Michael F. Easley, Governor
William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

April 22, 2003

Thank you for your interest in North Carolina's water quality issues. Enclosed is the basinwide water quality plan that you recently requested from the Division of Water Quality (DWQ).

The basinwide planning program aims to identify and restore full use to impaired waters, identify and protect highly valued resource waters, and protect the quality and intended uses of North Carolina's surface waters while allowing for sound economic planning and reasonable growth. North Carolina relies on the input and experience of its public to ensure that the water quality plans are effective. DWQ coordinates plan development; however, plan implementation and effectiveness entails the coordinated efforts and endorsement of many agencies, groups, local governments, and the general public. Your participation is essential for us to achieve our goals.

Our website (http://h2o.enr.state.nc.us/wqs/) provides detailed information on our program, other basin plans, current events, publications, and rules and regulations. Please visit us at this site.

DWQ appreciates your interest in water quality issues, and we hope to continue working with you into the future. Please contact me if you have any further questions or ideas on specific basins at (919) 733-5083, ext. 354.

Sincerely,

Darlene Kucken

Darlene Kucken
Basinwide Planning Program Coordinator

Enclosure

FRENCH BROAD RIVER BASINWIDE WATER QUALITY MANAGEMENT PLAN

(Includes the French Broad, Pigeon, and Nolichucky River Watersheds)

July, 1995

Prepared by:

North Carolina
Division of Environmental Management
Water Quality Section
P.O. Box 29535
Raleigh, NC 27626-0535

(919) 733-5083

This plan was approved and endorsed by the NC Environmental Management Commission on May 11, 1995 to be used as a guide by the NC Division of Environmental Management in carrying out its Water Quality Program duties and responsibilities in the French Broad River Basin.

Cover Photo Credits:

Top left - Black Mountains range, NC Travel and Tourism
Top right - Panning for gems, NC Travel and Tourism
Bottom left - Mountain camping, NC Travel and Tourism
Bottom right - Connestee Falls, Transylvannia County, NC Travel and Tourism

EXECUTIVE SUMMARY

NORTH CAROLINA'S BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT - PURPOSE OF FRENCH BROAD RIVER BASIN PLAN

Basinwide management is a watershed-based water quality management initiative being implemented by the North Carolina Division of Environmental Management (DEM). The *French Broad River Basinwide Water Quality Management Plan* (French Broad Plan) is the fifth 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 over the next five years. The plan will be used as a guide by DEM in carrying out its water quality program duties and responsibilities in the French Broad River Basin.

A basinwide management plan report is prepared for each basin in order to communicate to policy makers, the regulated community and the general public the state's rationale, approaches and long-term water quality management strategies for each 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. The plans are then to be evaluated, based on follow-up water quality monitoring, and updated at five year intervals.

The French Broad Plan is due for completion in May of 1995 and will be updated in the year 2000. Basinwide NPDES permitting is scheduled to occur in August, September and November of 1995 and October, November and December of 1996.

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 allowing for sound economic planning by businesses and local governments. 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.

PUBLIC WORKSHOP

A public workshop was held on June 2, 1994 in Fletcher, NC to familiarize stakeholders in the basin with DEM's basinwide approach and to solicit their comments on this basinwide plan. The workshop, which had 108 participants, was sponsored by the North Carolina Cooperative Extension Service (CES), DEM and the North Carolina League of Municipalities. Discussion groups identified priority issues and recommended actions:

Priority Issues Identified by Two or More Groups

- Agricultural pollution sources
- Point sources of pollution
- Development and land use planning
- Drinking water protection
- Education and public involvement
- Sedimentation
- Recreation impacts on water

Recommended Actions Identified by Two or More Discussion Groups

- Increase public education and involvement
- Increase technical and financial assistance for nonpoint sources, including agriculture
- Develop land use plans considering environmental and economic impacts
- Increase DEM resources for monitoring and enforcement
- Improve communications and coordination among parties involved in water quality
- Emphasize practical, simplified regulations to meet water quality goals
- Support new technologies for preventing and remediating pollution

DEM is striving to address these issues through its basinwide approach and has considered these and other issues identified by workshop participants in developing this basin plan. A more complete summary of the workshop is provided in Appendix V.

FRENCH BROAD BASIN OVERVIEW

The French Broad River Basin is the ninth largest river basin in the state covering 2,842 square miles. It is located entirely within the Southern Appalachian Mountains region of western North Carolina (Figure 2.1), west of the Eastern Continental Divide. All waters from the French Broad basin drain to the Gulf of Mexico via the Tennessee, Ohio and Mississippi Rivers. The basin includes the highest point in the United States east of the Mississippi River located atop Mount Mitchell (elevation 6,684 feet above mean sea level (MSL)). The lowest elevation in the basin is 1254 feet MSL where the French Broad River flows into Tennessee.

The French Broad Basin in North Carolina is composed of three separate drainages which flow northwest into Tennessee and do not join until they reach of the headwaters of Douglas Reservoir (a large multi-use impoundment managed by the Tennessee Valley Authority) (Figure 2.2). They include the Pigeon River, French Broad River and the Nolichucky River watersheds (which includes the North and South Toe Rivers and Cane River). There are 4,113 miles of freshwater streams in the basin and seven lakes, all man-made, greater than eight acres in size.

There are 9 counties and 24 municipalities located in whole or in part in the basin (Figure 2.3). The population of the basin, based on 1990 census data, was estimated to be 358,000. Municipalities with a population of 5,000 or more in the basin include Asheville, Black Mountain, Brevard, Hendersonville and Waynesville. The overall population density of the basin is 93 persons per square mile versus a statewide average of 123 persons per square mile. The percent population growth over the past ten years (1980 to 1990) was 8.7 % versus a statewide percentage increase of 12.7%.

Over half of the land in the basin is forested with much of it located within the 1.2 million-acre Pisgah National Forest. Steep slopes limit the land area suitable for development and crop production. Slopes of less than 12% are desirable for development purposes, and, in the absence of public sewer lines, soil depth of three feet or more over bedrock is desirable in order to allow construction of onsite septic systems. It is estimated that just 18% of lands in North Carolina's mountains meet these requirements. Most agricultural and development activities are therefore concentrated in river valleys. Statistics provided by the US Department of Agriculture, Soil Conservation Service indicate that cultivated cropland is shrinking as developed lands are increasing. Major industries in the basin include silviculture, agriculture (dairy, livestock, apples, Christmas trees), mining (feldspar, quartz, mica, gem stones and others) and tourism.

Water quality is generally high throughout the basin. Trout waters are abundant and many waters have been reclassified as High Quality or Outstanding Resource Waters.

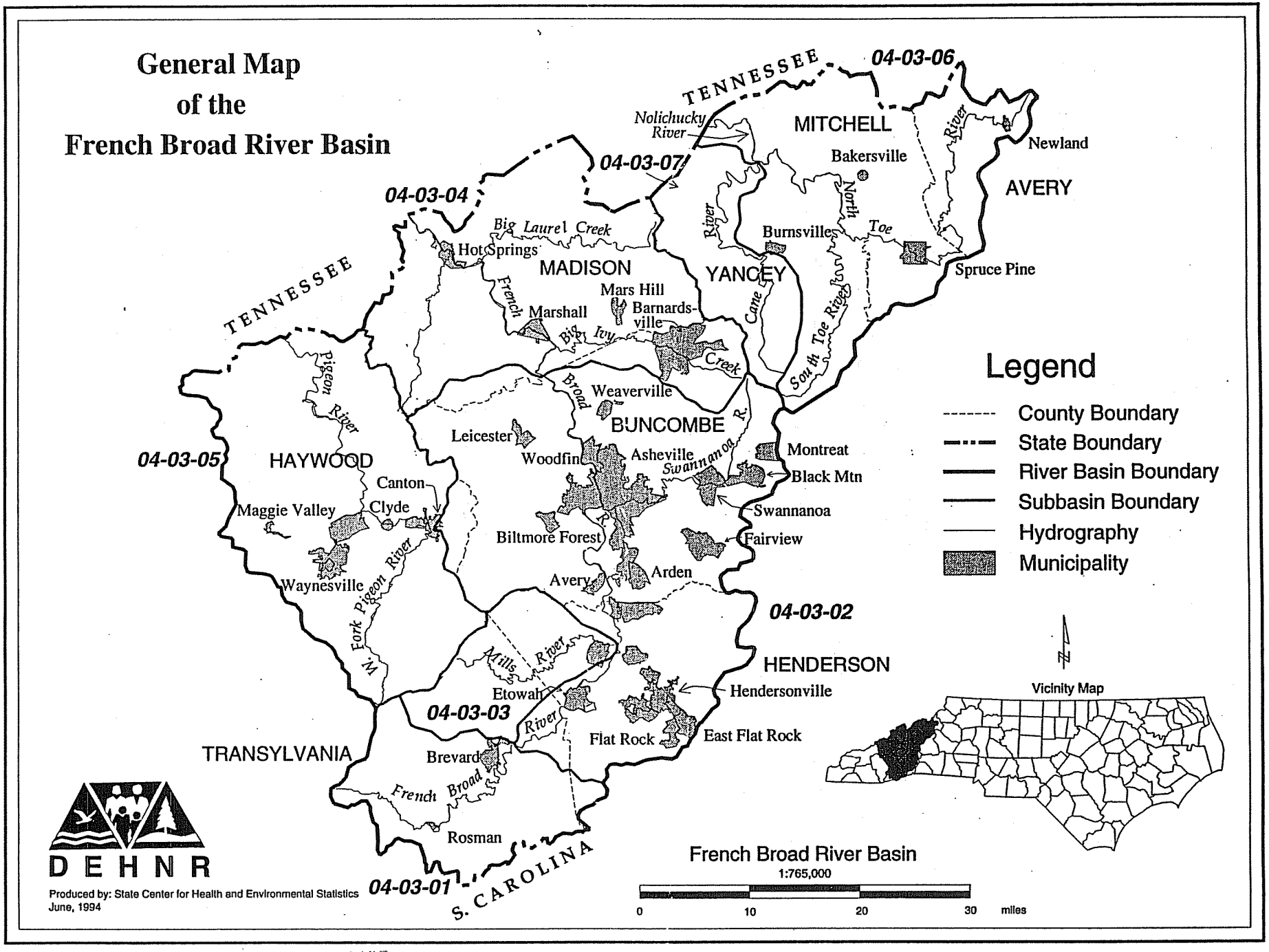

Figure 1 General Map of the French Broad River Basin

In the French Broad River Basin, there are 353 permitted NPDES dischargers, 176 of which are general permits or stormwater discharge permits. Of the total 353 dischargers, 14 are major facilities, 202 are domestic, 15 are municipalities and 84 are industries. The total permitted flow for all facilities is 120 million gallons per day (MGD).

ASSESSMENT OF WATER QUALITY IN THE FRENCH BROAD RIVER BASIN

An assessment of water quality data collected by DEM and others reveals that the French Broad River Basin has generally high water quality. Below is a summary of some key monitoring data that reflects the overall quality in the basin.

Summary of Biological Indicators

Benthic Macroinvertebrates - One type of biological monitoring used to indicate water quality and identify long-term trends is *benthic macroinvertebrate* sampling. These are primarily bottom-dwelling aquatic insect larvae of species such as stoneflies, mayflies and caddisflies. A total of 276 benthic macroinvertebrate collections at 152 sites in the French Broad River basin were sampled and analyzed from 1983 through 1992. The results clearly indicate the high water quality found in the French Broad River basin. All of the Poor sites listed below under 1992 were on Mud Creek, Clear Creek or Hominy Creek in subbasin 02 of the French Broad River Watershed.

Water Quality in the French Broad Basin as Indicated by Benthic Macroinvertebrate Sampling

	1983-1992		1992	
	No. of sites	% of total	No. of sites	% of total
Excellent	91	33	14	29
Good	55	20	12	24
Good-Fair	56	20	14	29
Fair	41	15	5	10
Poor	30	11	4	8
TOTALS	276	100	49	100

Benthos collections can also be used to determine changes in water quality for the 46 sites that have been sampled more than one time. Of these, over 70% showed no change in water quality. Ten sites indicated improvement in water quality, though some of these were minor changes. Four sites suggested a decline in bioclassification, but most of these sites were sampled in different seasons, with the summer samples showing the most impact. These may not be true declines, but rather denote that impacts can be more severe during low flow, high temperature periods.

Of the 49 basin assessment sites sampled in 1992, 21 have long-term benthos data. These are generally ambient sites on larger rivers and tributaries and probably give the most accurate presentation of changes in water quality in the basin. Of the 21 sites, 15 had no long-term change in bioclassification, 5 showed improvement, and only the French Broad River at Alexander showed a decline. This site is below the Metropolitan Sewerage District of Buncombe County WWTP and the Buncombe County Landfill and is subject to runoff from increasing development in the area.

The clearest improvement in water quality was found in the Cane River approximately eight miles below the Burnsville WWTP. It's bioclassification improved from Good-Fair in 1983 and 1985, to Good in 1987 and 1989, to Excellent in 1992. The increase in water quality seems to be related to improvements at the Burnsville WWTP made in 1985. Other improvements were found in the French Broad River near Asheville, the Swannanoa River near Biltmore, the Pigeon River below Champion Paper, and Richland Creek near Waynesville. The French Broad River site

improvement may be due to sewer system improvements and small dischargers connecting to the Metropolitan Sewerage District of Buncombe County WWTP. Improvements in upstream sewer systems and the closing of Sayles Biltmore Bleachery have probably contributed to the improved water quality for the Swannanoa River. Champion Paper has spent three hundred million dollars upgrading their manufacturing process, and while not complete in 1992 when biological sampling was performed by DEM, a positive effect on the benthos of the Pigeon River was found. Richland Creek improvements can be related to Dayco Corporation's decreased runoff from that facility into Richland Creek plus improvements to the Town of Waynesville's sewer system and the closure of the A.C. Lawrence Tannery.

Fish Community Evaluations - Fish community structure evaluations were performed at 43 locations in the French Broad River Basin from 1980 to 1993. Nineteen of these evaluations were conducted by the DEM. Collections from other sources, including the Wildlife Resources Commission, the University of North Carolina at Charlotte, and those of Rhode, accounted for the remaining information. The following table briefly summarizes the number of locations receiving various ratings for ecological health as determined by fish community structure analysis. Some streams within several of the individual subbasin summaries are particularly worth noting. The North Toe River, South Toe River, Cane River, Spring Creek, Big Ivy Creek, Shelton Laurel Creek, Reems Creek, and portions of the Swannanoa River each received ratings in either the Excellent category or the Good-Excellent category. The Poor and Very Poor sites were evaluated below the discharge of the Champion Paper Company on the Pigeon River. However, recent fish tissue sampling has shown decreased levels of dioxin in fish in the Pigeon River, and improvements in fish community structure are anticipated as a result of recent plant improvements.

Number of Fish Community Locations and rating categories

Excellent	4
Good-Excellent	12
Good	18
Fair-Good,	3
Fair	1
Poor-Fair	3
Poor	1
Very Poor	1

Use-Support Ratings

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* refers to activities such as swimming, fishing and water supply. DEM has collected extensive chemical and biological water quality monitoring data throughout the basin, some of which is 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 French Broad basin, described more fully in Chapter 4, are summarized below for freshwater streams and lakes.

Freshwater Streams and Rivers - Of the 4117 miles of freshwater streams and rivers in the French Broad basin, use support ratings were determined for 86% or 3522 miles with the following breakdown:

Use-support Rating Summary for the French Broad Basin (including Pigeon and Nolichucky)

Fully Supporting	51%
Fully Supporting but threatened	24%
Partially Supporting	10%
Not Supporting	1%
Not Evaluated	14%

Subbasin 02, which includes Asheville, Hendersonville and the Swannanoa River, was the only subbasin which had a larger percentage of streams which were either partially supporting or not supporting.

Probable causes and sources of impairment were determined for about 78% of the impaired streams. Sediment was the most widespread cause of impairment, followed by fecal coliform bacteria, dioxin and turbidity. Information on sources of impaired streams revealed that 356 miles were impaired by nonpoint sources, and 123 stream miles were impaired by point sources. Agriculture was the most widespread nonpoint source, followed by urban runoff, and construction. Subbasins 02 and 04 had the highest number of streams thought to be impaired by agriculture and subbasins 01 and 02 had the highest number attributed to urban runoff.

Lakes

Seven lakes in the French Broad Basin, totaling 1,373 acres, were monitored and assigned use support ratings (Table 4.7). Of these 7, six are fully supporting their uses and one is partially supporting its uses. Those supporting their uses include Lake Julian, Burnett Reservoir, Beetree Reservoir, Busbee Reservoir, Allen Creek Reservoir and Lake Junaluska. Lake Junaluska has been impacted by sediment and nutrients but it is still considered supporting its uses.

Waterville Lake (Walters) is rated as partially supporting its designated uses due to a fish consumption advisory issued by the State Health Director and problems with nutrient overenrichment. Elevated levels of dioxin were found in the lake fish tissues based on sampling conducted by DEM and the US Environmental Protection Agency in 1988. Champion International and several other wastewater treatment plants discharge upstream of Waterville Lake. Champion implemented a dioxin minimization plan in the mid to late 1980s. Recent fish tissue monitoring has found lower concentrations of dioxin in most fish species in the lake except for two bottom-feeders, carp and catfish. The no consumption advisory now applies only to carp and catfish. Monitoring for dioxin in fish tissue will continue at Waterville Lake annually.

MAJOR WATER QUALITY ISSUES AND RECOMMENDATIONS

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 potentially affected. Those issues considered most significant on a basinwide scale are presented below along with recommended corrective or research actions. These include: A. Sedimentation, B. Nutrients, C. Toxic Substances, D. Oxygen-consuming wastes, E. Protection of high value resource waters, F. Urban Stormwater, G. Alternative Water Supply Sources for Asheville and H. Fecal Coliform Bacteria.

A. SEDIMENTATION

Sediment is the most widespread cause of water quality use support impairment in the French Broad River Basin as it is throughout most of the state. Significant sources include agricultural activities, road construction, urban development, timber harvesting and mining. 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 programs there were still 266 miles of streams in the French Broad Basin found to be impaired by sediment, thus pointing to the need for continued overall improvements in erosion and sediment control. Most of the 19 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 continuing to improve erosion and sediment control.

Recommendations for Improving Erosion and Sediment Control

- Promote more effective implementation and maintenance of erosion and sediment control measures by contractors, farmers and other land owners.
- Evaluate effectiveness of enforcement of existing sediment control programs. Implement improvements that can be made with existing resources and/or identify additional resource needs.
- Encourage more widespread adoption of erosion and sediment control programs by local governments in rapidly developing areas.
- Promote public education at the state and local level on the impacts of sedimentation and the need for improved sediment control.
- Evaluate existing sedimentation and erosion control rules and statutes for possible strengthening. Consideration should be given to strengthening erosion control requirements. Examples include limiting the area of disturbed land on a given site and reducing the time period for reestablishing vegetation on denuded areas than currently required.
- Evaluate loopholes in interagency efforts to enforce sediment control measures, particularly as they relate to forestry and agricultural activities.

B. NUTRIENTS

The term *nutrients* in the context of this report refers to two major plant nutrients: nitrogen and phosphorus. Common sources of nutrients include fertilizers from agriculture and urban runoff, animal wastes and wastewater treatment plant effluent. High levels of these nutrients in the water can result in excessive algal growth and nuisance conditions in lakes. Two lakes and an unnamed pond in the basin have been identified as being adversely affected by nutrients, primarily by phosphorus.

Recommendations

Lake Junaluska - Lake Junaluska is affected primarily by nonpoint source runoff. A progressive program to implement nonpoint source controls is needed to reduce nutrient loading.

Waterville (Walters) Lake - Waterville Lake receives nutrients from both point and nonpoint sources. Nonpoint sources include runoff from animal operations, cropland and urban areas. Champion International is the major point source discharger upstream from the lake although others may also be contributing nutrients to the lake. It is recommended that a nutrient budget be developed over the next five years and that it be used to develop a lake nutrient management plan.

C. TOXIC SUBSTANCES

Point Source Toxicity Control Strategies

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. Thirty-three dischargers in the basin are required to conduct toxicity testing. 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. Point source-related toxicity impairment problems are being, or have successfully been, addressed on the following water bodies:

Name	Subbasin
Little River	02
Bat Fork Creek	02
Mud Creek	02
Hominy Creek	04
Pigeon River	05
Walters Lake	05

All new and expanding dischargers are required to dechlorinate their effluent if chlorine is used for disinfection.

Nonpoint Source Toxicity Control Strategies

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. Water quality in Richland Creek has been improved as a result of efforts by DEM and Dayco Industries to control industrial stormwater runoff. Pesticides from orchards in the Clear Creek watershed in the upper French Broad have been implicated in the poor biological quality of that creek. Pesticides need to be applied, stored and disposed of properly.

D. MANAGEMENT OF OXYGEN-CONSUMING WASTES FROM DISCHARGE FACILITIES

General Recommended Strategies for Expanding and Proposed Discharges in the French Broad Basin

HQW and ORW Waters throughout basin: Discharges to these waters will receive limits in accordance with the Division's Antidegradation Policy (15A NCAC 2B .0201).

All new and expanding facilities not located on HQW, ORW or zero flow streams: Permit limits for oxygen-demanding wastes (BOD) to be based on empirical models. Emphasis to be placed on addressing interacting discharges and protecting downstream HQW and ORW waters.

Recommended Strategies for Specific Stream Segments

Gash Creek and Mud Creek - Past studies have identified limited assimilative capacity and dissolved oxygen problems in these tributaries to the upper French Broad River. More stringent waste limits for discharges have been required. Many discharges have been eliminated both through rescinding of permits (Gash Creek) and connecting smaller discharges to the Hendersonville WWTP (Mud Creek).

Pigeon River - A level C model of the river resulted in stringent waste limits for Champion International's plant in Canton. The limits were intended to both reduce the impacts on Pigeon River and Walters (Waterville) Lake.

Future Modeling Plans for Assessing Oxygen-demanding Waste Assimilative Capacity in Selected Streams

French Broad River Watershed (other than HQW, ORW, and zero flow streams)

A QUAL2E model will be developed for the French Broad River from Brevard to Asheville. Upon its completion it is to be applied to mainstem discharges from new and expanding facilities. It may be used for reallocation of existing wasteload allocations in the next basin plan. This study will also include evaluation of minimum flow releases from Cascade Lake on Little River, assimilative capacity in Gash Creek and effects of discharges on dissolved oxygen in Hominy Creek and the French Broad River.

Pigeon River Watershed (other than HQW, ORW, and zero flow streams)

For the Pigeon River, a QUAL2E model will be applied to the mainstem from Canton to Walters Lake once long-term improvements to the paper mill effluent are observed.

Recommended Evaluation of Trout Farm General Permit

Water quality sampling below some trout farms has shown moderate to severe impacts. Trout farms are required to meet waste limits established by a general permit. A special study of trout farms is recommended to determine the adequacy of the trout farm general permit.

E. PROTECTION OF HIGH RESOURCE VALUE 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 NPDES permit conditions. Waters eligible for reclassification to HQW or ORW may include those designated 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 waters used for domestic water supply purposes and classified WS I or II. Portions of the following streams and their tributaries have been identified as potential candidates for reclassification to HQW or ORW. Each name is followed by its respective subbasin in parentheses. These streams will be evaluated for reclassification during the next basin schedule.

Potential HQW or ORW Streams

- French Broad River from source to SR 1129 (01)
- Laurel Branch (upstream sampling needed) and Sandymush Creek (02)
- Mills River and North Fork Mills River (03)
- Ivy Creek, Big Laurel Creek and Hickory Creek (04)
- Cold Springs Creek and Upper Jonathan Creek (05)
- Big Rock Creek (06)
- Cane River (07)

F. RUNOFF FROM URBAN STORMWATER AND DEVELOPMENT

Water quality impairment from growth and development is a major concern in the French Broad Basin. DEM has identified 76 miles of streams in the French Broad 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.

HQW, ORW and WS Stormwater Management

The HQW, ORW and WS waters carry with them specific management strategies to protect their uses, including measures to control stormwater runoff from urban development. The HQW and ORW requirements are implemented by DEM through it's 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. Development activities covered by water supply protection requirements must be reviewed and approved by the appropriate local government.

Industrial NPDES Stormwater Management

Throughout the French Broad 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 constructions 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.

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

While there are no municipalities in the basin large enough to be required to have an NPDES stormwater program, local governments in the basin are strongly encouraged to evaluate the impacts of stormwater runoff from their jurisdictions and to consider developing stormwater management programs. 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, and are strongly encourage to, develop their own ideas and activities for controlling sources of pollution.
- Reviewing local ordinances pertaining to parking, curb and gutter and open space requirements. Many of these local ordinances could be modified to enhance water quality protection from urban stormwater impacts.

G. USE OF THE FRENCH BROAD RIVER FOR WATER SUPPLY PURPOSES BY ASHEVILLE AND BUNCOMBE COUNTY

A section of the French Broad River upstream from the City of Asheville has been classified for use as a water supply by the North Carolina Environmental Management Commission. This area is classified as WS-IV. Assessment of water quality data collected by the NC Division of Environmental Management had found the quality of the water to be

suitable for water supply purposes; however, the quality of the water for water supply use has been the subject of debate within the community. Those that question the quality of the water have expressed concerns over the presence of toxic substances and pathogens from both point and nonpoint sources of pollution.

After failure of a bond referendum to construct a water supply intake and treatment plant on the French Broad River just upstream of Asheville, the Asheville-Buncombe Water Authority (Authority) decided to seek alternative water supply sources. Consequently, the Authority, along with Henderson County, has requested that the Environmental Management Commission reclassify sections of two watersheds further upstream for drinking water supply purposes. Two water supply intakes are proposed, one on the French Broad River upstream of the confluence of the Mills River and the second in the Mills River downstream of the City of Hendersonville's water supply intake. The Authority and County have requested that the French Broad River section be reclassified as WS-IV and the Mills River be reclassified as WS-II.

The Division of Environmental Management Asheville Regional Office staff is conducting water quality sampling in order to assess the suitability of these two water bodies as drinking water supply sources. If these sources are suitable as raw water supplies then the Environmental Management Commission can proceed to rule-making to solicit comment on the proposed water supply reclassifications.

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.

Use-support data compiled by DEM indicate that there are 74 miles of streams impaired by fecal coliform bacteria, although the actual number of miles is probably significantly higher. One of the reasons is that fecal coliform measurements are taken only at the 29 ambient monitoring sites in the basin, so there are potentially many hundreds of miles of stream miles (especially smaller tributaries) that are not monitored for fecal coliforms that may be impacted. Fecal coliform levels were found to exceed the 200/100 ml state standard at least least 20% of the time over the past five years at 12 of the 29 ambient monitoring stations in the basin.

Several recommendations for addressing fecal coliform contamination are presented below.

- Proper maintenance by homeowners of onsite waste disposal systems (such as septic tanks)
- Proper maintenance and repair of sanitary sewer lines by WWTP authorities.
- Elimination of direct unpermitted discharges of domestic sewage wastes (also known as "straight pipes") from homes.
- Proper management of livestock to keep wastes from reaching surface waters.
- Encouragement of local health departments to routinely monitor waters known to be used for body contact recreation (e.g., swimming and tubing). DEM has classified 177 miles of streams for primary water contact.

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CHAPTER 1
INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The purpose this Basinwide Water Quality Management 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.

This 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 the use and understanding of the document. It is one of 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 over the next five years 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.

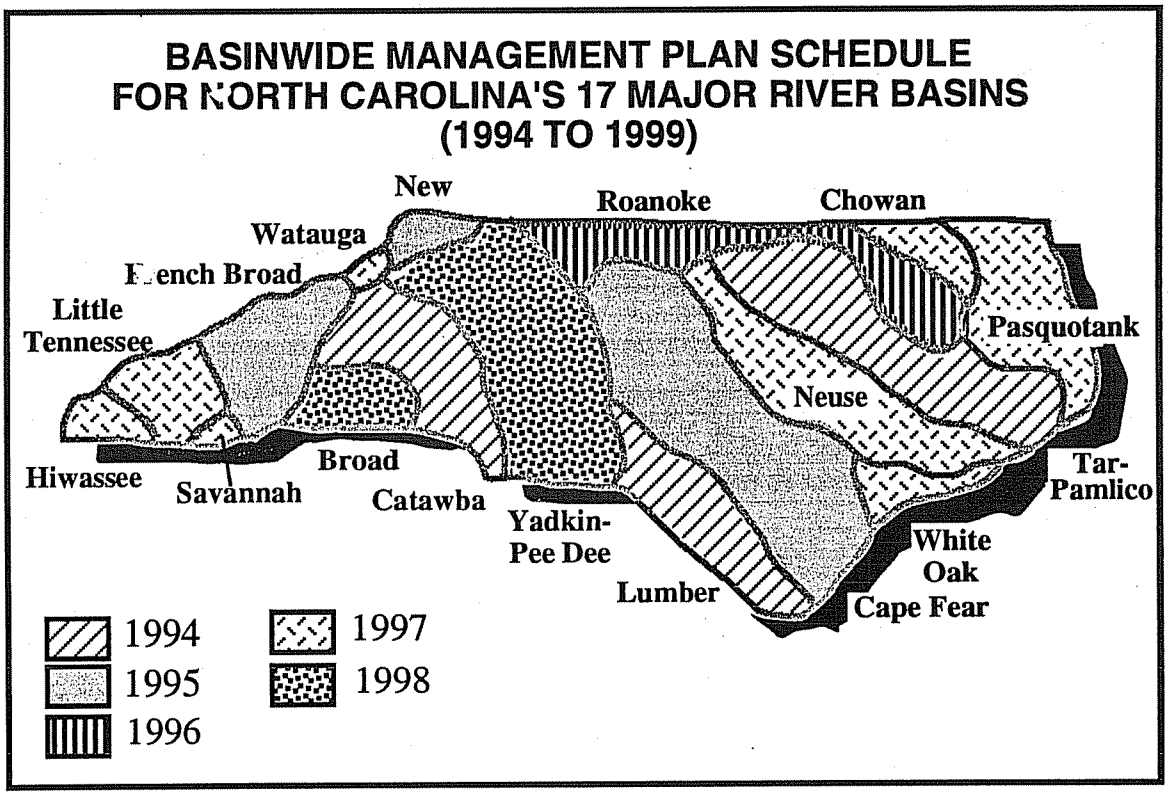


Figure 1.1 Basinwide Management Plan Schedule (1994 to 1999)

1.2 GUIDE TO USE OF THIS DOCUMENT

CHAPTER 1: Introduction - This chapter 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 - This chapter provides a general description of the basin. Some of the specific topics covered include:

- an overview of the major features such as location, rainfall, population, physiography, etc.
- hydrology of the basin and its eight subbasins
- a summary of land cover within the basin based on results of a 1982 and 1992 Nationwide Resources Inventory (NRI) conducted by the US Department of Agriculture Soil Conservation Service.
- population growth trends and densities by subbasin using 1970, '80 and '90 census data.
- major water uses in the basin and DEM's program of water quality classifications and standards.

CHAPTER 3: Causes and Sources of Water Pollution in the Basin - Chapter 3 discusses the causes and probable sources of surface water degradation in the 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 generally discusses water quality problem areas.

CHAPTER 4: Water Quality Status in the 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 basin. The chapter describes the various types of water quality monitoring conducted by DEM, summarizes water quality in each of the eight subbasins in the basin and presents a summary of use support ratings for those surface waters that have been monitored or evaluated.

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 basin. This includes generalized wasteload allocations for dischargers (for nutrients and biochemical oxygen demand (BOD)) and recommended programs and best management practices for controlling nonpoint sources.

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 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, and planning.

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 1998).

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	Hiwassee	12/97	5/97
French Broad	**8/95**	**4/95**			
New	11/95	6/95	Chowan	1/98	8/97
			Pasquotank	1/98	8/97
Cape Fear	1/96	8/95	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.

Plans to be updated every five years - The earliest basin plans will likely 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 four phases described below.

Year **Activity**

1 to 3 Water Quality Data Collection/Identification of Goals and Issues:
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: 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.

4 Preparation of Draft Basinwide Plan: 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: 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.

Basinwide NPDES permitting in the French Broad River basin will occur during time intervals between August, 1995 and December, 1996 (Table 1.2). Permits in subbasins 01, 02, and 03 will be issued from August through November of 1995. Permits in subbasins 04, 05, 06, and 07 will be issued from October 1996 through December 1996.

Table 1.2 Subbasin NPDES Permit Schedule for French Broad Basin

Subbasin No.	Month/Year	Subbasin No.	Month/Year
04-03-01	August, 1995	**04-03-05**	November, 1996
04-03-02	September, 1995	**04-03-06**	December, 1996
04-03-03	November, 1995	**04-03-07**	December, 1996
04-03-04	October, 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 1.2). 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.

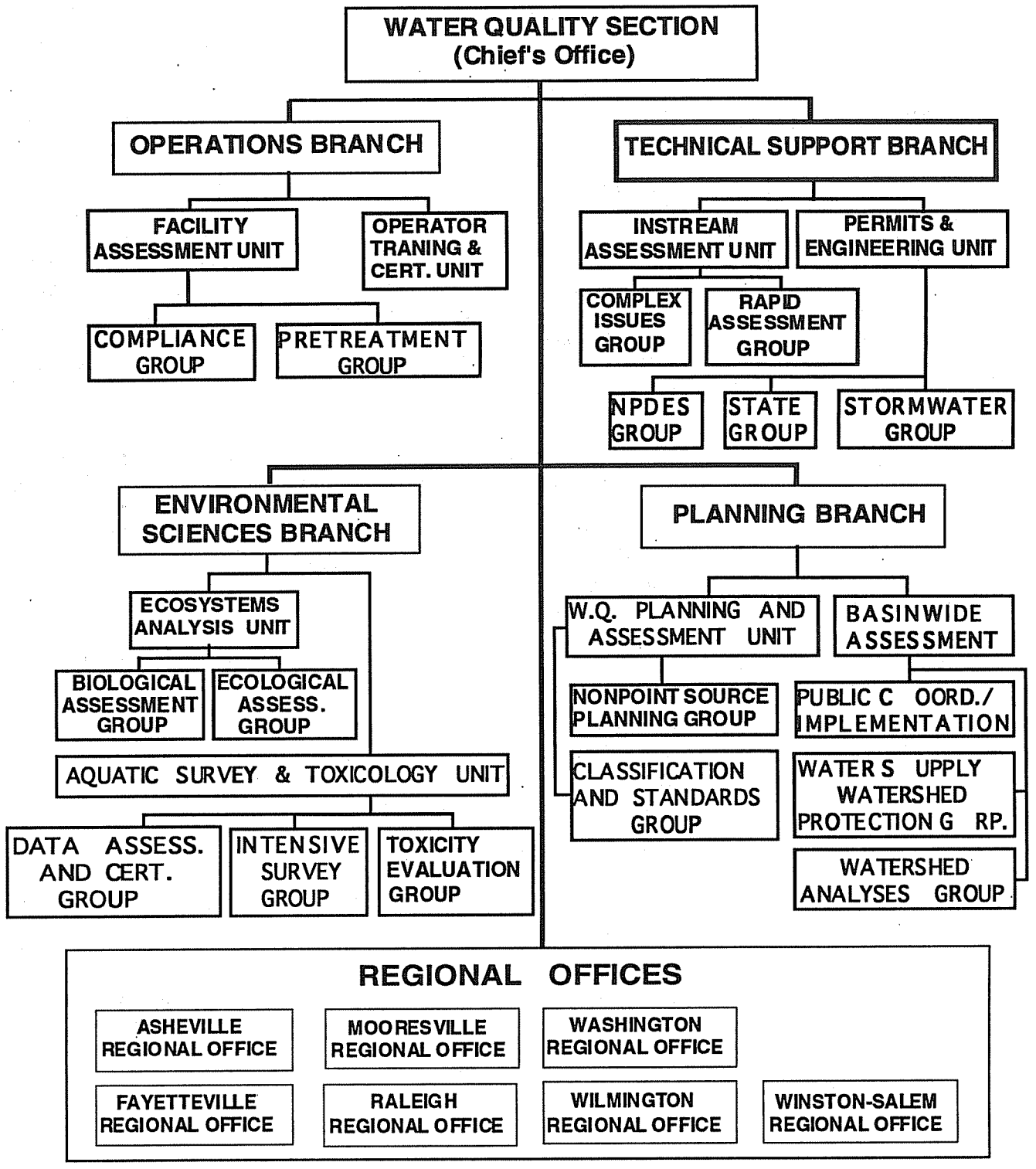


Figure 1.2 Organizational Structure of the DEM Water Quality Section

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. The major federal authorities (Section 1.5.1) for the state's water quality program are found in sections of the Clean Water Act (CWA). State authorities listed in Section 1.5.2 are from state statutes.

1.5.1 Federal Authorities for NC's Water Quality Program

- **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.

1.5.2 State Authorities for NC's Water Quality Program

- **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

Clayton, 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 FRENCH BROAD RIVER BASIN OVERVIEW

The French Broad River Basin is the ninth largest river basin in the state covering 2,842 square miles. It is located entirely within the Southern Appalachian Mountains region of western North Carolina (Figure 2.1), west of the Eastern Continental Divide. All waters from the French Broad basin drain to the Gulf of Mexico via the Tennessee, Ohio and Mississippi Rivers. The basin includes the highest point in the United States east of the Mississippi River located atop Mount Mitchell (elevation 6,684 feet above mean sea level (MSL)). The lowest elevation in the basin is 1254 feet MSL where the French Broad River flows into Tennessee.

The French Broad Basin in North Carolina is composed of three separate drainages which flow northwest into Tennessee and do not join until they reach of the headwaters of Douglas Reservoir (a large multi-use impoundment managed by the Tennessee Valley Authority) (Figure 2.2). These include the Pigeon River, French Broad River and the Nolichucky River watersheds. The Nolichucky includes the North and South Toe Rivers and Cane River. There are 4,113 miles of freshwater streams in the basin.

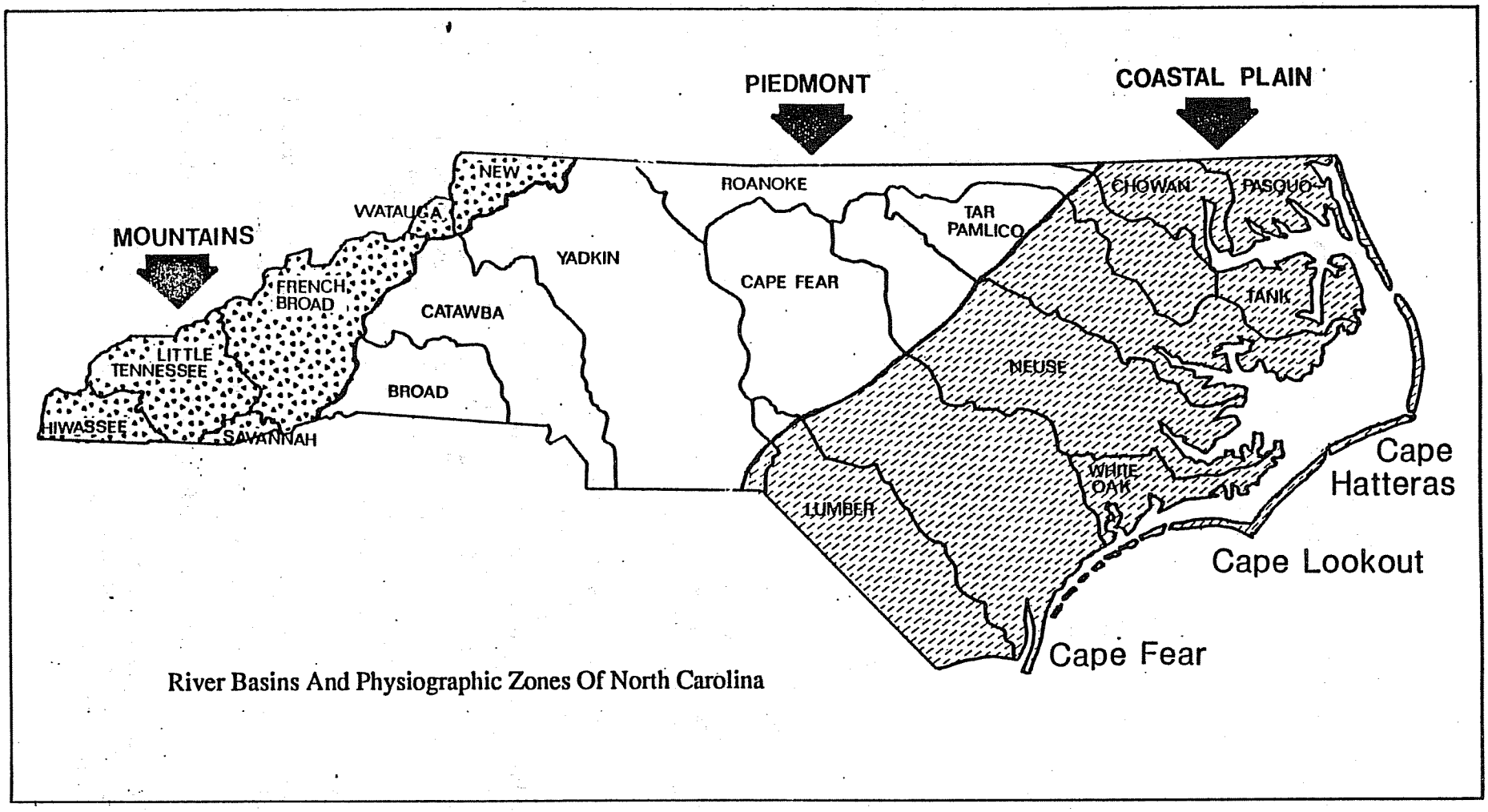
There are 9 counties and 24 municipalities located in whole or in part in the basin (Figure 2.3). The population of the basin, based on 1990 census data, was estimated to be 358,000. Municipalities with a population of 5,000 or more in the basin include Asheville, Black Mountain, Brevard, Hendersonville and Waynesville. The overall population density of the basin is 93 persons per square mile versus a statewide average of 123 persons per square mile. The percent population growth over the past ten years (1980 to 1990) was 8.7 % versus a statewide percentage increase of 12.7%.

Over half of the land in the basin is forested with much of it located within the 1.2 million-acre Pisgah National Forest. Steep slopes limit the land area suitable for development and crop production. Slopes of less than 12% are desirable for development purposes and, in the absence of public sewer lines, soil depth of three feet or more over bedrock is desirable in order to allow construction of onsite septic systems. It is estimated that just 18% of lands in North Carolina's mountains meet these requirements (Clay et. al., 1975). Most agricultural and development activities are therefore concentrated in river valleys. Statistics provided the US Department of Agriculture, Soil Conservation Service (USDA-SCS, 1994) indicate that cultivated cropland is shrinking as developed lands are increasing. Major industries in the basin include silviculture, agriculture (dairy, livestock, apples, Christmas trees), mining (feldspar, quartz, mica, gem stones and others) and tourism.

Water quality is generally high throughout the basin. Trout waters are abundant and many waters have been reclassified as High Quality or Outstanding Resource Waters. Impacts to water quality associated with land use activities or discharges are discussed in Chapter 3.

2.2 BASIN HYDROLOGY AND THE THREE MAJOR WATERSHEDS

The three major watersheds in the basin, the French Broad, Pigeon and Nolichucky Rivers, correspond with *8-digit hydrologic units* under a tiered watershed classification system devised by the U.S. Water Resources Council and U.S. Geological Survey (USGS) (Figure 2.2). In addition,



River Basins And Physiographic Zones Of North Carolina

Figure 2.1 **Physiographic Regions and Major River Basins in North Carolina**

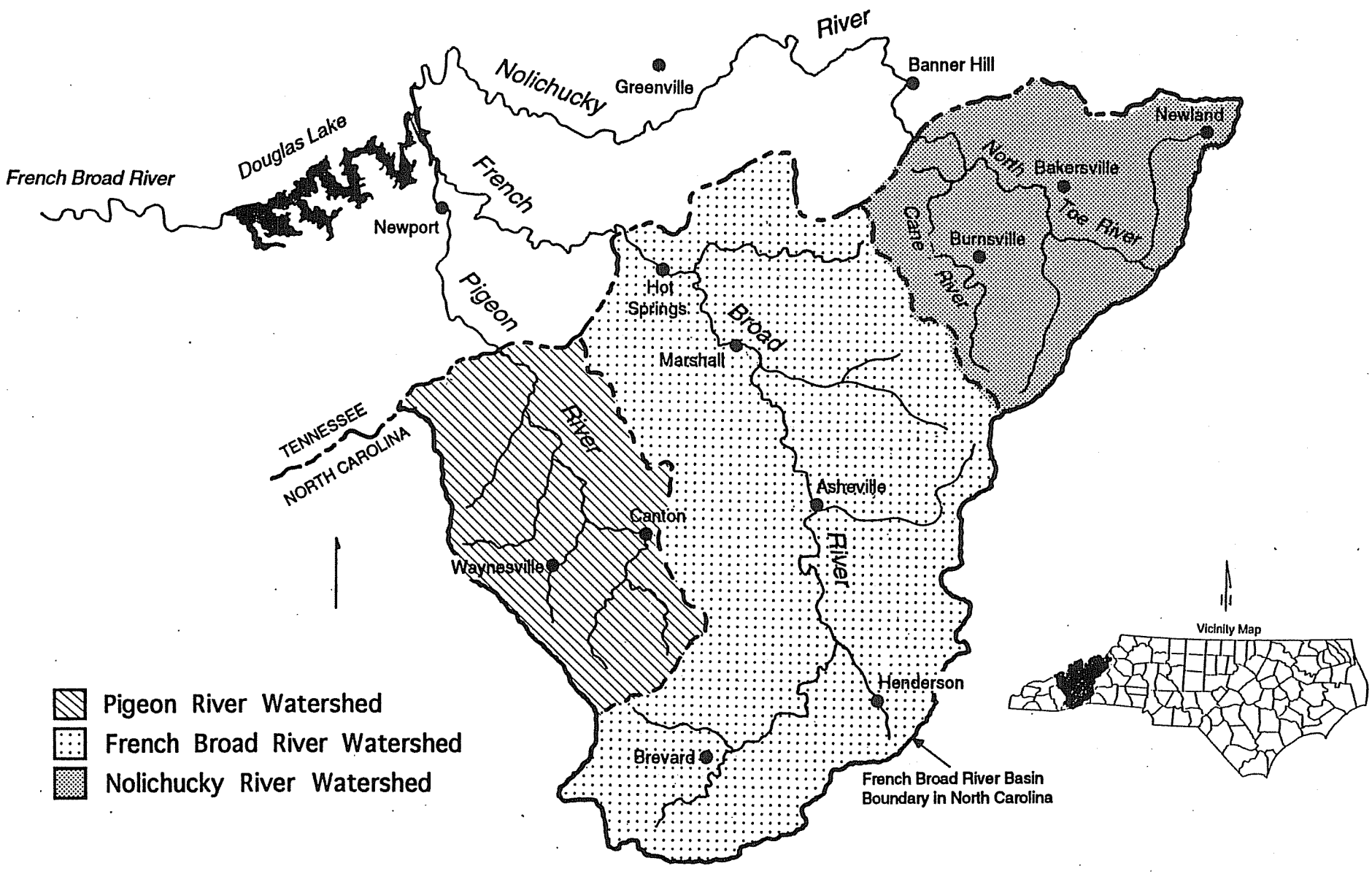


Figure 2.2 Three Major Watersheds of the French Broad River Basin

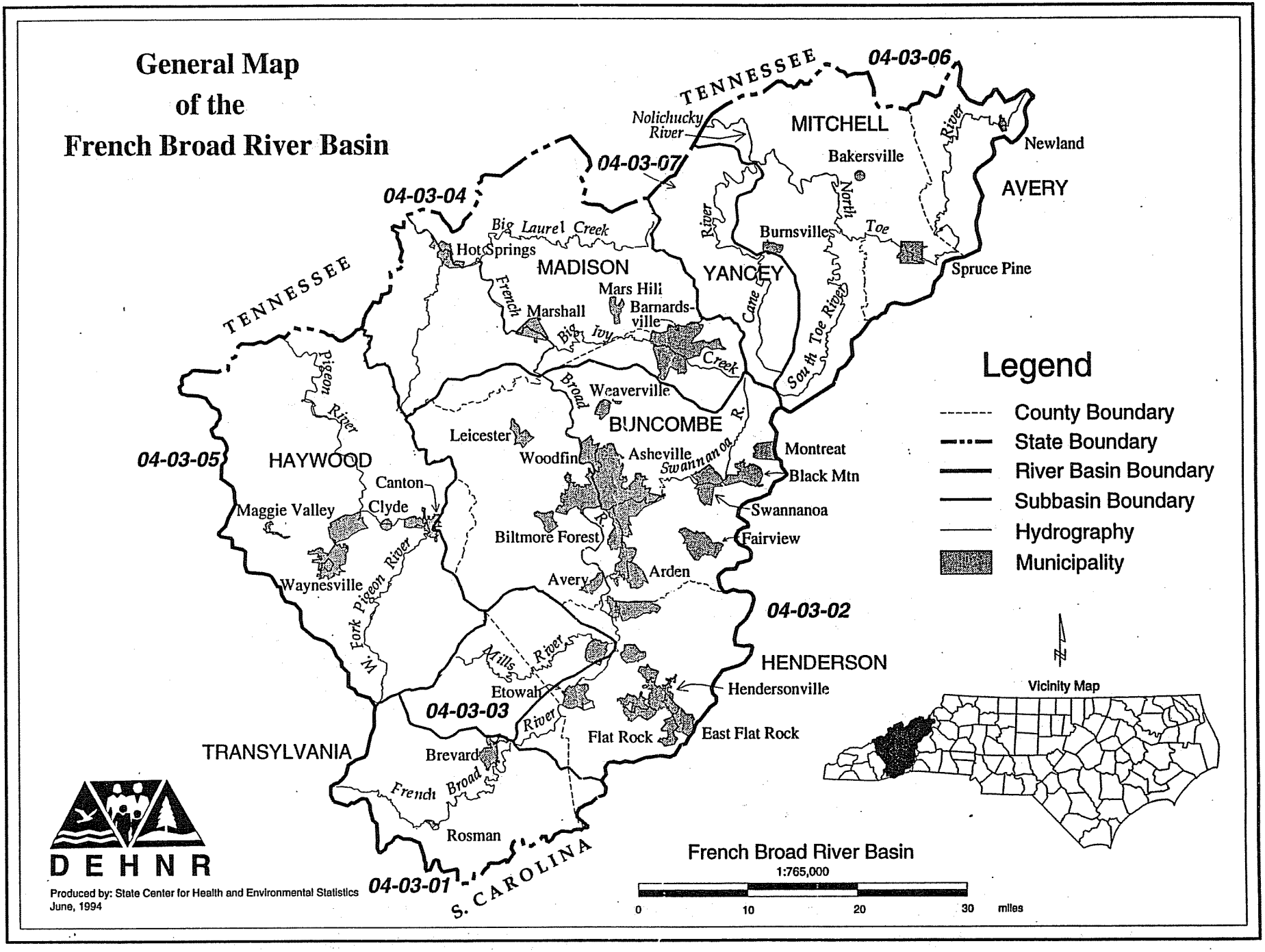


Figure 2.3 General Map of the French Broad River Basin

several of these watersheds are further subdivided for management purposes by DEM into subbasins denoted by 6-digit numbers (04-03-01 through 04-03-07) as shown in Figure 2.3, above, and presented in Table 2.1. Throughout the document, these subbasins are referred to by their last two digits (e.g. subbasin 04-03-01 would be called subbasin 01). The French Broad River watershed has four subbasins, the Pigeon River watershed has one and the Nolichucky watershed has two. There are a total of seven subbasins in the French Broad basin. Each of these three watersheds is discussed in more detail in sections 2.2.1 through 2.2.3, below.

Table 2.1 Hydrologic Divisions in the French Broad River Basin

Watershed Name and Major Tribs	USGS 8-digit Hydrologic Units (Figure 2.2)	DEM Subbasin 6-digit codes (Figure 2.3)
French Broad River and Major Tribs	**06010105**	**04-03-01 to 04**
Upper mainstem and headwater streams		
North, West and East Forks	"	01
Little River	"	01
Middle Mainstem and tribs	"	02
Mud Creek, Cane Creek, Swannanoa River, Hominy Creek, Sandymush Cr	"	02
Mills and Davidson River	"	03
Lower Mainstem and tribs	"	04
Big Ivy Creek (River), Big Laurel Creek and Spring Creek	"	04
Pigeon River and Major Tributaries	**06010106**	**04-03-05**
East and West Forks	"	05
Jonathon, Richland, Cataloochee and Big Creeks	"	05
Nolichucky River and Tributaries	**06010108**	**04-03-06 and 07**
Nolichucky Mainstem	"	06
North and South Toe Rivers		06
Big Rock Creek		06
Cane River	"	07

There are seven publically accessible impoundments (all manmade) in the basin which have been monitored by the NC Division of Environmental Management. Four are located in the French Broad watershed. Lake Julian (320 acres) is a cooling water lake owned by the Carolina Power and Light Company. Burnett Reservoir (330 acres) and Beetree Reservoir (55 acres) are water supply reservoirs for the City of Asheville. Busbee Reservoir (8 acres) is a small reservoir serving the Biltmore Estate. The other three impoundments are located in the Pigeon River watershed and include Waterville Lake (Walters Lake, 340 acres), Lake Junaluska (200 acres) and Allen Creek Reservoir (120 acres), a water supply for the City of Waynesville.

Despite its ranking as the ninth largest of the 17 river basins in the state, the French Broad basin has the third highest number of freshwater stream miles with 4,113. With a total land area of 2,842 square miles, the average drainage area per stream mile is 0.7 square mile. By comparison, the Cape Fear basin, with a total land area of 9,149 and 6,282 stream miles has an average drainage area of 1.5 square miles per stream mile.

2.3 LOCAL GOVERNMENT AND PLANNING JURISDICATIONS WITHIN THE BASIN

The basin encompasses all or part of the following 9 counties and 24 municipalities presented in Table 2.2. Also included in the table are abbreviations for the Lead Regional Organizations (Councils of Government) and Districts of the North Carolina League of Municipalities.

Table 2.2 Local Governments and Local Planning Units within the French Broad Basin

County	% of county in basin	Region	League District	Municipality	Watershed
Avery	(40%)	D	X	Newland Sugar Mountain	Nolichucky
Buncombe	(90%)	B	VII	Asheville Biltmore Forest Black Mountain Montreat Weaverville Woodfin	French Broad
Haywood	(100%)	A	XII	Canton Clyde Hazelwood Maggie Valley Waynesville	Pigeon
Henderson	(80%)	B	XII	Fletcher Hendersonville Laurel Park	French Broad
Madison	(100%)	B	XII	Hot Springs Mars Hill Marshall	French Broad
McDowell	(<1%)	C	XI	(none)	French Broad
Mitchell	(100%)	D	XII	Bakersville Spruce Pine	Nolichucky
Transylvannia	(70%)	B	XII	Brevard Rosman	French Broad
Yancey	(100%)	D	XII	Burnsville	Nolichucky

Lead Regional Organizations:

Region	Name	Location
A	Southwestern NC Planning and Economic Development Commission	Bryson City
B	Land-of-Sky Regional Council	Asheville
C	Isothermal Planning and Development Commission	Rutherfordton
D	Region D Council of Governments	Boone

2.4 LAND COVER, POPULATION AND GROWTH TRENDS

2.4.1 General Land Cover

Land cover information in this section is derived from the US Department of Agriculture (USDA), Soil Conservation Service's (SCS) National Resources Inventory (NRI) of 1992 and 1982 (USDA, 1994). The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. According to the SCS 1992 NRI Instructions booklet, the 1982 NRI was the most comprehensive study of our nation's natural resources ever conducted. It is considered accurate to the 8-digit hydrologic unit scale established by the US Geological Survey (SCS, 1993). A 1992 update of this data was recently released. In addition, 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 cover information based on recent satellite imagary. However, until these other land coverages become available, the 1992 NRI data is the most recent comprehensive data for the basin as a whole.

Table 2.3 summarizes acreages and percentage of land cover from the 1992 NRI for the basin as a whole and for three major watershed areas within the basin. Land cover types identified by the NRI as occurring in the French Broad River Basin include cultivated cropland, uncultivated

Table 2.3 Land Cover in the French Broad River Basin by Major Watersheds (8-Digit USGS Hydrologic Units) (Source: USDA, Soil Conservation Service - 1982 and 1992 NRI)

	French Broad 06010105		**Pigeon 06010106**		**Nolichucky 06010108**		TOTAL		% change
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	ACRES (1000s)	% of TOTAL	since 1982
Cult. Crop	45.6	4.4	0.0	0.0	0.0	0.0	45.6	2.5	-17
Uncult. Crop	12.1	1.2	3.8	1.1	4.5	1.1	20.4	1.1	-45
Pasture	163.0	15.6	38.6	11.4	36.2	8.5	237.8	13.1	-6
Forest	500.9	47.8	125.1	37.0	270.2	63.7	896.2	49.5	-3
Urban&built-up	129.2	12.3	27.5	8.1	25.0	5.9	181.7	10.0	+42
Other	196.3	18.7	143.4	42.4	88.1	20.8	427.8	23.6	+5
Totals	1047.1	100.0	338.4	100.0	424.0	100.0	1809.5	100.0	
% of Total Basin		57.9		18.7		23.4		100.0	
DEM Subbasins	01 to 04		05		06 and 07		01 to 07		

Note: The 95% confidence level for those categories with less than 30,000 acres ranges from approximately ± 50% to greater than 100% for noncultivated cropland in the Pigeon and Nolichucky watersheds. Therefore, total acres and comparisons with 1982 totals represent very rough approximations.

cropland, pastureland, forest land, urban - large and small built-up lands, rural transportation, small water areas and census waters (Table 2.4).

Land cover in the basin, as presented in Table 2.3, is dominated by forest land which covers approximately 50% of the land area. Agriculture (including cultivated and uncultivated cropland and pastureland) covers approximately 17%. The developed category has 10% of the land area. The remaining 24% of land cover is in the other category. Comparisons of land cover types

between 1982 and 1992 show a decrease in the cropland categories and a substantial increase in the urban and built-up category.

Table 2.4 Description of Land Cover Types (1992 NRI - USDA SCS)

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	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). Includes the following three categories 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. Minor Land: Lands not in one of the other categories.

2.4.2 Population and Growth Trends in the Basin

The French Broad River basin has an estimated population of 358,000 based on 1990 census data. Table 2.5 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. There are well-defined patterns of population density along the Interstate 40 corridor from Black Mountain to Waynesville and along Interstate 26 from Hendersonville to Asheville. Most of the population is located in subbasin 02 in and around Asheville and Hendersonville as depicted in the population density map (Figure 2.4). This one subbasin contains approximately 65% of the total basin population and has population density of 290 persons/square mile versus a basin average of 93 persons/square mile. Other population centers outside of these corridors include Brevard, Mars Hill, Burnsville, Spruce Pine and Newland. The percentage increase in population for the entire basin was 24% from 1970 to 1990 and was 8.5% 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 increases, by subbasin, are presented in Figure 2.5.

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.

Table 2.5 French Broad River 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)
03-04-01	14,269	16,111	17,853	66	75	83	137,498	215	1	214
03-04-02	182,108	209,252	232,903	227	261	290	515,494	806	5	801
03-04-03	4,576	7,279	7,530	32	51	53	90,317	141	0	141
03-04-04	19,092	20,205	20,660	38	40	41	317,139	496	2	494
03-04-05	38,670	42,322	43,746	72	79	82	340,710	532	1	531
03-04-06	25,862	29,858	29,806	55	64	64	298,054	466	1	465
03-04-07	4,637	4,878	5,434	30	31	35	98,265	153	0	153
TOTALS	289,214	329,905	357,932	74	86	93	1,797,478	2,809	10	2,799

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

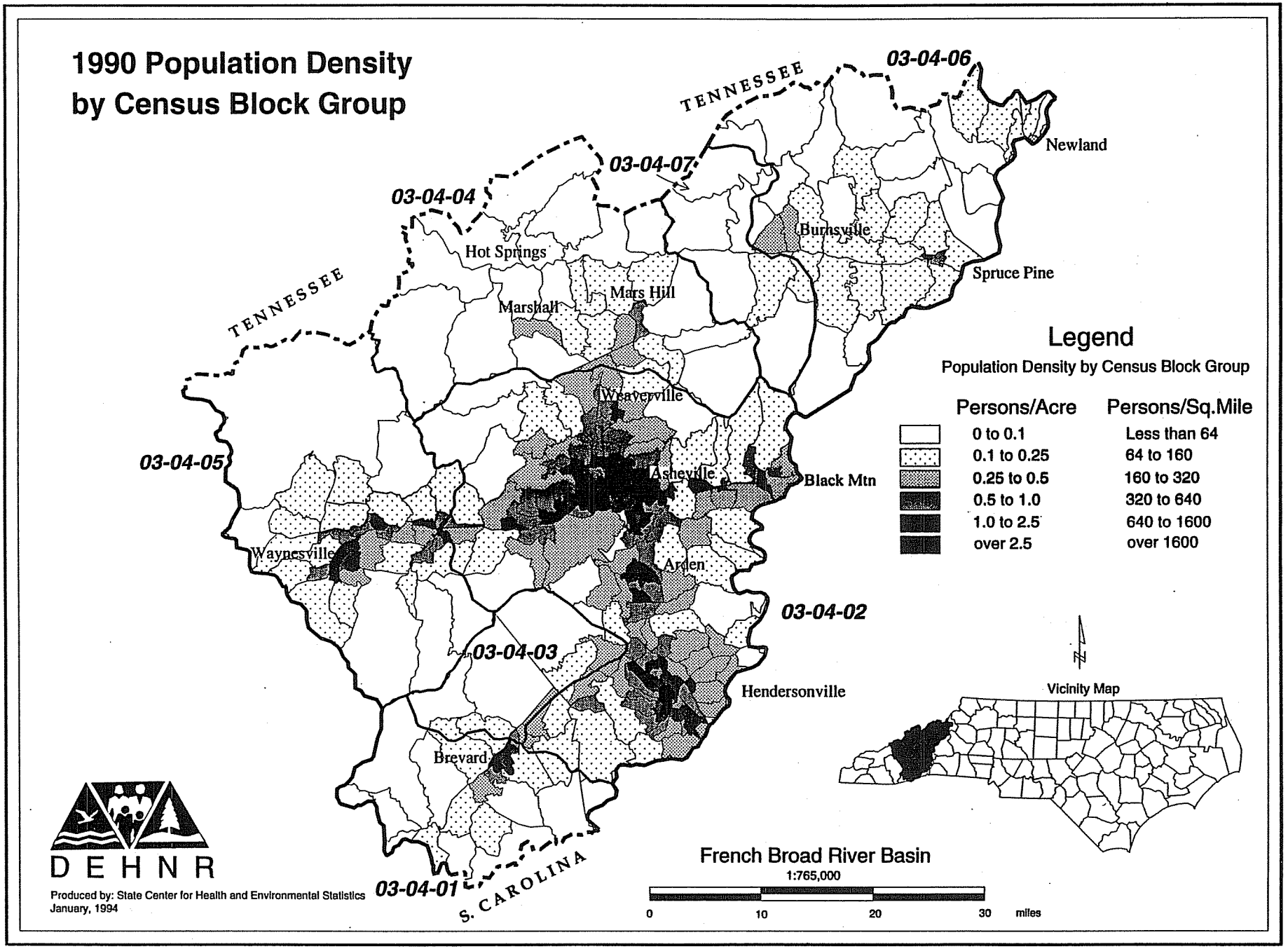


Figure 2.4 1990 Population Density by Census Block Group

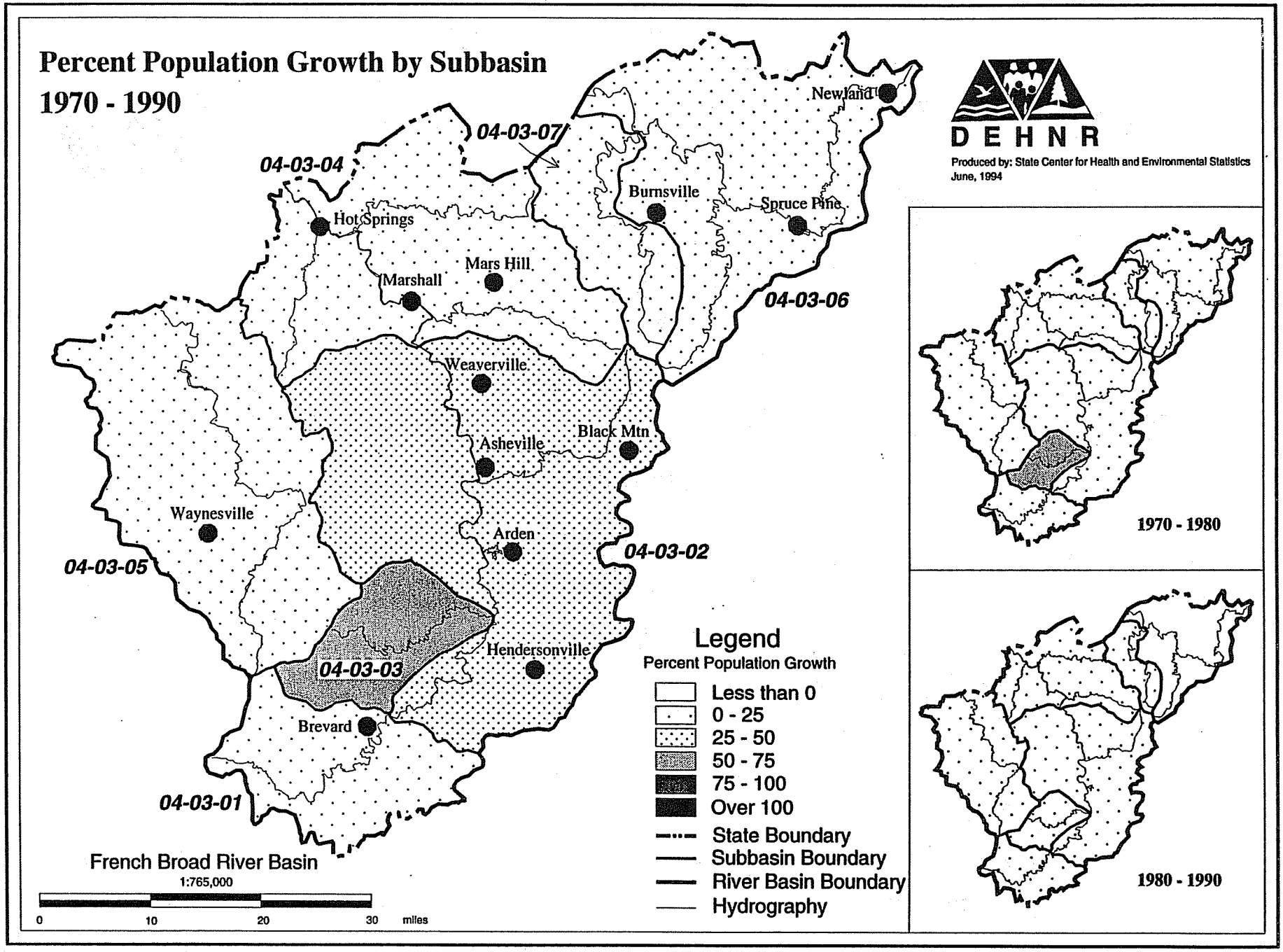


Figure 2.5 Population Growth Increases by Subbasin (1970 to 1990)

2.5 REGISTERED ANIMAL OPERATIONS

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for managing and reusing animal wastes from intensive livestock operations (See section 5.3.1 for additional information on rule requirements). 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 (chickens and turkeys) with a liquid waste system. The deadline for submittal of registrations to DEM for existing facilities was December 31, 1993. Table 2.6 summarizes the number of registered livestock operations and animals, by type and subbasin, for those registrations received for the basin through May 1994. Subbasins 05 (cattle) and 02 (dairy) have the largest concentrations of registered animal operations. It should be noted that there are no poultry operations listed because the registration requirement applies only to liquid wastewater systems. Most poultry operations use dry litter systems which do not require registration.

Table 2.6 Registered Animal Operations in the French Broad River Basin

TYPE OF OPERATION	SUBBASINS							TOTALS
	01	02	03	04	05	06	07	
CATTLE								
Operations	2	3	1	8	37	0	0	51
Animals	220	260	30	650	5,521	0	0	6,681
DAIRY								
Operations	0	27		1	12	0	0	40
Animals	0	6,934		245	3,118	0	0	10,297
SWINE								
Operations	0	0	1	0	0	0	0	1
Animals	0	0	200	0	0	0	0	200
TOTALS								
Operations	2	30	2	9	49	0	0	92
Animals	220	7,194	230	895	8,639	0	0	17,178

2.6 SURFACE WATER CLASSIFICATIONS AND WATER QUALITY STANDARDS

2.6.1 Program Overview

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.

2.6.2 Statewide Classifications and Water Quality Standards

All surface waters in the state are assigned a primary water classification, and they may also be assigned one or more supplemental classifications (Table 2.7). As noted above, classifications are assigned to protect uses of the waters such as swimming, aquatic life propagation or water supplies. For each classification, there is a set of water quality standards that must be met in order to protect the uses. Appendix I provides a more detailed summary of the state's primary and supplemental classifications including, for each classification, the best usage, water quality standards, stormwater controls and other protection 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.

Table 2.7 Freshwater Primary and Supplemental Classifications Applicable to the French Broad River Basin

PRIMARY FRESHWATER CLASSIFICATIONS

Class	Best Uses
C	Aquatic life propagation/protection and secondary recreation
B	Primary recreation and class C uses
WS	Water Supply watershed and class C uses. There are five WS classes, I through V. WS classifications are assigned to watersheds based on land use characteristics of the area. Each water supply classification has a set of management strategies to protect the surface water supply. A CA , or Critical Area, designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located.

SUPPLEMENTAL FRESHWATER CLASSIFICATIONS

Class	Best Uses
Tr	Trout Waters: modifies standards to protect trout propagation and survival
HQW	High Quality Waters: waters possessing special qualities including excellent water quality, Native or Special Native Trout Waters, Critical Habitat areas, or WS-I and WS-II water supplies
ORW	Outstanding Resource Waters: unique and special surface waters which are unimpacted by pollution and have some outstanding resource values.

Some of the classifications, particularly for HQW, ORW and WS 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.

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 wastewater facilities and for existing 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 of existing discharges are permitted, and stormwater controls for most development needing an Erosion and Sedimentation Control Plan are required.

The requirements for WS waters vary significantly from WS-I to WS-V. The WS-I classification carries the most stringest requirements for dischargers and surrounding land use activities while WS-V carries the least.

2.6.3 Surface Water Classifications in the French Broad Basin

The French Broad Basin has examples of all of the primary and supplemental classifications presented above. Mileages of streams by classification are presented in Table 2.8. The table also includes the acreages of watershed areas associated with the water supply, HQW and ORW classifications.

Table 2.8 Water Quality Classification Statistics for the French Broad River Basin

PRIMARY CLASSIFICATIONS

Class	C	B	WS-I	WS-II	WS-III	WS-IV	WS-V
Miles	3,458	177	112	351	411	251	40
% of Miles	72	4	2	7	9	5	1
Acres	NA	NA	45,367	144,407	167,541	67,766	NA
% of Acres	NA	NA	3	8	9	4	NA

SUPPLEMENTAL CLASSIFICATIONS

Class	Tr	ORW	HQW*
Miles	2,499	285	312
% of Miles	52	6	7
Acres	NA	99,374	116,194
% of Acres	NA	6	6

* Calculations for HQW miles and acres do not include waters that are classified as WS-I and WS- II, although these waters are HQW by definition.

A complete listing of classifications for all surface waters in the basin can be found in a DEM publication entitled "Classifications and Water Quality Standards Assigned to the Waters of the French Broad River Basin". Figure 2.6 shows the locations of water supply watersheds, HQWs and ORWs throughout the entire basin. Figure 2.7, 2.8 and 2.9 depicts the location and major water body names of the WS, HQW and ORW waters in each of the three major watersheds.

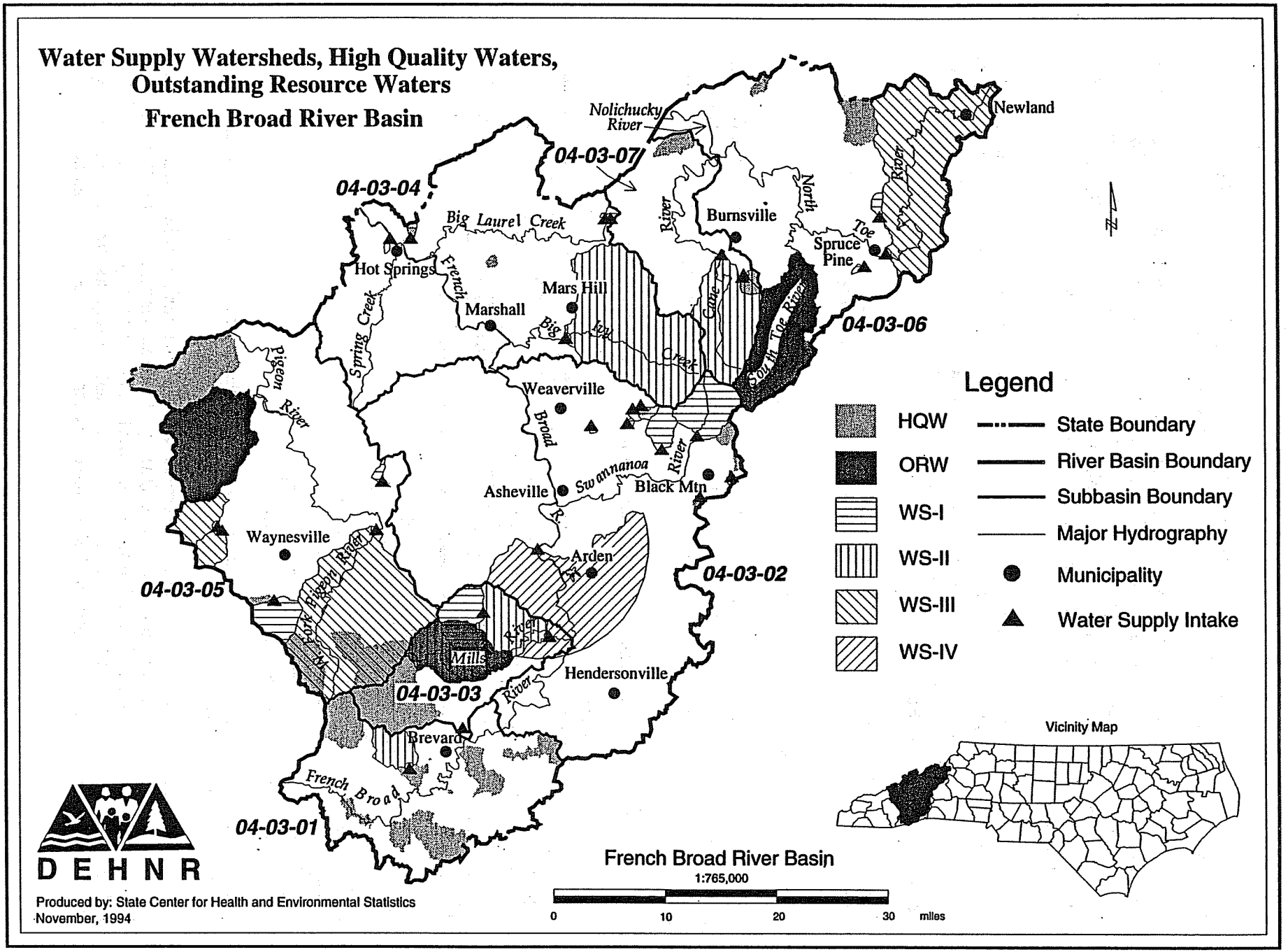


Figure 2.6 Water Supply Watersheds, High Quality Waters (HQW) and Outstanding Resource Waters (ORW) in the French Broad River Basin

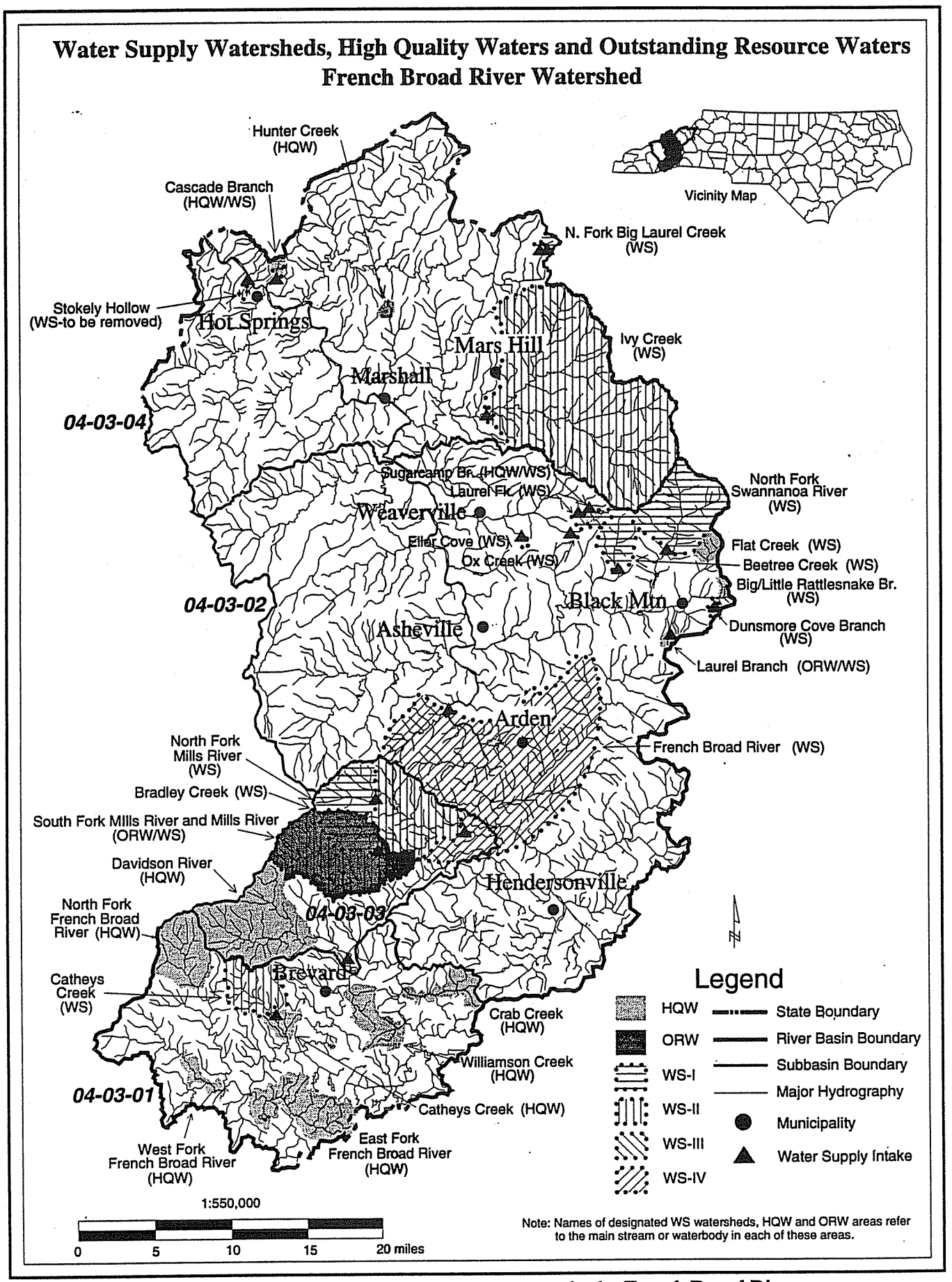


Figure 2.7 Water Supply Watersheds and HQW/ORW Waters in the French Broad River Watershed

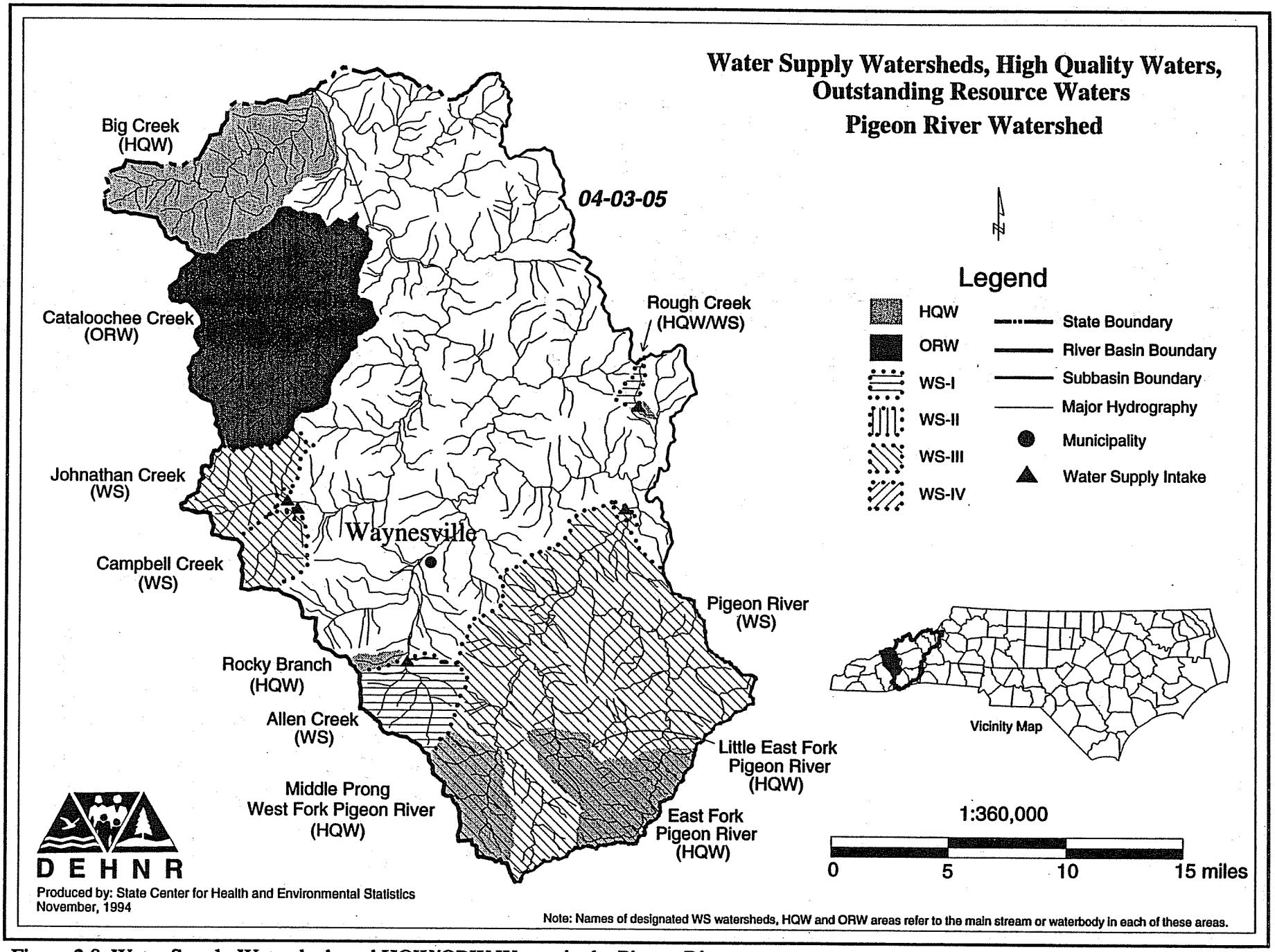


Figure 2.8 Water Supply Watersheds and HQW/ORW Waters in the Pigeon River Watershed

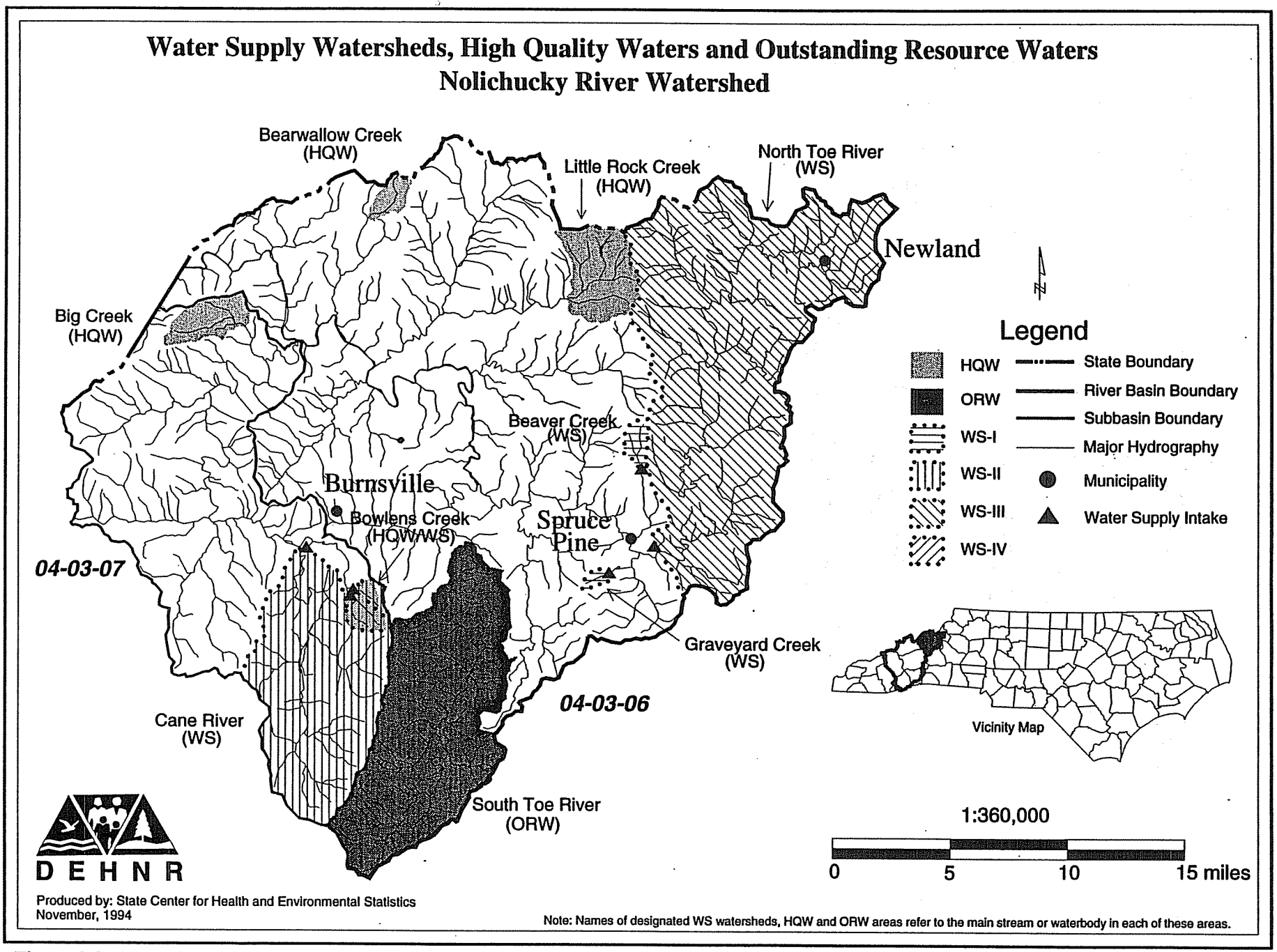


Figure 2.9 Water Supply Watersheds and HQW/ORW Waters in the Nolichucky River Watershed

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CHAPTER 3

CAUSES AND SOURCES OF WATER POLLUTION

3.1 INTRODUCTION

Water pollution is caused by a number of substances including oxygen-consuming wastes, nutrients, sediment, bacteria, , 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 French Broad River basin. **Sections 3.3** and **3.4** describe point and nonpoint source pollution in the basin.

3.2 CAUSES OF POLLUTION

3.2.1 Oxygen-Consuming Wastes

Oxygen-consuming wastes are substances such as decomposing organic matter or chemicals which reduce dissolved oxygen in the water column through chemical reactions or biological activity. 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. The concentration of dissolved oxygen (DO) in a water body is one indicator of the general health of an aquatic ecosystem. 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 (daily average with instantaneous readings not to fall below 4.0 mg/l) to protect the majority of its surface waters. An exception to this standard in the French Broad River Basin exists for waters supplementally classified as *trout waters*. Trout waters have a dissolved oxygen standard of 6.0 mg/l due to the higher sensitivity of trout to low dissolved oxygen levels.

Dissolved oxygen concentrations are affected by a number of factors. Higher dissolved oxygen is produced by turbulent actions which mix air and water such as waves, rapids and water falls. In addition, lower water temperature generally allows for retention of higher dissolved oxygen concentrations. Therefore, the cool swift-flowing streams of the mountains are generally high in dissolved oxygen. Low dissolved oxygen levels tend to occur more often in warm, slow-moving waters that receive a high input of effluent from wastewater treatment plants during low flow conditions. In general, the lowest dissolved oxygen concentrations usually occur during the warmest summer months and particularly during low flow periods. Water depth is also a factor. In deep slow moving waters, such as reservoirs or estuaries, dissolved oxygen 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.

Causes of dissolved oxygen depletion include 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 dissolved oxygen 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 dissolved oxygen.

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 often be identified by a marked reduction in instream dissolved oxygen concentrations and is commonly referred to as the *sag zone*. Frequently, dissolved oxygen 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.

Biochemical oxygen demand, or BOD, is a technical term that describes the overall demand on dissolved oxygen from the various oxygen-depleting processes presented above. 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 dissolved oxygen standards in the receiving waters.

Oxygen-Consuming Wastes in the French Broad River Basin

The total daily loading of biochemical oxygen demanding wastes (BOD) from NPDES (National Pollutant Discharge Elimination System) municipal and industrial dischargers in the French Broad Basin in 1993 is estimated to be approximately 65% less than it was 20 years ago despite just a 7% decrease in the total volume of treated wastewater. As shown in Figure 3.1a, the total

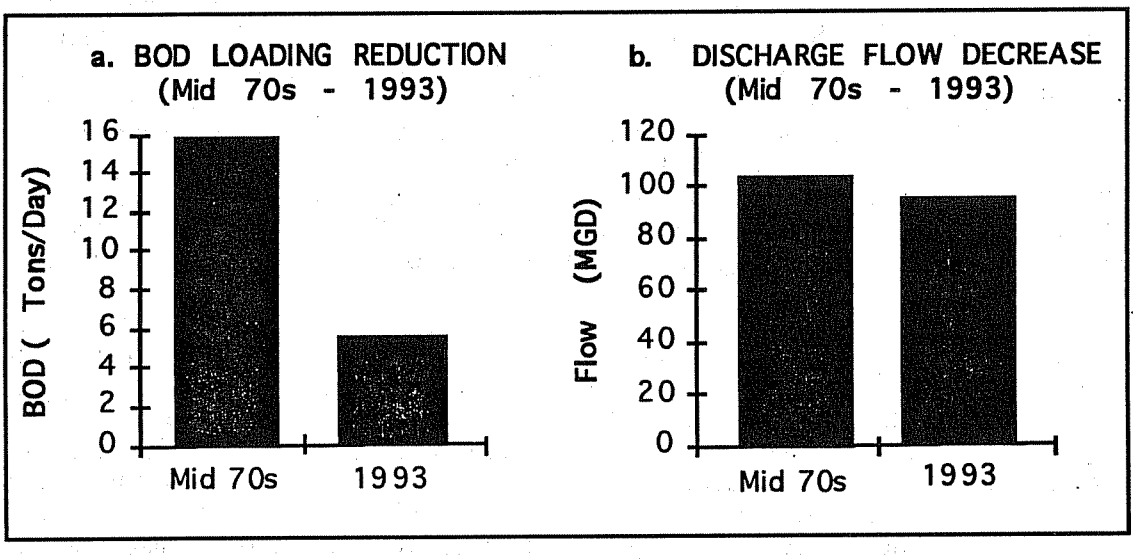


Figure 3.1 Comparison of (a) Total BOD Loading and (b) Effluent Flows from NPDES dischargers in the French Broad River Basin Between Mid-1970s and 1993

loading of BOD has decreased from approximately 16 tons per day in the mid-1970s to approximately 5.8 tons per day in 1993 while the total daily volume of effluent discharged decreased from 102 MGD in the mid 1970s to 95 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 as implemented through the state's NPDES program. Comparisons of BOD loadings and flows from selected wastewater treatment facilities in the basin are presented in Figures 3.2 and 3.3. These numbers are based on actual loadings and flows through 1993. In general, water quality standards for dissolved oxygen are being met throughout most of the basin. However, modeling studies have indicated that the BOD assimilative capacity is either becoming limited in some waters, such is in the upper French Broad and Pigeon Rivers, or has been severely stressed as in Mud and Gash Creek. Recommended management strategies for addressing BOD are presented in Section 6.3 of Chapter 6.

3.2.2 Nutrients

The term *nutrients* in this document refers to two major plant nutrients, phosphorus and nitrogen. These are common components of fertilizers, animal and human wastes, vegetation and some industrial processes. While nutrients are beneficial to aquatic life in small amounts, an overabundance under favorable conditions, can stimulate the occurrence of algal blooms and excessive plant growth in quiet waters such as ponds, lakes, reservoirs and estuaries.

Algae blooms deplete the water column of dissolved oxygen and can contribute to serious water quality problems. Nutrient overenrichment and the resultant problems of low dissolved oxygen are called *eutrophication.* In addition to problems with low dissolved oxygen, 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.

The main sources of nutrients are agricultural runoff, wastewater treatment plants, urban runoff and atmospheric deposition. 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. The State does have 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 and possible eutrophication. It is one of several measures used to assess the health of lakes and estuaries.

Nutrients in the French Broad Basin

Table 4.7 in Chapter 4 identifies Waterville (Walters) Lake in the Pigeon River watershed as being impaired by nutrients. Lake Junaluska is also being adversly affected by nutrients although it is currently rated as supporting its classified uses. Nutrient management strategies are discussed in Section 6.5 in Chapter 6.

Figure 3.2 Comparison Between Mid-1970s and 1993 Loading of Biochemical Oxygen Demand (BOD) from NPDES Dischargers in the French Broad River Basin

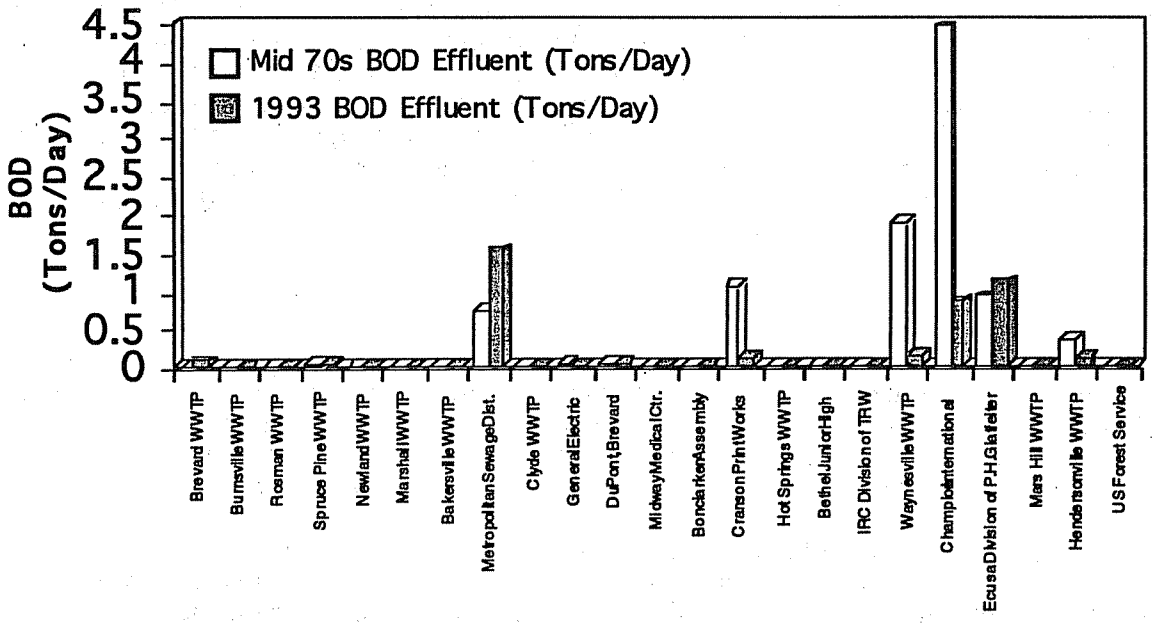
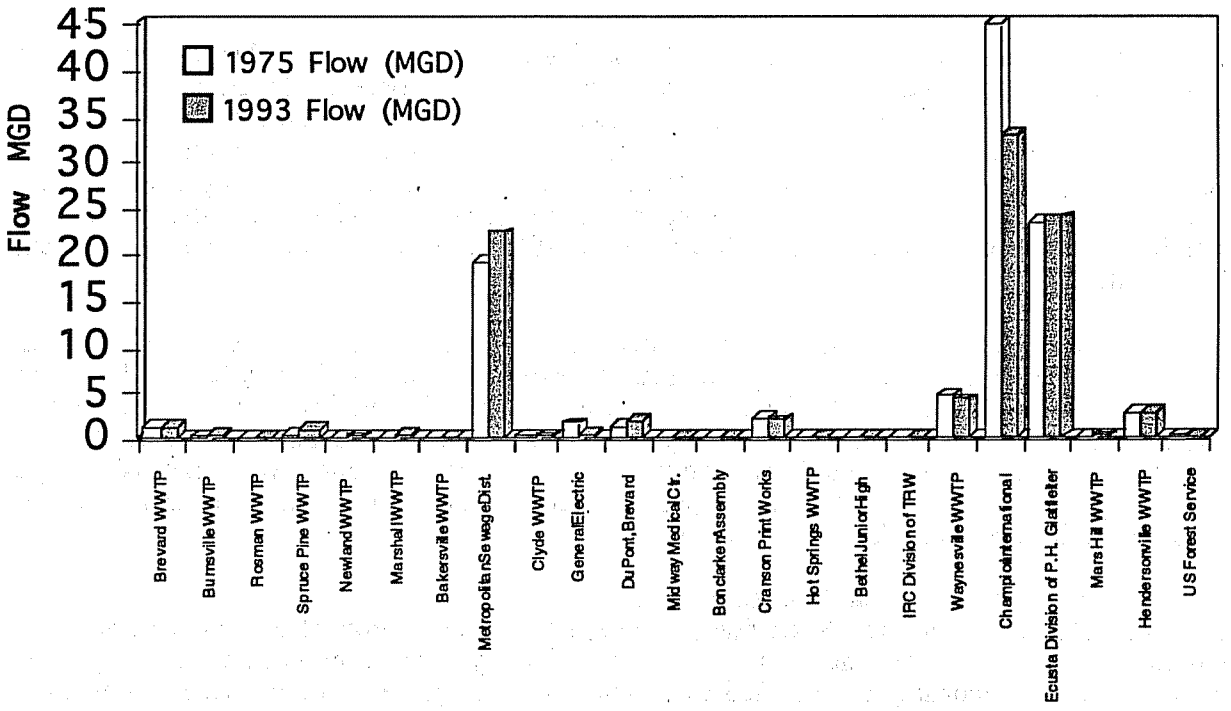


Figure 3.3 Comparison Between Mid-1970s and 1993 Daily Effluent Flow from NPDES Dischargers in the French Broad Basin



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 NPDES 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 4.2.4 and 5.2.5 of Chapters 4 and 5 respectively. Other testing, or monitoring, done to detect aquatic toxicity problems include fish tissue analyses, chemical water quality sampling and assessment of fish community and bottom-dwelling organisms such as aquatic insect larvae. These monitoring programs are discussed in Chapter 4.

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. Standards are listed in Appendix I. 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.

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 except for discharges to trout water, but one may be adopted in the

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.

Toxic substances in the French Broad River Basin

There are streams in all three of the major watersheds in the basin that are being impacted by toxic substances. For most of those being impacted by point source discharges, actions have been taken, or are underway to address the problems. Where nonpoint source toxicity impacts are noted, finding and correcting the problems are more difficult and further studies may be recommended. Streams for which management toxicity problems have been identified are discussed in Section 6.3 include Little River (above Cascade Lake), Bat Fork Creek, Mud Creek, Clear Creek, Hominy Creek, Pigeon River and Richland Creek.

3.2.4 Sediment

Sedimentation is the most widespread cause of nonpoint source pollution in the state and results from land-disturbing activities including agriculture, construction, urban runoff, mining and forestry. 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.

Statistics compiled by the US Department of Agriculture, Soil Conservation Service indicate a statewide decline in erosion from 1982 to 1992 (USDA, SCS, 1992) as shown in Table 3.1.

Table 3.1 Overall Erosion Trends in North Carolina

	1982	1987	1992
Area (1,000 acres)	33,708.2	33,708.2	33,708.2
Gross Erosion (1,000 tons/yr)	46,039.5	43,264.6	36,512.9
Erosion Rate (Tons/Yr/Ac)	1.4	1.3	1.1

The SCS statistics also indicate a statewide reduction per acre on cropland erosion using the Universal Soil Loss Equation (Table 3.2).

Table 3.2 USLE Erosion on Cultivated Cropland in North Carolina

	1982	1987	1992
CroplandArea (1,000 acres)	6,318.7	5,956.8	5,538
Gross Erosion (1,000 tons/yr)	40,921.4	37,475.3	30,908.3
Erosion Rate (Tons/Yr/Ac)	6.5	6.3	5.6

However, in the Blue Ridge Mountains region, which encompasses the entire French Broad Basin and several others, the overall erosion picture is less clear. Table 3.3 shows a significant decline in cultivated cropland acreage and a decline in gross erosion, but the erosion rate per acre is up from 12.7 tons/acre/year in 1982 to 18.3 tons/acre/year in 1992. Non-cultivated cropland erosion rates also increased from 1.4 tons/acre/year in 1982 to 1.7 tons/acre/year although pasture land rates dropped from 2.6 to 2.2 tons/acre/year over the same period.

Table 3.3 North Carolina Erosion in Blue Ridge Mountain Region

	1982	1987	1992
CroplandArea (1,000 acres)	122.9	97.9	76.2
Gross Erosion (1,000 tons/yr)	1,555.6	2,035.2	1,397.5
Erosion Rate (Tons/Yr/Ac)	12.7	20.8	18.3

Compared with other regions of the state, the overall erosion rates per acre for cultivated cropland in the mountains were very high. Also, the 10-year uptrend in the erosion rate was high compared to the other regions (Table 3.4) which were generally stable or slightly lower over the period.

Table 3.4 North Carolina Erosion on Major Land Resource Areas (MLRA) in Tons/acre/yr

	1982	1987	1992
Blue Ridge Mountains	12.7	20.8	18.3
Southern Piedmont	12.3	12.0	10.5
Carolina and Georgia Sand Hills	6.0	5.6	5.1
Southern Coastal Plain	3.9	3.9	4.0
Atlantic Coast Flatwoods	3.2	3.1	3.2
Tidewater Area	1.4	1.5	1.6

While much of this data relates to cropland and the need to continue to improve cropland erosion controls in the mountains, it also carries a broader message of the high erosion potential in the mountains not only from agricultural activities but for all land-disturbing activities. Given the high conversion of agriculture land to urban uses, strengthening erosion and sediment control programs

related to construction practices is essential to the reduction of sediment-related problems in the basin.

Sedimentation in the French Broad River Basin

Sediment is the most widespread cause of freshwater stream impairment in the French Broad River Basin. Use support information presented in Section 4.5 of Chapter 4 indicates that 266 miles of streams are impaired as a result of sedimentation. Freshwater stream impairment from sedimentation is distributed by subbasin as follows:

Subbasin No.:	01	02	03	04	05	06	07
Stream Miles Impaired by Sediment:	4	155	4	77	20	1	4

Most sediment-related impacts are associated with nonpoint source pollution. Programs aimed at addressing sedimentation are listed in Section 6.4 (Table 6.3) in Chapter 6 and are briefly described under nonpoint source pollution controls in Chapter 5. Nonpoint sources are considered to be in compliance with the turbidity standard if approved best management practices (BMPs) have been implemented.

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, microorganisms. They enter surface waters from both nonpoint source runoff and point source discharges. Common nonpoint sources of fecal coliforms include runoff from livestock and wildlife, urban stormwater runoff, leaking sewer lines or pump station overflows, and leaking or failing septic systems. Point sources of fecal coliforms are generally limited to improperly treated wastewater effluent (usually from smaller facilities such as package treatment plants) and unpermitted discharges. The most common unpermitted discharge of concern regarding fecal coliform bacteria is direct discharges (or straight pipes) from onsite septic systems.

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 (coastal shellfish) waters. MF is an abbreviation for the Membrane Filter procedure for determining fecal coliform concentrations. 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 French Broad River Basin

According to Table 4.6 in Chapter 4, there are 74 miles of streams in subbasins 01, 02 and 05 considered to be use-impaired due to elevated levels of fecal coliform bacteria. However, the actual number of stream miles impaired by fecal coliform bacteria could be consideraly higher since bacteria measurements are only done at monthly intervals at 29 ambient monitoring stations on large streams within the basin (See Figures 4.1 through 4.7 for sampling locations). Streams that are use-impaired, based on monitored data, are identified in Table 4.3 (see "Fecal" under Problem Parameter column). Management strategies for addressing fecal coliforms are presented in Section 6.8 of Chapter 6.

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 French Broad River Basin

While no streams in the basin have been rated as use-impaired due to color, color has been identified in the past as a major concern in the Pigeon River below the Champion Paper Mill. In July of 1988, Champion was given a variance for instream color which required them to meet 50 true color units at the North Carolina/Tennessee state line on a monthly average basis. They are also required to study and evaluate color removal technologies and report their findings on an annual basis to DEM. Since 1988, Champion has modernized their facility at Canton and has achieved greater than 75% reduction in their effluent color. Champion is continuing to investigate color removal technology and will be conducting a full-scale trial on a new patented in-process methodology which they call Bleach Filtrate Recycling (BFR™). The final design should be completed in 1994. Construction will occur in 1995 and operation is to begin in late 1995 and continue into 1996. BFR™ takes advantage of oxygen delignification, 100% chlorine dioxide substitution, oxidative extraction, and other technologies to significantly reduce the discharge of kraft pulp bleaching residues. This process has the potential to remove approximately 50% of the remaining effluent color. Another potential benefit associated with this new process is a decrease in the total chlorinated organic matter and BOD discharged from the bleach plant. These reductions are estimated to be 85% for total chlorinated organic matter and 70% for BOD.

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 point 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 6.7 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 French Broad Basin

In the French Broad River Basin, there are 353 permitted NPDES dischargers, 176 of which are general permits or stormwater permits. Table 3.5 summarizes the number of dischargers and their total permitted and actual 1993 flows for each subbasin. A distribution map of the discharge facilities is shown in Figure 3.4. It includes a list of the major dischargers in the basin. Location numbers are provided in the list for each major discharger that correlate with numbered locations shown in Figure 3.4 .

Of the total 353 dischargers, 14 are major facilities, 202 are domestic, 15 are municipalities and 84 are industries. The total permitted flow for all facilities is 120 million gallons per day (MGD). The average actual flow is higher than the permitted flow 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 56% of the permitted flows.

A total of 119 stream miles have been identified as being impaired by point source discharges.

3.4 NONPOINT SOURCES OF POLLUTION

Nonpoint source (NPS) refers to runoff that enters surface waters through stormwater, snowmelt or atmospheric deposition (e.g. acid rain). 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 earlier, 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, given the dispersed nature of stormwater runoff discussion of urban runoff will be included in this section.

Table 3.5 Summary of Major/Minor NPDES Dischargers and Permitted and Actual Flows by Subbasin

FACILITY CATEGORIES	SUBBASIN 01	02	03	04	05	06	07	TOTALS
Total Facilities	25	181	12	25	62	43	5	**353**
Facilities w/o Stormwtr & Gen. Permits	11	95	9	13	25	21	3	**177**
Total Permitted Flow (MGD)	32.48	59.50	0.31	1.01	11.40	14.63	0.83	**120.17**
# of Facilities Reporting	10	75	9	10	22	15	3	**144**
Total Avg. Flow (MGD)	27.51	259.47	0.17	0.39	7.98	5.07	0.46	**301.06**
***Major Discharges**	3	6	0	0	2	3	0	**14**
Total Permitted Flow (MGD)	32	56.5	0	0	6.75	8.83	0	**104.08**
# of Facilities Reporting	3	6	0	0	2	3	0	**14**
Total Avg. Flow (MGD)	27.29	257.38	0.00	0.00	6.44	3.99	0.00	**295.09**
***Minor Discharges**	8	89	9	13	23	18	3	**163**
Total Permitted Flow (MGD)	0.48	3.00	0.31	1.01	4.65	5.81	0.83	**16.09**
# of Facilities Reporting	7	69	9	10	20	12	3	**130**
Total Avg. Flow (MGD)	0.22	2.09	0.17	0.39	1.54	1.08	0.46	**5.96**
100% Domestic Wastewater	6	109	10	13	40	20	4	**202**
Total Permitted Flow (MGD)	0.34	1.60	0.13	0.11	0.24	0.10	0.03	**2.55**
# of Facilities Reporting	3	60	8	6	16	7	2	**102**
Total Avg. Flow (MGD)	0.15	0.56	0.05	0.01	0.09	0.03	0.01	**0.90**
Municipal Facilities	2	3	0	3	3	3	1	**15**
Total Permitted Flow (MGD)	2.59	43.20	0.00	0.91	6.96	0.84	0.80	**55.29**
# of Facilities Reporting	2	2	0	3	3	3	1	**14**
Total Avg. Flow (MGD)	1.14	23.84	0.00	0.38	4.54	0.66	0.45	**31.01**
Major Process Industrial	2	4	0	0	0	3	0	**9**
Total Permitted Flow (MGD)	29.5	13.3	0	0	0	8.83	0	**51.63**
# of Facilities Reporting	2	4	0	0	0	3	0	**9**
Total Avg. Flow (MGD)	26.18	233.54	0.00	0.00	0.00	3.99	0.00	**263.71**
Minor Process Industrial	3	12	0	3	5	7	1	**31**
Total Permitted Flow (MGD)	0.04	1.10	0.00	0.00	4.20	4.87	0.00	**10.21**
# of Facilities Reporting	2	6	0	1	1	2	0	**12**
Total Avg. Flow (MGD)	0.02	0.32	0.00	0.01	1.08	0.39	0.00	**1.82**
Nonprocess Industrial	8	14	2	5	9	6	0	**44**
Total Permitted Flow (MGD)	0.02	0.30	0.18	0.00	0.00	0.00	0.00	**0.50**
# of Facilities Reporting	1	3	1	0	2	0	0	**7**
Total Avg. Flow (MGD)	0.01	1.22	0.12	0.00	0.23	0.00	0.00	**1.58**
Stormwater Facilities	4	39	0	1	5	4	0	**53**
Total Avg. Flow (MGD)	0	0	0	0	0	0	0	**0**

*** Number of facilities without stormwater and general permits**

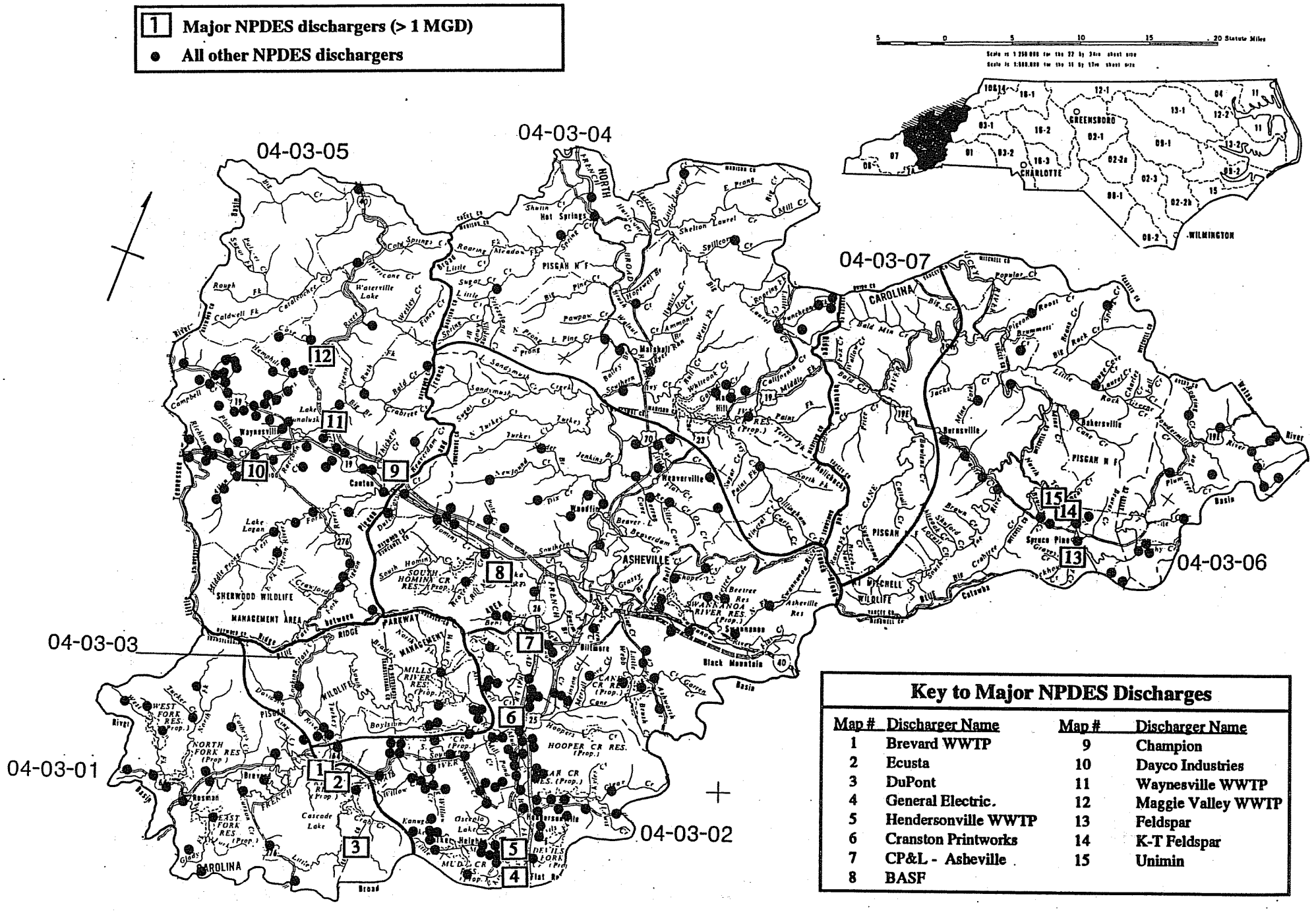


Figure 3.4 Distribution Map of NPDES Dischargers in the French Broad River Basin

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 French Broad River Basin. There are a total of 356 miles of streams in the basin identified as being impaired due to nonpoint pollution sources.

3.4.1 Agriculture

There are a number of activities associated with agriculture that can 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, orchards, Christmas tree farms 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 French Broad River Basin, 256 (over 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 53 miles in subbasin 04 (lower French Broad watershed). 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. 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. Best management practices for addressing agricultural nonpoint source pollution are presented in Appendix VI.

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. 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 an indicator of where urban development and potential urban stream impacts are likely to occur. Based on Table 4.5 in Chapter 4, there are 75 miles of streams that are impaired due to urban runoff. Management strategies for addressing urban runoff are presented in Chapter 6. Best management practices for addressing urban nonpoint source pollution are presented in Appendix VI.

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 severe and long lasting.

Construction activity tends to be concentrated in the more rapidly developing areas of the basin such as subbasins 02 and 05. 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 61 miles of streams impaired due to construction activity. Construction-related sedimentation is addressed through the Sedimentation Pollution Control Act (see Section 5.5.3 in Chapter 5).

3.4.4 Forestry

Forestry is a major industry in North Carolina that has the potential to impact water quality in a number of ways if not properly managed. In mountainous areas, sedimentation is a prime concern. Clear-cutting and improper construction of logging roads and stream crossings can produce damaging sedimentation. In addition, removing riparian vegetation along stream banks can cause water temperature to rise substantially, and improperly applied pesticides can result in toxicity problems.

In the French Broad River Basin, over 50% of the land area is forested and portions of 1.2 million-acre Pisgah National Forest occur in all of the counties in the basin. Trees in the forest are maturing from the last major round of cutting earlier this century, so timbering activity is expected to increase. The National Forest Service has been working on revising and updating its 1987 forest management plan aimed, in part, to ensure that harvesting is done in an environmentally sound manner. Clear-cutting, for example, will be all but eliminated, and harvesting on many of the steeper slopes will be minimized. Also, the North Carolina Division of Forest Resources has established voluntary best-management practices for forestry activities on private lands (Section 5.3.6 in Chapter 5). Based on Table 4.5 in Chapter 4, there are 11 miles of streams impaired due to forestry activities. Best management practices for addressing froestry nonpoint source pollution are presented in Appendix VI.

3.4.5 Mining

Mining is another important industry in the French Broad River Basin, especially in the Nolichucky watershed area including portions of Yancey, Mitchell and Avery Counties. While stone quarries are common throughout the basin, the Nolichucky watershed is valued as a source of feldspar, mica, olivine and gem stones. Mining operations can produce high localized levels of stream sedimentation if not properly treated. Chemicals used in the production of mined materials can also pose a problem such as the use of hydrofluoric acid in the production of feldspar and quartz. These operations have resulted in high fluoride levels in receiving streams that are being addressed through revised NPDES permit limits (see section 6.5.2 in Chapter 6). Nonpoint source impacts associated with mining are addressed, in part, through the Mining Act (see section 5.3.7 in Chapter 5). Best management practices for addressing mining nonpoint source pollution are presented in Appendix VI.

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 can also contribute to eutrophication problems in impoundments. Best management practices for addressing onsite wastewater disposal nonpoint source pollution are presented in Appendix VI.

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 solid wastes can serve as a source of a wide array of pollutants. As an example, CERCLIS and State Inactive Hazardous Waste Sites can represent unregulated nonpoint sources discharges to surface waters in the French Broad basin that have local water quality impacts. These sites are investigated and addressed through programs administered by the NC Division of Solid Waste Management and the US Environmental Protection Agency. Permitted solid waste facilities, where properly designed, constructed and operated, should not significantly affect water quality.

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CHAPTER 4

WATER QUALITY AND USE SUPPORT RATINGS IN THE FRENCH BROAD RIVER BASIN

4.1 INTRODUCTION

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

Water Quality Monitoring and Assessment

- **Section 4.2** presents a summary of seven 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 French Broad River Basin (NCDEM, 1994).
- **Section 4.3** 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 4.4** 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 V.
- **Section 4.5** presents the use support ratings for most of streams and lakes in the French Broad 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 4.2.1 and Appendix II),
- Fish population and tissue monitoring(Section 4.2.2 and Appendix II),
- Lakes assessment (including phytoplankton monitoring) (Section 4.2.3 and Appendix II),
- Aquatic toxicity monitoring (Section 4.2.4),
- Special chemical/physical water quality investigations (Section 4.2.5),
- Sediment oxygen demand monitoring (Section 4.2.6), and
- Ambient water quality monitoring (covering the period 1988-1992) (Section 4.2.7).

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 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.

Appendix II contains a more detailed discussion of the NCIBI as well as a listing of the community assessment sites and NCIBI ratings.

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. The North Carolina Trophic State Index (NCTSI) is a relative measure of nutrient enrichment and productivity, and whether the designated uses of the lake have been threatened or impaired by pollution. This index is explained more fully in Appendix II.

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. A list of all NPDES facilities required to conduct aquatic toxicity testing is provided in Appendix II.

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.

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 French Broad Basin are incorporated in the subbasin summaries.

Table 4.1. Ambient Monitoring System Parameters

C and SC WATERS (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

NUTRIENT-SENSITIVE WATERS
- Chlorophyll *a* (where appropriate)

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

PLUS any additional parameters of concern for individual station locations

4.3 NARRATIVE WATER QUALITY SUMMARIES BY SUBBASIN

4.3.1 Subbasin 01 - French Broad River Headwaters

DESCRIPTION

Subbasin 01 contains the headwater reaches of the French Broad River in Transylvania County and the headwater segment of the Little River (Figures 4.1a and b). The French Broad River originates at the confluence of the West and North Forks of the French Broad near the town of Rosman. The East Fork of the French Broad also flows into the French Broad River near Rosman. These major tributaries generally are unstressed, high gradient, streams which support viable trout populations. Approximately one half of the land within this subbasin is contained in the Pisgah National Forest and Pisgah Game Land. This portion of the catchment is therefore protected from most land disturbing activities and has a limited number of point source discharges. Below Rosman, the French Broad River is a much wider, lower gradient river which meanders through a mostly undeveloped watershed to the town of Brevard. Brevard is the largest urban area in the subbasin. Some agriculture and development are present in this reach of the French Broad River. There are 25 known point source dischargers in subbasin 01, eight of which are trout farms.

OVERVIEW OF WATER QUALITY

Ambient water quality data is currently being collected from two locations in this subbasin, the French Broad River at Rosman and the Little River near High Falls. These data have indicated good water quality, with very few violations of water quality standards at either site. Excesses were noted for pH and turbidity at the Rosman location and pH, turbidity, and metals at the Little River location. Long term observations of water quality data have noted a slight decline in pH values at the Rosman location.

Benthic macroinvertebrate samples have been collected from 29 locations in this subbasin since 1983. These investigations have generally found Excellent or Good water quality conditions. Excellent bioclassifications (based on benthic macroinvertebrates) have been consistly assigned to the ambient monitoring location at Rosman. Fish tissue samples from this location have detected organic compounds (PCB's) exceeding the EPA recommended screening value, but these values were below the FDA criteria for fish consumption.

Major sections of the North Fork, West Fork, and East Fork French Broad River and all of the Catheys Creek catchment have been designated High Quality Waters. Many small dischargers (especially trout farms) are located in some of these catchments and may cause localized enrichment and/or organic loading problems. For example, a joint study with the NC Agricultural Extension Service and the NC Wildlife Resources Commission to assess the effects of trout farm discharges on mountain stream ecology found these discharges degrade water quality in the upper section of the West Fork French Broad River.

POTENTIAL HQW/ORW STREAMS

Benthos data collected from this subbasin in 1992 did not suggest any "new" potential HQW/ORW streams. However, a review of the upper French Broad River HQW report (B-890510) indicated that the French Broad River from its source to SR 1129 was inadvertently overlooked for HQW designation. Data from the SR 1129 location continues to indicate Excellent water quality in this segment of the river, and it is DEM's intent to pursue reclassification of this stream reach.

French Broad River Basin
040301

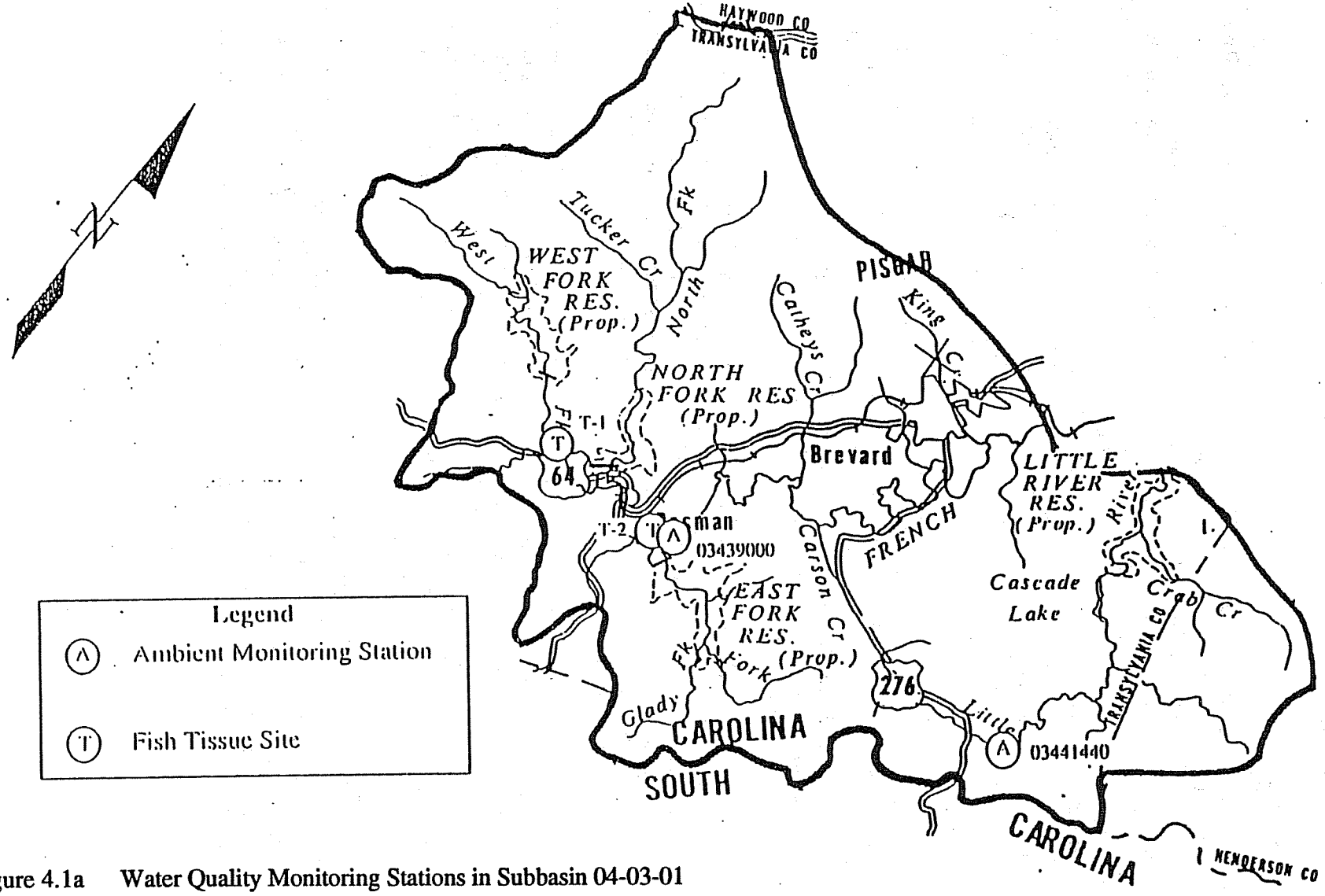


Figure 4.1a Water Quality Monitoring Stations in Subbasin 04-03-01

French Broad River Basin
040301

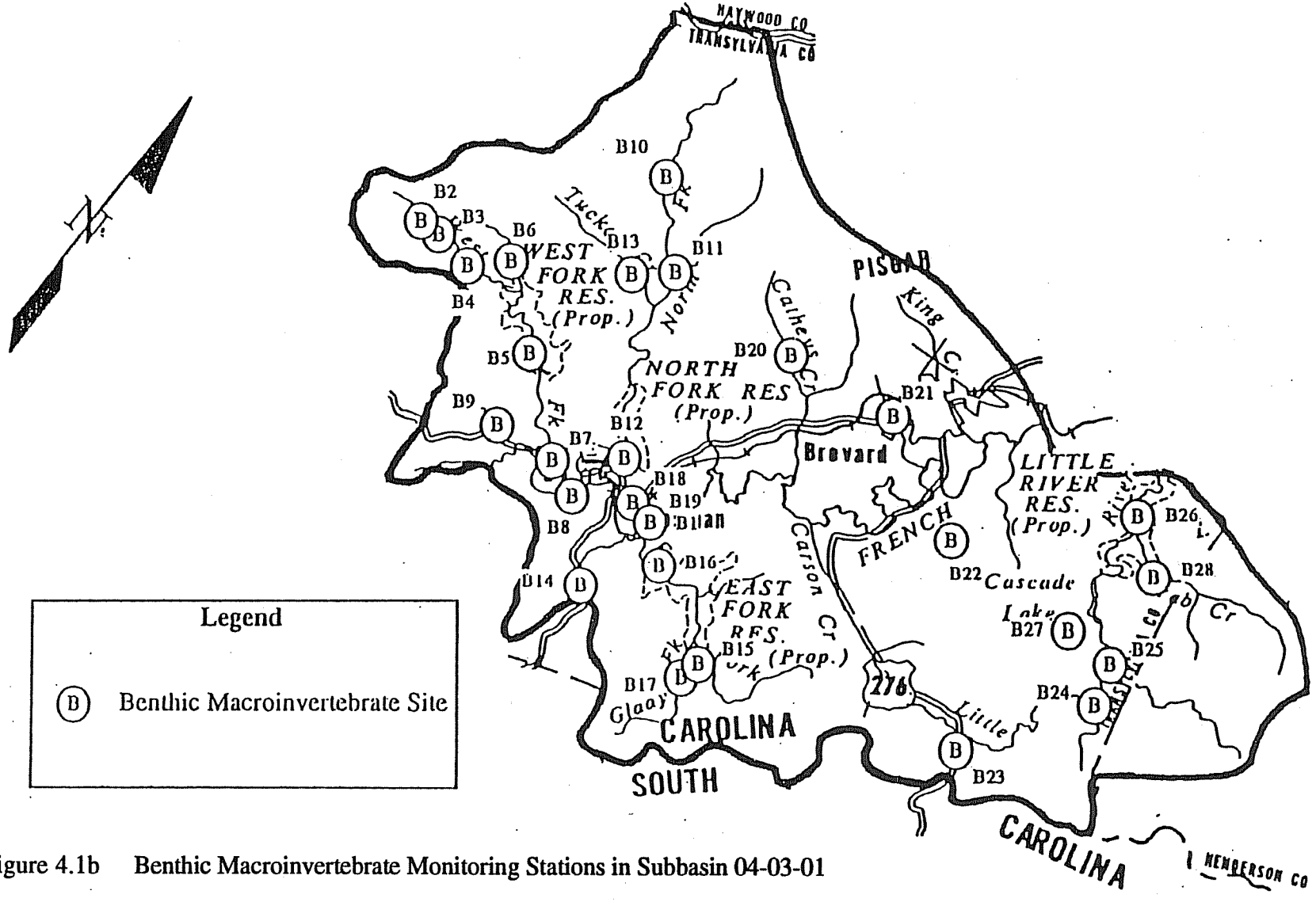


Figure 4.1b Benthic Macroinvertebrate Monitoring Stations in Subbasin 04-03-01

4.3.2 Subbasin 02 - Upper French Broad River

DESCRIPTION

French Broad subbasin 02 contains approximately 40 river miles of the French Broad River from the confluence of the Little River in Transylvania County to the confluence of Sandymush Creek in Buncombe County (Figure 4.2). The French Broad River in this subbasin is generally a very wide mountain river capable of supporting several warm water gamefish species. The major tributaries of the French Broad River in this subbasin include Mud Creek, Cane Creek, Hominy Creek, Swannanoa River, and Turkey Creek. Most tributaries in this catchment have unstressed, high elevation, headwaters. However, agriculture (orchards and row crops, including corn, tomatoes, and burley tobacco) and urbanization often affects the middle and lower portions of these streams This reach of the French Broad River contains the urban area of Asheville and Hendersonville. There are 153 known point source dischargers in this subbasin.

OVERVIEW OF WATER QUALITY

Ambient water quality monitoring information is currently being collected from eight locations in the subbasin with four of these locations located on the mainstem of the French Broad River. Benthic macroinvertebrate (Figure 4.2a) and fish community samples have been collected from 57 locations in this subbasin since 1983. These investigations were conducted to assess the effects of both point and nonpoint sources of pollution. The 1992 benthic macroinvertebrate collections at French Broad River sites generally showed a downstream decline in water quality: Good at Skyland (upstream of Asheville), Good/Fair at Asheville, and Fair at Alexander (below Asheville). This decline in water quality may be related to several large point source dischargers and nonpoint source runoff. Analysis of long-term changes in the benthos suggested a slight improvement in water quality at the Skyland site, a greater improvement at the Asheville site (Fair to Good-Fair), but no similar improvement for the Alexander site. Conductivity values showed a significant decline (improvement) at the former two sites from 1981 to 1993.

A similar downstream change was observed in the ambient water chemistry data from the French Broad River locations. For example, the frequency of fecal coliform numbers measured above the criteria of 200/100 ml (for the period 2/88 to 5/93) increased from 20% at Blantyre (upstream of this subbasin) to 38% at Skyland, 40% at Asheville, and 31% at Alexander. Median total phosphorus values were 0.04, 0.07, 0.07, and 0.14 mg/l for these sites respectively during the same time period. Long term observations in BOD and total phosphorus mimic these upstream to downstream trends.

Excellent water quality is primarily confined to the upper reaches of tributaries, with many point and nonpoint source problems in the lower reaches. Biological investigations have been conducted in several tributary stream systems in this subbasin. Mud Creek has consistently been given a Poor bioclassification due to point sources (Hendersonville WWTP, General Electric, Kyocera Feldmuehle, Inc.), urban runoff, and agricultural runoff. Seventy-nine percent of all fecal coliform samples (15/19) collected from the ambient location on Mud Creek from 9/91 to 5/93 had excesses of the water quality criteria. Runoff from apple orchards and multiple small dischargers were shown to cause severe water quality problems in Clear Creek.

Benthic macroinvertebrate and fish community structure indicated Good water quality in headwater reaches of Hominy Creek. However, both point and nonpoint sources contribute to the Poor bioclassification of the lower reaches of this catchment. Seventy-one percent of all fecal coliform samples (15/21) collected from the ambient location on Hominy Creek during 9/91 to 5/93 exceeded water quality criteria. In addition, Hominy Creek was one of nine monitoring locations that recorded excesses of total phosphorous (0.1 ppm, to prevent excess algal growth) as part of an independent monitoring program in Buncombe County (Maas, et al., 1993). Other streams in this monitoring network with high total phosphorus values in this subbasin included Reed, Newfound, Sandymush, Reems, and Turkey Creeks. DEM nonpoint source investigations also found Poor

French Broad River Basin
040302

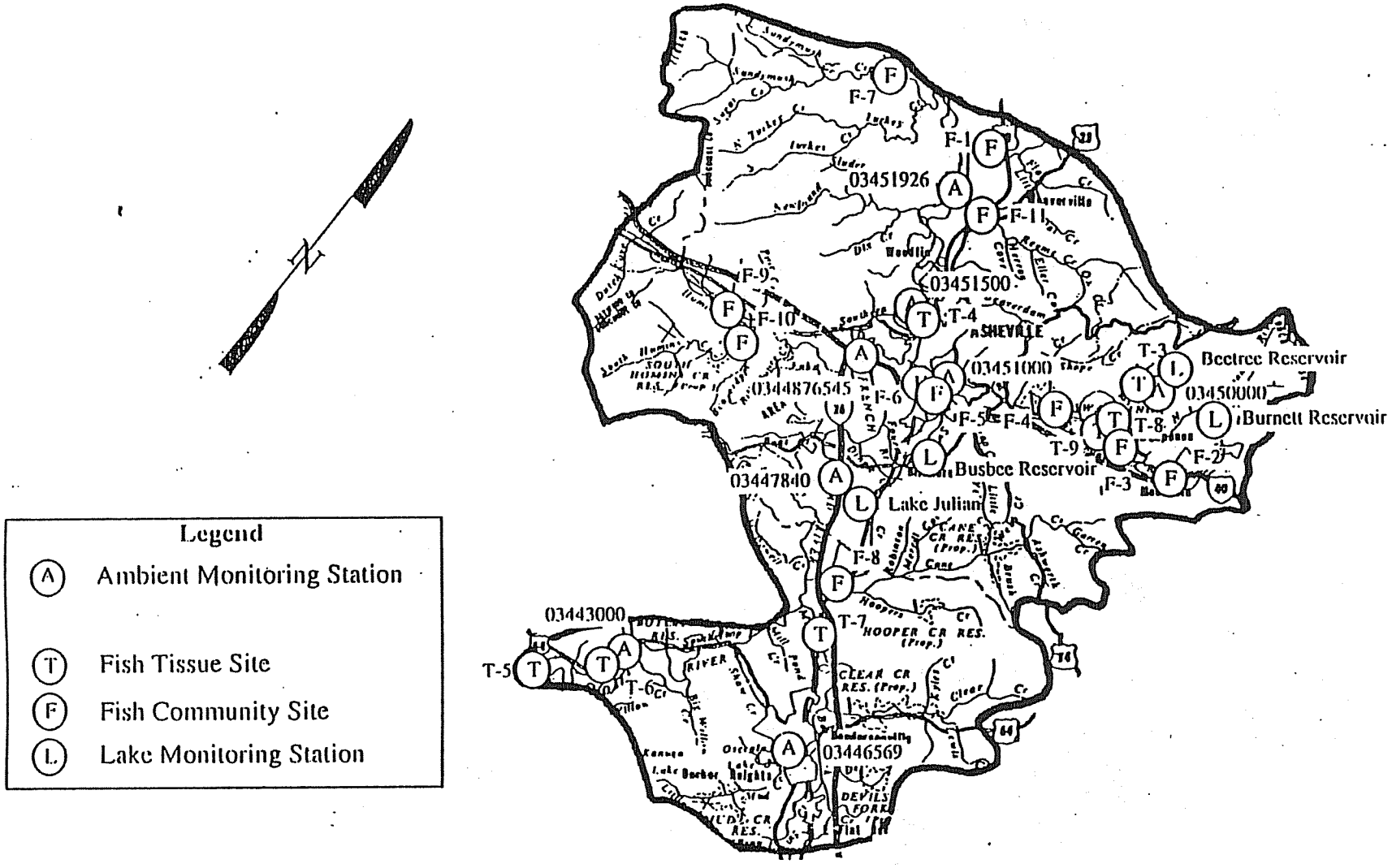


Figure 4.2 Water Quality Monitoring Stations in Subbasin 04-03-02

French Broad River Basin
040302

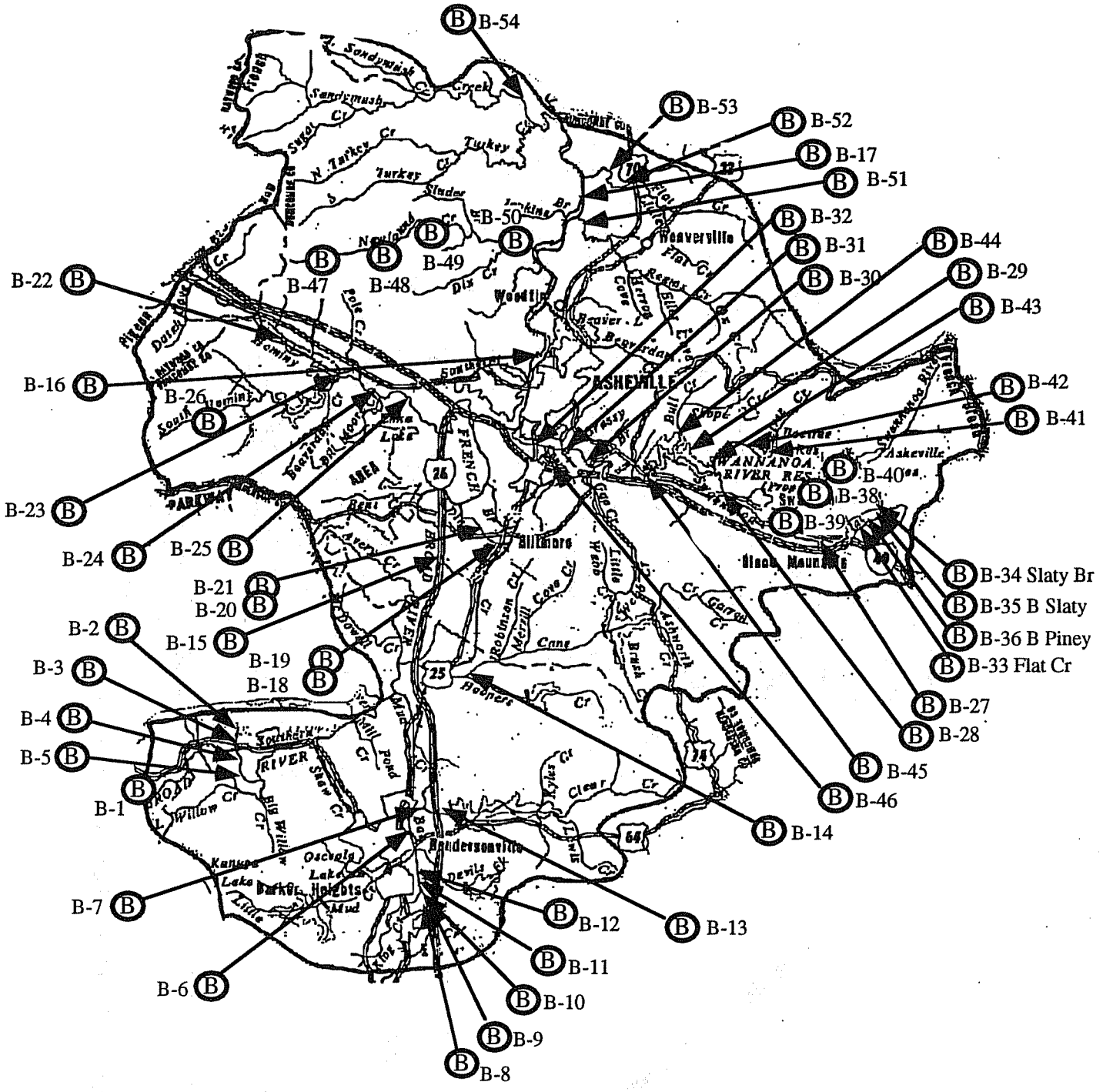


Figure 4.2 Benthic Monitoring Stations in Subbasin 04-03-02

water quality in the lower portion of Newfound Creek watershed due to runoff from numerous dairy operations in the catchment.

The lower section of the Swannanoa River has been shown to have severe water quality problems associated with spills, point source discharges and nonpoint source runoff. For example, 53% of all fecal coliform samples (16/30) collected from the ambient location (from 2/88 to 5/93) noted excesses of water quality standards. Ambient water chemistry data and benthic macroinvertebrate collections, however, have shown improvements in water quality conditions in the Swannanoa River since 1985. A site near Biltmore improved from Fair or Poor in 1987-1989 to Good-Fair in 1992. Improvements in upstream sewer systems and the closing of Sayles Biltmore Bleachery have probably contributed to the improved water quality at this site. The middle and upstream reaches of the Swannanoa River have had less severe problems; both fish and invertebrate collections indicate Good or Good-Fair conditions in this portion of the river.

Fish tissue samples have been collected from three locations on the French Broad River. Twenty samples were collected and analyzed for metals and four for organics from the French Broad River at the ambient station at Asheville. All metals were below FDA and EPA criteria, while three of the four organic samples contained dieldrin exceeding the EPA screening value (0.007 ppm) but were below the FDA criteria for fish consumption. Fish tissue samples were also collected from the French Broad River at Patton Bridge and near Crab Creek Road, both sites located below Ecusta plant in Brevard. Samples were collected for metals and dioxin from the Patton Bridge location. These tissue data noted one excess for mercury and three samples containing dioxin levels equal to or exceeding the recommended EPA screening value of 0.007 ppm. Ten dioxin samples were collected from the French Broad River near Crab Creek Road. All dioxin results were lower than EPA and North Carolina criteria. Therefore there are no fish consumption advisories in this area.

Water quality investigations have been conducted in four reservoirs in the subbasin. These four waterbodies are Lake Julian, Burnett Reservoir, Beetree Reservoir, and Busbee Reservoir. All four waterbodies are oligotrophic systems and are currently supporting all of their designated uses.

POTENTIAL HQW/ORW STREAMS
Based on DEM surveys in 1992, upper Sandymush Creek may be eligible for HQW designation. However, this stream is potentially affected by agricultural (primarily dairies) runoff.

4.3.3 Subbasin 03

DESCRIPTION
French Broad subbasin 03 contains the Mills River and Davidson River watersheds (Figure 4.3). The Mills River is formed by the confluence of the North and South Fork Mills River. From its source, the Mills River flows past the community of Mills River to the French Broad River. The Davidson River flows into the French Broad River near Brevard. Approximately three quarters of the land within this subbasin is contained in the Pisgah National Forest and Pisgah Game Land; this portion of the subbasin has a limited number of point source discharges and is protected from most land disturbing activities. Many streams in this subbasin are capable of supporting reproducing trout populations. There are 12 known point source dischargers in this subbasin.

OVERVIEW OF WATER QUALITY
Benthic macroinvertebrate and fish community samples have been collected from eight locations in this subbasin, generally indicating Excellent water quality conditions. Most of the South Fork Mills River and its tributaries are classified as Outstanding Resource Waters and most of the Davidson River and its tributaries are High Quality Waters. Ambient water quality data is currently being collected from three locations in the subbasin. Very few exceedances of water quality standards have been recorded with the exception of low pH values from the Davidson River and Bradley Creek.

French Broad River Basin
040303

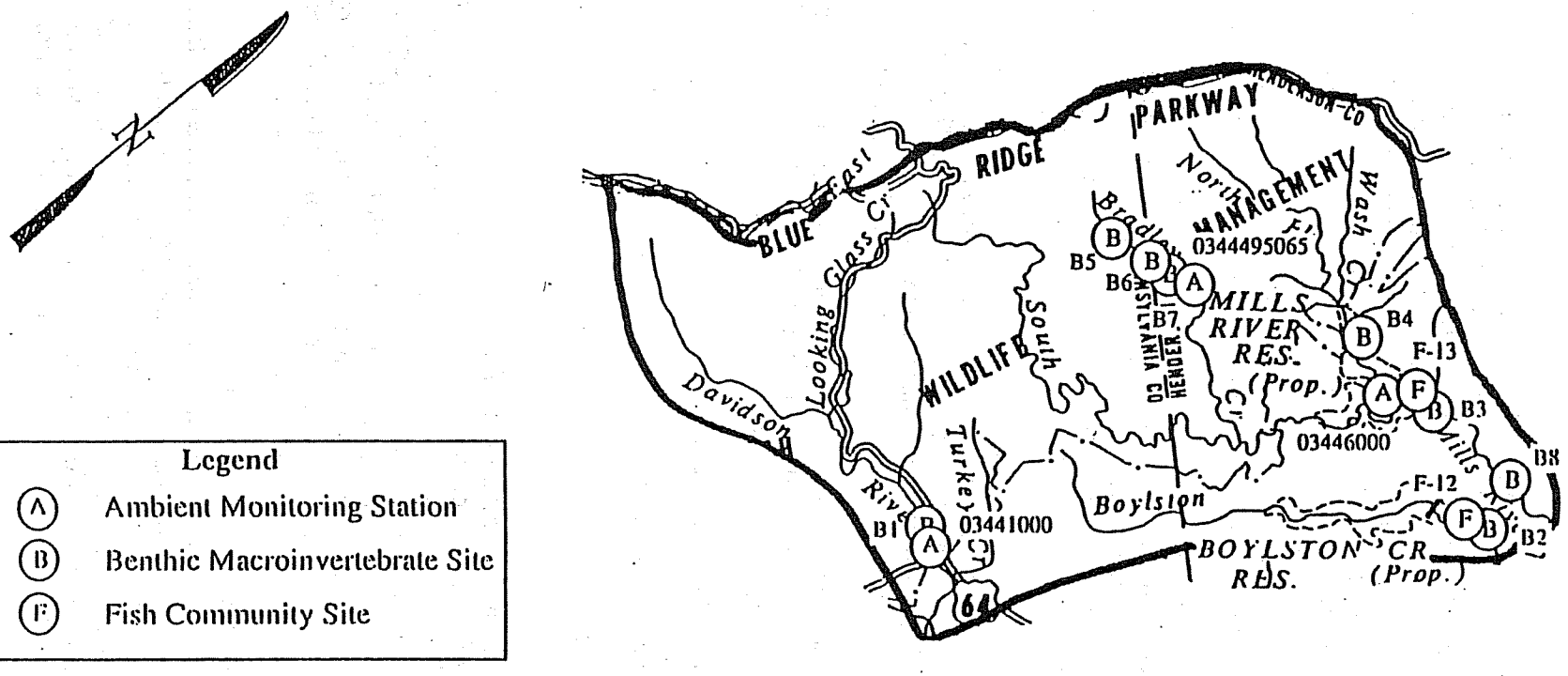


Figure 4.3 **Water Quality Monitoring Stations in Subbasin 04-03-03**

Bolyston Creek is a low elevation tributary stream of the French Broad River and receives nonpoint source runoff from several dairy operations in the catchment. Good/Fair bioclassifications have been assigned to the lower portion of Bolyston Creek (SR 1314) in 1992 based on both benthic macroinvertebrate and fish community data. Earlier DEM studies (1977) had indicated Fair-Poor conditions at this site. Fish community structure data from Bolyston Creek showed an increase in the percentage of omnivorous fish species in 1992 compared to data collected in 1980, suggesting increased enrichment.

POTENTIAL HQW/ORW STREAMS
Based on DEM surveys in 1992 and prior data, the Mills River and North Fork Mills River may be eligible for HQW or ORW designation.

4.3.4 Subbasin 04 - Lower French Broad River and Ivy Creek

DESCRIPTION
This subbasin includes the French Broad River in Madison County and its tributaries including Ivy Creek (Figure 4.4). Much of the catchment is undeveloped land within the Pisgah National Forest. The largest towns in this area are Marshall and Mars Hill. There are no major dischargers in this subbasin.

OVERVIEW OF WATER QUALITY
Much of the subbasin lies within the Pisgah National Forest and most of the tributaries have Good or Excellent water quality. Hunter Creek has been classified HQW and portions of several other tributaries also may qualify.

The Ivy Creek (River) catchment was surveyed in 1993 to determine if any areas were suitable for HQW classification. Excellent water quality was found in two headwater streams, Carter and Mineral Creeks. A Good bioclassification was found for Dillingham Creek, Stoney Creek, North Fork Ivy Creek and three Ivy Creek sites. Portions of Ivy Creek are very sandy, and this stream becomes very turbid after rainfall. Some tributaries also appeared to be affected by nonpoint source runoff. Fisheries information gave a slightly higher rating (Excellent) to Ivy Creek at SR 2150. In the French Broad River mainstem, data from all programs indicate Good-Fair water quality. Water chemistry from the ambient site at Marshall showed little change from the upstream Alexander site, although the bioclassification usually improves from Fair at Alexander (below the Asheville WWTP) to Good-Fair at Marshall. The Marshall site gives some indication of improvement since 1983, although the bioclassification also is influenced by annual changes in flow.

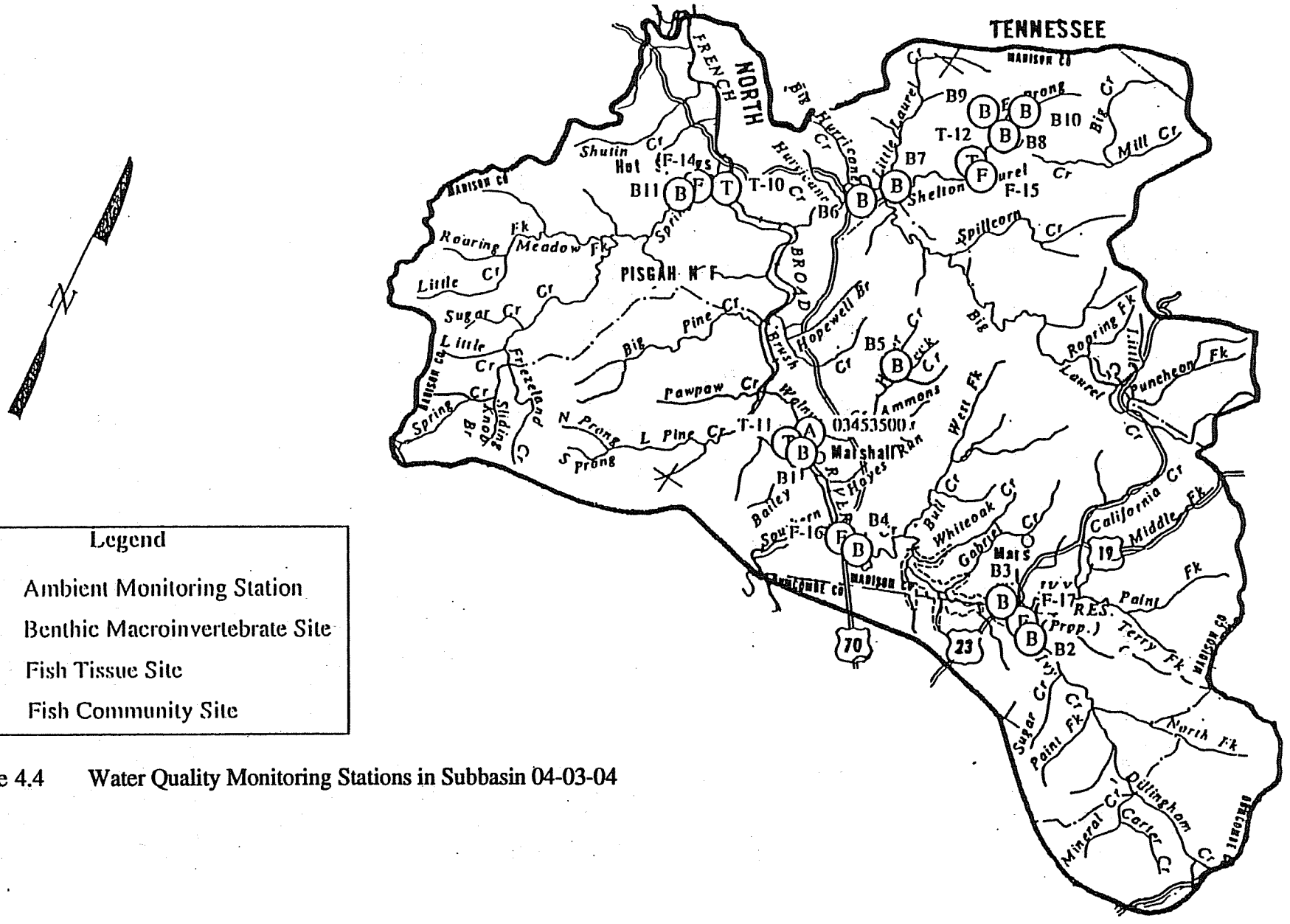
POTENTIAL HQW/ORW STREAMS
Based on recent biological investigations, portions of Ivy Creek (River), Big Laurel Creek, Hickory Fork (Hickey Creek) and their tributaries may qualify for HQW or ORW reclassification.

4.3.5 Subbasin 05 - Pigeon River Watershed

DESCRIPTION
This subbasin includes the Pigeon River and its tributaries (Figure 4.5). Much of the catchment is undeveloped land within the Great Smoky Mountains National Park, Pisgah National Forest and Pisgah Game Lands. The largest urban areas are Waynesville and Canton. There are four major dischargers in this subbasin: Dayco Corporation, Waynesville WWTP, Maggie Valley WWTP, and Champion International.

OVERVIEW OF WATER QUALITY
The discharge from Champion Paper has been the single most significant source of water pollution in this subbasin for many years. A survey in 1965 showed that pollution-intolerant organisms

French Broad River Basin
040304



Legend

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

Figure 4.4 Water Quality Monitoring Stations in Subbasin 04-03-04

French Broad River Basin 040305

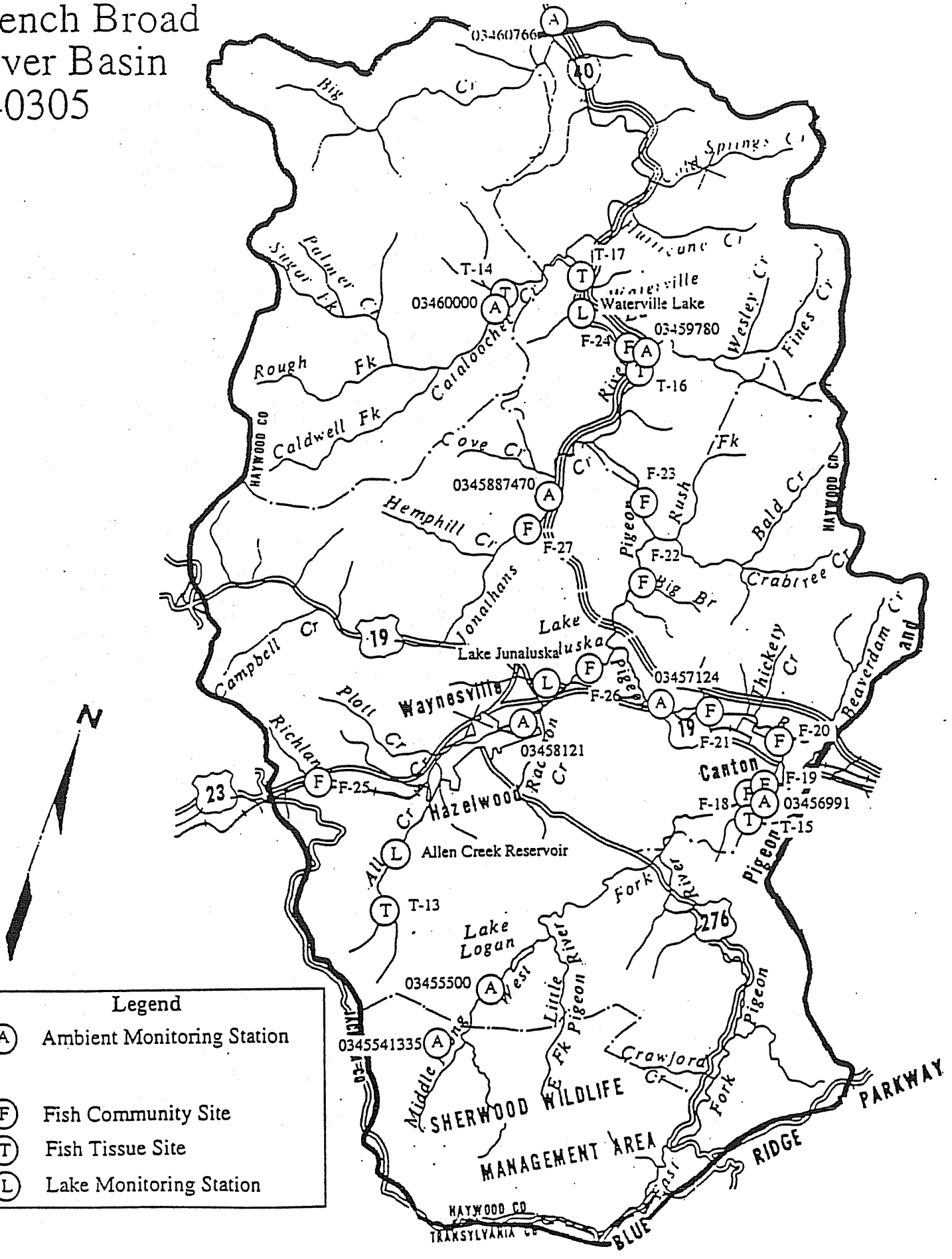


Figure 4.5 Water Quality Monitoring Stations in Subbasin 04-03-05

were not found in the Pigeon River below Champion Paper Company down to the state line. The survey found a biological community indicative of low dissolved oxygen and heavy organic loading. DEM conducted intensive surveys in 1978, 1979, 1980 and 1982, in addition to regular monthly or yearly monitoring at four ambient sites in the Pigeon River. This sampling strategy also has been supplemented by many special surveys (especially fish tissue studies) and surveys of major tributaries.

Data from the 1978-1982 period showed a clear improvement over the 1965 survey, particularly a decrease in the amount of organic loading. The amount of impact has been found to be a function of both stream flow and temperature, with higher flows and lower temperatures acting as mitigating factors. Water chemistry, benthic macroinvertebrate collections and fish collections prior to 1992 all showed a similar pattern in the Pigeon River: Good above Canton and Poor at Clyde (below Champion), with a gradual recovery to Good-Fair at the NC/TN state line. Both fish and macroinvertebrate data have indicated that toxicity has been a problem below Champion Paper. As discussed in Chapter 6, Champion has recently completed a $330 million modernization project which has resulted in substantial improvement in the quality of its effluent. While DEM has not conducted benthic sampling in the river since the improvements were completed, benthic macroinvertebrate collections were already showing some improvement at the Clyde site, improving from Poor in 1984-1989 to Fair in 1992.

Fish-tissue samples from the Pigeon River below Canton have shown elevated levels of dioxin. A "no consumption" advisory for all fish species was issued in 1988 for the Pigeon River (including Waterville Lake) from Canton to the Tennessee border. However, sampling of fish tissue in 1992-1993 in the lake and river have shown reduced dioxin levels in most fish species. As a result of these findings, the consumption advisory has been lifted for all fish species except for carp and catfish. Additional fish tissue monitoring will be conducted prior to updating the basin plan in the year 2000. Champion reports that the levels of dioxin in fish tissues it has sampled have been lower every year since 1990. The plant modernization project noted above included eliminating the use of chlorine in the paper bleaching process which was the source of dioxin in the effluent.

Development on both Jonathan Creek and Richland Creek has resulted in some water quality degradation. Historically, the problems have been much more severe in Richland Creek; however, improvements at Dayco Corporation have resulted in improved water quality in the creek. Benthos data indicated that Richland Creek at SR 1184 near Waynesville has improved in recent years, going from Poor in 1983, to Fair in 1985 and 1988, and to Good-Fair in 1992.

Three lakes in this subbasin have been evaluated: Allen Creek Reservoir, Lake Junaluska and Waterville Lake. Allen Creek Reservoir is oligotrophic; but both Lake Junaluska and Waterville Lake have enrichment problems. Waterville Lake is hypereutrophic from the effects of Champion Paper, several wastewater treatment plants and nonpoint sources.

Lake Junaluska has historic problems with sedimentation and eutrophication. It is dredged about every ten years. Poor land use practices in the watershed have been identified as a potential sources of sediment and nutrients. Lake Junaluska is a small reservoir located in Haywood County near Waynesville, North Carolina. The lake is privately owned by the Methodist Church and was built in 1914. Inflows into the lake come predominantly from the Richland Creek drainage, while smaller amounts enter from Factory Branch, and from the hillsides surrounding the lake itself (Yurkovich 1984). The lake has a very high ratio of drainage area to volume making the lake very suseptable to sediment loading with little sediment storage capacity. The mean depth of the lake is only 17 feet which is shallow compared to other mountain lakes (NCDEHNR, 1992).

Traditionally, land in the watershed was mainly forested, however the land is increasingly becoming more urban with private home-building. Private homes are replacing orchards, pasture land and forests. Ken Futrell (pers. com. 1994) of the Natural Resources Conservation Service

believes that home construction is a large contributor of sediment that ends up in Lake Junaluska. Agriculture in the watershed is minimal; some tobacco is grown, but the watershed is mostly urban and forested. Streams that drain the watershed flow within channels that have high gradients. These high gradient streams produce turbulence which enables the streams to become effective erosional agents, consequently, transporting sediments to Lake Junaluska (Yurkovich 1984).

Richland Creek flows through Waynesville. In addition to the above mentioned nonpoint sources, all runoff from the town of Waynesville is deposited in Lake Junaluska via Richland Creek. Several cleanups have been initiated on Richland Creek and there are buoyed skimmers to prevent trash from entering Lake Junaluska, but these have little or no effect on sediment (Futrell, K. pers. com. 1994).

Lake Junaluska has historically had problems with sedimentation and eutrophication. It took fifty years for the lake to fill with sediment the first time. The lake was dredged in 1964, in 1973, and again in 1982. Sedimentation rates in the watershed have increased greatly over the past thirty years and can be attributed to highway construction and residential and industrial growth within Haywood County (Yurkovich 1984). The lake was most recently dredged in 1992 or 1993. A considerable amount of sediment was removed and the dredging process took almost one year to complete.

Concurrent with sediment influx to the lake, chemical and solid waste have also entered, occasionally resulting in fish kills. Sources could originate from septic system bypasses, street cleaning operations, agricultural chemicals and trash and garbage (Yurkovich 1984).

There are several high quality streams in this subbasin, including the upper part of the Pigeon River catchment, Cataloochee Creek and Big Creek. Cataloochee Creek has been designated as Outstanding Resource Waters while the Middle Prong West Fork Pigeon River, East Fork Pigeon River, Little East Fork Pigeon River, Big Creek and portions of Rough Creek and Rocky Branch have been designated High Quality Waters. Low pH may become a concern in some of these streams, with values of less than 5.5 already recorded in the upper portions of the Pigeon River catchment (West Fork, Right Prong).

POTENTIAL HQW/ORW STREAMS
Based on recent biological investigations, Cold Springs Creek and upper portions of Jonathan Creek may qualify for HQW or ORW.

4.3.6 Subbasin 06 - Nolichucky, North Toe and South Toe River Watersheds

DESCRIPTION
This subbasin includes the Nolichucky, the North Toe River and the South Toe River (Figure 4.6). Much of the land in this area is undeveloped and lies within the Pisgah National Forest. The largest town is Spruce Pine and several major dischargers are located near this city, including the Spruce Pine WWTP and three mine processors: Feldspar, Unimin and K-T Feldspar. Many of the streams in this subbasin have a supplemental trout water classification.

OVERVIEW OF WATER QUALITY
Water chemistry data is available from two sites on the North Toe River (bracketing the Spruce Pine area), two sites on the South Toe River and a single site on the Nolichucky River. Low pH values (<6.0) have been observed at the South Toe River sites since 1991, with some values of less than 5.0 during fall and winter months. Long term records suggest a steady decline in pH at the South Toe River near Celo. The North Toe River at Penland (below the Spruce Pine dischargers) shows elevated conductivity values, as well as elevated fluoride values. The South Toe River sites appear to be the least affected sites, consistently having low conductivities and lower concentrations of nutrients and solids.

French Broad River Basin
040306

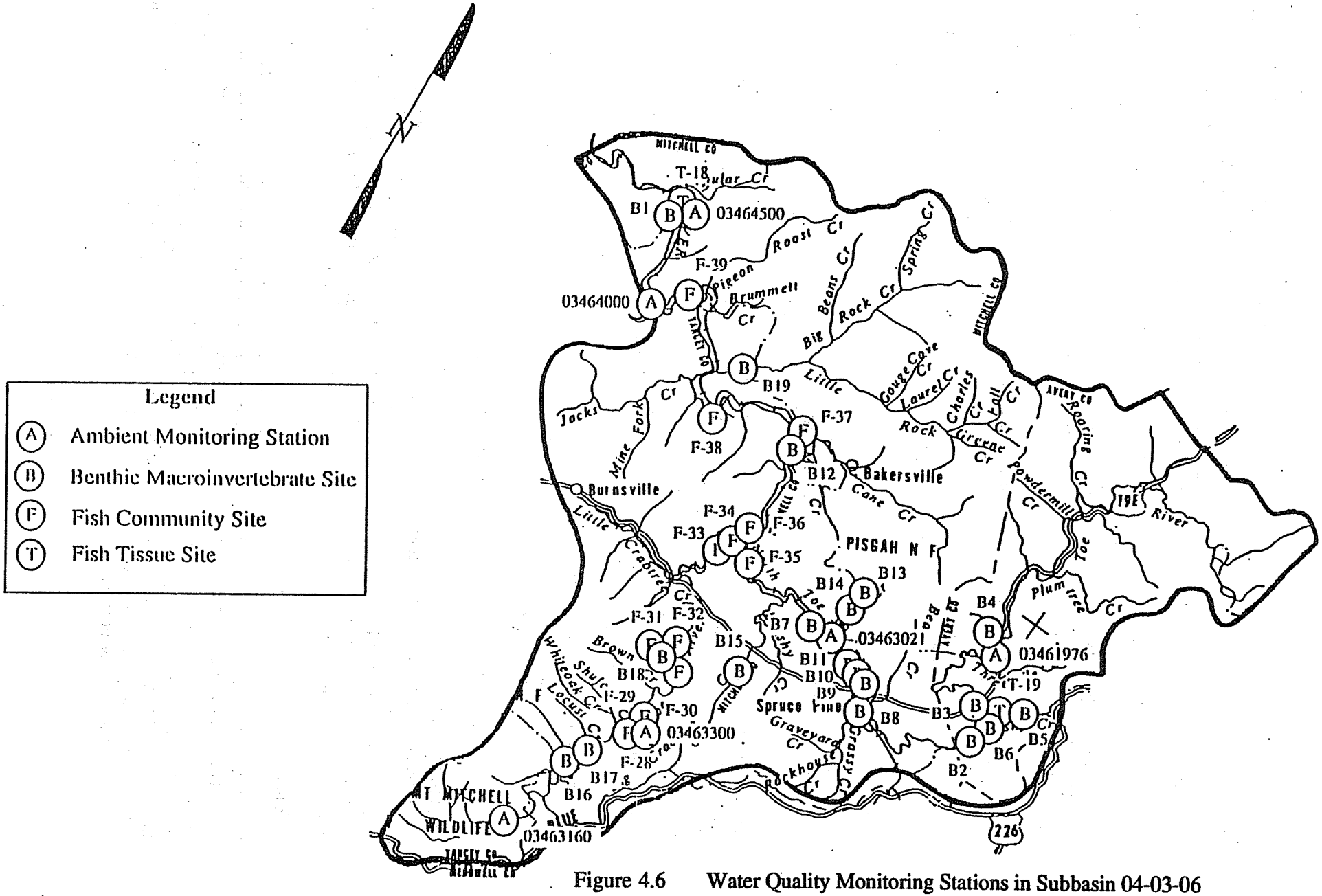


Figure 4.6 Water Quality Monitoring Stations in Subbasin 04-03-06

Benthos collections have indicated Good or Excellent water quality in most streams, but some problems are associated with dischargers in the North Toe River near Spruce Pine. Degraded areas include the North Toe River at Penland (Fair or Good-Fair), Little Bear Creek (Poor), and Brushy Creek (Good-Fair). Some improvement has been observed at the Penland site, going from Fair in 1985-1987 to Good-Fair in 1989 and 1992. The proposed endangered mussel *Alasmodonta raveleniana* has been found in the Nolichucky and North Toe Rivers.

Most of the South Toe River watershed has been designated as Outstanding Resource Waters, but the upper North Toe River and the Nolichucky River both appear to have some problems with sedimentation. Fisheries information suggested that the South Toe ORW section might be extended to include the lower seven miles, and benthos collections suggested that Big Rock Creek may qualify for ORW or HQW classification.

Two specimens of the blotched logperch, Percina burtoni, were collected in the lower portion of the South Toe River which is currently classified C-Tr. All of the South Toe River upstream of US-19E is classified ORW. Only the lower seven miles of this river are not. The South Toe River is the only known location of the blotched logperch in North Carolina. The site where this species was collected also received an Excellent ecological health rating.

POTENTIAL HQW/ORW STREAMS
Based on recent biological investigations, Big Rock Creek and its tributaries may qualify for HQW or ORW.

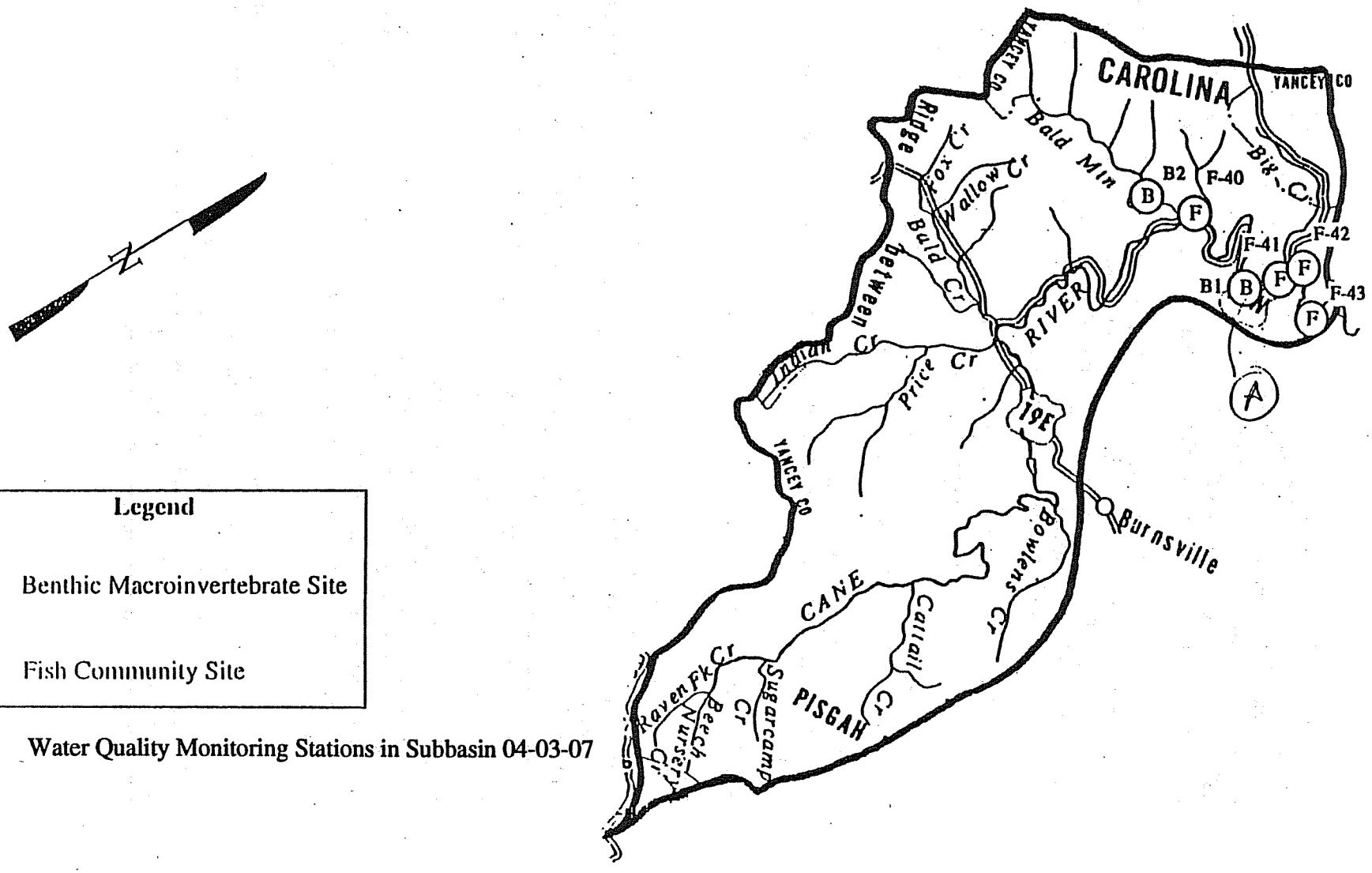
4.3.7 Subbasin 07 - Cane River Watershed

DESCRIPTION
This subbasin includes the entire Cane River catchment. About two-thirds of this subbasin is within the Pisgah National Forest, including most of the subbasin south of NC 19, plus the area north of Bald Mountain Creek. Minor development is located in the middle of the subbasin near the Town of Burnsville. Burnsville's WWTP is the only major discharger. Major tributary streams in subbasin 07 include Bald Mountain Creek and Bald Creek. Cane River and its tributaries are classified as WS-II upstream of the Town of Burnsville water supply intake. Below the water intake, most stream segments are classified as C-Tr. Bowlens Creek is classified as HQW based on its native and special native trout waters status.

OVERVIEW OF WATER QUALITY
Chemical and biological collections have been limited to the downstream portion of the Cane River subbasin. These collections include chemistry at a single ambient site (Cane River near Sioux), two invertebrate sites (Cane River and Bald Mountain Creek), and fish collections at four Cane River sites.The proposed endangered mussel *Alasmodonta raveleniana* has been found in the Cane River at US-19W.

Water chemistry data has shown few violations of water quality criteria, although the river is frequently turbid. The biological information, however, shows a clear improvement in water quality likely reflecting the improvements at the Burnsville WWTP. Benthic macroinvertebrate collections showed a change in bioclassification from Good-Fair (1983-1985), to Good in 1987 and 1989, and to Excellent in 1992. Fish collections in 1992 and 1993 also indicated Excellent water quality in the lower part of the Cane River.

French Broad River Basin
040307



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(B) Benthic Macroinvertebrate Site

(F) Fish Community Site

Figure 4.7 Water Quality Monitoring Stations in Subbasin 04-03-07

4.4 USE-SUPPORT: DEFINITIONS AND METHODOLOGY

Determining the *use support* status of a waterbody, that is how well a waterbody supports its designated uses, is a method of interpreting water quality data and assessing water quality. Use support assessments are presented in Section 4.5 using figures, tables and maps for freshwater streams and lakes within the French Broad River Basin. The methodology used in determining use support is presented in Appendix V.

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 support 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).

It should be noted that the use support ratings are most directly applicable to assessing the aquatic life support capabilities of the rated water bodies and less applicable toward assessing potential human health concerns. There are two reasons for this. First, most of the ratings are based on either biological data collection or on "evaluated" information from workshops held in the late 1980s (much of the evaluated data was based on best professional judgement which addressed sedimentation concerns). Water chemistry data (which measures heavy metals and other parameters) and fecal coliform data (an indicator of disease organisms) are collected at just 29 locations throughout the basin (locations are shown in Figures 4.1 through 4.7). Sites where fecal coliform bacteria levels have been found to be higher than the state standard of 200/100 ml are shown under the problem parameters column in Table 4.2 (the number in parentheses indicates the percent of samples that are above the standard). Second, in assigning an overall use support rating to a stream, biological data are weighted more heavily than fecal coliform or chemical data. As an example, the French Broad River near Skyland in subbasin 03 (station number 3447840) is assigned a fully supporting rating because the biological rating is Good even though the fecal coliform levels were measured above the standard 43% of the time. In summary, the use support ratings provide a reasonable indication of the overall biological health of a water body, while the potential health risk for human body contact and drinking water can only be inferred from these ratings (except in areas in close proximity to ambient water quality monitoring stations where more definitive information is available).

For the purposes of this document, the term *impaired* refers to waters that are rated as either partially supporting or not supporting their uses based on specific criteria discussed more fully in Appendix V. 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.

4.5 USE SUPPORT RATINGS FOR THE FRENCH BROAD BASIN

Use support ratings and background data for all monitored stream segments are presented in Table 4.2. Ratings for all monitored and evaluated surface waters are presented on color-coded maps in Figure 4.8. Stream use-support ratings are summarized by subbasin in Table 4.3 and Figure 4.9

4.5.1 Freshwater Streams and Rivers

Of the 4116.6 miles of freshwater streams and rivers in the French Broad basin, use support ratings were determined for 86% or 3522 miles with the following breakdown: 51% were rated

Table 4.2 Summary of Use Support Ratings for Monitored Stream Segments - French Broad River Basin (page 1 of 3)

Station Number	Station Location	Classification	Supple. Class.	Index Number	Miles	Chemical Rating 89-93	Biological Rating 1988	1989	1990	1991	1992	Problem Parameters	Overall Use Support	Source
SUBBASIN 40301														
3439000	French Broad River at Rosman, US Hwy 168	C TR		6-(1)	20.2	FS	Excellent	Excellent	Excellent		Excellent	pH(11.4),Turb(10.2)	S	
	West Fork French Broad above trout farms, off NC 281,	C TR		6-2-(0.5)a	2.8				Excellent/Excellent				S	
	West Fork French Broad, below Trout Farms at 1306, b	C TR		6-2-(0.5)b	0.5				Fair				FS	
	West Fork French Broad at NC 281, Transylvania Co.	C TR		6-2-(0.5)c	0.6			Good-Fai	Good/Good				S	
	West Fork French Broad at SR-1312, Transylvania Co.	C TR		6-2-(0.5)d	4.3						Excellent		S	
	Parker Creek, SR 1310, Transylvania	C Tr		6-2-4	4.4			Good					S	
	West Fork French Broad at NC 64, Transylvania Co.	C Tr HQW		6-2-(7.5)a	3.7			Excellent			Excellent		S	P
	West Fork French Broad at NC 64, Transylvania Co.	C Tr HQW		6-2-(7.5)b	1.1						Excellent		S	
	North Fork Flat Creek, source to Flat Creek SR 1319	C Tr		6-2-10-1	3.6			Good					S	
	North Fork French Broad at NC 215	C Tr		6-3-(6.5)a	0.4			Excellent					S	
	North Fork French Broad at SR-1324, Transylvania Co.	C Tr		6-3-(6.5)b	0.9			Good					S	
	North Fork French Broad at SR-1322, Transylvania Co.	C Tr		6-3-(6.5)c	9.0			Excellent			Excellent		S	
	Tucker CreekSR 1325, Transylvania	C Tr		6-3-10	5.4			Good-Fair					ST	NP
	Middle Fk French Broad Rv NC 178, Trans.	C Tr		6-5	4.2			Good					S	
	East Fork French Broad at SR-1105 & 1007, Transylvan	C Tr HQW		6-6-	11.5			Excellent/Excellent					S	NP
	Catheys Creek at SR-1338, Transylvania Co.	WS-II Tr (HQW)		6-16-(0.5)	4.3			Excellent				Sed	S	NP
3443000	French Broad River at Blantyre, SR-1503	C		6-(27)	26.9	FS						Fecal (21.7)	FS	NP
3441440	Little R from NC 276 to nr Cedar Mt, be High Falls, ab B	C Tr		6-38-(1)b	10.1	FS		Good				pH(24.1)	S	NP
	Little River at SR 1533 Transyl.	C		6-38-(20)	4.8						Good -Fair	Sed	ST	NP
SUBBASIN 40302														
3446363	Mud Creek at SR-1508 above & below WWTP, Henderso	C		6-55-(1)	15.2	NS					Poor	Fecal(78.9),Turb(10.5)	NS	P
	Bat Fork at SR-1807, NC 176 , SR-1809, SR-1803, SR	C		6-55-8-1	4.8			Poor					NS	NP,P
	Clear Creek, SR 1513, Henderson Co.	C		6-55-11-(5)	6.3						Poor		NS	NP
3451500	French Broad River near Asheville, SR-1348	C		6-(67.5)a	11.5	NS					Good-Fair	Fecal(57.1)	ST	
3451926	French Broad River at Alexander, SR-1634	C		6-(67.5)b	9.6	NS			Good-Fair		Fair	Fecal(45.5),Turb(18)	FS	
3453500	French Broad River at Marshall, NC Hwy 213	C		6-(67.5)c	33.9	NS	Fair		Good-Fair		Good-Fair	Fecal(56.8),Turb(16)	ST	P
	Hominy Cr., SR 1141, Luther , Buncombe Co.	C		6-76a	6.4			Good-Fair				Sed	ST	NP
	Hominy Cr., NC 151 @ Candler, Buncombe Co.	C		6-76b	3.3						Good	Sed	S	NP
	Hominy Cr., NC 112 ab. Enka Lake, Bumcombe Co.	C		6-76c	3.1						Fair	Sed	FS	NP
344876545	Hominy Cr., SR 3412 @ Sand Hill, Buncombe Co.	C		6-76d	8.7	NS					Poor	Sed, Fecal(71.4)	NS	NP, P
	S Hominy NC 151 at Cndler, Buncombe	C Tr		6-76-5	6.4						Good-Fair		ST	
	Swannanoa River, NC 81/240, Buncombe Co.	C		6-78d	10.6		Fair						FS	NP
	Swannanoa River US 25 nr Biltmore	C		6-78e	0.2		Fair						FS	NP
3451000	Swannanoa River at Biltmore	C		6-78f	1.3	NS	Poor		Fair		Good-Fair	Fecal(47.6), Hg(19.4)	ST	NP
	Flat Cr, nr Hwy 9 ab Big Piney Cr, Buncombee	C HQW		6-78-6-(1)	2.4					Excellent			S	P
	Big Slaty Br, nr Hwy 9 ab Slay Br. Bun	C HQW		6-78-6-2	0.8					Excellent			S	
	Little Slaty Br, nr Hwy 9 ab Big Piney Cr, Buncombe	C HQW		6-78-6-3	1.1					Excellent			S	
	Big Piney Cr, nr Hwy 9 nr Montreat, Bun.	C HQW		6-78-6-5	1.0					Excellent			S	
	Laurel Br, nr mouth, Buncombe	B Tr		6-78-8-(2)	1.5						Excellent		S	
		C HQW		6-78-10-(1)	1.0					Excellent			S	
3450000	Beetree Creek near Swannanoa	WS-I (HQW)		6-78-15-(1)	4.3	FS						pH (12.2)	FS	
	Newfound Creek at SR-1296 Buncombe Co	C		6-84a	3.9		Excellent	Excellent				Sed	S	NP
	Newfound Creek at SR-1297 and Vickie Lane	C		6-84b	1.3			Fair				Sed	FS	NP

Table 4.2 Summary of Use Support Ratings for Monitored Stream Segments - French Broad River Basin (page 2 of 3)

Station Number	Station Location	Classification	Supple. Class.	Index Number	Miles	Chemical Rating 89-93	Biological Rating 1988	1989	1990	1991	1992	Problem Parameters	Overall Use Support	Source
	Newfound Creek at SR-1378, Buncombe Co.	C		6-84c	2.3		Fair					Sed	FS	NP
	Newfound Creek at SR-1622, Buncombe Co.	C		6-84d	6.6		Poor	Fair				Sed	NS	NP
	Reems Creek, NC 251, Buncombe Co.	C		6-87-(10)	4.2						Good-Fair		ST	
	Flat Creek, Hwy. 70, Buncombe Co.	C		6-88a	12.3		Fair					Sed	FS	NP
	Flat Creek, SR 1741 Buncombe	C		6-88b	0.1		Good-Fair					Sed	ST	NP
	Sandymush Cr, SR 1114 Madison/SR1607 Buncombe	C		6-92-(9)	11.1						Excellent	Sed	S	NP
SUBBASIN 40303														
3441000	Davidson River near Brevard, US Hwy 64/B1 is at 276 c	WS-V Tr		6-34-(17)	2.3	FS					Excellent	pH (25)	S	
3447840	French Broad River near Skyland, NC Hwy 280	WS-IV		6-(51.5)	13.2	NS			Good		Good	Fecal (42.9)	S	P
	Boylston Cr, SR 1314, Henderson	WS-IV		6-52-(10.5)	4.2						Good-Fair		ST	
3446000	Mills River near Mills River, SR-1337	WS-II Tr		6-54-(1)	2.8	S	Excellent		Excellent		Excellent		S	
344495065	Bradley Creek off SR 1345 nr Yellow Gap (3 sites)	WS-I ORW		6-54-3-17	2.6	NS				Excellent		pH (31.6)	S	
	Mills R, SR 1353	WS-IV		6-54-(5)	2.6						Good		S	NP
SUBBASIN 40304														
	Ivy Creek (River), SR 2150, Buncombe	WS-II (HQW)		6-96-(0.5)	7.7						Excellent	Sed	S	NP
	Little Ivy Cr, SR 1610, Madison	WS-II (HQW)		6-96-10	4.7						Good	Sed	S	NP,P
	Ivy Cr NC 25/70 Bus, Madison	C		6-96-(11.7)	10.2						Good	Sed	S	NP
	Hunter Cr nr Hunter Cr R nr Marshal, Madison	C HQW		6-106-2-(1)	1.3					Excellent			S	NP
	Big Laurel Cr NC 208 Madison	C Tr		6-112	33.1						Excellent		S	P
	Shelton Laurel Creek at NC 212, Madison Co.	C Tr		6-112-26	17.2				Excellent		Good		S	
	Hickory Fork at SR-1310, Madison Co.	C Tr		6-112-26-7	1.1				Excellent				S	
	West Prong Hickory Fork at SR 1310, Madison Co.	C Tr		6-112-26-7-1	2.8				Excellent				S	
	East Prong Hickory Fork at FR 465, Madison Co.	C		6-112-26-7-2	3.6				Excellent				S	
	Spring Cr, NC 209, Madison	C		6-118-(27)	1.8						Good-Fair	Sed	ST	NP
SUBBASIN 40305														
3456991	Pigeon R at NC HWY 215 near Canton, NC Haywood	WS-III Tr		5-(1)	4.2	S	Good-Fair				Good		S	
3455500	West Fork Pigeon River Burnett Siding, and UT W Fk Pig	WS-III Tr		5-(2)	18.2	FS			Excellent	Excellent		pH (18)	S	
	Tom Creek at NC 215, Haywood, Co.	WS-III Tr		5-2-5	1.5					Excellent			S	
	Middle Prong West Fork Pigeon River at mouth, Haywoo	WS-III Tr HQW		5-2-7	3.9				Excellent	Excellent			S	
345541335	Right Hand Prong,Site #2 , 91 BMAN Haywood, Co.	WS-III Tr HQW		5-2-7-7	3.0	FS			Excellent	Excellent		pH(16.7)	S	
	UT Little E Fk Pigeon R, nr Shining Rock. Haywood	WS-III Tr HQW		5-2-12-(0.5)	4.0					Excellent			S	
	Little East Fork Pigeon River, SR 1129 ab camp, Haywo	WS-III Tr HQW		5-2-12-(5.5)	4.2					Excellent			S	
3456991	Pigeon R at NC HWY 215 near Canton, NC Haywood	WS-III Tr HQW		5-(6.5)	0.6	S	Good-Fair				Good		S	
3457124	Pigeon River at Clyde, SR-1642	C		5-(7)a	7.0	NS	Fair/Poor	Fair			Fair	Dioxin, Fecal(31.8)	FS	P
	Pigeon River at Crabtree Ck nr Crabtree Haywd B-12	C		5-(7)b	7.9		Fair					Dioxin	FS	P
3459780	Pigeon River near Hepco, SR-1338	C		5-(7)c	7.0	NS	Fair					Dioxin, Fecal (52.4)	FS	P
	Pigeon River at Hurrican Cr, Haywood	C		5-(7)d	8.7						Good-Fair	Dioxin	FS	P
	Pigeon River at Counterfeit Br, Haywood	C		5-(7)e	5.4						Good	Dioxin	FS	P
3460766	Pigeon River at Waterville, SR-1184	C		5-(7)f	2.6	S	Good	Good/Fair	Good-Fair			Dioxin	FS	P
	Bus 23 above Dayco, Haywood Lake Junaluska Dam/SR	B		5-16-(1)a	8.0						Fair		FS	
3458121	Richland Creek near Waynesville, SR-1184	B		5-16-(1)b	6.7	NS	Fair				Good-Fair	Fecal (57.8)	ST	
	Rocky Br, SR 1219 haywood	C HQW		5-16-7-9-(1)	2.3					Excellent			S	
	Richland Cr SR 1519, Haywood	C		5-16-(16)	2.4						Fair	Sed	FS	NP

Table 4.2 Summary of Use Support Ratings for Monitored Stream Segments - French Broad River Basin (page 3 of 3)

Station Number	Station Location	Classification	Supple. Class.	Index Number	Miles	Chemical Rating 89-93	Biological Rating 1988	1989	1990	1991	1992	Problem Parameters	Overall Use Support	Source
	Jonathons Creek at SR 1306	C Tr		5-26-(7)a	1.2						Excellent	Sed	S	NP,P
	Jonathons Creek at SR 1322 Haywood	C Tr		5-26-(7)b	8.0						Good	Sed	S	NP
345887470	Jonathons Creek at US HWY 276 (or SR 1350) nr Cove	C Tr		5-26-(7)c	5.3	PS					Good-Fair	Sed, Turb (14.3)	ST	NP,P
	Fines Cr, SR 1355 nr I 40 Haywood	C		5-32	10.4						Good-Fair		ST	NP
3460000	Cataloochee Creek near Cataloochee at SR-1395, Hayv	C Tr	ORW	5-41	8.5	S		Excellent	Excellent	Excellent	Excellent		S	
	UT Rough Br, nr SR 1395, Haywood	C Tr	ORW	5-41-1	4.6					Excellent			S	
	Palmer Creek nr SR 1395, Haywood Co.	C Tr	ORW	5-41-2	3.2					Excellent			S	
	Pretty Hollow Creek nr SR 1395, Haywood Co.	C Tr	ORW	5-41-2-4	3.7					Excellent			S	
	Lower Double Creek at SR-1397, (ab Cataloochee Cr nr	C Tr	ORW	5-41-6	1.2				Excellent				S	
	Little Cataloochee Creek at SR-1397, Haywood Co.	C Tr	ORW	5-41-10	1.7				Excellent				S	
	Cold Spns Cr, Gov Rd nr cmpg Haywood	C Tr		5-45	6.2						Excellent	Sed	S	NP
SUBBASIN 40306														
3464500	Nolichucky River at Poplar SR-1321	C		7	10.0	S	Good		Good		Good		S	
3461976	North Toe River near Ingalls, US Hwy 19E, Avery Co.	WS-III Tr		7-2-(0.5)a	23.8	PS	Good	Good			Good	Turb (16.1)	S	P
	North Toe River 19E, below Brushy Creek, Avery Co.	WS-III Tr		7-2-(0.5)b	15.8			Good/Fair					ST	
	Above and Below the Landfill, Avery Co.	WS-III Tr		7-2-29-	3.6			Good/Fair				Sed	ST	NP,P
3463021	North Toe River at Penland , SR-1162, Mitchell Co.	C Tr		7-2-(38.5)d	1.3	NS	Poor	Good/Fair			Good/Fair	Turb(32.3),Fecal(22.7)	ST	NP
	North Toe River SR 1314, Yancey	C Tr		7-2-(38.5)e	28.0						Good		S	NP
	Crabtree Cr at SR 1002, Mitchell	C Tr		7-2-48	15.5						Good		S	
3463160	South Toe River near Deep Gap	B Tr	ORW	7-2-52-(1)a	1.3	NS						pH(26.8),Hg(10.7)	*S	NP
	South Toe River above and below NC 80 bridge	B Tr	ORW	7-2-52-(1)b	9.0				Excellent		Excell/Good		S	
3463300	South Toe River near Celo, SR-1168	B Tr	ORW	7-2-52-(1)c	15.0	PS	Excellent				Excellent	pH(20.8)	S	
	Big Rock Cr, NC 197, Mitchell	C Tr		7-2-64	14.6						Excellent		S	
SUBBASIN 40307														
3464000	Cane R SR 1417, nr 19W, nr Ramseytown, Yancey	C Tr		7-3-(13.7)	23.9	NS		Good			Excellent	Turb(33.3), Temp(13.3	S	P
	Bald Mt Cr, SR 1408, Yancey	C Tr		7-3-32	8.4						Good-Fair		ST	

Explanation of Column Headings

Station Number	Refers to sites where ambient water quality data (physical and chemical data) are collected monthly
Station Location	Locations for all monitoring sites (biological and chemical). See Section 4.2 for descriptions.
Classification	Water quality classification of monitored stream segment. See Section 2.5 (Chapter 2) and Appendix II.
Supple. Class.	Supplemental Classifications. See Section 2.5 (Chapter 2) and Appendix II.
Index Number	Reference number used by DEM to identify specific stream segments
Chemical Rating	Lists the use-support rating for that station based on chemical monitoring data. See Table 4.1 for types of data collected. Ratings are explained in Section 4.4.
Biological Rating	These ratings are based on sampling and evaluation of bottom-dwelling aquatic insect larvae (benthic macroinvertebrates) and fish . There are five ratings: Excellent, Good, Good-Fair, Fair and Poor. See Appendix II for further details.
Problem Parameters	Causes of water quality impairment are listed if either the chemical rating is PS (partially supporting) or NS (not supporting) The numbers in parentheses refer to the percentage of samples which exceed the water quality criteria at that station.
Overall Use Support	Provides the use support rating based on weighing the chemical and biological ratings. The biological ratings are given more weight. See Section 4.4 for further explanation

Key to Abbreviations

Fecal	Fecal Coliform Bacteria
Hg	Mercury
NP	Nonpoint Sources
NS	Not Supporting
P	Point Sources
PS	Partially Supporting
Sed	Sediment
ST	Support-threatened
Temp	Temperature
Turb	Turbidity

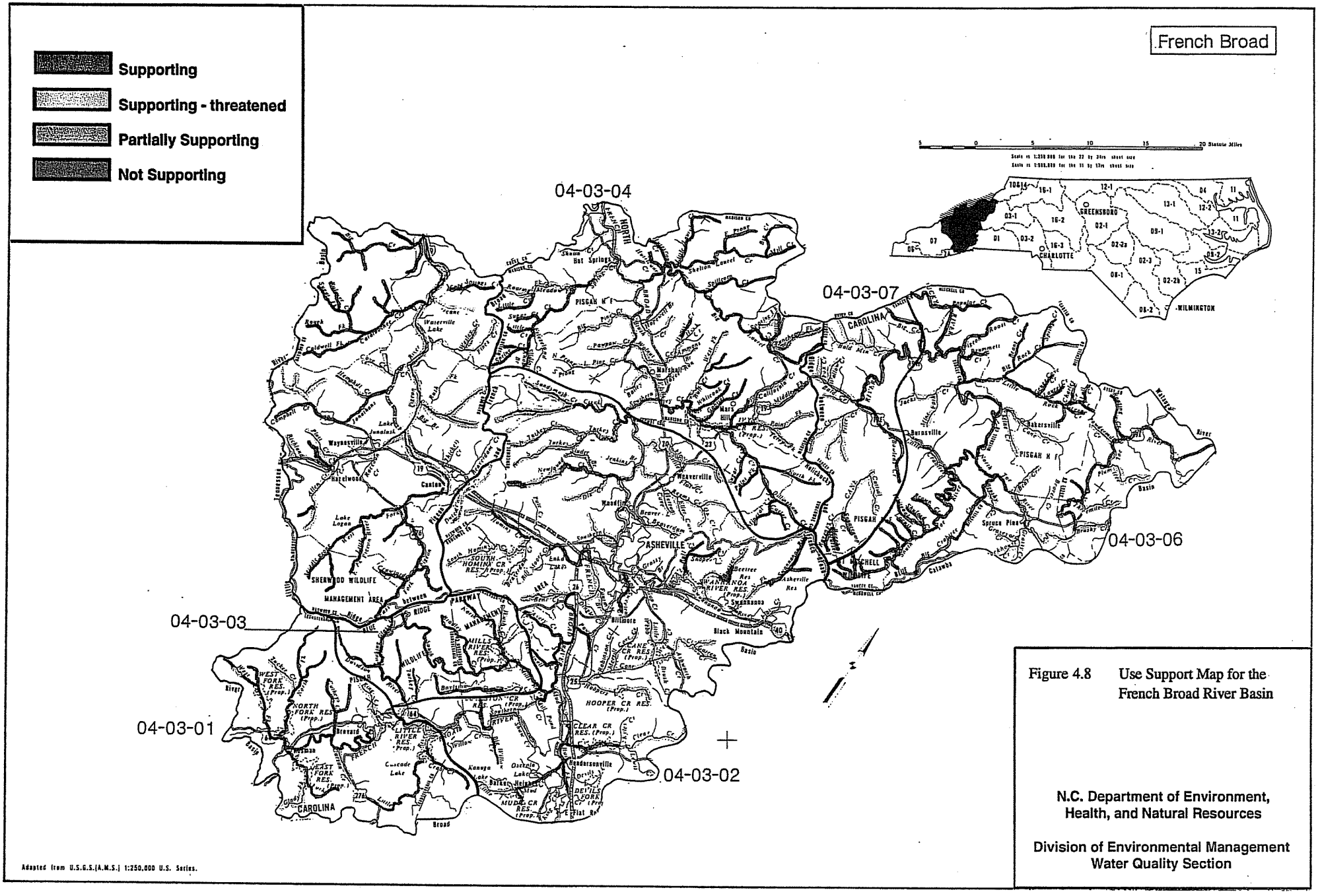

Figure 4.8 Use Support Map for the French Broad River Basin

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

Division of Environmental Management
Water Quality Section

Table 4.3 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
40301	327.7	52.3	34.6	0.4	25.3	440.3
40302	132.8	298.2	179	53.5	306.2	969.7
40303	223.6	6.2	4.2	0	2.8	236.8
40304	433	132	77.9	0	111.9	754.8
40305	409.4	158.8	71.6	3.5	133.8	777.1
40306	474.3	206.8	26.5	0.5	9.6	717.7
40307	97.8	113.7	3.9	0	4.8	220.2
TOTAL	2098.6	968	397.7	57.9	594.4	4116.6
PERCENTAGE	51	24	10	1	14	100

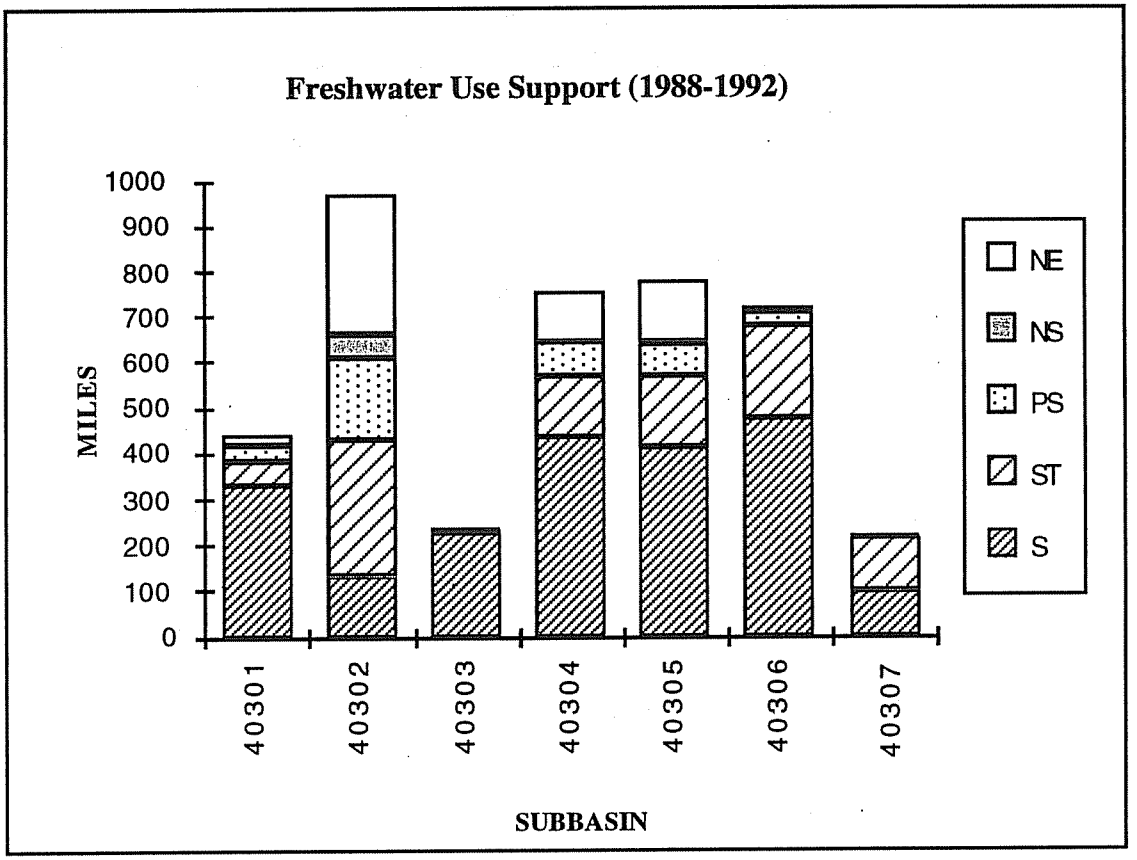

Figure 4.9 Bar Graph Showing Freshwater Use Support Distribution by Subbasin

fully supporting, 24% support-threatened, 10% partially supporting, one percent not supporting, and 14% nonevaluated. Table 4.3 and Figure 4.9 present the use support determinations by subbasin. In general, subbasins 01 and 03 through 07 had a majority of their streams which were either supporting or support-threatened. Subbasin 02, which includes the Asheville and Hendersonville urban areas, had a larger percentage of streams which were partially supporting or not supporting.

Probable causes and sources of impairment were determined for about 78% of the impaired streams with the information summarized in Tables 4.4 and 4.5. 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 4.3. As an example, if a 10-mile long stream segment was determined to be impaired as a result of both point sources and urban development, then 10 miles would be entered under both the urban

Table 4.4 Sources of Use Support Impairment in Freshwaters of the French Broad Basin

PROBABLE SOURCES OF USE SUPPORT IMPAIRMENT (MILES)									
Subbasin	Non-Point Source	Point Source	Agriculture	Forestry	Constr.	Urban	Mining	Land Disposal	Unknown
40301	34.5	27.3	28.9	0	4.2	26.9	0	0.4	1
40302	182.9	53.6	138	0	55.3	40	0	22.6	6.9
40303	4.2	0	0	0	0	4.2	0	0	0
40304	77.3	0	53.2	0	0	0	0	0	24.1
40305	28.5	0	17.6	4.9	0	2.4	0	0	10.9
40306	24.6	0	18	5.8	1.1	1.1	3.6	0.5	3
40307	3.9	0	0	0	0	0	0	0	3.9
Total Miles	355.9	80.9	255.7	10.7	60.6	74.6	3.6	23.5	49.8
% of PS and NS	78	18	56	2	13	16	1	5	11

* **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) = 455.6 miles (from Table 4.4)

Table 4.5 Major Causes of Use Support Impairment in Freshwaters in the French Broad Basin

CAUSES OF USE SUPPORT IMPAIRMENT (MILES)					
Subbasin	Sediment	Fecal	Dioxin	Turbidity	pH
40301	4.2	26.9	0	0	0
40302	155.1	33.5	0	24.8	4.3
40303	4.2	0	0	0	0
40304	77.3	0	0	0	0
40305	20.4	14	38.6	0	0
40306	1.1	0	0	0	0
40307	3.9	0	0	0	0
Total Miles	266.2	74.4	38.6	24.8	4.3
% of PS and NS	58	16	8	5	1

column and point source column in Table 4.4. 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, dioxin, turbidity and pH.

Information on sources of impairment for stream miles rated partially or not supporting indicated that 356 stream miles were impaired by nonpoint sources, and 81 stream miles were impaired by point sources. Agriculture was the most widespread nonpoint source, followed by urban runoff, and construction. Subbasins 02 and 04 had the highest number of streams thought to be impaired by agriculture and subbasins 01 and 02 had the highest number attributed to urban runoff.

4.5.2 Lakes

Seven lakes in the French Broad Basin, totaling 1,373 acres, were monitored and assigned use support ratings (Table 4.6). Of these 7, six are fully supporting their uses and one is partially supporting its uses.

Four of the seven lakes are located in subbasin 02. Lake Julian, Burnett Reservoir, and Beetree Reservoir are all designated as water supplies, and all have been found to be oligotrophic. The fourth lake, Busbee Reservoir, is classified as C and is also oligotrophic. All four lakes fully support all of their designated uses.

In subbasin 05 (Pigeon River watershed), Allen Creek Reservoir is classified as WS-I and is fully supporting. This lake was selected to be evaluated as a potential regional reference lake in 1991. Extensive monitoring during the last three years have shown nutrients, chlorophyll *a*, algae biovolume and density all to be low. Lake Junaluska is classified B and supports its designated uses. It is mesotrophic and has had historic problems with sedimentation and eutrophication. The sedimentation has increased primarily due to highway construction and residential growth in the watershed.

Waterville Lake is classified as C, and it has been rated as partially supporting its designated uses based on a fish consumption advisory for carp and catfish (due to elevated dioxin levels) and on high nutrient levels in the lake. Champion mill and several other wastewater treatment plants discharge to waters upstream of Waterville Lake. In 1988, DEM and EPA collected fish from the Pigeon River and Waterville Lake and analyzed the tissue for dioxin. Elevated dioxin levels were found in the fish tissues of all species and an advisory was issued by the state not to consume any fish from the river and lake. The lake was rated as not supporting its uses. Champion implemented a dioxin minimization plan in the mid to late 1980s and completed a plant modernization project in April 1994 which has essentially eliminated dioxin in its effluent. More recent fish tissue analyses found reduced dioxin levels. In response to the most recent tissue sampling data, the State Health Director adjusted the advisory to state that it would apply to just carp and catfish. The current advisory reads as follows:

> "Carp and catfish in the Pigeon River may contain low levels of dioxins and should not be consumed. Consumption of all other fish species is not considered to present a health risk and are not affected by this advisory. Swimming, boating and other recreational activities present no health risk."

Monitoring for dioxin in carp and catfish tissue will continue at Waterville Lake annually. Champion also reports substantially reduced discharges of ammonia nitrogen, orthophosphate and organic nitrogen and phosphorus resulting from its plant improvements. DEM is recommending that a nutrient budget be developed for the lake and that a nutrient management plan addressing both point and nonpoint pollution sources be developed. The use-support rating for Waterville

Lake and the other lakes in the basin will be reevaluated based on upcoming monitoring in preparation for the French Broad River basin plan update in 2000.

Table 4.6 Lakes Use Support Status and Causes and Sources of Impairment

LAKE NAME	County Name	Size Acres	Class	Over-all Use	Aq. Life & Fish Adv	Secondary Contact	Swim-ing	Drink-ing Water	Trophic Status	Problem Parameters
Subbasin 02										
LAKE JULIAN	Buncombe	320	C	S	S	S	n/a	n/a	Oligo.	
BURNETT RESER	Buncombe	330	WS	S	S	S	n/a	S	Oligo.	
BEETREE RESER	Buncombe	41	WS	S	S	S	n/a	S	Oligo.	
BUSBEE RESER	Buncombe	8	C	S	S	S	n/a	n/a	Oligo.	
Subbasin 05										
WATERVILLE LK	Haywood	340	C	PS	PS	PS	n/a	n/a	Eutro.	Priority Organ-ics, Nutrients
LAKE JUNALUSKA	Haywood	200	B	S	S	S	S	n/a	Meso.	(sediment)
ALLEN CREEK RES	Haywood	120	WS	S	S	S	n/a	S	Oligo.	

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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 French Broad 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. NPDES Permit Review and Processing (Section 5.2.2),
2. Wasteload Allocation Modeling (Section 5.2.3),
3. Compliance Monitoring and Enforcement (Section 5.2.4),
4. Aquatic Toxicity Testing (Section 5.2.5),
5. Pretreatment (Section 5.2.6),
6. Operator Certification and Training (Section 5.2.7) and
7. Nondischarge and Regional Wastewater Treatment Alternatives (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 French Broad basin, for example, all of the existing permits will expire and be renewed between August 1995 and December 1996. The permitting schedule for the French Broad 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 should 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 (which may actually be conducted prior to submittal of complete application for existing facilities that are up for renewal). If the Division finds the application acceptable, then a public notice, called a Notice of Intent to Issue, 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 sufficient interest. Under Basinwide Management, the Notice of Intent will include all of the permit applications for a particular subbasin (or subbasins) that will be issued within a given month. A public hearing would be scheduled for just those applications where sufficient 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 IV, 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 SOP manual has been developed to support State and Federal regulations and guidelines and has 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. 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, then the facility will 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 SOP alone does not provide adequate guidance. Since the SOP addresses mostly single discharge or relatively simple interaction of multiple discharges, WLA procedures outside the realm of the SOP represent the larger, basinwide strategy that DEM is implementing.

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 monitoring, 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. The NC Biological Laboratory Certification Program, much like WET permitting in North Carolina, is looked at as a national leader in its field.

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.

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 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 land application of residuals and 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 Regional 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, trickling systems and underground injection. 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 French Broad 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

	MANAGEMENT AGENCIES		
PROGRAM	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	SWCD	DEM, DSW, CES	SCS
Laboratory Testing Services		NCDA	
Watershed Protection (PL-566)			SCS
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.; **SCS**, Soil 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, 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. Common agricultural BMPs are listed in Appendix VI.

- **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-Soil 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 French Broad River Basin districts, approximately $3.43 million in BMP cost share dollars have been spent. 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 North Carolina, 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 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 pounds of hazardous waste and less than 2 pounds 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. Their were 92 registered operations in the French Broad Basin as of November 1994. 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 Soil 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, plans are to be making more routine inspections to make sure that 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 an individual nondischarge permit. An illegally discharging operation may also be designated as a concentrated animal feeding operation (CAFO), be fined $5,000 and be required to apply for a NPDES discharge permit.

- **NC Cooperative Extension Service and Agricultural Research Service**
Crop and animal production programs are administered under the research and education activities of the NC Agricultural Research Service (ARS) and the NC 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 NC Agricultural Research Service and the NC 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. In addition, CES has begun assisting DEM in holding a series of public workshops in each river basin prior to DEM's preparation of the draft basin plan. The June 2, 1994 workshop for this basin is discussed in the Executive Summary and in Appendix V.

- **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-Soil Conservation Service in cooperation with the NC 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 French Broad 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 Soil Conservation Service (SCS). Other cooperating agencies include the NC CES, 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 Soil 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 Soil 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 Soil 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, Raleigh, Winston-Salem and Fayetteville/Cumberland County. 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. Common best management practices to address urban runoff are listed in Appendix VI.

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 (BAT)/Best Conventional Pollutant Control Technology (BCT) 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 jurisdiction 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 25 local governments in the French Broad 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 NC 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 (see examples listed in Appendix VI) 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 French Broad 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 NC 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. BMPs for onsite sewage systems are listed in Appendix VI.

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 sanitariums 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. Commonly used forestry BMPs are listed in Appendix VI.

- **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. Common BMPs for mining activities are listed in Appendix VI.

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 streams 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 French Broad basin, 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 French Broad River Basin. The French Broad River, for example, is composed of 3 separate watersheds in North Carolina (Pigeon, French Broad, and Nolichucky) 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 French Broad 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

WATER QUALITY CONCERNS, GOALS AND RECOMMENDED MANAGEMENT STRATEGIES FOR THE FRENCH BROAD RIVER BASIN

6.1 BASINWIDE MANAGEMENT GOALS

The French Broad basin has experienced significant population growth and development over the past 20 years and that growth is expected to continue. From an economic standpoint, this is viewed very positively by businesses, local governments and others. However, as the population grows, so will the volume of wastewater that will need to be treated. In addition, land development accompanying population increases will generate additional nonpoint source pollution.

The long-range goal of basinwide management is to provide a means of addressing the complex problems of planning for increased development and economic growth while enhancing and/or restoring the quality and intended uses of the French Broad Basin's surface waters.

In striving towards the long-range goal stated above, DEM's highest priority near-term goals will be as follows:

- identification and restoration of the most serious water quality problems in the basin (**Section 6.2.1**),
- protection of those waters known to be of the highest quality or supporting biological communities of special importance (Section 6.2.2), and
- management of problem pollutants, particularly toxic substances, sediment, nutrients, biochemical oxygen demand and fecal coliform bacteria in order to correct existing water quality problems and to ensure protection of those waters currently supporting their uses (Sections 6.2.3 and 6.3 through 6.8).

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. A list of those impaired waters has been compiled in Table 6.1. Table 6.1 includes those streams which have been monitored. Monitored streams are those based on biological or chemical data collected between 1987 and 1993. The table includes the current and future water quality management strategies for these waters.

Current Management Strategies, as presented in the table, include several categories of recommended or ongoing point or nonpoint source pollution control strategies. These are described below. *Future Management Strategies*, in Table 6.1, includes those followup actions needed to assess the effectiveness of current strategies or to identify further studies or investigations needed to identify the causes of impairment.

The first category of current management strategies includes specific strategies for a particular water body that have either been recently implemented or are now underway. For example, there

Table 6.1 Recommended Strategies for Impaired Streams in the French Broad Basin

Sub-basin	Name of Water Body	Current Mgmt. Strategy	Future Management Strategy	Reference Sections	NPS Priority
01	W. Fork	Issue gen. permits for trout	Review trout farm general	6.6.1	Medium
	Fr. Broad	farms	permits and farm operations		
02	Mud Creek	PS (consolidate discharges),	Relocate, expand & upgrade	6.3.4, 6.6.4	High
		NPS	Hendersonville WWTP		
	Bat Fork Cr	Remove GE discharge, NPS	Monitor	6.4.4	High
	Clear Cr	NPS (possible pesticides)	IS	6.3.2	High
	Hominy Cr	NPS	CEP, monitor	6.3.4, 6.5.4	High
	Gash Cr	Upgrade WWTPs	Monitor	6.6.4	
	Fr. Broad R.	NPS	Level C model study	6.5, 6.6.1	High
	Swannanoa	NPS	Monitor	6.6.1	High
	Newfound Cr	NPS (agriculture, sediment)	CEP, monitor	6.4	High
05	Walters Lake	PS (upgrade Champion), NPS	Monitor, develop nutrient budget	6.3, 6.5	High
	Pigeon River	PS (upgrade Champion)	Monitor	6.3	
	Richland Cr	PS (upgrade Dayco), NPS	Monitor	6.3	High
	Lk Junaluska	NPS	CEP, monitor	6.5	Medium
	Jonathon Cr	PS (consolidate discharges),	Monitor	6.6.2	Medium
		NPS			

	DEFINITIONS
NPS	Includes all existing agricultural, urban, and local NPS control programs, summarized in Table 5.1.
PS	Areas where specific point source control strategies are needed to address water impairment
CEP	Continue Existing Programs. Many programs are in their initial phases. More time is needed to monitor their effectiveness toward restoring these waters.
IS	Investigate Sources. Involves cooperative efforts between government agencies to identify and prioritize where BMPs need to be implemented.

are plans that are in place to remove or upgrade existing wastewater treatment plants, but the plants have not yet been removed or the upgrades not completed. Even where pollutant reductions have been achieved, it may take some time for the effects to be measurable, particularly in the Pigeon River and Waterville (Walters) Lake. The future management strategy for this category of current strategies will typically be to conduct periodic monitoring to assess the effectiveness of the strategy.

A second category of current management strategies includes ongoing programs for planned expansion and regionalization of wastewater treatment plants (WWTPs) to reduce pollution loading to waters of the French Broad Basin. Under these programs, many small dischargers in the basin are currently in the process of connecting to new sewer lines particularly with Henderson and Buncombe counties to remove point sources from small tributaries. As in the above example, the future strategy will be to monitor the waters to assess the effectiveness of these efforts. A good example of a successful program of this type is in the Swannanoa River. Monitoring data have shown marked improvements in water quality resulting from new interceptor lines and removal of smaller discharges and septic systems.

A third category includes broad-based nonpoint source pollution control programs many of which 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 lands, are examples of potentially effective ongoing programs which should reduce water quality impacts of certain agricultural activities over the long run. Another agricultural-related strategy is a new set of regulations pertaining to concentrated animal waste operations (NCAC 2H 0.200). These rules require existing operators of large operations to develop and implement waste management plans by 1997. The planned management strategy for this category of current strategies is to allow these programs to continue and to conduct monitoring.

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 French Broad Basin is the Clear Creek study. DEM is sampling Clear Creek to determine the source of impairment. A management plan for Clear Creek is to be developed based on the outcome of the stream study.

In other waters where the causes of impairment have been identified, new programs are expected to be implemented in the next several years. The state is now in the process of implementing an NPDES permit program for urban runoff for municipalities greater than 100,000 population that will not apply to any discharges in the French Broad basin based on population size. However, Asheville is implementing a stormwater management program on its own. Many streams impacted by urban runoff in subbasin 02 are expected to benefit from this program.

The list of impaired streams in Table 6.1 cannot be considered a comprehensive list of all streams where water quality improvements are necessary. This list includes just those impaired streams that have been identified through water quality monitoring conducted by DEM as presented in Table 4.2 of Chapter 4. DEM has monitored less than half of the stream miles in the basin, therefore, some impaired stream segments may not yet have been identified by DEM. Stream segments where water quality issues may exist but specific data have not been obtained to evaluate water quality have been identified by public comment, State and Federal agency comment, and other sources. For example, the following streams were identified at regional workshops as having impairments due to excess sedimentation: Corner Rock Creek, Puncheon Fork, Roaring Fork, Hurricane Creek, Right Fork Cane Creek and Little Creek.

Monitoring of these streams is recommended. The lack of resources at the state level to conduct more widespread monitoring, especially in smaller streams, enhances the value of localized monitoring efforts such as those conducted through the VWIN (Volunteer Water Information Network) sampling program. VWIN is being conducted by citizen volunteers in Buncombe, Henderson and Madison counties. Technical assistance is being provided by the University of North Carolina-Asheville Environmental Quality Institute.

The *NPS 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.

High priority streams:

- monitored streams that have an overall use support rating of "nonsupporting," (Figure 6.1)
- monitored streams that have a "partial support" rating but have a predicted loading of one or more pollutants that is high, (Figure 6.1)
- streams that are unusually sensitive as documented by special studies (discussed in Section 6.2.2, below, and depicted in Figures 2.6 to 2.9 in Chapter 2):

  - High Quality Waters
  - Outstanding Resource Waters
  - Water Supply I; Water Supply II; Critical Areas of WS-II, WS-III, WS-IV
  - Coastal Shellfish Waters (Class SA) with a Significant Shellfish Resource (SSR) closed due to pollutants (as identified by the Division of Environmental Health).

Medium priority streams:

Monitored streams that have an overall use support rating of "partially supporting" (Figure 6.1). Shellfish Waters (Class SA - coastal waters only) 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 (see Appendix I) may include designated 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 (WS I and II). 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 or SC (Appendix I). Designated HQWs/ORWs in the French Broad basin are presented in Table 2.8 in Chapter 2.

In addition, 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. Possible protection measures may include dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, backup power provisions to minimize accidental plant spills, 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.

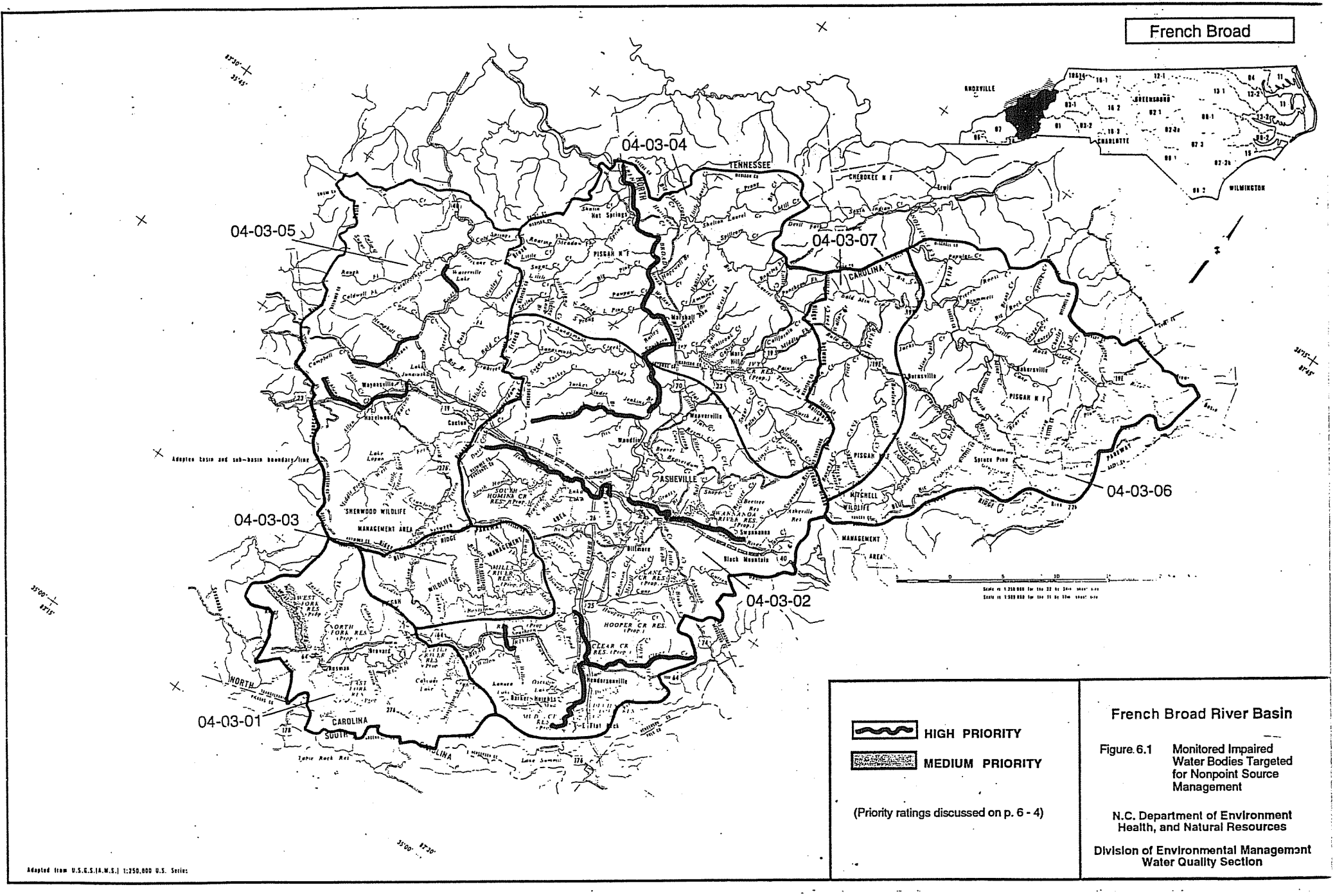
French Broad
04-03-04
04-03-05
04-03-07
04-03-06
04-03-03
04-03-02
04-03-01
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
ASHEVILLE
HIGH PRIORITY
MEDIUM PRIORITY
(Priority ratings discussed on p. 6 - 4)
French Broad River Basin
Figure 6.1 Monitored Impaired Water Bodies Targeted for Nonpoint Source Management
N.C. Department of Environment Health, and Natural Resources
Division of Environmental Management Water Quality Section
Adapted from U.S.G.S.(A.M.S.) 1:250,000 U.S. Series

Table 6.3 Potential ORW and HQW Waters in the French Broad River Basin

04-03-01:	French Broad River from source to SR 1129
04-03-02:	Laurel Branch (upstream sampling needed)
	Sandymush Creek
04-03-03:	Mills River
	North Fork Mills River
04-03-04:	Ivy Creek
	Big Laurel Creek
	Hickory Fork
04-03-05:	Cold Springs Creek
	upper Jonathan Creek
04-03-06:	Big Rock Creek
04-03-07:	Cane 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 requires controlling the causes and sources of water pollution. Existing point and nonpoint source programs are outlined in Chapter 5. Toxicants, sediment, nutrients (in lakes), oxygen-demanding wastes, or biochemical oxygen demand (BOD), and fecal coliform bacteria are problem pollutants of most concern in the French Broad Basin. Toxic substances (including metals, ammonia and chlorine) are addressed in section 6.3. Sediment control is discussed in section 6.4. Nutrients are addressed in section 6.5. Point-source oriented control strategies for oxygen-demanding wastes are further addressed in section 6.6 and fecal coliform bacteria strategies are found in Section 6.8.

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 TOXIC SUBSTANCES

6.3.1 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 of receiving waters, that is the amount of wastewater a stream can assimilate under designated flow conditions (7Q10 for aquatic life based standards, average flow for carcinogens), available for toxicants in the French Broad 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, discharge facilities will receive chemical specific limits which are close to the in stream water quality standard. Toxicants from nonpoint sources also 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 French Broad Basin indicates that while most ambient stations where metals data are collected show levels of copper, zinc and iron above detection, and

in some cases above the designated action level instream, biological data for these stations show no instream impairment. Copper, zinc, and iron occur naturally in North Carolina's waters, therefore action levels have been developed rather than standards. Action levels are not limited in the effluent of a discharge facility unless there is 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.

6.3.2 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 Appendix III of this report. Whole effluent toxicity limits are also assigned to all major dischargers and any discharger of complex wastewater. Thirty-three discharge facilities are required to conduct effluent toxicity tests (See list in Appendix II).

Nonpoint source strategies to be implemented through the industrial NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters. The industrial stormwater program emphasizes controlling the source of pollutants, reducing the potential for the stormwater runoff to become contaminated. One example of a method to control the source of pollutants is to cover stockpiles of toxic materials that could pose a threat to water quality. In addition, stormwater runoff programs implemented as part of the state program (WS, ORW, HQW) should reduce toxic substance loading to surface waters as well.

Subbasin 04-03-01

There are three major industrial discharges in this subbasin.

Mitchell-Bissell Industries	West Fork French Broad River
Ecusta	French Broad River
E.I. DuPont	Little River

West Fork French Broad River
Mitchell-Bissell (0.3 MGD) is a metal plater which discharges to the West Fork of the French Broad near HWY 64. A special benthic survey was done in 1992 to determine if the HQW classification was accurate given the presence of an industry. Samples were taken at two upstream sites and one downstream site. The first upstream site was rated Excellent but showed impact from the trout farms upstream. The site above Mitchell-Bissell received an Excellent water quality rating and is classified HQW. The downstream site was also rated Excellent but showed impact due to Mitchell-Bissell. This site had the lowest overall abundance of pollution intolerant species. The study concluded that the HQW classification is justified. Thus, there should be no additional pollutant loading permitted to Mitchell-Bissell per the anti-degradation regulations.

French Broad River
Ecusta, a division of P.H. Glatfelter, manufactures fine papers from flax straw and currently has no chemical specific limits in the permit. Since Ecusta's primary effect on the water quality is related to oxygen depletion rather than toxicants, further discussion may be found in Section 6.6.

Little River
E.I. DuPont (2.0 MGD) produces X-ray film and discharges a resilient wastewater to the Little River above High Falls and Cascade Lake. The benthic data show impairment below E.I. DuPont. Above Cascade Lake, the ambient data show metals violations. There is some recovery above Cascade Lake but there is impairment near the mouth of Little River due to erosion and agricultural runoff.

Subbasin 04-03-02

Subbasin 02 is the most heavily developed and industrialized subbasin within the French Broad River basin. There are five major discharges of toxicants listed below.

Discharger	Receiving Stream
1. General Electric	Bat Fork Creek
2. Hendersonville WWTP	Mud Creek
3. Cranston Print Works	French Broad River
4. BASF	Hominy Creek
5. CP&L/Asheville	French Broad River

Nonpoint source pollution is also a potential contributor to toxicity problems. Clear Creek, for example, exhibits Poor biological quality with pesticides being a suspected cause. Streams with toxicity problems in this subbasin are described below.

Bat Fork Creek
General Electric Lighting Systems manufactures outdoor commercial and industrial lighting fixtures. GE has a history of failing toxicity tests but has been passing recently and is scheduled to send its process wastewater to the Hendersonville WWTP for treatment. This will remove the discharge of process wastewater (0.5 MGD) from Bat Fork Creek which is currently rated as Poor. However, the stormwater discharges from the site will continue to be permitted through the stormwater program and will be monitored for a number of priority pollutants. Limits will be developed as needed.

Mud Creek
Hendersonville WWTP is a major municipal treatment system with an industrial pretreatment program. The facility is limited for a number of chemical specific parameters and monitors for a number of others. In addition, the facility is required to test quarterly for chronic toxicity. This plant has been permitted to expand to 6.0 MGD with a discharge to Mud Creek which will allow the WWTP to accept GE's process wastewater and extend sewer service to a larger area of Hendersonville. The city is currently investigating the possibility of expanding to 7-14 MGD and relocating the discharge to the French Broad River.

Clear Creek
Clear Creek has been rated as Poor biologically though there are few discharges in the upper reaches. Studies are underway to determine if pesticides from apple orchards are contributing to the degradation of aquatic life. Development of a pesticide control program will be recommended if appropriate.

French Broad River
The French Broad River is not currently listed as impaired due to toxics although a regional approach to wastewater control is recommended as a result of the continued development pressure from Brevard to Asheville. In order to better protect water quality in the French Broad River, connecting industrial discharges to a municipal system is recommended. Two major point sources of toxics to the French Broad River in subbasin 02 include the following:

Cranston Printworks bleaches, dyes, and prints textile fabrics and discharges 4.0 MGD of process wastewater to the French Broad River. Federal guideline limits should protect for chronic toxicity. The facility is limited for a number of priority pollutants. These limits will be reevaluated upon development of a field calibrated model to determine if there is interaction with other facilities on the French Broad River.

CP&L operates a coal-fired electric power plant which discharges up to 1.9 MGD of wastewater including coal pile runoff and stormwater to the French Broad River.

Hominy Creek
BASF discharges 4.0 MGD to Hominy Creek a tributary of the French Broad River near Asheville. BASF is an organic chemical manufacturing facility with a resilient wastewater. The toxics limits will be re-evaluated at permit renewal and instream monitoring recommended. Hominy Creek is rated as Poor below BASF's discharge. The field staff and region reports that there are impacts due to tomato farming, erosion from highways, as well as impacts from BASF. There is a strong change in habitat from rocky to sandy below NC 151. Staff reported that the uppermost site, though rated Good, is impacted with an unknown source. Further investigations are needed to identify the cause and source.

Subbasin 04-03-05

Pigeon River
As a result of a series of process improvements in the late 1980's, Champion reports that there has been no measurable level of dioxin in the mill since 1989. By 1994, Champion completed a $330 million modernization program. An important component of the modernization was to completely replace chlorine as a bleaching agent with chlorine dioxide and oxygen delignification to further ensure no inadvertent formation of dioxin. This new process which has been installed by Champion is the technology on which EPA has based its new effluent standards for the industry to adopt by 1998. Champion is also experimenting with a new patented technology called Bleach Filtrate Recycling (BFR ™) which, if technically and economically successful, could facilitate further improvement in the mill's color (see Section 3.2.6) and effluent quality.

Annually, since 1990, Champion has collected fish from below the mill discharger and into Tennessee. Each successive sampling has shown improvements. As a result, the state has now partially rescinded the fish consumption advisory it originally issued in 1988 for all fish in the Pigeon River. The new advisory, issued by the State Health Director in late 1994, applies only to carp and catfish.

Benthic sampling in 1992 indicated Good water quality at NC 215 (above the mill) and Fair quality at SR 1642 (downstream of the mill near Clyde). These are both improvements over past sampling results. NC 215 is upstream of Champion Paper and may be impacted by farming, particularly tomato farming. Liming at farms has a short-term effect on instream pH. The SR 1642 site near Clyde has been upgraded from Poor to Fair for the first time, possibly resulting from improvements in Champion's effluent quality.

Richland Creek
Richland Creek has recovered from Poor to Fair water quality since improvements to handling of wastewater and stormwater at Dayco have occurred. Lake Junaluska, just upstream of the mouth of Richland Creek, is impacted by nutrient and sediment loading. Nonpoint sources are suspected.

Subbasin 06

The landscape of the North Toe and lower South Toe rivers are dotted with mines. An updated inventory is needed to determine the effect of both active and inactive mines.

The North Toe River below the feldspar and quartz mines is impacted by fluoride and sediment. The mines use hydrofluoric acid in the production of feldspar and quartz. A 1986 biological survey showed that water quality was increasingly degraded below each mine. As a result, a survey of fluoride use at the 4 mines in the Spruce Pine area was conducted and a reallocation of fluorides loading was done. The permits for these discharges were reissued in 1993 with the

loading reallocated between 3 discharges: Unimin Corporation (formerly IMC), The Feldspar Corporation and K - T Feldspar. There is also a proposed feldspar mine which may discharge fluoride to the South Toe River downstream of the ORW classification area.

Biological monitoring in 1992 indicates that water quality below the mines has improved from a Poor rating in 1986 to a Good-Fair rating. Additional discharges of fluoride will require a reallocation of fluoride loading among the existing discharges.

FACILITY	LOCATION
Unimin Corporation	North Toe River
Unimin Corporation	Brushy Creek
Feldspar Corporation	North Toe River
K-T Feldspar Corporation	North Toe River

6.4 MANAGEMENT STRATEGIES FOR CONTROLLING SEDIMENTATION

Sedimentation is the most widespread cause of stream impairment in the French Broad Basin as indicated in section 3.2.4 of Chapter 3. It is a widespread nonpoint source-related water quality problem which results from land-disturbing activities. The most significant of these activities include agriculture, land development (e.g., highways, shopping centers and residential subdivisions), timber harvesting and mining. For each of these major 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
  - 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
  - Sections 404 and 401 (Water Quality Certifications)of the Clean Water Act

DEM's role in sediment control is to work cooperatively with those agencies that administer the erosion and 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, erosion and sediment controls are carried out on a voluntary basis through programs administered by several different agencies. A federal Farm Bill program administered by the USDA Soil Conservation Service provides an incentive not to farm on highly erodible land by taking away federal subsidies to a farmer that fails to comply with the provision.

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. Listed below are 10-year cumulative totals, through January 1, 1994, of acres affected, tons of soil saved and total contract amount. The cost share figures include a wide array of BMPs including, but not limited to, 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 structures along streams.

Table 6.4 NC Agricultural Cost Share Program Statistics for Erosion Control in the French Broad River Basin (Cumulative totals through January 1, 1994)

SUBBASIN	ACRES AFFECTED	TONS OF SOIL SAVED	TOTAL CONTRACT AMT.
040301	4,126	4,387	$309,706
040302	12,503	96,399	$880,007
040303	1,620	22,954	$133,868
040304	9,169	11,208	$589,677
040305	5,372	43,362	$479,969
040306	7,442	18,763	$732,706
040307	3,425	4,134	$304,682
TOTALS	43,657	201,207	$3,430,616

Despite the combined efforts of all of the above programs for construction, forestry, mining and agriculture, there were still 266 miles of streams in the French Broad Basin estimated to be impaired by sediment, thus pointing to the need for continued overall improvements in erosion and sediment control. Further recommendations for improving sediment control are presented below.

- Promote more effective implementation and maintenance of erosion and sediment control measures by contractors, farmers and other land owners.
- Evaluate effectiveness of enforcement of existing sediment control programs. Implement improvements that can be made with existing resources and/or identify additional resource needs.
- Encourage more widespread adoption of erosion and sediment control programs by local governments in rapidly developing areas.

- Promote public education at the state and local level on the impacts of sedimentation and the need for improved sediment control.
- Evaluate existing sedimentation and erosion control rules and statutes for possible strengthening. Consideration should be given to strengthening erosion control requirements. Examples include limiting the area of disturbed land on a given site and reducing the time period for reestablishing vegetation on denuded areas than currently required.
- Evaluate loopholes in interagency efforts to enforce sediment control measures, particularly as they relate to forestry and agricultural activities.

All or portions of the following streams have been listed in Table 4.3 in Chapter 4 as being impaired or threatened by sedimentation and should receive priority as sediment control programs are implemented. The list below includes only streams that have been monitored by DEM. It therefore represents only a portion of those streams throughout the basin that are adversely affected by sedimentation.

Stream	Subbasin	Stream	Subbasin
Little River	01	Spring Creek	04
Hominy Creek	02	Richland Creek	05
Flat Creek	02	Lower Jonathan Cr	05
Swannanoa River	02	North Toe River	06
Newfound Creek	02		

6.5 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. In general, excess nutrient loading is only a problem in slow-moving waters and areas with long retention times. In the French Broad Basin, only lakes appear to be subject to eutrophication. Localized problems are described below.

6.5.1 Subbasin 04-03-03

Mills River
Van Wingerden International is under a Special Order by Consent (SOC) due to wastewater from its greenhouses which discharge TN = 100 mg/l to a nearby pond. The SOC is a legal agreement between the company and the state which stipulates an enforceable time schedule for correcting the problem.

6.5.2 Subbasin 04-03-05

Lake Junaluska
Lake Junaluska receives runoff from the surrounding area. The lake acts as a retention basin which controls flows and sediment input to the Pigeon River. Due to recent dredging for sediment removal, nutrient levels in the lake and resultant blooms have been reduced. A progressive program to implement nonpoint source controls is needed to lessen nutrient loading and the need for future dredging.

Waterville (Walters) Lake
The Waterville Hydroelectric Project is owned and operated by Carolina Power and Light and is located on the Pigeon River. The powerhouse is located near the NC-TN line approximately 12 miles below the dam. A 6.2 mile water conduit tunnel delivers water from the lake to the

powerhouse, bypassing this section of the Pigeon River below the dam. The headwaters of the lake are located 20.7 miles below the Champion International discharge. Walters Lake receives runoff from animal operations, cropland and urban areas. In addition, Waterville Lake is impacted by refractory BOD and nutrients from Champion's discharge. Lake water quality problems include algal blooms, chlorophyll-a violations, and DO violations. A nutrient budget will be developed prior to the next basin plan to examine point and nonpoint sources of nutrients to the lake and to be incorporated into a lake management strategy.

6.6 RECOMMENDED MANAGEMENT STRATEGIES FOR OXYGEN-DEMANDING WASTES

Oxygen-demanding wastes are described in Chapter 3. Biochemical oxygen demand (BOD5) and ammonia nitrogen (NH3) are generally the types of oxygen-consuming wastes of greatest concern. Therefore, NPDES permits generally limit BOD_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, 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, 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. The choice of model, North Carolina's empirical model or the field calibrated, QUAL2E model, used is determined by the amount of data available for a given stream reach (APPENDIX III-A). The empirical model is routinely used to determine wasteload allocations in the absence of intensive water quality studies of the discharge reach.

Table 6.5 General Recommended Strategies for Expanding and Proposed Discharges in the French Broad Basin

HQW and ORW Waters throughout basin: Discharges to these waters will receive limits in accordance with the Division's Antidegradation Policy (15A NCAC 2B .0201).

All new and expanding facilities not located on HQW, ORW or zero flow streams: Limits for BOD and NH3 are based on North Carolina's empirical model and following standard procedures, particularly for interacting discharges.

French Broad River Watershed (other than HQW, ORW, and zero flow streams)
A QUAL2E model will be developed for the French Broad River from Brevard to Asheville. Upon its completion the model will be used to evaluate new/expanding discharges on the mainstem. Where there are documented water quality problems, the model may be used for reallocation of existing wasteload allocations for the next basin plan.

Pigeon River Watershed (other than HQW, ORW, and zero flow streams)
For the Pigeon River, the existing QUAL2E model will be used for new/expanding discharges to the mainstem from Canton to Waterville Lake. The model will be re-calibrated in the future due to significant changes in wastewater from Champion.

6.6.1 French Broad River Watershed (Subbasins 04-03-01 through 04-03-04)

No dissolved oxygen (DO) water quality standard violations in the French Broad mainstem have been documented through DEM's ambient monitoring stations nor by NPDES instream self-monitoring data from dischargers along the river. However, data do indicate that DO concentrations are depressed below the Ecusta Company's discharge. To evaluate the river's water quality, an empirical, desktop model (Appendix III-A) was developed from Mitchell-Bissell Company's discharge to below Asheville, a reach of about 60 miles.

For the next basin plan, a field calibrated model will be developed for the French Broad River from Brevard to Asheville. Data from a 1978 dye and reaeration study will be supplemented with data from a 1993 reaeration study by EPA. Additional field studies to extend the model from Brevard to Asheville will be recommended.

The field calibrated model should more accurately predict the current water quality conditions than the empirical model. Previous water quality evaluations were done using an empirical model with velocities from the 1978 study (at more than twice the 7Q10 flow). In addition, the 7Q10 flow was entered for the Davidson and Little Rivers. However, the Davidson River is used as a water source for Ecusta except under very low stream flows. Thus, the 7Q10 flow may not be accurate. The Little River is impounded by a FERC licensed hydropower dam. The current minimum release is 10 cfs (the 7Q10 flow is 18 cfs). A new minimum release is being negotiated; USFWS seeks 15 cfs while Cascade Power is asking for 2 cfs. Future modeling efforts will account for flow withdrawals and minimum releases.

The benthic data for the mainstem of the French Broad River shows Excellent water quality in the headwaters with a steady decline in quality downstream. Downstream of Ecusta's effluent, the river is rated Good. Near Asheville the rating is Good/Fair and near Marshall the rating fluctuates between Good/Fair and Fair. The dissolved oxygen levels improve at the downstream sites so it is likely that the impairment is not attributable to oxygen-consuming wastes. The nonpoint sources should be inventoried. More detailed information on these models and subbasin water quality is provided below.

Subbasin 04-03-01 (Upper French Broad River from Headwaters to the Davidson River)

<u>Upper French Broad River</u>

The French Broad is formed by the West Fork, North Fork and East Fork French Broad Rivers. The uppermost North Fork and most of the East Fork and a section of the West Fork are classified as HQW. Excellent water quality ratings were confirmed by 1992 benthic sampling of the North and West Forks as well as the French Broad at Rosman. However, sampling below trout farms in 1983 showed moderate to severe impacts on the benthic community. There are at least nine trout farms in this subbasin; most discharge to HQW tributaries to the headwaters. A special study of trout farms is recommended to determine if the current permit conditions are adequate to protect water quality. This study should include water quality surveys to determine whether water quality has improved since 1983. It should be noted that the High Valley Trout Hatchery is upstream of Brevard's water treatment plant and has not been able to implement management controls due to accessibility problems (steep slopes) below the Hatchery.

In addition to the trout farms, there are seven minor sources of oxygen-consuming wastes to the headwaters of the French Broad. Due to concern over the presence of discharges within and upstream of the HQW boundary, a special study was done in 1993 which confirmed that though these discharges are present, Excellent water quality exists. The HQW regulations will apply.

An empirical model was developed for this subbasin review. This model covers 22 miles from the West Fork French Broad to the confluence with the Davidson River. The wastewater inputs total 0.435 MGD for an instream waste concentration of less than 3% based on headwater flow. No DO sag is predicted. Therefore, no specific point source management strategy is recommended. Though Ecusta and the Brevard WWTP are part of this subbasin, they are modeled with the discharges to the French Broad in subbasin 02. The small domestic discharges near Brevard should be considered for tie-in to the Brevard WWTP.

Little River

An empirical model for DuPont's discharge to the Little River shows a DO sag to 6.4 mg/l just below DuPont. The CBOD is not fully assimilated prior to entering Cascade Lake. Two other discharges to the Little River watershed do not interact and cause no DO sags. The minimum release from Cascade Lake and nonpoint sources will be investigated prior to completing a field calibrated analysis of the French Broad River for the next basin plan.

Subbasin 04-03-02 (Middle French Broad River and Tributaries from Davidson River to Buncombe/Madison County line)

A field calibrated model was developed for the French Broad River between Ecusta and HWY 64 in 1980. Data from this model were used to update DEM's empirical desktop model. EPA conducted a reaeration study for this reach of the French Broad in November 1993 during 7Q10 conditions. A revised field calibrated model is planned for the next basin plan. In the meantime, the empirical model will continue to be used. French Broad subbasin 02 includes the mainstem from the Davidson River to below Asheville.

French Broad from Ecusta to Asheville

An empirical model has been developed for the French Broad River from the Brevard WWTP to the Swannanoa River, covering 60 miles from the Brevard WWTP to upstream of the Buncombe MSD in Asheville. At its permitted limits, Ecusta is the dominating discharge in this reach at over 20% instream waste concentration. The other major in this subbasin, Brevard, is over 10 times smaller than Ecusta. Empirical modeling indicates that the DO standard should be met unless stream flows above Ecusta fall below the 7Q10 due to withdrawals by Ecusta. Since there are no known DO problems on the French Broad below Ecusta, this empirical model will continue to be used with the standard procedures to determine permit limits for oxygen consuming wastes until a field calibrated model is developed for the area. A study plan for the French Broad from Brevard to Asheville will be developed.

Gash Creek

A study of Gash Creek in 1986 confirmed that discharge limits had been overallocated due to a diversion of the stream for irrigation by the Etowah Golf Club. Thus, stream flows have been reduced by 90%. Based on the Poor water quality rating, the new flow information was used to revise the wasteload allocations. A revised model was done at 1/10th the previous streamflow and limits were revised upon permit renewal. In addition, a number of permits have been rescinded as the facilities had not been constructed and municipal sewer service is now available. The only remaining discharges are:

Etowah Sewer Co.
Henderson Housing Authority
Nicholson MHP

With a cumulative instream waste concentration (IWC) of 70%, the effluent dominates the stream under summer low flow conditions. A follow-up water quality survey is recommended to determine if there has been improvement since the limits have been revised. An empirical model was run to the French Broad but background conditions were not reached at the mouth of Gash Creek. A DO sag to 5.6 mg/l was predicted 0.4 miles below the Etowah Sewer Co. A more

complete evaluation will be done in conjunction with a detailed study resulting in a field calibrated model of the French Broad River.

Mud Creek

Due to continued Poor biological quality ratings and the proliferation of discharges, a field calibrated model was developed for Mud Creek in 1992. Discharges to Mud Creek, Allen Branch, Cherry Branch, Featherstone Creek and Clear Creek were included in the model. New and expanding discharges to this watershed will be required to meet advanced treatment with limits of 10 mg/l BOD5 and 2 mg/l NH3-N. The Hendersonville WWTP dominates the assimilative capacity of Mud Creek below Clear Creek. A copy of the modeling report is available from DEM.

Based on the modeling results, Hendersonville may relocate its discharge to the French Broad River. The City and County should work together to reduce the total number of discharges. Clear Creek is rated biologically Poor though there are few discharges in the upper reaches. The City has extended a sewer interceptor up Clear Creek to Cherry Branch and Allen Creek, and discharges have begun to connect to it. An interceptor has also been constructed part way up Bat Fork Creek which serves East Flat Rock Development, East Henderson High School and Blue Ridge Technical College. General Electric is sending most of its process wastewater to the City of Hendersonville's wastewater treatment plant through a separate pump station and sewer line.

Empirical models have been developed for tributaries to Mud Creek upstream of the field calibrated model area. Clear Creek outside Hendersonville has only two permitted discharges. Neither have a significant impact on the assimilative capacity. Standard procedures will be followed to allocate oxygen-consuming wastes. A comprehensive empirical model of Bat Fork, Devils Creek, King Creek, and Dunn Creek has been done. With all existing discharges, the model predicts no DO violations on these tributaries but there is residual BOD further downstream where the tributaries flow into Mud Creek. Four of the discharges are scheduled to tie on to the Hendersonville WWTP. With the remaining six discharges, background conditions will be reached at the mouth of Bat Fork. City sewer service is available for the two discharges to Britton Creek and connection to the City is strongly encouraged.

Cane Creek

There are four small discharges to Cane Creek, as well as two small discharges to tributaries. An empirical model done to evaluate interaction among discharges shows no DO sags from the discharges. The empirical model will continue to be used to determine wasteload allocations.

Hominy Creek

Hominy Creek is currently on the list of impaired streams. A major industry, BASF, which is permitted at 4 MGD (actual flow is 2 MGD), discharges to Hominy Creek and contributes to the impairment in the lower reaches. Hominy Creek was sampled by the Biological Monitoring Group in 1992. Three sites were sampled; two above BASF and one downstream. The survey showed the water quality becomes progressively more impaired at each station: Good, Fair, Poor. An empirical model of Hominy Creek indicates a DO sag to 6.1 mg/l one mile below BASF but no violations of the DO standard. In addition, background water quality is not achieved prior to the confluence with the French Broad River. Instream concentrations of CBOD are quite high. At this time the empirical model will be used for wasteload allocations. A field calibrated model of the French Broad in this area will be developed for the next basin plan which will more closely examine the impact of BASF on Hominy Creek and the French Broad River.

Swannanoa River

In the past, there were a number of direct discharges to the river, however, ongoing sewer interceptor construction along the river is resulting in the elimination of discharges with wastewater being sent to the Buncombe County Metropolitan Sewerage District plant. Though water quality

remains impaired due to urban runoff, there has been improvement in the benthic community from Poor to Good-Fair.

French Broad from Asheville to Sandymush Creek
The Buncombe County MSD discharges 40 MGD of secondarily treated wastewater to the powerhouse flume upstream of a hydropower plant that it owns and operates. A minimum continuous release is maintained but it is lower than the 7Q10. At DEM's ambient monitoring station at Alexander, downstream from the discharge, benthic macroinvertebrate water quality data has shown a decline from Good-Fair in 1987 to Fair in 1990 and 1992. During much of this period, the Buncombe MSD was operating with relaxed limits under a Judicial Order of Consent (JOC) which required expansion and improvements to the WWTP and discharge. The JOC expired in 1990. The WWTP's permit and compliance record will be closely evaluated since the instream waste concentration below Asheville is approximately 20% and the area is used for recreation.

Subbasin 04-03-03 (Davidson and Mills Rivers Watersheds)

Davidson River
Much of the Davidson River is classified as HQW. Within the HQW section there is one discharge on Looking Glass Creek. Near the mouth there are three discharges to Davidson River and Turkey Creek. Connection of the Schenck Job Corps Center discharge to the city of Brevard WWTP is strongly encouraged.

The Davidson River is used as a water supply for Ecusta, a Division of P.H. Glatfelter. In 1980, a biological survey indicated severe problems below the withdrawal point. Ecusta withdraws 29 MGD for industrial use. Water is withdrawn until the streamflow drops to 30 MGD (46.5 cfs) or almost to the 7Q10. Thus the stream may be stressed by low flows on a regular basis. The lower Davidson River will be re-evaluated as part of a field study for the next basin plan.

Mills River
South Fork Mills River and its tributaries are ORW. The North Fork and part of the Mills River above Hendersonville's water supply intake are WS-I and WS-II. All benthic studies have reflected Excellent water quality. An empirical model shows no DO sag and no interaction among discharges. Permit limits for oxygen-consuming wastes will be determined in accordance with standard procedures and HQW rules. However, updated USGS flows suggest that many of the tributaries of Mills River are zero flow and unsuitable for receiving wastewater. New and expanding discharges may be denied.

Subbasin 04-03-04 (Lower French Broad River Mainstem and Tributaries from Buncombe/Madison County line to Tennessee)

French Broad River
This subbasin contains the lower French Broad River drainage area and flows into Tennessee. Significant discharges include CP&L in Marshall, Marshall WWTP (0.4 MGD), and the Hot Springs WWTP (.08 MGD). Since there is no interaction between the relatively few discharges, permit limits for oxygen-consuming wastes will be determined in accordance with standard procedures. The water quality is impaired, however, and fluctuates between ratings of Fair and Good/Fair at the Marshall ambient monitoring station. The impairment is attributed to upstream point and nonpoint sources.

Ivy River
The Ivy River from its headwaters to Adkins Creek is classified as WS-II, HQW but has been exempted from the water supply watershed protection rules limiting local development. The only significant discharge is the Mars Hill WWTP which discharges 0.425 MGD of treated wastewater

to Gabriels Creek. The only other discharges in the watershed are the Greater Ivy Community Center and Ohio Electric Motors. The empirical model and HQW rules will be used to allocate new and expanding discharges.

Benthic sampling has been done near the headwaters and mouth of the Ivy River. Near the headwaters there is Excellent water quality while at the mouth there is Good quality. Little Ivy River near the mouth is also rated Good.

Laurel Creek
There are a number of discharges within this watershed. Trout farms dominate Big and Little Laurel Creeks and will be further studied as discussed in subbasin -01. The remaining discharges are spread out over the watershed and if properly run should cause no significant impact. Big Laurel has been rated Excellent at its mouth while Shelton Laurel has been rated Good at its mouth. The upper watershed particularly Hampton Creek and Wolf Laurel Creek is under development pressure from resorts. Blue Mountain Golf & Country Club discharges to Wolf Laurel Branch and Skistok, Inc. will discharge to Hampton Creek . Another facility, English Wolf Lodge has received a permit for pump and haul. The empirical model will be used to allocate new and expanding discharges. Benthic surveys of this area are recommended.

6.6.2 Pigeon River Watershed (Subbasin 04-03-05)

Subbasin 030405 contains the Pigeon River basin from its headwaters to Tennessee. The watershed includes both impaired waters and a large portion of HQW and ORW waters. There is one major lake, Waterville (Walters Lake), created on the Pigeon River by CP&L for hydropower production.

West Fork Pigeon River
The Middle Prong of the West Fork is classified HQW from its headwaters to Lake Logan based on an Excellent water quality rating. There are no significant discharges of oxygen-consuming wastes in this watershed. Bethel Junior High School discharges to Bird Creek to class WS-III Trout waters.

East Fork Pigeon River
The East Fork is classified HQW from its headwaters to Bee Branch based on an Excellent water quality rating. As discussed for subbasin 01, trout farms (3) can be a source of impact and should be studied further.

Pigeon River
Though there are few discharges to the Pigeon River, water quality has been significantly affected due to Champion International's effluent which dominates the river. Champion has made significant operational changes to reduce loading to the river since 1989. Effluent flow has been reduced from 48 MGD to 29 MGD. Stringent limits were recommended based on the results of a field calibrated study done by VERSAR in 1989. Limits were based on instream oxygenation and best available technology for wastewater treatment. Champion discharges a heated, high strength effluent. Champion also employs sidestream aeration at two sites below the plant to improve instream DO levels. The wasteload allocation results in DOs of at least 5 mg/l within the Pigeon River but may not adequately protect Waterville Lake downstream. The travel time from the discharge to Waterville Lake is approximately 2 days which may not be enough time for the decay of BOD within the river. As a result, Champion's effluent remains in the lake to be broken down. Waterville Lake is impacted by refractory BOD and nutrients from Champion's discharge. Lake water quality problems include algal blooms, chlorophyll-a violations, sedimentation, DO violations, dioxin contamination, and color impacts. The ongoing improvements to Champion's wastewater treatment plant should result in improved water quality in Waterville Lake and the Pigeon River below the lake. Currently, water is drawn from the mid-level of the lake and

discharged through a hydroelectric facility downstream of the dam. As a result, the anoxic lake waters are impacting the river below the lake.

A field calibrated model commissioned by the US EPA indicates that Champion dominates the DO levels in the Pigeon River. Improvements to the municipal discharges, Clyde WWTP (0.21 MGD) and Waynesville WWTP (6 MGD) did not cause significant improvements in DO and were not recommended by VERSAR. However, since Waynesville is a significant discharger, future expansion requests may result in more stringent limits than are currently applied to this discharge. The remaining interacting discharges within this drainage area will be adequately managed through application of the field calibrated model.

Together Champion and Waynesville comprise 54% of the wasteflow to the Pigeon. Improvement to effluent and stream quality has been observed as Champion has implemented new treatment methods. Waynesville makes up 17% of the wasteflow and meets secondary treatment limits. If Waynesville requests expansion of its WWTP, improvements to its treatment will be required. The remaining discharges are insignificant at this time. A field study and new model calibration are recommended for the future once long term improvements to the paper mill effluent are observed.

Beaverdam Creek
The Canton water treatment plant discharges to Rough Creek, a tributary of Beaverdam Creek. Rough Creek has been classified WS-I, HQW above the Canton water supply and HQW downstream.

Richland Creek
Empirical modeling of Richland Creek and Factory Branch indicates that oxygen-consuming wastes are not impacting the streams or Lake Junaluska. However, connection to municipal sewerage is recommended for new and expanding discharges to Factory Branch.

Allen Creek
A tributary to Richland Creek, upper Allen Creek is classified WS-I for protection of Waynesville's water supply and is subject to HQW and WS-I regulations. Any future upstream discharges must protect these classifications.

Jonathan Creek
The Maggie Valley WWTP on Jonathan Creek has been permitted at 1 MGD. Though this plant has been sized to become the regional facility for the area; there are still a few discharges remaining in the upper reaches. Two of these facilities, Woodland Village and Hemlock Village, are scheduled for city sewer service. Biological monitoring shows Good water quality. The empirical model shows no DO sag but background water quality is not achieved prior to the confluence with the Pigeon River. Impact on the Pigeon is expected to be minimal.

Cataloochee Creek
Cataloochee Creek and its tributaries are classified as ORW based on an Excellent rating of aquatic life, thus restricting any future proposed discharges to the creek.

Big Creek
Big Creek and its tributaries are classified as HQW based on an Excellent rating of aquatic life. There are no significant discharges in either watershed and any future proposed discharges would need to able to meet stringent limits so as to maintain the existing high water quality standards in the creek in accordance with the established regulations.

6.6.3 Nolichucky River Mainstem (04-03-06 through 04-03-07)

No DO problems in the Nolichucky watershed have been documented through DEM's ambient monitoring network nor by NPDES instream self-monitoring data. There are a few discharges of oxygen-consuming wastes in the watershed. In addition, water temperatures are low and flow is available to assimilate wastes. Thus, no field calibrated models have been done. Permit limits for oxygen-consuming wastes will be determined in accordance with standard procedures.

Subbasin 06 (North and South Toe River Watersheds)

North Toe River

There are a few domestic discharges in this basin; most discharges are from mineral process industries. The largest municipal discharge is the Spruce Pine WWTP (0.8 MGD) which is expected to continue to expand. Smaller municipalities include Bakersville and Newland. There is no interaction between domestic discharges. The most significant discharges in the basin are quartz, feldspar and mica mines which contribute to the sedimentation of the North Toe River, but which have no oxygen-consuming wastes. The empirical model will be used to determine permit limits for new and expanding discharges.

Little Crabtree Creek

A tributary to the South Toe, Little Crabtree Creek and its tributaries George Fork and Allen Branch include 4 existing and 1 proposed discharge. An empirical model of these discharges shows no interaction between discharges and water quality at background conditions prior to confluence with the South Toe River.

Yancey County and the Town of Burnsville have proposed a new regional facility which will serve this area and eliminate the individual discharges. The proposed 300,000 gallon per day municipal wastewater plant may discharge to the South Toe River approximately one mile below the ORW classification line. The plant will include textile waste and will tie in the four small facilities nearby. A new feldspar mine has also been proposed for this reach but is not expected to have any oxygen-consuming waste components.

Lower North Toe River

The North Toe River below the South Toe River has no direct discharges. The only discharge is Tipton Hill School which discharges to Racoon Creek. Part of the North Toe River may be upgraded to Class B waters since the waters are used for whitewater rafting.

Nolichucky River

The Nolichucky River is formed by the confluence of the Cane and North Toe Rivers. There are no discharges to the Nolichucky River or its tributaries. The river may be reclassified to B waters due to recreational usage. A reclassification study is planned for the summer of 1995.

Subbasin 07 (Cane River Watershed)

Subbasin 07 contains the watershed of the Cane River, a tributary of the Nolichucky River. The river is classified WS-II Trout from the headwaters to the Town of Burnsville's water supply intake. These waters are subject to the Water Supply rules for WS-II waters and the HQW management strategy. The only significant discharge in this reach is the Burnsville WWTP (0.8 MGD). An empirical model including the two existing discharges has been developed and permit limits for oxygen-consuming wastes will be determined in accordance with standard procedures. The Burnsville WWTP discharge, along with the DOC-Yancey County discharge is located downstream of the water supply area. There is interaction between Burnsville and DOC-Yancey Co., but no DO sag is predicted.

6.7 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 75 miles of streams in the French Broad 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 for municipalities greater than 100,000 in population (see Section 5.3.2).

6.7.1 HQW, ORW and Water Supply Watersheds

The French Broad 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 in this basin are implemented by DEM through it's Asheville Regional Office. 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 25 local governments in the French Broad basin that have developed water supply watershed protective ordinances for watersheds in the basin. Development activities covered by water supply protection requirements must be reviewed and approved by the appropriate local government.

6.7.2 NPDES Stormwater Management

Throughout the 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.

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

Local governments throughout the French Broad basin that have a population of less than 100,000 are strongly 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 developing 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.
- Reviewing local ordinances pertaining to parking, curb and gutter and open space requirements. Many of these local ordinances could be modified to enhance water quality protection from urban stormwater runoff impacts.

6.8 MANAGEMENT STRATEGIES FOR 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.

Table 4.6 in Chapter 4 indicates that there are 74 miles of streams impaired by fecal coliform bacteria, although the actual number of miles is probably significantly higher. First, in developing the use support ratings in Chapter 4, a Good or Excellent biological rating for a specific monitoring site would outweigh a fecal coliform measurement, at that same site, that was above the stream water quality standard. There are six stream segments in Table 4.2 that are considered supporting or support-threatened that have elevated fecal coliform levels. Secondly, fecal coliform measurements are taken only at the 29 ambient monitoring sites in the basin, so there are potentially many hundreds of miles of streams that are not monitored for fecal coliforms that may be impacted. The fecal coliform standard of 200/100ml was found to be exceeded at least 20% of the time over the past five years at 12 of the 29 ambient stations in the basin.

Several recommendations for addressing fecal coliform contamination are presented below.

- Proper maintenance by homeowners of onsite waste disposal systems such as septic tanks Best management practices (BMPs) for onsite waste systems are presented on page A-VI-10 in Appendix VI.
- Proper maintenance and repair of sanitary sewer lines by WWTP authorities.
- Elimination of direct unpermitted discharges of domestic sewage wastes (also known as "straight pipes") from homes.
- Proper management of livestock to keep wastes from reaching surface waters. BMPs for controlling fecal coliform bacteria from livestock are listed on page A-VI-2 in Appendix VI.
- Encouragement of local health departments to routinely monitor waters known to be used for body contact recreation (e.g., swimming and tubing). DEM classifies such waters as B (see section 2.6 and Appendix I). There are 177 miles of streams in the French Broad basin with a B classification.

REFERENCES CITED - CHAPTER 6

North Carolina Division of Environmental Management, 1980, A Wasteload Allocation Analysis for the Champion Paper Mill in Canton, NC, NCDEM Water Quality Section, Raleigh, NC.

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North Carolina Division of Environmental Management, 1992a, A QUAL2E-UNCAS Application to Mud Creek., NCDEM Water Quality Section, Raleigh, NC.

VERSAR, 1989. Development of a Wasteload Allocation Model for the Pigeon River Between Canton and Hepco, NC, Volume I - Text. Prepared for USEPA Region IV, Atlanta, GA.

APPENDIX 1

CONTENTS:

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 throughout 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(d): 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 other waters = 200/100 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 discharges

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		

Water Quality Standards for Freshwater Classifications

Parameters	Standards for All Freshwater		More Stringent Standards to Support Additional Uses	
	Aquatic life	Human health	Water supply classes	Trout waters
Arsenic (µg/l)	50			
Barium (mg/l)			1.0	
Benzene (µg/l)		71.4	1.19	
Beryllium (ng/l)		117.0	6.8	
Cadmium (µg/l)	2.0			0.4
Carbon tetrachloride (µg/l)		4.42	0.254	
Chloride (mg/l)	230 (AL)		250	
Chlorinated benzenes (µg/l)			488	
Chlorine, total residual (µg/l)	17 (AL)			17
Chlorophyll *a*, corrected (µg/l)	40 (N)			15 (N)
Chromium, total (µg/l)	50			
Coliform, total (MFTCC/100ml)			50 (N) (2)	
Coliform, fecal (MFTCC/100ml)		200 (N)		
Copper (µg/l)	7 (AL)			
Cyanide (µg/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 (µg/l)		49.7	0.445	
Iron (mg/l)	1.0 (AL)			
Lead (µg/l)	25 (N)			
Manganese (µg/l)			200	
MBAS (Methylene-Blue-Active Substances) (µg/l)	500			
Mercury (µg/l)	0.012			
Nickel (µg/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 (µg/l)			100	
2,4,5-TP (Silvex) (µg/l)			10	
pH (units)	6.0-9.0 (Sw)			
Phenolic compounds (µg/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 (µg/l)	5			
Silver (µg/l)	0.06 (AL)			
Solids, total dissolved (mg/l)			500	
Solids, suspended	(N)			
Sulfates (mg/l)			250	

Water Quality Standards for Freshwater Classifications (continued)

Parameters	Standards for All Freshwater		More Stringent Standards to Support Additional Uses	
	Aquatic life	Human health	Water supply classes	Trout waters
Temperature	(N)			
Tetrachloroethane (1,1,2,2) (µg/l)		10.8	0.172	
Tetrachloroethylene (µg/l)			0.8	
Toluene (µg/l)	11			0.36
Toxic substances	(N)			
Trialkyltin (µg/l)	0.008			
Trichloroethylene (µg/l)		92.4	3.08	
Turbidity (NTU)	50; 25 (N)			10 (N)
Vinyl chloride (µg/l)		525.0	2.0	
Zinc (µg/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 µg/l, but the daily average must be 5.0 µg/l or more.
(2) Applies only to unfiltered water supplies

Water Quality Standards for Tidal Saltwater Classifications

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

NOTE: (N) See 2B .0212 (b), (c), (d), or (e) 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**
- **Effluent Toxicity Testing**

A-II.1 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, below, presents a summary of benthic macroinvertebrate samples collected in the French Broad River Basin.

Table 1. Benthic macroinvertebrate collections in the French Broad River Basin, 1983-1992. (Note: Site locations are shown on the subbasin maps in Chapter 4)

FBR 01

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
French Broad R, SR 1129, Rosman, Trans.	A/B-1	6-(1)	07/92	108/51	3.74/2.50	Excellent
			08/90	98/43	3.73/2.63	Excellent
			03/89	107/57	3.35/2.40	Excellent
			08/88	96/48	3.99/3.02	Excellent
			07/86	102/50	3.92/2.79	Excellent
			08/84	89/38	4.09/2.99	Good
			08/84	84/32	3.99/2.98	Good
W Fk French Broad R, ab trout farms, off NC 281, Transylvania	81/B-2	6-2	08/90	83/45	2.58/1.97	Excellent
			05/90	96/55	2.55/1.71	Excellent
W Fk French Broad R, be trout farms, SR 1306,Transylvania	82/B-3	6-2	08/90	51/15	5.92/3.31	Fair
			05/90	72/33	4.82/2.64	Good-Fair
W Fk French Broad R, NC 281, Transylvania	83/B-4	6-2	08/90	78/32	4.84/3.65	Good
			05/90	97/44	4.41/2.85	Good
			03/89	-/27	-/3.54	Good-Fair
W Fk French Broad R, SR 1312, Transylvania	22/B-5	6-2	02/92	99/53	3.03/1.94	Excellent
			05/87	-/49	-/2.49	Excellent
			10/84	94/42	3.81/2.61	Good
W Fk French Broad R, NC 64, ab M-B Industry, Transylvania	59/B-6	6-2	07/92	87/46	3.53/2.31	Excellent
			02/92	110/57	3.28/2.27	Excellent
			03/89	87/50	3.07/2.31	Excellent
W Fk French Broad R, be M-B Industry, Transyl.	-/B-7	6-2	02/92	79/45	3.28/2.15	Excellent
Parker Cr, SR 1310, Transylvania	60/B-8	6-2-4	03/89	-/44	-/2.56	Good
N Flat Cr, SR 1319, Transylvania	-/B-9	6-2-10-1	03/89	-/38	-/2.77	Good
N Fk French Broad R, NC 215, Transylvania	54/B-10	6-3	03/89	-/45	-/1.98	Excellent
N Fk French Broad R, SR 1324, Transylvania	55/B-11	6-3	03/89	-/36	-/2.83	Good
N Fk French Broad R, SR 1322, Transylvania	56/B-12	6-3	07/92	85/42	3.28/2.30	Excellent
		03/89	89/44	3.39/2.49	Excellent	
Tucker Cr, SR 1325, Transylvania	57/B-13	6-3-10	03/89	-/35	-/2.69	Good-Fair
M Fk French Broad R, NC 178, Transylvania	62/B-14	6-5	03/89	-/35	-/1.75	Good
E Fk French Broad R, SR 1105, Transylvania	63/B-15	6-6	03/89	-/51	-/1.96	Excellent
E Fk French Broad R, SR 1007, Transylvania	64/B-16	6-6	03/89	107/54	2.77/2.08	Excellent
Glady Fk, SR 1105, Transylvania	28/B-17	6-6-7	05/87	-/29	-/2.88	Good-Fair
Galloway Cr, US 64, ab landfill, Transyl.	30/B-18	6-8	05/87	-/16	-/2.61	Fair
Galloway Cr, US 64, be landfill, Transyl.	31/B-19	6-8	05/87	-/10	-/3.00	Poor
Catheys Cr, SR 1338, Transylvania	23/B-20	6-16-(.5)	03/89	-/58	-/2.02	Excellent
			05/87	-/49	-/1.79	Excellent
Norton Cr, US 64, Transylvania	29/B-21	6-28-2	05/87	-/14	-/4.82	Fair
Williamson Cr, SR 1541, Transylvania	27/B-22	6-32	05/87	-/44	-/2.42	Good
Little R NC 276, Transylvania	24/B-23	6-38-(1)	05/87	-/38	-/3.02	Good
Little R, nr Cedar Mt, ab High Falls, off SR 1536, Transylvania	B/B-24	6-38-(1)	08/87	83/19	6.33/4.69	Fair
			08/85	82/22	5.83/4.59	Fair
Little R, nr Cedar Mt, be High Falls, Trans.	-/B-25	6-38-(1)	07/89	81/32	4.55/3.72	Good
Little R, SR 1533, Transylvania	-/B-26	6-38-(1)	07/92	-/26	-/4.15	Good-Fair
Laurel Cr, SR 1536, Transylvania	25/B-27	6-38-17	05/87	-/44	-/2.10	Good
Crab Cr, SR 1532, Transylvania	26/B-28	6-38-23	05/87	-/38	-/2.94	Good

FBR 02

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
French Broad R,SR 1503 @ Blantyre, Trans.	C/B-1	6-(27)	07/86	57/21	5.76/4.28	Fair
			08/83	55/20	5.85/4.43	Fair
Gash Cr, SR 1322 Henderson	1/B-2	6-41	09/86	19/7	6.09/4.45	Fair
Gash Cr, US 64, Henderson	1/B-3	6-41	09/86	21/1	8.07/5.77	Poor
Gash Cr, SR 1203, Henderson	1/B-4	6-41	09/86	26/1	8.31/6.22	Poor
Gash Cr, SR 1205, Henderson	1/B-5	6-41	09/86	40/5	7.58/5.94	Poor
Mud Cr, SR 1508 ab WWTP, Henderson	2/B-6	6-55	07/92	-/10	-/5.52	Poor
			09/85	51/9	7.18/5.80	Poor
Mud Cr, SR 1508 be WWTP, Henderson	3/B-7	6-55	07/92	-/7	-/6.36	Poor
			09/85	26/4	7.20/5.04	Poor

FBR 02 Continued

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Bat Fork, SR 1807, Henderson	65/B-8	6-55-8-1	04/89	-/2	-/2.55	Poor
Bat Fork , US 176, Henderson	66/B-9	6-55-8-1	04/89	44/6	7.60/5.98	Poor
Bat Fork, SR 1809, Henderson	67/B-10	6-55-8-1	04/89	19/2	8.61/1.29	Poor
Bat Fork, SR 1803, Henderson	68/B-11	6-55-8-1	04/89	25/4	7.73/6.65	Poor
Bat Fork, SR 1779, Henderson	69/B-12	6-55-8-1	04/89	-/2	-/7.64	Poor
Clear Cr SR 1513, Henderson	-/B-13	6-55-11-(5)	07/92	-/9	-/5.28	Poor
Cane Cr, SR 1006 nr Fletcher, Henderson	-/B-14	6-57-(9)	07/92	-/27	-/4.05	Good-Fair
French Broad R, NC 280, nr Skyland, Buncombe	R/B-15	6-(66.5)	07/92	86/41	4.97/4.08	Good
			07/90	80/34	5.23/3.88	Good
			08/87	80/30	5.35/4.12	Good-Fair
French Broad R, SR 1348, nr Asheville Buncombe	E/B-16	6-(67.5)	07/92	73/32	5.13/4.22	Good-Fair
			08/87	71/24	5.11/3.87	Good-Fair
			08/85	53/19	5.55/4.28	Good-Fair
			08/83	56/19	5.97/4.39	Fair
French Broad R, SR 1634, nr Alexander Buncombe	S/B-17	6-(67.5)	07/92	54/20	5.96/4.58	Fair
			07/90	61/19	5.61/4.10	Good-Fair
			08/87	68/26	5.55/4.01	Good-Fair
Dingle Cr, US 25, Buncombe	32/B-18	6-71	02/87	-/10	-/5.52	Poor
Dingle Cr, US 25, Buncombe	33/B-19	6-71	02/87	-/2	-/4.34	Poor
Dingle Cr, Blue Ridge Pkwy, Buncombe	34/B-20	6-71	02/87	-/14	-/3.03	Fair
Dingle Cr, Blue Ridge Pkwy, Buncombe	35/B-21	6-71	02/87	-/16	-/2.12	Good-Fair
Hominy Cr, SR 1141, Luther, Buncombe	-/B-22	6-76	01/89	-/18	-/3.19	Good-Fair
Hominy Cr, NC 151 @ Candler, Buncombe	-/B-23	6-76	07/92	-/28	-/3.31	Good
Hominy Cr, NC 112 ab Enka Lake, Buncombe	-/B-24	6-76	07/92	-/11	-/3.94	Fair
Hominy Cr, Sr 3412 @ Sand Hill, Buncombe	-/B-25	6-76	07/92	-/8	-/3.58	Poor
S Hominy Cr, NC 151 @ Candler, Buncombe	-/B-26	6-76-5	07/92	-/20	-/3.21	Good-Fair
Swannanoa R, SR 2500 @ Black Mt., Bun.	39/B-27	6-78	10/87	56/19	5.61/4.45	Fair
Swannanoa R, SR 2727 @ Swannanoa, Bun.	38/B-28	6-78	10/87	50/18	5.14/4.00	Good-Fair
Swannanoa R, SR 2416 @ Warren Wilson Buncombe	37/B-29	6-78	10/87	60/22	5.01/3.91	Good-Fair
			07/87	73/33	5.13/3.96	Good-Fair
Swannanoa R, NC 81/240 @ River Rd, Bun.	36/B-30	6-78	03/88	70/24	5.87/4.14	Fair
			10/87	68/24	5.81/4.24	Good-Fair
			07/87	76/29	5.51/4.32	Good-Fair
Swannanoa R, NC 81 be 240, River Rd, Bun.	36/B-31		03/88	56/18	6.26/4.39	Fair
Swannanoa R, US 25 nr Biltmore, Buncombe	D/B-32	6-78	07/92	72/27	5.65/4.38	Good-Fair
			07/89	60/15	6.30/4.50	Fair
			03/88	47/8	7.02/5.96	Poor
			10/87	54/17	6.34/4.87	Fair
			08/85	41/9	7.38/4.99	Poor
Flat Cr, nr Hwy 9 ab Big Piney Cr, Buncombe	-/B-33	6-78-6-(1)	12/91	-/35	-/1.54	Excellent
Big Slaty Br, nr Hwy 9, ab Slaty Br, Bun.	-/B-34	6-78-6-2	12/91	-/34	-/1,50	Excellent
Slaty Br, (Little Slaty Br), nr Hwy 9 ab Big Piney Cr, Buncombe	-/B-35	6-78-6-3	12/91	-/37	-/1.54	Excellent
Big Piney Cr, nr Hwy 9 nr Montreat, Bun.	-/B-36	6-78-6-5	12/91	-/32	-/1.37	Excellent
Wolfpit Br, nr High Top Colony Rd, Bun.	-/B-37	6-78-10-(1)	12/91	-/26	-/1.35	Excellent
N Fk Swannanoa R, SR 2576 ab Grovestone, Buncombe	46/B-38	6-78-11-(13)	10/87	-/14	-/3.85	Fair
N Fk Swannanoa, Hwy 70, be Grovestone, Buncombe	45/B-39	6-78-11-(13)	10/87	-/12	4.46	Fair
Laurel Br, nr mouth, Buncombe	-/B-40	6-78-11-16	02/92	58/32	2.79/1.67	Excellent
Beetree Cr, SR 2427, Buncombe	5/B-41	6-78-15-(1)	03/86	72/39	3.56/2.83	Excellent
Beetree Cr, SR 2429, Buncombe	44/B-42	6-78-15-(1)	10/87	-/15	-/3.01	Good-Fair
Beetree Cr, SR 2416, Buncombe	43/B-43	6-78-15-(1)	10/87	-/19	-/3.72	Good-Fair
Bull Cr, SR 2408, Buncombe	42/B-44	6-78-18	10/87	-/27	-/3.47	Good
Christian Cr, SR 2838, Buncombe	41/B-45	6-78-19	10/87	-/17	-/4.53	Good-Fair
Sweeten Cr, NC 25A, Buncombe	40/B-46	6-78-24	10/87	-/1	-/5.50	Poor
Newfound Cr, SR 1296, Buncombe	51/B-47	6-84	06/89	74/38	3.88/3.14	Excellent
			06/88	94/39	4.13/3.30	Excellent
Newfound Cr, SR 1297, Buncombe	52/B-48	6-84	06/89	56/16	6.53/4.53	Fair
Newfound Cr, SR 1378, Buncombe	6/B-49	6-84	06/88	62/17	6.45/4.81	Fair
		04/86	50/126.73/4.77		Poor	
Newfound Cr, SR 1622, Buncombe	7/B-50	6-84	07/89	59/17	7.05/5.36	Fair

FBR 02 Continued

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
			06/89	53/8	7.50/5.63	Poor
			04/89	47/7	7.21/5.65	Poor
			02/89	40/3	7.96/6.77	Poor
			06/88	65/13	7.23/5.66	Poor
			04/86	43/10	6.65/5.20	Poor
Reems Cr, NC 251, Buncombe	-/B-51	6-87-(10)	07/92	-/20	-/3.37	Good-Fair
Flat Cr, Hwy 70, Buncombe	47/B-52	6-88	10/87	-/15	-/4.02	Fair
Flat Cr, SR 1741, Buncombe	8/B-53	6-88	04/86	75/24	4.91/3.49	Good-Fair
Sandymush Cr, SR 1104, Madison	-/B-54	6-92-(9)	07/92	-/36	-/4.06	Excellent

FBR 03

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Davidson R, NC 276 @ campground, Trans.	-/B-1	6-34-(15.5)	07/92	-/45	-/1.82	Excellent
Bolyston Cr, SR 1314, Henderson	-/B-2	6-52	07/92	-/26	-/4.65	Good-Fair
Mills R, SR 1337 @ Mills River, Henderson	F/B-3	6-54-(1)	07/92	89/52	3.08/2.23	Excellent
			07/90	105/51	3.52/2.34	Excellent
			08/88	84/37	3.91/2.69	Excellent
			07/86	90/48	3.51/2.72	Excellent
			08/84	91/45	3.59/2.74	Excellent
Mills R, SR 1353, Henderson	4/B-4	6-54-(5)	07/92	81/35	4.07/3.07	Good
N Fk Mills R, SR 1341, Henderson	-/B-5	6-54-2-(9)	09/85	91/37	3.76/2.55	Excellent
Bradley Cr, FR 1206, Transylvania	-/B-6	6-54-3-17	04/91	-/55	-/1.58	Excellent
Bradley Cr, FR 1206 ab State Rock Cr, Hen.	-/B-7	6-54-3-17	04/91	-/47	-/1.82	Excellent
Bradley Cr, FR 1206 ab Yellow Gap Cr, Hen.	-/B-8	6-54-3-17	07/91	-/38	-/1.52	Excellent
			04/91	-/60	-/1.60	Excellent

FBR 04

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
French Broad R, NC 213 at Marshall, Madison	G/B-1	6-(67.5)	07/92	67/25	5.23/4.42	Good-Fair
			07/90	49/18	5.34/4.53	Good-Fair
			08/88	71/22	5.82/4.56	Fair
			07/86	79/31	5.39/3.85	Good-Fair
			08/85	62/18	5.58/4.28	Good-Fair
			08/84	41/16	5.18/4.04	Good-Fair
			08/83	54/19	5.54/4.22	Good-Fair
Ivy Cr (R), SR 2150, Buncombe	-/B-2	6-96-(0.5)	07/92	-/38	-/3.35	Excellent
Little Ivy Cr, SR 1610, Madison	-/B-3	6-96-10	07/92	-/34	-/3.26	Good
Ivy Cr (R), NC 25/70 Bus., Madison	-/B-4	6-99-(11.7)	07/92	87/36	4.61/3.61	Good
Hunter Cr, nr Hunter Cr R nr Marshall, Madison	-/B-5	6-106-2-(1)	12/91	-/30	-/1.65	Excellent
Big Laurel Cr, NC 208, Madison	-/B-6	6-112	08/92	-/38	-/3.00	Excellent
Shelton Laurel Cr, NC 208/212, Madison	85/B-7	6-112-26	08/92	-/32	-/2.90	Good
			05/90	-/44	-/2.55	Excellent
Hickory Fk (Hickey Cr), SR 1310, Madison	84/B-8	6-112-26-7	05/90	-/43	-/1.90	Excellent
W Pr Hickory Fk (W Pr Hickey Cr), SR 1310, Madison	86/B-9	6-112-26-7-1	05/90	-/38	-/1.62	Excellent
E Pr Hickory Fk (Little Pr E Pr Hickey Cr), FR 465, Madison	87/B-10	6-112-26-7-2	05/90	-/32	-/1.35	Excellent
Spring Cr, NC 209, Madison	-/B-11	6-118-27	08/92	-/26	-/2.75	Good-Fair

FBR 05

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Pigeon R, off NC 215, nr Woodrow, Haywood	-/B-1	5-(1)	07/84	87/37	4.49/3.11	Good
Pigeon R, NC 215 at Canton, Haywood	H/B-2	5-(1)	08/92	84/37	4.39/3.33	Good
			08/88	86/33	5.01/3.67	Good-Fair
			02/88	87/35	4.47/3.54	Good
			07/86	80/38	4.61/3.63	Good
			07/84	83/32	4.14/2.55	Good
			08/83	86/29	5.07/3.55	Good-Fair
W Fk Pigeon R, Burnett Siding, Haywood	80/B-3	5-2	07/91	-/42	-/1.82	Excellent
			05/90	-/49	-/1.83	Excellent
UT W Fk Pigeon R, nr NC 215, Haywood	77/B-4	5-2	05/90	-/34	-/1.26	Excellent
Tom Cr, nr NC 215, Haywood	-/B-5	5-2-5	12/91	-/35	-/1.52	Excellent
			07/91	-/39	-/1.13	Excellent

FBR 05 Continued

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
M Pr W Fk Pigeon R, at mouth, Haywood	79/B-6	5-2-7	07/91	-/39	-/1.55	Excellent
			04/91	-/42	-/1.40	Excellent
			05/90	-/42	-/1.70	Excellent
R Pr M Pr W Fk Pigeon R, Haywood	78/B-7	5-2-7-7	07/91	-/34	-/1.65	Excellent
			04/91	-/42	-/1.37	Excellent
			05/90	-/36	-/1.50	Excellent
UT Little E Fk Pigeon R, nr Shining Rock, Hay.	-/B-8	5-2-12-(0.5)	04/91	-/38	-/1.45	Excellent
Little E Fk Pigeon R, SR 1129 ab camp, Haywood	-/B-9	5-2-12-(5.5)	04/91	-/51	-/1.50	Excellent
E Fk Pigeon R, US 276, nr Cruso, Haywood	-/B-10	5-3-(6.5)	07/84	87/39	3.93/2.39	Excellent
Pigeon R, SR 1642 at Clyde, Haywood	I/B-11	5-(7)	08/92	63/16	6.70/4.27	Fair
			09/89	47/7	6.70/4.39	Fair
			08/88	31/4	7.83/5.19	Poor
			02/88	51/12	6.82/4.52	Fair
			07/86	34/2	8.23/3.59	Poor
Pigeon R, at Crabtree Cr nr Crabtree, Haywd	48/B-12	5-(7)	02/88	53/16	6.13/3.97	Fair
Pigeon R, SR 1338 nr Hepco nr Fines Cr, Haywood	49/B-13	5-(7)	08/88	49/14	5.96/3.88	Fair
			02/88	46/24	4.82/3.76	Good-Fair
Pigeon R, at Counterfeit Br, Haywood	-/B-14	5-(7)	04/92	94/43	4.26/2.77	Good
			03/92	77/41	4.02/2.85	Good
Pigeon R, at Hurricane Cr, Haywood	-/B-15	5-(7)	04/92	74/28	5.69/4.42	Good-Fair
			03/92	74/30	5.52/3.68	Good-Fair
Pigeon R, I-40, at Waterville, Haywood	L/B-16	5-(7)	07/90	57/22	4.52/3.75	Good-Fair
			07/89	62/28	5.02/3.96	Good-Fair
			08/88	67/24	4.74/3.41	Good
			08/87	58/25	4.84/3.55	Good-Fair
			07/86	67/28	4.72/3.72	Good
			08/85	59/18	5.71/3.77	Fair
			08/84	68/30	4.66/3.21	Good
			08/83	67/24	5.30/3.39	Good-Fair
Richland Cr, SR 1184 at Waynesville, Haywood	J/B-17	5-16-(1)	08/92	-/27	-/3.36	Good-Fair
			08/88	42/11	6.07/4.87	Fair
			08/85	28/8	6.42/4.36	Fair
			08/83	43/9	7.15/3.70	Poor
Richland Cr, Bus. 23 ab Dayco, Haywood	-/B-18	5-16-(1)	08/92	-/17	-/3.52	Fair
Hyatt Cr, SR 1159, Haywood	13/B-19	5-16-6	04/84	41/17	5.44/3.68	Good-Fair
Hyatt Cr, SR 1159, Haywood	13/B-20	5-16-6	04/84	30/10	6.20/3.82	Fair
Rocky Br, SR 1219, Haywood	-/B-21	5-16-7-9	12/91	-/35	-/1.38	Excellent
Richland Cr, SR 1519, Haywood	-/B-22	5-16-(16)	08/92	-/14	-/4.47	Fair
Jonathan Cr, SR 1306, Haywood	-/B-23	5-26-(7)	08/92	-/42	-/2.06	Excellent
Jonathan Cr, SR 1322, Haywood	-/B-24	5-26-(7)	08/92	-/33	-/3.28	Good
Jonathan Cr, SR 1350, Haywood	-/B-25	5-26-(7)	08/92	-/23	-/3.72	Good-Fair
Fines Cr, SR 1355 nr I 40, Haywood	-/B-26	5-32	08/92	-/19	-/3.74	Good-Fair
Cataloochee Cr, SR 1395 (Gov. Rd), Haywood	K/B-27	5-41	08/92	84/42	3.10/2.10	Excellent
			07/91	80/48	2.59/1.88	Excellent
			10/90	86/47	2.60/1.73	Excellent
			07/90	95/51	2.99/1.74	Excellent
			04/90	86/56	2.19/1.82	Excellent
			01/90	85/51	2.21/1.80	Excellent
			07/89	101/53	2.86/1.77	Excellent
			07/86	102/47	3.38/1.95	Excellent
			08/84	96/42	3.16/1.72	Excellent
Cataloochee Cr, nr SR 1395 ab Palmer Cr, Hay.	-/B-28	5-41	01/90	-/45	-/1.52	Excellent
UT Rough Br, nr SR 1395, Haywood	-/B-29	5-41-1	04/91	-/47	-/1.66	Excellent
Palmer Cr, nr SR 1395, Haywood	-/B-30	5-41-2	04/91	-/46	-/1.51	Excellent
Pretty Hollow Cr, nr SR 1395, Haywood	-/B-31	5-41-2-4	04/91	-/47	-/1.46	Excellent
Lower Double Br, ab Cataloochee Cr nr Gov. Rd., Haywood	74/B-32	5-41-6	10/90	63/37	2.64/1.48	Excellent
			07/90	54/31	2.81/1.73	Excellent
			04/90	57/36	2.09/1.41	Excellent
			01/90	57/36	1.84/1.31	Excellent
Little Cataloochee Cr, SR 1397, Haywood	75/B-33	5-41-10	01/90	-/40	-/1.95	Excellent
Cold Springs Cr, Gov't. Rd nr cmpg, Haywood	-/B-34	5-45	04/92	84/48	2.75/1.98	Excellent
			03/92	78/45	2.73/1.71	Excellent

FBR 06

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Nolichucky R, SR 1321 nr Poplar, Mitchell	P/B-1	7	07/92	88/42	4.14/3.37	Good
			07/90	83/38	4.31/3.27	Good
			08/88	93/35	4.86/3.81	Good
			07/86	84/37	4.86/3.57	Good
			08/85	72/28	4.63/3.36	Good
			08/84	68/31	4.47/3.73	Good
			08/83	78/34	4.55/3.86	Good
North Toe R, NC 80 be Brushy Cr, Avery	-/B-2	7-2-(0.5)	02/89	59/35	4.01/2.68	Good
North Toe R, US 19E at Ingalls, Avery	M/B-3	7-2-(0.5)	07/92	99/41	4.13/3.01	Good
			08/89	93/34	4.28/3.48	Good
			02/89	58/29	4.45/3.14	Good
			08/88	-/34	-/2.83	Good
			08/87	92/38	4.58/3.23	Good
			09/85	85/35	4.78/3.33	Good
			08/84	84/36	4.15/2.93	Good
Jones Cr, SR-1100, Avery	21/B-4	7-2-24	09/85	75/29	3.67/2.27	Good
Brushy Cr, SR 1101 ab landfill, Avery	70/B-5	7-2-29	02/89	-/27	-/2.36	Good-Fair
Brushy Cr, SR 1101 be landfill, Avery	71/B-6	7-2-29	02/89	-/24	-/3.40	Good-Fair
North Toe R, SR 1162 at Penland, Mitchell	N/B-7	7-2-(38.5)	07/92	78/23	5.14/2.98	Good-Fair
			08/89	63/24	5.49/3.27	Good-Fair
			08/88	-/10	-/2.88	Poor
			08/87	62/20	5.97/3.68	Fair
			07/86	70/22	5.89/3.59	Fair
			09/85	46/12	6.20/3.67	Fair
			08/84	63/22	5.36/3.27	Good-Fair
North Toe R, SR 1121 ab Feldspar, Mitchell	15/B-8	7-2-(38.5)	09/85	77/32	4.94/3.64	Good-Fair
North Toe R, NC 226 be Feldspar, Mitchell	16/B-9	7-2-(38.5)	09/85	62/23	5.40/4.01	Good-Fair
North Toe R, SR-1551, Mitchell	17/B-10	7-2-(38.5)	08/85	61/17	6.29/3.85	Fair
North Toe R be Indusmin, Mitchell	18/B-11	7-2-(38.5)	09/85	50/18	5.70/3.45	Fair
North Toe R, SR 1314 at Loafers Glory, Yancey	-/B-12	7-2-(38.5)	07/92	92/40	4.65/3.87	Good
Little Bear Cr, nr NC 226 ab IMC Corp, Mitch.	20/B-13	7-2-46-1	09/85	31/8	4.74/2.76	Fair
Little Bear Cr, be IMC Corp., Mitchell	20/B-14	7-2-46-1	09/85	9/2	7.59/4.29	Poor
Crabtree Cr, SR 1002, Mitchell	-/B-15	7-2-48	07/92	-/32	-/2.06	Good
South Toe R ab NC 80 bridge, Yancey	88/B-16	7-2-52-(1)	01/91	-/51	-/2.01	Excellent
			06/90	-/41	-/2.05	Excellent
South Toe R be NC 80 bridge, Yancey	89/B-17	7-2-52-(1)	01/91	-/44	-/1.70	Good
			06/90	-/46	-/2.12	Excellent
South Toe R, SR 1167 at Celo, Yancey	O/B-18	7-2-52-(1)	07/92	102/48	3.43/2.44	Excellent
			08/88	113/48	4.02/2.73	Excellent
			08/85	99/42	3.85/2.96	Excellent
			08/83	100/41	4.12/2.92	Good
Big Rock Cr, NC-197, Mitchell	-/B-19	7-2-64	07/92	-/44	-/2.73	Excellent

FBR 07

Site	Old/New DEM #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Cane R, SR 1417 nr 19W at Sioux (nr Ramseytown), Yancey	Q/B-1	7-3	07/92	94/49	4.37/3.44	Excellent
			08/89	81/37	4.57/3.84	Good
			08/87	77/34	4.71/3.75	Good
			08/85	62/23	5.23/3.65	Good-Fair
			08/83	70/27	5.35/4.05	Good-Fair
Bald Mt Cr, SR 1408, Yancey	-/B-2-	7-3-32	07/92	-/26	-/3.50	Good-Fair

A-II.2 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.

A-II.2.1 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. Table 2 presents a summary of fish community assessment data from 1980 to 1993 for each sampling location in the basin.

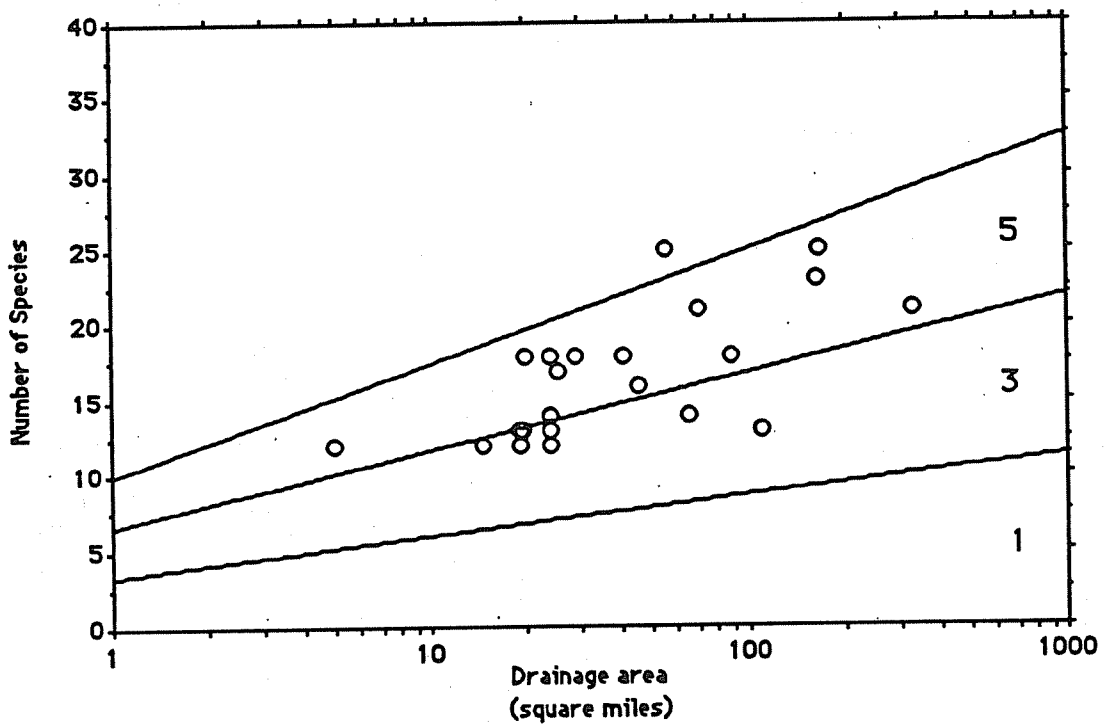

Figure 1. Expectations of the Number of Species based upon Drainage Area Size

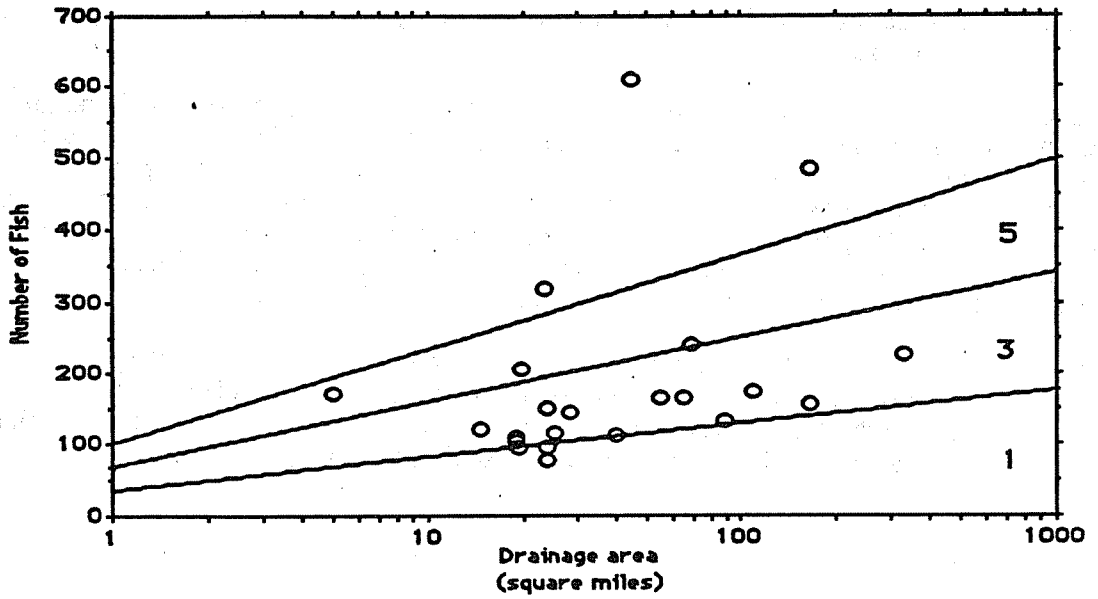

Figure 2. Expectations of the Number of Fish based upon Drainage Area Size

Table 2. Fish Community Assessment Ratings for the French Broad Basin (Note: locations are shown on the subbasin maps in Chapter 4)

Subbasin 02

Site	Stream	Location	Drainage Area(mi^2)	Date	County	NCIBI Score	NCIBI Rating	Collector
F-1	Flat Cr	SR-1742	25	800825	Buncombe	50	Good	NCWRC
F-2	Swannanoa R.	SR-2500	20	871021	Buncombe	52	Good	NCDEM
F-3	Swannanoa R.	SR-2727	60.4	871021	Buncombe	50	Good	NCDEM
F-4	Swannanoa R.	SR-2416	81	871020	Buncombe	56	Excellent-Good	NCDEM
F-5	Swannanoa R.	NC-81	102	871020	Buncombe	54	Excellent-Good	NCDEM
F-6	Swannanoa R.	NC-25	130	871020	Buncombe	50	Good	NCDEM
F-6	Swannanoa R.	NC-25	130	930628	Buncombe	46	Good-Fair	NCDEM
F-7	Sandymush Cr.	SR-1607	45	800820	Buncombe	46	Good-Fair	NCWRC
F-7	Sandymush Cr.	SR-1607	45	931116	Buncombe	52	Good	NCDEM
F-8	Cane Creek	NC-25	82	930926	Buncombe	50	Good	ROHDE
F-9	Hominy Creek	NC-151	30	930723	Buncombe	50	Good	NCDEM
F-10	South Hominy Cr	NC-151	38	930723	Buncombe	46	Good-Fair	NCDEM
F-11	Reems Creek	NC-251	36	931117	Buncombe	56	Excellent-Good	NCDEM

Subbasin 04

Site	Stream	Location	Drainage Area(mi^2)	Date	County	NCIBI Score	NCIBI Rating	Collector
F-14	Spring Cr	Hot Springs	72	800920	Madison	54	Excellent-Good	UNCC
F-15	Shelton Laurel Cr	NC-208	35	920724	Madison	54	Excellent-Good	NCDEM
F-16	Ivy R	US-25/70	161	931116	Madison	52	Good	NCDEM
F-17	Big Ivy Cr	SR-2150	63	931117	Buncombe	58	Excellent	NCDEM

Subbasin 05

Site	Stream	Location	Drainage Area(mi^2)	Date	County	NCIBI Score	NCIBI Rating	Collector
F-18	Pigeon River	RM-65.5	133	870723	Haywood	52	Good	EA
F-19	Pigeon River	RM-64.5	133	870718	Haywood	52	Good	EA
F-20	Pigeon River	RM-63	136	870717	Haywood	36	Fair-Poor	EA
F-21	Pigeon River	RM-59	162	870716	Haywood	36	Fair-Poor	EA
F-22	Pigeon River	RM-52.3	243	870721	Haywood	38	Fair-Poor	EA
F-23	Pigeon River	RM-48.2	278	870721	Haywood	14	Very Poor	EA
F-24	Pigeon River	RM-42.6	381	870719	Haywood	30	Poor	EA
F-25	Richland Creek	US-23	13	920723	Haywood	46	Good-Fair	NCDEM
F-26	Richland Creek	SR-1519	68	870717	Haywood	48	Good	EA
F-27	Jonathan Creek	NC-276	65	931116	Haywood	50	Good	NCDEM

Subbasin 06

Site	Stream	Location	Drainage Area(mi^2)	Date	County	NCIBI Score	NCIBI Rating	Collector
F-28	South Toe R	SR-1168	43	930723	Yancey	48	Good	ROHDE
F-29	South Toe R	SR-1169/1167	43	930721	Yancey	54	Excellent-Good	ROHDE
F-30	South Toe R	SR-1169/1152	54	930721	Yancey	50	Good	ROHDE
F-31	South Toe R	SR-1201	56	930906	Yancey	58	Excellent	ROHDE
F-32	South Toe R	SR-1152/1169	57	930723	Yancey	58	Excellent	ROHDE
F-33	South Toe R	SR-1309	84	930905	Yancey	58	Excellent	ROHDE
F-34	South Toe R	SR-1305	85	930905	Yancey	54	Excellent-Good	ROHDE
F-35	North Toe R	NC-80	180	930718	Yancey	52	Good	ROHDE
F-36	North Toe R	SR-1177	268	921003	Mitchell	52	Good	ROHDE
F-37	North Toe R	SR-1187	268	930720	Mitchell	54	Excellent-Good	ROHDE
F-38	North Toe R	SR-1336	326	921003	Yancey	56	Excellent-Good	ROHDE
F-39	North Toe R	NC-197	442	930722	Mitchell	52	Good	ROHDE

Subbasin 07

Site	Stream	Location	Drainage Area(mi^2)	Date	County	NCIBI Score	NCIBI Rating	Collector
F-40	Cane River	SR-1411	138	930719	Yancey	54	Excellent-Good	ROHDE
F-41	Cane River	SR-1417	157	921002	Yancey	54	Excellent-Good	ROHDE
F-42	Cane River	US-19W	157	930904	Yancey	52	Good	ROHDE
F-43	Cane River	SR-1343	158	930904	Yancey	56	Excellent-Good	ROHDE

A-II.2.2 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.

A-II.3 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.

A-II.4 Effluent Toxicity Testing

Effluent toxicity testing is required on a quarterly basis for major NPDES dischargers and any discharger containing complex (industrial) wastewater. DEM's Aquatic Toxicology Unit maintains a compliance summary for all facilities required to perform toxicity tests and provides a monthly update of this information to the regional offices and DEM administration.

Table 3. NPDES Discharge Facilities Required to Conduct Effluent Toxicity Testing

Subbasin 01

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Dupont-Brevard	NC0000337/001	Little River	Transylvania	2.0000	14.66
Ecusta Division	NC0000078/001	French Broad River	Transylvania	27.5000	21.05
MB Industries	NC0000311/001	W Fk French Broad	Transylvania	0.0430	0.17

Subbasin 02

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
BASF	NC0000299/001	Hominy Cr.	Buncombe	4.0	21.2
Bon Worth, Inc.	NC0037176/001	Allen Br.	Henderson	0.006	3.7
Brevard WWTP	NC0060534/001	Fr. Broad River	Transylvan.	2.5	2.40
Buncombe Co. MSD	NC0024911/001	Fr. Broad River	Buncombe	40.0	11.7
Carol. Water Serv.-Bent Cr.	NC0036684/001	Wesley Cr.	Buncombe	0.1	28.0
Cedars Of Clear Creek	NC0067245/001	Cherry Branch	Henderson	0.018	27.0
CP&L-Asheville Ash Pond	NC0000396/001	Fr. Broad River	Buncombe	1.9	0.77
Cranston Print Works	NC0000094/001	Fr. Broad River	Henderson	4.0	1.85
Etowah WWTP	NC0071323/001	Gash Cr.	Henderson	0.125	71.0
GE Lighting Systems	NC0077771/001	Bat Fork Cr.	Henderson	0.3	61.0
General Electric	NC0000507/001	Bat Fork Cr.	Henderson	0.5	72.1
Hampton Inn	NC0062880/001	Allen Branch	Henderson	Ceased Discharge	
Henderson Co. Schools	NC0066681/001	UT Mill Pond	Henderson	0.009	13.0
Hendersonville WWTP	NC0025534/001	Mud Cr.	Henderson	3.2	11.01
Holiday Inn-Henderson	NC0034231/001	Allen Branch	Henderson	Ceased Discharge	
Kyocera Ind. Ceramics	NC0057878/001	UT Mud Cr.	Henderson	NA	43.0
Wedgefield Acres MHP	NC0062634/001	UT Pond Br.	Buncombe	0.025	100.0

Subbasin 04

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Marshall WWTP	NC0021733/001	French Broad River	Madison	0.4000	0.12

Subbasin 05

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Champion Paper-Canton	NC0000272/001	Pigeon River	Haywood	48.5000	100.00
Maggie Valley WWTP	NC0056561/001	Jonathan Cr.	Haywood	1.0000	6.30
Mt. Pisgah Lodge/Recreation Area	NC0072729/001	UT Pisgah Cr.	Haywood	0.0320	25.00
Waynesville WWTP	NC0025321/001	Pigeon River	Haywood	6.0000	8.91

Subbasin 06

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Bakersville WWTP	NC0025461/001	Cane Cr.	Mitchell	0.0750	3.12
Feldspar Corp.	NC0000353/001	North Toe River	Mitchell	3.5000	11.18
K-T Feldspar	NC0000400/001	North Toe River	Mitchell	1.7300	5.73
Ledbetter Oil Co- Rain. Pantry #5	NC0076911/001	White Oak Cr.	Avery	0.0045	1.90
Spruce Pine WWTP	NC0021423/001	North Toe River	Mitchell	0.6000	2.06
Unimin Corp-Mica Operations	NC0000361/001	North Toe River	Avery	2.1600	10.00
Unimin Corp-Quartz Operations	NC0000175/001	North Toe River	Mitchell	3.6100	11.00

Subbasin 07

Facility	NPDES#	Receiving Stream	County	Flow(MGD)	IWC(%)
Burnsville WWTP	NC0020290/001	Cane River	Yancey	0.8000	6.13

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

SUMMARY OF BASINWIDE PLANNING WORKSHOP

June 2, 1994

NCSU Mountain Horticultural
Crops Research and Extension Center
Fletcher, NC

North Carolina
Cooperative Extension Service
NORTH CAROLINA STATE UNIVERSITY
COLLEGE OF AGRICULTURE & LIFE SCIENCES

Department of Biological and Agricultural Engineering • Box 7625 • Raleigh, NC 27695-7625 • Tel: (919) 515-2675 • FAX: (919) 515-6772

PHONE: (919) 515-6795

June 10, 1994

To Participants in the June 2 French Broad Basinwide Planning Workshop:

Thank you for participating in the June 2 French Broad Basinwide Planning Workshop in Fletcher. The French Broad Basinwide Water Quality Management Plan being developed by the North Carolina Division of Environmental Management will affect all residents of the French Broad, Pigeon, and Nolichucky River Basins. Your input is necessary to make this program successful in meeting its water quality protection goals.

Attached is a summary of the June 2 Workshop. Participants identified many issues and recommended actions to address these issues. Some of these recommendations require state action, but many require that local governments and citizens become involved in managing water resources.

The next step in the Basinwide Planning process is development of the Draft Management Plan. The Division of Environmental Management will send you a copy of the Draft Management Plan's Executive Summary to review when it is available. A full Draft Management Plan will be sent to you upon request. A series of public meetings will be conducted in the French Broad River Basin to receive public comment on the Plan this Fall.

Thank you again for participating in the Workshop. Please contact me if you have any questions.

Sincerely,

Gregory D. Jennings, Ph.D.
Extension Specialist

cc: Alan Clark, NC Division of Environmental Management
Paula Thomas, NC League of Municipalities

French Broad Basinwide Planning Workshop Summary

Prepared by Greg Jennings, Extension Specialist
North Carolina Cooperative Extension Service, North Carolina State University

The French Broad Basinwide Planning Workshop was conducted June 2, 1994, at the NCSU Mountain Horticultural Crops Research and Extension Center in Fletcher with 108 participants representing the following interests:

17 County Government	13 City Government	6 Regional Agencies
15 State Agencies	5 Federal Agencies	13 Business / Industry
11 Farmers / Landowners	14 Private Organizations	14 Cooperative Extension Service

Workshop Objectives:

1. Describe local implications of the French Broad Basinwide Water Quality Management Plan; and
2. Increase public involvement in developing and implementing the French Broad 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 French Broad River Basin - Alan Clark, DEM
10:30	Discussion Groups to Answer: "Based on your knowledge of water quality in the French Broad 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 Wrap-up - 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 French Broad 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:

- **Agricultural pollution sources**
- **Point sources of pollution**
- **Development and land use planning**
- **Drinking water protection**
- **Education and public involvement**
- **Sedimentation**
- **Recreation impacts on water**

Recommended Actions Identified by Two or More Discussion Groups:

- **Increase public education and involvement**
- **Increase technical and financial assistance for nonpoint sources, including agriculture**
- **Develop land use plans considering environmental and economic impacts**
- **Increase DEM resources for monitoring and enforcement**
- **Improve communications and coordination among all parties involved with water quality**
- **Emphasize practical, simplified regulations to meet water quality goals**
- **Support new technologies for preventing and remediating pollution**

Below are summarized the priority issues and recommended actions of the 6 discussion groups:

Group 1 Priority Issues (Facilitator: Kenneth Reeves, CES - Buncombe County):

1. Agriculture
2. Development
3. Drinking water protection
4. Public policy education
5. Point sources

Group 1 Recommended Actions:

1. Implement buffers with compensation to landowner for non-use of land near streams
2. Increase enforcement for development and point sources
3. Increase public education:
   - Agricultural BMPs
   - Public policy education for local officials
   - Responsible development
4. Use available data to evaluate sources of drinking water
5. Implement realistic regulations

Group 2 Priority Issues (Facilitator: Jim Ray, CES - Yancey):

1. Agriculture:
   - How to reduce runoff?
   - Need for technical assistance
2. Recreation uses - need for clean streams
3. Cost-benefit relationships for taxpayers
4. Need for studies to support regulatory efforts
5. Private property rights

Group 2 Recommended Actions:

1. Increase enforcement of point sources
2. Increase technical & financial assistance to reduce nonpoint sources
3. Address urban development & residential nonpoint sources (e.g. pesticides)
4. Provide guidance for developers in methods of reducing sedimentation
5. Increase education & public involvement

Group 3 Priority Issues (Facilitator: Jeff Owen, CES - Avery County):

1. Sedimentation from construction & development
2. Education & Public involvement
3. Regulatory enforcement
4. Identification and prioritization of pollution sources and water quality impacts
5. Pesticides
6. Drinking water protection
7. Recreation impacts

Group 3 Recommended Actions:

1. Increase local involvement in identifying and prioritizing problems
2. Improve communications among competing groups
3. Increase education on solutions (e.g. soil conservation, buffers)
4. Implement a community stream watch program with a hotline for reporting problems
5. Conduct a risk analysis and inform the public of water quality concerns
6. Use incentives & disincentives for protecting water quality (consider profitability)
7. Use ethical, unbiased permitting process
8. Promote scientific basis for water quality protection instead of perception basis

Group 4 Issues (Facilitator: Steve West, CES - Haywood County):

1. Agriculture including timber production & logging
2. Public education on water issues & existing initiatives
3. Development and landscaping impacts
4. Sediment and erosion control
5. Nonpoint source control:
   - nutrient management
   - golf courses
   - waste
   - dumping

Group 4 Recommended Actions:

1. Implement major education programs:
   - Workshops
   - Schools
   - Promote interagency understanding
2. Recognize and reward positive efforts concerning water quality
3. Develop and evaluate realistic proactive regulations addressing all segments of society
4. Clarify roles of all governmental agencies

Group 5 Issues (Facilitator: Greg Jennings, CES - NCSU):

1. Development and land use planning
2. Agriculture: Pesticides, Sediment, Animal waste
3. Residential & recreation impacts
4. Community awareness & education
5. Watershed protection for water supplies (addressing point and nonpoint sources)
6. Pigeon River restoration
7. Sedimentation

Group 5 Recommended Actions:

1. Increase technical assistance, cost-share, and enforcement for agricultural problems
2. Education and public awareness of problems, policies, and time frames for solutions:
   - Schools
   - Watershed residents affected by permit changes
3. Protect drinking water supplies through increased watershed protection and water testing

4. Develop a comprehensive land use plan:
   - Evaluation impacts of development
   - Basinwide zoning
   - Identify and regulate nonpoint source impacts
   - Implement long-term public remediation plans
   - Consider public transportation
   - Regulate storm water in smaller communities
   - Reduce government regulation
5. Pigeon River restoration:
   - Force Champion Mill to eliminate chlorine bleaching & meet color standards
   - Require independent testing of industrial discharge quality
   - Require new technology for cleanup of industrial discharge problems

Group 6 Issues (Facilitator: Frank Humenik, CES - NCSU):

1. Point sources: Municipal & industrial discharges
2. Development
3. Urban runoff
4. Animal waste

Group 6 Recommended Actions:

1. Increase DEM field resources to support regulatory enforcement
2. Consolidate individual waste treatment systems to improve effectiveness
3. Implement land use planning with environmental impact assessment
4. Increase education and public awareness of problems and solutions
5. Develop and implement new technologies and BMPs
6. Simplify rules
7. Consider 3 sub-basins independently
8. Conduct more workshops in the interim as the basinwide plan is being developed

APPENDIX V

Use Support Data Interpretation and Assessment Methodology

APPENDIX V

Interpretation of Data

The assessment of water quality presented in Section 4.5 of Chapter 4 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 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 sections of Chapters 4 and 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 VI

LISTS OF BEST MANAGEMENT PRACTICES (BMPs) FOR:

- **Agriculture**
- **Urban Runoff**
- **Sedimentation and Erosion Control**
- **Onsite Wastewater Disposal**
- **Forestry**
- **Mining**

Note: The BMPs lists included in this appendix were excerpted from a document entitled North Carolina Nonpoint Source Management Program (Report 89-02). The document was prepared by the North Carolina Department of Environment, Health, and Natural Resources, Division of Environmental Managment, Water Quality Section.

Table 4. BMPs for Agriculture

I. Crop and Pasture Lands

A. BMPs for sediment control

Conservation Tillage System
Critical Area Planting
Cropland Conversion
Diversion
Field Border
Filter Strip
Grade Stabilization Structure
Grassed Waterway
Rock-lined Waterways or Outlets
Sediment Control Structure
Sod-based Rotation
Stripcropping
Terrace
Water Control Structure
Pastureland Conversion

B. BMPs for nutrient control

Legumes in Rotation
Soil Testing
Liming
Setting Realistic Crop Yield Goals (determines fertilization rates)
Fertilizer Waste Application (method, rate, and timing)
Sediment Control BMP's

C. BMPs for pesticide control

Alternative Pesticides
Optimize Pesticide Formulation, Amount, Placement Timing, Frequency
Crop Rotation
Resistant Crop Varieties
Other Cultural or Biological Controls
Optimize Crop Planting Time
Plant Pest Quarantines
Proper Disposal of Obsolete Pesticides and Containers
Certification of Applicators
Sediment Control BMP's

Table 4 Cont.

II. Animal Production (esp. Confined Animal Operations)

BMPs for bacteria and nutrient control

Grade Stabilization Structures
Heavy Use Area Protection
Livestock Exclusion
Spring Development
Stock Trails and Walkways
Trough or Tank
Waste Management System
Waste Storage Pond
Waste Storage Structure
Waste Treatment Lagoon
Land Application of Waste
Water Control Structure

Table 5
BEST MANAGEMENT PRACTICES ELIGIBLE FOR COST SHARING
UNDER THE AGRICULTURE COST SHARE PROGRAM

Practice	Minimum Life Expectancy (years)
Conservation Tillage System	1
Critical Area Planting	10
Cropland Conversion (Trees, Grasses, or Permanent Wildlife Plantings)	10
Diversion	10
Field Border	10
Filter Strip	10
Grassed Waterway	10
Heavy Use Area Protection	10
Livestock Exclusion	10
Pastureland Conversion	10
Rock-lined Waterway or Outlet	10
Sediment Control Structure	10
Sod-based Rotation	4 or 5
Spring Development	10
Stock Trails and Walkways	10
Stripcropping	5
Terrace	10
Trough or Tank	10
Waste Management System	10
Waste Storage Pond	10
Waste Storage Structure	10
Waste Treatment Lagoon	10
Land Application of Waste	1
Grade Stabilization Structure	10
Water Control Structure	10

The minimum life expectancy of the BMPs is also listed in Table 5. Practices designated by a District shall meet the life expectancy requirement established by the Division for that District BMP.

Conservation tillage systems, sod-based rotation, stripcropping, and land application of animal wastes shall be funded under a cost-share incentive payment. Payments for conservation tillage systems and land application of animal wastes are limited to a maximum of three years per farm. Farmers are expected to incorporate BMPs on their own initiative after this time.

The ACSP has a detailed implementation plan that is to be used in conjunction with the rules and regulations for the Program. The following is a list of definition of practices in the plan:

(1) Conservation Tillage System means a form of non-inversion tillage that retains protective amounts of residue mulch on the surface throughout the year. These include no tillage, strip tillage, stubble mulching and other types of non-inversion tillage which maintain a minimum of 50 percent ground cover at planting or a minimum surface residue of 2,000, 1,500, and 1,000 pounds per acre for corn, soybeans, and small grain, respectively.

(2) Critical Area Planting means planting trees, shrubs, grasses, or legumes on critically eroding agricultural areas in order to reduce erosion, sediment delivery and nonpoint source pollution to receiving waters.

(3) Critical Erosion as applied to critical areas means erosion so severe that special agricultural BMPs must be used to stabilize the area of concern.

(4) Cropland Conversion means the establishment of perennial grasses, trees, or permanent wildlife plantings on excessively eroding cropland. Cost share will be based on 75 percent of the average cost of establishing fescue.

(5) Diversion means a channel with a supporting ridge on the lower side constructed across the slope to divert excess water from cropland areas.

(6) Excessive Erosion means sheet, rill and/or concentrated erosion on agricultural lands occurring at an annual rate greater than the soil loss tolerance (T).

(7) Field Border means a strip of perennial vegetation

established at the edge of the field to control erosion.

(8) Filter Strip means a strip or area of perennial vegetation for removing sediment, organic matter, and other pollutants from cropland or as part of waste management systems for treating runoff from concentrated animal areas.

(9) Grade Stabilization Structure means a structure to stabilize the grade of agricultural cropland or pasture land where concentrated and high velocity runoff results in head cutting and gully formation.

(10) Grassed Waterway means a natural waterway or outlet, shaped or graded, established in suitable vegetation and used to route excess water from cropland, reduce gully erosion and reduce nonpoint source pollutant delivery to receiving waters. As a condition for cost sharing, the field or treatment unit draining into the waterway must have installed, or the farmer must agree to install as part of the agreement, erosion control measures necessary to prevent damage from washout or excessive sedimentation in the waterway.

(11) Heavy Use Area Protection means stabilizing high concentration areas for livestock to reduce stream loading of sediment and/or animal waste.

(12) Livestock Exclusion means permanent fencing used to exclude livestock from an area and is to be used in conjunction with livestock waste treatment systems, stream crossings, streambank protection or other areas as needed to protect surface water quality.

(13) Pastureland Conversion means establishing trees or perennial wildlife plantings on excessively eroding pasture that is too steep to mow or maintain with conventional equipment. (Class VII Land)

(14) Rock-lined Waterway or Outlet means a waterway or outlet having an erosion-resistant lining of permanent material which provides safe disposal of runoff where unlined or grassed waterways would be inadequate.

(15) Sediment Control Structure means a temporary or permanent basin constructed to collect and store sediment and other agricultural nonpoint source pollution.

(16) Sod-based Rotation means establishing perennial grasses and/or legumes or a mixture of them on excessively eroding cropland and maintaining at least a four-year rotation. A one-time incentive payment per field will be made for establishment.

(17) Spring Development means improving springs and seeps by excavating, cleaning, capping or providing collection and storage facilities. Springs are to be developed as a source for livestock watering in conjunction with livestock exclusion from streams. The SWCD's have been made aware of the potential conflict of spring development with habitat preservation for wetland flora and fauna. Conflicts are reviewed on a case-by-case basis.

(18) Stock Trails and Walkways means a system used to control erosion where livestock cross ditches, streams, or other areas where surface water quality needs to be protected. Trails and walkways must be used in conjunction with livestock exclusion.

(19) Stripcropping means growing crops in a systematic arrangement of strips or bands across the general slope. The crops are arranged so that a strip of grass or close-growing crop is alternated with a clean-tilled crop or a crop under a conservation tillage system. Cost sharing will be based on a one-time payment of 75 percent of the average cost of establishing fescue multiplied by the acres in sod plus an incentive payment for the establishment of the strips.

(20) Terrace means an earth embankment, a channel, or a combination ridge and channel constructed across the slope.

(21) Trough or Tank means constructing a device for livestock watering in conjunction with livestock exclusion from streams.

(22) Waste Management System means a planned system for managing liquid, solid waste, and runoff from concentrated animal areas. System components may include:

(A) Waste Storage Pond means an impoundment made by excavation or earthfill for temporary storage of animal or other agricultural waste.

(B) Waste Storage Structure means a fabricated structure for temporary storage of animal or agricultural waste.

(C) Waste Treatment Lagoon means an impoundment made by excavation or earthfill for biological treatment of animal or other agricultural waste.

(D) Land application of Wastes means the application of agricultural wastes on land in an environmentally acceptable manner.

(23) Water Control Structure means a man-made structure installed in on-farm water management systems to reduce the delivery of nonpoint source pollutants into main water courses.

Best Management Practices

Structural best management practices for urban runoff control typically are designed to reduce sediment, its attached pollutants, and nutrients. In addition, other BMPs provide shade to waterbodies and reduce the likelihood of excessive water temperatures. Nonstructural BMPs, such as a design manual or a public education program, encourage the comprehensive and effective implementation of structural BMPs. Table 6 contains a list of both structural and nonstructural BMPs. This list will become more complete when the design manual for urban BMPs (currently being written by the Water Quality Section of DEM) is available.

Table 6. BMPS for Urban Runoff Control

STRUCTURAL
- Wet Detention Basin
- Infiltration Basin
- Vegetative Practices
  - Filter Strips
  - Swales with Check Dams
- Oil and Grease Separator
- Rollover-Type Curbing

NONSTRUCTURAL
- Design Manual for Urban BMPs
- Public Education
- Identification and Enforcement of Illegal Discharges
- Land-Use Control

Structural BMPs may affect groundwater quality in certain situations. Devices that recharge groundwater pose the risk of passing soluble pollutants, collected from stormwater runoff, into groundwater systems. At present it is not known whether pollutant concentrations in recharged groundwater areas pose a significant environmental or health risk. USGS is presently conducting a study of the groundwater quality effects of urban BMPs. In addition, if funds are made available, DEM could conduct a similar study in North Carolina. It is hoped that monitoring projects, like the USGS project, will clarify the groundwater quality impacts of urban BMPs.

Best Management Practices

The typical or suggested BMPs of the North Carolina Sedimentation Pollution Control Act of 1973 are selected on the basis of performance in providing protection from the maximum peak rate of runoff from a 10-year storm. This allows the developer/designer of the control measures, structures, or devices to determine and submit for approval the most economical and effective means of controlling erosion and preventing sedimentation damage. Practices are therefore reviewed for acceptability based upon the characteristics of each individual site and its erosion potential. Ideally, the erosion control plan will employ both practices and construction management techniques which will provide the most effective and reasonable means of controlling erosion while considering the uniqueness of each site. Table 7 provides a list of practices commonly used in sedimentation and erosion control plans across North Carolina.

Table 7. BMPs for Sedimentation Control

Land Grading
Surface Roughening
Topsoiling
Tree Preservation & Protection
Temporary Gravel Construction Entrance/Exit
Temporary Seeding
Permanent Seeding
Sodding
Trees, Shrubs, Vines & Ground Covers
Mulching
Riprap
Vegetative Dune Stabilization
Temporary Diversions
Permanent Diversions
Perimeter Dike
Right-Of-Way Diversions
Grass-lined Channels
Grass Channels with Liner
Riprap-lined Channels
Paved Channels
Temporary Slope Drains
Paved Flume (Chutes)
Level Spreader
Outlet Stabilization Structure
Temporary Excavated Drop Inlet Protection
Fabric Drop Inlet Protection
Temporary Block & Gravel Inlet Protection
Sod Drop Inlet Protection
Temporary Sediment Trap
Sediment Basin
Sediment Fence
Rock Dam
Temporary Stream Crossing
Permanent Stream Crossing
Vegetative Streambank Stabilization
Structural Streambank Stabilization
Construction Road Stabilization
Subsurface Drain
Grade Stabilization Structure
Check Dam
Dust Control
Sand Fence (Wind Fence)

Best Management Practices

In order to protect public health and water quality, best management practices (BMPs) need to be implemented throughout the life cycle of an on-site wastewater disposal system. Life-cycle management problems can be addressed in three phases (Steinbeck, 1984). The first phase includes system siting, design, and installation. The second phase involves the operation of the system and phase three involves maintenance and repair when the system malfunctions or fails. As BMPs are applied in each life-cycle phase, the primary factor influencing the success of the system is the participation of the local health department and the cooperation of the developer, owner, design engineer, system operator, and the state. The following is a summary of the current life-cycle management practices and penalties utilized in North Carolina to implement the on-site sewage systems program (Steinbeck, 1984).

Table 8. BMPs for On-Site Wastewater Disposal

1. Application -- The developer or property owner meets with the staff of the local health department to review the project proposal and submits an application to the local health department that contains information regarding ownership, plat of property, site plan, type of facility, estimated sewage flow, and proposed method of sewage collection, treatment, and disposal.

2. Site Evaluation -- The local health department, with technical assistance from the state, evaluates the proposed sewage effluent disposal site for several factors, including slope, landscape position, soil morphology, soil drainage, soil depth, and space requirements. Next, the local health department will assign a site suitability classification, establish the design sewage flow, and the design loading rate for the soil disposal system.

3. Design Review --The applicant is required to submit plans and specifications for the sewage collection, treatment, and disposal system prepared by a professional engineer, for complex systems, or for systems exceeding 3,000

gal/day. Reviews are made by both state and local health departments. The designer must also include in the plans and specifications, installation procedures, phasing schedules, operation and maintenance procedures, monitoring requirements, and designate the responsible agents for operation and maintenance.

4. Legal Document Review -- For systems with multiple ownership or off-site disposal, the applicant must prepare and submit to state and local health departments for their legal review documents applicable to the project.

5. Improvement Permit -- Issued only after a successful review of the proposed project, including each of the items discussed above and allows construction to begin for the on-site sewage system. The improvement permit must be issued prior to other construction permits and allows only temporary electrical power to the site. This permit contains the necessary conditions for construction of the projects with the plans, specifications, and legal documentation appended to it.

6. Operation Permit -- Issued to the owner of the on-site sewage system by the local health department when it determines that all the requirements in the rules, plans and specifications are met; all conditions on the improvement permit are met; and the design engineer for the sewage collection, treatment, and disposal system certifies in writing to the local health department that the on-site system has been installed in accordance with the approved plans and specifications. The operation permit is also conditioned to establish performance requirements and may be issued for a specific period of time. It allows the on-site sewage system to be placed into use, prevents permanent electrical service to the project and prevents occupancy of the facilities until issued. The operation permit applies to systems larger than 480 gallons per day. A certificate of completion is required for conventional septic tank systems when the design sewage flow is less than 480 gal/day.

7. Surveillance -- Once an on-site sewage system is placed into operation the local health department must make routine inspections at least annually for large systems to determine that the system is performing satisfactorily and not creating a public health nuisance or hazard. Additionally, required monitoring reports are routinely submitted to the local health department as required in the permits. The state provides technical assistance to the local health department and the system operator in assuring adequate performance. While annual inspections are required, frequent performance checks must be made by the local health department.

8. Remedies -- When voluntary compliance with the performance requirements for the on-site system is unsuccessful, the General Statutes (1983) provide for the following remedies:

   a. Right of Entry -- Allows the state or local health department to enter the premises to determine compliance with the laws and rules and provides for an administrative search and inspection warrant when entry is denied.

   b. Injunction -- The state or local health department may institute an action for injunctive relief against the owner to bring the on-site sewage system into compliance.

   c. Order of Abatement -- The state or local health department is empowered to issue an order of abatement directing the owner to take any necessary action to bring the system into compliance. However, if the on-site system is determined to be creating an imminent health hazard, the state or local health department may, after previous unsuccessful attempts at correction, take the necessary action to correct the problem and recover any costs for abatement from the owner. This is the least frequently applied remedy.

   d. Administrative Penalties -- The state may impose administrative penalties up to $300 per day for violation of the laws, rules, or any permit condition for on-site sewage systems serving multi-family residences with a flow greater than 480 gal/day. A penalty of up to $50 per day can be assessed for malfunctioning systems where the flow is less than or equal to 480 gal/day.

   e. Suspension and Revocation of Permits -- The state may suspend or revoke a permit for violations of the laws, rules, or permit conditions upon a finding that a violation has occurred.

   f. Misdemeanor -- The owner who violates the sewage laws or rules shall be guilty of a misdemeanor and punishable by a fine or imprisonment as determined by the courts. This is the most frequently used remedy.

Best Management Practices for Forestry

The North Carolina Forestry Council has prepared a reference document for silvicultural BMPs entitled "Forest Practices Guidelines Related to Water Quality." Table 10 summarizes these BMPs:

Table 10. BMPs for North Carolina Forests

1. Properly design and place access roads, skid trails, and loading areas on forestland.

   a. Avoid streambanks and channels except when crossing streams.
   b. Install water management structures and techniques.
   c. Stabilize bare soil areas.
   d. Prevent steep slopes on roads and trails.

2. Designate streamside management zones (SMZ) which are undisturbed strips of vegetation parallel and adjacent to the stream channels.

3. Avoid placing debris in stream channels (Stream Obstruction Law).

4. Use practices which minimize soil exposure when reforesting.

5. Use environmentally safe procedures when applying chemicals in forested areas.

6. Train forestry related personnel in nonpoint source pollution control methods.

Best Management Practices

Significant environmental damage can and often times does occur during land-disturbing activities of mining operations, especially during the initial stages. The potential for such damage can be substantially reduced with the installation of BMPs. Once the mining has terminated, BMPs are used to reclaim or reasonably rehabilitate the site (for mined lands after June 11, 1971). The basic objective of the reclamation is to establish on a continuing basis the vegetative covers, soil stability, and water and safety conditions appropriate to the area. The BMPs are basically performance oriented allowing the applicant for a mining permit to design and submit for approval the most economical and effective means of a) controlling erosion and preventing off-site sedimentation damage; b) preventing contamination of surface waters and groundwater; and, c) preventing any condition that will have unduly adverse effects on wildlife or freshwater, estuarine, or marine fisheries. BMP selection is site specific and controlled in part by the pre- and post-mining land use(s). The acceptability, therefore, of a BMP is based upon the characteristics of the individual site and its potential for off-site damage.

Table 12 provides a list of BMPs which is virtually the same as apply in the Sedimentation and Erosion Control Program since the problems are similar.

Table 12. BMPs for Mining

Land Grading
Surface Roughening
Topsoiling
Tree Preservation and Protection
Temporary Gravel Construction Entrance/Exit
Temporary Seeding
Permanent Seeding
Sodding
Trees, Shrubs, Vines & Ground Covers
Mulching
Riprap
Vegetative Dune Stabilization
Temporary Diversions
Permanent Diversions
Perimeter Dike
Right-of-Way Diversions
Grass-lined Channel
Grass Channels with Liner

Table 12 (Cont.)

Riprap-lined Channels
Temporary Slope Drains
Paved Flume (Chutes)
Level Spreader
Outlet Stabilization Structure
Temporary Excavated Drop Inlet Protection
Temporary Fabric Drop Inlet Protection
Temporary Block and Gravel Inlet Protection
Sod Drop Inlet Protection
Temporary Sediment Trap
Sediment Basin
Sediment Fence
Rock Dam
Temporary Stream Crossing
Permanent Stream Crossing
Vegetative Streambank Stabilization
Structural Streambank Stabilization
Construction Road Stabilization
Subsurface Drain
Grade Stabilization Structure
Check Dam
Dust Control
Sand Fence (Wind Fence)
Groundwater Monitoring Wells
Mining Newsletter