation events. As stormwater flows across land surfaces it picks up and carries with it significant amounts of pollutants. The stormwater flow eventually reaches surface waters where the pollutants it carries may be introduced to the receiving waters. These pollutant loads can cause significant water quality impairment in these waters. Some of the major influences on the potential stormwater pollution threat in a given area are the types of activities and the level of development and built-upon surfaces in the area. Built-upon surfaces prevent precipitation from infiltrating into the soil surface and therefore increase the amount of precipitation that becomes stormwater runoff. In addition, the activities associated with built-upon areas also generate increased levels of various pollutants. These pollutants tend to be concentrated in various locations on the built-upon surfaces and thus made readily available for transport by stormwater flows.

In urban and urbanizing areas, the affects of increased built-upon area and highly intensive urban activities create an environment where significant stormwater pollutant sources may exist. Section 402(p) of the Clean Water Act (CWA) and related federal regulations (40 CFR 122.26) recognize the pollutant contribution of heavily urbanized areas and require NPDES permits and stormwater quality management programs for stormwater discharges from certain municipal separate storm sewer systems (MS4s). A separate storm sewer system is a conveyance or system of conveyances which are designed or used to collect or convey stormwater runoff which is not part of a combined sewer system or treatment works. This can include, but is not limited to, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains that convey stormwater runoff and ultimately discharge to waters of the State.

The provisions of this permit require that pollutants discharged from the MS4 are reduced to the maximum extent practical. The cities involved in municipal NPDES stormwater permit coverage are responsible for reviewing pollutant sources and activities throughout the municipal area and developing and implementing a comprehensive stormwater quality management program (SWQMP) to control pollutants discharged to, and ultimately from, their storm sewer system.

Location of Discharge

The discharge covered by the permit is located within the jurisdictional area of the City of Charlotte, Mecklenburg County, North Carolina. Areas adjacent to surrounding or interconnected with the City may also be covered by this permit as appropriate. A location map is included as Attachment 1 of this NPDES permit Fact Sheet.

Receiving Waters

Discharge from the City of Charlotte's municipal storm sewer system enters the waters of two major river basins in North Carolina. The majority of the discharge enters the Catawba River Basin and a small portion entering the Yadkin River Basin. The following table lists five major stream segments that receive stormwater discharge from the City's storm sewer system:

Stream Segment	River Basin
Long Creek	Catawba River Basin
Sugar Creek	Catawba River Basin
Steele Creek	Catawba River Basin
Back Creek	Yadkin-Pee Dee River Basin
Mallard Creek	Yadkin-Pee Dee River Basin

Individual outfalls from the storm sewer system may discharge to tributaries of these creeks. The surface water classification of the waters receiving discharge from Charlotte's municipal storm sewer system are Class C, B or WS-IV. These surface water classifications are defined in the North Carolina Administrative Code 15A NCAC 2B .0200.

2. DESCRIPTION OF PERMIT COVERAGE

Coverage Under this Permit

The permit authorizes point source discharges of stormwater runoff from the city of Charlotte's MS4 in accordance with permit conditions and the city's approved SWQMP (Note: The SWQMP is an enforceable part of the NPDES permit). These discharges from the MS4 are, in general, to be composed only of stormwater runoff. Some incidental non-stormwater flows are allowed to enter the MS4 as long as these flows are not significantly impacting water quality. A list of these non-stormwater sources is contained in Part I, Section A of the permit and includes flow to the MS4 from: water line flushing, irrigation, springs, footing drains, street washing and fire fighting. In addition, some other discharges to the MS4 may be allowed as discussed below.

Non-stormwater discharges into the MS4, such as process and non-process wastewater discharge, may be allowed, but only if these discharges are covered by NPDES permits that are independent of the permit issued to the MS4. In addition, there are eleven categories of industries that are required by the CWA and federal regulations (40 CFR 122.26) to obtain NPDES stormwater permits for point source discharges of stormwater runoff from their sites. These specific facilities are responsible for the pollutants discharged through stormwater runoff from their site and are required to obtain independent NPDES stormwater discharge permits and to develop stormwater pollution prevention programs for their sites. Those industrial stormwater discharges that have been permitted independently under NPDES stormwater requirements are allowed to discharge stormwater through the MS4. Discharge of stormwater from these industrial areas into the MS4 without an appropriate NPDES permit and management program is not allowed.

The authorized discharges covered by this permit include all point source discharge locations (or outfalls) from the MS4. This includes all currently located outfalls from the system and new outfalls located or constructed after finalization of this permit. Permit conditions including the implementation of the SWQMP are required to control and reduce the pollutant loads associated with discharges from the MS4 outfalls. The area of physical coverage of the permit may be expected to change, not only due to new outfalls, but also due to expansion of the city's jurisdictional boundaries and potential interlocal agreements between city, county and other entities as determined necessary to address areas where pollutants are discharged to the municipal storm sewer system and subsequently to waters of the state.

Scope of Permit Coverage

The intent of municipal stormwater NPDES coverage, and requirements of the CWA, is to reduce pollutant discharge to the maximum extent practical. The ultimate goal being protection of the integrity and quality of the state's surface waters from potential impacts of runoff from urban areas. Accomplishment of this objective requires that a broad based approach be taken in developing stormwater permit conditions. The reasons for this approach are found in the nature of urban stormwater runoff. Stormwater runoff essentially begins as a diffuse or nonpoint source of pollution. Unlike other nonpoint sources, stormwater runoff in urban settings is, to a high degree, directed to stormwater conveyance systems (storm sewers) and is ultimately discharged as a point source which may be regulated under the NPDES stormwater program. Because of the large number of stormwater discharge points in an urban setting and the variability in stormwater flow, controlling these discharges like conventional wastewater point sources with end-of-pipe controls is not appropriate. Instead, the coverage for these discharges is necessarily based on a broader approach allowing a flexible means by which municipalities can develop comprehensive stormwater programs that are directed at sources of pollutants.

The comprehensive stormwater programs in the SWQMP, and the permit itself, are to be implemented throughout the entire jurisdictional area of the City of Charlotte. This coverage area may expand based on changes in the jurisdictional area of the city and/or interlocal or interagency agreements to provide stormwater management programs. Implementation of these programs is required to the extent that pollutant discharge to waters of the state must be controlled and reduced to the maximum extent practical. Ultimate permit conditions are tied to long term control of pollutants discharged from the municipal storm sewer system and reduction of pollutant loading from the system. In this context, the Division of Environmental Management, herin refered to as the Division, considers the municipal system to include discharges from public and private storm sewer networks within the city's jurisdictional control. The scope of this coverage recognizes that situations may exist where the municipality will not have complete authority for the storm sewer system and outfall (i.e. private systems). However, within the municipal jurisdiction, the city has authority through land use control, controls on discharge to waters, etc. to manage the pollutants introduced to, and ultimately discharged from, the system regardless of ownership of the specific segment of the sewer system.

3. URBAN STORMWATER QUALITY

Pollutants of Concern

A wide range of land uses and activities can be expected to exist within a large urban area. All of these uses can potentially contribute pollutants to the municipal storm sewer system. With various levels and types of residential, commercial, industrial, institutional and construction activity ongoing in an urban area, it is often difficult to pinpoint specific pollutants or pollutant levels expected for individual urban activities or locations. However, it has been shown that urban development and the subsequent stormwater runoff from these areas represent a major cumulative source of pollution to surface waters. Table 1. indicates some of the major pollutant categories that are of primary concern in dealing with urban stormwater quality management. The table represents a general overview of expected categories of pollutants. Various additional pollutants may be present in a given area due to the activities ongoing within the area.

Management Alternatives

The Division and the U. S. Environmental Protection Agency (EPA) stress a source reduction/pollution prevention approach for stormwater quality management. This is essentially founded on the basis that the quality of stormwater discharged from the storm sewer system is dependent on the sources of pollutants available to be contributed to the system through stormwater runoff. Reducing the pollutant sources reduces the pollutant impact of storm sewer discharge. On a local level, this type of management program may consist of various components including, but not limited to, sedimentation and erosion control programs for disturbed areas, land use planning and ordinance controls in developing areas, municipal programs for recycling and hazardous waste collection, public education and training programs, spill failure/containment programs, and programs to detect and remove illicit connections to the storm sewer system. These types of Best Management Practices (BMPs) are considered to be the most efficient and effective methods from a cost and management standpoint. It is recognized, however, that in some situations, engineered stormwater control structures for stormwater management may be utilized. The municipalities involved in the NPDES stormwater program must evaluate the land uses and activities in their area to determine the most appropriate management practices to manage and control stormwater discharges.

4. PROPOSED DISCHARGE CONTROLS AND LIMITS

Provisions for controls and limitations can be found in the attached copy of Part I, Section A of the Draft Permit.

5. MONITORING AND REPORTING REQUIREMENTS

Provisions for monitoring and reporting requirements can be found in the attached copy of Part I, Section B of the Draft Permit.

Table 1. Categories of Pollutants Expected in Urban Stormwater Runoff

Sediment	• Sediment is often viewed as the largest pollutant load associated with stormwater runoff in an urban setting. The loadings have been shown to be exceptionally high in the case of construction activity. • Sediment is associated with numerous impacts in surface waters including increased turbidity, effects on aquatic and benthic habitat and reduction in capacity of impoundments. • A number of other pollutants often attach to, and are carried by, sediment particles.
Nutrients	• The nutrients most often identified in stormwater runoff are phosphorus and nitrogen. • In surface waters, these nutrient loads can lead to heavy algae growth, eutrophication (especially in impoundments) and low dissolved oxygen levels. • Nutrients are input into the urban system in a variety of ways including landscaping practices (commercial and home) and leaks from sanitary sewers and septic systems.
Organic Matter	• Various forms of organic matter may be carried by stormwater in urban areas. Decomposition of this material by organisms in surface waters results in depleted oxygen levels. • Low levels of dissolved oxygen severely impact water quality and life within surface waters. • Sources of organic matter include leaking septic systems, garbage, yard waste, etc.
Bacteria	• High bacterial levels may be found in stormwater runoff as a result of leaking sanitary systems, garbage, pet waste, etc. • The impacts of bacteria on surface waters may affect recreational uses and aquatic life as well as presenting possible health risks.
Oil and Grease	• Numerous activities in urban areas produce oil, grease and lubricating agents that are readily transported by stormwater. • The intensity of activities, including vehicle traffic, maintenance and fueling activities, leaks and spills and manufacturing processes within an urban setting contribute heavily to the level of these pollutants present in adjacent surface waters.
Toxic Substances	• Many toxic substances may potentially be associated with urban stormwater including metals, pesticides, herbicides and hydrocarbons. • Toxic compounds may affect biological systems, and accumulate in bottom sediments of surface waters.
Heavy Metals	• Heavy metals such as copper, lead, zinc, arsenic, chromium and cadmium may be typically found in urban stormwater runoff. • Metals in stormwater may be toxic to some aquatic life and may accumulate in aquatic animals. • Urban sources of metals in stormwater may include automobiles, paints, preservatives, motor oil and various urban activities.

6. EFFECTIVE DATE OF PROPOSED CONTROL PROGRAMS

The City of Charlotte's stormwater program - including permit conditions and the SWQMP - will be evaluated on the basis of program progress and results over the reporting periods throughout the life of the permit. As appropriate, the Division may specify compliance schedules for any and all components of the city's MS4 permit in order to achieve the level of implementation and progress deemed necessary by the Division to achieve water quality protection and meet the intent of the municipal permitting program. The Division will coordinate reviews with the city of Charlotte to assure a proper understanding of related city activities associated with the timing of various programs. During initial reviews, the Division will pay close attention to overall program progress, appropriateness of program development schedules and modifications in programs and program direction in response to monitoring efforts.

7. BASIS FOR PROPOSED STORMWATER MANAGEMENT PROGRAMS

General

The conditions of this permit and the city of Charlotte's SWQMP (which is an enforceable part of this permit) have been developed to achieve water quality protection in accordance with the provisions of the Clean Water Act. These provisions mandate that municipal storm sewer system NPDES permits include requirements to:

- effectively prohibit non-stormwater discharges into the storm sewer system; and
- control the discharge of pollutants from the storm sewer system to the maximum extent practicable.

If the Director of the Division determines that water quality problems exist that require water quality based controls or effluent limitations to protect the receiving waters, these requirements may be added as provisions of this permit or a subsequent reissuance of this permit. The proposed permit is based on considerations for appropriate stormwater management practices in an urban setting, and considerations as outlined in the following sections.

The assessment of stormwater management alternatives in the proposed permit is based on the intent of the NPDES municipal program to control pollutants discharged through the storm sewer system of heavily urbanized areas. The CWA, federal regulations and state permitting requirements recognized that control of stormwater flows from MS4s must be accomplished on a site specific basis. This necessitates that flexibility be allowed in the development of local programs so that local conditions, land uses, activities and existing programs are appropriately considered. In this context, the MS4 permit application process required that the city of Charlotte develop information characterizing their municipal storm sewer system and existing management programs including:

- o Mapping of the storm sewer system, outfall locations and land use within the city's jurisdiction.
- o Screening of outfalls to assess potential illicit connections.
- o Development of information describing existing and proposed legal authority for stormwater control programs.
- o Storm event sampling of representative outfalls to characterize the quality of stormwater discharge.
- o Review of existing programs, data and other information addressing stormwater quality management.

Stormwater Quality Management Program (SWQMP) - The information gathered above, and overall analysis of the city's storm sewer system, resulted in the city's development of a comprehensive SWQMP to control pollutants discharged through their storm sewer system. The SWQMP is a significant part of the proposed conditions for the NPDES permit for stormwater discharge from the city of Charlotte's MS4 and is an enforceable part of the permit.

The draft permit proposes that implementation of the city's SWQMP and best management practices along with appropriate monitoring, review and modification of the SWQMP will control pollutant discharges from the city's MS4 in conformance with section 402(p) of the Clean Water Act. The permit does not address specific water quality based controls or effluent limitations at this time for a number of reasons. First of all, the Clean Water Act and associated federal regulations do not require that these strict provisions be a part of municipal NPDES permits. In fact, the records from these federal actions indicate that in development of the NPDES stormwater permit requirements, it was recognized that MS4 permits would <u>not</u> necessarily be like other discharge permits and should be structured to allow flexibility for development of site-specific programs for stormwater management. In addition, the Division believes that it is not appropriate at this time to establish specific standards for stormwater discharges from MS4s due to the unique nature of each municipal system as well as the variability of stormwater flows.

The Division feels that the most economically and environmentally feasible alternatives for stormwater management are Best Management Practices (BMPs). In the case of stormwater discharges from MS4s, this approach has been taken through the programs established in the SWQMP. These programs are established on a local level and reflect local priorities, principals, practices and authorities that will be most effective in managing stormwater discharges. In using this approach, the Division has recognized the provisions of the Clean Water Act, along with previous experiences which indicate that BMPs can effectively reduce pollutant discharges. It should be noted that federal regulations - 40 CFR Part 122.44(k)(2) - authorize the use of best management practices (BMPs) for pollutant reduction when the permitting agency finds that numeric limits are infeasible.

In developing the draft NPDES permit conditions, consideration has been given to the usefulness of engineered treatment alternatives for stormwater management. The Division recognizes that in some situations these methods may be the best alternatives available on a small scale. On a broad basis, however, these methods would not appear to be an answer to stormwater pollutant problems throughout the municipal area. The large number of discharge (outfall) locations associated with

the municipal storm sewer system, along with the intermittent high flow conditions associated with stormwater discharges, do not allow efficient design or integration of end-of-pipe treatment methods on a system scale. This leads to permit conditions in the form of comprehensive stormwater quality management programs implemented on a jurisdiction-wide basis to control sources of pollution to the storm sewer system rather that targeting treatment methods prior to discharge.

Coverage

A wide range of land use activities occur in urban areas, and all of these activities potentially discharge stormwater and pollutants associated with stormwater to the municipal storm sewer system. To effectively reduce the discharge of pollutants, the municipal SWQMP involves the development and implementation of comprehensive programs that address stormwater management and source reduction/pollution prevention for a variety of land use activities including: residential, commercial, industrial, institutional and construction areas. The draft permit proposes that the city of Charlotte's stormwater management programs be implemented over the entire jurisdictional area of the city rather than only in those areas where the city owns the storm sewer system. This requirement is based on the Division's interpretation of the intent of the Clean Water Act in addressing stormwater flows from urban areas, the emphasis of which is to reduce pollutant discharge from the storm sewer system in order to achieve water quality benefits in adjacent surface waters.

The Division's position is that limiting the NPDES permit and stormwater management programs to those areas of the storm sewer system under public ownership does not appropriately address the potential stormwater pollutant sources present in the municipal area. In municipal areas such as the city of Charlotte, it would be impossible to attempt to obtain water quality benefits in receiving streams by addressing only those storm sewer system segments owned by the municipality. Excluding private areas would produce a fragmented stormwater management program that would not only be ineffective, but would also be difficult to administer on the local level. It is apparent that privately owned storm sewer systems collect and convey pollutants to surface waters either through interconnection with the MS4 or directly, regardless of the ownership of these systems. Local governments have authorities in these private areas that allow them to administer programs consistent with the intent of the SWQMP.

At a minimum, the city has authority over land use activities and pollutants that may be discharged in areas under their jurisdiction. Although they may not have ownership in these areas, the city can use these legal authorities to control the pollutant contribution from these areas. The SWQMP and the proposed permit allow flexibility for the city to deal with stormwater problems, including those in private areas, according to the best alternatives available in any given situation. In some situations the city may determine that the most efficient and effective method of controlling pollutant discharge in a area is to consider options for obtaining ownership or operational responsibility for storm sewer systems in a specific area. This permit does not direct the city to obtain these more specific authorities, but allows flexibility for other control alternatives to be utilized to control stormwater runoff in the context of the city's authorities. It is anticipated that total program

coverage may vary depending on the available authorities of the municipality. For example, the city may have areas where general land use and police powers afford the opportunity to control inputs of pollutants to storm sewer systems, but because the systems are privately owned, the city decides that maintenance responsibilities do not apply and are not necessary. Other situations may dictate that the city review pollution potential and consider options for obtaining ownership and/or maintenance responsibilities to assure reduction of pollutants to storm sewer systems and ultimately waters of the state.

Permit Conditions

In evaluating the stormwater management program for the city of Charlotte and developing the draft permit, the Division has given consideration to the need for flexibility in total program coverage. This flexibility allows for the location, targeting and control of stormwater pollutant sources throughout the municipal area and potentially surrounding areas as appropriate according to local authorities and programs. The ultimate condition of the permit is that pollutants discharged from Charlotte's MS4 must be reduced to the maximum extent practical. In order to meet this condition, Charlotte is required to develop and implement the provisions of their SWQMP which includes various components aimed at addressing specific needs and priorities of Charlotte's stormwater program. The SWQMP is an enforceable part of the draft permit and includes components to address stormwater management through education and outreach programs; pollutant reduction from commercial, residential and construction areas; detection and removal of illicit connections; review, control and inspection of industrial and waste treatment or disposal facilities; and operation and maintenance of facilities as necessary. Additional provisions of the draft permit require that adequate and appropriate legal authorities and financial assurances be developed and maintained by the city to administer the stormwater management programs, and that the city continue to assess the extent of their storm sewer system including outfalls, drainage areas and pollutant load characterization.

Monitoring and Reporting

In support of the city's stormwater management program, the draft permit requires that appropriate monitoring and reporting activities are undertaken to assess the progress and results of the local programs. Various monitoring efforts are proposed by the city and may be specific to certain components of the stormwater program as well as inclusive of the overall stormwater program. These efforts include monitoring, sampling, inspections, maintenance, enforcement and program implementation components. The city will develop and submit reports on their stormwater management program at least on an annual basis and may be requested to submit additional reporting information throughout the year as deemed necessary by the Division to assess the status and results of the city's program. Specific reporting and monitoring conditions can be found in the attached copy of Part I Section C of the Draft Permit.

8. THE ADMINISTRATIVE RECORD

The administrative record, including application information, draft permit, fact sheet, public notice, comments received and additional information is available by writing to:

N. C. Division of Environmental Management
Water Quality Section
Stormwater Group
P. O. Box 29535
Raleigh, North Carolina 27626-0535

The above information is available for review and copying between the hours of 8:00 AM and 5:00 PM Monday through Friday at:

Archdale Building, 6th Floor
Water Quality Section
Stormwater Group
512 North Salisbury Street
Raleigh, North Carolina

Copies will be provided at a charge of 10 cents per page.

9. STATE CONTACT

Additional information concerning the permit application and draft permit may be obtained at the above address or by contacting Bradley Bennett at (919) 733-5083.

10. PROPOSED SCHEDULE FOR PERMIT ISSUANCE

Draft Permit Sent to Public Notice - September 1, 1993

Permit Scheduled to be Issued - October 15, 1993

11. PROCEDURE FOR THE FORMULATION OF FINAL DETERMINATIONS

a. Comment Period

The *Division of Environmental Management proposes to issue an NPDES* Stormwater Permit for the above described stormwater discharge subject to the outlined limitations, management practices, and special conditions. These determinations are tentative and are open to comment from the public.

Interested persons are invited to submit written comments on the permit application or on the Division of Environmental Management's proposed determinations to the following address:

DIVISION OF ENVIRONMENTAL MANAGEMENT
WATER QUALITY SECTION, STORMWATER GROUP
P.O. BOX 29535
RALEIGH, NORTH CAROLINA 27626-0535
Attn. Bradley Bennett

All comments received within thirty days following the date of public notice will be considered in the formulation of final determinations with regard to this application.

b. Public Meeting

The Director of the Division of Environmental Management may hold a public meeting if there is a significant degree of public interest in a proposed permit. Public notice of such a meeting will be circulated in newspapers in the geographic area of the discharge and to those on the Division of Environmental Management's mailing list at least thirty days prior to the meeting.

c. Appeal Hearing

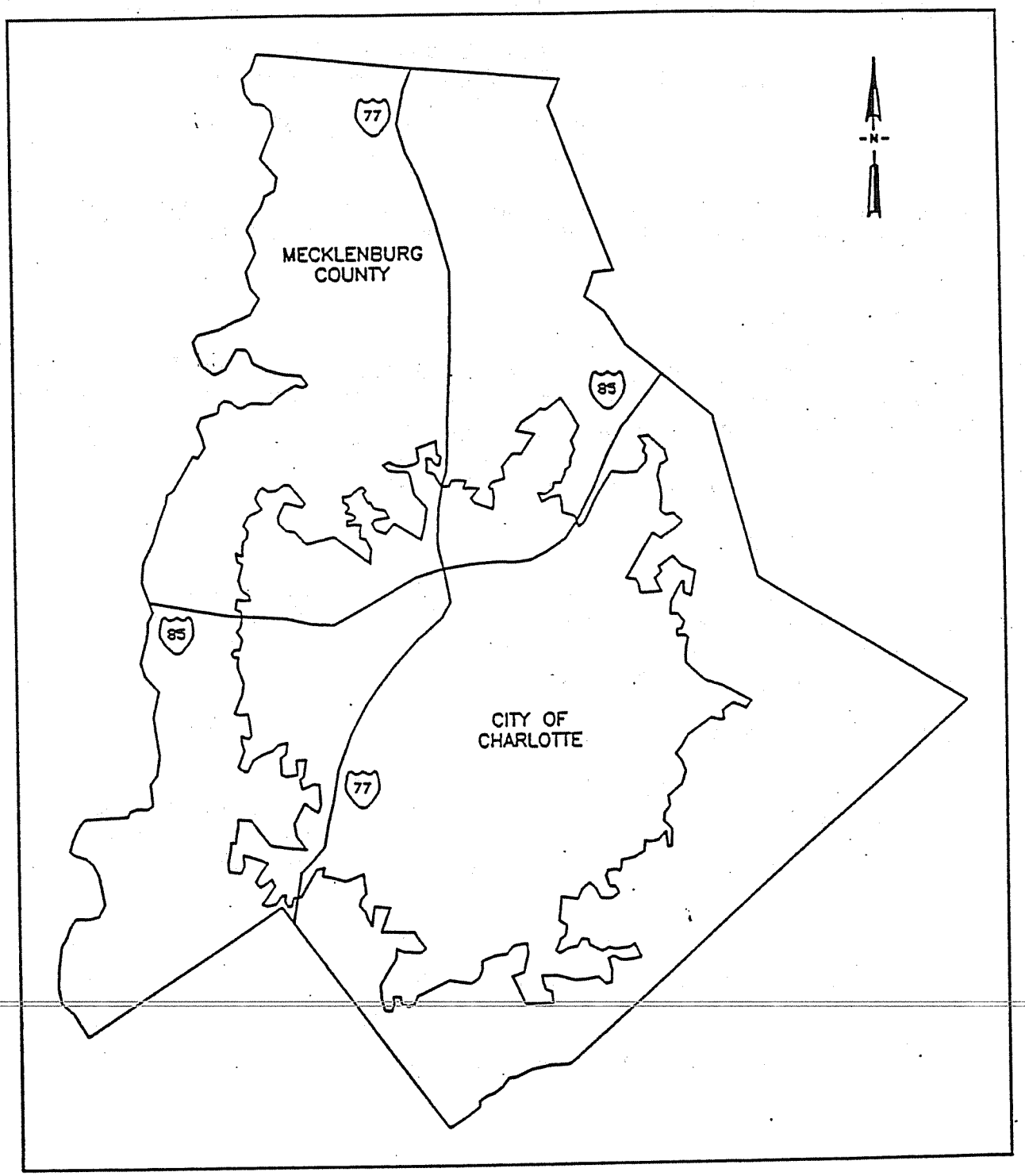
An applicant whose permit is denied, or is granted subject to conditions he deems unacceptable, shall have the right to a hearing before the Commission upon making written demand to the Office of Administrative Hearing within 30 days following issuance or denial of the permit.

d. Issuance of a permit when no hearing is held

If no public meeting or appeal hearing is held, after review of the comments received, and if the Division of Environmental Management's determinations are substantially unchanged, the permit will be issued and become effective immediately. This will be the final action of the Division of Environmental Management.

If a public meeting or appeal hearing is not held, but there have been substantial changes, public notice of the Division of Environmental Management's revised determinations will be made. Following a 30-day comment period, the permit will be issued and will become effective immediately. This will be the final action of the Division of Environmental Management unless a public meeting or appeal is granted.

ATTACHMENT 1



City of Charlotte Location Map.