BASINWIDE ASSESSMENT REPORT

CATAWBA RIVER BASIN

NORTH CAROLINA
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Division of Water Quality
Water Quality Section
Environmental Sciences Branch

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EXECUTIVE SUMMARY

The water quality of the Catawba River basin was evaluated for the period 1997 through 2002. The previous evaluation covered the period 1992 through 1997. Assessments conducted by the North Carolina Division of Water Quality included ambient chemistry, benthic macroinvertebrates, fish community, fish kills, lakes, and whole effluent toxicity testing.

The river basin experienced a prolonged drought which started in 1998 and intensified during 2002. The drought caused very low stream flows which reduced nonpoint source pollution impacts but magnified the intensity of point source contributions because of the lack of dilution. Despite the drought, permitted wastewater and industrial facilities were compliant with their whole effluent toxicity limits 90 to 95 percent of the time, a compliance rate typical of other regions in the state. The compliance rate during the drought in 2002 was the greatest it has been since testing began in 1985. However, ten percent of the facilities had difficulty meeting the toxicity limits during the period from 1997 to 2002.

Although tributary inflows into the reservoirs were reduced due to the drought, many of the reservoirs had substantial water quality and use support problems. Issues were related to noxious aquatic plants, bluegreen algal blooms, taste and odor problems in treated drinking water which were associated with algal blooms, and an increase in nutrients. Some of these problems were of recent origin, others had been documented in previous assessments.

Based upon biological monitoring of benthic macroinvertebrate and fish communities, roughly one-third of the evaluated streams in the Catawba River basin were rated Good or Excellent. These streams were associated with forested watersheds, typically in the upper part of the basin, where there were quality instream and riparian habitats. Another one-third of the evaluated streams were degraded and rated Poor or Fair. These streams were often associated with urban or agricultural watersheds. Degradation was caused by poor land use practices, sediment from agricultural operations, and permitted point source effluents being discharged into low flowing streams that offered little dilution during the drought. The remaining one-third of the evaluated streams were rated Good-Fair.

More than 70 percent of the streams based upon benthic macroinvertebrates and 38 percent of the streams based upon fish communities had no change in their water quality ratings between 1997 and 2002. Improvements in ratings (at six percent of the benthic macroinvertebrate sites and 21 percent of the fish community sites) were attributed to watershed restoration efforts and upgrades to existing wastewater treatment plants. Declines in ratings (at 24 percent of the benthic macroinvertebrate sites and 48 percent of the fish community sites) were attributed to the drought and low flow conditions, increasing urbanization, point source discharges, or to unknown factors.

There were no waterbody-specific fish consumption advisories in the basin. A statewide advisory remained in effect for bowfin due to elevated mercury levels. Fish kills were rare in the Catawba River basin during the past five years. Reported kills were attributed to isolated chemical spills or to unknown causes.

In general, testing for compliance with water quality standards during the most recent five year period were similar to those in the previous assessment periods. Only two of the 46 assessment sites had more than 10 percent of the dissolved oxygen concentrations less than 5 mg/L. Wilson Creek had chronic problems with low pH, possibly due to the effects from acid precipitation. Four of the 46 sites had more than 10 percent of the samples exceeding the turbidity standard (50 NTU) and 20 sites had copper concentrations exceeding the action level (7 µg/L). Fecal coliform bacteria was elevated at 13 sites, but none of the waterbodies were classified for primary recreation activities. Elevated nutrients were documented below wastewater treatment plants and were showing an increase trend at Clark and Crowders Creeks.

There remain substantial water quality concerns in the Catawba River basin. Nutrient enrichment, sprawl and urbanization of once rural landscapes, instream sedimentation from nonpoint sources, and impacts from permitted dischargers are pronounced in the basin. Although there remain many Good or Excellent streams in the upper part of the basin, approximately one third of the assessed streams, especially near the urban areas, were degraded.

OVERVIEW OF THE WATER QUALITY OF THE CATAWBA RIVER BASIN

Basin Description

The Catawba River basin, along with the Broad River basin, forms the headwaters of the Santee-Cooper River system, which flows through South Carolina to the Atlantic Ocean (Figure 1). The basin is the eighth largest river basin in the state covering 3,279 square miles in the south central portion of western North Carolina. The Catawba River has its source on the eastern slopes of the Blue Ridge Mountains near the Town of Old Fort in McDowell County, and flows eastward, then southward, to the state line near Charlotte. The basin encompasses all or part of 12 counties: Alexander, Avery, Burke, Caldwell, Catawba, Gaston, Iredell, Lincoln, McDowell, Mecklenburg, Union, and Watauga. Large urban areas include Belmont, Charlotte, Conover, Gastonia, Hickory, Lenoir, Lincolnton, Mooresville, Morganton, Mt. Holly, and Newton. The basin is subdivided into nine subbasins that are coded 030830 through 030838 (Figure 2).

The headwaters of the river are formed by swift flowing, cold water streams originating in the steep terrain of the mountains. Many of these streams exhibit good to excellent water quality and are classified as trout waters. The basin contains the Linville River, one of only four rivers in the state designated as a Natural and Scenic River. The Linville River flows through the Pisgah National Forest Wilderness areas and into Lake James. Although the topography of the upper basin is characterized by mountains, smaller hills give way to a rolling terrain near the state line. As the basin enters the Inner Piedmont, land use shifts from forest to agricultural and urban uses. Nonpoint runoff from agricultural operations, urban runoff, and other sources has caused nutrient enrichment and sedimentation problems in the streams, rivers, and lakes. Though urban areas are not numerous in the upper basin, the lower basin contains many cities including the Charlotte metropolitan area. In this region, urban growth has affected the water quality of the lakes and rivers.

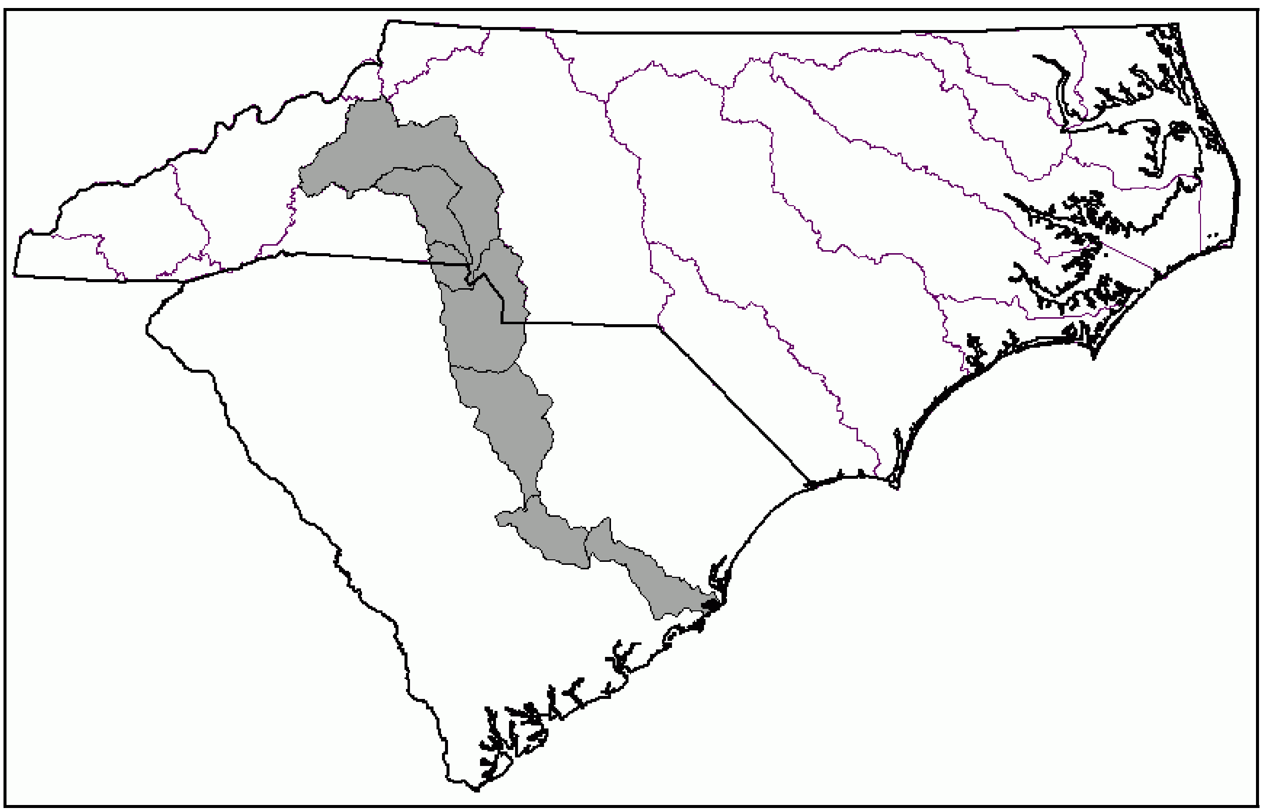


Figure 1. Geographical relationships of the Catawba River basin in North and South Carolina.

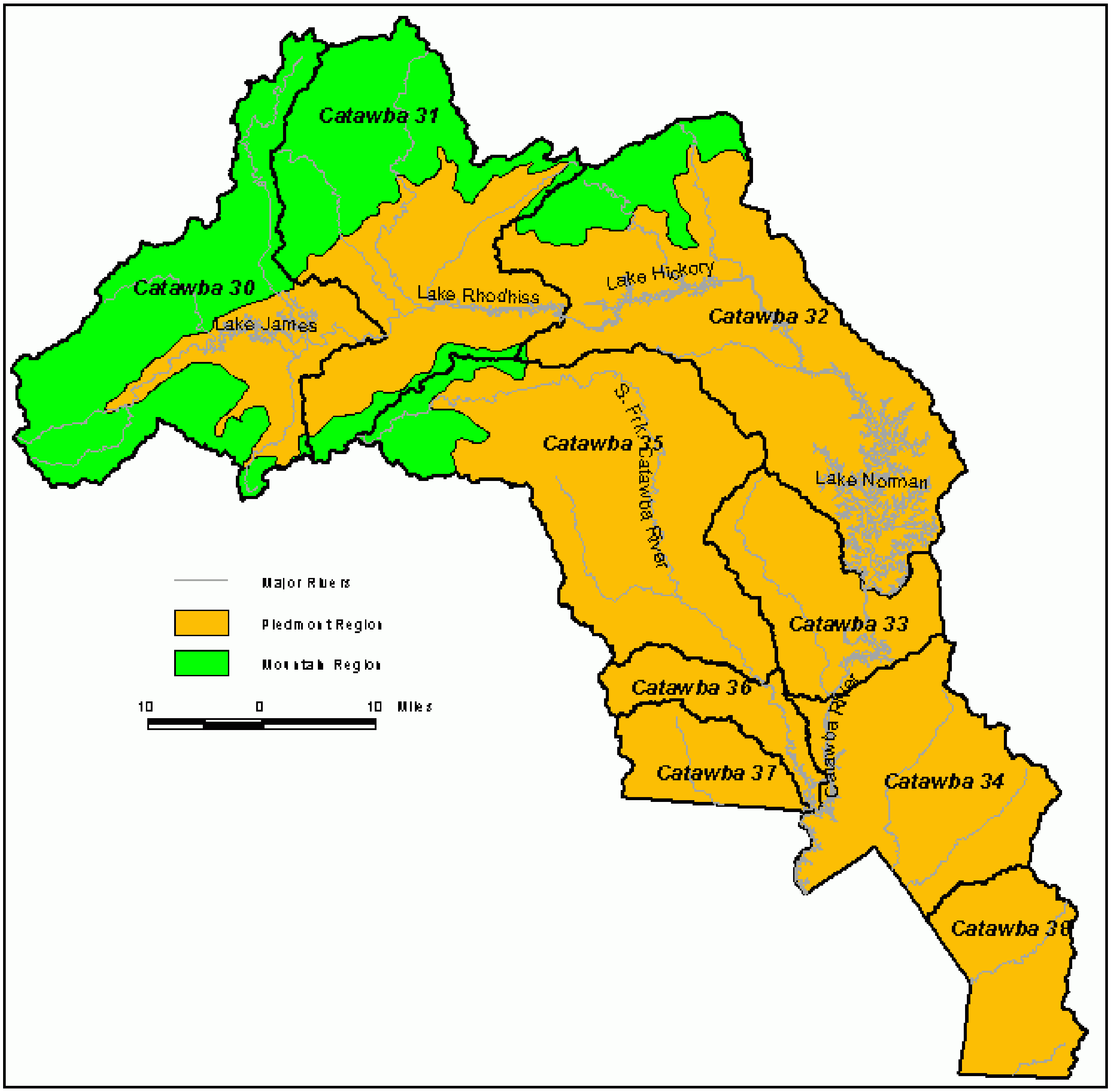


Figure 2. **Physiographic regions of the Catawba River basin.**

Catawba Chain Lakes and Other Reservoirs
A prominent feature of basin is the series of seven hydroelectric dams along the length of the river. The reservoirs formed by these dams are commonly referred to as the Catawba Chain of Lakes. All are owned by Duke Energy and were created to generate electricity. The lakes were created between 1904 and 1928, except Lake Norman, which was completed in 1967. They begin with Lake James, located at the foot of the Blue Ridge Mountains, followed by Rhodhiss, Hickory, Lookout Shoals, Norman, Mountain Island, and Wylie (Figure 2). The water quality of each impoundment is influenced by the discharge from the upstream reservoir, as well as inputs from the surrounding watershed.

Lake James has had the best water quality of all the lakes, but was eutrophic during part of the summer in 2002. Increasing residential development around the lake is a concern. Lake Tahoma (a small impoundment of Buck Creek) was oligotrophic. Of the next three impoundments, Rhodhiss Lake is usually eutrophic. Although there were high nutrient concentrations, algal blooms were often limited by the reservoir's short retention time. Drought conditions increased retention times and blooms of nuisance algae (especially blue-greens that caused taste and odor problems) were recorded in 2001 and 2002. Nutrient reductions may help to alleviate these problems.

Lake Hickory has improved from eutrophic in the 1980's to mesotrophic. High productivity was indicated in August 2002, but no visible algal blooms were observed. Lookout Shoals Lake is a small run-of-the-river lake with a retention time of only nine days, and a trophic state that fluctuates from oligotrophic to eutrophic depending on the nutrient loading and flow conditions. A nuisance aquatic plant, *Myriophyllum aquaticum,* infested the upper ends of Hickory and Lookout Shoals. Lookout Shoals was drawn down in the fall of 2002 in an attempt to control the spread of this plant.

Lake Norman, which is the largest reservoir in North Carolina, has been monitored by Duke Energy since the 1970's and DWQ has sampled the reservoir since 1981. This reservoir has consistently been evaluated as oligotrophic with low nutrient values and low algal production. *Hydrilla*, another nuisance aquatic plant, was found in Lake Norman. This macrophyte is invasive, can decrease fish habitat, and can impact recreational activities such as swimming and boating. It also has the potential of clogging intakes of water treatment plants. In an effort to manage its growth, Duke Energy treated the infestation with an herbicide.

Mountain Island Lake is a small reservoir just downstream of Lake Norman. In 2002 it was classified as oligotrophic and received the lowest trophic scores since 1981. These improved conditions might have been due to decreased runoff as a result of the drought. *Hydrilla* is established here also, and grass carp were stocked in 2000 and 2002 to help manage its growth.

Lake Wylie is the most downstream reservoir in the Chain of Lakes. Its immediate watershed is rapidly being converted from traditional agricultural to more urban land uses. This reservoir was eutrophic in 2001 and 2002. However, as a result of the City of Gastonia decommissioning its Catawba Creek WWTP and redirecting this effluent to the improved Long Creek WWTP, the Crowders Creek arm has shown an overall decrease in total phosphorus and total nitrogen. Despite these improvements, there are still sufficient nutrients entering the reservoir to keep it classified as eutrophic.

Newton City Lake was oligotrophic in 2002 and nutrient concentrations were generally low. Bessemer City Lake, a small water supply reservoir for Bessemer City, was also oligotrophic in 2002.

Upper Catawba River Basin (Subbasins 30 and 31)

The headwater reaches of the Catawba River lie near the Eastern Continental Divide, west of the Town of Old Fort. The river flows generally eastward with the largest tributaries (Curtis, Buck, and Lower Creeks and the North Fork Catawba, Linville, and Johns Rivers) flowing south from their mountainous headwaters. Many headwater tributaries are designated as HQW and Wilson Creek has been designated ORW. Several smaller tributaries such as Crooked and Muddy Creeks flow north to the Catawba River from less mountainous and more agricultural catchments.

This is a physiographically diverse area including the High Mountains, Eastern Blue Ridge Foothills, Northern Inner Piedmont, and Southern Crystalline Ridges and Mountain ecoregions. Much of this land is contained within the Pisgah National Forest and, therefore, protected from many land disturbing activities. The cities of Marion, Morganton, Lenoir, Drexel, and Granite Falls are found in this upper area.

Overall, water quality is high in this area, except around urban areas. The drought appeared to be the major stressor that affected benthic communities. An Excellent benthos bioclassification was retained at Armstrong Creek and the Linville River below the gorge, before it flows into Lake James. Curtis, Mackey, and Crooked Creeks had Excellent fish ratings and Good benthos ratings. Mackey Creek, below a metal plating discharge whose permit was rescinded in June 2001, was the major success story. Poor benthos and fish ratings were found prior to removal of the discharge.

Streams that originate in the Pisgah National Forest had Good or Excellent water quality ratings based on either fish or macroinvertebrate data (Figure 3). These streams included the Johns River, Upper, Mulberry, and Wilson Creeks, Gragg Prong, and Warrior Fork. Even though there is some recreational use and development in the

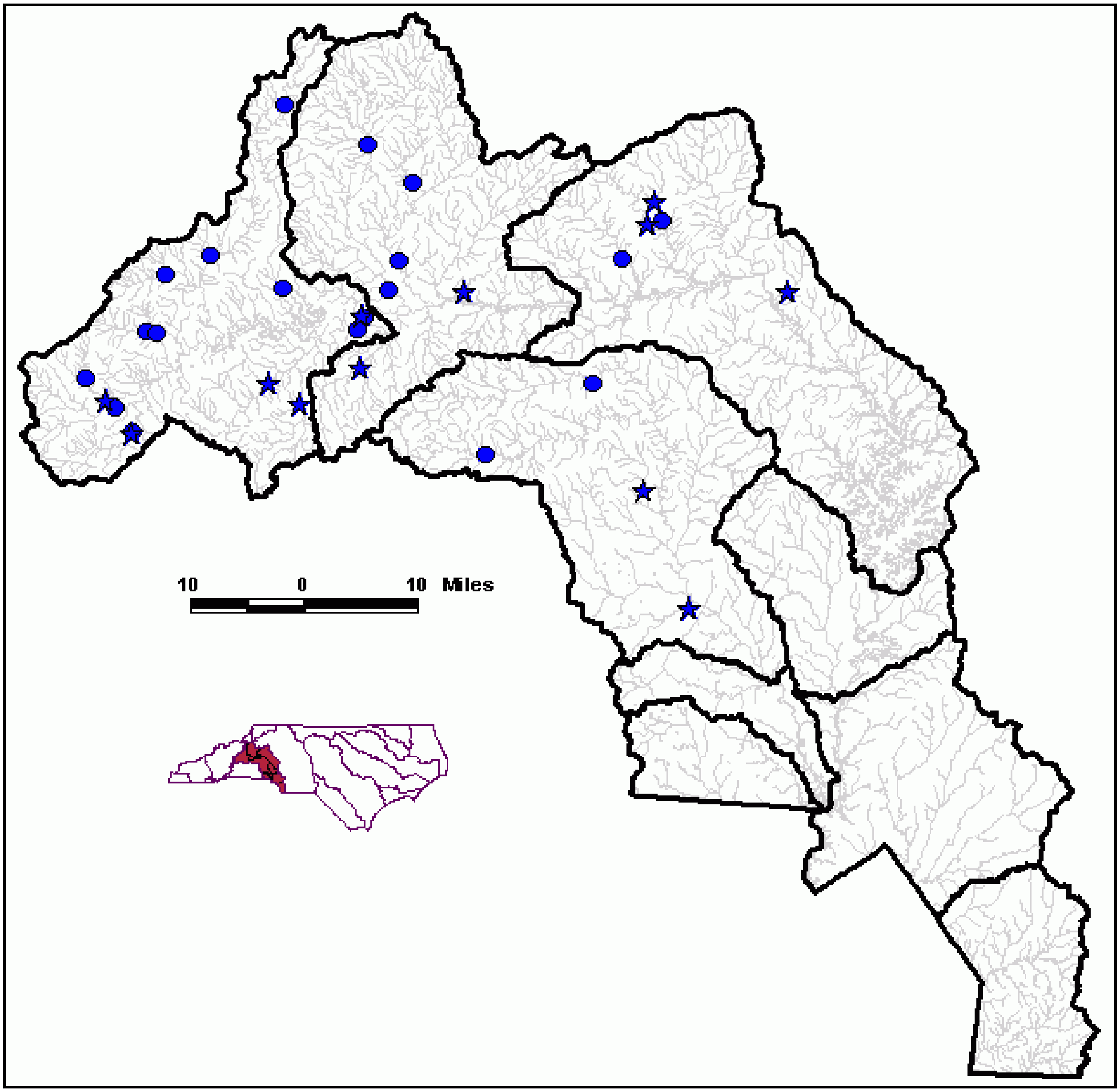


Figure 3. **Fish community and benthic macroinvertebrate assessment sites rated Good or Excellent in the Catawba River basin, 2002. Stars = fish sites and circles = benthic macroinvertebrate sites.**

upper sections of these creeks, there has been no substantial impairment of water quality. Extensive valleys used for the cultivation of ornamental shrubs and trees present potential threats to water quality. Wilson Creek supports an unusually large number of rare macroinvertebrate species.

Most of the Catawba River sites were given Good benthos ratings, but the low flows produced prolific growths of the rooted aquatic plant, *Elodea canadensis*, in some areas. Other streams with Good biological ratings were Buck, Little Buck, and Canoe Creeks. North Muddy and South Muddy Creeks, which drain urban areas or have wastewater treatment plant discharges, had better fish communities (Good), than benthos (Good-Fair). Cattle access to Paddy Creek seemed to be the cause of the Good-Fair fish rating in this small stream draining the Pisgah National Forest. A fish community sample from Irish Creek (a tributary of Warrior Fork) showed severe habitat problems and was rated Fair.

The North Fork Catawba River just below the Baxter Healthcare Corporation discharge declined from Excellent to Good between 1997 and 2002 and there was a dramatic decline from Good to Fair further downstream, where the river was wider with slower flow. The drought conditions provided minimal dilution and a conductivity value of 576 µmhos/cm was observed in August 2002.

Where watersheds have become more developed around Morganton, Lenoir and Valdese, the bioclassifications were lower (Good-Fair or Fair) (Figure 4). The physical characteristics of these streams have also changed. Lower, Silver, Hunting, and McGalliard Creeks had lower gradients and were much sandier than streams in the northern part of the subbasin. McGalliard Creek declined in bioclassification between 1997 and 2002 based on biological data. An intensive survey of the Lower Creek catchment in 2002 documented problems for many streams around Lenoir.

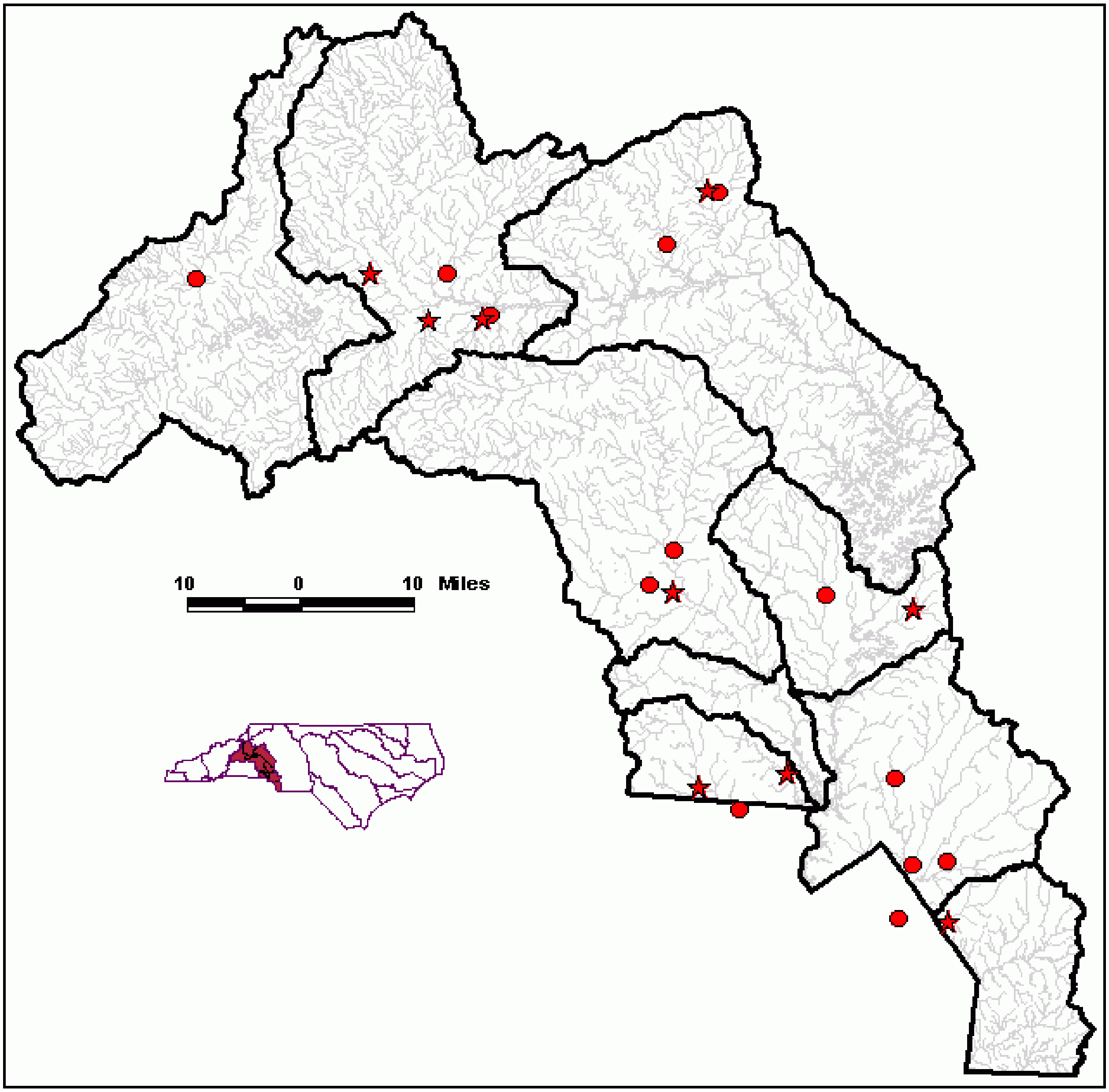


Figure 4. Fish community and benthic macroinvertebrate assessment sites rated Fair or Poor in the Catawba River basin, 2002. Stars = fish sites and circles = benthic macroinvertebrate sites.

There are eight ambient water chemistry stations in this area. The headwater sites had the lowest median values for conductivity, total suspended solids, and turbidity of all the subbasins. Nutrient values were also low. Wilson Creek had many pH measurements less than 6.0 s.u., with one reading less than 5.0 s.u.. This pattern had not been observed at this site since the early 1990's and suggested that similar low pH values may be occurring in other high elevation streams that drain forested catchments. Such areas have low buffering capacity and are most susceptible to acid precipitation. The site on Lower Creek reflected the influence of various point and nonpoint source problems near Lenoir: high turbidity, high fecal coliform bacteria, and elevated conductivity.

Middle Catawba River Basin (Subbasins 32 and 33)
This subbasin is located in the Northern Inner Piedmont and Southern Outer Piedmont ecoregions with the extreme northwestern headwaters of several streams in the Eastern Blue Ridge Foothills ecoregion. The southeastern portion of this subbasin (east of the Lower Little River and south of the Catawba River) is flatter than the northern section. Highly erodible soils and moderate gradients contribute large amounts of sediment in the Little River watershed. However, a majority of the middle watershed remains forested.

Recent biological data produced Good or Good-Fair ratings for several streams: Lower Little River and Duck, Elk Shoal, McLin, and Gunpowder Creeks. However, a Fair macroinvertebrate rating was recorded for a section of the Middle Little River and for Muddy Fork. Muddy Fork showed signs of organic loading from nearby animal operations. Fish data also produced a Fair rating for a section of the Lower Little River. The benthic Fair rating for the Middle Little River seemed to be due to low flow in 2002 and did not represent a significant water quality problem. This finding was reinforced by the Excellent fish community rating given to the river. The cause of the Fair rating (fish data) for the headwaters of the Lower Little River (above the Town of Taylorsville WWTP) was unknown, although a sand-dipping operation was noted just above the sampling reach.

Further south, the largest watershed is Dutchmans Creek, formed by the confluence of Leepers and Killian Creeks. Dutchmans Creek flows into the Catawba River just downstream of Mountain Island Lake. Streams in the lower area are often sandy, low gradient streams. Based on past benthic macroinvertebrate data, Dutchmans and Killian Creeks have been rated Excellent or Good, and McDowell Creek was rated Good-Fair. In 2002, however, based on benthic macroinvertebrate data Dutchmans Creek declined to Good-Fair and Killian and McDowell Creeks declined to Fair. Similar trends were observed for the fish community at McDowell Creek, which declined from Fair in 1997 to Poor in 2002 and in Killian Creek, which declined from Good in 1997 to Good-Fair in 2002. The lower benthic macroinvertebrate and fish ratings were likely the result of the prolonged drought in Killian Creek while the lower ratings in McDowell Creek were likely the result of the expanding urbanization from the Charlotte metropolitan area.

South Fork Catawba River Watershed (Subbasins 35 and 36)
There are three ecoregions in this watershed: the Eastern Blue Ridge Foothills (including the South Mountains), the Northern Inner Piedmont, and the Southern Outer Piedmont. The South Fork Catawba River has its origin at the confluence of Henry and Jacob Forks. Other major tributaries include Clark, Indian, and Long Creeks. Land use is primarily forested but there is also a large percentage of pasture.

Prior to 2002, Excellent ratings were typically found in Jacob Fork, Good ratings in Henry Fork and Howards Creek, and Good-Fair at Indian and Clark Creeks. In 2002 benthic macroinvertebrate data showed that every site, except for Henry Fork, declined in bioclassification. Henry Fork may have maintained its Good rating during the drought because of its large watershed size. The fish community at Indian Creek, which drains Cherryville, was rated Fair in 1997 and 2002. In contrast, Beaverdam Creek, which also drains Cherryville, had a Good fish community rating, as did Pott Creek, a large tributary of the Catawba River north of Lincolnton. Long Creek in 2002 had a Good-Fair rating.

Charlotte Metropolitan Area (Subbasins 34, 37, and 38)
Three distinctly different ecoregions are found in the area surrounding Charlotte. The Southern Outer Piedmont ecoregion contains the Sugar Creek watershed, a portion of Lake Wylie, and much of the City of Charlotte metropolitan area. This is the most heavily urbanized region in the state. There are currently over 50 NPDES permitted dischargers in the Sugar Creek

watershed. The largest one is the Charlotte/Mecklenburg Utilities District's WWTPs which discharge to Irwin Creek (30 MGD), McAlpine Creek (48 MGD), and Little Sugar Creek (20 MGD).

The Catawba and Crowders Creeks watersheds flow through the Kings Mountain and Southern Outer Piedmont ecoregions. Urban areas include Bessemer City, the South Gastonia, and a portion of Gastonia, south of the Interstate 85 corridor.

The third ecoregion is the Carolina Slate Belt. It contains Sixmile and Twelvemile Creeks, tributaries to the Catawba River in South Carolina. These streams have very low flows during the summer and may stop flowing during drought periods, which naturally limits the diversity of the stream fauna. No benthic macroinvertebrate samples have been collected from this subbasin since 1992.

Based upon biological data, urban streams such as McAlpine, Sugar, and Little Sugar Creeks are degraded with Poor or Fair bioclassifications. These low ratings were due to urban drainages, large WWTP discharges, and poor habitat. Declines in 2002 were attributed to the drought rather than further declines in water quality.

Crowders Creek is another degraded stream in the Gastonia area. Though some discharge changes have occurred in the watershed, only slight improvement in the fish and benthos have been found, and Fair bioclassifications were typical in 2002. The fish community in Twelvemile Creek declined from Good in 1997 to Good-Fair in 2002, while Sixmile Creek maintained its Fair rating in 2002.

EXECUTIVE SUMMARIES BY PROGRAM AREA

BENTHIC MACROINVERTEBRATES

Bioclassifications and Water Quality Changes

Benthic macroinvertebrates have been collected at more than 200 rated sites in the basin since 1983. In 2002, more sites were rated Good-Fair than any other rating (Figure 5), although there were also high numbers of Fair and Good ratings. The distribution of the ratings for all sites sampled since 1983 (Table 1) had a higher percentage of Good and Excellent sites than in 2002 (48 *vs*. 31 percent) due to the inclusion of data from ORW/HQW studies in Subbasins 30, 31, and 35.

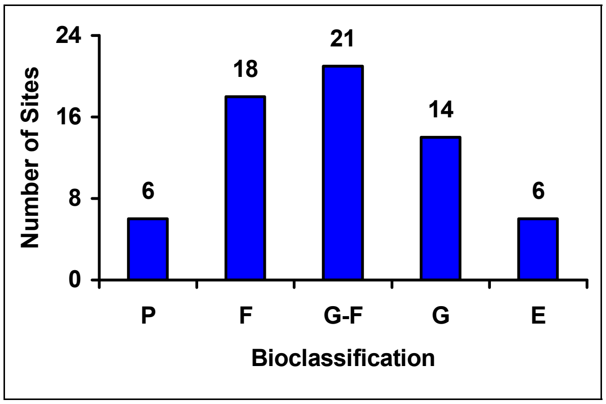


Figure 5. Distribution of bioclassifications for 65 benthic invertebrate samples collected in the Catawba River basin in 2002. Abbreviations are: P = Poor, F = Fair, G-F = Good-Fair, G = Good, and E = Excellent.

Table 1. Most recent ratings for all rateable benthic macroinvertebrate sites in the Catawba River basin sampled since 1983.[1]

	Bioclass[2]				
Subbasin	**P**	**F**	**G-F**	**G**	**E**
30	1	2	6	31	8
31	1	10	7	9	16
32	---	4	8	2	---
33	---	3	1	1	4
34	8	7	3	---	---
35	2	9	10	12	9
36	---	2	6	9	---
37	6	7	6	---	---
38	---	---	3	---	---
Total (#)	**18**	**44**	**50**	**64**	**37**
Total (%)	**9**	**21**	**24**	**30**	**18**

[1]Some older ratings were not included, especially if there was an indication from other sites or other data sources that water quality had improved.
[2]Abbreviations are: P = Poor, F = Fair, G-F = Good-Fair, G = Good, and E = Excellent.

Excellent ratings were found in 4 of the 9 subbasins, with the greatest number of high quality sites in areas draining the Pisgah National Forest and the South Mountains State Park. Rare invertebrate species were most often found in these areas, especially in Wilson Creek (Appendix 9). Poor and Fair ratings usually were found near the larger towns, reflecting the effects of urban runoff and point-source dischargers.

A severe drought during 2002 interfered with the collection of samples and the determination of water quality trends. No samples were collected from Subbasins 36 and 38 due to a lack of flowing water in the streams during the summer. Declines at several sites may have been due to low flows, rather than to a between-year decline in water quality.

Between-year changes in water quality were evaluated at more than 50 sites in the basin, although some of these sites could only be evaluated for short-term changes over the last five years. Thirty-six sites had no change in water quality since the 1997 basinwide survey, other than flow-related changes in bioclassification. Improving water quality was observed at only a few sites, usually as a result of removal or upgrade of a wastewater discharge (Table 2). Declining water quality was documented at 12 sites, although low flow conditions often made it difficult to interpret these changes.

Table 2. Sites with improving or declining water quality in the Catawba River basin.

Subbasin	Waterbody
Improving	
30	Swannanoa Cr, soybean oil spill recovery
	Mackey Cr, discharger removal
37	UT Abernathy Cr, discharger upgrade
Declining	
30	N Fk Catawba R (two sites), discharger effect[1]
31	Warrior Fk & Johns R, nursery plant area[1]
	Headwaters of Lower Cr, unknown[1]
	McGalliard Cr, urban area[1]
32	Middle Little R, low flow effect?[1]
	Lower Little R, discharger effect[1]
33	McDowell Cr, development?
	Dutchmans Cr, unknown[1]
	Killian Cr, discharger effect?[1]
35	Indian Cr, unknown[1]

[1]Maybe effect of low flow during extreme drought.

Management or elimination of some dischargers in the late 1980's and early 1990's produced some long-term improvements in water quality, although these sites have been stable in the last few basinwide cycles. Those sites with a long-term improvement included the Catawba River below the Town of Old Fort, Sugar Creek downstream of many municipal dischargers, and Abernathy Creek below Lithium Corporation.

Some sites, such as North Fork Catawba River, Lower Little River, and Killian Creek, which were downstream of major dischargers showed a decline in water quality between 1997 and 2002. This was probably due to decreased dilution of effluents during the 2002 drought.

FISHERIES

Fish Community Assessment

In 2002, 29 sites were sampled from late April through late May (Figure 6). Two Special Studies (Mackey Creek and Corpening Creek, Subbasin 30) were conducted at the request of the Asheville Regional Office and the Modeling/TMDL Unit. All streams were evaluated using the North Carolina Index of Biotic Integrity (NCIBI) (Appendices 10 - 12). The ratings ranged from Poor to Excellent (Figure 7) with the scores ranging from 22 to 60.

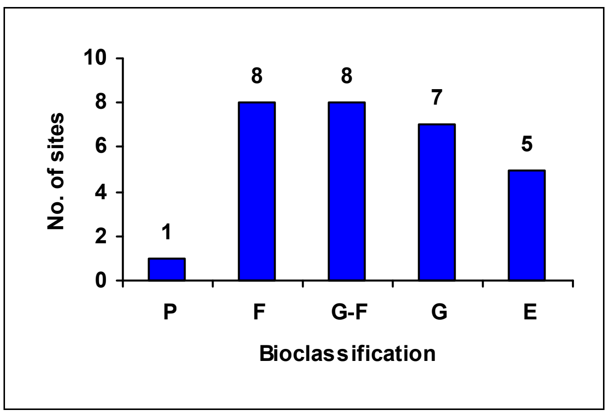


Figure 7. Bioclassifications of 29 fish community basinwide sites in the Catawba River basin, 2002. Abbreviations as in Figure ---.

Twenty-one sites were sampled in 1997 and 2002. The range in the difference in the NCIBI scores between 2002 and 1997 was from –18 to + 6 units (Figure 8). A majority (57 percent) of the sites had scores that were different by only ± 4 units.

The bioclassifications did not change at 8 sites, increased 1 classification at 3 sites, and decreased 1 or 2 classification at 10 sites (Figure 9).

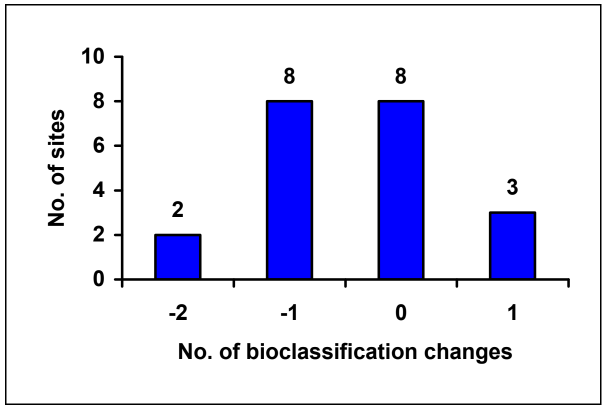


Figure 9. Bioclassification changes between 1997 and 2002 at 21 fish community sites in the Catawba River basin.

Substantial bioclassification declines that were attributable to the long-term drought were noted at Elk Shoal, Killian, Hoyle, and Twelvemile Mile Creeks and at the Lower Little River. Declines attributable to urban and developmental impacts were noted at McGalliard and McDowell Creeks.

Substantial bioclassification increases were noted at Paddy and Long Creeks. The improvement in the fish community in Long Creek was attributed to implementation of best management practices, changing land use, and the closure of a mining operation in its watershed. The cause for the improvement in Paddy Creek was unknown.

Eighty-two fish community samples with associated habitat evaluations have been collected throughout the basin since 1997. This data set showed that as instream and riparian habitat deteriorated, so did the fish community ratings (Figure 10).

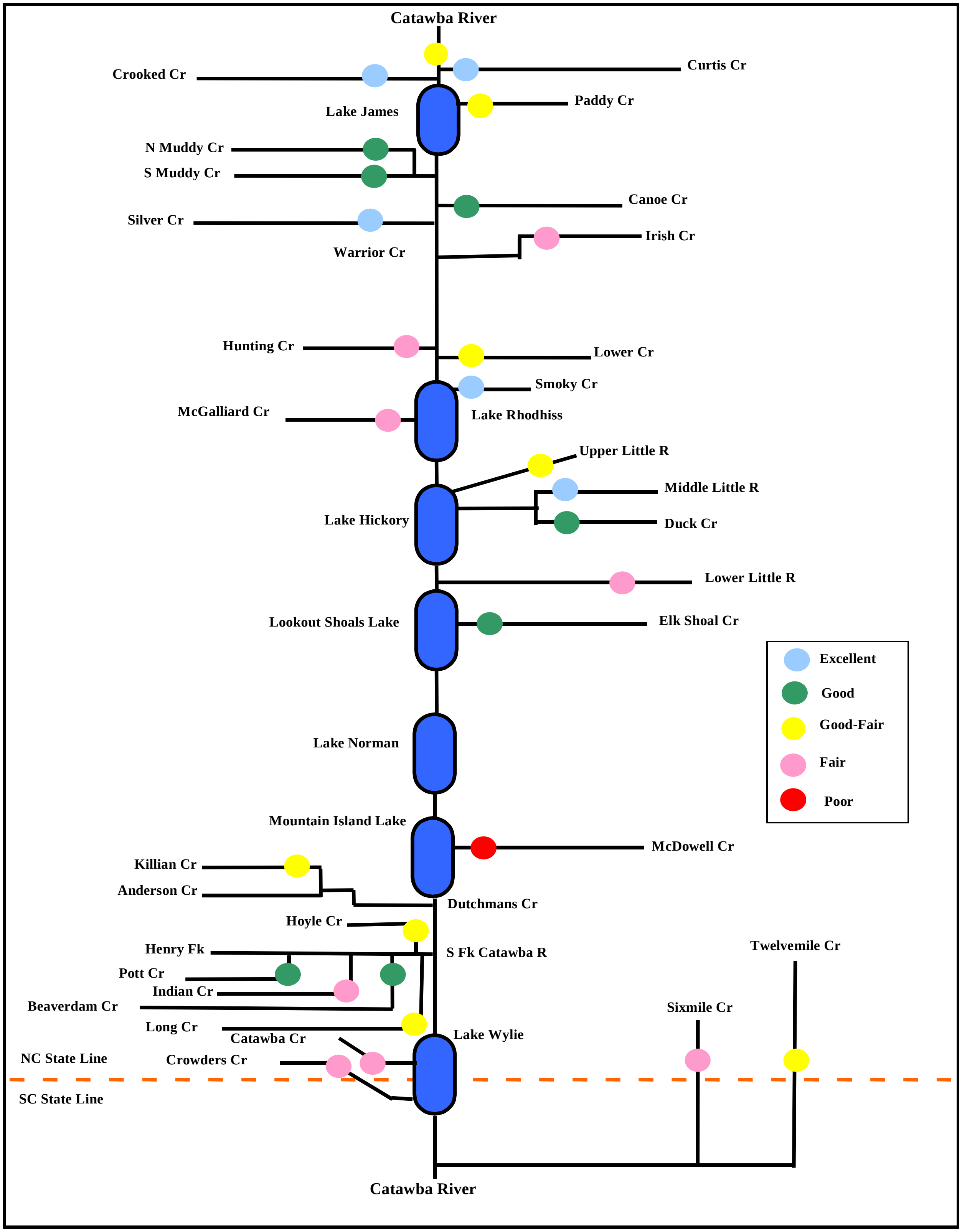


Figure 6. **Fish community assessment sites in the Catawba River basin, 2002. Map is not drawn to scale.**

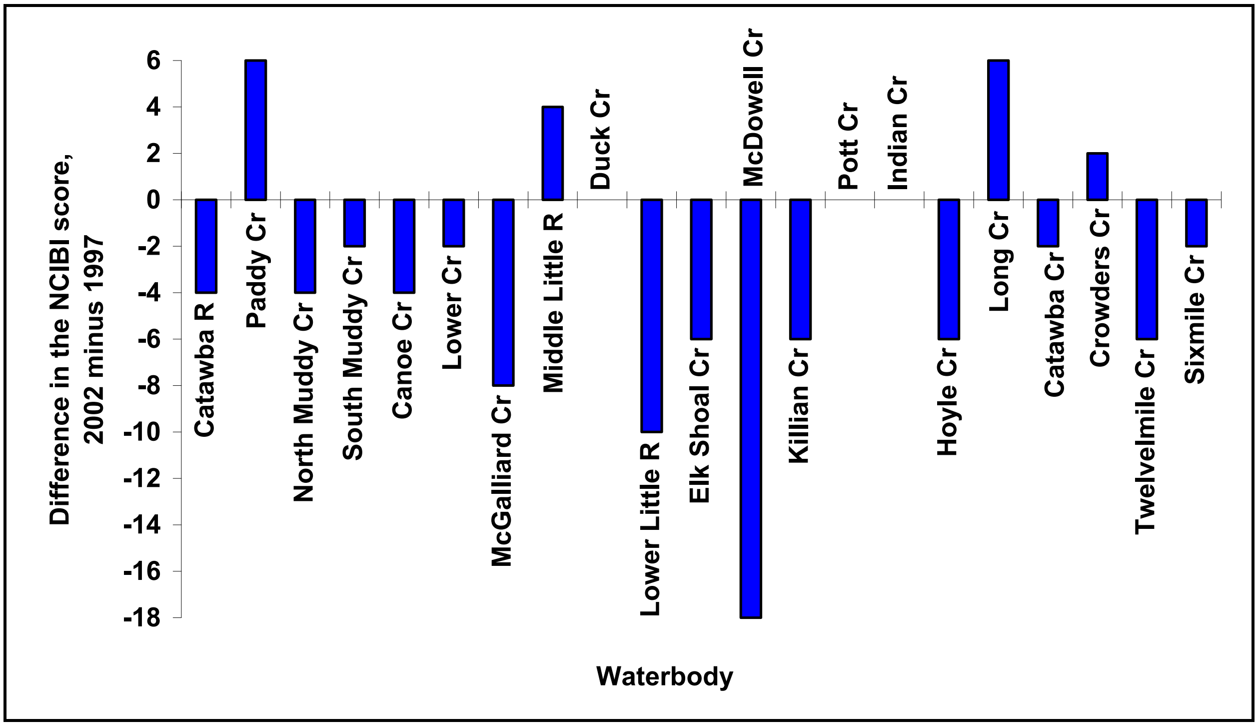


Figure 8. A comparison of the NCIBI scores at 21 rateable fish community sites in the Catawba River basin between 2002 and 1997.

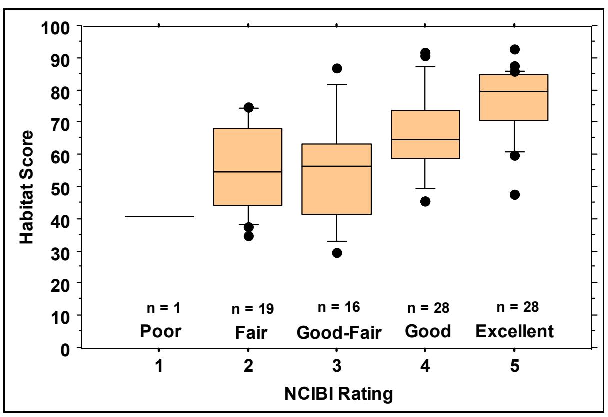


Figure 10. Relationships between habitat scores and NCIBI ratings in the Catawba River basin, 1997 - 2002. Note: other sites in the basin have been rated Poor but were located below permitted discharges and were influenced more by the discharges than by the habitats.

In 2002 with a few exceptions, fish communities rated Excellent were found in streams with moderate to high quality habitats; conversely, communities rated Good-Fair, Fair, or Poor were generally found in low to poor quality habitats.

Fish Tissue Contaminants

There are no site-specific consumption advisories in the basin. However, in June 1997, the State Health Director issued a statewide fish consumption advisory for bowfin due to elevated mercury. The advisory states:

➢ *"Some bowfin (or blackfish) sampled across the state have been found to contain potentially unsafe levels of mercury. Based on these findings, consumption of bowfin caught in North Carolina should be limited to no more than two meals per person per month. Children, pregnant women and women of childbearing age should not eat bowfin collected in North Carolina".*

Additional information on consumption advisories in North Carolina may be found at: http://www.schs.state.nc.us/epi/fish/current.html

Fish Kills

The NC DWQ has systematically monitored and reported on fish kill events since 1996. Investigators reported 11 significant kills in the basin from 1998 to 2002. Mortality counts ranged from 90 to 7,500 with 10,665 fish killed during the five year period. Most events occurred from toxic spills or unknown causes. Fish kill activity in the basin is considered light when compared to other regions, especially coastal areas. (NCDENR 2002).

LAKE ASSESSMENT

Ten lakes were monitored in 2002 as part of the Lakes Assessment program. Each lake was sampled three times during the summer. Water quality concerns during this period included:

- *Hydrilla* has been found in Mountain Island Lake and Lakes James and Norman. This aquatic macrophyte is invasive, can decrease fish habitat, and can impact recreational activities. It also has the potential to clog intakes of water treatment plants. To manage the growth of *Hydrilla*, Duke Energy staff stocked these lakes with grass carp.
- *Myriophyllum aquaticum*, another nuisance aquatic plant, has infested the upper ends of Lake Hickory and Lookout Shoals Lake. Like *Hydrilla*, this plant can interfere with recreational and industrial uses of the lake. Lookout Shoals Lake was drawn down in the Fall 2002 in an attempt to control the spread of this plant. Due to the degree of infestation, the designated uses at the upper end of the reservoir are impaired.
- Lakes Rhodhiss and Hickory experienced problematic bluegreen algal blooms in 2001 and 2002, which produced taste and odor problems in drinking water. Due to frequent algal blooms and elevated percent dissolved oxygen saturation values, Lake Rhodhiss is impaired in its support of aquatic life.
- Lake Wylie continued to be eutrophic. The greatest concentrations of nutrients and dissolved oxygen, as well as, the highest percent dissolved oxygen saturation values, were observed in the Crowders Creek arm. Crowders Creek receives stormwater runoff from the City of Gastonia and is on the 303 (d) list for biological impairment. Nutrients in nonpoint source runoff as well as from wastewater treatment facilities may be contributing to these elevated nutrients concentrations.

AMBIENT MONITORING SYSTEM

Physical and chemical measurements were collected from 46 monitoring stations between September 01, 1997 and August 31, 2002. Significant findings during the assessment period included:

- Two stations had more than 10 percent of the measurements for dissolved oxygen less than 5.0 mg/L. No temporal patterns were evident at these stations, thus patterns observed during this assessment period have been present historically.
- The pH measurements at Wilson Creek were less than 6.0 s.u. in approximately 18 percent of the samples. This was the only station where more than 10 percent of the pH measurements were less than 6.0 s.u. This is a high altitude site and low readings occurred in the early 1980s and 1990s.
- Four stations had more than 10 percent of the observations exceeding a turbidity standard. About 22 percent of the turbidity values at Lower Creek near the City of Morganton exceeded 50 NTU.
- Exceedances for copper were common and 20 stations exceeded the action level of 7.0 µg/L.
- Since April 1999 when the Laboratory Section began using a new analytical technique, no stations had more than 10 percent of the zinc concentrations exceeding the standard.
- Thirteen stations exhibited problems with fecal coliform bacteria but none of these sites were classified for swimming.
- Elevated nutrient concentrations occurred at stations downstream of wastewater treatment plants. Decreasing concentrations of nutrients occurred at Little Sugar, Sugar, and Catawba Creek. Increasing concentrations of nutrients occurred at Clark and Crowders Creeks but drought conditions during the past three years may have produced this pattern.

AQUATIC TOXICTY MONITORING

Ninety-five facility permits in the basin currently require whole effluent toxicity (WET) monitoring. Seventy-three facilities have a WET limit; the other 22 facility permits specify monitoring with no limit. Since 1995 the compliance rate for those facilities with a limit has stabilized at approximately 90 to 95 percent. Ten facilities have had difficulty meeting their toxicity limits (Table 3).

Table 3. Facilities that have had difficulty meeting toxicity limits in the Catawba River basin.

Subbasin	Facility
32	Alcoa Extrusions (UT Lake Norman)
	Comm Scope, Inc. (UT Terrapin Cr)
	Express Food Mart (UT Mundy Cr)
	Schneider Mills, Inc. (Muddy Fork Cr)
34	American Truetzschler (UT Catawba R)
	Cousins Real Estate (Irwin Cr)
	First Union Commons (Little Sugar Cr)
35	Stanley WWTP (Mauney Cr)
36	Dallas WWTP (UT Long Cr)
37	Textron, Inc. (UT Crowders Cr)

INTRODUCTION TO PROGRAM METHODS

The North Carolina Division of Water Quality (hereafter referred to as DWQ) uses a basinwide approach to water quality management. Activities within DWQ, including permitting, monitoring, modeling, nonpoint source assessments, and planning are coordinated and integrated for each of the 17 major river basins within the state. All basins are reassessed every five years, and the Catawba River basin was sampled by the Environmental Sciences Branch in 2002.

The Environmental Sciences Branch collects a variety of biological, chemical, and physical data that can be used in a myriad of ways within the basinwide planning program. In some areas there may be adequate data from several program areas to allow a fairly comprehensive analysis of ecological integrity or water quality. In other areas, data may be limited to one program area, such as only benthic macroinvertebrate data or only fisheries data, with no other information available. Such data may or may not be adequate to provide a definitive assessment of water quality, but can provide general indications of water quality. The primary program areas from which data were drawn for this assessment of the Catawba River basin include benthic macroinvertebrates, fish community, lake assessment, ambient monitoring, and aquatic toxicity monitoring.

QUALITY ASSURANCE

Laboratory measurements play a key role in the assessment and protection of water quality. Laboratory analyses are needed to identify problems and to monitor the effectiveness of management strategies to abate these problems. The relative accuracy and precision of laboratory data must be considered as part of any data interpretation or analysis of trends and use support. Absolute certainty in laboratory measurements can never be achieved. However, it is the goal of quality assurance and quality control efforts to quantify an acceptable amount of uncertainty. The evaluation of data quality is thus a relative determination. What is high quality for one situation could be unacceptable in another.

DWQ's Chemistry Laboratory has recently established rigorous internal quality assurance evaluations. These evaluations may have significant implications on interpretation of historical data and how new data are generated and reviewed. DWQ will continue to work on ensuring the quality of water analyses in North Carolina. It is obviously beneficial to generate the highest quality information to apply a statistical level of significance to water quality observations. In addition to quantification limits, lower limits of detection, method detection limits, and instrumentation detection limits must be evaluated on a continuing basis to ensure sound data and information. Because each of these detection limits can represent different levels of confidence, water quality evaluations may change from time to time based on improved laboratory instruments, analytical methods, and improved quality assurance and quality control applications.

BENTHIC MACROINVERTEBRATES

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. Because 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 stressors.

Sampling methods and criteria (Appendix 6) have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample from flowing fresh waters based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPT S) and the value of the North Carolina Biotic Index (NCBI or BI). This index summarizes tolerance data for all taxa in each collection. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is not assessed as well by a taxa richness analysis. Different criteria have been developed for different ecoregions (mountains, piedmont, and coastal) within North Carolina for freshwater flowing waterbodies.

Bioclassifications listed in this report (Appendix 7) may differ from older reports because evaluation criteria have changed since 1983. Originally, Total S and EPT S criteria were used, then just EPT S, and now NCBI and EPT S criteria are used for flowing freshwater sites. Refinements of the criteria continue to occur as more data are gathered.

FISHERIES

Fish Community Structure

The NCIBI is a modification of the Index of Biotic Integrity initially proposed by Karr (1981) and Karr, *et al*. (1986) (Appendix 10). The IBI method was developed for assessing a stream's biological integrity by examining the structure and health of its fish community. The scores derived from this index are a measure of the ecological health of the waterbody and may not directly correlate to water quality. For example, a stream with excellent water quality, but with poor or fair fish habitat, would not be rated excellent with this index. However, in many instances, a stream which rated excellent on the NCIBI should be expected to have excellent water quality.

The Index of Biological Integrity 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 indicate additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

Fish Kills

Fish kills investigation protocols were established in 1996 to investigate, report, and track fish kill events throughout the state. Fish kill and fish health data collected by trained NCDWQ and other resource agency personnel are recorded on a standardized form. Fish kill investigation forms and supplemental information are compiled in a database where the data can be managed and retrieved for use in reporting to concerned parties. Additional information on fish kills may be found at: http://www.esb.enr.state.nc.us/.

LAKE ASSESSMENT

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. Assessments have been made at publicly accessible lakes, at lakes which supply domestic drinking water, and at lakes (public or private) where water quality problems have been observed.

AMBIENT MONITORING SYSTEM

Assessments of water quality can be obtained from information about the fish and benthic invertebrate communities present in a body of water or from chemical measurements of particular water quality parameters. The Ambient Monitoring System is a network of stream, lake, and estuarine stations strategically located for the collection of physical and chemical water quality data. Parametric coverage is determined by freshwater or saltwater waterbody classification and corresponding water quality standards. Under this arrangement, core parameters are based on Class C waters with additional parameters appended when justified (Table 4).

Table 4. Freshwater parametric coverage for the ambient monitoring system.[1]

Parameter	All freshwater	Water Supply
Dissolved oxygen (s)	✔	✔
pH (s)	✔	✔
Specific conductance	✔	✔
Temperature (s)	✔	✔
Total phosphorus	✔	✔
Ammonia as N	✔	✔
Total Kjeldahl as N	✔	✔
Nitrate+nitrite as N (s)	✔	✔
Total suspended solids	✔	✔
Turbidity (s)	✔	✔
Fecal coliform bacteria (s)	✔	✔
Aluminum	✔	✔
Arsenic (s)	✔	✔
Cadmium (s)	✔	✔
Chromium, total (s)	✔	✔
Copper, total (s)	✔	✔
Iron (s)	✔	✔
Lead (s)	✔	✔
Mercury (s)	✔	✔
Nickel (s)	✔	✔
Zinc (s)	✔	✔
Manganese (s)	---	✔
Chlorophyll *a*[2] (s)	✔	✔

[1]A check (✔) indicates the parameter is collected and an 's' indicates the parameter has a standard or action level.
[2]Chlorophyll *a* is collected in Nutrient Sensitive Waters (NSW).

Water quality data collected at all sites were evaluated for the previous five year period. Some stations have little or no data for several parameters. However, for the purpose of standardization, data summaries for each station include all parameters. These chemistry data summaries are found at the end of the Ambient Monitoring Section.

Data collected from January 1996 to September 2000 were displayed in box plots. Box plots provide measures of central tendency and variation (Figure 11). The parameters presented in this report were also presented in the previous basin assessment report (NCDEHNR 1997).

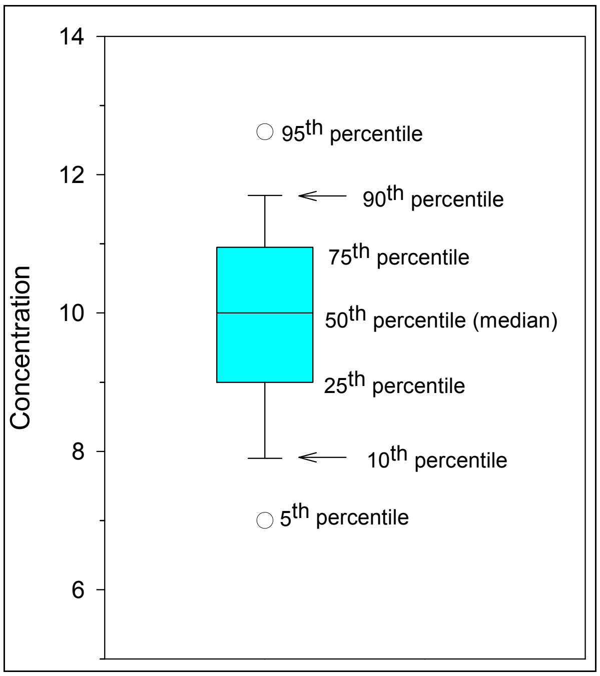


Figure 11. Explanation of box and whisker charts.

The water quality reference value may be an ecological evaluation level, a narrative or numeric standard, or an action level as specified in the North Carolina Administrative Code 15A NCAC 2B .0200 (Table 5). Zinc is included in the summaries for metals but recent (since April 1995) sampling or laboratory analyses may have been contaminated and the data may be unreliable. In this report, conductivity is synonymous with specific conductance. It is reported in micromhos per centimeter (µmhos/cm) at 25 °C.

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. Facilities without monitoring requirements may have their effluents evaluated for toxicity by the NC DWQ's Aquatic Toxicology Laboratory. If toxicity is detected, NCDWQ may include aquatic toxicity testing upon permit renewal.

The NC DWQ's 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 NCDWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

Table 5. Selected water quality standards for parameters sampled as part of the ambient monitoring system.[1]

	Standards for All Freshwater			Standards to Support Additional Uses		
Parameter (µg/L, unless noted)	**Aquatic Life**	**Human Health**	**Water Supply Classifications**	**Trout Water**	**HQW**	**Swamp Waters**
Arsenic	50					
Cadmium	2.0			0.4		
Chloride	230,000[2]		250,000			
Chlorophyll *a*, corrected	40[3]			15[3]		
Chromium, total	50					
Coliform, total (MFTCC/100 ml)[4]			50[3] (WS-I only)			
Coliform, fecal (MFFCC/100 ml)[5]		200[3]				
Copper, total	7[2]					
Dissolved oxygen (mg/L)	5.0[6,7]			6.0		[3, 7]
Hardness, total (mg/L)			100			
Iron (mg/L)	1[2]					
Lead	25[3]					
Manganese			200			
Mercury	0.012					
Nickel	88		25			
Nitrate nitrogen			10,000			
pH (units)	6.0 - 9.0[3, 7]					[3, 7]
Selenium	5					
Solids, total dissolved (mg/L)			500			
Solids, total suspended (mg/L)					10 Trout, 20 other[8]	
Turbidity (NTU)	50, 25[3]			10[3]		
Zinc	50[2]					

[1]Standards apply to all classifications. For the protection of water supply and supplemental classifications, standards listed under Standards to Support Additional Uses should be used unless standards for aquatic life or human health are listed and are more stringent. Standards are the same for all water supply classifications (Administrative Code 15A NCAC 2B 0200, eff. April 1, 2001).
[2]Action level.
[3]Refer to 2B .0211 for narrative description of limits.
[4]Membrane filter total coliform count per 100 ml of sample.
[5]Membrane filter fecal coliform count per 100 ml of sample.
[6]An instantaneous reading may be as low as 4.0 mg/L, but the daily average must be 5.0 mg/L or more.
[7]Designated swamp waters may have a dissolved oxygen less than 5.0 mg/L and a pH as low as 4.3, if due to natural conditions.
[8]For effluent limits only, refer to 2B .0224(1)(b)(ii).

CATAWBA RIVER SUBBASIN 30

Description

This subbasin contains the headwater reaches of the Catawba River, from its source near the Eastern Continental Divide west of the Town of Old Fort to the confluence with Silver Creek in Burke County (Figure 12). Major tributaries include Curtis, Buck, Crooked, and Muddy Creeks and the North Fork Catawba and Linville Rivers. Also included in this subbasin is a 25 mile reach of the upper Catawba River and the entire watershed of Lake James.

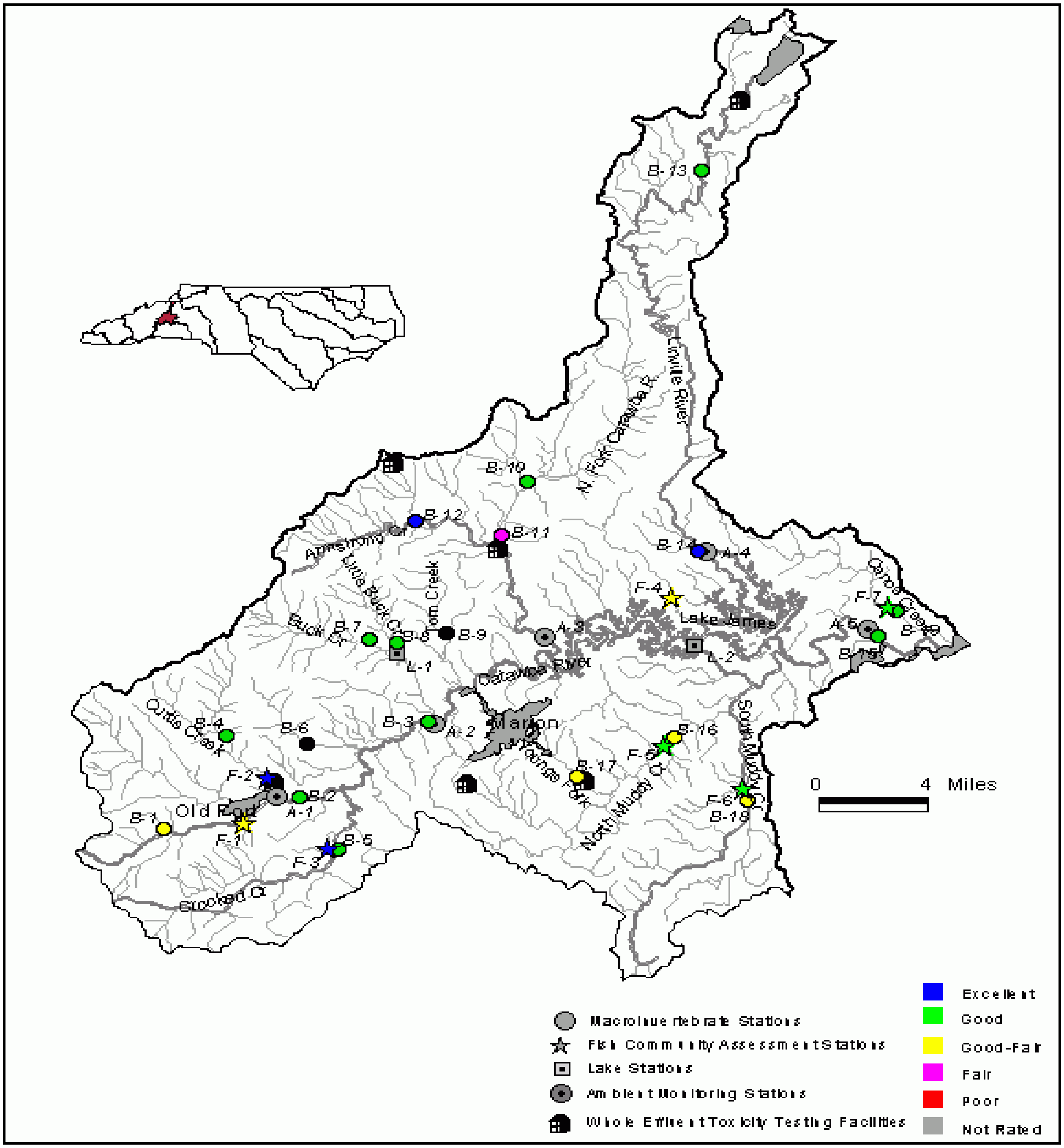


Figure 12. Sampling sites in Subbasin 30 in the Catawba River basin.

The Catawba River flows generally eastward with the largest tributaries flowing south from mountainous headwaters. These northern tributaries are typically swiftly flowing, cold-water stream systems capable of supporting trout populations. Several smaller tributaries such as Crooked and Muddy Creeks flow north to the Catawba River from less mountainous and more agricultural catchments.

This is a physiographically diverse subbasin including the High Mountains, Eastern Blue Ridge Foothills, and the Northern Inner Piedmont ecoregions (Griffith *et al* 2002). A greater percentage of land in this subbasin is forested than found in any other subbasin (Table 6). It also had the least amount of lands classified as pasture or urban than in any other subbasin. Much of this land is contained within the Pisgah National Forest and, therefore, protected from many land disturbing activities.

Table 6. Land use in Subbasin 30. Based upon CGIA coverage 1993 - 1995, total area = 526 square miles (NCDENR 1999).

Land use	Percent
Water	3
Cultivated crop	1
Pasture	8
Urban	1
Forest	87

Overview of Water Quality

This headwater subbasin was intensively sampled in 2002 with 19 benthos basinwide sites, 7 fish community sites, and 2 lakes sampled (Table 7). The drought appeared to be the major stressor that affected benthic communities by causing a decline by one bioclassification at eight sites. Three benthos sites increased by one bioclassification, but these were either larger sites or an urban site that would have had less nonpoint runoff during the drought.

Overall, water quality is high in this area. An Excellent benthos bioclassification was retained from at Armstrong Creek and the Linville River below the gorge, before it flows into Lake James. Curtis, Mackey, and Crooked Creeks had Excellent fish ratings and Good benthos rating. Mackey Creek, below a metal plating discharge whose permit was rescinded in June 2001, was the biggest success story in this subbasin. Poor benthos and fish ratings were found prior to removal of the discharge.

The entire Catawba River (except for the headwater portion, which was Good-Fair), was given a Good benthos rating, but the low flows produced prolific growths of the rooted aquatic plant, *Elodea canadensis*, in some areas. Other streams with Good benthos ratings were Buck, Little Buck, and Canoe Creeks. Canoe Creek had a Good fish rating also.

North Muddy and South Muddy Creeks, which drain urban areas or have wastewater treatment plant discharges, had better fish communities (Good), than benthos (Good-Fair). Cattle access to Paddy Creek seemed to be the cause of the Good-Fair fish rating in this small stream draining the Pisgah National Forest.

The North Fork Catawba River just below the Baxter Healthcare Corporation discharge declined from Excellent to Good between 1997 and 2002 but there was a dramatic decline from Good to Fair further downstream, where the river was wider with slower flow. The drought conditions provided minimal dilution and a conductivity value of 576 µmhos/cm was observed at the time of the benthos sampling in August 2002.

Lake James and Lake Tahoma were oligotrophic, although Lake James was eutrophic during part of the summer in 2002. Increasing residential development around Lake James remains a concern.

There are five ambient water chemistry stations in this subbasin. These sites had the lowest median values for conductivity, total suspended solids, and turbidity of all the subbasins. Nutrient values were also low overall. The Catawba River near Pleasant Gardens had the most metal analyses (11) greater than the reporting level, for all subbasins, but concentrations were still low.

Table 7. Waterbodies monitored in Subbasin 30 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
B-1	Catawba R	McDowell	SR 1274 at end	Good-Fair	Good-Fair
B-2	Catawba R	McDowell	SR 1234	Good-Fair	Good
B-3	Catawba R	McDowell	SR 1221	Good	Good
B-4	Curtis Cr[2]	McDowell	off SR 1227	Good	Good
B-5	Crooked Cr	McDowell	SR 1135	Good	Good
B-6	Mackey Cr	McDowell	SR 1453	Good	Not Impaired
B-7	Buck Cr	McDowell	off NC 80	Excellent	Good
B-8	L Buck Cr	McDowell	SR 1436	Excellent	Good
B-9	Toms Cr	McDowell	SR 1434	Good	Not Impaired
B-10	N Fk Catawba R	McDowell	SR 1573	Excellent	Good
B-11	N Fk Catawba R	McDowell	SR 1560	Good	Fair
B-12	Armstrong Cr	McDowell	end of USFS Road	Excellent	Excellent
B-13	Linville R	Avery	US 221	Good-Fair	Good
B-14	Linville R	Burke	NC 126	Excellent	Excellent
B-15	Catawba R	Burke	SR 1147	Good	Good
B-16	North Muddy Cr	McDowell	SR 1750	Good	Good-Fair
B-17	Youngs Fk (Corpening Cr)	McDowell	SR 1819	Fair	Good-Fair
B-18	South Muddy Cr	McDowell	SR 1764	Good-Fair	Good-Fair
B-19	Canoe Cr	Burke	SR 1250	Good-Fair	Good
F-1	Catawba R	McDowell	SR 1110	Good	Good-Fair
F-2	Curtis Cr	McDowell	US 70	---	Excellent
F-3	Crooked Cr	McDowell	SR 1135	---	Excellent
F-4	Paddy Cr	Burke	NC 126	Fair	Good-Fair
F-5	North Muddy Cr	McDowell	SR 1760	Good	Good
F-6	South Muddy Cr[2]	McDowell	SR 1764	Good	Good
F-7	Canoe Cr[2]	Burke	SR 1250	Excellent	Good
L-1	Lake Tahoma	McDowell			
L-2	Lake James	Burke			

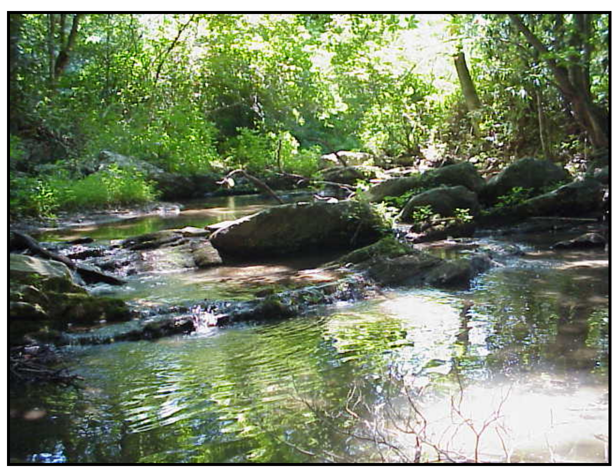
[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites; L = lake assessment sites.
[2]Data are available prior to 1997, refer to Appendices 7 and 11.

River and Stream Assessment

Mill Creek near the community of Graphite was not sampled for benthic macroinvertebrates in 2002. This small stream will no longer be a basinwide monitoring site. Other sites in McDowell County that are too small for basinwide assessment include Mackey Creek at SR 1453, the Catawba River at SR 1274, and Toms Creek at SR 1434.

Armstrong Creek was not sampled for fish community assessment in 2002. Data had been collected as recently as 1999 and the community has consistently been rated Excellent (Appendix 11).

Catawba River, at end of SR 1274
The headwater area of the Catawba River is a small stream and was only four meters wide during the 2002 summer drought. The drainage area is about six square miles. Habitat at this benthos site was fairly good (habitat score of 75) with a mix of boulder, rubble and gravel, little sand (in contrast to the 1997 sample), and clear water. The adjacent land was forested on one side, with the road and rural residences on the other side.



Catawba River at the end of SR 1274, McDowell County.

There was no change in the benthos bioclassification (Good-Fair) between 1997 and 2002, although EPT S increased from 24 to 26. Dominant organisms in 1997 included facultative grazers (Baetidae) and filter-feeders (Hydropsychidae). In 2002, however, abundant taxa were more intolerant. Present were the stoneflies *Pteronarcys, Tallaperla,* and *Leuctra*; mayflies *Epeorus rubidus* and *Leucrocuta*; and caddisflies *Dolophilodes* and *Neophylax oligius*. The snail, *Elimia*, was very abundant in 2002.

Catawba River, SR 1110

This fish community site, above Mill Creek, is located in a broad valley near the Town of Old Fort in western McDowell County. There are no NPDES facilities in its watershed, but livestock have direct access to the stream at this locale. An open canopy, shallow clear water, and nutrients contribute to excessive periphyton growths.

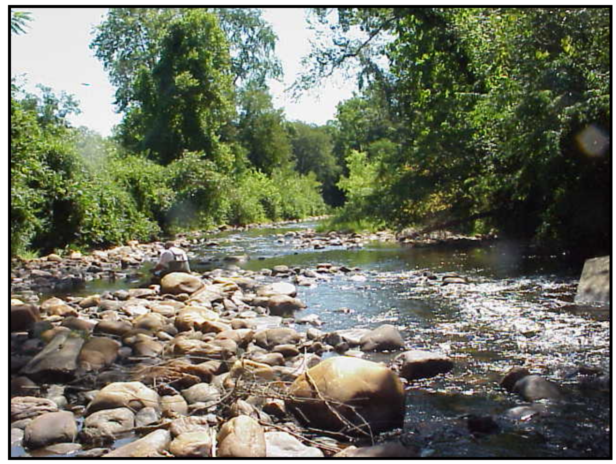
Upstream view of the Catawba River at SR 1110, McDowell County.

In 2002, the fish community was rated Good-Fair; in 1997 it was Good (NCIBI = 46 and 50, respectively). The dominant species in both years was the herbivorous, central stoneroller, a species able to exploit the abundant periphyton in streams such as this one. The percentage of omnivores+ herbivores was greater in this stream than at any of the other sites in the basin in 2002 (Appendix 12). The slight decrease in score and rating in 2002 were due to an absence of trout and a decrease in the percentage of insectivores.

Catawba River, SR 1234

This site was downstream of the Old Fort finishing plant which ceased discharge in 1984. The Town of Old Fort's WWTP still discharges to nearby Curtis Creek, a tributary of the Catawba River, about five miles above this site. The discharge is reflected in the higher conductivity found during benthos sampling at this site than at the SR 1274 site (153 and 50 µmhos/cm, respectively). This site is located about seven miles downstream of the March 1997 soybean-oil spill into Swannanoa Creek, a tributary of the Catawba River.

This benthos site had an unusual geology with large rounded rocks. The river is about 12 meters wide (drainage area is 54 square miles) with a swift current and a very rocky substrate. The habitat score was 87.



Catawba River at SR 1234, McDowell County.

The changes in benthos ratings in this stretch of river have been related to problems with the Old Fort finishing plant in the 1980s (Fair), and with the soybean oil spill in 1997 (Good-Fair). A bioclassification of Good was found in 1990, 1992 and 2002. The 2002 sample indicated complete recovery from the spill. *Elimia* was very abundant followed in dominance by heptageniid mayflies.

Catawba River, SR 1221

This portion of the Catawba River near Pleasant Gardens is 30 meters wide (drainage area = 126 square miles) and had a slow current in 2002. The water level was very low with only one area of fast flow found several hundred meters below the bridge. There were prolific growths of the rooted aquatic plant, *Elodea canadensis*, throughout the sample reach. This plant had not been noted in prior years.

Catawba River at SR 1221, McDowell County.

The 2002 benthos bioclassification was Good-Fair, a decline from the Good ratings found since 1990, but similar to what was found all during the 1980s. In 2002, the EPT S declined to 27 from 35 in 1997 with few intolerant taxa and only one stonefly found. The largest decrease in taxa was within the mayflies. The BI increased from 4.46 to 5.38. Chironomids were particularly abundant, especially *Crictopus bicinctus*, which is a toxic indicator species.

Since there are no dischargers between the SR 1234 site and this site, the cause for the decline in water quality is unclear. One possibility is that the slower current at this site allowed the oxygen consuming effects of upstream dischargers to be more evident even though conductivity was lower at this site than at the SR 1234 site (94 vs. 153 µmhos/cm). Higher water temperatures may also have played a role; temperatures increased from 20°C at the most upstream Catawba River site to 25°C at this site in August.

Curtis Creek, SR 1227

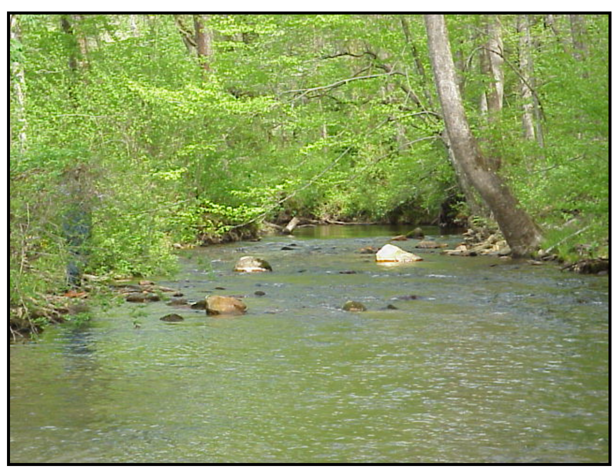
Curtis Creek is a small stream, six meters wide with a drainage area of 12 square miles. There is good macroinvertebrate habitat and swift current. The watershed above this site lies entirely within the Pisgah National Forest and the Mt. Mitchell Wildlife Management Area. The Town of Old Fort's WWTP discharges to the stream but the discharge is much further down in the watershed.

Curtis Creek at SR 1227, McDowell County.

Curtis Creek received a Good bioclassification during in 1992, 1997, and 2002. The benthos community was characterized by low productivity and many intolerant taxa.

Curtis Creek, US 70

Curtis Creek was sampled for the first time for fish community assessment in 2002. In northwest McDowell County, the stream is a tributary to the upper Catawba River and portions of its watershed are within the Pisgah National Forest. There are no NPDES facilities within the watershed and the conductivity was very low (18 µmhos/cm). The stream is classified as Class C Tr and is a Hatchery Supported Trout Waters. At this crossing, the instream, riparian, and watershed characteristics qualified the site as a new regional reference site.



Upstream view of Curtis Creek at US 70, McDowell County.

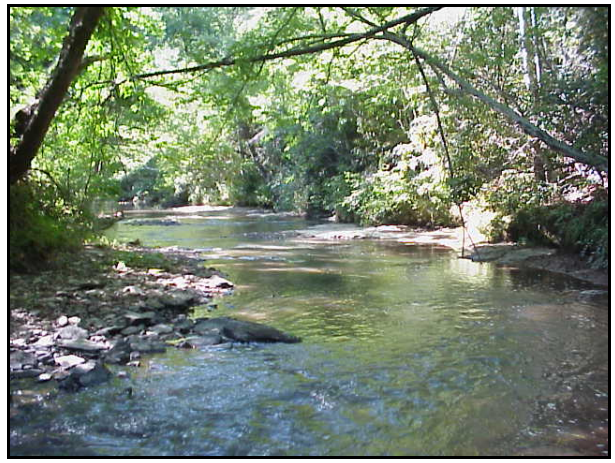
The fish community was rated Excellent (NCIBI = 60) and the dominant species was the warpaint shiner.

Crooked Creek, SR 1135
Crooked Creek was sampled for the first time for fish community assessment in 2002. Draining southwestern McDowell County, the stream is a tributary to the extreme upper reaches of the Catawba River. At this crossing, the instream, riparian, and watershed characteristics qualified the site as a new regional reference site. However, despite the low flow and drought conditions, the stream was turbid. The source of this turbidity in such an relatively undeveloped watershed should be investigated.

Upstream view of Crooked Creek at SR 1135, McDowell County, April 2002.

The fish community was rated Excellent (NCIBI = 56) and the dominant species was the bluehead chub. The community was the most diverse of any stream sampled in the basin in 2002 (n = 22 species) (Appendix 12).

During the summer 2002 benthos sampling, the stream was seven meters wide with a heterogeneous rocky substrate. The heavy sand deposits noted in 1997 were not found in 2002.



Crooked Creek at SR 1135, McDowell County, August 2002.

This area received a Good benthos rating during collections in 1992, 1997, and 2002. EPT S decreased somewhat in 2002, but this was due mainly to the collection of fewer caddisfly taxa, including taxa that had been abundant or common during the previous two basin cycles: *Symphitopsyche bronta, Brachycentrus nigrosoma*, and *Glossosoma*. Lower flows and higher water temperatures may have caused some of these community changes, but the changes were not enough to change the rating.

Mackey Creek, SR 1453
Mackey Creek at this site has a drainage area of seven square miles. During benthos sampling in 2002 the stream was very narrow with low flow. Even though it is a rocky stream with high gradient, there was a lot of sand in the slower areas and a layer of silt over the rocks. Recent land disturbing activities on property just upstream of the site were identified as a source of sediment. The land quality violations lead to enforcement actions against the property owner.

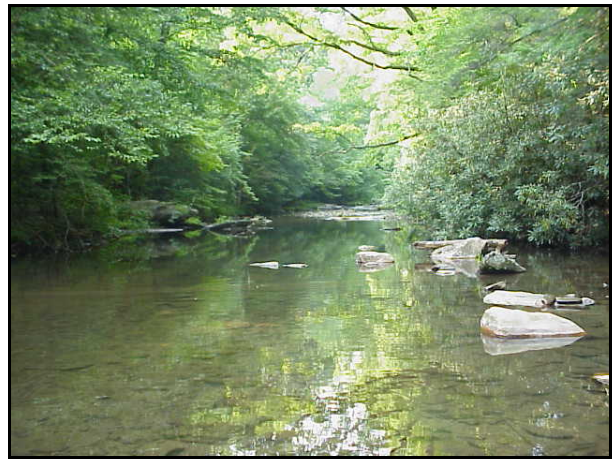
Mackey Creek at SR 1453, McDowell County.

Between 1992 and 1997, a decline in EPT S resulted in a decline in bioclassification from Excellent to Good. The sediment impacts in 2002 reduced EPT S even further from 29 in 1997 to 23 in 2002. Though rated as Not Impaired (due to its small width), a Good-Fair rating would have been assigned had flows covered the full channel width. A more tolerant benthic community was found in 2002.

Mackey Creek was also sampled further downstream at US 70 (see Special Studies) in the same week and was given a Good bioclassification. This upstream Mackey Creek site will no longer be a basin assessment site due to its small size.

Buck Creek, off NC 80

Buck Creek is the principle tributary of Lake Tahoma and flows parallel to NC 80. Benthos samples were taken at the first turnout off NC 80 above the lake. The drainage area is 14 square miles. The stream carries a high sediment load, but the high gradient prevents heavy accumulations of sand in most parts of the creek. The width of the main channel of the stream varied from 10 to 20 meters in 2002. However, the benthos sampling effort was concentrated in a narrow (four to five meters) side channel with faster flow than was found in the main stream channel.

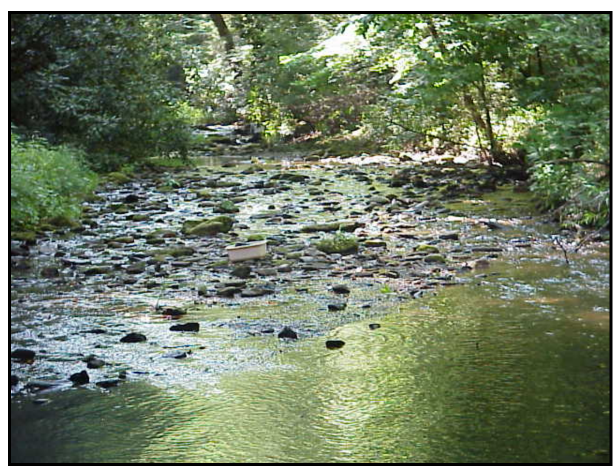


Buck Creek off NC 80, McDowell County.

This stream was assigned an Excellent rating in 1992 and 1997. The low flows in 2002 reduced edge habitat, and allowed a silt layer to be deposited in the slower reaches. EPT S decreased from 38 in 1997 to 31 in 2002 resulting in a Good bioclassification. However, abundant taxa were similar both years and the only differences between years was in the rare taxa.

Little Buck Creek, SR 1436

Little Buck Creek is another tributary to Lake Tahoma, but is much smaller (five meters wide and a drainage area of six square miles) than Buck Creek. Good instream and riparian habitats during benthos sampling resulted in a habitat score of 89. Extremely low water levels left many rocks nearly out of the water in riffle areas.



Little Buck Creek at SR 1436, McDowell County.

An Excellent rating assigned in 1992 and 1997, decreased to Good in 2002. EPT S only decreased from 37 to 35 for the last two basin cycles which suggested no real change in water quality. However, productivity was sharply reduced. EPT N was nearly halved from 203 in 1997 to 125 in 2002 with over one-half the taxa considered rare (one or two specimens collected).

Toms Creek, SR 1434

Toms Creek is a small stream (three meters wide) in an agricultural catchment. Flows were so low during summer benthos sampling, that only an EPT sample was collected to evaluate what would survive in a nearly dry stream. Unlike prior benthos samples the substrate was not embedded and the stream had a habitat score of 89. This stream is so susceptible to low flows that it will no longer be a basin assessment site, even though it's drainage area (eight square miles) is larger than some other basin assessment sites.

Toms Creek at SR 1434, McDowell County.

The stream is highly productive with large numbers of grazing invertebrates, especially *Elimia* (which literally covered every rock) and *Neophylax oligius*. Prior summer collections indicated a bioclassification intermediate between Good and Excellent. In 2002 despite the very low water level, there was enough flow to support 26 EPT S of which nine were abundant. The EPT BI was lower than the EPT BI when Good and Excellent ratings were assigned which suggested no change in water quality. Due to the reduced width a Not Impaired rating was given to the stream.

North Fork Catawba River, SR 1573

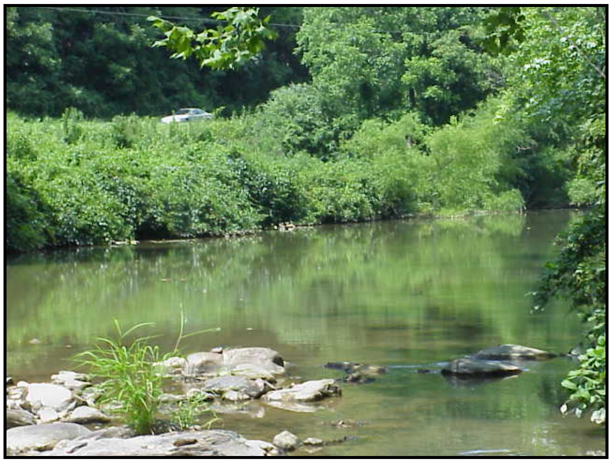
This benthos site is downstream of the Baxter Healthcare Corporation discharge (1.2 MGD). The stream width varied between 7 and 14 meters; the drainage area of the watershed is 31 square miles. The substrate was very rocky, but all the rocks were black on the underside. The high periphyton growths noted in 1997 were not found, but *Podostemum* was very abundant. Conductivity was extremely high -- 576 µmhos/cm, compared to the value of 220 µmhos/cm found in 1997.

North Fork Catawba River at SR 1573, McDowell County.

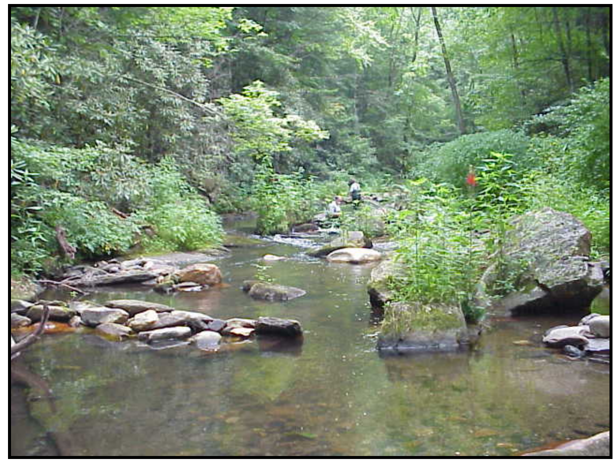
Despite the high conductivity and black rocks, EPT S only decreased from 37 in 1997 to 28 in 2002, with a consequent rating decline from Excellent to Good. Both grazers and filter-feeders were very abundant, especially the grazing snails (*Elimia*). This characteristic was found at many other sites in this subbasin. The caddisfly, *Chimarra* and the mayfly *Isonychia* dominated the EPT fauna. Heptageniid mayflies, an ubiquitous component of all streams even degraded ones, were sparse.

North Fork Catawba River, SR 1560

This benthos sampling location was located below the SR 1560 bridge in the community of Sevier. This site appears to be above the American Thread discharge as the plant itself was downstream. There was no visible flow in the deeper, wider (15 meters) section of the river at the bridge. The drainage area of the river at this site is 45 square miles. A riffle was formed as the river went around an island in a channel five to six meters wide.



North Fork Catawba River at SR 1560, McDowell County.



Armstrong Creek at end of USFS road, McDowell County.

This site decreased dramatically to Fair in 2002 from Good in 1997. It seemed that the discharge at SR 1573 was having an effect several miles downstream, rather than in the immediate area of the discharge. No heptageniid mayflies or stoneflies were found. The caddisfly fauna was also very different from that at the SR 1573 site. Hundreds of *Hydropsyche venularis* and *H. betteni* covered the rocks at the SR 1560 site, but none were found at the upstream site. The abundances of *Cricotopus bicinctus* and *Polypedilum illinoense* also indicated a toxic impact.

Armstrong Creek, off US Forest Service Road

Armstrong Creek was sampled near the start of a USFS road off NC 226A and above Three Mile Creek in an area that is largely undisturbed (habitat score was 95). Clear, cold water and diverse substrate provide good habitat for benthos and fish. A state fish hatchery discharges to the stream above this site and the lower segment near the benthos site is managed for trout fishing by the adjacent landowner.

Benthos collections since 1992 indicated Excellent water quality. A recent expansion and upgrade at the hatchery had no measurable effect on the benthic fauna. Drainage area of this site is only about 12 square miles, but flows did not appear reduced in 2002.

Paddy Creek, NC 126

The watershed of Paddy Creek lies to the west of the Linville River and Linville River Gorge; the stream is a small tributary to Lake James. The watershed is forested with pasture in the lower reaches. There are no NPDES facilities in its watershed, but livestock have direct access to the stream at this locale. Shallow, clear water and nutrients contributes to excessive periphyton growths. The conductivity and pH were low (11 and 12 µmhos/cm in 1997 and 2002, respectively and 6.0 and 6.3 s.u. in 1997 and 2002, respectively). These values were the lowest of any stream monitored in the basin in either year during fish community sampling.

Upstream view of Paddy Creek at NC 126, Burke County.

In 2002, the fish community was rated Good-Fair; in 1997 it was rated Fair (NCIBI = 46 and 40, respectively). The improved rating was due to a greater diversities of fish, of sunfish, bass, and trout, of intolerant species, and of piscivorous species. The number of fish and the percentages of omnivores+herbivores and insectivores were nearly identical in both years. The stoneroller and the bluehead chub again constituted 45 percent of the fauna – just like in 1997. However, the abundance of redbreast sunfish increased from 3 percent in 1997 to 14 percent in 2002.

Despite having high quality habitats (Appendices 2 – 4), the fish community in Paddy Creek seemed to be affected by long-term poor land use, specifically, the policy of permitting cattle to have complete access to the stream. And although the rating improved from Fair to Good-Fair, the community has not changed dramatically since the early 1960s (Louder 1964). The dominant species during this 40 year period has continued to be the central stoneroller, a species that successfully exploits Mountain streams that have been altered by livestock. In addition, Lake James continues to serve as a barrier to recolonization of the stream by some species. Two or three additional species of darters should occur in Paddy Creek -- the tessellated darter, seagreen darter, and Piedmont darter. These species have been found in the adjacent Linville River or other nearby streams, but not in Paddy Creek.

Linville River, US 221

This portion of the Linville River near Pineola drains a highly developed area, including three golf courses, one of which has an impoundment of the Linville River less than a mile upstream of this benthos monitoring site. The river is only 8 meters wide in this (DA is 20 square miles), with good instream habitat, though the very slippery rocks indicate suggested nutrient enrichment in this portion of the Linville River. Residential and agricultural land use near this site affect the stream habitat, resulting in a narrow riparian zone, unstable banks, and infrequent pools.

Linville River at US 221, Avery County.

The 2002 sample had one more EPT S (28) than 1997, so it edged into the Good bioclassification. Most benthos samples from this site have resulted in a high Good-Fair or Good rating, with no indication of long-term changes in water quality.

Linville River, NC 126

The Linville River at this benthos site is below Linville Gorge and just above Lake James. The river is about twice as wide here (16 meters), and drainage area is three times higher (67 square miles) compared to the upstream site, but still has indications of nutrient enrichment (abundant periphyton and *Podostemum* growths). This site has been sampled during the summer nine times since 1983 and was sampled twice in 2002, one sample was a QA/QC overlap sample.

Linville River downstream of NC 126, Burke County.

The site consistently is rated Excellent based on benthos data. EPT S reached a maximum in 1997 (53), and Total S was as high as 108 in 1992. Very rare macroinvertebrates were found at this site in 2002 (Appendix 9).

This large dataset allowed some interesting evaluation of community changes, and presence/absence of taxa, without change in bioclassification. Using just the six summer samples from 1990 through 2002, 200 different benthic taxa have been collected of which 88 were EPT taxa. EPT S for any one sample has ranged from 43 to 53. Of the 88 EPT S, only 16 were collected in all six samples. Of the 200 taxa, only *Isonychia*, *Promoresia elegans*, and *Corydalus cornutus* have been abundant in all six samples and only 27 taxa were found in all six samples.

In 2002, three EPT taxa were abundant in one sample, but absent from the other; 14 other EPT taxa were collected (but not abundant) in one sample, but were absent in the other. Yet, EPT S was nearly identical in both samples (47 and 48). The robustness of both collection techniques and benthic metrics, as well as the need to view community change rather than single taxa change, is clear from these data.

Catawba River, SR 1147

This portion of the Catawba River is about 10 miles downstream of Lake James and has a drainage area of 504 square miles. Because it is below the powerhouse, there are large daily fluctuations in water level. This site near Glen Alpine is characterized by lush growths of *Podostemum* in shallow riffle areas which can only be reached safely while water is not being released from the powerhouse. The river is at least 60 meters wide at this location.

Catawba River below SR 1147, Burke County.

This site has received a Good benthos rating for three samples between 1988 and 2002. EPT S decreased in 2002, but the BI improved. The snail, *Elimia*, was very abundant at this site also. Thirteen of the 21 EPT taxa in 2002 were abundant, indicating that taxa able to withstand the daily water level changes can thrive in such conditions. Edge species were nearly absent as the "shore" is dry for much of each day.

North Muddy Creek, SR 1760

Draining south-central McDowell County, the watershed of North Muddy Creek includes the City of Marion’s wastewater treatment plant (*via* Corpening Creek) plus four smaller dischargers. Upstream, the fish community in Corpening Creek is rated Fair (see Special Studies).

North Muddy Creek at SR 1750, McDowell County.

The fish community in North Muddy Creek was rated Good in 2002 and 1997 (NCIBI = 48 and 52, respectively). But, the low flow conditions seemed to have slightly increased the percentage of omnivores+herbivores. Bluehead chub, central stoneroller, and spottail shiner all increased in dominance from 23, 3 and 3 percent, respectively in 1997 to 27, 13, and 9 percent, respectively in 2002. The percentage of insectivores correspondingly declined from 68 to 49 percent between 1997 and 2002.

Summer benthic sampling at this site during basinwide monitoring has produced very consistent EPT S (32, 33, and 32), but the bioclassification has changed from Good-Fair in 1992, to Good in 1997, and back to Good-Fair in 2002. The BI improved slightly in 1997 to 4.76, but increased to 5.53 in 2002.

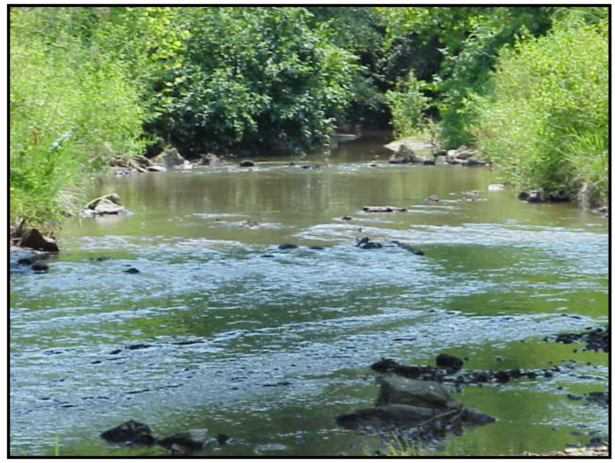
This was the only benthos site in this subbasin where the pleurocerid snail, *Elimia*, was rare in 2002. Slimy rocks and abundant silt deposits reflect the nutrient enrichment and sedimentation problems in this stream.

Youngs Fork (Corpening Creek), SR 1819
This stream drains a highly urban portion of the Town of Marion. It is a small (five meters wide with drainage area of seven square miles), shallow, sand filled stream with a few rocks that provide some habitat. This site is located upstream of Marion's WWTP discharge.

Corpening Creek at SR 1819, McDowell County.

Data from all benthos collections until 2002 had consistently produced a Fair rating for this site. In 2002 the benthos rating improved to Good-Fair, with 22 EPT S collected. Low flows in 2002 may have reduced the nonpoint impacts typical of urban streams.

South Muddy Creek, SR 1764
Draining southeastern McDowell County, South Muddy Creek is a tributary to North Muddy Creek. There are no NPDES facilities within its watershed and much of the land is used for agricultural purposes. Nonpoint source problems are evident in the sandy substrate and infrequent pools; the riparian zones are narrow along both banks.



South Muddy Creek at SR 1764, McDowell County.

The fish community has consistently been rated Good in 1993, 1997, and 2002 (NCIBI = 50, 50, and 48, respectively), although there are no true pools and habitat characteristics are of low quality (Appendices 2 - 4). The overall species diversity, sunfish diversity, and percentage of piscivores is lower than expected and the percentage of omnivores+herbivores is slightly elevated. Watershed restoration efforts and sediment monitoring are currently underway by private conservation organizations and public resource agencies.

EPT benthos samples during basinwide monitoring have consistently assigned a Good-Fair rating to this site. EPT S declined slightly from 27 in 1992 to 23 in 2002 and the EPT BI increased from 3.64 to 4.21. Intolerant taxa, such as *Epeorus, Chimarra* and *Leuctra* were rare, while tolerants such as *Stenonema modestum* and *Cheumatopsyche* were the most abundant taxa collected.

Canoe Creek, SR 1250
The watershed of Canoe Creek lies northwest of the City of Morganton and drains a region

bounded by NC 181 and NC 126. This tributary to the Catawba River has no NPDES facilities in its watershed. The stream bottom appeared to be more covered with silt in 2002 than in 1997. The substrate was largely sand, but infrequent cobble riffles provided adequate habitat for the benthic fauna.

Upstream view of Canoe Creek at SR 2150, Burke County.

The stream has been sampled for fish in every basin cycle – 1993, 1997, and 2002; the ratings have varied from Good-Fair to Excellent. The community was rated Good in 2002 (Figure 13).

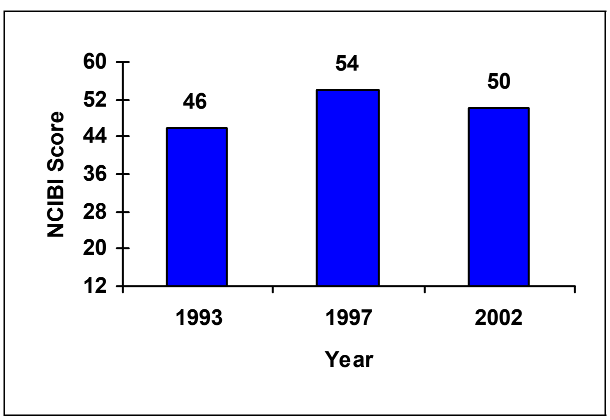


Figure 13. NCIBI scores from Canoe Creek at SR 2150, Burke County, 1993 – 2002.

In 2002, the community was unusual – no redbreast sunfish were collected (the only site in the basin where this species was not found) and the dominant species was the piscivorous, yellow perch, an introduced species. Twenty-nine percent of all the fish were this species and most of them were one-year old fish (~ 80 mm total length), thin and emaciated. This species was not collected in 1997 and may have migrated from the Catawba River and Lake Rhodhiss.

The dominant species in 1997 was the rosyside dace (19 percent), it declined slightly to 12 percent of the fauna in 2002. Also declining were the total species diversity (from 15 to 12) and the percentage of insectivores (from 73 to 50 percent). No intolerant species have been ever been collected at this site.

Based upon EPT benthic invertebrate samples, the stream received a Good-Fair bioclassification in 1992 and 1997, but increased to Good in 2002. The highest EPT S (28) and EPT N (103) was recorded in 2002, which suggested that nonpoint source runoff was the major pollutant in this stream. The low abundance of Hydropsychidae in 2002 suggested some impact from low flow during summer drought conditions.

SPECIAL STUDIES

Swannanoa Creek Recovery Following a Soybean Oil Spill

Benthic macroinvertebrates and fish were collected in April and June 1997 and February 1998 to evaluate the impacts of a March 30, 1997 soybean oil spill into Swannanoa Creek (Biological Assessment Unit Memoranda 19970424, 19970711, and 19980205). Benthic macroinvertebrate samples were again collected from this stream in 2002 to verify the recovery of the stream during summer conditions; an Excellent bioclassification was found. The stream was reclassified to High Quality Waters in 2001.

Paddy Creek, NC 126

In 1999 the Basinwide and Estuary Planning Unit requested an EPT benthic macroinvertebrate sample be collected from Paddy Creek to confirm or refute the Fair rating the stream had received from the fish community sampled collected in 1997. In May 1999, the benthic community was rated Good (DWQ unpublished data).

Youngs Fork (Corpening Creek) TMDL

As part of DWQ's Collaborative Assessment of Watersheds and Streams program of the Modeling/TMDL Unit, benthic macroinvertebrates were sampled in April 2001 at three sites on Youngs Fork (Corpening Creek) and Jacktown Creek (McDowell County), a small tributary site, to help determine the causes of impairment in this watershed. Fair or Poor bioclassifications were found at all sites. The benthic community suggested toxic inputs of some pollutant near the source of the stream in the City of Marion, and also near the sludge field of the Marion WWTP (Biological Assessment Unit Memorandum 20010522).

The fish community at SR 1794 (McDowell County) was evaluated to determine any impacts from the City of Marion's wastewater treatment plant (3 MGD, NPDES Permit No. NC0031879) and downstream urban runoff. The community was rated Fair and dominated by omnivores+ herbivores, indicative of nutrient enrichment from upstream point and nonpoint sources (Biological Assessment Unit Memorandum 20021025).

Fish Community Reference Streams
In 1999, Mill Creek at SR 1400, McDowell County, was evaluated as a regional fish community reference site. The fish community was rated Excellent (NCIBI = 58) (Biological Assessment Unit Memorandum 20000922). The stream will again become a basinwide monitoring site in 2007.

Fish Community Temporal Variability
The fish community in Armstrong Creek at SR 1456, McDowell County, was sampled in April, June, and October 1999 to determine the temporal variability of the NCIBI during DWQ's traditional monitoring period. The community was rated Excellent during each month (NCIBI = 54, 56, and 54, respectively) despite a prolonged summer drought. It was determined that seasonality was not an important factor to consider when using the NCIBI to assess the fish community of a stream (Biological Assessment Unit Memorandum 20000922).

Discontinuance of a Metal Plating Discharge
The fish community of Mackey Creek (at US 70, McDowell County) above and below Metal Industries metal plating discharge (0.01 MGD, NPDES Permit No. NC0057819) was investigated in 1998 and in 2002 (below only). The discharge was discontinued in July 2000 and the permit was rescinded in June 2001.

Prior to its discontinuance, the fish community in 1998 was rated Good above and Poor below the discharge (NCIBI = 48 and 18, respectively) (Biological Assessment Unit Memorandum 19980415). In April 2002, the community below the discharge was rated Good (NCIBI = 52) and the community had quickly recovered from the toxic discharge. The fish community and its components were now typical of those found in mountains and foothills streams in the upper Catawba River basin (Biological Assessment Unit Memorandum 20021025). The benthic macroinvertebrate community improved from Fair in 1998 to Good in 2002.

Lake Assessment

Lake Tahoma
Lake Tahoma was built in the 1920's and is privately owned by Lake Tahoma, Inc., a corporation comprised of lake front property owners. This lake is located on Buck Creek, a tributary of the Catawba River upstream of Lake James (Figure 14). The land around the lake is residential and the lake is used for recreation.

In 2002, nutrient and chlorophyll *a* values were low. Dissolved oxygen concentrations peaked at a depth of four to five meters from the surface with the highest concentration (12.6 mg/L) observed at a depth of seven meters at Station CTBLT2 in June. Values for pH and percent oxygen saturation at these depths were not elevated. Surface metals were within applicable water quality standards. In 2002 based on the NCTSI, the lake was oligotrophic; it was also oligotrophic in 1992. The lake was fully supporting its designated uses in 2002.

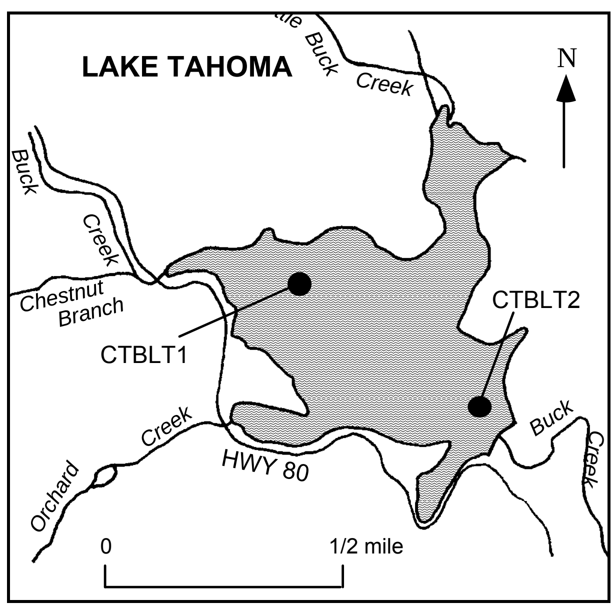


Figure 14. Sampling sites at Lake Tahoma, McDowell County.

Lake James
Lake James, which is owned by Duke Energy, was created by three dams that impounded waters of the Catawba River and the Linville River. The Catawba, the North Fork of the Catawba, and the Linville Rivers are its major tributaries (Figure 15). The lake is used to generate electricity at the Bridgewater Hydroelectric Plant; public recreation is a secondary use.

The most upstream of the impoundments in the Catawba River Chain of Lakes system, Lake James is divided into two hydrologic units: the Catawba River section and the Linville River section. A manmade canal located at the Highway 126 bridge connects these units. As a result, the lake is a hydrologically complex system.

In 2001, nutrient and chlorophyll *a* values on July 10 were very low with the exception of total phosphorus concentrations in the Catawba River arm (Stations CTB013B, CTB013C, and CTB015A), which were moderately elevated. On July 24 ammonia was also extremely elevated (Appendix 16). All other nutrient concentrations were generally low. Secchi depths were usually greater than two meters, which indicated good water clarity. Based on the NCTSI scores, the reservoir was consistently oligotrophic in 2001 with the exception of Station CTB013B, which was predominantly mesotrophic.

In 2002, Secchi depths were similar to those observed in 2001 with the exception of depths recorded at Station CTB013B which were very low (Appendix 16). Surface dissolved oxygen and pH values were consistently elevated at this site. Field notes indicated that the water appeared green which suggested the presence of an algal bloom. Chlorophyll *a* values, however, were low to moderate. Total phosphorus concentrations were consistently elevated at Station CTB013B in 2002. Surface metals were within applicable water quality standards. Overall, the reservoir was oligotrophic in 2002. However, Station CTB013B was found to be mesotrophic in June and eutrophic in July and August.

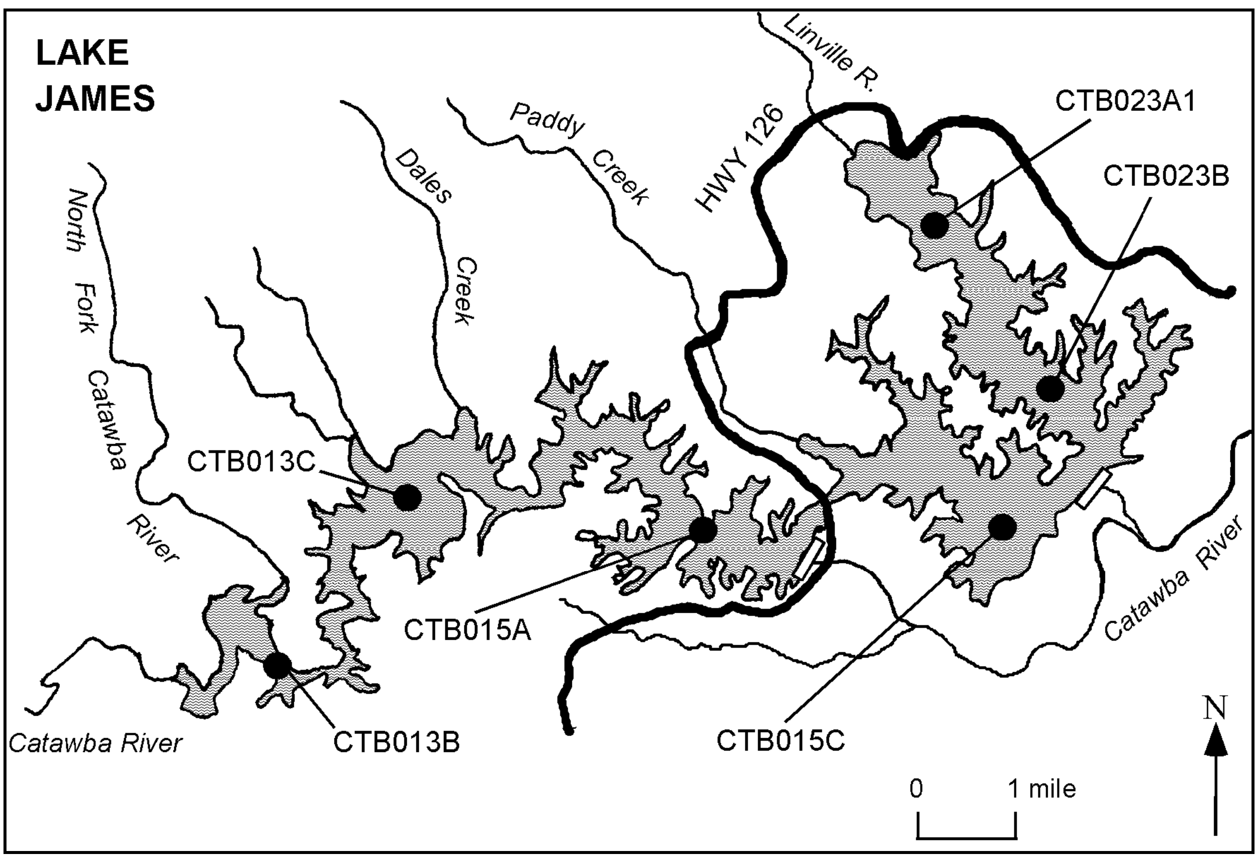


Figure 15. Sampling sites at Lake James, Burke County.

The reservoir was previously monitored in 1997. Nutrient concentrations were generally low to moderate with the exception of nitrite+nitrate, which was often elevated, particularly in June and July. The lowest Secchi depths and highest total phosphorus values were generally found at the sampling site at Station CTB013B. Surface metals were within applicable water quality standards. Algal Growth Potential Tests indicated phosphorus limitation at 5 of the 6 sites; Station CTB013B was nitrogen limited.

The reservoir is currently meeting all designated uses. However, increasing residential growth along the shoreline poses a threat to water quality. An increase in the number of lakefront homes with septic tanks and greater recreational boating activities are viewed as potentially damaging to the lake's water quality. The nuisance aquatic plant, *Hydrilla* was discovered in the Catawba River arm by Duke Energy in 1999. This plant has the potential of spreading rapidly throughout the lake, reducing available boating and swimming areas, and decreasing the lake’s aesthetic appearance. In 2002, 21,500 grass carp were stocked by the NC Wildlife Resources Commission stocked to control the spread of *Hydrilla.*

CATAWBA RIVER SUBBASIN 31

Description

This subbasin is located in the Northern Inner Piedmont ecoregion with only the highest, northwestern reaches in the Southern Crystalline Ridges and Mountain ecoregion (Griffith *et al* 2002). The Catawba River flows generally eastward with major tributaries such as Warrior Fork, Lower Creek, and the Johns River flowing south (Figure 16). Many headwater tributaries are designated as HQW and Wilson Creek has been designated ORW. Portions of this subbasin are within the Pisgah National Forest and approximately 85 percent of the subbasin is forested (Table 8). This is the second greatest percentage of any of the subbasins.

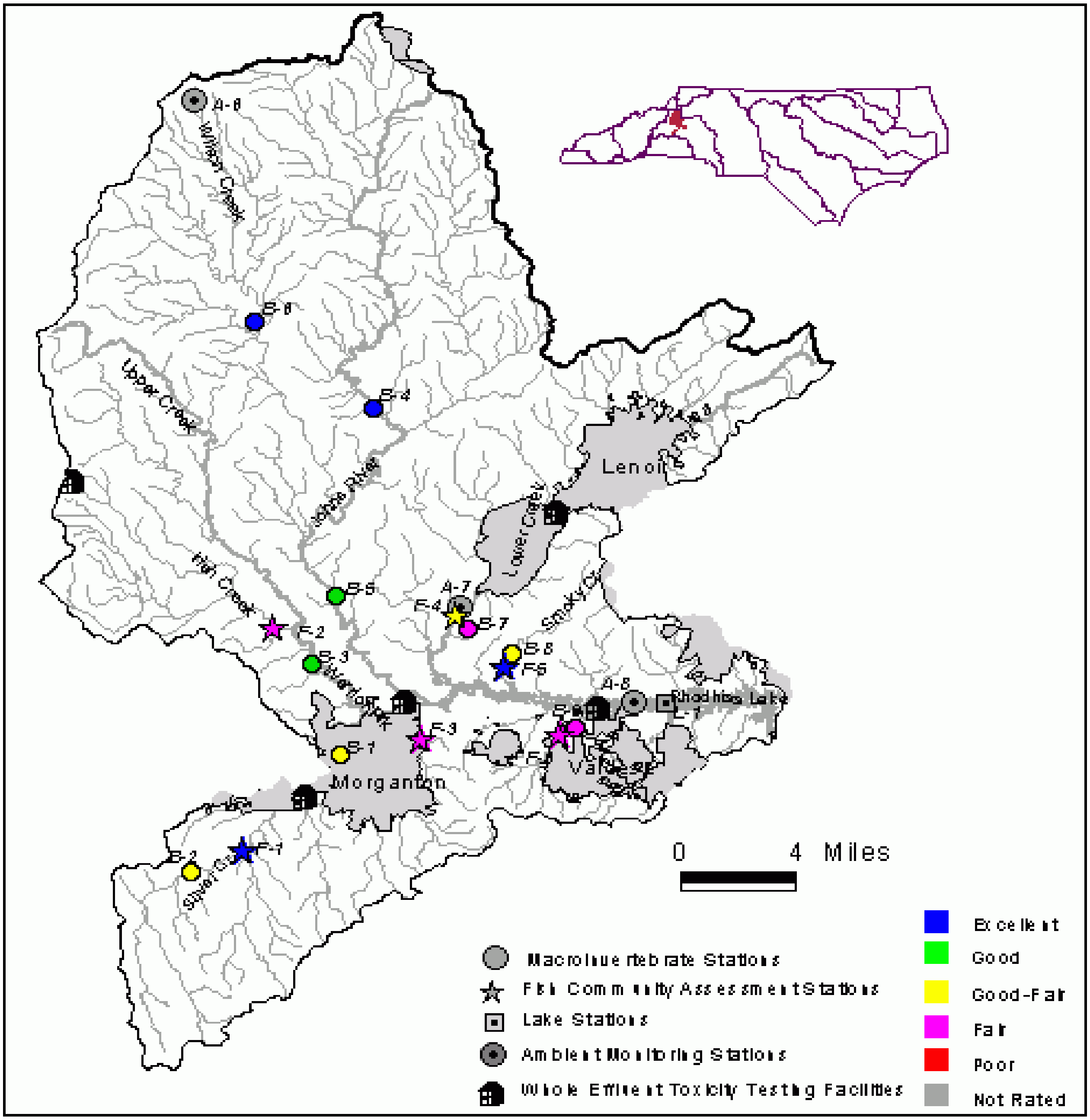


Figure 16. Sampling sites in Subbasin 31 in the Catawba River basin.

Table 8. Land use in Subbasin 31. Based upon CGIA coverage 1993 - 1995, total area = 581 square miles (NCDENR 1999).

Land use	Percent
Water	1
Cultivated crop	1
Pasture	10
Urban	3
Forest	85

The Johns River catchment also contains some high quality areas, but this area has widespread agricultural land use, especially cultivation of ornamental shrubs and trees. The cities of Morganton, Lenoir, Drexel, and Granite Falls are found in this subbasin. Urban development and runoff from Lenoir and Morganton have impacted several tributaries to the Catawba River in the southeastern potion of the subbasin.

Overview of Water Quality

There are three ambient monitoring sites in this subbasin: Lower Creek near Morganton, Wilson Creek near Gragg (a high elevation, headwater site), and Lake Rhodhiss. None of these sites represents typical water quality for this subbasin. Wilson Creek had many pH measurements less than 6.0 s.u. (18 percent) with one reading less than 5.0 s.u.. This pattern had not been observed at this site since the early 1990's and it suggested that similar low pH values may be occurring in other high elevation streams that drain forested catchments. Such areas have low buffering capacity and are most susceptible to acid precipitation.

The site on Lower Creek reflected the influence of various point and nonpoint source problems near the City of Lenoir: high turbidity (22 percent of the values greater than 50 NTU); high fecal coliforms (geometric mean = 253 colonies/100 ml); and elevated conductivity (median = 93 µmhos/cm). Samples from the site on Lake Rhodhiss often reflected algal bloom problems with elevated dissolved oxygen concentrations and pH values. The Catawba River near the City of Morganton was rated Good-Fair in 1997 and 2002 (Table 9). Some intolerant organisms were abundant at this site, but daily variations in flow, due to power generation at the upstream Lake James dam, affected the quality of the instream habitats. There seemed to be a decline in water quality between the Glen Alpine site (in Subbasin 30) and this site.

Many of the streams that originate in the Pisgah National Forest had Good or Excellent water quality ratings based on biological data. These streams included Johns River, Upper, Mulberry, and Wilson Creeks, Gragg Prong, and Warrior Fork (Table 9). Even though there is some recreational use and development in the upper sections of these creeks, there has been no substantial impairment of water quality. Wilson Creek supports an unusually large number of rare invertebrate species (Appendix 9).

Table 9. Waterbodies monitored in Subbasin 31 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
B-1	Catawba R[2]	Burke	NC 181	Good-Fair	Good-Fair
B-2	Silver Cr	Burke	SR 1149/SR 1127	Good-Fair	Good-Fair
B-3	Warrior Fk	Burke	SR 1440	Excellent	Good
B-4	Johns R	Caldwell	SR 1356	Excellent	Excellent
B-5	Johns R	Burke	SR 1438	---	Good
B-6	Wilson Cr	Caldwell	SR 1335/SR 1328	Excellent	Excellent
B-7	Lower Cr	Burke	SR 1501	Fair	Fair
B-8	Smoky Cr	Burke	SR 1515	Good	Good-Fair
B-9	McGalliard Cr	Burke	SR 1538	Good-Fair	Fair
F-1	Silver Cr	Burke	SR 1149	---	Excellent
F-2	Irish Cr	Burke	SR 1439	---	Fair
F-3	Hunting Cr	Burke	SR 1512	---	Fair
F-4	Lower Cr[2]	Burke	SR 1501	Good-Fair	Good-Fair
F-5	Smoky Cr[2]	Burke	SR 1515	---	Excellent
F-6	McGalliard Cr[2]	Burke	SR 1538	Good	Fair
L-1	Lake Rhodhiss	Burke, Caldwell			

[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites; L = lake assessment sites.
[2]Data are available prior to 1997, refer to Appendices 7 and 11.

The middle portion of this catchment has extensive areas used for the cultivation of ornamental shrubs and trees. While streams in this area usually still have good water quality, several sites have recently (2002) shown a decline from an Excellent to a Good bioclassification based on macroinvertebrate data: Warrior Fork and the lower section of the Johns River. It is not known if drought conditions contributed to this decline. A fish community sample from Irish Creek (a tributary of Warrior Fork) showed severe habitat problems and was rated Fair.

Where watersheds have become more developed around the cities of Morganton, Lenoir and Valdese, the stream bioclassifications were lower (Good-Fair or Fair). The physical characteristics of these streams has also changed. Lower, Silver, Hunting, and McGalliard Creeks had lower gradients and were much sandier than streams in the northern part of the subbasin. McGalliard Creek showed a decline in bioclassification between 1997 and 2002, based on fish and macroinvertebrates. An intensive survey of the Lower Creek catchment in 2002 documented problems for many streams around Lenoir.

Rhodhiss Lake has been sampled by DWQ since 1981. This lake is usually eutrophic although it was evaluated as mesotrophic in 1989 and 1997. Although there were high nutrient concentrations, algal blooms were often limited by the reservoir's short retention time. Drought conditions increased retention times and blooms of nuisance algae (especially blue-greens) were recorded in 2001 and 2002. Frequent blooms and percent dissolved oxygen saturation values greater than the water quality standard indicated the reservoir was impaired in its support of aquatic life. The presence of algae which create taste and odor problems in treated drinking water made it necessary for water treatment plants to use activated charcoal to make the water drinkable. Nutrient reductions may help to alleviate these problems.

Five facilities in this subbasin monitor effluent toxicity. The two largest municipal dischargers (Lenoir's WWTP, 6 MGD and Morganton's WWTP, 8 MGD) have experienced occasional failures over the last 10 years. Lenoir's facility failed about 25 percent of its self-monitoring toxicity tests between 1992 and 1999, but has passed all tests since 2000. Morganton's facility still tends to have about one failure per year, with the last documented problems in January 2002, April 2001, and January 2001.

River and Stream Assessment

Upper and Mulberry Creeks were not sampled for fish community assessment in 2002. Data had been collected as recently as 1999 and the communities have consistently been rated Excellent (Appendix 11). Upper Creek at SR 1439, Burke County, is within a reach designated as a Significant Natural Heritage Area (Oakley 2002).

Catawba River, NC 181
This portion of the Catawba River near Morganton was about 40 meters wide with a very sandy substrate. There was one area, however, of boulder and rubble downstream of the bridge. Flow in this part of the river is regulated by hydroelectric power generation at Lake James and flow may rise sharply during the day. During benthic sampling in 2002, there was no water in bank areas during the night and early morning, so this area was unsuitable for macroinvertebrates. Similar conditions were observed in 1997.

Riffle area in the Catawba River at NC 181, Burke County.

This site is only about seven miles downstream of site near Glen Alpine (SR 1147, Subbasin 30), but there were several important differences in habitat and water quality between these two locations. The Morganton site was sandier and it was also located downstream of the City of Morganton's WWTP (8 MGD). This facility is generally well run, but it had failed quarterly self-monitoring toxicity tests in January 2002, April 2001, and January 2001.

This site received a Good-Fair bioclassification in 2002 and 1997, although a Good rating had been assigned in 1992. Higher water levels in 1992 produced more bank-associated taxa (*Triaenodes*, *Oecetis*, and *Hexagenia*), so this decline was most likely related to flow alteration, rather than to any change in water quality. Low flow conditions, however, might affect water quality by providing less dilution for upstream dischargers.

Although taxa richness was low (46 in 2002), several intolerant taxa were abundant, including *Lepidostoma*, *Brachycentrus numerosus*, and *Pteronarcys*. Large numbers of a grazing snail, *Elimia,* may have acted to reduce the abundance of chironomid species.

Comparison with the Glen Alpine site suggested a decline in water quality between these two locations in 2002, with a decline in the abundance of *Acroneuria abnormis*, *Serratella serratoides*, *Micrasema wataga*, and *Glossosoma*.

Silver Creek, SR 1127
In 2002 the site on Silver Creek was moved upstream from SR 1149 to SR 1127 due to lack of flow at the downstream site. Collections from both sites have consistently yielded a Good-Fair bioclassification in three samples since 1992.

The new site was very similar to Canoe Creek (Subbasin 30). This portion of Silver Creek had a mean width of six meters, sandy substrate, and infrequent riffles. Leaf packs were the most important habitat for benthic macroinvertebrates, producing six stonefly taxa. Some small-stream species were recorded including *Eccoptura xanthenes* and *Diplectrona modesta*.

Silver Creek at SR 1127, Burke County.

Silver Creek, SR 1149
Silver Creek was sampled for the first time for fish community assessment in 2002. Draining southwestern Burke County, the watershed is bordered by Interstate 40 to the north and the South Mountains to the south. There are no NPDES facilities in the watershed above the sampling site. The stream is a tributary to the Catawba River near the City of Morganton.

Although this stream lacked cobble riffles, the woody debris in the current provided favorable habitat for three species of darters. The community was dominated by the greenhead shiner and was rated Excellent.

Upstream view of Silver Creek at SR 1149, Burke County.

Warrior Fork, SR 1440
Warrior Creek is a large stream (14 meters wide) with a sand-gravel substrate. Some rubble-

boulder substrate, however, was found near the bridge. This site is located in an area used to grow ornamental plants (nursery plants). Adjacent fields had a poor riparian buffer and the presence of dead plants suggested that herbicides had been used near the stream.

Rocky riffle area at the bridge in Warrior Fork at SR 1440, Burke County.

More typical sand-gravel riffle in Warrior Fork at SR 1440, Burke County.

The stream declined from Excellent in 1997 to Good in 2002; EPT S declined from 41 to 34. Many of the expected caddisfly taxa were reduced or absent in 2002, including *Brachycentrus numerosus*, *Micrasema wataga*, *Psychomyia nomada*, and *Lepidostoma*. Both Hydropsychidae and Baetidae were sparse in 2002, although Plecoptera were both abundant (three taxa) and diverse (six taxa).

Irish Creek, SR 1439

Irish Creek was sampled for the first time for fish community assessment in 2002. Draining central Burke County, Irish and Upper Creeks join to form Warrior Fork, a tributary to the Catawba River north of the City of Morganton. The valleys in this area of Burke County are used extensively for nursery tree propagation. Consequently, the streams' instream and riparian habitats suffer. At this locale, Irish Creek was deeply incised with easily erodible vertical banks and sandy substrate; the habitat score was 38 (Appendices 2 and 3).

Downstream view of Irish Creek at SR 1439, Burke County.

The fish community was rated Fair (NCIBI = 38). Although diverse, few fish were collected for a stream of its size in its ecoregion. Typical of many streams with habitats and water quality like Irish Creek, there was only species of darter present, the bluehead chub was dominant, and the percentage of diseased fish was high. The greenhead shiner was also absent; only one other stream in the upper Catawba River basin did not have this species (Lower Creek).

Hunting Creek, SR 1512

Hunting Creek was sampled for the first time for fish community assessment in 2002. This urban stream drains the southern and southeastern areas of the City of Morganton in central Burke County. There are no NPDES facilities in the watershed above the site near the stream's mouth. The stream is a tributary to the Catawba River just above Lake Rhodhiss.

At this locale, Hunting Creek has easily erodible vertical banks and a sandy substrate with no true rock riffles; the habitat score was 44 (Appendices 2 and 3).

Downstream view of clear water with a shallow, shifting sandy substrate at Hunting Creek at SR 1512, Burke County.

Similar to Irish Creek which also had poor instream habitats, the fish community was rated Fair (NCIBI = 38). There was an absence of intolerant species and piscivores, a low diversity and abundance of sunfish, and the percentage of diseased fish was high. The bluehead chub was the dominant species.

Johns River, SR 1356

The headwaters of the Johns River was similar to the Warrior Fork site in size (15 meters wide) and substrate (sand/gravel). As at Warrior Fork, some high quality rubble-boulder riffles were found within the sample reach. The surrounding area was largely residential, although nursery operations were present in this catchment. There was no evidence of excessive periphyton growths in contrast to the Johns River at SR 1438, although small patches of *Potamogeton diversifolius* occurred along the bank.

Johns River at SR 1536, Caldwell County.

This site has been consistently rated Excellent in three summer collections since 1992. Four-sample EPT S has ranged from 42 to 49. The low-flow conditions in 2002 affected the habitat (greater silt deposition) and the composition of the fauna. Slow water taxa became more abundant, especially *Neureclipsis* and *Stenacron pallidum*. Many intolerant taxa were common or abundant at this site. Unusual records included *Nixe* sp. (new species or very restricted distribution), *Rhithrogena*, *Ceraclea mentiea*, and *Helicopsyche*.

Johns River, SR 1438

This downstream site on the Johns River was added at the request of the DWQ's Planning Branch to examine the possible effects of local land use and increased sedimentation in a low-gradient portion of the river. This site was slightly larger (22 meters wide) than the upstream site at SR 1536, but retained the same types of habitats -- large areas of sand and gravel with some high-quality rubble riffles. The distance between the two sites is about 15 miles.

Riffle in the background on the Johns River at SR 1438, Burke County.

The Johns River at SR 1438 is located in an area with more agricultural land use particularly cultivation of nursery plants than the SR 1536 site. Runoff from these areas has resulted in enrichment in the lower river with abundant growth of filamentous algae (*Spirogyra*) and aquatic macrophytes (*Potamogeton diversifolius*).

***Spirogyra* growing atop the substrate in the Johns River at SR 1438, Burke County.**

This site was rated Excellent in 1983 and 1989, but Good in 2002. This pattern was similar to that observed at another watershed (Warrior Fork) used extensively for nursery plant cultivation.

Wilson Creek, off SR 1358

This new basinwide monitoring site was added as a reference site for the sites on the Johns River and Warrior Fork. A new site on Wilson Creek (off SR 1358 below Mortimer) was selected in 2002, because the upstream site at SR 1358 was too small to compare to the Johns River sites. The new site is comparable to the Wilson Creek site at SR 1335 sampled in 1997. Two portions of Wilson Creek are in the Pisgah National Forest (headwater areas and the Wilson Creek Gorge), but this new segment was located in an area of private land above the gorge that has been developed for residential and recreational uses.

Here the stream was 15 meters wide with very clear water and good rubble-boulder substrate. Specific conductance was 22 µmhos/cm. *Potamogeton* growth was abundant in areas of highest current speed and *Nostoc* was abundant in areas of slower current, especially on bedrock substrate. High numbers of a grazing snail (*Leptoxis*) kept periphyton growths at a very low level of abundance.

Wilson Creek off SR 1328, Caldwell County.

High EPT S (45) and a very low BI (3.3) confirmed extremely high water quality at this site. Many intolerant taxa were abundant including *Drunella allegheniensis*, *Lepidostoma*, *Micrasema wataga*, *M. rickeri*, *M. bennetti*, *Helicopsyche*, and *Ceraclea ancylus*. Other unusual taxa included *Setodes*, *Mystacides*, *Brachycercus*, *Acroneuria lycorias*, and *Paragnetina ichusa*. Some of the taxa recorded at this site were extremely rare, with some new species or new state records for North Carolina (Appendix 9).

Lower Creek, SR 1501

The watershed of Lower Creek includes the City of Lenoir and drains primarily the southwest portion of Caldwell County into the upper reaches of Lake Rhodhiss. Sampled near the lower part of its watershed in an agricultural valley, this was the largest watershed monitored for fish community assessments in 2002 (89.5 square miles). Potential impacts to this site include urban and agricultural nonpoint source runoff, the Lenoir's WWTP discharge (4.1 MGD), and a variety of smaller dischargers.

The 2002 fish community site was relocated about 200 yards above the 1997 site because of the existence of sand dipping operations above and below the bridge. A slightly wider riparian zone providing more shade to the stream was present further away from the bridge at the 2002 site. Livestock did not seem to have access to the stream in 2002 as they had in 1997. But, as in 1997, the water had a greenish, turbid cast to it.

Lack of a riparian zone towards the bridge at Lower Creek at SR 1501, Burke County.

The fish community was rated Good-Fair in 2002 and 1997 (NCIBI = 42 and 44, respectively). More species, total fish, species of suckers, and piscivores were collected in 2002 than in 1997. In 1997, only 49 fish were collected (the fewest fish of any site monitored that year) contrasted to 211 collected in 2002. However, these "gains' were offset by an absence of intolerant species, fewer insectivores, and a higher percentage of diseased fish in 2002 than in 1997. In 1997, two species (redbreast sunfish and bluegill sunfish) dominated the community; this contrasted to five species (tessellated darter, bluehead chub, redbreast sunfish, bluegill sunfish, and yellow perch) which constituted 73 percent of all the fish collected in 2002.

This site has been sampled for benthic macroinvertebrates six times since 1984, with a bioclassification of Fair for all invertebrate collections. The 2002 sample had the lowest EPT S, but this may have been influenced by the September collection and drought conditions. Specific conductance in 2002 (161 µmhos/cm) was over twice that observed in 1997 (60 µmhos/cm), suggesting greater influence of point source dischargers in 2002.

Although EPT S was lowest in 2002, there have been no significant changes in Total S, EPT N, or BI since 1992. Water quality appears to be relatively stable at this site over the last 10 years.

Smoky Creek, SR 1515

Smoky Creek was sampled for the first time for fish community assessment in 2002. This small stream (7.6 square mile drainage) is a tributary to Lake Rhodhiss and is classified as WS-IV C. There are no NPDES facilities within its watershed. At this crossing, the instream, riparian, and watershed characteristics qualified the site as a new regional reference site. One large sloughing bank near the upper end of the sampling reach may be contributing some of the orange clay turbidity and sediment observed at the site. This bank sloughing appeared natural and may have been caused by high flows.

Upstream view of Smoky Creek at SR 1515, Burke County.

The fish community was rated Excellent (NCIBI = 58).

By the time benthic macroinvertebrates samples were collected in 2002, the steam was small (five meters wide) and may have experienced extremely low flow during the drought. Many flow-dependent taxa (Philopotamidae, Hydropsychidae, and Baetidae) were reduced in abundance in 2002 relative to prior collections. This stream had extensive silt deposits in 2002, but there remained one good riffle area about 30 meters upstream of the bridge. Extensive periphyton growths were noted in 2002, often growing over the silt deposits.

Based upon benthic macroinvertebrates, the stream declined from Good in 1992 and 1997 to Good-Fair in 2002. Taxa that were lost were often cool-water mountain taxa (*Epeorus*, and *Symphitopsyche sparna*) which suggested warmer temperatures under low-flow conditions. Some moderately intolerant species (*Acroneuria*) remained abundant in all years, again indicating a drought-associated change in water quality.

McGalliard Creek, SR 1538

The watershed of McGalliard Creek drains an area dissected by Interstate 40, US 64/70, and includes the Town of Valdese. The stream is also a tributary to Lake Rhodhiss. Although there are no NPDES facilities within its watershed, the conductivity was elevated (107 µmhos/cm) due to urban run-off.

Upstream view of McGalliard Creek at SR 1538, Burke County.

The stream has been sampled for fish in every basin cycle – 1993, 1997, and 2002 (Figure 17). The ratings have varied from Fair to Good; in 2002 the community was rated Fair.

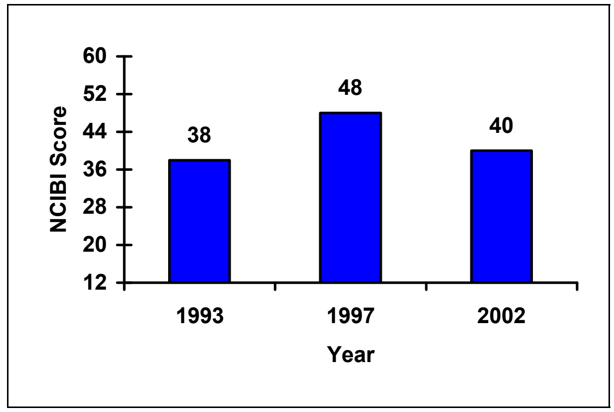


Figure 17. NCIBI scores from McGalliard Creek at SR 1538, Burke County, 1993 – 2002.

Contrasting 2002 to 1997 results, real declines were noted in the number of species (from 10 to 9), number of fish (from 165 to 143), and percentage of species with multiple age classes (from 60 to 44 percent); increases were noted in the percentage of tolerant fish (from 15 to 57 percent). This percentage of tolerant fish was greater in this stream than at any other site in the basin in 2002 (Appendix 12). This was because the redbreast sunfish increased in dominance from 15 percent of all the fish collected in 1997 to 55 percent in 2002. The greenhead shiner decreased from 31 percent in 1997 to 1.4 percent in 2002. No species of darters or intolerant species have ever been collected from McGalliard Creek.

McGalliard Creek and Smoky Creek are identical in terms of drainage area size and elevation. However, the land use, habitats, fish communities, and ratings were very different (Table 10 and Appendix 12).

Table 10. Comparisons of Smoky and McGalliard Creeks, Burke County, 2002.

	Waterbody	
Variable	Smoky Cr	McGalliard Cr
Land use	Rural	Suburban, urban
Habitat score	71	55
No. species	16	9
No. fish	277	143
No. darters	2	0
No. suckers	2	1
No. intolerant species	1	0
% tolerants	8	57
NCIBI score	58	40
NCIBI rating	Excellent	Fair

In 1963, when the NCWRC sampled McGalliard Creek, it was heavily polluted and creosote was observed floating atop the water (Louder 1964).

Only one fish, a creek chub, was collected and the stream was considered too polluted for fish reproduction. Although 10 additional species were collected in 1997 and 2002, there are two main obstacles preventing natural recolonization of the stream from downstream sources – Lake Rhodhiss and McGalliard Creek Falls. The falls is approximately 40 ft high (Figure 18). These two barriers essentially isolate the stream from any possible recolonization. Even though the stream was stocked in June 2001 and 2002 with 1,200 rainbow trout just above the falls for a fishing tournament (www.ci.valdese.nc.us/mcgalliard_falls.htm), this species probably did not survive for any extended length of time in the stream. The NCIBI ratings may never be greater than 50 (Good) if the stream is not colonized by two species of darter, an additional species of sucker, and at least one intolerant species.

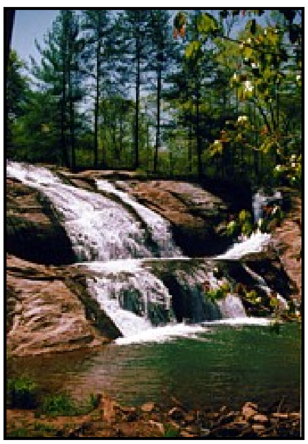


Figure 18. McGalliard Creek Falls at SR 1538, Burke County. Copyrighted photograph courtesy of the Town of Valdese.

By the time benthic macroinvertebrates samples were collected, this small stream may have experienced low-flow problems during the 2002 drought. The stream had poor habitat with very limited riffle area. The substrate was over 90 percent sand and silt. During benthic sampling conductivity was high at 144µmhos/cm, almost double the value recorded in 1992.

The invertebrate fauna was very sparse with only four abundant taxa and included some very tolerant taxa (*Baetis flavistriga* and *Hydropsyche betteni*). The rating declined from Good-Fair in 1992 and 1997 to Fair in 2002.

SPECIAL STUDIES

Lower Creek TMDL Development

Fifteen sites were sampled for benthic macroinvertebrates in the Lower Creek watershed during September 2002. Samples from Lower Creek produced a Poor rating for the most upstream site and Fair ratings for three downstream sites. Many of the tributary streams were too small to rate, but paired sites often showed "Not Impaired" headwater sites with a substantial decline in water quality downstream of urban areas. Although many streams had poor habitat, comparisons with other streams in this area suggested there were also significant water quality problems (Biological Assessment Unit Memorandum 20030319).

Fish Community Reference Streams

In 1998 and 1999, Gragg Prong Creek at SR 1367, Caldwell County, was evaluated as a regional fish community reference site. The fish community was rated Excellent (NCIBI = 56) (Biological Assessment Unit Memorandum 20000922). The stream will again become a basinwide monitoring site in 2007.

Fish Community Temporal Variability

The fish community in Upper Creek at SR 1439 and in Mulberry Creek at NC 90, Burke County, were sampled in April, June, and October 1999 to determine the temporal variability of the NCIBI during NC DWQ's traditional monitoring period. The communities were rated Excellent during each month (NCIBI range 54 - 60) despite a prolonged summer drought. It was determined that seasonality was not an important factor to consider when using the NCIBI to assess the fish community of a stream (Biological Assessment Unit Memorandum 20000922).

Lake Rhodhiss

Lake Rhodhiss, which is owned by Duke Energy, is located between Lake James and Lake Hickory on the Catawba River (Figure 19). This is a run-of-the-river reservoir has a mean hydraulic retention time of 21 days. Beside hydroelectric power production the reservoir is used as a water supply and for public recreation. Algal blooms in 2001 and public complaints of taste and odor problems in processed lake resulted in a special study to investigate the extent and nature of the algal blooms.

In 2001, surface dissolved oxygen and percent dissolved oxygen values were generally elevated from mid-lake at the Town of Valdese's water treatment plant (WTP) intake downstream to the dam. Surface pH values were also elevated which suggested elevated algal photosynthetic activity. Total phosphorus concentrations were moderately to extremely elevated at the upper end of the lake and ammonia was extremely elevated downstream of the City of Morganton's WWTP. Chlorophyll *a* values in 2001 ranged from low to moderate. Algal assemblages were dominated by two blue-green species, *Anabaena spiroides* and *Aphanizomenon flow-aquae*. These species are known to cause taste and odor problems in processed drinking water. To control this problem, the water treatment plants began using activated charcoal in 2001 as part of the water treatment process. Based on NCTSI scores, the lake was eutrophic in 2001 and 2002.

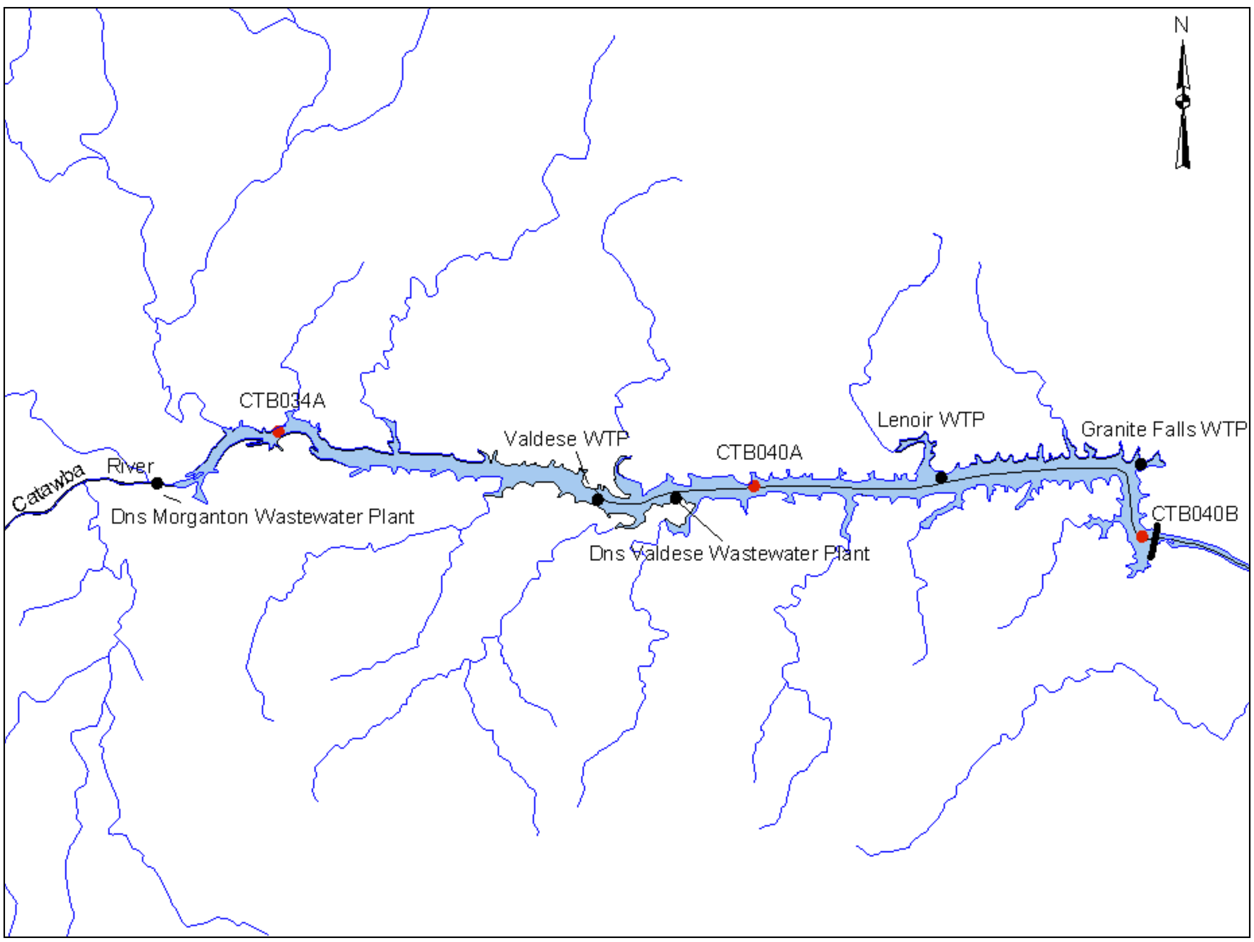


Figure 19. Sampling sites at Lake Rhodhiss, Burke and Caldwell Counties, 2001 and 2002.

In 2002, Secchi depths were generally less than one meter, with the shallowest depths observed at the upper end of the reservoir. Turbidity and total phosphorus values were also greater at the upper end of the lake (Appendix 16). Suspended sediment and wastewater discharge may have accounted for these observations. Increases in nutrient concentrations were observed from May to August. Chlorophyll *a* values ranged from low to elevated. In May, chlorophyll *a* values from the City of Granite Falls' Water Treatment Plant intake to Station CTB040B (44 and 50 µg/L, respectively) were greater than the water quality standard (40 µg/L). Algal assemblages in May were dominated by unicellular green alga (*Golenkina* sp.) and a filamentous blue-green alga (*Anabaena* sp.).

The availability of nutrients may have increased algal productivity as suggested by elevated surface dissolved oxygen and pH values in May and July. Surface percent dissolved oxygen was frequently greater than the water quality standard (110 percent for dissolved gasses) in these months with the greatest values (169 percent) observed at Station CTB040B and near the Granite Falls Water Treatment Plant intake. In August, surface dissolved oxygen values decreased significantly and the value near the Granite Falls Water Treatment Plant intake (3.6 mg/L) was less than the water quality standard (4.0 mg/L for an instantaneous reading). This drastic change in dissolved oxygen concentrations may have been due to light limitation. Field notes indicated the sky was overcast on the August sampling date. The decrease in sunlight may have reduced algae photosynthesis such that low dissolved oxygen levels, which usually occur in highly productive lakes at night due to oxygen uptake by algae, did not fully recover by the following day.

This reservoir was previously sampled in 1997. Surface dissolved oxygen was consistently elevated at Station CTB040B and percent oxygen saturation at the mid-lake and dam sites were consistently supersaturated. Secchi depths of less than one meter were observed near the dam in June and at Station CTB034A in August. The greatest total phosphorus value (0.07 mg/L) was also measured at this site in August. Ammonia values were greatest at this site on each of the three days the reservoir was sampled.

Frequent algal blooms and percent dissolved oxygen saturation values greater than the water quality standard indicated the reservoir is impaired in its support of aquatic life. The presence of algae which create taste and odor problems in treated drinking water has made it necessary for the water treatment plants to use activated charcoal to make the water drinkable. Nutrient reductions may help to alleviate these problems.

CATAWBA RIVER SUBBASIN 32

Description

This subbasin is located in the Northern Inner Piedmont and Southern Outer Piedmont ecoregions with the extreme northwestern headwaters of several streams in the Eastern Blue Ridge Foothills ecoregion (Griffith *et al* 2002) (Figure 20). The southeastern portion of this subbasin (east of the Lower Little River and south of the Catawba River) is flatter and more characteristic of Piedmont areas than the northern section.

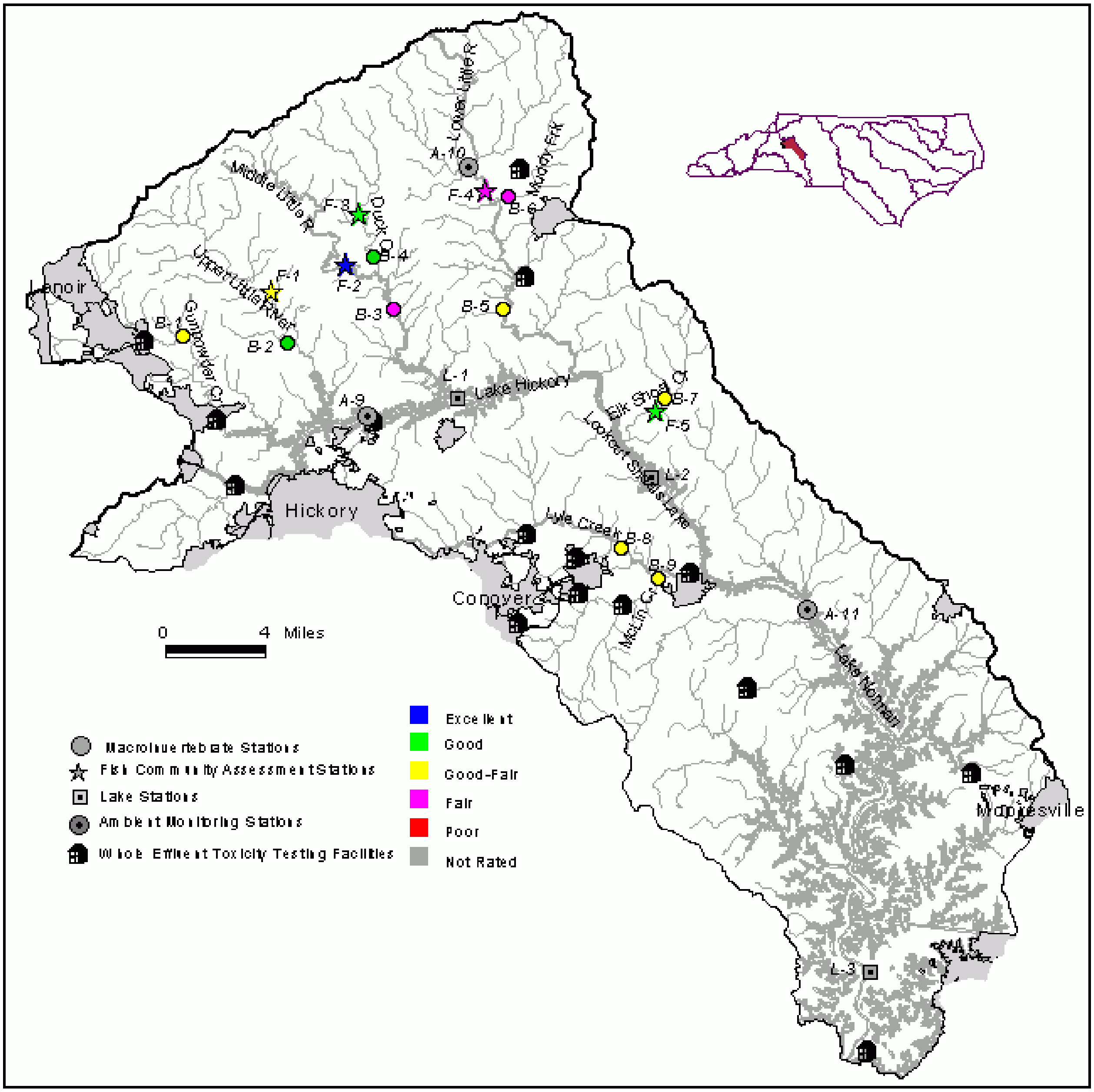


Figure 20. Sampling sites in Subbasin 32 in the Catawba River basin.

Highly erodible soils and moderate gradients contribute large amounts of sediment in the Little River watershed. However, a majority of the subbasin remains forested (Table 11). Major reservoirs in this subbasin include Lakes Hickory and Norman and Lookout Shoals Lake. Because of these impoundments, a greater percentage of this subbasin is classified as water than any of the other subbasins.

Table 11. Land use in Subbasin 32. Based upon CGIA coverage 1993 - 1995, total area = 706 square miles (NCDENR 1999).

Land use	Percent
Water	9
Cultivated crop	3
Pasture	31
Urban	3
Forest	54

This subbasin contains portions of the cities of Hickory, Conover, and Newton, although most dischargers from these cities are located in Subbasin 35.

Overview of Water Quality

There are three ambient monitoring sites in this subbasin: two on Lakes Hickory and Norman and one the Lower Little River. There were few unusual measurements at the two lake sites, although high algal production sometimes produced high dissolved oxygen concentrations and pH readings. The Lower Little River had elevated fecal coliforms (geometric mean = 200 colonies/100 ml) and high turbidity after rainfall events (10 percent of the values were greater than 25 NTU).

Recent biological data (fish and benthic macroinvertebrates) produced Good or Good-Fair ratings for most monitored streams in this subbasin (Table 12). However, a Fair macroinvertebrate rating was recorded for a section of Middle Little River and for Muddy Fork. Fish data also produced a Fair rating for a section of the Lower Little River. The benthic Fair rating for the Middle Little River seemed to be due to low flow in 2002 and did not represent a significant water quality problem. This finding was reinforced by the Excellent fish community rating given to the river. Muddy Fork, however, showed signs of organic loading from nearby animal operations. The cause of the Fair rating (fish data) for the headwaters of the Lower Little River (above the Town of Taylorsville WWTP) was unknown, although a sand-dipping operation was noted just above the sampling reach.

Table 12. Waterbodies monitored in Subbasin 32 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
B-1	Gunpowder Cr	Caldwell	SR 1718 (SR 1002)	Good-Fair	Good-Fair
B-2	Upper Little R[2]	Caldwell	SR 1740	Good	Good
B-3	Middle Little R[2]	Alexander	SR 1153	Good-Fair	Fair
B-4	Duck Cr[2]	Alexander	NC 127	Good-Fair	Good
B-5	Lower Little R[2]	Alexander	SR 1131	Good	Good-Fair
B-6	Muddy Fk	Alexander	SR 1313	Good-Fair	Fair
B-7	Elk Shoal Cr[2]	Alexander	SR 1605	Good-Fair	Good-Fair
B-8	Lyle Cr[2]	Catawba	US 64/70	Good-Fair	Good-Fair
B-9	McLin Cr	Catawba	SR 1722	Good-Fair	Good-Fair
F-1	Upper Little R	Caldwell	SR 1786	---	Good-Fair
F-2	Middle Little R[2]	Alexander	SR 1002	Good	Excellent
F-3	Duck Cr[2]	Alexander	NC 90	Good	Good
F-4	Lower Little R[2]	Alexander	SR 1318	Good	Fair
F-5	Elk Shoal Cr[2]	Alexander	SR 1605	Excellent	Good
L-1	Lake Hickory	Catawba, Alexander			
L-2	Lookout Shoals Lake	Catawba, Alexander, Iredell			
L-3	Lake Norman	Lincoln, Mecklenburg			

[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites; L = lake assessment sites.
[2]Data are available prior to 1997, refer to Appendices 7 and 11.

Based upon benthic macroinvertebrate data, water quality was fairly stable in this subbasin. The majority of the between year changes in ratings were associated with between-year changes in flow. These changes fell into three categories:

1) Streams where drought conditions resulted in loss of flow. These streams showed a decline during the extreme drought. Example: Middle Little River.
2) Streams which maintained flow under drought conditions and were influenced mainly by nonpoint source pollution. These streams improved under drought conditions due to a reduction in nonpoint source runoff. Example: Duck Creek.
3) Streams influenced by point source dischargers. These streams declined under drought conditions due to higher instream waste concentrations. Example: the downstream segment of the Lower Little River below the Town of Taylorsville.

Lake Hickory has been sampled by DWQ since 1981. This reservoir was consistently evaluated as eutrophic from 1981 to 1992. Since then, however, the reservoir has been most frequently evaluated as mesotrophic. High productivity was indicated in August 2002, but no algal blooms were observed.

Lookout Shoals Lake is a small run-of-the-river lake with a retention time of only nine days. It has been sampled by DWQ since 1981 and the trophic state has fluctuated from oligotrophic to eutrophic depending on the nutrient loading and flows. The reservoir's water quality is thought to be more reflective of releases from upstream impoundments than conditions in the immediate, surrounding watershed.

Lake Norman is the state's largest reservoir. It has been monitored by Duke Energy since the 1970's and by DWQ since 1981. The reservoir has consistently been evaluated as oligotrophic with low nutrient values and low algal production. *Hydrilla*, a nuisance aquatic plant, was found in the reservoir. This macrophyte is invasive, can decrease fish habitat, and can impact recreational activities such as swimming and boating. It also has the potential of clogging intakes of water treatment plants. In an effort to manage its growth, Duke Energy treated the infestation with an herbicide.

Another nuisance aquatic plant, *Myriophyllum aquaticum,* infested the upper ends of Lakes Hickory and Lookout Shoals. This plant can interfere with recreational and industrial uses of the lakes. Lookout Shoals Lake was drawn down in the Fall of 2002 in an attempt to control the spread of this plant. Due to the degree of infestation, the designated uses at the upper end of this reservoir are considered impaired.

Sixteen facilities monitor effluent toxicity, some having multiple discharges. Four dischargers had problems with toxicity, although three were very small dischargers with a permitted flow less than 0.02 MGD. This group of discharges was associated with either groundwater remediation or contact cooling water. Problems with Schneider Mills (permitted flow = 0.8 MGD) seemed to be associated with an extended illness of the plant operator. There have been no failures at the facility since April 2000.

River and Stream Assessment

Lyle and Buffalo Shoals Creeks were not sampled for fish community assessments in 2002 because no changes were expected in the two communities. The streams had been rated Excellent (Buffalo Shoals Creek in 1997) or Good (Lyle Creek in 1993 and 1997) (Appendix 11). Lyle Creek at US 70 is at the end of the Lyle Creek Corridor – a Significant Natural Heritage Area (Rossell 2002). Four of the five fish community sites in this subbasin have been sampled in every basinwide monitoring cycle beginning in 1993.

Gunpowder Creek, SR 1718

The 1997 benthos sample was taken from a downstream location at SR 1002. No flow was observed at this site in 2002 and this low gradient section (just above an old mill pond) may have atypical habitats. Collections in 2002 were taken at the next upstream location at SR 1718.

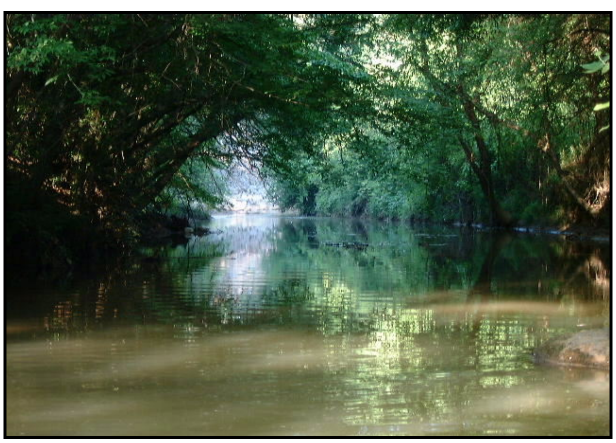
Substrate for this seven meter wide stream was over 90 percent sand and silt with a single rocky riffle near the bridge. Most of the stream was a uniform shallow and sandy run. Specific conductance was elevated at 158 µmhos/cm, probably reflecting the upstream discharge from the City of Lenoir's WWTP (2 MGD).

Uniform sandy run habitat and very low flow at Gunpowder Creek at SR 1718, Caldwell County.

This site was rated Good-Fair in 2002, similar to results from the SR 1002 location in 1997. Water quality problems were evident from the lack of any abundant stonefly taxa, no philopotamid caddisflies, and the abundance of the very tolerant caddisfly, *Hydropsyche betteni*.

Upper Little River, SR 1786

The Upper Little River was sampled for the first time for fish community assessment in 2002. This stream is a tributary to Lake Hickory and drains the southwest portion of the Brushy Mountains and eastern Caldwell County. Despite the flow being only 36 percent of the median flow during mid-May 2002, the water was turbid. Anecdotally, a sand dipping operation was reported to be active much further upstream beyond the fish community sampling reach.



Upstream view of the Upper Little River at SR 1786, Caldwell County.

The fish community was rated Good-Fair with only one species of darter and sunfish present, no intolerant species, and no piscivores. The dominant species was the rosyside dace; 41 percent of all the fish collected were this species.

Upper Little River, SR 1740

The Upper Little River at SR 1740 is a large stream (13 meters wide) with an unusually rocky substrate. This substrate probably reflected local granitic geology. It had rained just before the 2002 benthic macroinvertebrate collection and the stream was very turbid. This site had a higher habitat score (78) than many of the sandy streams in this subbasin, but the pools were filled-in with sediment.

Upper Little River at SR 1740, Caldwell County.

This site received a Good bioclassification for all three collections from 1992 to 2002, but showed a slight change in the benthic community between 1997 and 2002. Over this time period, EPT S declined from 39 to 33, while the BI increased from 4.3 to 4.9. These changes generally reflected the loss of more intolerant taxa, including *Serratella deficiens*, *Lepidostoma*, and *Micrasema wataga*. Some intolerant species, however, remained abundant at this site, notably *Serratella serratoides* and *Chimarra*.

Middle Little River, SR 1002

The watershed of the Middle Little River drains western Alexander and eastern Caldwell counties, including the southwest portion of the Brushy Mountains. There are no NPDES facilities in this tributary to Lake Hickory and the conductivity is low for a piedmont stream (31 µmhos/cm). The stream is a fish community regional reference site.

Wooded bluff along the Middle Little River at SR 1002, Alexander County.

The stream has been sampled for fish in every basin cycle – 1993, 1997, and 2002 (Figure 21). The ratings have increased from Good-Fair to Excellent. The slight increase in score in 2002 was attributed to the collection of largemouth bass, a species absent in 1993 and 1997. The dominant species in 2002 was the rosyside dace.

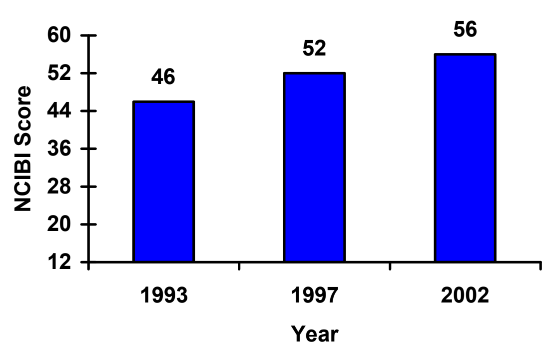


Figure 21. NCIBI scores from the Middle Little River at SR 1002, Alexander County, 1993 – 2002.

Middle Little River, SR 1153

The Middle Little River had very poor habitat -- no riffles, severe bank erosion, and a uniform sandy run habitat. All three collections from this site have shown that the substrate is almost 100 percent sand and silt.

Middle Little River at SR 1153, Alexander County. Shallow sandy segment (typical) in background.

Bank erosion along the Middle Little River at SR 1153, Alexander County.

This site has shown a steady decline in bioclassification over the past 10 years: Good in 1992, Good-Fair in 1997, and Fair in 2002. Many of the taxa that disappeared in 2002, however, were flow-dependent, especially several Hydropsychidae. Some intolerant taxa were still common or abundant at this site in 2002 (*Acroneuria abnormis*, *Pteronarcys*, and *Brachycentrus nigrosoma*), supporting the idea that the most recent decline in bioclassification was an effect of the drought. This hypothesis is also supported by the improvement in EPT BI over the 10 year period (Figure 22).

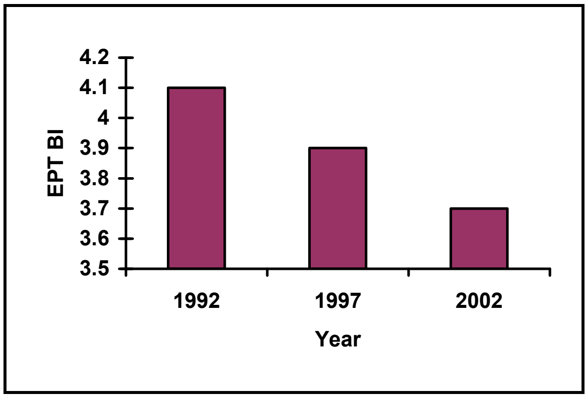


Figure 22. EPT Biotic Index (EPT BI) at the Middle Little River at SR 1153, Alexander County.

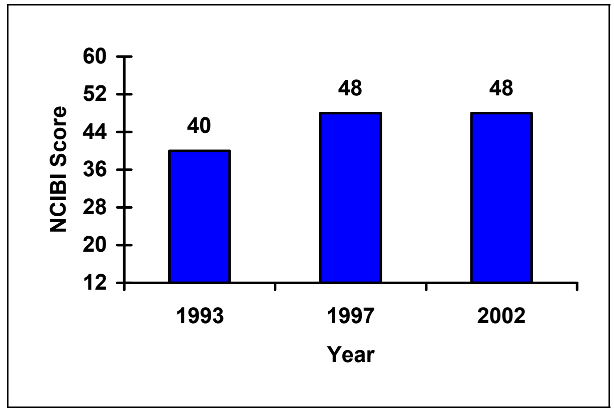


Figure 23. NCIBI scores from Duck Creek at NC 90, Alexander County, 1993 – 2002.

Duck Creek, NC 90

The watershed of Duck Creek drains the northeast portion of the Brushy Mountains in western Alexander and eastern Caldwell counties. There are no NPDES facilities in this tributary to the Middle Little River. In 2002, it appeared that cattle no longer had access to the stream and habitats were much better than in 1997 (Appendices 3 and 4).

Duck Creek at NC 90, Alexander County.

The stream has been sampled for fish in every basin cycle – 1993, 1997, and 2002 (Figure 23). The ratings have increased from Fair in 1993 to Good in 1997 and 2002. Due to the low flow conditions, more fish were collected at this site than at any of the other sites in the basin in 2002. (n = 1,666). This represented a four-fold increase over the number of fish collected in 1997. Three species (out of 10), greenhead shiner, bluehead chub, and rosyside dace constituted 83 percent of all the fish collected in 2002.

Duck Creek, NC 127

Duck Creek is near the Upper Little River site (at SR 1740), and appeared to share the same geologic characteristics. Duck Creek had an unusually rocky substrate for this subbasin and a high habitat score (83). There were large amounts of bedrock in this portion of the stream.

Duck Creek at NC 127, Alexander County.

EPT S increased from 26 and 27 in 1992 and 1997 to 33 in 2002. Bioclassification also showed an increase over the same time period from Good-Fair to Good. This is the expected change for a stream that can maintain flow under drought conditions, but is slightly affected by nonpoint source runoff. Changes in the fauna also suggested that this stream was warmer in 1997 and 2002 than in 1992. Several cool-water taxa were lost in the later collections, notably *Epeorus rubidus*.

Lower Little River, SR 1318
This stream's watershed drains the northeast portion of the Brushy Mountains and northwestern Alexander County, northwest of the Town of Taylorsville. It is a tributary to Lookout Shoals Reservoir. In 2002, a new sand dipping operation was functional above the sampling reach.

Lower Little River at SR 1318, Alexander County.

The stream has been sampled for fish in every basin cycle – 1993, 1997, and 2002 (Figure 24). The ratings have ranged from Poor to Good; in 2002 the community was rated Fair. The 10-point decline between 1997 and 2002 was attributed to decreases in the diversities of sunfish and suckers, an absence of piscivores, and a slight increase in the percentage of omnivores+ herbivores. Only one specimen of one species of darter was present in 2002. The bluehead chub increased in dominance from 45 to 52 percent between 1997 and 2002.

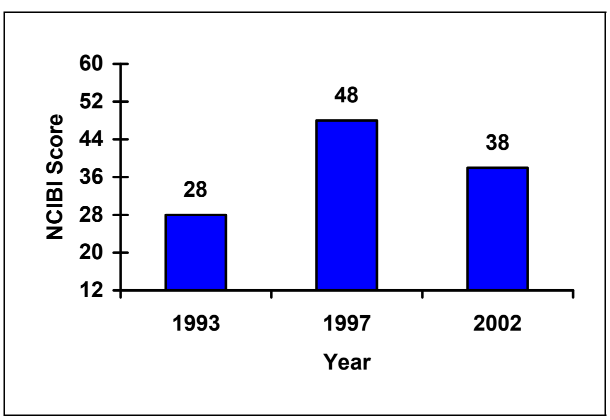


Figure 24. NCIBI scores from the Lower Little River at SR 1318, Alexander County, 1993 – 2002.

Lower Little River, SR 1131
The Lower Little River is a medium-sized stream (11 meters wide) with some rocky riffle areas. It was probably large enough to maintain flow throughout 2002. The site at SR 1131 had good habitats, although there was silt deposited in pool areas. Specific conductance almost doubled between 1997 and 2002 (45 and 86 µmhos/cm, respectively) probably reflecting the influence of the Town of Taylorsville's WWTP (0.8 MGD) under low flow conditions in 2002.

This site declined from Good in 1992 and 1997 to Good-Fair in 2002. Significant losses included all stoneflies (although this group was only common in prior collections), *Serratella deficiens*, and *Elimia*. These losses were offset by the appearance in 2002 of *Heterocloeon curiosum*, *Tricorythodes*, *Brachycentrus nigrosoma*, and *Ceraclea ancylus*. All of these latter taxa were abundant in 2002, but rare or absent in prior collections. This pattern suggested that only minor between-year changes have occurred in the invertebrate fauna of the Lower Little River.

Muddy Fork, SR 1313
Muddy Fork had very poor habitat, generally lacking riffles and pools. Bridge rubble produced a single riffle at the road crossing; other segments of this stream consisted of shallow and sandy runs; good leaves and root mats were present. The immediate riparian zones were used for cattle grazing and cattle had direct access to the stream above SR 1313.

Riffle at bridge in Muddy Fork at SR 1438, Alexander County.

Typical shallow sandy areas in Muddy Fork at SR 1438, Alexander County.

Bryozoan colonies were abundant under most rocks, generally a sign of low dissolved oxygen levels. The benthic macroinvertebrate fauna suggested inputs of organic particulates, with large numbers of the tolerant filter-feeders, *Hydropsyche betteni*. This species was the only abundant EPT taxon, although field notes indicated that isopods and midges were abundant.

The stream declined from Good-Fair in 1997 to Fair in 2002. This change was marked by a sharp decline in EPT S (from 22 to 12) and an increase in the EPT BI (from 5.4 to 6.0). Although low flow may have contributed to the decline observed at this site in 2002, similar declines were not observed for most of the other small streams in this subbasin. Problems seemed to be caused by organic loading, possibly from cattle wastes.

Elk Shoal Creek, SR 1605

The watershed of Elk Shoal Creek drains southeastern Alexander County before emptying into the upper region of Lake Norman. There are no NPDES facilities in this primarily agricultural watershed. Cattle which had been fenced out of the stream in 1997 once again had access in 2002. This shallow stream carries a heavy sediment load.

Elk Shoal Creek at SR 1605, Alexander County.

The stream has been sampled for fish in every basin cycle – 1993, 1997, and 2002 (Figure 25). The ratings have ranged from Good to Excellent; in 2002 the community was again rated Good.

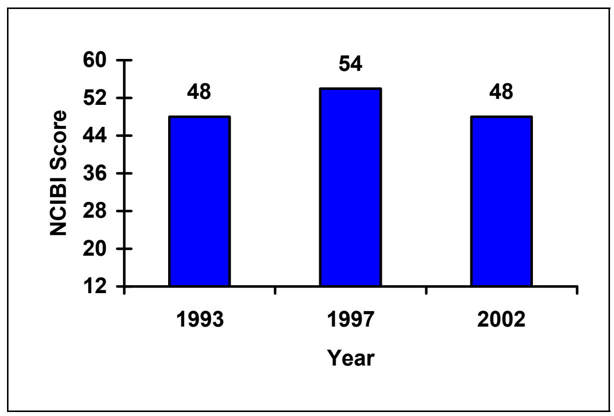


Figure 25. NCIBI scores from Elk Shoal Creek at SR 1605, Alexander County, 1993 – 2002.

Similar to the community in the Lower Little River, the 6-point decline between 1997 and 2002 was attributed to decreases in total species and sunfish diversities and an absence of piscivores. The bluehead chub decreased in abundance from 34 to 17 percent while the rosyside dace increased from 12 to 35 percent of all the fish collected. These shifts slightly improved the trophic structure of the community.

By the time benthic macroinvertebrates samples were collected, this stream was very small with a width of only one to two meters at the bridge. Average width, however, was about four meters in more typical portions of the stream.

Elk Shoal Creek at SR 1605, Alexander County during benthic macroinvertebrate sampling in 2002.

Using piedmont benthic macroinvertebrate criteria, this stream has consistently been rated Good-Fair rating. EPT S has varied between 15 and 18 over three collections between 1992 and 2002. Intolerant invertebrate species are rare at this site, and were usually absent under the low-flow conditions seen in 2002.

Lyle Creek, US 64/70

Lyle Creek is a sandy, medium-size stream (nine meters wide) with a rubble substrate only near the bridge. Sampling in 2002 followed heavy rainfall, so the stream was very turbid.

Lyle Creek at US 64/70, Catawba County. Note turbidity following a rain event and the only rubble area in the background.

EPT S has been stable (22 or 23 taxa) over from 1992 to 2002 . The stream has consistently been rated Good-Fair. Water quality problems were indicated by the lack of philopotamid caddisflies and the lack of any abundant stoneflies.

McLin Creek, SR 1722

McLin Creek has a good riparian buffer at this site, but the channel is filled in with sediment and there are many areas of severe bank erosion. Although the substrate is mainly sand and gravel, there were some rubble riffles, plus good root and leafpack habitats.

McLin Creek at SR 1722, Caldwell County.

This site had a Good-Fair rating in 1997 and 2002. Like Lyle Creek, some water quality problems were evident in the lack of philopotamid caddisflies and the scarcity of stoneflies. This small stream (four meters wide) may have been affected by low summer flows. Most flow-dependent taxa were reduced in abundance in 2002, especially Baetidae and Hydropsychidae.

SPECIAL STUDY

Horseford Creek

In response to a citizen complaint, a benthic macroinvertebrate sample was collected in September 2002 from Horseford Creek in the City of Hickory. This stream had good habitat, but water quality problems associated with urban runoff produced a Poor bioclassification (Biological Assessment Unit Memorandum 20030326).

Lake Assessment

Lake Hickory

Lake Hickory is a run-of-the-river impoundment located between Lake Rhodhiss and Lookout Shoals Lake on the Catawba River (Figure 26). The lake is owned by Duke Energy and is used to generate hydroelectric power; public recreation is a secondary use. There are several municipal wastewater dischargers located in the reservoir's immediate watershed. These discharges, as well as nonpoint source pollution, have contributed to the eutrophic conditions observed over the years.

The reservoir was most recently monitored in 2002. Surface dissolved oxygen and pH values were elevated in May and surface percent dissolved oxygen saturations (~ 115 percent) were greater than the water quality standard (110 percent for dissolved gasses). These values suggested the possibility of an algal bloom. Chlorophyll *a* values ranged from moderate to elevated, but were not greater than the water quality standard (40 µg/L). Chlorophyll *a* concentrations at Station CTB048A were consistently greater than those at the other three sites (Appendix 16). Surface metals were within applicable water quality standards. Based on the NCTSI scores, the reservoir was mesotrophic in May and July and eutrophic in August.

The Town of Hickory experienced taste and odor problems in their drinking water in 2002. Algal samples in May indicated the presence of filamentous blue-green algae, which may have contributed to the problems. Since elevated densities of blue-green algae were also present in Lake Rhodhiss, the problem persisted until the algae died back in both reservoirs.

Duke Energy staff sampled the reservoir for DWQ in 1997. Surface dissolved oxygen was consistently greater than 9.0 mg/L at Station CTB056A. In July, surface percent dissolved oxygen saturation ranged from 111 to 124 percent throughout the reservoir and in August was approximately 115 percent from Station CTB056A to Station CTB058D. Secchi depth was consistently lowest, and nutrient values were generally greatest, at the most upstream site (Station CTB048A). Trophic conditions in 1997 were similar to those observed in previous years.

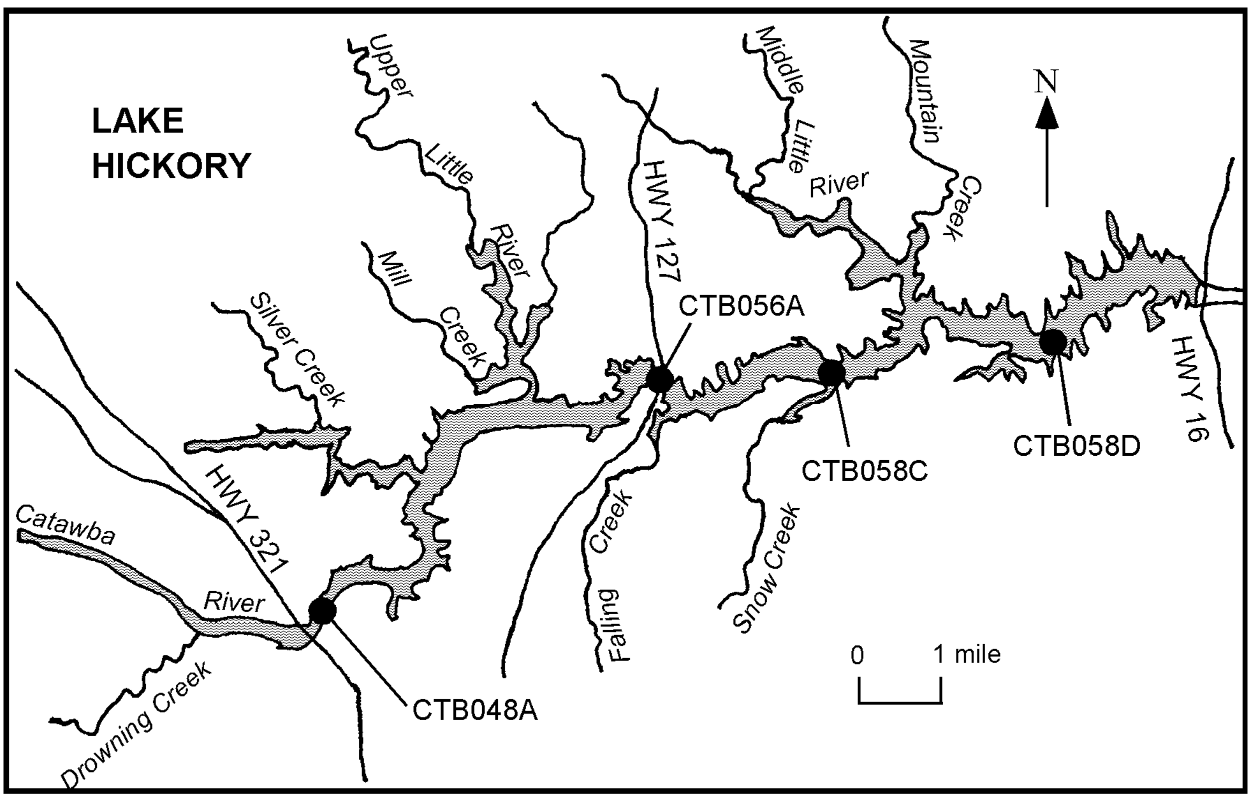


Figure 26. **Sampling Sites at Lake Hickory, Alexander and Catawba counties.**

In 2001, Duke Energy staff discovered Parrot Feather, *Myriophyllum aquaticum*, an invasive aquatic macrophyte, in the reservoir. Since 2001, the original 10 acre infestation has spread to 84 acres near the NC 321 bridge. Two drinking water intakes are located nearby and have the potential of becoming clogged by this plant. Businesses which rely on water-based recreation are also concerned because the infestation can make boating and swimming impossible. Duke Energy along with stakeholders and DWQ will work to develop and implement a Parrot Feather management program for the reservoir.

Lookout Shoals Lake

Lookout Shoals Lake, situated between Lakes Hickory and Norman, is one of the smaller Catawba River Chain of Lakes (Figure 27). The lake is owned by Duke Energy and is used to generate hydroelectric power; public recreation is a secondary use. The lake's water quality is more reflective of releases from upstream impoundments (Lakes Hickory, Rhodhiss, and James) than conditions in the immediate watershed.

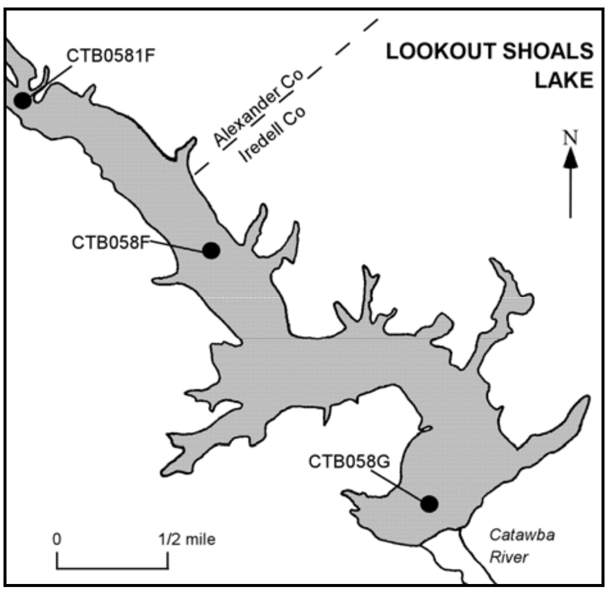


Figure 27. Sampling sites at Lookout Shoals Lake, Alexander, Catawba, and Iredell Counties.

The reservoir was most recently monitored in 2002. Trophic conditions ranged from oligotrophic in June to mesotrophic in July and August. Historically, the lake has been borderline eutrophic. Total phosphorus and chlorophyll *a* values were lower in 2002 and Secchi depths were greater than those in previous years. This might have resulted from the drought and reduced nonpoint source runoff which had influenced the trophic conditions in previous years. Surface metals in 2002 were within applicable water quality standards.

The reservoir was also monitored in 1997. Surface dissolved oxygen was consistently elevated at the most downstream site (Station CTB058G) which suggested increased photosynthetic activity (Appendix 16). Nutrient concentrations were generally similar to those observed in previous years with the exception of ammonia, which was elevated at the upper end of the lake in June and July. Zinc (70 µg/L) and copper (9.7 µg/L) concentrations at Station CTB058G in July were greater than the applicable water quality action levels for these metals. In 2002 all metal concentrations were less than the water quality standards or action levels.

In 2002 the upper end of the lake was infested with *Myriophyllum aquaticum*, the same species that is thriving in Lake Hickory (Figure 28). Low surface dissolved oxygen concentrations at this site in June (4.6 mg/L) may have resulted from the hypolimnetic release from Lake Hickory and/or biological activity associated with this macrophyte.

Figure 28. Parrot feather infestation in the upper end of Lookout Shoals Lake (photograph courtesy of Kenneth Manuel, DPC).

To control the spread of Parrot Feather, Duke Energy drew down the water level to a target of 20 feet below full pool in November 2002. But due to rainfall in December, the water level rose to 14.3 feet below full pool in early January 2003. The pool level was brought to its normal operation level of three feet below full pool by February 2003 to accommodate annual fish spawning. Thus the efficacy of the draw down will probably be minor.

The uses of Lookout Shoals Lake at the upper end of the reservoir where Parrot Feather has become established are impaired. The remainder of the lake fully supports its designated uses.

Lake Norman

Lake Norman, the state's largest man-made reservoir, is located between Lookout Shoals and Mountain Island Lakes on the Catawba River (Figure 29). The lake is owned by Duke Energy and is used to generate hydroelectric power at Cowans Ford Dam and for multiple purposes at the Marshall Steam Station and the McGuire Nuclear Plant; public recreation is a secondary use.

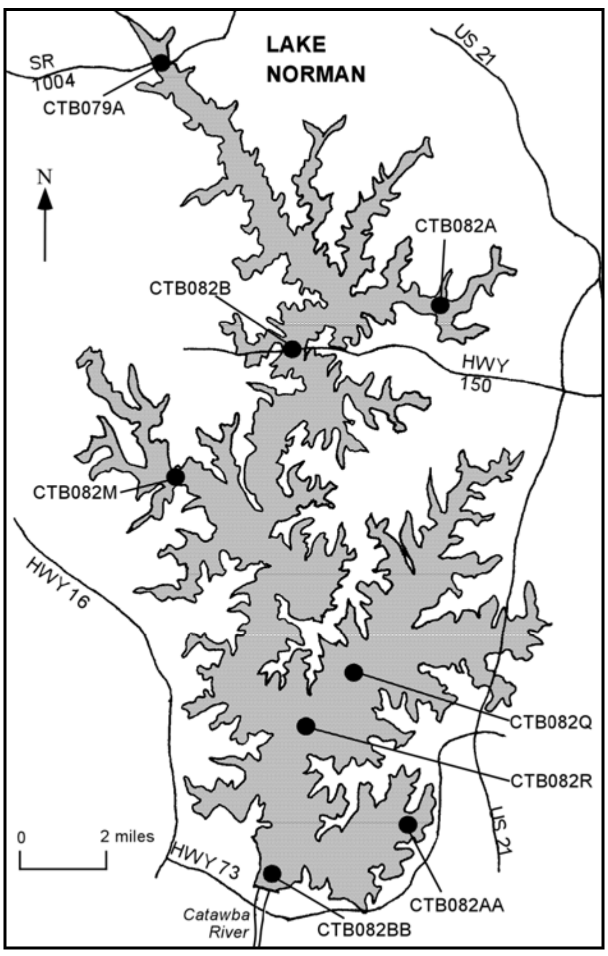


Figure 29. Sampling sites at Lake Norman, Lincoln and Mecklenburg counties.

The reservoir was most recently monitored in 2002. Surface dissolved oxygen concentrations were elevated at Stations CTB079A and CTB082A. Surface percent dissolved oxygen saturation at these sites was greater than the water quality standard for dissolved gasses (110 percent). Nutrients and chlorophyll *a* concentrations were low or less than laboratory detection levels; surface metals were within applicable water quality standards. Based upon the NCTSI scores, the reservoir was oligotrophic.

The lake was also sampled in 1997. Surface dissolved oxygen measurements were elevated in June at the four most upstream sites. Total phosphorous and nitrite+nitrate concentrations were consistently greatest at Station CTB079A. Ammonia values were generally less than 0.01 mg/L, except for a concentration of 0.04 mg/L measured at Station CTB082B in August. Metals which equaled or exceeded the respective water quality action level or standard were:

- zinc = 50 µg/L at Station CTB082Q in July;
- copper = 7.2 µg/L at Station CTB082B in June and 14.0 µg/L at Station CTB082A in August; and
- manganese = 432 µg/L at Station CTB082B in August.

Data were also collected in 2001 by Duke Energy Staff as an NPDES requirement for operation of the McGuire Nuclear Station. Dissolved oxygen and nutrient concentrations and water temperatures were similar to those observed in past monitoring efforts (Duke Energy 2003).

In 1999, approximately 25 acres of *Hydrilla* were discovered in the reservoir by Duke Energy Staff. This invasive macrophyte has the potential for rapid growth with the subsequent loss of swimming and boating areas. It also has the potential to clog intakes of water treatment and power generation plants. A survey conducted in October 2002 by Duke Energy Staff found *Hydrilla* as far upstream as the NC 150 bridge (Figure 30). There is also the potential for Parrot Feather, *Myriophyllum aquaticum*, to become established in Lake Norman *via* introduction from contaminated boat trailers or from plant fragments floating downstream from Lookout Shoals Lake.

The occurrence of *Hydrilla* and the potential for Parrot Feather infestation pose a more immediate threat to recreation, water supply use, and power generation uses of the lake than excursions of the water quality standard for percent dissolved oxygen in the surface water and in the concentrations of several metals.

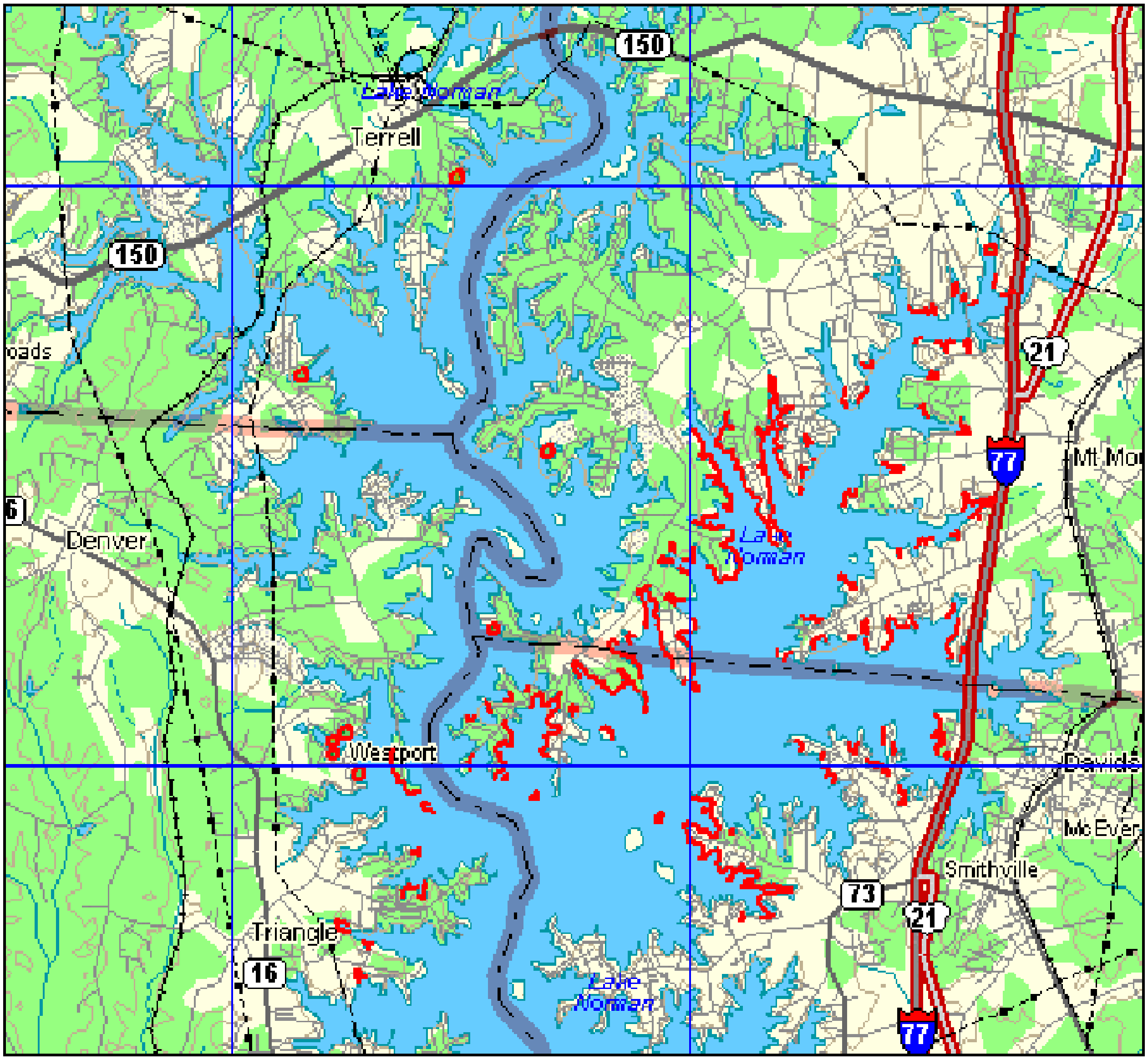


Figure 30. **Location of *Hydrilla* in Lake Norman (in red) based on a survey conducted by Duke Energy on October 31, 2002 (map courtesy of Kenneth L. Manuel, DPC).**

CATAWBA RIVER SUBBASIN 33

Description

This subbasin is located in the Southern Outer Piedmont ecoregion (Griffith *et al* 2002). The largest watershed in this subbasin is Dutchman's Creek, formed by the confluence of Leepers and Killian Creeks (Figure 31). Dutchman's Creek flows into the Catawba River just downstream of Mountain Island Lake. Streams in the subbasin are often sandy, low gradient streams. Land use is primarily forested (Table 13). The largest discharger in this subbasin is the Charlotte/ Mecklenburg Utilities District which discharges 3 MGD into McDowell Creek.

Table 13. Land use in Subbasin 33. Based upon CGIA coverage 1993 - 1995, total area = 220 square miles (NCDENR 1999).

Land use	Percent
Water	2
Cultivated crop	2
Pasture	25
Urban	2
Forest	69

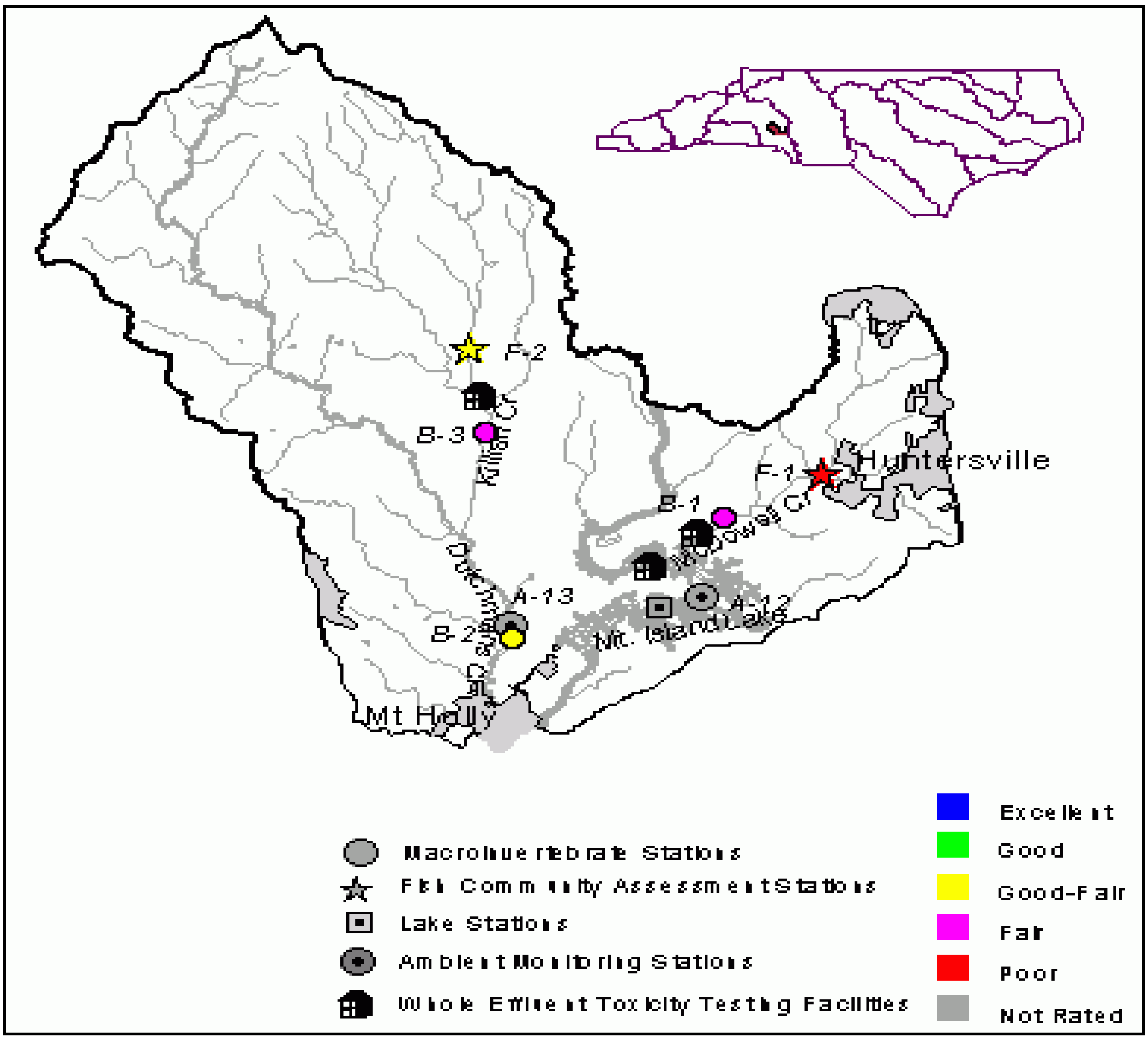


Figure 31. Sampling sites in Subbasin 33 in the Catawba River basin.

Overview of Water Quality

There are three ambient monitoring sites located in this subbasin: Mountain Island Lake above Gar Creek, Dutchmans Creek at SR 1918, and the Catawba River at NC 27. All three sites have exhibited elevated trends in conductivity since the middle and late 1990's. Remaining water chemistry parameters have shown no significant trends since monitoring commenced in the early 1980's.

Gar Creek could not be sampled due to a lack of flow. Based on past benthic macroinvertebrate data, Dutchmans and Killian Creeks have been rated either Excellent or Good; McDowell Creek was rated Good-Fair (Table 14). In 2002, however, based on benthic macroinvertebrate data Dutchmans Creek declined to Good-Fair and Killian and McDowell Creeks declined to Fair. Similar trends were observed for the fish community at McDowell Creek, which declined from Fair in 1997 to Poor in 2002 and in Killian Creek, which declined from Good in 1997 to Good-Fair in 2002. The lower benthic macroinvertebrate and fish ratings were likely the result of the prolonged drought in Killian Creek while the lower ratings in McDowell Creek were likely the result of expanding urbanization of the City of Charlotte metropolitan area. Remaining benthic macroinvertebrate sites which declined in 2002 from previous samples were likely due to extended low flows from the drought.

Mountain Island Lake is located on the Catawba River downstream of Lake Norman. In 2002 it was classified as oligotrophic and received the lowest trophic scores since 1981. Nutrient levels in 2002 were generally lower than measured in the past and lakewide Secchi depths were correspondingly high. These improved conditions might have been due to decreased runoff as a result of the drought. The noxious exotic macrophyte *Hydrilla* is established and covers more than 600 acres. To manage it, grass carp were stocked in 2000 and 2002.

There are six facilities in this subbasin required to monitor effluent toxicity. Five facilities have passed all required toxicity tests. The CMUD/McDowell Creek WWTP has had three failing tests since 1997.

Table 14. Waterbodies monitored in Subbasin 33 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
B-1	McDowell Cr[2]	Mecklenburg	SR 2128	---	Fair
B-2	Dutchmans Cr[2]	Gaston	SR 1918	Good	Good-Fair
B-3	Killian Cr[2]	Lincoln	SR 1511	Good	Fair
F-1	McDowell Cr	Mecklenburg	SR 2136	Fair	Poor
F-2	Killian Cr	Lincoln	NC 73	Good	Good-Fair
L-1	Mountain Island Lake	Mecklenburg			

[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites; L = lake assessment sites.
[2]Data are available prior to 1997, refer to Appendix 7.

River and Stream Assessment

Benthic macroinvertebrate samples were not collected from the basinwide monitoring site on Gar Creek (SR 2074, Mecklenburg County) due to a lack of flow. This was the first time since sampling began in 1992 that samples could not be collected. The low flows were likely the result of the prolonged drought.

Leepers Creek was not sampled for fish community assessment in 2002 because no appreciable changes were expected in the community. The stream had been rated Good in 1997 and Excellent in 1993 (Appendix 11).

McDowell Creek, SR 2136
McDowell Creek is a tributary to the upper reaches of Mountain Island Lake and drains the suburban areas bordering the Towns of Cornelius and Huntersville and the lands between Interstate 77 and Lake Norman. There are no NPDES facilities in the watershed above the monitoring site. There are also no riffles in this sandy-bottom stream and pools are very shallow.

Upstream view of McDowell Creek at SR 2136, Mecklenburg County.

In 1997, the fish community was rated Fair, in 2002 it rated Poor (NCIBI = 40 and 22, respectively). This 18-point decline was attributed to substantial decreases in total species diversity (from 15 to 5 species) and abundance (from 157 to 81 fish) and an absence of omnivores+ herbivores. The number of fish collected was the lowest of any stream monitored in the basin in 2002 (Appendix 12). McDowell Creek was also the only stream in the basin where the bluehead chub was not collected. In addition, suckers, intolerant species, and piscivores were absent; and between 1997 and 2002, the percentage of tolerant fish and insectivores increased substantially (from 39 to 63 percent and from 53 to 100 percent, respectively). Only one specimen of one species of darter was present in 2002. The dominant species in 2002 was the redbreast sunfish.

McDowell Creek, SR 2128
This reach of McDowell Creek was extremely sandy (85 percent) and was very turbid at the time of sampling despite no rainfall. This stream drains the rapidly growing northwestern portion of Mecklenburg County between the Town of Huntersville and the City of Charlotte. This site was added in 2002 as a basinwide monitoring site to track this rapidly developing portion of Mecklenburg County.

This site was sampled in 1990 and had a BI of 6.3, an EPT S of 17, an EPT BI of 5.4, and was rated Good-Fair. In 2002, the BI and EPT BI increased to 6.7 and 5.7, respectively and only eight EPT S were collected. The site was rated Fair. Taxa absent in 2002 that were common or abundant in 1990 included the mayflies *Hexagenia* and *Isonychia*. There were also three species of long-lived intolerant stoneflies collected in 1990 which were not collected in 2002.

Dutchmans Creek, SR 1918
This reach of Dutchmans Creek has a mostly sand substrate although there are some well-developed riffle areas. Bank erosion was moderate despite an intact riparian zone.

This stream has been sampled five times since 1988 and has been rated Excellent (1988) or Good (1992, 1994, and 1997). In 2002, the rating declined to Good-Fair. Taxa absent or rare in 2002 that were common or abundant in the previous four samples included the intolerant stonefly *Paragnetina fumosa*, the mayfly *Heptagenia marginalis*, as well as the caddisflies *Hydropsyche betteni* and *Ceratopsyche sparna*. The absence of these caddisflies indicated there might have been a lack of flow or that flow was generally minimal at this site for a long time prior to sample collection. This conclusion is further strengthened by the fact that *Cheumatopsyche* was rare in 2002 when previously it had been abundant.

Additional evidence of drought effects came from a decrease in stream width in 2002. From 1988 to 1997 the width was 10 to 15 meters. In 2002 it had decreased to seven meters. It was likely this site had a decreased rating as a result of prolonged low flow conditions exacerbated by declining water quality in the catchment. This conclusion was supported by ambient monitoring data which indicated increased conductivity levels at this site since the late 1990’s (Figure 32).

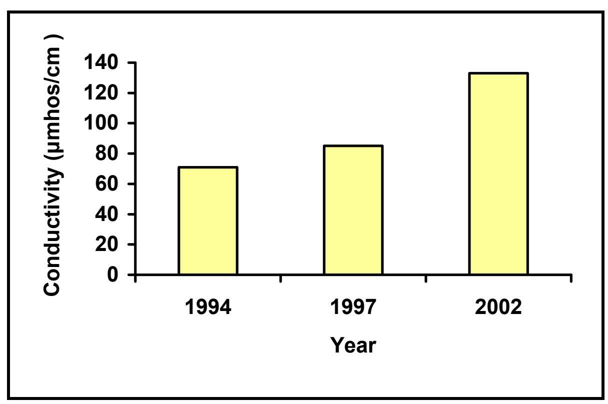


Figure 32. Conductivity measurements (µmhos/cm) at Dutchmans Creek, SR 1918, Gaston County.

Killian Creek, NC 73
Killian Creek is a tributary to upper Dutchmans Creek in southeastern Lincoln County. Although there are no NPDES facilities in this rural watershed, the conductivity was elevated at 131 µmhos/cm. Flows were less than 20 percent of historical median flow during late May and the stream was very shallow.

Upstream view of Killian Creek at NC 73, Lincoln County.

In 1997, the fish community was rated Good, in 2002 it rated Good-Fair (NCIBI = 52 and 46, respectively). This 6-point decline was attributed to substantial decreases in total species diversity (from 16 to 10 species), sunfish and sucker diversities and in the percentage of piscivores. Intolerant species were also absent. The spotted killifish was the dominant species in 2002; it can dominant the fish community in shallow, sandy-bottom, Piedmont streams.

Killian Creek, SR 1511
This reach of Killian Creek is quite sandy with highly embedded riffles. The percentage of sandy substrate has varied from 35 to 90 percent (Figure 33). In 1997 the riffle habitats had been filled in, although riffles habitats were again present in 2002. Despite this slight habitat improvement, the bioclassification decreased substantially. In 1992 and 1994 the stream was rated Excellent, Good in 1997, and Fair in 2002. The long-term drought-effects seemed to be reflected by a decrease in stream width from 7 to 10 meters in 1992 - 1997 to four meters in 2002.

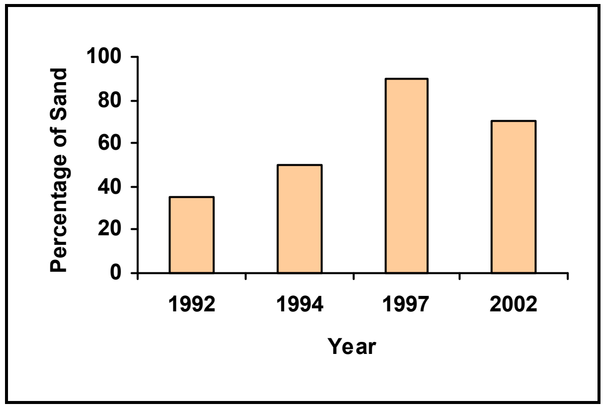


Figure 33. The percentage of substrate estimated as sand at Killian Creek, SR 1511, Lincoln County.

Taxa absent or rare in 2002 that were common or abundant from previous samples included the intolerant, long lived stonefly *Pteronarcys* and the flow-indicating caddisflies *Hydropsyche betteni, H. venularis,* and *Ceratopsyche sparna*. This suggested the site lacked adequate flow or had minimal flow for a long time before sampling. Some intolerant stoneflies reduced in number in 2002 from previous years include *Acroneuria abnormis* (Abundant in 1997, Common in 1994, and Rare in 2002) and *Paragnetina fumosa* (Abundant in 1994 and 1997 and Rare in 2002).

The decrease in rating was also due to a reduced dilution of instream wastes from the Forney Creek and Fa Be Enterprises WWTPs. These facilities discharge to Forney Creek, a tributary to Killian Creek. Conductivity measurements in Killian Creek have increased substantially during the last two monitoring cycles (Figure 34). Ambient monitoring trends also indicated increasing conductivity levels since the late 1990's.

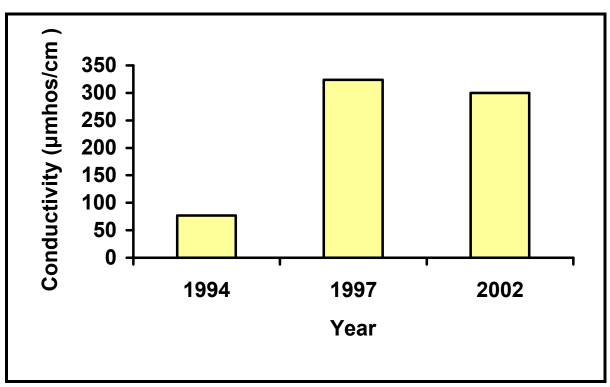


Figure 34. Conductivity measurements at Killian Creek, SR 1511, Lincoln County.

Mountain Island Lake

Mountain Island Lake is owned by Duke Energy and is located on the Catawba River downstream from Lake Norman (Figure 35). The reservoir is used as a water supply for the City of Charlotte and to generate electricity at the Riverbend Steam and Mountain Island Stations.

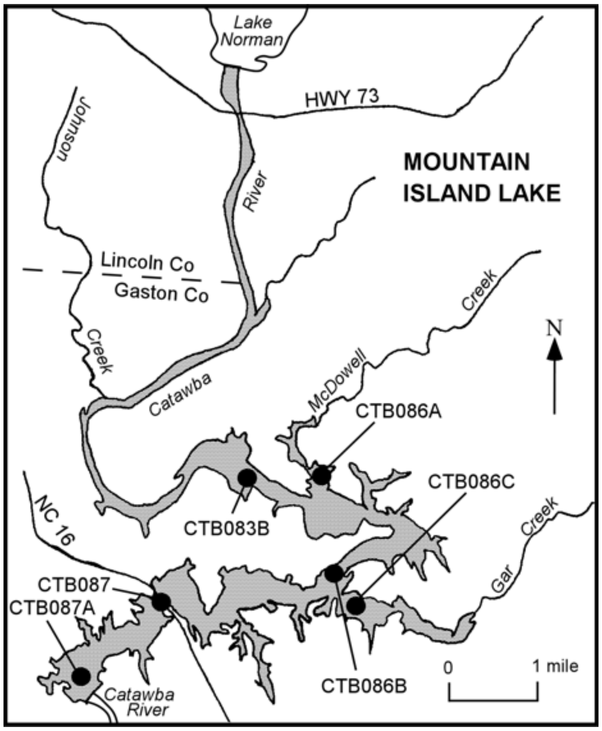


Figure 35. Sampling sites at Mountain Island Lake, Mecklenburg and Gaston counties.

The reservoir was most recently monitored by DWQ in 2002. The lake was classified as oligotrophic and the NCTSI scores were the lowest recorded for the reservoir since 1981. Nutrient concentrations were generally lower than those observed in the past. Lakewide Secchi depths were high which indicated good water clarity. Decreased nutrient concentrations and greater Secchi depths may have been due to the drought conditions, which decreased nonpoint source runoff throughout the basin. All surface metals were within applicable water quality standards.

Prior to 2002, the most recent monitoring was conducted in 1997. Secchi depths ranged from 0.7 meter Station CTB086A to 2.6 meters at Stations CTB083B and CTB087A in June. Mean Secchi depths were similar to those observed in 2002. Total phosphorous and ammonia concentrations were generally low in 1997 while nitrite+nitrate concentrations were elevated (Appendix 16). Zinc at Station CTB086C in August was 52 µg/L, which was slightly greater than the water quality action level (50 µg/L). Copper at Station CTB087A in August was at the water quality action level (7.0 µg/L).

Hydrilla is established in the reservoir and covers approximately 625 acres (Bonham, 2001). The exotic macrophyte was observed in the upper end of the reservoir in 2002. Grass carp were first stocked in 2000 as a possible biological control agent for this plant. In 2002, an additional 20,000 fish were stocked.

CATAWBA RIVER SUBBASIN 34

Description

This subbasin is in the Southern Outer Piedmont ecoregion and contains the Sugar Creek watershed, a portion of Lake Wylie, and much of the City of Charlotte metropolitan area (Figure 36). This is the most heavily urbanized region of the basin (Table 15) and the state. Only 52 percent of the subbasin is forested – the smallest percentage of any of the subbasins.

Table 15. Land use in Subbasin 34. Based upon CGIA coverage 1993 - 1995, total area = 324 square miles (NCDENR 1999).

Land use	Percent
Water	2
Cultivated crop	< 1
Pasture	13
Urban	32
Forest	52

There are currently over 50 NPDES permitted dischargers in this subbasin. The largest one is the Charlotte/Mecklenburg Utilities District which discharges to Irwin Creek (30 MGD), McAlpine Creek (48 MGD), and Little Sugar Creek (20 MGD).

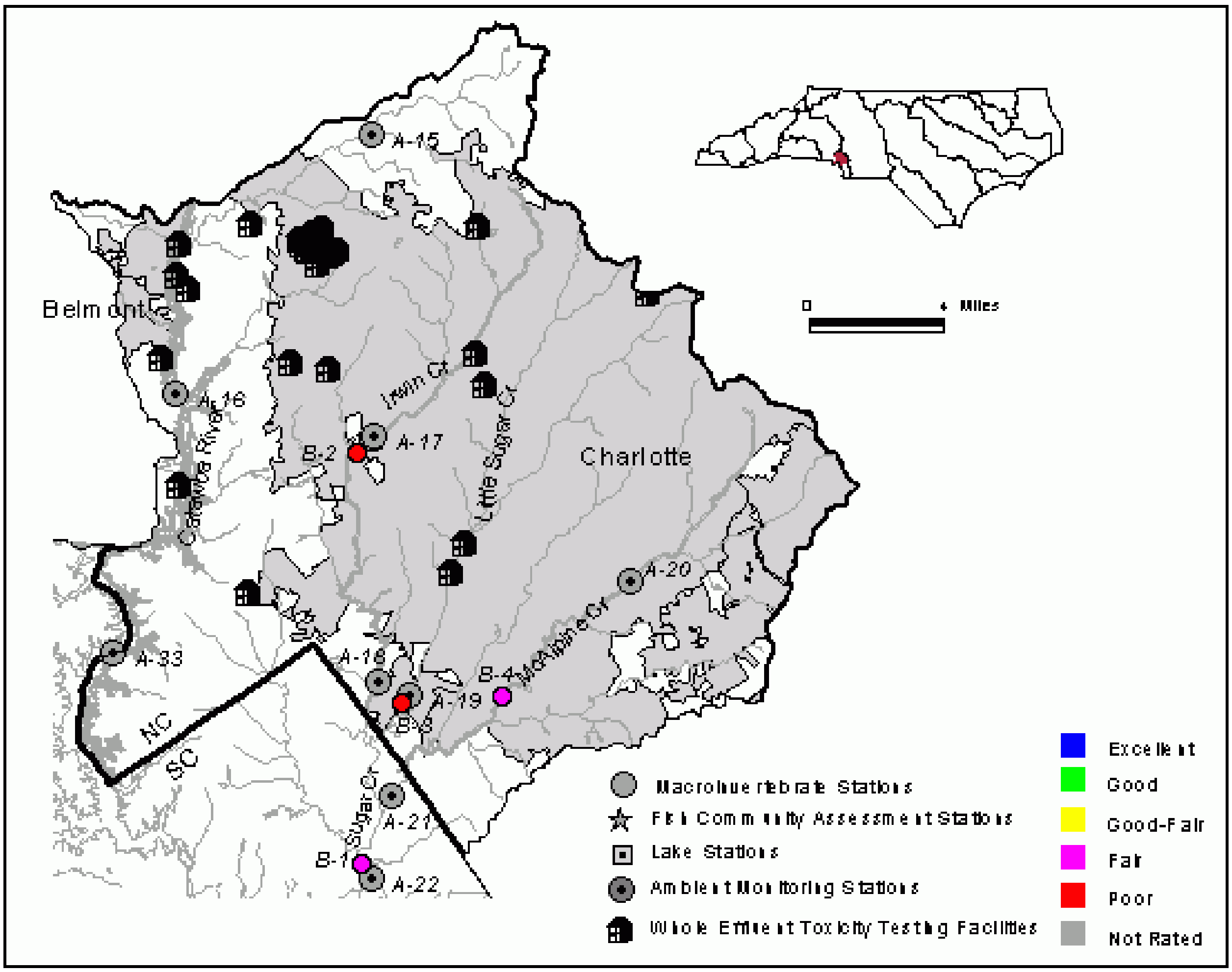


Figure 36. Sampling sites in Subbasin 34 in the Catawba River basin.

Overview of Water Quality

There are six ambient monitoring stations located in this subbasin: Irwin Creek, Sugar Creek at NC 51 and at SC 160, Little Sugar Creek at NC 51, and McAlpine Creek at SR 3356 and at SR 2964. The Irwin Creek site is showing a slight trend of lowered conductivity since the middle 1990's. Conversely, McAlpine Creek at SR 3356 showed slightly elevated conductivity trends since the middle 1990's. In addition, McAlpine Creek at SR 3356 had slightly elevated levels of NO_2+NO_3-N, and ammonia since the early 1990's. Sugar Creek at NC 51 has had slightly elevated levels in NO_2+NO_3-N while other nutrients have decreased notably since the early 1980's. Dissolved oxygen concentrations have steadily increased since the late 1960's at this site. Sugar Creek at SC 160 has shown elevated trends in NO_2+NO_3-N and dissolved oxygen since the late 1980's, while ammonia and total Kjeldahl nitrogen have dramatically decreased since the late 1970's.

Based upon benthic macroinvertebrates McAlpine Creek and Sugar Creek (at SC 160) were rated Fair in 1997 and 2002, while Sugar Creek at SR 1156 and Little Sugar Creek were rated Poor (Table 16). Both streams had been rated Fair in 1997. These low ratings were due to urban drainages, large WWTP discharges, and poor habitat. The declines were attributed to the drought rather than significant declines in water quality.

Little Sugar Creek and Sugar Creek (at SR 1156) were sampled for fish in 1999 as special studies to determine the multi-year temporal repeatability of NCIBI sites with impaired water quality. Sugar Creek was rated Poor in 1997 and 1999, while Little Sugar Creek was rated Fair in 1997 and Good-Fair in 1999.

Lake Wylie is the most downstream reservoir in the Catawba River Chain of Lakes. Its immediate watershed is rapidly being converted from traditional agricultural to more urban land uses and one of its major tributaries, Crowders Creek, is on the impaired streams list. This reservoir was monitored in 2001 and 2002 and was classified as eutrophic. Percent oxygen saturation at the surface exceeded the water quality standard for dissolved gases. Nutrient concentrations ranged from moderate to elevated with particularly high levels of total phosphorus and total Kjeldahl nitrogen in the Crowders Creek arm. This arm also had elevated total phosphorus concentrations in 1997. However, as a result of the City of Gastonia decommissioning its Catawba Creek WWTP and redirecting this effluent to the improved Long Creek WWTP, the Crowders Creek arm has shown an overall decrease in total phosphorus and total nitrogen. Despite these improvements, there are still sufficient nutrients entering the reservoir to keep it classified as eutrophic.

There are 30 facilities in this subbasin required to monitor effluent toxicity. Of these, six facilities have had more than one failing toxicity test since 1997: American Truetzschler, Inc. (12), Cousins Real Estate/Gateway Village (12), Duke Power/Allen 002 (3), First Union Commons (4), Hoechst Celanese/Dreyfus (2), and Unocal/Rhom & Haas Facility (5). Four other facilities had one failing test since 1997: (AquAir WWTP, Belmont WWTP, CMUD/Irwin Creek WWTP, and CMUD/McAlpine Creek WWTP).

Table 16. Waterbodies monitored in Subbasin 34 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
B-1	Sugar Cr[2]	York, SC	SC 160	Fair	Fair
B-2	Sugar Cr[2]	Mecklenburg	SR 1156	Fair	Poor
B-3	Little Sugar Cr[2]	Mecklenburg	NC 51	Fair	Poor
B-4	McAlpine Cr[2]	Mecklenburg	NC 51	Fair	Fair
L-1	Lake Wylie	Mecklenburg, York			

[1]B = benthic macroinvertebrate monitoring sites; L = lake assessment sites.
[2]Data are available prior to 199y, refer to Appendix 7.

Sugar and Little Sugar Creeks were not sampled for fish community assessment in 2002. Data had been collected as recently as 1999 and the communities have been rated Poor (Sugar Creek) or Fair to Good-Fair (Little Sugar Creek) (Appendix 11).

Sugar Creek, SR 1156
This site is located below one of the City of Charlotte's WWTPs (30 MGD) and within Charlotte's downtown area. Predictably, the riparian zone was not intact, the substrate was highly embedded, and bank erosion was prevalent. There were however several deep pools and a good mix of boulder, cobble, and gravel substrates producing good riffles. The habitat available at this site would likely support an abundant and diverse benthic community if the water quality were not affected so adversely by the urban runoff and the WWTP.

This site was Poor in 1992 (EPT S= 4), improved to Fair in 1997 (EPT S=7) and was again Poor in 2002 (EPT S= 5). The bioclassification decline in 2002 was likely the result of extremely low flows which adversely affected the amount of habitat available for colonization and not the result of significant water quality declines. This conclusion was supported by the reduction in stream width from 16 meters in 1997 to only nine meters in 2002; the reduction in conductivity from 402 µmhos/cm in 1997 to 332 µmhos/cm in 2002; and most importantly, the decrease in conductivity levels below the Irwin Creek WWTP since the mid-1990's.

Sugar Creek, SC 160
This reach of Sugar Creek is quite large (approximately 20 meters wide) and is comprised mainly of deep run habitat. However, there is one section of boulder and bedrock that produced a suitable riffle habitat. The dominant substrate type was sand (70 percent) and silt (20 percent), and as a result, the riffle habitat was highly embedded. The watershed receives large amounts of point and nonpoint pollution from the City of Charlotte metropolitan area.

Sugar Creek at SC 160, York County, SC.

These impacts have greatly affected the water quality at this site for decades. The bioclassification was Poor in 1983 – 1988, but in 1990 and 1991 this site improved to Fair as a result of better operation of upstream WWTPs. In 1992 this site improved further to Good-Fair but this improvement was attributed to lower flows with a corresponding decrease in nonpoint pollution runoff. In 1997, this site reverted back to Fair and was again Fair in 2002.

Based on the improvement in 1992 under low flow conditions, another improvement in ratings should have been expected in 2002 due to the drought. The fact there was no improvement in 2002 may not be the result of a significant decline in water quality, but might have indicated that flow was so low that it adversely affected the habitat available for invertebrate colonization. This conclusion is strengthened by the generally static long-term trends in conductivity from 1981 to 2002, a reduction in conductivity from 490 µmhos/cm in 1997 to 306 µmhos/cm in 2002, and a significant reduction in width from 35 meters in 1997 to 20 meters in 2002.

The abundance of many flow-dependent caddisflies in 2002 (e.g., *Cheumatopsyche*, *Hydropsyche venularis*, and *H. betteni*) suggested that flows were high enough to support these organisms on riffles in the thalweg (where flow is concentrated), but might not have been sufficient to support in habitats elsewhere (e.g., root mats, undercut banks, and snags).

Little Sugar Creek, Polk Street
This site was moved one block south to Polk Street due to poor access at the NC 51 site. Comparison of habitat data from the two sites revealed no significant differences. The catchment is comprised entirely of the City of Charlotte and the site is located below one of Charlotte's WWTPs (20 MGD. The stream is shallow, has a largely sand substrate, a poor riparian zone, and severe bank erosion.

Little Sugar Creek at Polk Street, Mecklenburg County.

Since 1992, a slight improvement in water quality has occurred at this site. EPT S increased from only three taxa in 1992 (Poor bioclassification) to seven taxa in 1997 (Fair bioclassification). In 2002 the six EPT S was sufficient to decrease the bioclassification to a borderline Poor.

This decrease in rating did not represent a real change in water quality. This conclusion is supported by the drastic reduction in width from 17 meters in 1997 to only seven meters in 2002, by the reduction in conductivity from 519 µmhos/cm in 1997 to 412 µmhos/cm in 2002, and by the generally static long-term trends in conductivity since the middle 1990's.

McAlpine Creek, NC 51
This reach of McAlpine Creek was estimated at 14 meters wide in 2002. Unlike other streams in the lower part of t he river basin, the width at this site had not decreased from previous years. Instream substrate was entirely sand (100 percent); there were no riffle areas; there were numerous sandbars in the middle of the channel; and despite an upstream discharge, the flow was poor. The banks were unstable with sparse trees and shrubs resulting in poor soil-binding stability. Predictably, bank erosion was very severe.

McAlpine Creek at NC 51, Mecklenburg County.

Bank erosion at McAlpine Creek at NC 51, Mecklenburg County.

Bioclassification at this site was Fair for three samples between 1992 and 2002. Some taxa absent in 2002 that were previously collected in 1997 included the flow dependent caddisflies *Hydropsyche venularis*, *H. betteni*, and *H. rossi*. These taxa were also absent from the 1992 sample perhaps suggesting an overall impaired flow regime at this site. Another disturbing trend at this site was the disappearance of the root-dwelling caddisfly *Triaenodes ignitus*. This species was abundant in 1992 but has not been collected since then. Its disappearance may indicate that root habitat is being deleteriously impacted. This impact is likely the synergistic combination of poor flows, severe bank erosion, and extreme in-channel sedimentation.

SPECIAL STUDIES

Fish Community Repeatability at Impaired Sites

Sugar Creek at SR 1156 and Little Sugar Creek at NC 51, Mecklenburg County, were sampled in 1999 to determine the multi-year temporal repeatability of the NCIBI at sites with known impaired water quality. Sampled in heavily urbanized areas and downstream from the Charlotte-Mecklenburg Utility District Irwin Creek WWTP (15 MGD, NPDES Permit No. NC0024945) and the Sugar Creek WWTP (20 MGD, NPDES Permit No. NC0024937), the conductivity at each site was approximately 400 µmhos/cm during 1997 and 1999.

In 1997, and 1999, the fish community in Sugar Creek was rated Poor (NCIBI = 32 and 28, respectively). The fish community in Little Sugar Creek was rated Fair in 1997 and Good-Fair in 1999 (NCIBI = 40 and 42). The communities were dominated by tolerant redbreast sunfish, the diversity was low to moderate, there was an absence of darters and intolerant species; and the incidence of diseased fish was high (NCDWQ unpublished data). Instream habitats were not a limiting factor to the Sugar Creek community (habitat scores = 79 and 70 in 1997 and 1999, respectively), however, the habitats at Little Sugar Creek were severely degraded (habitat scores = 35 and 30 in 1997 and 1999, respectively). If improvements to the discharges or if stream restoration activities occur, the sites may once again become basinwide monitoring sites in 2007.

McAlpine Creek TMDL

Historical data from DWQ and Mecklenburg County Dept of Environmental Protection were evaluated to determine the primary causes of biological impairment to the McAlpine Creek watershed. (Biological Assessment Unit Memorandum 20032603).

Lake Assessment

Lake Wylie

Lake Wylie is the most downstream reservoir of in the Catawba River Chain of Lakes in North Carolina. The reservoir was formed by the impoundment of the Catawba River in 1904 by a hydroelectric dam located near Fort Mills, SC (Figure 37). The lake is owned by Duke Energy. There are more than 327 miles of shoreline with the majority of the reservoir in South Carolina. The immediate watershed of Lake Wylie is being converted from forested and agricultural areas to more urban land uses. Crowders Creek, a tributary, is listed on the 303 (d) list for biological impairment due to urban runoff and storm sewer contributions. The City of Gastonia is the largest urbanized area located within the Crowders Creek watershed.

The reservoir was most recently monitored in 2001 and 2002. During both years, the reservoir was classified as eutrophic. In 2002, 50 percent of the observations for dissolved oxygen and percent dissolved oxygen saturation at the surface were greater than the water quality standard. The sampling site in the Crowders Creek Arm consistently had elevated surface dissolved oxygen and pH values in 2002.

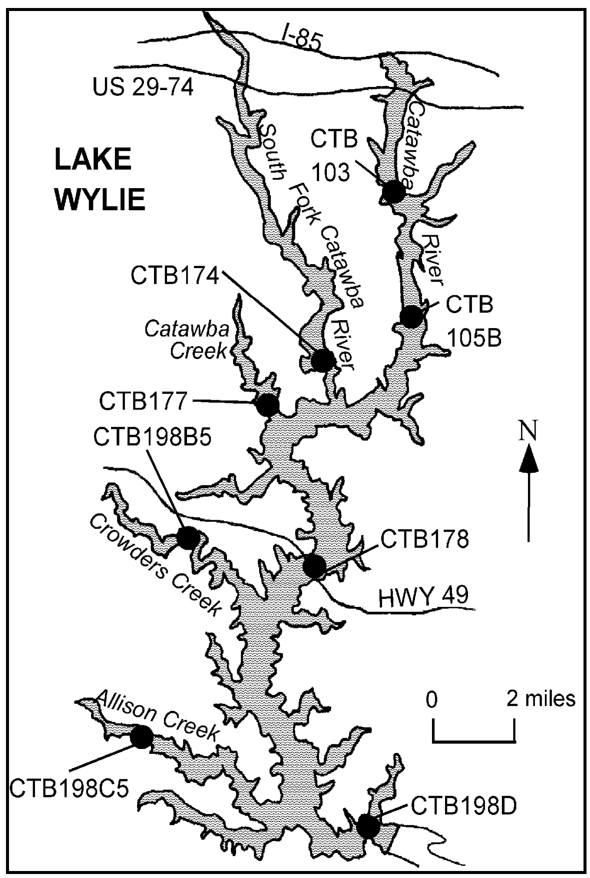


Figure 37. Sampling sites at Lake Wylie, Mecklenburg County, NC and York County, SC.

Nutrient concentrations ranged from moderate to elevated. Total phosphorus and total Kjeldahl nitrogen concentrations were extremely elevated in the Crowders Creek arm in July and August. Other nutrient concentrations were also elevated at this site (Appendix 16). Similar conditions were observed in 2001. Surface metals were within applicable water quality standards in 2001 and 2002.

The reservoir was previously sampled in1997. Surface dissolved oxygen was consistently elevated in the Crowders Creek arm. The greatest total phosphorus concentration (0.14 mg/L) was also observed in this arm in September. Ammonia concentrations were generally low in 1997, except for an elevated concentration (0.37 mg/L) observed in the Crowders Creek arm in August.

An Algal Growth Potential Test was conducted in August 1997. The Control Mean Standing Crop (MSC) ranged from 1.75 mg/L in the Catawba River arm (Station CTB103) to 26.46 mg/L in the Crowders Creek arm. Control MSC values for Catawba Creek, the site at the NC 49 bridge, and the site near the dam were equal to or greater than 5.0 mg/L. This indicated that these sites had sufficient nutrients to support algal blooms.

Lake Wylie and several of its major tributaries have experienced eutrophic conditions for decades. A joint study by DWQ and South Carolina Department of Environmental Control from April 1989 to September 1990 resulted in nutrient limitations for dischargers in an effort to reduce nutrient loading. Initially, minimum requirements were for a BOD_5 of 15.0 mg/L, NH_3 at 4.0 mg/L, and dissolved oxygen at 5.0 mg/L (NCDEM 1989). Additional recommendations were made in 1995:

- any new or expanding facility with a permitted design flow greater than or equal to 1.0 MGD must meet monthly average limits of 1.0 mg/L total phosphorus and 6.0 mg/L summer total nitrogen;
- for facilities with a permitted design flow of less than 1.0 MGD but greater than 0.05 MGD, a total phosphorus limit of 2.0 mg/L was recommended;
- dischargers into Catawba Creek with a permitted design flow $\geq$ 0.05 MGD would have to meet a limit of 0.5 mg/L total phosphorus and total nitrogen limits in the summer of 4.0 mg/L and 8.0 mg/L in the winter by January 1, 2006;
- dischargers to Crowders Creek with a permitted discharge design of $\geq$ 1.0 MGD would have to reach a nutrient limit of 1.0 mg/L total phosphorus and 6.0 mg/L for total nitrogen in the summer by January 1, 2000 (NCDENR 1999).

Since the 1995 recommendations, the City of Gastonia has decommissioned the Catawba Creek WWTP (Subbasin 37) and redirected wastewater to the improved Long Creek WWTP (Subbasin 36). The Crowders Creek WWTP currently meets or is below the limits recommended in 1995.

Nutrient data for the Crowders Creek site was analyzed to determine if these nutrient reductions have had an impact (Figures 38 and 39).

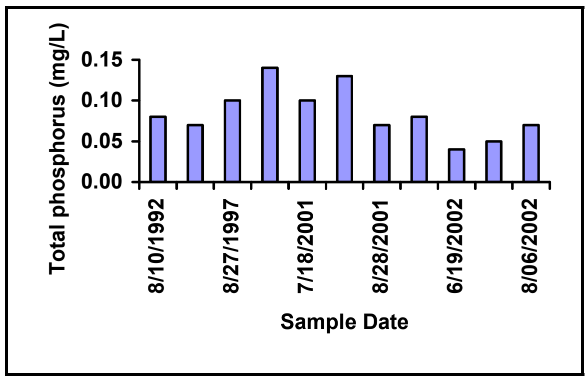


Figure 38. Total phosphorus concentrations (mg/L) in the Crowders Creek arm of Lake Wylie, 1992 – 2002.

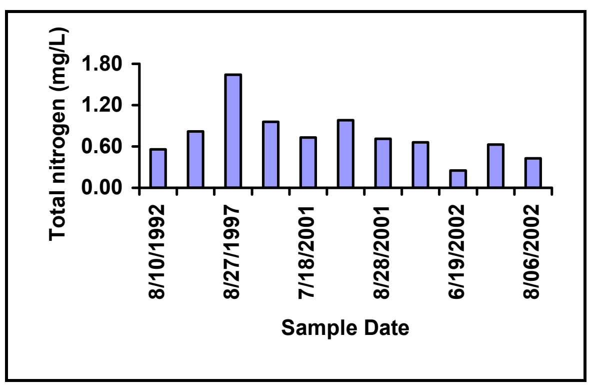


Figure 39. Total nitrogen concentrations (mg/L) in the Crowders Creek arm of Lake Wylie, 1992 – 2002.

Total phosphorus and total nitrogen appeared to show reductions since 1997. The data for 2001 and 2002 were collected during drought conditions and their apparent reduction might also have been due to a reduction in contributions from nonpoint source runoff.

The elevated percent dissolved oxygen saturation values in the reservoir coupled with elevated nutrient concentrations indicated that the best uses of Lake Wylie may be threatened by increasing biological productivity. Although 2001 and 2002 were drought years which limited nonpoint source runoff, the eutrophic conditions observed suggested that the lake may have sufficient nutrients coming into the lake from point sources as well as from internal cycling to maintain elevated biological productivity. Increasing urbanization of the watershed also threaten the best uses of this lake.

CATAWBA RIVER SUBBASIN 35

Description

There are three ecoregions in this subbasin: the Eastern Blue Ridge Foothills (including the South Mountains), the Northern Inner Piedmont, and the Southern Outer Piedmont (Griffith *et al* 2002). The subbasin forms most of the watershed of the South Fork Catawba River (Figure 40). This river has its origin at the confluence of Henry and Jacob Forks. The other major tributaries in this subbasin include Clark and Indian Creeks.

Land use is primarily forested but there is also a large percentage of the subbasin in pasture (Table 17). A greater percentage of this subbasin is in pasture than in any other subbasin.

Table 17. Land use in Subbasin 35. Based upon CGIA coverage 1993 - 1995, total area = 559 square miles (NCDENR 1999).

Land use	Percent
Water	< 1
Cultivated crop	4
Pasture	35
Urban	3
Forest	57

The largest dischargers in this subbasin are those of municipalities (Hickory, 15 MGD to Henry Fork, Lincolnton, 6 MGD to South Fork Catawba River, and Newton, 12.5 MGD to Clark Creek). Smaller dischargers include the Town of Cherryville's WWTP (2 MGD to Indian Creek), Delta Mills, Inc. (1 MGD to Clark Creek), and the Town of Stanly's WWTP (1 MGD to Mauney Creek).

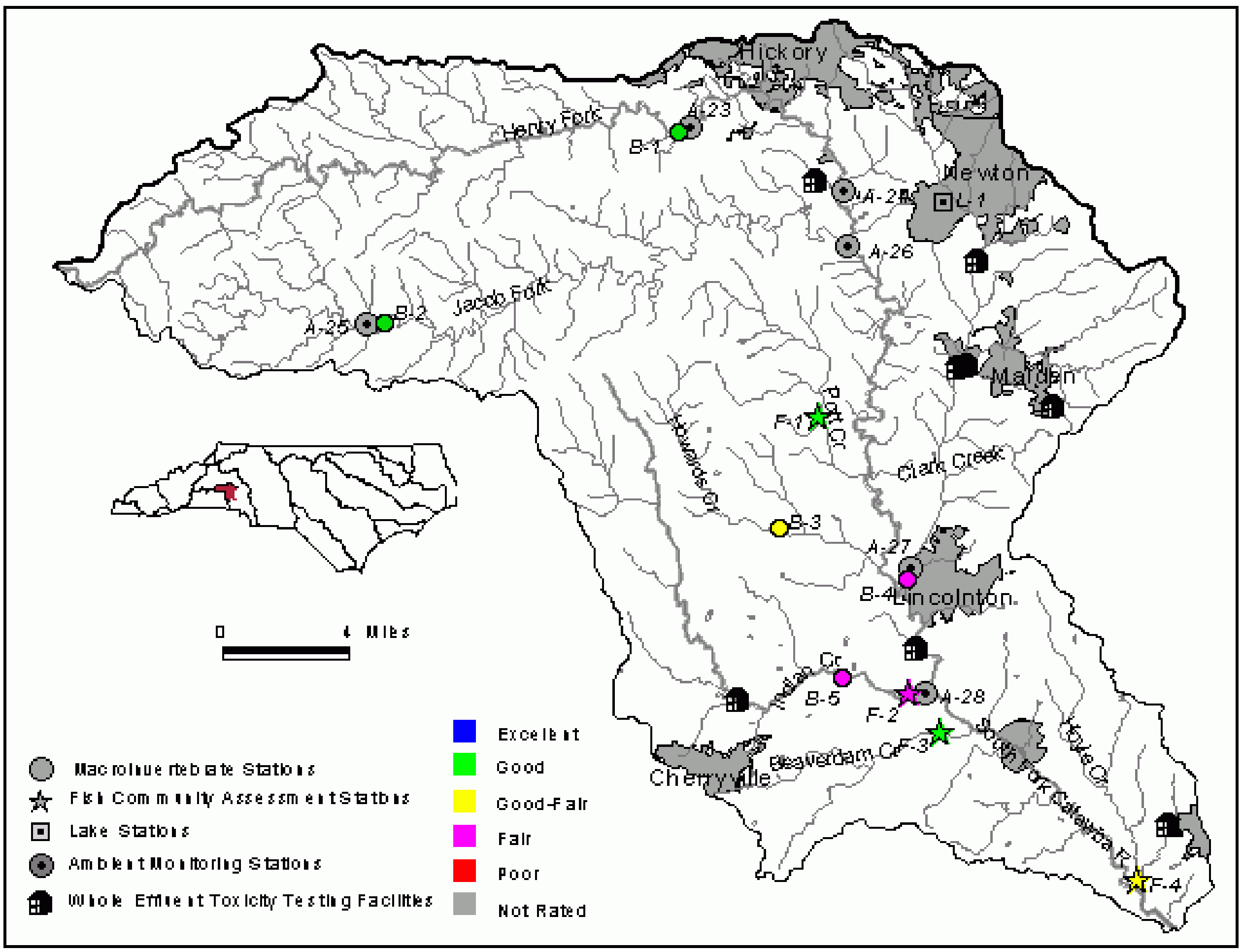


Figure 40. Sampling sites in Subbasin 35 in the Catawba River basin.

Overview of Water Quality

There are five ambient monitoring stations in this subbasin: Henry and Jacob Forks, South Fork Catawba River and Clark and Indian Creeks. Henry Fork and South Fork Catawba River have shown elevated trends in conductivity since the late 1990's. In addition Henry Fork and Clark Creek have shown elevated levels of NO_2+NO_3-N and pH since the late 1970's, while Indian Creek has shown slightly elevated trends in pH since the early 1980's.

All the streams sampled for benthic macro-invertebrates were classified using Piedmont criteria, except for Jacob and Henry Forks which were evaluated using Mountain criteria. Prior to 2002, Excellent ratings were typically found in Jacob Fork, Good ratings in Henry Fork, Howards Creek, and Indian Creek, and Good-Fair at Clark Creek.

Benthic macroinvertebrate data showed that every site, except for Henry Fork declined in bioclassification (Table 18). Henry Fork may have maintained its Good rating because of its large catchment despite the drought and the City of Hickory's discharge

Benthic data suggested that the wastewater treatments plants for the Towns of Newton and Cherryville and Delta Mills may be having deleterious affects, likely exacerbated by the drought, on Clark and Indian Creeks. Both streams declined from Good-Fair in 1997 to Fair in 2002.

The fish community at Indian Creek was also rated Fair in 1997 and 2002. In contrast, Beaverdam Creek, which also drains Cherryville, had a Good fish community rating, as did Pott Creek, a large tributary of the Catawba River north of Lincolnton.

Newton City Lake was monitored in 2002 and nutrient concentrations were generally low. Secchi depth in July was less than one meter and the percent saturation of dissolved oxygen exceeded the water quality standard for dissolved gases. The reservoir was rated oligotrophic in 2002; the same rating it received in 1992.

There are seven facilities in this subbasin which are required to monitor effluent toxicity. Five municipal and one industrial facilities had one or more failing tests since 1997: Cherryville (3), Delta Mills (1), Lincolnton (3), Maiden Creek (1), and Stanley WWTP (9).

Table 18. Waterbodies monitored in Subbasin 35 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
B-1	Henry Fork[2]	Catawba	SR 1124	Good	Good
B-2	Jacob Fork[2]	Burke	SR 1924	Excellent	Good
B-3	Howards Cr[2]	Lincoln	SR 1200	Good	Good-Fair
B-4	Clark Cr[2]	Lincoln	SR 1008	Good-Fair	Fair
B-5	Indian Cr[2]	Lincoln	SR 1252/SR 1177	Good	Fair
F-1	Pott Cr	Lincoln	SR 1217	Good	Good
F-2	Indian Cr	Lincoln	SR 1252	Fair	Fair
F-3	Beaverdam Cr	Gaston	SR 1609	---	Good
F-4	Hoyle Cr	Gaston	SR 1836	Good	Good-Fair
L-1	Newton City Lake	Catawba			

[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites; L = lake assessment sites.
[2]Data are available prior to 1997, refer to Appendix B2.

River and Stream Assessment

The South Fork Catawba River at NC 10 (Catawba County) was not sampled for benthic macroinvertebrates due to high flows during and after the scheduled sampling period.
Henry and Jacob Forks were not sampled for fish community assessment in 2002. Data had been collected from Jacob Fork as recently as 1999 and the community has been rated Good or Excellent. Jacob Fork at SR 1924, Burke County is within the Jacob Fork (South Fork Catawba) Aquatic Habitat, an area designated as a Significant Natural Heritage Area (Oakley 2002). The fish community in Henry Fork was last sampled in 1998 and was rated Good (Appendix 11).

Henry Fork, SR 1124
This site is south of the City of Hickory and Town of Icard. Habitats are good with a mixture of boulder, rubble, and sand substrate, a well-developed riparian zone, and abundant instream habitats. In 1986 and 1987 the site was rated Good-Fair. It has been rated Good since 1989. Although the BI increased from 4.1 in 1997 to 4.8 in 2002, the EPT BI was essentially unchanged (3.34 in 2002 and 3.49 in 1997).

Jacob Fork, SR 1924
This site is located downstream of South Mountains State Park and was designated ORW in 1989. Habitat at this site include well-developed riffles, stable banks, and intact riparian zones. This site had much less sand and silt than any other site assessed in this subbasin.

In 1992 and 1997 this site was rated Excellent but it declined to Good in 2002. Considering the drought and that conductivity was essentially identical in 1997 and 2002 (24 and 29 µmhos/cm) it seemed likely that low flows resulted in slightly lower EPT S in 2002. This conclusion was supported by the reduction in stream width from 12 meters in 1997 to only six meters in 2002.

Howards Creek, SR 1200
Howards Creek is only six meters wide and has a predominately sand and silt substrates, poor riffles, and an intact riparian zone. In 1997 banks were considered "stable" but there were many erosion areas detected in 2002. The stream was rated Good in 1992 and 1997, but declined to Good-Fair in 2002. The decline most likely resulted from the low flow due to drought and not declining water quality. This conclusion was partially supported by the fact that conductivity was essentially unchanged between 1997 and 2002 (53 and 60 µmhos/cm) and by the absence in 2002 of the flow-dependent and cool water caddisfly *Ceratopsyche sparna*. This species was common in 1992 and 1997. Another potential indicator of low flow was the reduction in abundance of the root-dwelling caddisfly *Triaenodes ignitus*. This species was common in 1992 and 1997 but rare in 2002.

Clark Creek, SR 1008
At this site Clark Creek is approximately eight meters wide and is located within the Town of Lincolnton. It is shallow and has a substrate of boulder, rubble and sand. Instream habitat was adequate and pools were varied in size and frequent. The banks were unstable and erosion was severe despite a well-developed riparian area.

In 1997, the water was red and had a conductivity of 405 µmhos/cm. In 2002, the stream was again red and the conductivity was 520 µmhos/cm. WWTPs for Delta Mills, Inc. (1 MGD) and the Town of Newton (12.5 MGD) discharge to Clark Creek upstream of this site. The Town of Newton's facility receives wastewater from domestic, industrial, and textile sources -- likely the sources of the dye.

This site was Fair in 1985, 1988, and 1992 with improvement to Good-Fair in 1997. In 2002, this site was again rated Fair. In 1997 this site had 48 Total S, 16 EPT S, and 60 EPT N. In 2002 Total S was 47, but EPT S declined by almost one-half to 9, and EPT N also decreased by almost one-half to 33, much like the values found prior to 1997. These trends seemed to indicate that the Good-Fair rating in 1997 was an anomaly.

Notable absences for 2002 included the tolerant caddisfly *Hydropsyche venularis* which was abundant or common in all previous samples. Furthermore, and perhaps most indicative of water quality problems at this site, was the absence of the ubiquitous and tolerant mayfly *Stenonema modestum*. This species was abundant or common in all previous samples.

Pott Creek, SR 1217
Pott Creek drains southern Catawba - northern Lincoln counties; there are two NPDES-permitted schools within the watershed. Overall stream and riparian habitats are of moderately high quality.

Upstream view of Pott Creek at SR 1217, Lincoln County.

The fish community was rated Good in 1997 and 2002 (NCIBI = 50). The bluehead chub was the dominant species in both years.

Indian Creek, SR 1177

In 2002 the monitoring site was moved approximately 1.5 miles upstream from the historical site at SR 1252 site because of poor flow. The two sites were similar, except the new site had less boulder and rubble habitats. The stream was approximately four meters wide and the substrate was mostly sand with occasional gravel riffles. The riparian zone was intact, but bank erosion was severe. At the time of sampling it was obvious that flows had been severely affected by the drought. Most root mats were far out of the water and the flow was restricted to narrow areas of the thalweg.

Improvements observed between 1990 (Good-Fair) and 1992 and 1997 (Good) resulted from improved operation of the Town of Cherryville's WWTP. In 2002, this site declined to Fair.

Conductivity in 1997and 2002 were the same (~ 135 µmhos/cm) and long term ambient monitoring data demonstrated generally stable conductivity levels since the early 1980's. Therefore, overall water quality has likely not degraded and was probably not the primary explanation for the decline in bioclassification. What was more likely was that the drought lowered base flow to the point of reducing available habitat. This was seen at other sites where flows were low, where conductivity was basically unchanged from previous years, but where bioclassifications sharply declined. This hypothesis was supported at this site by the reduction of intolerant and long-lived stoneflies *Acroneuria abnormis* and *Paragnetina fumosa* (abundant in 1997 to rare in 2002) and *Pteronarcys dorsata* (collected in 1992 and 1997 but absent in 2002). Further support came from the absence of the flow-indicating caddisflies *Hydropsyche betteni* (abundant in 1992 and 1997) and *H. venularis* (common in 1997).

Indian Creek, SR 1252

The watershed of Indian Creek includes western Lincoln County and the extreme northwestern corner of Gaston County encompassing the north side of the Town of Cherryville. This site is eight miles below the Town of Cherryville's WWTP (2 MGD) and a smaller WWTP associated with the West Lincoln High School (0.01 MGD). Similar to Pott Creek, the overall stream and riparian habitats are of moderately high quality.

Upstream view of Indian Creek at SR 1252, Lincoln County.

The fish community was rated Fair in 1997 and 2002 (NCIBI = 38). As in 1997, there was an absence of darters and intolerant species.
This stream was 1 of 3 streams in the basin where there was an absence of darters. There were no real changes between years; the bluehead chub was the dominant species in both years.

Beaverdam Creek, SR 1609

Whereas Indian Creek drains the north side of the Town of Cherryville, Beaverdam Creek drains the eastern and southeastern portion of the town. There are no NPDES facilities within the water-shed. The stream and riparian habitats are of moderately high quality; however the stream became very turbid while wading and the bottom of the pools were covered with sand, silt, and detritus. The sources of this turbidity should be investigated.

Downstream view (above the bridge) of Beaverdam Creek at SR 1609, Gaston County.

The fish community was sampled for the first time in 2002; it was rated Good (NCIBI = 50). The percentage of tolerant fish was high (46 percent) because of the abundance and dominance by redbreast sunfish and, to a lesser extent, by white suckers. Other suckers such as large notchlip redhorse and striped jumprock were also abundant.

Hoyle Creek, SR 1836
This site on Hoyle Creek was located 0.4 miles above its mouth on the South Fork Catawba River. The stream is entrenched with easily eroded banks. There are three NPDES facilities with a combined discharge of 0.6 MGD above the site: Lincoln County's WWTP, the Town of Stanly's Lola Street WWTP, and a small, mobile home park's WWTP.

Upstream view of Hoyle Creek at SR 1836, Gaston County.

In 1997, and 2002, the community was rated Good and Good-Fair (NCIBI = 48 and 42, respectively). Although more fish (600 *vs*. 157) and two additional species of darters and one additional species of sucker were collected in 2002 than in 1997, the community shifted towards one with a greater percentage of omnivores+herbivores, especially bluehead chubs. In 2002, 35 percent of all fish collected were the bluehead chub; in 1997 it was 21 percent. Despite good snags and pools, only one species of sunfish, redbreast sunfish, was collected in 2002 and its abundance had decreased from 21 percent in 1997 to 3 percent in 2002. In 1997 green sunfish, bluegill, redear sunfish, and largemouth bass were also present.

SPECIAL STUDIES
Breached Mill Dam on Henry Fork
Two sites on Henry Fork (Burke County) were sampled as part of a study to examine the effects of a breached mill dam. This breaching released large amounts of sediment into portions of the stream. A site at SR 1803 upstream of the breached mill dam had good riffle habitat with a mix of boulder, rubble, gravel, sand, and silt substrates. There were 33 EPT S and a BI of 5.1 which resulted in a Good-Fair rating.

The stream below the dam (off SR 1854) was noticeably impacted by the sediment release as evidenced by the substrate being dominated by sand (~ 70 percent). The sand was several feet thick and was sufficient to eliminate all bank and most riffle habitats. The site was rated Fair and had fewer EPT S (18) and a slightly greater BI (5.5) relative to the upstream site (Biological Assessment Unit Memorandum 20010917).

Minimum Flows in Maiden Creek
This site at SR 1810 (Catawba County) was sampled at the request by the NC Division of Water Resources which sought benthos data to determine minimum flow requirement for the Town of Maiden's water supply reservoir. The stream width at the time of initial sampling was estimated at four meters. However, as we finished our sample, we noticed stream flow had declined by approximately one-half of what it was when the sampling began. The estimated width after this flow decrease was between two and three meters. This site was rated Fair (Biological Assessment Unit Memorandum 20021210).

Watershed Assessment and Restoration Project - Clark Creek
This study was initiated as a Watershed Assessment and Restoration Project designed to identify and prioritize the impacts to Clark Creek and its major tributaries in Catawba and Lincoln counties (Biological Assessment Unit Memorandum 20021028).

Fish Community Reference Streams
In 1998 Jacob Fork at SR 1924 and Henry Fork at SR 1922, Burke County, were evaluated as regional fish community reference sites. The fish communities were rated Good (Henry Fork) and Excellent (Jacob Fork). Jacob Fork was further evaluated in 1999; it was rated Good (Biological Assessment Unit Memorandum 20000922). The streams will again become basinwide monitoring sites in 2007.

Newton City Lake
Newton City Lake, which was constructed in the 1930's, is a small water supply reservoir located on an unnamed tributary of Clark Creek (Figure 41). Public access to the lake is restricted and the watershed is forested close to the lake with some residential development.

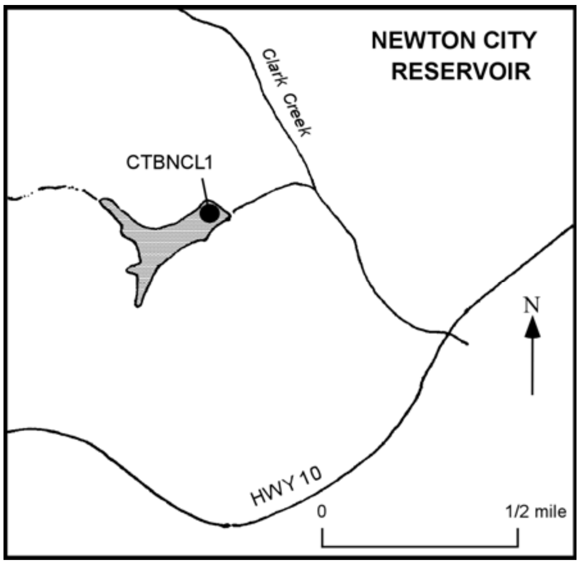


Figure 41. Sampling sites at Newton City Lake, Catawba County.

The reservoir was most recently sampled by DWQ in 2002. Nutrient concentrations were generally low with the exception of ammonia in June and August when values were elevated (Appendix 16). The Secchi depth in July was less than one meter and surface dissolved oxygen was elevated. The percent saturation of dissolved oxygen (115 percent) was greater than the water quality standard (110 percent for dissolved gasses). Surface metals were within applicable water quality standards with the exception of iron in July (1,200 µg/L) which was greater than the water quality action level (1,000 µg/L). In 2002, the lake was determined to be oligotrophic; the same trophic classification it received in 1992. In 2002, the lake was fully supporting its designated use as a water supply.

In 1992, low nutrient and chlorophyll *a* values were observed. Low turbidity (2.4 NTU) and a Secchi depth (1.8 meters) indicated good water clarity. Metals were within applicable water quality standards.

CATAWBA RIVER SUBBASIN 36

Description

Subbasin 36 is located entirely in Lincoln County in the Southern Outer Piedmont ecoregion. The small subbasin consists of the Long Creek watershed and a portion of the South Fork Catawba River between the Town of Stanly and Lake Wiley (Figure 42). Major metropolitan areas include the cites of Gastonia and Belmont, the Interstate 85 corridor, and parts of Bessemer City. Major dischargers in this watershed include Collins and Aikman Products (4 MGD) and the City of Gastonia's Long Creek WWTP (16 MGD), both discharging to the South Fork Catawba River. Most of the streams are very sandy due to erosion problems throughout the area. Land use remains primarily forested (Table 19).

Table 19. Land use in Subbasin 36. Based upon CGIA coverage 1993 - 1995, total area = 104 square miles (NCDENR 1999).

Land use	Percent
Water	3
Cultivated crop	2
Pasture	27
Urban	14
Forest	54

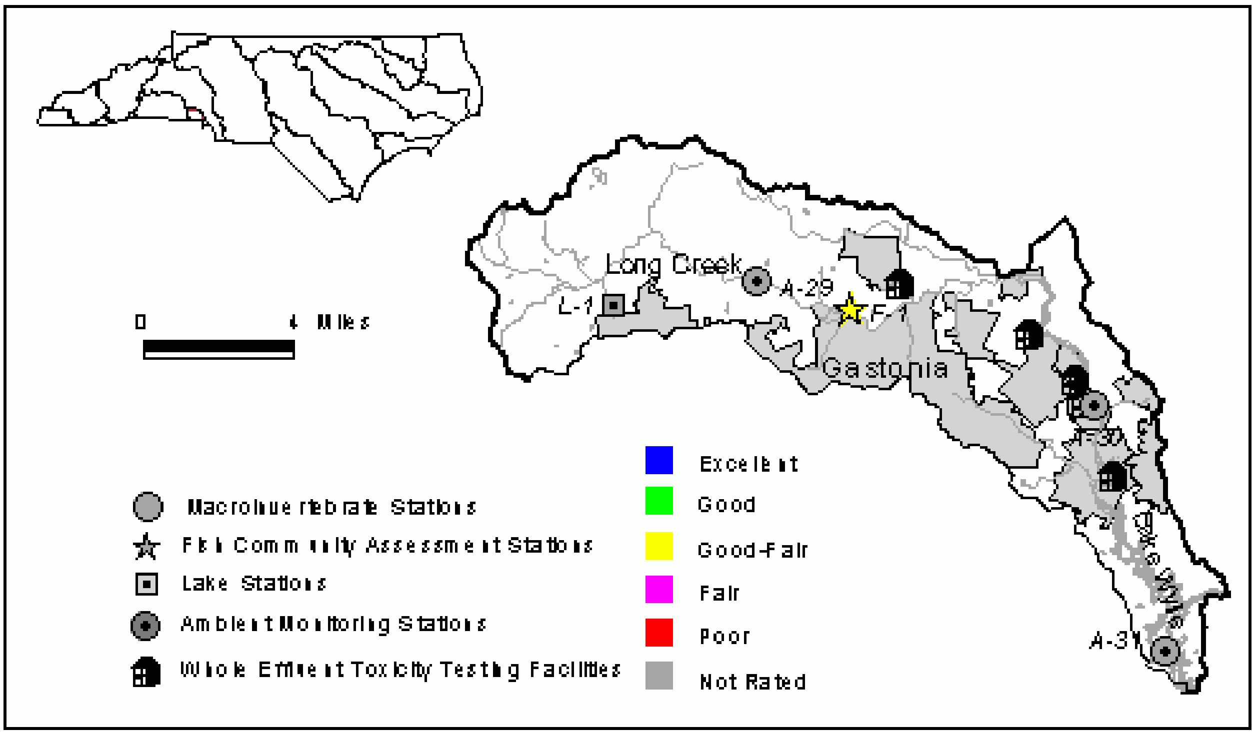


Figure 42. Sampling sites in Subbasin 36 in the Catawba River basin.

Overview of Water Quality

There are four ambient monitoring sites located in this subbasin: Long Creek at SR 1456, Long Creek at SR 2042, South Fork Catawba River at NC 7, and South Fork Catawba River at SR 2524. The Long Creek at SR 1456 site has exhibited elevated conductivity trends since the early 1990's, and has also shown elevated levels in pH since the middle 1980's. Long Creek at SR 2042 has shown declining trends in nutrients since the middle 1980's.

Benthic macroinvertebrate sampling could not be conducted in 2002 at the South Fork Catawba River and Long Creek sites due to flow problems.

However, fish community assessment was conducted on Long Creek in 2002 and resulted in a Good-Fair rating (Table 20).

Bessemer City Lake, a small water supply reservoir for Bessemer City, was classified as oligotrophic in 2002. Nutrient concentrations were low with the exception of elevated ammonia levels in June.

There are six facilities in this subbasin required to monitor effluent toxicity. Five of these facilities had one or more failing tests since 1997: Cramerton WWTP (2), Dallas WWTP (6), Lowell WWTP (2), Pharr Yarns (1), and Yorkshire Americas (3).

Table 20. Waterbodies monitored in Subbasin 36 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
F-1	Long Cr[2]	Gaston	US 321	Fair	Good-Fair
L-1	Bessemer City Lake	Gaston			

[1]F = fish community monitoring site; L = lake assessment sites.
[2]Data are available prior to 1997, refer to Appendix 11.

River and Stream Assessment

The South Fork Catawba River at NC 7 (Gaston County) was not sampled for benthos due to high flows; conversely, Long Creek at SR 1456 was not sampled due to low flows (Appendix 1). It was evident that during the August sampling trip, the South Fork Catawba River catchment had experienced a massive, albeit isolated, rain event. This rain event did not effect any other streams in the lower Catawba River basin.

Long Creek, US 321

The watershed of Long Creek includes the north side of Gastonia and Bessemer City and central Gaston County. An eight year study recently concluded on implementing nonpoint source controls in the upper two-thirds of the watershed. Best management practices, land use changes, closure of mining operations, construction of livestock exclusion fencing, and riparian buffer establishments all led to significant decreases in nutrients, sediment, and bacterial concentrations in the stream (Line and Jennings 2002).

At the fish community site, although the stream flows under US 321, beyond the bridges there is a good canopy across the stream, there are a variety of pools, and the riparian zones are fairly intact and wide.

Long Creek at US 321, Gaston County.

The stream has been sampled for fish in every basin cycle since 1993 and the ratings have improved from Poor to Good-Fair during this period (Figure 43).

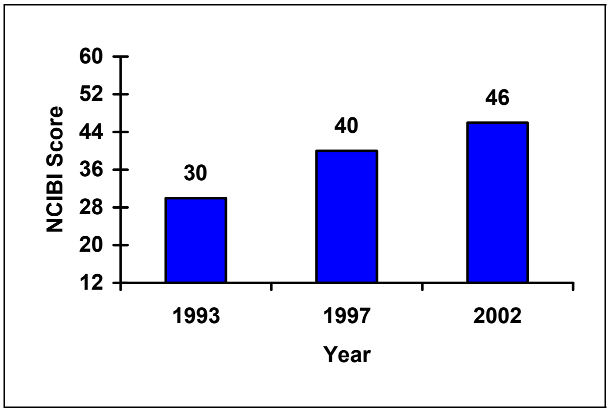


Figure 43. NCIBI scores from Long Creek at US 321, Gaston County, 1993 – 2002.

The number of fish collected has increased from 44 in 1993 to 290 in 2002; the species diversity has also increased from 5 in 1993 to 12 in 2002. The percentage of diseased fish decreased from 3.33 percent in 1997 to 0.34 percent in 2002. In 1997, the redbreast sunfish and bluegill were the two dominant species (37 and 34 percent, respectively). In 2002, the bluegill had replaced the redbreast as the dominant species (52 and 24 percent, respectively). As in 1997, only one specimen of a darter (a seagreen darter) was collected in 2002. The diversity of darters in this stream continued to be very low.

SPECIAL STUDIES
Streamside Best Management Practices
Two sites (Kiser Branch off SR 1448 and Kaglor Branch at Rankin Lake Park) were sampled as part of a study to examine the efficacy of streamside best management practices (BMPs). These BMPs included fencing out cattle, riparian zone replanting, and streambank stabilization. These BMPs failed to improve the invertebrate community at either site. In addition, the instream habitat (i.e., streambank stabilization) was unchanged after the BMP installation at Kaglor Branch. Conversely, the instream habitat and riparian zone of Kiser Branch was slightly improved after the installation of the BMPs (Biological Assessment Unit Memorandum 20010619).

Lake Assessment

Bessemer City Lake
This small impoundment on an unnamed tributary to Long Creek is the primary water supply for Bessemer City where public access is restricted (Figure 44). The drainage area is characterized by rolling hills with land use mostly forest interspersed with small residential and agricultural areas. The lake has been sampled five times by DWQ.

In 2002, dissolved oxygen and pH values in June and July peaked at a depth of four meters (11.0 mg/L in June and 8.5 mg/L in July), suggesting a subsurface algal bloom. Secchi depths were greater than two meters, indicating that light was available to support algal growth at the depths that the elevated dissolved oxygen were observed (Appendix 16). The subsurface dissolved oxygen maximum was not observed in August. Nutrient concentrations were low with the exception of ammonia in June, which was elevated. Chlorophyll *a* values were also low in June and August, but moderate in July. Surface metals were within applicable water quality standards. In 2002, the lake was oligotrophic, the same trophic classification it received in 1992. In 2002, the lake was supporting its designated use as a water supply.

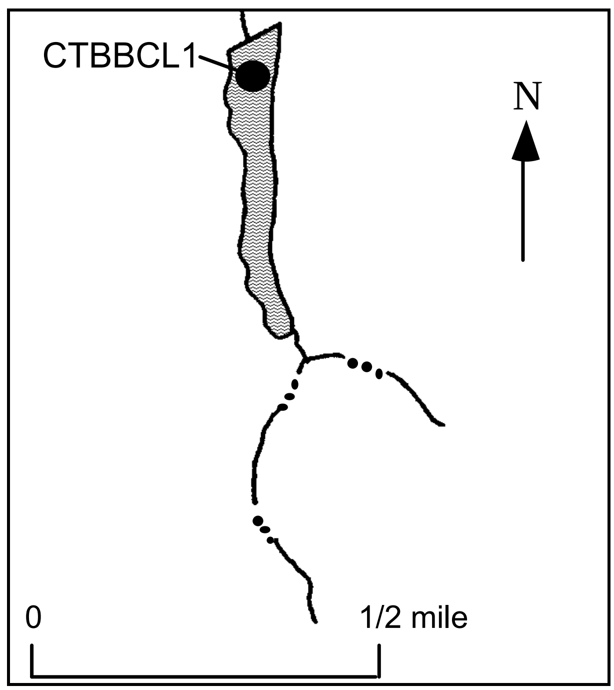


Figure 44. Sampling sites at Bessemer City Lake, Gaston County.

CATAWBA RIVER SUBBASIN 37

Description

This subbasin contains the Catawba and Crowders Creeks watersheds which flow through the Kings Mountain and Southern Outer Piedmont ecoregions (Griffith *et al* 2002) (Figure 45). Much of the subbasin is forested (Table 21), but there are also substantial urban areas including Bessemer City, the City of South Gastonia, and a portion of the City of Gastonia, south of the Interstate 85 corridor. The largest discharger is the City of Gastonia with two permitted WWTP discharges -- one to Catawba Creek (9 MGD) and one to Crowders Creek (6 MGD).

Table 21. Land use in Subbasin 37. Based upon CGIA coverage 1993 - 1995, total area = 106 square miles (NCDENR 1999).

Land use	Percent
Water	1
Cultivated crop	1
Pasture	20
Urban	15
Forest	63

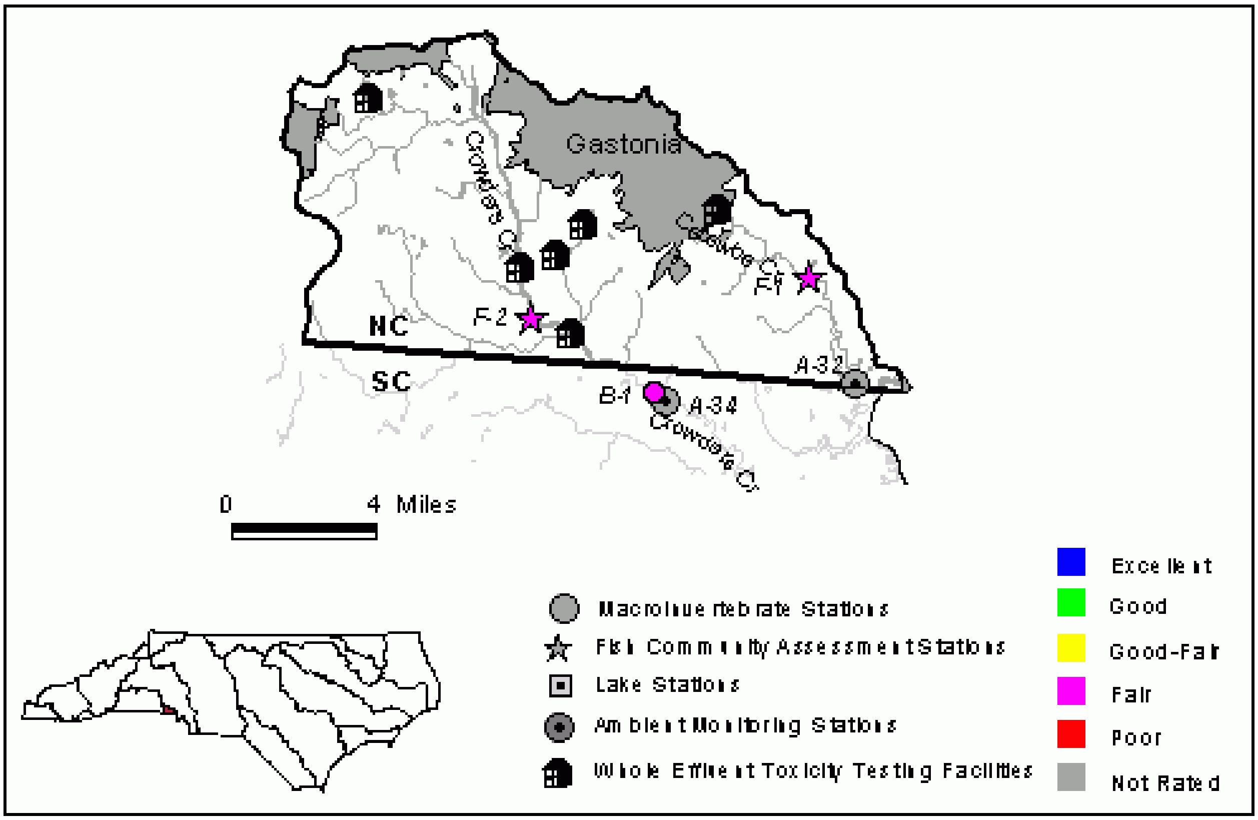


Figure 45. Sampling sites in Subbasin 37 in the Catawba River basin.

Overview of Water Quality

There are three ambient monitoring sites located in this subbasin: Catawba Creek at SR 2302, Lake Wylie at NC 49, and Crowders Creek at SC 564. Catawba Creek has shown a steady decrease in conductivity since the middle 1980's, whereas Crowders Creek has shown a steady elevated trend in conductivity levels since the early 1990's. Catawba Creek has shown slightly decreased total phosphorus concentrations since the late 1970's while dissolved oxygen concentrations have consistently dropped since the late 1970's. Crowder's Creek has shown elevated trends in NO_2+NO_3-N and pH since the early 1980's.

Point source dischargers have historically contributed to severe problems in Crowders Creek. A benthic macroinvertebrate sample at the SC 564 site in 1988 was rated Poor. Although the rating improved to Fair in 1989 and Good-Fair in 1992, this site has been rated Fair since 1997 (Table 22). One facility implicated in the degraded water quality was the Carolina and Southern Processing plant. Approximately three years ago, this facility tied onto the City of Gastonia's WWTP and has ceased its direct discharge to Crowders Creek. Additionally, in the spring of 2002, the Bessemer City WWTP ceased its 1.5 MGD discharge to Abernethy Creek (a tributary to Crowders Creek); its wastes now go Gastonia's WWTP which also recently underwent treatment upgrades. These changes may have been responsible for the slight improvement in community metrics seen in Crowders Creek from the 1997 sample. Additional improvements from Fair in 1989 to Good-Fair in 2001 occurred at an upstream site at SR 1125.

A fish sample was also collected in 2002 further upstream on Crowders Creek at SR 1108. This sample was rated Fair; the same rating it received in 1997.

There are six facilities in this subbasin required to monitor effluent toxicity. Five of these facilities have had one or more failing tests since 1997: Gastonia/Catawba Creek WWTP (3 failures), FMC Corp. (formerly Lithium Corp.) (3), Rhodia Inc. (4), CR Industries (3), and Textron, Inc. (7).

Table 22. Waterbodies monitored in Subbasin 37 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
B-1	Crowders Cr[2]	Gaston	SC 564	Fair	Fair
F-1	Catawba Cr	Gaston	SR 2435	Good-Fair	Fair
F-2	Crowders Cr	Gaston	SR 1108	Fair	Fair

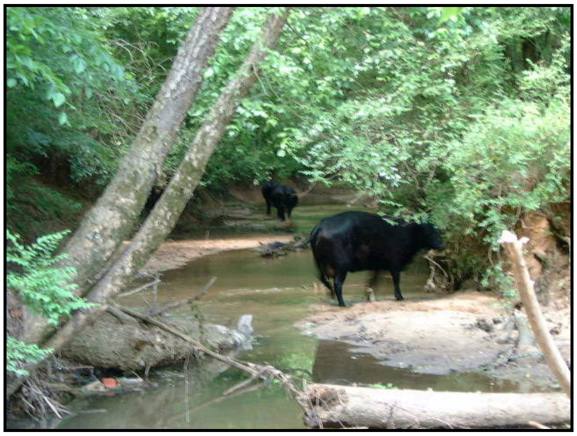
[1]B = benthic macroinvertebrate monitoring sites; F = fish community monitoring sites.
[2]Data are available prior to 1997, refer to Appendix 7.

River and Stream Assessment

Catawba Creek, SR 2435

Catawba Creek, a tributary to Lake Wylie, drains the south and southeast area of the City of Gastonia and southeastern Gaston County. The City of Gastonia's 9 MGD WWTP which previously discharged to Catawba Creek no longer discharges into this watershed. Eliminating this discharge decreased the conductivity in the stream from 293 µmhos/cm in 1997 to 148 µmhos/cm in 2002. Three smaller NPDES permitted dischargers continue to operate with the watershed. At this site, the stream and riparian zones are degraded by poor land use and permitting livestock to have access to the stream and the entire stream channel.

Vertical and eroding banks at Catawba Creek at SR 2435, Gaston County.



Cattle in Catawba Creek at SR 2435, Gaston County.

The fish community was rated Fair in 2002, in 1997 it was rated Good-Fair (NCIBI = 40 and 42, respectively). Similar to Hoyle Creek in Subbasin 35, at Catawba Creek although more fish (348 *vs*. 138) were collected in 2002 than in 1997, the community slightly shifted towards one with a greater percentage of omnivores+herbivores, especially bluehead chubs. In 2002, 39 percent of all fish collected were the bluehead chub; in 1997 it was 14 percent. The percentages of the other two trophic metrics, insectivores and piscivores, also declined between 1997 and 2002. Intolerant species were absent in 1997 and in 2002.

Crowders Creek, SR 1108

Crowders Creek, also a tributary to Lake Wylie, drains the south and western region of the City of Gastonia, the Interstate 85 corridor, and the eastern area of the Town of Kings Mountain. As a result of its urban watershed, discarded automobile tires were common in the stream. At this location, riffles were absent and the stream was shallow with a sandy substrate. There are seven NPDES permitted dischargers within the site's watershed with a combined discharge of 1.02 MGD. The conductivity in 1997 and 2002 during fish sampling was 178 and 172 µmhos/cm, respectively.

Crowders Creek at SR 1108, Gaston County.

The fish community was rated Fair in 1997 and 2002 (NCIBI = 36 and 38, respectively). More species and fish were collected in 2002 than in 1997 but there was a decline in the diversities of suckers and sunfish and an absence of piscivores. Only one specimen of a darter and only one specimen of an intolerant species were present in 2002. As in 1997, the bluehead chub was the dominant species in 2002.

Crowders Creek, SC 564

The habitat along this reach of Crowders Creek is comprised primarily of sand substrate (80 percent). Pools were well developed, riffles were infrequent, and bank erosion was severe despite the well-developed riparian zone.

Crowders Creek at SC 564, York County, SC.

In 1988 this site was rated Poor because of chronic problems associated at Carolina and Southern Processing (a chicken processing plant). This facility had problems through 1997.

Approximately three years ago this facility tied into the City of Gastonia's WWTP. In addition, Bessemer City ceased its discharges to Abernethy Creek, which is a tributary to Crowders Creek.

The site was rated Good-Fair in 1992 and Fair in 1997 and 2002. Although the bioclassification did not change, several of the metrics improved between 1997 and 2002:

- the number of EPT S increased from 11 to 14;
- the EPT N increased from 40 to 58; and
- the BI decreased from 6.6 in 1997 to 6.3 in 2002.

This site may be exhibiting the initial signs of improvement due to discharge relocations and facility upgrades.

SPECIAL STUDIES

Crowders Creek TMDL Development.

Eleven sites were sampled as part of a TMDL study to evaluate present water quality conditions following the ceasing of the discharges from the Town of Kings Mountain's and Bessemer City's WWTPs. The goal of the study was also to determine the stressors causing the loss of biological integrity in this catchment (Biological Assessment Unit Memorandum 20021125).

CATAWBA RIVER SUBBASIN 38

Description

This small subbasin includes portions of two ecoregions – the Southern Outer Piedmont and the Carolina Slate Belt (Griffith *et al* 2002) (Figure 46). The streams, tributaries to the Catawba River in South Carolina, have very low flows during the summer and may stop flowing during drought periods. Much of the subbasin is forested but a greater percentage of the land is classified as cultivated than in any other subbasin (Table 23). Major dischargers in this subbasin include the Union County/Six Mile Creek (1.0 MGD) and Twelvemile Creek WWTPs (2.5 MGD).

Table 23. Land use in Subbasin 38. Based upon CGIA coverage 1993 - 1995, total area = 179 square miles (NCDENR 1999).

Land use	Percent
Water	1
Cultivated crop	7
Pasture	28
Urban	4
Forest	61

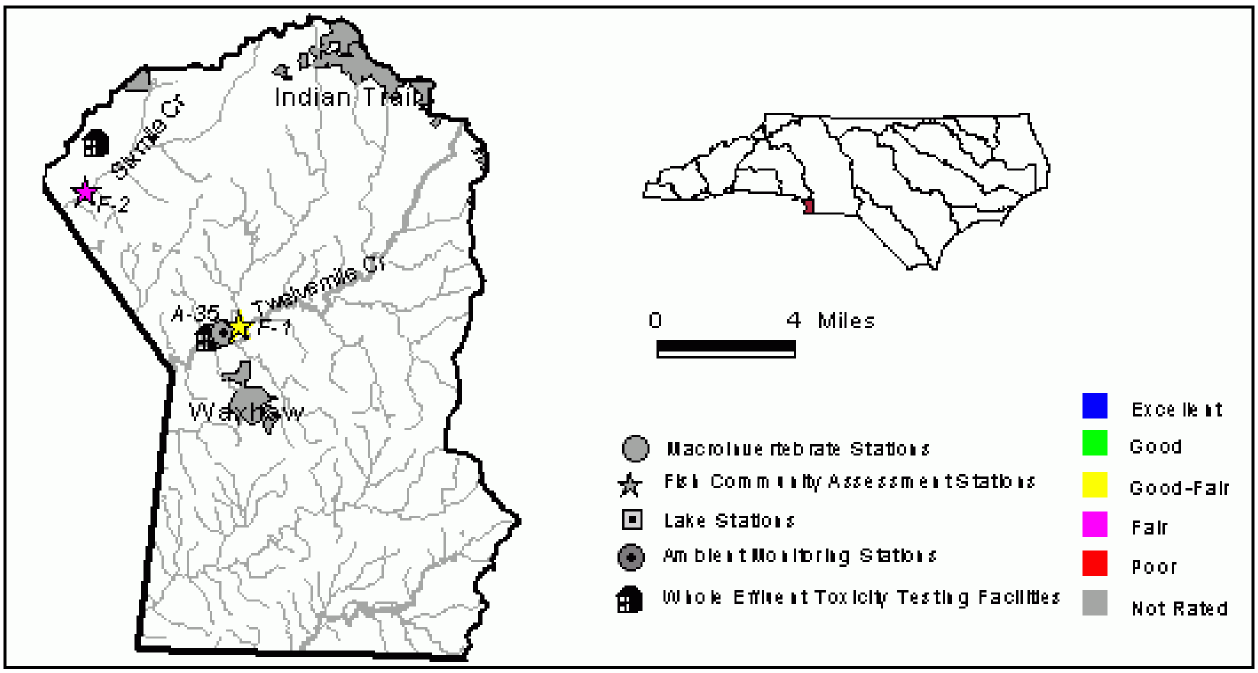


Figure 46. Sampling sites in Subbasin 38 in the Catawba River basin.

Overview of Water Quality

There is only one ambient monitoring site in this subbasin: Twelve Mile Creek at NC 16. This site has exhibited elevated conductivity trends since the early 1990's; other parameters have remained stable since monitoring began in the early 1980's.

Nonpoint source runoff is a major source of water quality degradation in this subbasin. However, acute and prolonged lack of flows during the summer intrinsically limit the diversity of the stream fauna. No benthic macroinvertebrate samples have been collected from this subbasin since 1992. Benthic macroinvertebrates have been collected only six times from three locations since 1983. Four of the collections were made in the winter and early spring when flows were the highest. Twelvemile and Waxhaw Creeks were last rated Good-Fair in the early 1990s.

The fish community in Twelvemile Creek declined from Good in 1997 to Good-Fair in 2002, while Sixmile Creek maintained its Fair rating in 2002 (Table 24).

There are two facilities in this subbasin which are required to monitor effluent toxicity. Since 1997, the Union County/Six Mile Creek WWTP failed two tests and the Union County/Twelve Mile Creek WWTP failed three tests.

Table 24. Waterbodies monitored in Subbasin 38 in the Catawba River basin for basinwide assessment, 1997 - 2002.

Map #[1]	Waterbody	County	Location	1997	2002
F-1	Twelvemile Cr	NC 16	Union	Good	Good-Fair
F-2	Sixmile Cr	SR 1312	Union	Fair	Fair

[1]F = fish community monitoring sites.

River and Stream Assessment

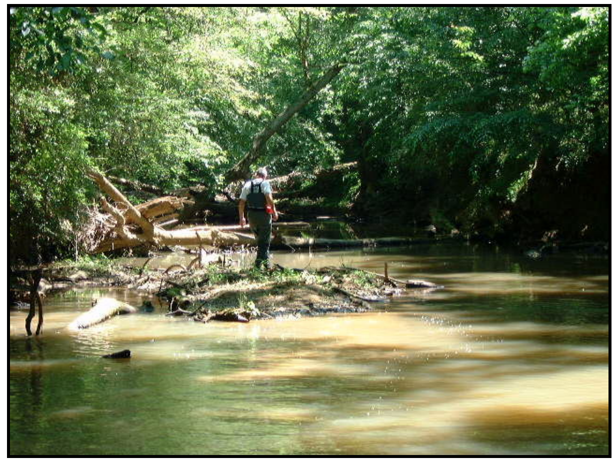
Twelvemile Creek (NC 16), Sixmile Creek (SR 1312), and Waxhaw Creek (SR 1103), all in Union County, were not sampled for benthos in 2002 due to lack of flow (Appendix 1). In addition, no benthic macroinvertebrate samples were collected from this subbasin in 1997 due to no flow conditions. Benthic macroinvertebrate samples have been collected only six times from three locations in this subbasin since 1983.

Waxhaw Creek was not sampled for fish community assessment in 2002. The stream is classified by the North Carolina Wildlife Resources Commission as Collection Sensitive Waters where sampling is strictly controlled. It was rated Excellent in 1997 (Appendix 11).

Twelvemile Creek, NC 16

The watershed of Twelvemile Creek abuts against the Crooked Creek watershed in the Yadkin River basin. There are no NPDES facilities within the site's watershed.

Draining southwestern Union County, the stream lies within the only portion of the Carolina Slate Belt in the Catawba River basin. At the top of the 600 ft. reach, the West Fork Twelvemile Creek and the East Fork Twelvemile Creek join to form Twelvemile Creek. Suspended sediment from the West Fork discolored the entire channel of Twelvelmile Creek. The habitats of the East Fork are Slate Belt-like while below its mouth, Twelvemile Creek changes to primarily snags and wide pools with a gravel and sand substrate; riffles are also absent. A study should be done to compare the fish communities in each of the two forks of Twelvemile Creek.



Turbidity seen in Twelvemile Creek at NC 16, Union County.

In 1997, the fish community was rated Good, in 2002 it was rated Good-Fair (NCIBI = 48 and 42, respectively). This decline was attributed to three metrics: total species diversity, fish abundance, and the diversity of suckers. Between 1997 and 2002, the species diversity decreased from 23 to 15; fish abundance decreased from 208 to 111, and the diversity of suckers decreased from 3 to 1. Species lost in 2002 were greenfin shiner, spottail shiner, white sucker, notchlip sucker, brassy jumprock, flat bullhead, margined madtom, eastern mosquitofish, black crappie, yellow perch, and tessellated darter. Twenty six species are known from this site, but only 15 were collected in 2002.

In 1997, the dominant species was bluegill (21 percent), in 2002 it was the sandbar shiner (41 percent). The sandbar shine constituted only 3 percent of the fish in 1997 and the bluegill only 5 percent in 2002. No intolerant species were collected in 1997 or 2002. Darters were also absent in 2002.

Sixmile Creek, SR 1312
Sixmile Creek flows along the border between Mecklenburg and Union counties and drains the southeast and southwest portions of each county respectively. There are two NPDES facilities in the watershed above the monitoring site with a combined discharge of 0.25 MGD. During fish community sampling, the conductivity (185 µmhos/cm) in Sixmile Creek was the highest of any site in the basin in 2002. Livestock had access to the stream along the northwest shoreline through a broken fence.

Sixmile Creek at SR 1312, Union County.

The fish community was rated Fair in 1997 and 2002 (NCIBI = 40 and 38, respectively). No suckers or intolerant species were collected in 2002. In 2002, the dominant species was the swallowtail shiner; in 1997 it had been the redbreast sunfish.

AMBIENT MONITORING SYSTEM

An understanding of human activities and natural forces that affect pollution loads and their potential impacts on water quality can be obtained through routine sampling from fixed monitoring stations. Routine sampling is referred to as ambient water quality monitoring and during this five year assessment period (September 1, 1997 – August 31, 2002), 35 stations were monitored by DWQ within the basin (Table 25 and Figure 47).

The Ambient Monitoring System is based on a network of fixed stations established at convenient access points (e.g., bridge crossings) and sampled on a monthly basis. These locations have been chosen to characterize the effects of point source dischargers and non-point sources such as agriculture, animal operations, and urbanization within watersheds. Currently, DWQ does not conduct random or probabilistic monitoring.

Table 25. Ambient monitoring system sites within the Catawba River basin.

Subbasin/ Map Code[1]	Station Number	Waterbody/Location	County	Class
03-08-30				
A-1	C0145000	Catawba R at SR 1234 near Greenlee	McDowell	C
A-2	C0250000	Catawba R at SR 1221 near Pleasant Gardens	McDowell	C
A-3	C0550000	N Fork Catawba R at SR 1552 near Hankins	McDowell	C
A-4	C1000000	Linville R at NC 126 near Nebo	Burke	B HQW
A-5	C1210000	Catawba R at SR 1147 near Glen Alpine Marion	Burke	WS-IV
03-08-31				
A-6	C1370000	Wilson Cr at US 221 near Gragg	Avery	B Tr ORW
A-7	C1750000	Lower Cr at SR 1501 near Morganton Marion	Burke	WS-IV
A-8	C2030000	Lake Rhodhiss at SR 1001 near Baton Marion	Burke	WS-IV & B CA
03-08-32				
A-9	C2600000	Lake Hickory at NC 127 near Hickory	Catawba	WS-V&B
A-10	C2818000	Lower Little R at SR 1313 near All Healing Springs	Alexander	C
A-11	C3420000	Lake Norman at SR 1004 near Mooresville	Iredell	WS-IV&B CA
03-08-33				
A-12	C3699000	Mountain Island Lake Above Gar Cr near Croft	Gaston	WS-IV&B CA
A-13	C3860000	Dutchmans Cr at SR 1918 at Mountain Island	Gaston	WS-IV
A-14	C3900000	Catawba R at NC 27 near Thrift	Mecklenburg	WS-IV CA
03-08-34				
A-15	C4040000	Long Cr at SR 2042 near Paw Creek	Gaston	WS-IV
A-16	C4220000	Catawba R at powerline crossing at South Belmont	Mecklenburg	WS-IV&B CA
A-33	C7500000	Lake Wylie at NC 49 near Oak Grove	Mecklenburg	WS-V&B
A-17	C8896500	Irwin Cr at Irwin Cr WWTP near Charlotte	Mecklenburg	C
A-18	C9050000	Sugar Cr at NC 51 at Pineville	Mecklenburg	C
A-19	C9210000	Little Sugar Cr at NC 51 at Pineville	Mecklenburg	C
A-20	C9370000	McAlpine Cr at SR 3356 Sardis Rd near Charlotte	Mecklenburg	C
A-21	C9680000	McAlpine Cr at SC SR 2964 near Camp Cox SC	Lancaster (SC)	FW
A-22	C9790000	Sugar Cr at SC 160 near Fort Mill SC	Mecklenburg	FW
03-08-35				
A-23	C4300000	Henry Fork R at SR 1124 near Henry River	Catawba	C
A-24	C4360000	Henry Fork R at SR 1143 near Brookford	Catawba	C
A-25	C4370000	Jacob Fork at SR 1924 at Ramsey	Burke	WS-III ORW
A-26	C4380000	S Fork Catawba R at NC 10 near Startown	Catawba	WS-IV
A-27	C4800000	Clark Cr at SR 1008 Grove St at Lincolnton	Lincoln	WS-IV
A-28	C5170000	Indian Cr at SR 1252 near Laboratory	Lincoln	WS-IV
03-08-36				
A-29	C5900000	Long Cr at SR 1456 near Bessemer City	Gaston	C
A-30	C6500000	S Fork Catawba R at NC 7 at Mcadenville	Gaston	WS-V
A-31	C7000000	S Fork Catawba R at SR 2524 near South Belmont	Gaston	WS-V&B
03-08-37				
A-32	C7400000	Catawba Cr at SR 2302 at SC State Line	Gaston	C
A-34	C8660000	Crowders Cr at SC 564, near Bowling Green, SC	York (SC)	FW
03-08-38				
A-35	C9819500	Twelve Mile Cr at NC 16 near Waxhaw	Union	C

[1]See Figure ---.
[2]Sites with an "FW" classification are in South Carolina.

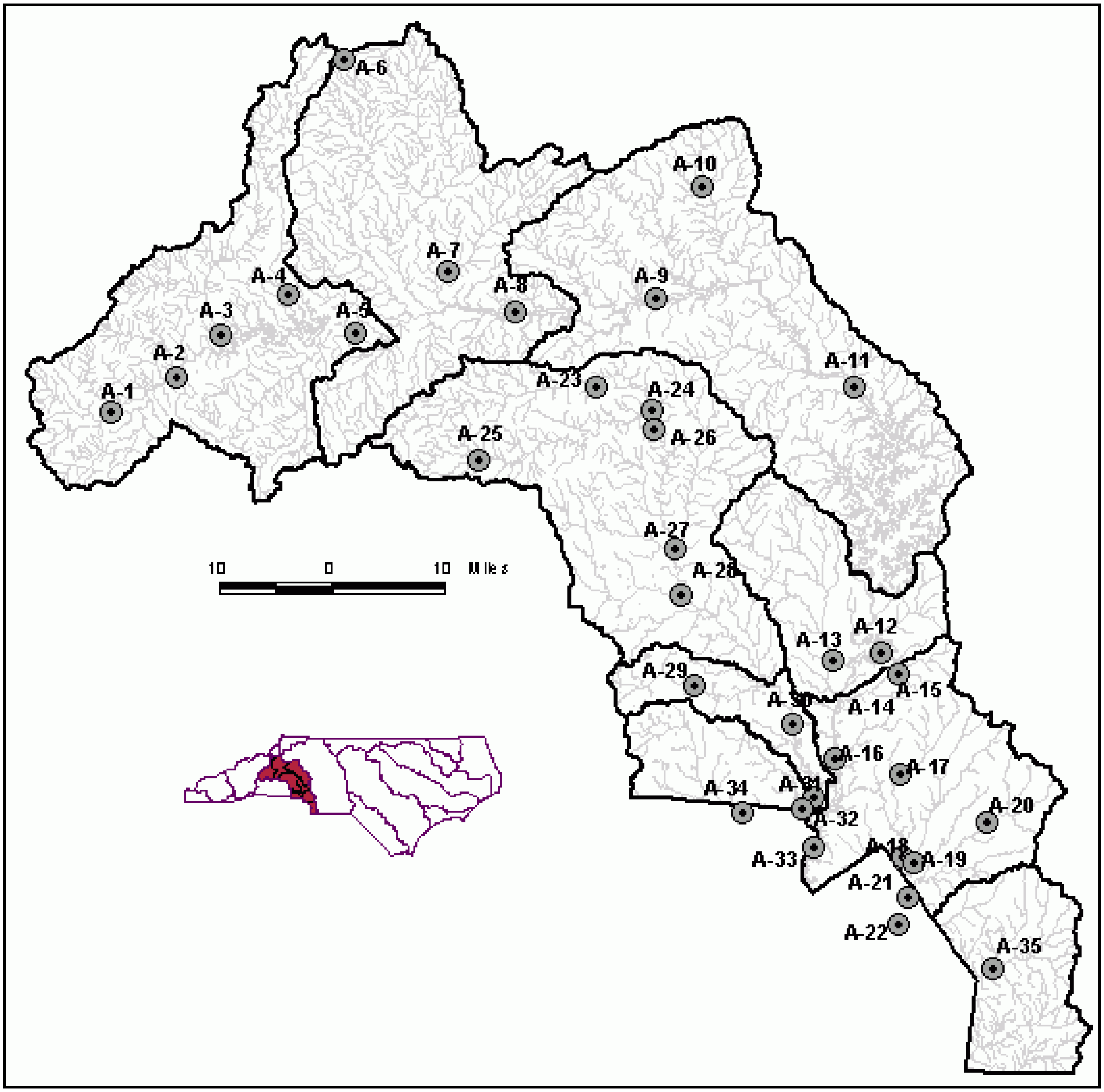


Figure 47. Ambient monitoring system sites within the Catawba River basin.

Data from the System is used to identify long term trends within watersheds, to develop Total Maximum Daily Loads, and to compare measured values with water quality standards to identify possible areas of impairment.

Data Assessment and Interpretation

Monitoring and sampling results considered in this report represent samples collected or measurements taken at less than one meter in depth to establish a consistent comparison among the stations throughout the basin. Median and percentile statistics are calculated for most of the data. Percentiles were calculated using Microsoft® Excel 2000; values less than the minimum reporting level were evaluated as equal to the reporting level. Box and whisker plots (constructed using SigmaPlot® 2002 version 8.02) are presented only for those water quality characteristics that showed significant variation among the stations.

Analytical Considerations

Two issues were noted as part of the analytical laboratory process during this assessment period:

1) laboratory or sampling related contamination may have produced higher than expected values of zinc beginning in April 1995 and ending in March 1999; and
2) reporting levels for nutrients changed during 2002 during the initiation of new quality assurance procedures (Table 26).
3) Due to quality assurance problems with nitrogen and phosphorus parameters discovered in early 2001, ammonia (NH_3), nitrate+nitrite nitrogen (NO_2+NO_3-N) and total phosphorus results less than 0.05 mg/L and total Kjeldahl nitrogen results less than 1.0 mg/L., did not meet desired quality assurance measures. Neither the accuracy nor bias of those results is known. The results therefore are presented as reported but should be considered with a great deal of uncertainty.

Table 26. DWQ Laboratory Section reporting levels for nutrients during 2001.

	Nutrient			
Time Period	NH_3 as N	TKN as N	NO_2+NO_3 as N	TP
pre 2001	0.01	0.1	0.01	0.01
03/13 – 29/2001	0.5	1.0	0.5	0.5
03/30 – 07/24/2001	0.2	0.6	0.15	0.1
since 07/25/2001	0.01	0.2	0.01	0.02

Use Support Assessment Considerations

1) The dissolved freshwater oxygen concentrations of 5.0 and 4.0 mg/L are presented as evaluation levels. Instantaneous concentrations of 4.0 mg/L or less can occur and may be acceptable if caused by natural (e.g. swampy) conditions.
2) Action levels (copper, iron, and zinc) are used primarily as evaluation guidelines because results include fractions that may have little effect on aquatic life. Where appropriate, follow-up toxicological work will need to be conducted before use support determination can be made for these parameters.
3) The geometric mean and median statistics were calculated for fecal coliform results for each station.

Specific information on water quality standards and action levels is found in the NCAC (2002).

Dissolved Oxygen

During this assessment period, two stations had more than 10 percent of the measurements less than 5.0 mg/L and one station had more than 10 percent of the measurements less than 4.0 mg/L (Figure 48 and Table 27). All available data from these sites were graphed to determine if long term increases or decreases were present over time. No temporal patterns were evident.

Table 27. Percentage of all dissolved oxygen concentrations less than 5 and 4 mg/L at select sites in the Catawba River basin, 1997 – 2002.

Station	Waterbody/Location	N	< 5	< 4
C9680000	McAlpine Cr near Camp Cox, SC	59	---	10.2
C9819500	Twelve Mile Cr at NC 16 near Waxhaw	58	10.3	15.5

Among some stations, the lowest concentrations of dissolved oxygen were observed during the summers of 2001 and 2002, perhaps related to drought conditions and low flow.

pH

Throughout North Carolina, the pH of natural waters can vary. Low values (<< 7.0 s.u.) can be found in waters rich in dissolved organic matter, such as wetlands, whereas high values (>> 7.0 s.u.) are found during algal blooms. Point source dischargers can also influence the pH of a stream. The measurement of pH is relatively easy, however extremely accurate measurements are difficult to make under field conditions. This is due, in part, because the scale for measuring pH is logarithmic (i.e. a pH of 8 is ten times less concentrated in hydrogen ions than a pH of 7).

The water quality standards for pH in freshwaters consider values less than 6.0 s.u. or greater than 9.0 s.u. to warrant attention. Only Wilson Creek (Station C1370000) had more than 10 percent (17.5 percent) of the samples less than 6.0 s.u. within this monitoring period (Figures 49 and 50). There is no known reason for the drop in pH at this site during this period although this high altitude station was established primarily to document pH and impacts from acid precipitation.

Conductivity

Conductivity is a measure of the ability of water to conduct an electric current. The presence of ions and temperature are major factors in the ability of water to conduct a current. Clean, freshwater has a low conductivity, whereas high conductivities may indicate polluted water. Measurements reported are corrected for temperature, thus the range of values reported over a period of time indicate the relative presence of ions in water.

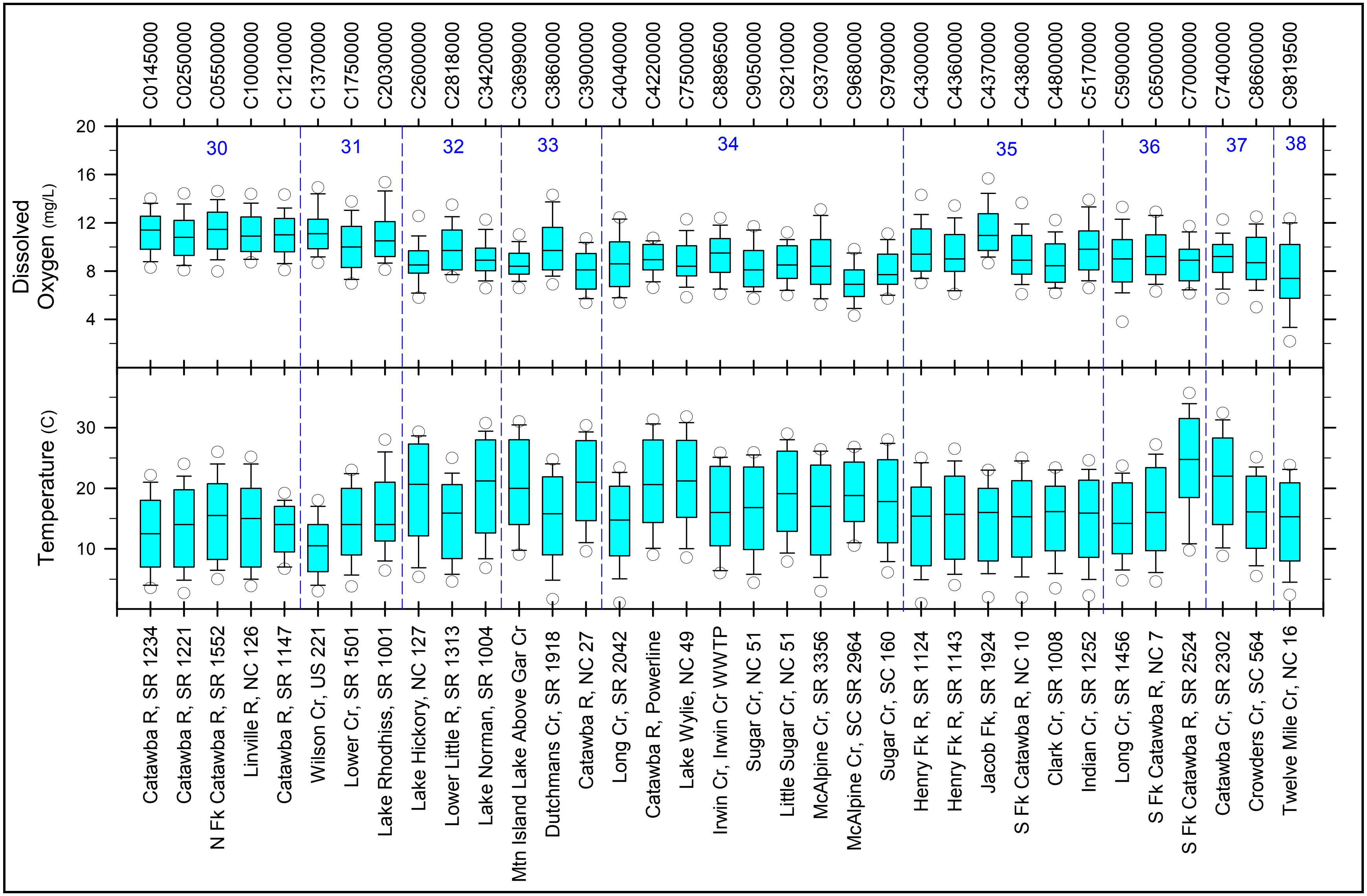


Figure 48. Box and whisker plots for dissolved oxygen and temperature in the Catawba River basin, September 1997 to August 2002. Data are plotted in subbasin and station number order.

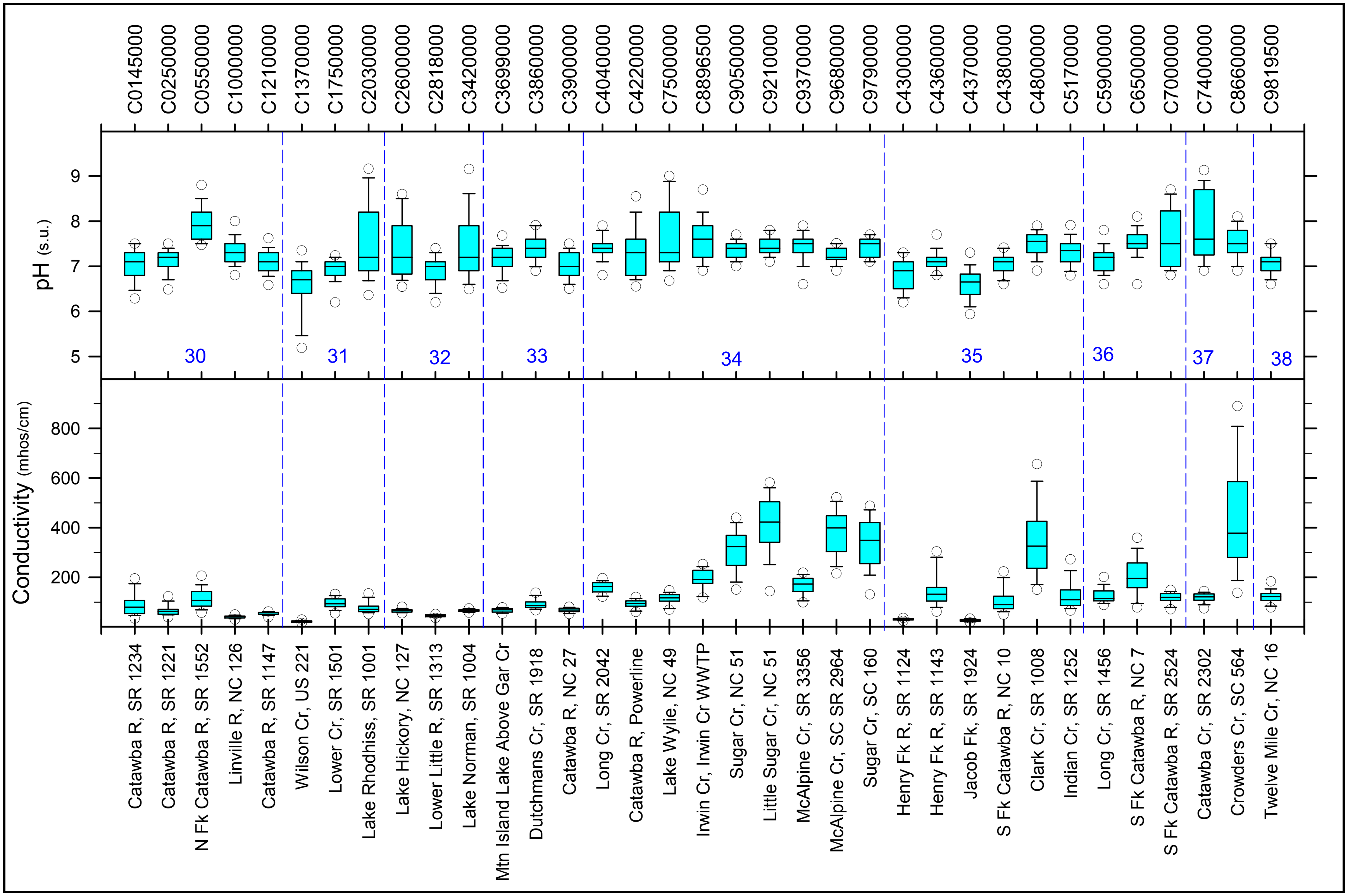


Figure 49. **Box and whisker plots for pH and conductivity in the Catawba River basin, September 1997 to August 2002. Data are plotted in subbasin and station number order.**

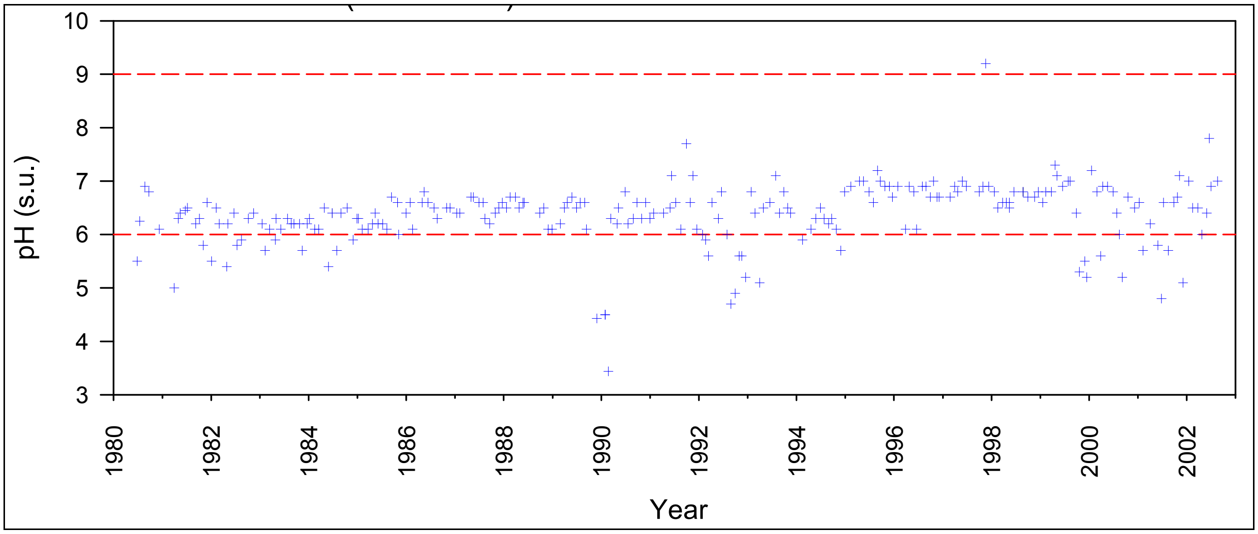


Figure 50. pH at Wilson Creek, at US 221 near Gragg, Avery County, 1980 – 2002.

Conductivities in US waters commonly vary between 50 to 1,500 µmhos/cm (APHA 1998). However 95 percent of the values observed from the basin were between 22 and 500 µmhos/cm (Figure 48); a maximum of 1,670 µmhos/cm was observed at Crowders Creek (Station C8660000) on August 13, 2002.

Conductivity can be used to evaluate variations in dissolved mineral concentrations (ions) among sites with varying degree of impact resulting from point source discharges. Generally, impacted sites show elevated and widely ranging values for conductivity. Many stations (for example in Subbasins 34- 36) showed widely varying values which were the result of point source dischargers located upstream of the sample site (Figure 48). Notable were the effluent- and urban-dominated streams of Mecklenburg County.

Turbidity

Turbidity data may denote episodic high values on particular dates or within narrow time periods These can often be the result of intense or sustained rainfall events; however elevated values can occur at other times. Four stations within this assessment period had more than 10 percent of the observations greater than the water quality standard (Table 28 and Figure 51). However, no long term increasing or decreasing patterns were evident.

Table 28. Stations with more than 10 percent of the samples exceeding the turbidity standard.[1]

Station	Waterbody/Location	Class	N	% >50
C1750000	Lower Cr at SR 150	WS-IV	54	22.2
C4040000	Long Cr at SR 2042	WS-IV	59	10.2
C9790000	Sugar Cr at SC 160	FW	58	10.3
C9819500	Twelve Mile Cr at NC 16	C	55	12.7

[1]Turbidity standard = 10 NTU for trout waters; 25 NTU for reservoirs; and 50 NTU for all other stations.

Metals

Arsenic, cadmium, chromium, lead, mercury and nickel rarely exceeded the analytical reporting level (Appendix 17). Concentrations greater than the reporting level were generally too few to interpret statistically. Almost 9,000 analyses for these six metals were reported during this assessment period and only 75 analyses (< 1 percent) were greater than the reporting level. Monthly sampling occurred up to mid-year 2000; afterwards quarterly sampling was initiated.

The Catawba River near Pleasant Gardens (Station C0250000) had the most analyses (11) greater than the reporting level. Of the seven analyses for lead that were greater than the reporting level (10 µg/L), only one was greater than the water quality standard (25 µg/L). Four analyses for nickel had concentrations greater than the reporting level (10 µg/L), but none were greater than the standard (88 µg/L).

Metals that typically had a sufficient number of concentrations that exceeded reporting levels included aluminum, copper, iron, manganese and

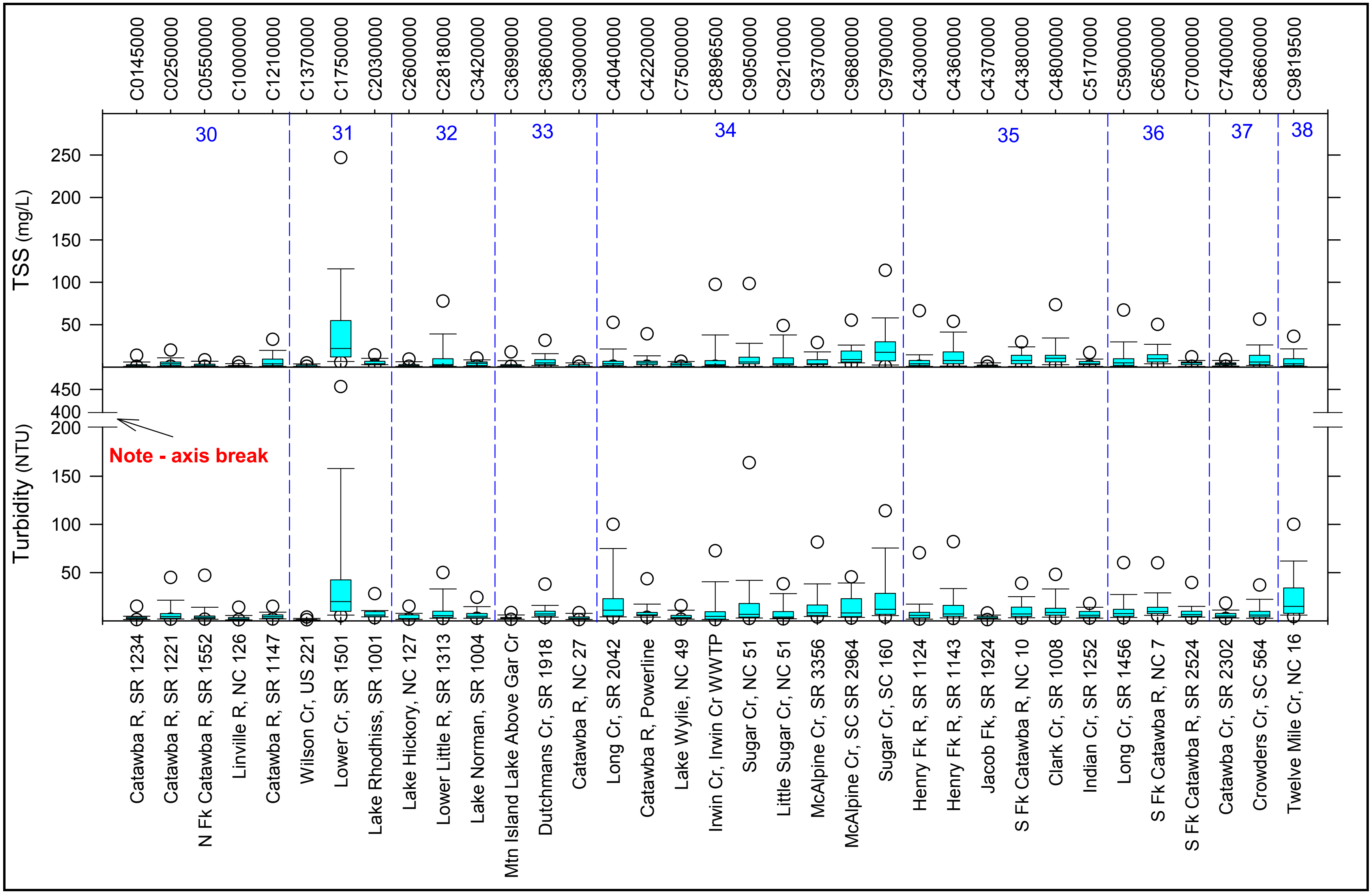


Figure 51. **Box and whisker plots for total suspended solids (TSS) and turbidity in the Catawba River basin, September 1997 to August 2002. Data are plotted in subbasin and station number order.**

zinc. Aluminum and iron are elements commonly observed to exceed their action levels but these elements are found naturally in the clay-based soils in the Piedmont.

Twenty stations had more than 10 percent of the copper concentrations greater than the action level (7.0 µg/L) (Table 29). Only the South Fork Catawba River near South Belmont (Station C7000000) had a median concentration (9.2 µg/L), greater than action level and 81 percent of the samples exceeded the action level.

Only three stations had more than 10 percent of the zinc analyses greater than the action level (50 µg/L). However these results include all the samples collected during this assessment period (August 1997 to September 2002). The DWQ Laboratory Section noted analytical issues with zinc during the early portion of the assessment period and began block digestion in April 1999. Since April 1999 no station had more than 10 percent of the zinc concentrations greater than the action level.

Seventeen stations have water supply classification and standards for manganese. Only Long Creek (Station C4040000) had more than 10 percent of the samples (11.4 percent) exceeding the water quality standard (200 µg/L). The 90th percentile concentration for this site was 198 µg/L.)

Fecal Coliform Bacteria
Fecal coliform bacteria concentrations can vary greatly. The descriptive statistics used to gage these concentrations include the geometric mean or the median and these depend on the classification of the waterbody. Basically for all freshwater bodies the standard specified in NCAC (2002) is applicable: *"Organisms of the coliform group: fecal coliforms shall not exceed a geometric mean of 200/100ml (MF count) based upon at least five consecutive samples examined during any 30 day period, nor exceed 400/100ml in more than 20 percent of the samples examined during such period; violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable nonpoint source pollution; all coliform concentrations are to be analyzed using the membrane filter technique unless high turbidity or other adverse conditions necessitate the tube dilution method; in case of controversy over results, the MPN 5-tube dilution technique shall be used as the reference method."* The applicability of this standard is often hindered because the monthly (*circa* 30 day) sampling frequency employed for ambient monitoring usually does not provide for more than one sample per 30 day period. However water quality problems can be discerned using monthly sampling (Table 50 and Figure 52).

Thirteen stations exceeded the geometric mean of 200 colonies/100 ml reference level (standard). None of these were Class B stations -- stations classified for organized swimming activities.

Nutrients
Elevated nutrient concentrations were present at many tributary stations (Figures 53 and 54). Overall, this pattern was due to the effects of point source discharges. Long term patterns were evident at only a few stations (Figures 55 and 56). Although concentrations were very high at Little Sugar and Sugar Creeks (Stations C9210000 and C9790000, respectively), the long term patterns showed a dramatic decrease in concentrations. Increasing concentrations were evident at Clark and Crowders Creeks (Stations C4800000 and C8660000, respectively). There were spikes in ammonia nitrogen and total Kjeldahl nitrogen at Crowders Creek between 1996 and 1998 (Figure 57). Currently, there are no explanations for these spikes.

Analyses by Subbasin
Mean and median values by subbasin are provided in Table 31. This summary provides a regional perspective to water quality assessment and assist natural resource management agencies in identifying watersheds for restoration, wetland mitigation, wastewater treatment facility improvements, stormwater management, and nonpoint source improvements. These tables should be used in conjunction with Figures 48 - 54 and with the understanding that the means and median values are based on different sample sizes (number of monitoring stations) among the subbasins.

The state's largest metropolitan area is the City of Charlotte. In the Catawba River basin; it occupies or influences large portions of Subbasins 34, 37, and 38. It is within these subbasins that the data depict urban influences on water quality. These influences include elevated nutrient and fecal coliform concentrations.

Table 29. Summary of copper concentrations in the Catawba River basin, September 1997 – August 2002.[1]

Subbasin/Station	Waterbody/Location	N	Median	Maximum	% > 7 μg/L
03-08-30					
C0145000	Catawba R at SR 1234 near Greenlee	42	2.0	19	14.3
C0550000	N Fork Catawba R at SR 1552 near Hankins	41	2.2	15	7.3
C0250000	Catawba R at SR 1221 near Pleasant Gardens	42	2.0	14	7.1
C1000000	Linville R at NC 126 near Nebo	40	2.0	17	2.5
C1210000	Catawba R at SR 1147 near Glen Alpine Marion	42	2.0	5.4	---
03-08-31					
C1750000	Lower Cr at SR 1501 near Morganton	42	2.4	20	23.8
C2030000	Lake Rhodhiss at SR 1001 near Baton Marion	33	2.0	12	6.1
C1370000	Wilson Cr at US 221 near Gragg	41	2.0	8.1	4.9
03-08-32					
C2818000	Lower Little R at SR 1313 near All Healing Springs	44	2.0	63	11.4
C2600000	Lake Hickory at NC 127 near Hickory	43	2.0	14	7.0
C3420000	Lake Norman at SR 1004 near Mooresville	43	2.0	19	4.7
03-08-33					
C3699000	Mountain Island Lake above Gar Cr near Croft	41	2.8	76	4.9
C3900000	Catawba R at NC 27 near Thrift	41	2.5	10	4.9
C3860000	Dutchmans Cr at SR 1918 at Mountain Island	44	2.0	15	2.3
03-08-34					
C9050000	Sugar Cr at NC 51 at Pineville	44	5.6	170	34.1
C8896500	Irwin Cr at Irwin Cr WWTP near Charlotte	44	3.1	48	22.7
C9790000	Sugar Cr at SC 160 near Fort Mill, SC	44	5.3	30	20.5
C7500000	Lake Wylie at NC 49 near Oak Grove	42	4.7	11	16.7
C9210000	Little Sugar Cr at NC 51 at Pineville	44	4.9	42	15.9
C4220000	Catawba R at powerline crossing at South Belmont	42	3.1	140	14.3
C9370000	McAlpine Cr at SR 3356 Sardis Rd near Charlotte	44	2.6	28	13.6
C9680000	McAlpine Cr at SC SR 2964 near Camp Cox, SC	44	4.3	13	13.6
C4040000	Long Cr at SR 2042 near Paw Creek	44	3.0	13	11.4
03-08-35					
C4800000	Clark Cr at SR 1008 Grove St at Lincolnton	44	4.0	15	13.6
C4360000	Henry Fork R at SR 1143 near Brookford	43	3.2	14	11.6
C5170000	Indian Cr at SR 1252 near Laboratory	44	3.0	17	11.4
C4380000	S Fork Catawba R at NC 10 near Startown	44	2.2	13	4.5
C4300000	Henry Fork R at SR 1124 near Henry River	44	2.0	6.5	---
C4370000	Jacob Fork at SR 1924 at Ramsey	34	2.0	3.6	---
03-08-36					
C7000000	S Fork Catawba R at SR 2524 near South Belmont	42	9.2	36	81.0
C6500000	S Fork Catawba R at NC 7 at Mcadenville	44	3.0	350	11.4
C5900000	Long Cr at SR 1456 near Bessemer City	43	2.0	18	7.0
03-08-37					
C7400000	Catawba Cr at SR 2302 at NC-SC State Line	42	4.8	13	19.0
C8660000	Crowders Cr at SC 564 near Bowling Green, SC	43	3.6	21	18.6
03-08-38					
C9819500	Twelve Mile Cr at NC 16 near Waxhaw	43	2.6	17	11.6

[1]Sorted by subbasin and descending proportion of samples > 7.0 μg/L (the Action Level.)

Table 30. Summary of fecal coliform bacteria concentrations in the Catawba River basin, September 1997 – August 2002.[1]

Subbasin/Station	Waterbody/Location	N	% > 400	Geometric Mean
03-08-30				
C0145000	Catawba R at SR 1234 near Greenlee	58	8.6	25.3
C0250000	Catawba R at SR 1221 near Pleasant Gardens	57	7	26.7
C0550000	N Fork Catawba R at SR 1552 near Hankins	55	3.6	18.3
C1000000	Linville R at NC 126 near Nebo	55	---	3.5
C1210000	Catawba R at SR 1147 near Glen Alpine Marion	56	---	9.4
03-08-31				
C1370000	Wilson Cr at US 221 near Gragg	55	---	1.4
C1750000	Lower Cr at SR 1501 near Morganton Marion	54	38.9	252.7
C2030000	Lake Rhodhiss at SR 1001 near Baton Marion	22	---	2.5
03-08-32				
C2600000	Lake Hickory at NC 127 near Hickory	55	---	7.5
C2818000	Lower Little R at SR 1313 near All Healing Springs	59	42.4	199.6
C3420000	Lake Norman at SR 1004 near Mooresville	54	5.6	13.8
03-08-33				
C3699000	Mountain Island Lake above Gar Cr near Croft	46	---	9.8
C3860000	Dutchmans Cr at SR 1918 at Mountain Island	59	10.2	125.3
C3900000	Catawba R at NC 27 near Thrift	48	---	11.3
03-08-34				
C4040000	Long Cr at SR 2042 near Paw Creek	59	39	324.2
C4220000	Catawba R at Powerline Crossing at South Belmont	47	2.1	10.6
C7500000	Lake Wylie at NC 49 near Oak Grove	53	---	7.6
C8896500	Irwin Cr at Irwin Cr WWTP near Charlotte	59	49.2	592.0
C9050000	Sugar Cr at NC 51 at Pineville	58	36.2	308.6
C9210000	Little Sugar Cr at NC 51 at Pineville	58	29.3	233.5
C9370000	McAlpine Cr at SR 3356 Sardis Rd near Charlotte	59	40.7	287.9
C9680000	McAlpine Cr at Sc SR 2964 near Camp Cox, SC	58	25.9	230.5
C9790000	Sugar Cr at SC 160 near Fort Mill, Sc	58	32.8	325.0
03-08-35				
C4300000	Henry Fork R at SR 1124 near Henry River	57	8.8	43.1
C4360000	Henry Fork R at SR 1143 near Brookford	56	16.1	124.6
C4370000	Jacob Fork at SR 1924 at Ramsey	47	---	8.8
C4380000	S Fork Catawba R at NC 10 near Startown	57	12.3	144.9
C4800000	Clark Cr at SR 1008 Grove St at Lincolnton	59	42.4	361.7
C5170000	Indian Cr at SR 1252 near Laboratory	59	13.6	188.7
03-08-36				
C5900000	Long Cr at SR 1456 near Bessemer City	58	37.9	349.6
C6500000	S Fork Catawba R at NC 7 at Mcadenville	56	7.1	63.1
C7000000	S Fork Catawba R at SR 2524 near South Belmont	53	1.9	12.8
03-08-37				
C7400000	Catawba Cr at SR 2302 at NC-SC State Line	52	---	8.9
C8660000	Crowders Cr at SC 564 near Bowling Green, SC	58	22.4	224.1
03-08-38				
C9819500	Twelve Mile Cr at NC 16 near Waxahaw	57	31.6	285.9

[1]Stations sorted first by subbasin number, then by station number.

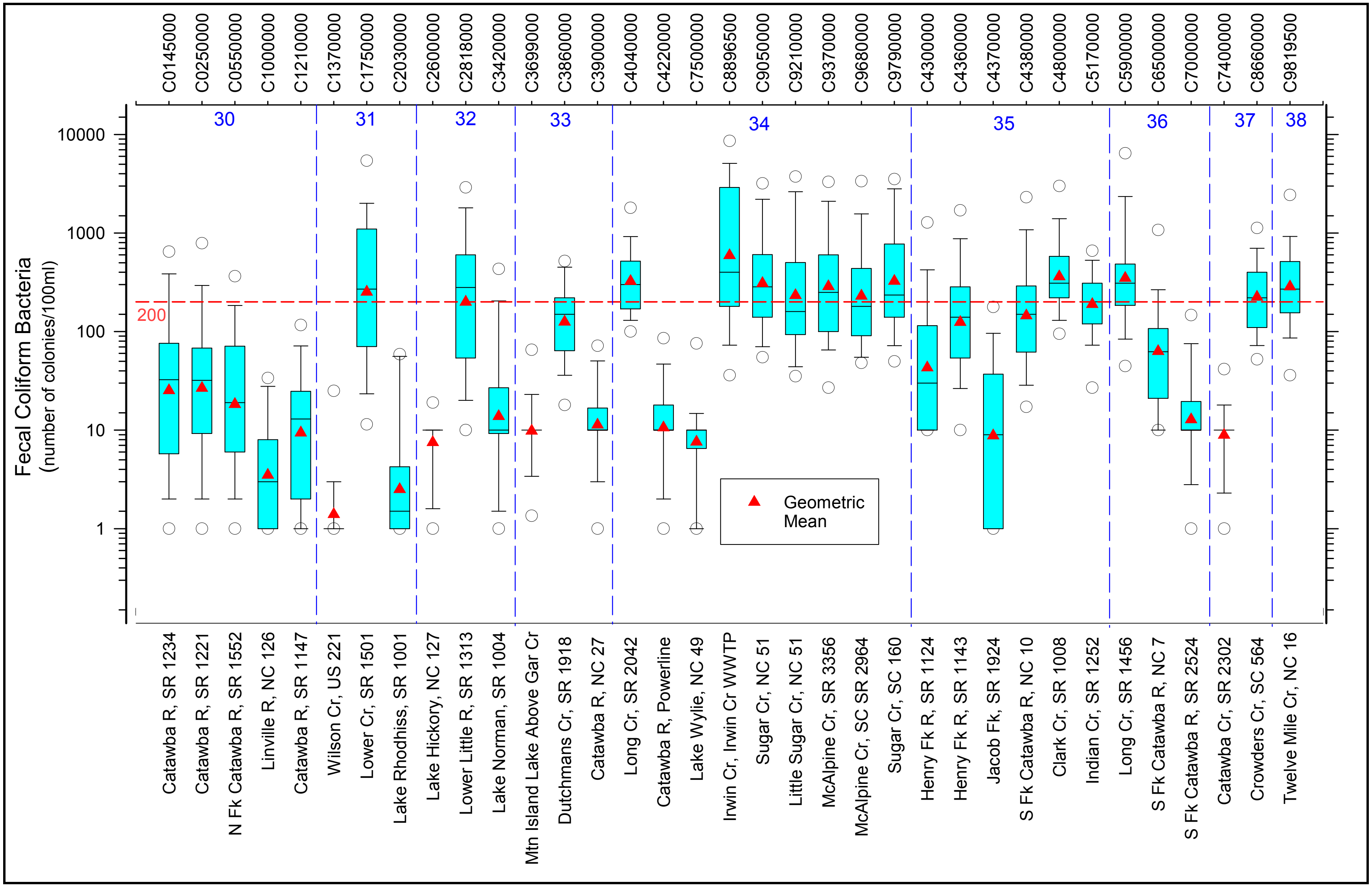


Figure 52. **Box and whisker plots for fecal coliform bacteria and a plot of the geometric mean in the Catawba River basin, September 1997 to August 2002. Data are plotted in subbasin and station number order.**

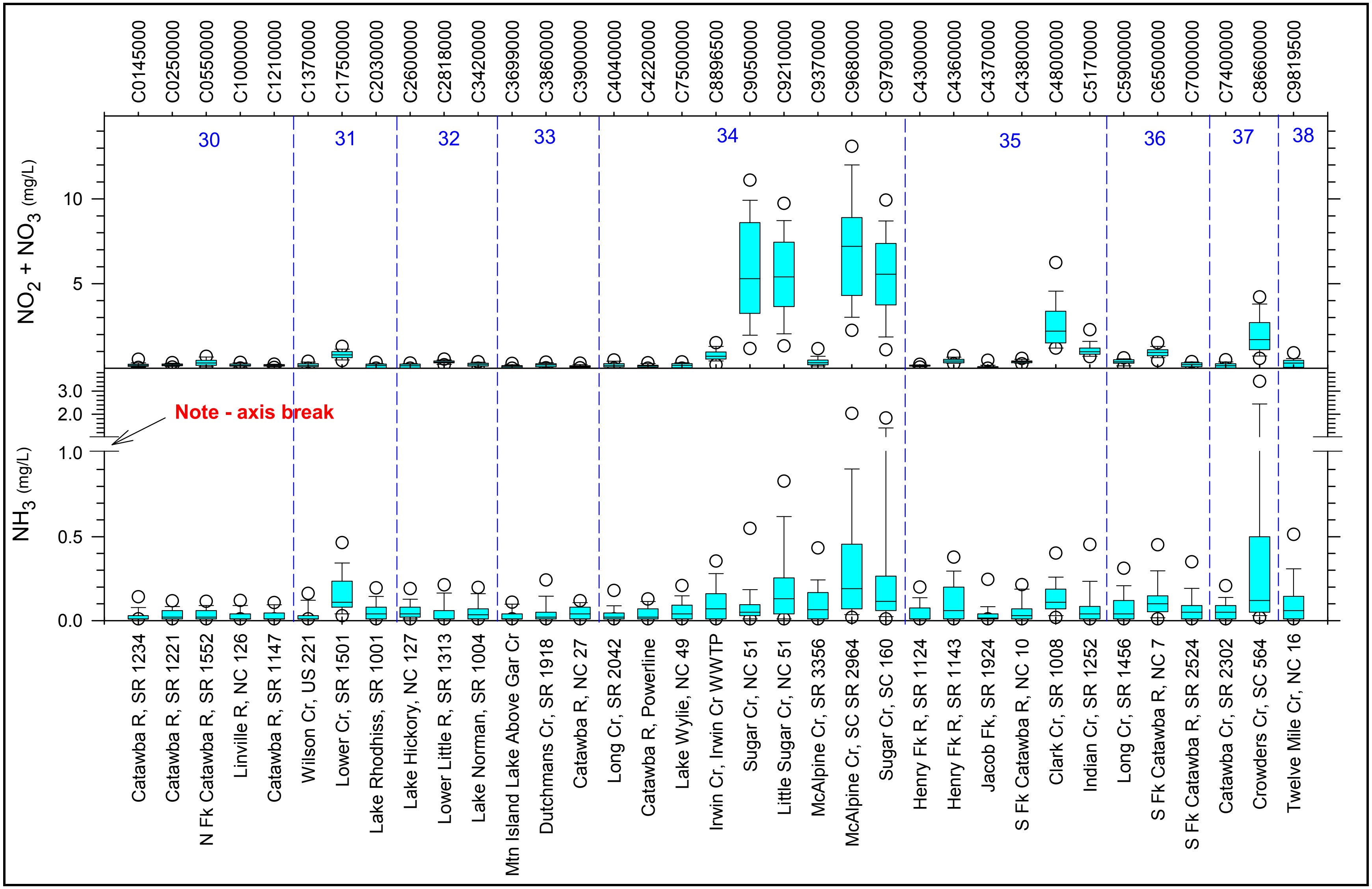


Figure 53. **Box and whisker plots for nitrite+nitrate nitrogen (NO_2+NO_3-N) and ammonia nitrogen (NH_3) in the Catawba River basin, September 1997 to August 2002. Data are plotted in subbasin and station number order.**

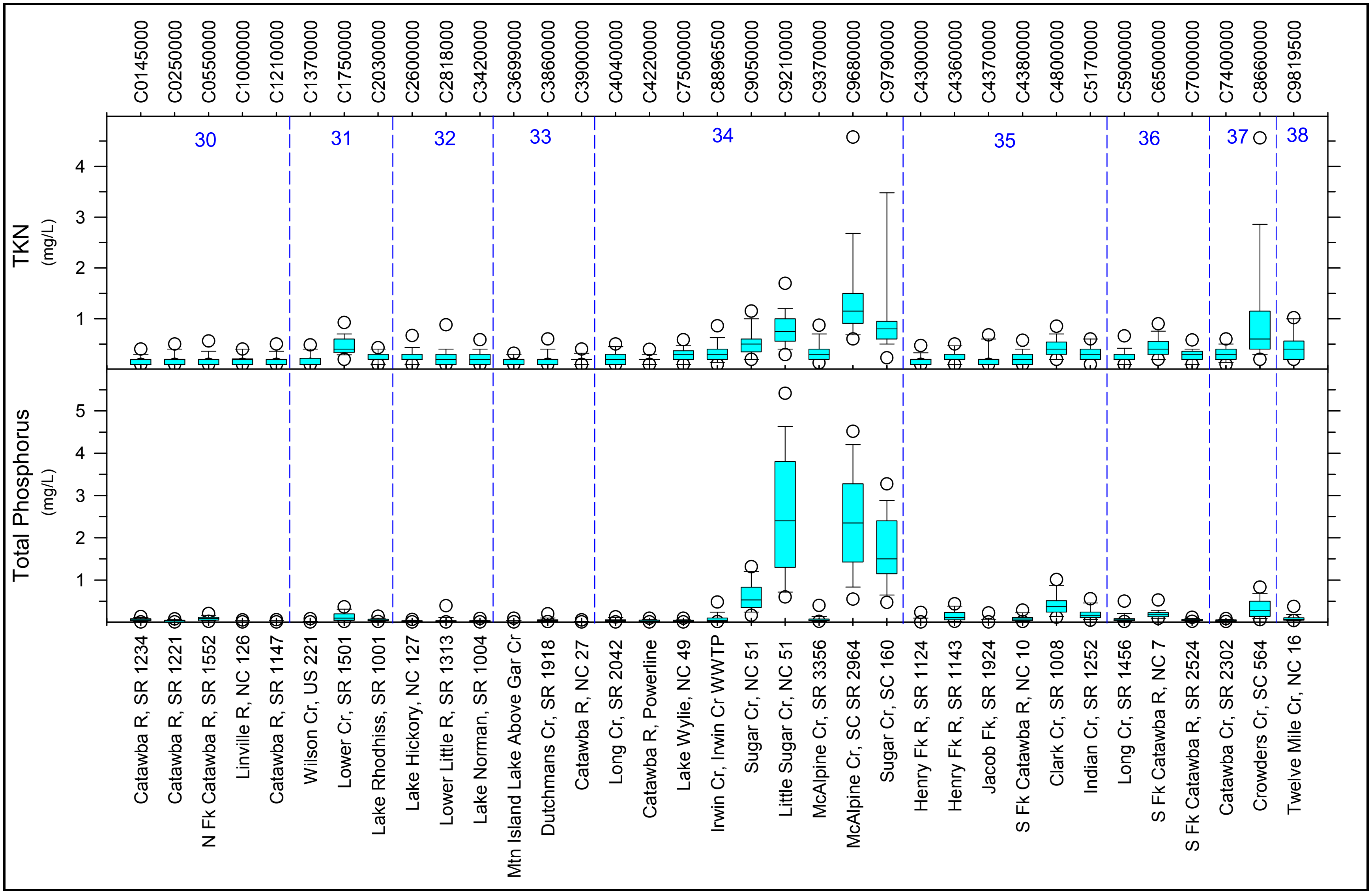


Figure 54. **Box and whisker plots for total Kjeldahl nitrogen (TKN) and total phosphorus (TP) in the Catawba River basin, September 1997 to August 2002. Data are plotted in subbasin and station number order.**

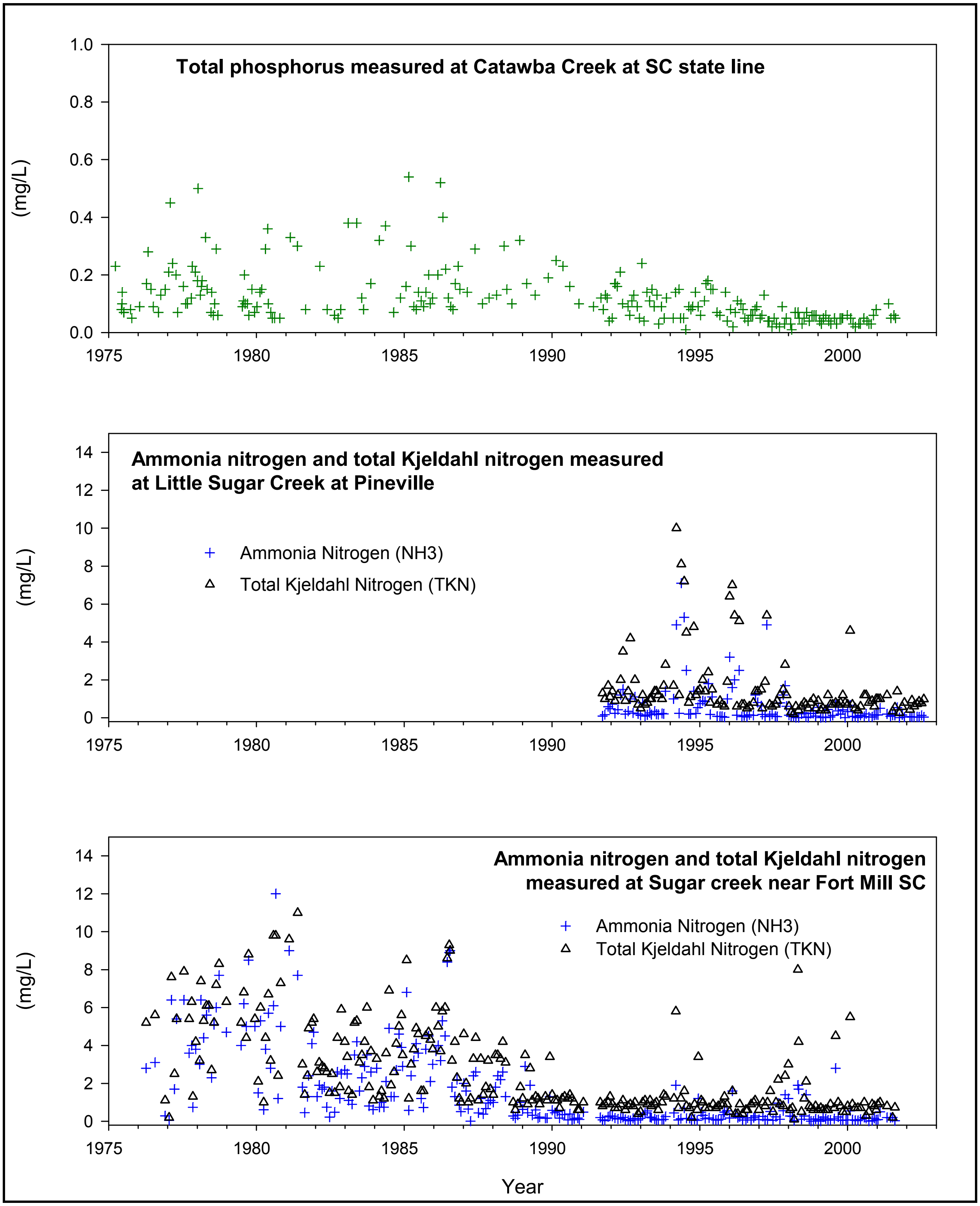


Figure 55. **Decreasing concentrations of nutrients over time are found at Catawba, Little Sugar, and Sugar Creeks (Stations C7400000, C9210000, and C9790000, respectively), 1977 – 2002.**

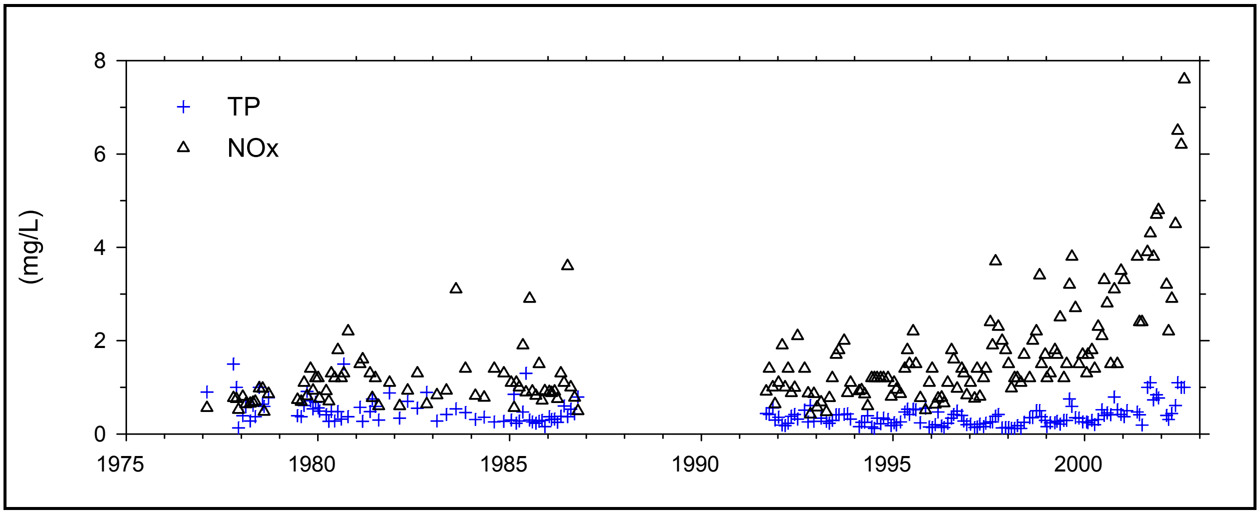


Figure 56. **Increasing concentrations of total phosphorus and nitrate+nitrite-nitrogen over time at Clark Creek (Station C9480000), 1977 – 2002.**

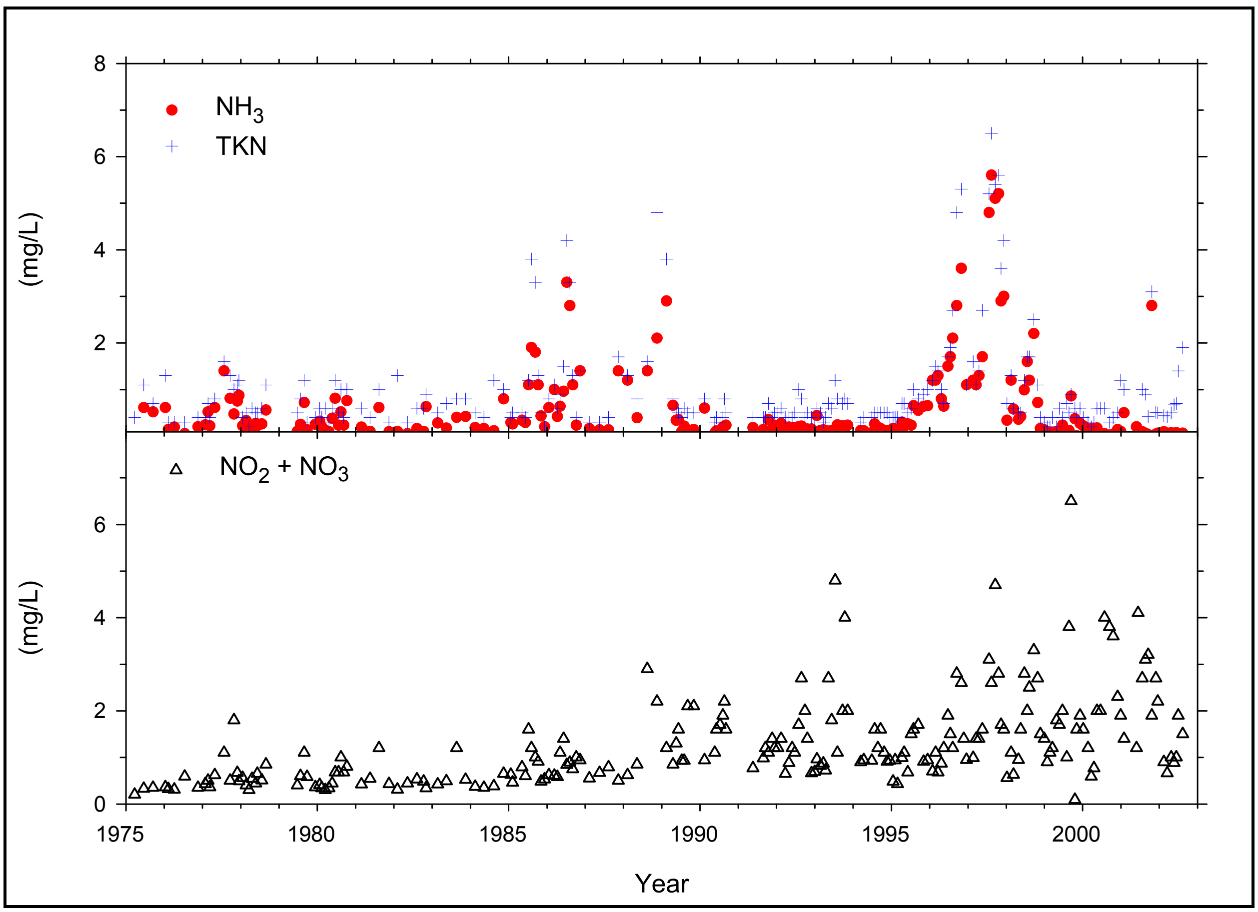


Figure 57. **Increasing concentrations of ammonia nitrogen , total Kjeldahl nitrogen, and nitrate+nitrite-nitrogen over time at Crowders Creek (Station C8660000), 1977 – 2002.**

Table 31. Summary of the water quality median values in the Catawba River basin, September 1997 – August 2002.[1,2] Sample sizes are not reported.

Parameter	Subbasin 30	31	32	33	34	35	36	37	38
pH (s.u.)	7.3	6.9	7.1	7.3	7.4	7.1	7.4	7.6	7.1
Conductivity (μmhos/cm)	59	62	60	74	203	94	129	148	122
Hardness (mg/L)	12.0	15.0	16.0	22.0	64.0	20.0	32.5	40.0	47.5
Total Suspended Solids (mg/L)	2.0	4.0	3.0	3.0	5.0	5.0	6.0	5.0	4.0
Turbidity (NTU)	3.3	5.4	4.3	3.5	6.7	6.2	8.2	5.6	15.0
Metals (μg/L)									
Aluminum	110	255	200	155	340	320	380	310	560
Arsenic	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Cadmium	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Chromium	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Copper	2.0	2.0	2.0	2.2	4.3	2.5	3.8	4.4	2.6
Iron	220	385	320	200	590	730	780	450	1400
Lead	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Mercury	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Zinc	10.0	11.0	10.0	10.0	21.0	11.0	10.0	12.0	10.0
Nutrients (mg/L)									
Nitrite+Nitrate Nitrogen	0.19	0.30	0.27	0.14	1.10	0.44	0.45	0.83	0.32
Ammonia Nitrogen	0.01	0.05	0.03	0.02	0.06	0.04	0.06	0.07	0.06
Total Kjeldahl Nitrogen	0.20	0.30	0.20	0.20	0.40	0.20	0.30	0.40	0.40
Total Phosphorus	0.03	0.05	0.02	0.02	0.22	0.10	0.08	0.11	0.07
Fecal Coliform Bacteria (#/100ml)[1]									
Geometric mean	13.4	13.1	28.9	27.4	155.8	95.5	69	48.7	285.9
Proportion (%) samples > 400	3.9	16	16.7	3.9	29.3	16.1	16.2	11.8	31.6

[1]Results for fecal coliform bacteria are the geometric mean and proportion of samples > 400 colonies/100ml.
[2]Sample sizes vary by parameter and subbasin. See station data summary sheets for the number of samples by parameter and the number of stations in each subbasin.

AQUATIC TOXICITY MONITORING

Ninety-five facility permits in the Catawba River basin currently require whole effluent toxicity (WET) monitoring (Figure 58 and Table 32). Seventy-three facility permits have a WET limit; the other twenty-two facility permits specify monitoring with no limit.

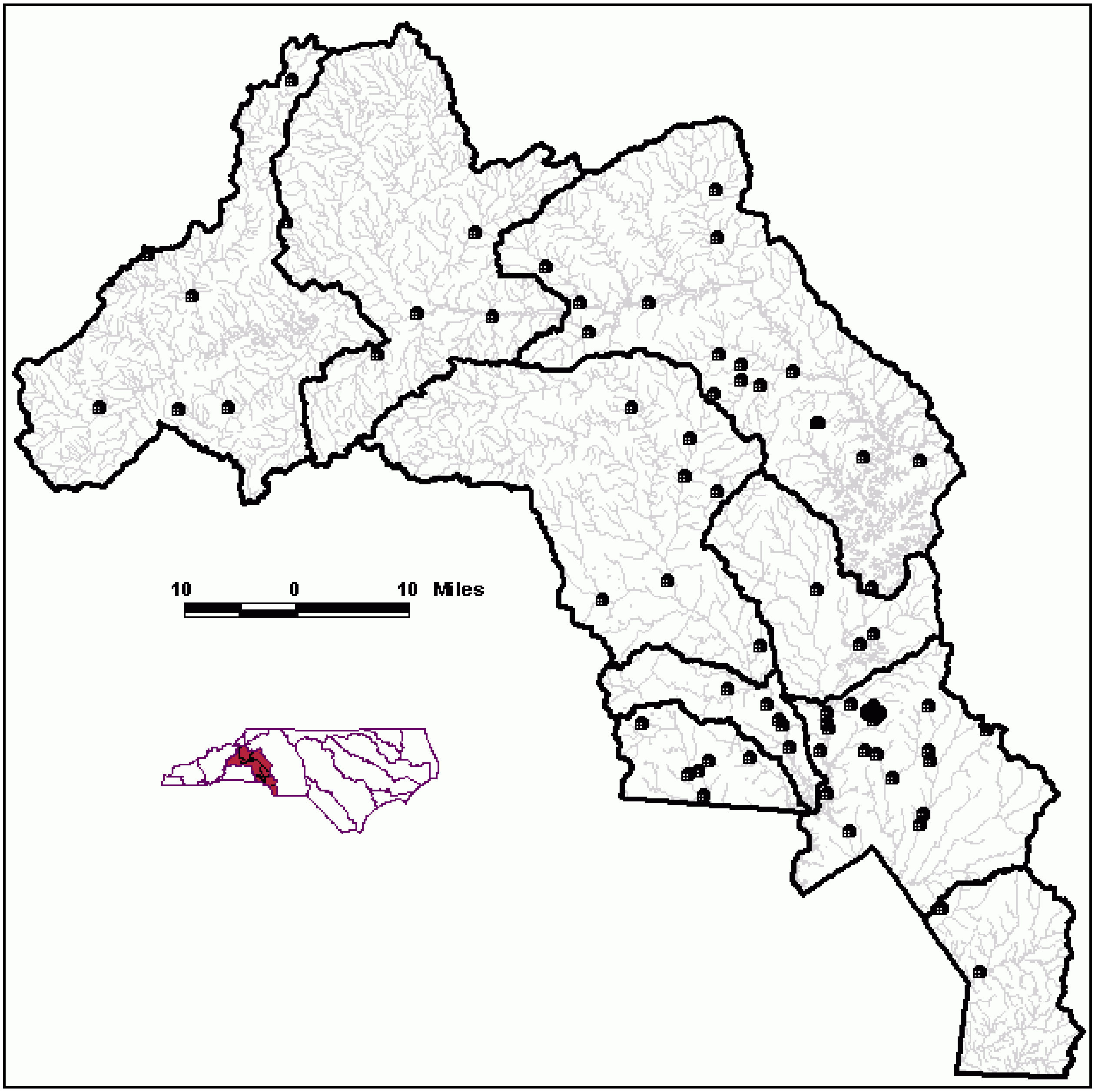


Figure 58. Facilities required to perform toxicity testing in the Catawba River basin.

Table 32 **Facilities in the Catawba River basin required to perform whole effluent toxicity testing.**

Subbasin/Facility	NPDES Permit No.	Receiving Stream	County	Flow (MGD)	IWC (%)	7Q10 (cfs)
03-08-30						
Baxter Healthcare Corp.	NC0006564/001	N Fork Catawba R	McDowell	1.2	15.5	10.2
Chalet Motor Lodge	NC0030996/001	UT Buchanan Cr	McDowell	0.010	100	0.0
Coats American-Sevier Plant	NC0004243/001	N Fork Catawba R	McDowell	2.0	14.7	18.0
Linville Resorts, Inc.	NC0039446/001	Linville R	Avery	0.10	10.0	2.1
Marion-Corpening Cr WWTP	NC0031879/001	Corpening Cr	McDowell	3.0	66.9	2.3
Old Fort WWTP	NC0021229/001	Curtis Cr	McDowell	1.2	28	4.9
Sugar Hill Truck Stop	NC0029831/001	UT N. Muddy Cr	McDowell	0.005	2.36	0.320
03-08-31						
Lenoir- Lower Cr WWTP	NC0023981/001	Lower Cr	Caldwell	6.0	44	11.75
Morganton-Catawba R. PCF	NC0026573/001	Catawba R	Burke	8.0	8.96	126
NC Outward Bound School	NC0040754/001	Roses Cr	Burke	0.0075	100	
SGL Carbon, LLC	NC0005258/001	Silver Cr	Burke	1.5	10	20.9
Valdese WWTP	NC0041696/001	Lake Rhodhiss	Burke	7.5	4.8	228.7
03-08-32						
ALCOA Extrusions	NC0048712/001	UT L. Norman	Catawba	0.0007	100	0
Catawba WWTP	NC0025542/001	Lyle Cr	Catawba	0.225	2.1	16
Claremont North WWTP	NC0032662/001	Mull Cr	Catawba	0.10	13	1.0
Claremont South WWTP	NC0026549/001	UT McLin Cr	Catawba	0.10	60.78	0.10
Claremont-McLin Cr WWTP	NC0081370/001	McLin Cr	Catawba	0.3	9.0	5.0
Comm Scope Inc./001	NC0034754/001	UT Terrapin Cr	Catawba	0.02	34	0.06
Comm Scope Inc./002	NC0034754/002	UT Terrapin Cr	Catawba	VAR	NA	0.05
Comm Scope Inc./003	NC0034754/003	UT Terrapin Cr	Catawba	VAR	NA	0.0
Comm Scope Inc./004	NC0034754/004	UT Terrapin Cr	Catawba	VAR	NA	0.0
Conover NE WWTP	NC0024252/001	Lyle Cr	Catawba	1.5	32.0	5.0
Conover SE WWTP-001	NC0024279/001	McLin Cr	Catawba	0.30	48.2	0.50
Conover SE WWTP-002	NC0024279/002	McLin Cr	Catawba	0.30	48	0.5
Duke Power-Marshall	NC0004987/002	Lake Norman	Catawba	5.3	12.0	60.0
Duke Power-McGuire	NC0024392/001	Lake Norman	Mecklenburg	NA	90	80
Express Food Mart	NC0085545/001	UT Mundy Cr	Catawba	0.0115	100	0.0
Granite Falls WWTP	NC0021890/001	Gunpowder Cr	Caldwell	0.90	13	9.3
Hickory-N.E. WWTP	NC0020401/001	Catawba R	Catawba	6.0	13	60.0
Huffman Finishing	NC0025135/001	Catawba R	Caldwell	0.25	0.96	40
Lenoir-Gunpowder Cr WWTP	NC0023736/001	Gunpowder Cr	Caldwell	2.0	52.0	3.0
Schneider Mills, Inc.	NC0034860/001	Muddy Fork Cr	Alexander	0.78	46	1.40
Taylorsville WWTP	NC0026271/001	Lower Little R	Alexander	0.83	8.2	14.4
03-08-33						
CMUD-McDowell Cr WWTP	NC0036277/001	McDowell Cr	Mecklenburg	6.0	85	1.80
Duke Power-Lincoln Turbine	NC0080781/001	Killian Cr	Lincoln	0.4	23	2.1
Duke Power-McGuire 002	NC0024392/002	Catawba River	Mecklenburg	0.3315	0.64	80.0
Duke Power-McGuire 005	NC0024392/005	Catawba R	Mecklenburg	0.754	1.4	80.0
Duke Power-River Bend	NC0004961/002	Catawba R	Gaston	NA	10.36	80.0
Mt. Holly WWTP	NC0021156/001	Catawba R	Gaston	4.0	6.0	95.0
03-08-34						
American Truetzschler, Inc.	NC0085928/001	UT Catawba R	Mecklenburg	0.05	100	0.0
AquAir WWTP	NC0086673/001	UT Steele Cr	Mecklenburg	0.0864	100	0.0
Belmont WWTP	NC0021181/001	UT Catawba R	Gaston	5.0	8.0	95.0
Carillon Building	NC0085731/001	Irwin Cr	Mecklenburg	0.0316		
Charlotte-Douglas Airport-001	NC0083887/001	UT Ticer Cr	Mecklenburg	VAR	NA	0.0
Charlotte-Douglas Airport-002	NC0083887/002	Coffey Cr	Mecklenburg	NA	NA	NA
Charlotte-Douglas Airport-003	NC0083887/003	UT Taggart Cr	Mecklenburg	NA	NA	NA
Citgo-Paw Cr Bulk Terminal	NC0021962/001	UT Gum Br.	Mecklenburg	NA	100	0.0
Clariant Corp.-Mt. Holly Plant	NC0004375/001	Catawba R	Mecklenburg	3.9	1.8	329
CMUD-Irwin Cr WWTP	NC0024945/001	Irwin Cr	Mecklenburg	15.0	83.0	4.9
CMUD-McAlpine WWTP	NC0024970/001	McAlpine Cr	Mecklenburg	64	99.35	0.3
CMUD-Sugar Cr WWTP	NC0024937/001	Little Sugar Cr	Mecklenburg	20.0	90	3.4
Colonial Pipeline-Charlotte	NC0031038/001	UT Gum Branch	Mecklenburg	N/A	100.0	0
Cousins R. Estate-Gateway Village	NC0086517/001	Irwin Cr	Mecklenburg	0.050	100	0
Crown Central Petro/001	NC0046531/001	UT Gum Branch	Mecklenburg	NA	100	0.0
Duke Power-Allen 002	NC0004979/002	Catawba R	Gaston	11.6	16	95.0
Exxon Co-Charlotte Marketing Term.	NC0004839/001	UT Long Cr	Mecklenburg	NA	NA	0.0
First Union Commons	NC0086886/001	Little Sugar Cr	Mecklenburg	0.086	100	0.85
Hoechst Celanese Corp-Dreyfus	NC0084301/001	Little Sugar Cr	Mecklenburg	0.1152	4.9	3.5
Livingstone Coating Corporation	NC0086002/001	UT Long Cr	Mecklenburg	0.0216	100	0.0

Table 32 (continued).

Subbasin/Facility	NPDES Permit No.	Receiving Stream	County	Flow (MGD)	IWC (%)	7Q10 (cfs)
Louis Dreyfus Energy Corp.	NC0021971/009	UT Paw Cr	Mecklenburg	VAR	100	0.0
Marathon Petroleum	NC0046213/001	UT Long Cr	Mecklenburg	VAR	100	0.0
Motiva Enterprises LLC	NC0046892/002	UT Long Cr	Mecklenburg	0.864	100	0.0
Motiva Enterprises LLC	NC0046892/001	UT Long Cr	Mecklenburg	NA	100	0.0
Motiva Enterprises-Paw Cr	NC0022187/001	UT Gum Branch	Mecklenburg	NA	100	0.0
National Welders Supply Company	NC0079758/001	UT Taggart Cr	Mecklenburg	0.0143	100	0.0
Phillips Pipeline Co. 001	NC0032891/001	UT Gum Br.	Mecklenburg	VAR	100	0.0
Phillips Pipeline Co. 002	NC0032891/002	UT Gum Branch	Mecklenburg	VAR	100	0.0
PYA/Monarch Inc.	NC0085561/001	UT Taggart Cr	Mecklenburg	0.0216	100	0.0
The Boulevard at 715 N. Church LLC	NC0087513/001	UT Little Sugar Cr	Mecklenburg	0.072	100	0
Transmontaigne #1	NC0005771/001	UT Paw Cr	Mecklenburg	VAR	100	0.0
Unocal Corp-Rhom and Haas Facility	NC0085057/001	UT Brier Cr	Mecklenburg	0.0432	100	0.0
Valero Marketing and Supply Co.	NC0004723/001	UT Paw Cr	Mecklenburg	NA	NA	0.0
Williams Energy Ventures	NC0005185/006	UT Long Cr	Mecklenburg	NA	100	0.0
Williams Terminals Holdings, L.P.	NC0074705/001	UT Paw Cr	Mecklenburg	0	100	0
03-08-35						
Cherryville WWTP	NC0044440/001	Indian Cr	Gaston	2.0	34	6.1
Delta Mills	NC0006190/001	Clark Cr	Catawba	1.0	11	12
Hickory-Henry Fork WWTP	NC0040797/001	Henry Fork R	Catawba	9.0	34	27
Lincolnton WWTP	NC0025496/001	SF Catawba R	Lincoln	6.0	11.0	77.0
Maiden WWTP	NC0039594/001	Clark Cr	Catawba	1.0	11	12.0
Newton WWTP	NC0036196/001	Clark Cr	Catawba	5.0	56.32	6.0
Stanley WWTP	NC0020036/001	Mauney Cr	Gaston	0.5	65	0.41
03-08-36						
Cramerton WWTP	NC0006033/001	SF Catawba R	Gaston	4.0	4.7	125
Dallas WWTP	NC0068888/001	UT Long Cr	Gaston	0.75	93.93	0.075
Gastonia-Long Cr WWTP	NC0020184/001	SF Catawba R	Gaston	16.0	10	109
Lowell WWTP	NC0025861/001	SF Catawba R	Gaston	0.6	0.74	124.0
Pharr Yarns, Inc.	NC0004812/001	SF Catawba R	Gaston	0.5	1.22	125.0
Yorkshire Americas, Inc.	NC0005274/001	SF Catawba R	Gaston	0.40	0.50	123.0
03-08-37						
Gastonia-Catawba Cr WWTP	NC0020192/001	Catawba Cr	Gaston	9.0	90.29	1.5
Gastonia-Crowders Cr	NC0074268/001	Crowders Cr	Gaston	6.0	41	13.3
Lithium Corp	NC0005177/001	UT Abernathy Cr	Gaston	0.615	78	0.27
Rhodia, Inc.	NC0084638/001	UT Crowders Cr	Gaston	0.1944	100	0.0
SKF USA (CR Industries)	NC0004260/001	Crowders Cr	Gaston	0.0144	0.33	6.7
Textron, Inc.	NC0084662/001	UT Crowders Cr	Gaston	0.3	66	0.24
03-08-38						
Union County-Six Mile Cr	NC0066559/001	Six Mile Cr	Union	1.0	100	0.0
Union County-Twelve Mile Cr WWTP	NC0085359/001	Twelve Mile Cr	Union	2.5	100	0.0

The number of facilities in this basin monitoring whole effluent toxicity has increased steadily since 1985, the first year that monitoring was required (Figure 59). Whole effluent toxicity limits were written into permits in North Carolina beginning in 1987. The compliance rate of those facilities has generally risen since the inception of the program. Since 1995 the compliance rate has stabilized at approximately 90 to 95 percent (Figure 59 and Table 33).

Alcoa Extrusions (Subbasin 32) experienced problems meeting its whole effluent toxicity limit from late December 2001 through June 2002. The discharge is composed of contact cooling water. Alcoa personnel investigated the toxicity of biocides and corrosion inhibitors in use at the facility but ultimately installed an ion exchange system that allowed reuse of cooling water and ceased wastewater discharge in July 2002.

Comm Scope, Inc. (Subbasin 32) was intermittently noncompliant with its WET limit during the period 1999 through early 2001. The facility extrudes plastic to coat copper wire. The wastewater is composed of contact cooling water. The facility was noncompliant with some chemical parameters during the same period. The facility improved operation of its treatment works resulting in compliance with chemical parameters and its WET test.

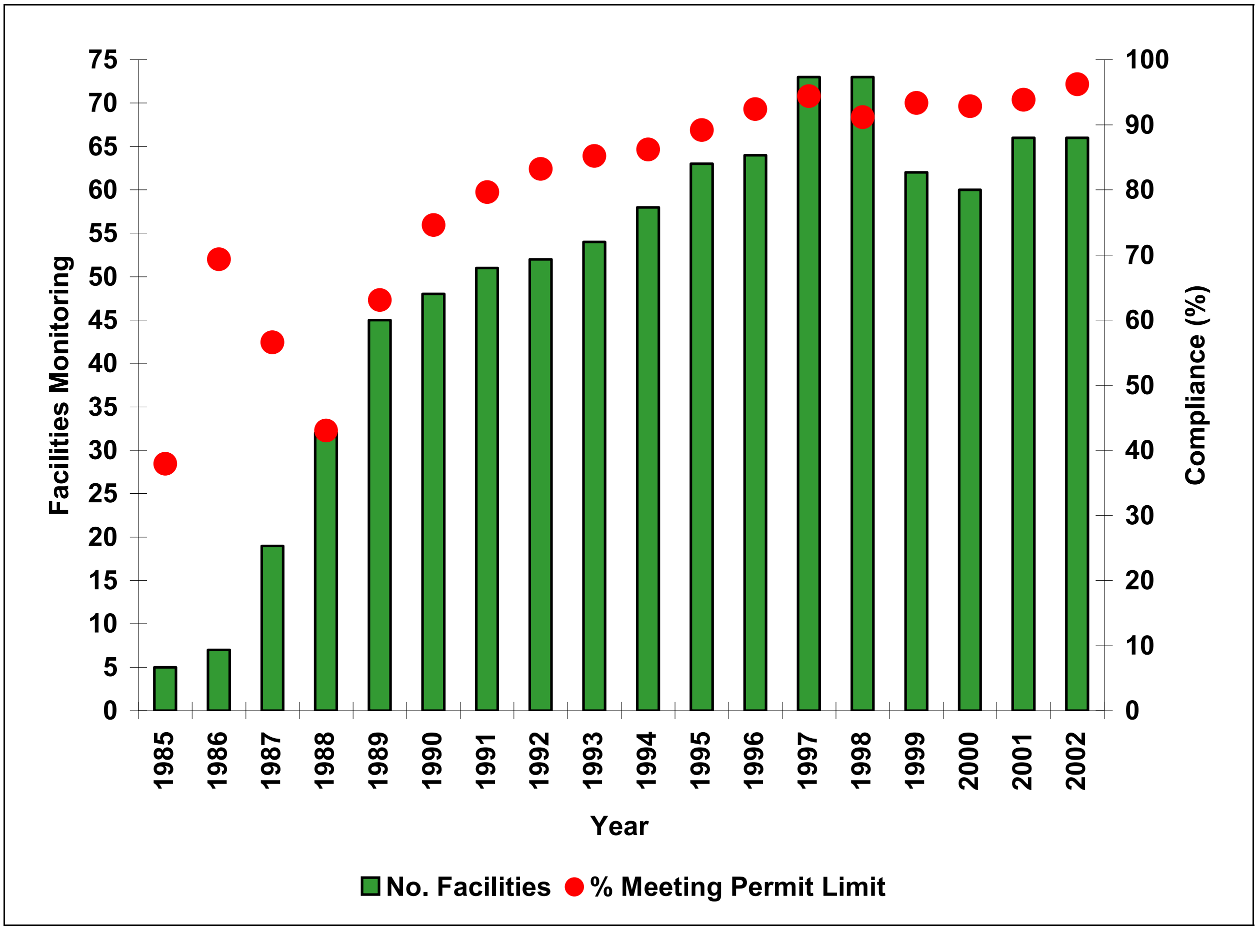


Figure 59. Whole effluent toxicity monitoring in the Catawba River basin, 1985 - 2002. The compliance values were calculated by determining whether a facility was meeting its ultimate permit limit during the given time period, regardless of any SOCs in force.

The Express Food Mart groundwater remediation facility (Subbasin 32) has been intermittently noncompliant from the time that it began operation in July 1999 through February 2002. The facility initiated toxicity identification work during early 2002 that did not definitively identify a toxicant. The facility has been compliant with its WET limit since April 2002.

Schneider Mills, Inc. (Subbasin 32) failed five consecutive chronic toxicity tests from December 1999 through April 2000. The failures seemed to be associated with operational deficiencies coinciding with the extended illness of the plant operator. There have been no WET non-compliances since April 2000.

The American Truetzschler groundwater remediation facility (Subbasin 34) experienced failures with its WET limit from December 1999 through December 2001. Facility representatives and their consultants are considering several measures to address the toxicity including alternative treatment strategies and relocating the discharge pipe from its current location on a zero flow stream.

The groundwater remediation facility operated by Cousins Real Estate (Subbasin 34) has experienced toxicity failures since it began operation in April of 1999. The facility's consultants indicated that the noncompliances can be associated with construction activities and sewage system leaks at the site. Since repairs to equipment at the site were completed in October of 2002, the facility has not had a discharge and likely will not have a discharge in the near future.

The groundwater remediation facility operated by First Union Commons (Subbasin 34) has experienced toxicity failures since it began operation in April of 2001. Its problems may be associated with sewage infiltration from the CMUD collection system. The facility is conducting negotiations with CMUD to connect the outfall to CMUD's system.

The Town of Stanley's WWTP (Subbasin 35) had several noncompliances during 1999 and 2000. Facility personnel have not been able to determine the source of toxicity. The Town has no significant industrial users. There have been no failures since October of 2001.

The Town of Dallas's WWTP (Subbasin 36) has been continuously noncompliant since WET monitoring was re-instituted in its permit beginning in February of 2002. Review of submitted WET report forms indicated that some of the observed toxicity can be related to residual chlorine. The facility has switched from chlorine to chlorine dioxide disinfection with no improvement in toxicity. Mooresville Regional Office personnel have recommended implementation of dechlorination at the facility.

The Textron, Inc. groundwater remediation site (Subbasin 37) has had sporadic noncompliances since 1999. The facility's consultants have adjusted the treatment works operation and are prepared to conduct further testing. The facility has not failed a toxicity test since March of 2002.

Table 33. Compliance record of facilities performing whole effluent toxicity testing in the Catawba River basin.

Subbasin	Facility	NPDES Permit No.	Pre 2002 Passes[1]	Pre 2002 Fails	2002 Passes	2002 Fails
03-08-30						
	Baxter Healthcare Corp.	NC0006564/001	18	2	4	0
	Chalet Motor Lodge	NC0030996/001	7	4	2	0
	Coats American-Sevier Plant	NC0004243/001	16	0	4	0
	Linville Resorts, Inc.	NC0039446/001	4	0	4	0
	Marion-Corpening Cr WWTP	NC0031879/001	17	1	4	0
	Old Fort WWTP	NC0021229/001	16	0	4	0
	Sugar Hill Truck Stop	NC0029831/001	16	2	4	0
03-08-31						
	Lenoir-Lower Creek WWTP	NC0023981/001	15	5	4	0
	Morganton-Catawba R PCF	NC0026573/001	18	3	5	1
	NC Outward Bound School	NC0040754/001	2	3	5	1
	SGL Carbon, LLC	NC0005258/001	17	0	4	0
	Valdese WWTP	NC0041696/001	17	1	4	0
03-08-32						
	ALCOA Extrusions	NC0048712/001	18	5	2	5
	Catawba WWTP	NC0025542/001	16	0	4	0
	Claremont North WWTP	NC0032662/001	16	0	6	0
	Claremont-McLin Creek WWTP	NC0081370/001	16	0	5	0
	Comm Scope Inc./001	NC0034754/001	16	9	4	0
	Comm Scope Inc./002	NC0034754/002	0	1	0	0
	Comm Scope Inc./003	NC0034754/003	0	1	0	0
	Conover NE WWTP	NC0024252/001	16	0	3	0
	Conover SE WWTP-001	NC0024279/001	1	0	4	0
	Conover SE WWTP-002	NC0024279/002	1	0	5	1
	Duke Power-Marshall 002	NC0004987/002	17	0	4	0
	Duke Power-McGuire 001	NC0024392/001	16	0	5	0
	Express Food Mart	NC0085545/001	5	7	5	1
	Granite Falls WWTP	NC0021890/001	16	0	4	0
	Hickory-N.E. WWTP	NC0020401/001	16	1	4	0
	Huffman Finishing	NC0025135/001	16	1	4	0
	Lenoir-Gunpowder Creek WWTP	NC0023736/001	16	0	4	0
	Schneider Mills, Inc.- 001	NC0034860/001	16	4	5	0
	Taylorsville WWTP	NC0026271/001	16	1	4	0
03-08-33						
	CMUD-McDowell Cr WWTP	NC0036277/001	18	3	4	0
	Duke Power-Lincoln Turbine	NC0080781/001	15	0	5	0
	Duke Power-McGuire 002	NC0024392/002	16	0	4	0
	Duke Power-McGuire 005	NC0024392/005	15	0	4	0
	Duke Power-River Bend 002	NC0004961/002	15	0	4	0
	Mt. Holly WWTP	NC0021156/001	16	0	4	0
03-08-34						
	American Truetzschler, Inc.	NC0085928/001	11	10	2	0

Table 33 (continued).

Subbasin	Facility	NPDES Permit No.	Pre 2002 Passes[1]	Pre 2002 Fails	2002 Passes	2002 Fails
	AquAir WWTP	NC0086673/001	5	1	4	0
	Belmont WWTP	NC0021181/001	17	1	4	0
	Charlotte-Douglas Airport-001	NC0083887/001	1	3	0	0
	Citgo-Paw Cr Bulk Terminal	NC0021962/001	4	0	0	0
	Clariant Corp.-Mt. Holly Plant	NC0004375/001	17	0	3	1
	CMUD-Irwin Creek WWTP	NC0024945/001	18	1	4	0
	CMUD-McAlpine WWTP	NC0024970/001	17	0	3	0
	CMUD-Sugar Cr WWTP	NC0024937/001	16	0	4	0
	Colonial Pipeline-Charlotte	NC0031038/001	5	0	2	0
	Cousins Real Estate-Gateway Village	NC0086517/001	6	12	0	3
	Crown Central Petro/001	NC0046531/001	4	0	1	0
	Duke Power-Allen 002	NC0004979/002	16	1	4	0
	Exxon Co-Charlotte Marketing Terminal	NC0004839/001	6	0	0	0
	First Union Commons	NC0086886/001	3	4	3	1
	Hoechst Celanese Corp-Dreyfus	NC0084301/001	17	2	0	0
	Livingstone Coating Corporation	NC0086002/001	15	0	4	0
	Louis Dreyfus Energy Corp.	NC0021971/009	4	0	1	0
	Marathon Petroleum	NC0046213/001	4	0	0	0
	Motiva Enterprises LLC	NC0046892/002	15	0	1	0
	Motiva Enterprises LLC	NC0046892/001	4	0	1	0
	Motiva Enterprises-Paw Creek	NC0022187/001	5	1	1	0
	National Welders Supply Company	NC0079758/001	3	4	0	0
	Phillips Pipeline Co. 001	NC0032891/001	2	2	1	0
	Phillips Pipeline Co. 002	NC0032891/002	3	1	0	1
	Transmontaigne #1	NC0005771/001	4	0	1	0
	Unocal Corp-Rhom and Haas Facility	NC0085057/001	14	3	5	1
	Valero Marketing and Supply Co.	NC0004723/001	4	0	1	0
	Williams Energy Ventures	NC0005185/006	4	0	1	0
	Williams Terminals Holdings, L.P.	NC0074705/001	4	0	1	0
03-08-35						
	Cherryville WWTP	NC0044440/001	15	2	5	1
	Delta Mills	NC0006190/001	15	2	4	0
	Hickory-Henry Fork WWTP	NC0040797/001	16	0	4	0
	Lincolnton WWTP	NC0025496/001	18	2	4	0
	Maiden WWTP	NC0039594/001	17	1	4	0
	Newton WWTP	NC0036196/001	17	0	3	1
	Stanley WWTP	NC0020036/001	16	9	4	0
03-08-36						
	Cramerton WWTP	NC0006033/001	20	2	4	0
	Dallas WWTP	NC0068888/001	0	0	1	9
	Gastonia-Long Cr WWTP	NC0020184/001	16	0	4	0
	Lowell WWTP	NC0025861/001	16	1	6	1
	Pharr Yarns, Inc.	NC0004812/001	16	0	4	0
	Yorkshire Americas, Inc.	NC0005274/001	17	1	4	0
03-08-37						
	Gastonia-Catawba Cr WWTP	NC0020192/001	6	2	0	0
	Gastonia-Crowders Creek	NC0074268/001	16	0	4	0
	Lithium Corp	NC0005177/001	16	0	3	0
	Rhodia, Inc.	NC0084638/001	17	1	3	0
	SKF USA (CR Industries)	NC0004260/001	15	2	4	0
	Textron, Inc.	NC0084662/001	17	3	4	2
03-08-38						
	Union County-Six Mile Cr	NC0066559/001	6	2	0	0
	Union County-Twelve Mile Cr WWTP	NC0085359/001	16	1	4	2

[1]Note that “pass” denotes meeting a permit limit or, for those facilities with a monitoring requirement, meeting a target value. The actual test result may be a “pass” (from a pass/fail acute or chronic test), LC_{50}, or chronic value. Conversely, “fail” means failing to meet a permit limit or target value.

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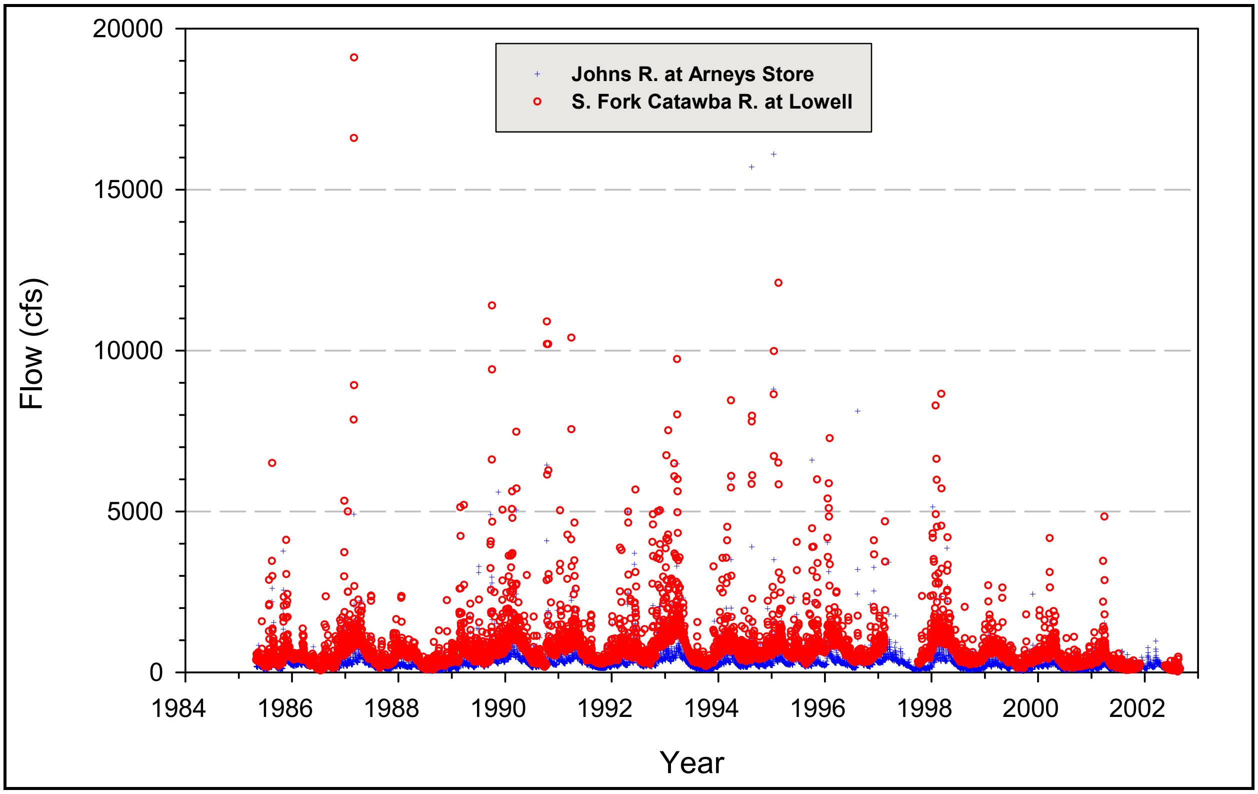
Appendix 1. Flow measurement and flow conditions in the Catawba River basin, 2002.

The Catawba River basin experienced a prolonged drought throughout 2002 (Figures 1 - 5). During fish community sampling (April - June) daily flows at some sites were 20 – 50 percent of the historical median flow. At these lower flows clays and silts tended to accumulate atop the rocks and settle out in the pools; periphyton growths were also abundant on the rocky substrate. These two conditions were prevalent throughout the basin but especially in Subbasins 30 and 31.

Changes in the benthic macroinvertebrate community are often used to help assess between-year changes in water quality. Some between-year changes in the communities, however, may be due to changes in flow. High flows magnify the potential effects of nonpoint source runoff, leading to scour, substrate instability, and reduced periphyton. Low flows accentuate the effect of point source dischargers by providing less dilution of wastes. Flow-related changes are decided on a site-by-site basis by looking at:

- *Flow*. In the three months prior to collection, daily flow patterns are examined from gauge sites. Areas affected by nonpoint source runoff are expected to have a decline in water quality after high flow, but may improve during low flow. An exception is in smaller headwater streams, which may cease flowing during extreme droughts. Streams affected by point source dischargers may improve after high flow (with dilution of the effluent) and decline after low flows. These changes, however, usually produce a between-year change of only one bioclassification.
- *Changes throughout the subbasin*. Flow-related changes usually affect several sites, not just a single site.
- *Changes in species composition*. Real changes in water quality are usually reflected in a significant change in the composition of the invertebrate community.

All between-year changes are considered in light of flow conditions for one month prior to the sampling date. Flow information is obtained gauge sites and compared to the long-term median flows. High flow is defined as a median flow greater than 140 percent of the long-term median for that time period, low flow is a median flow less than 60 percent of the long-term median; and normal flow is 60 to 140 percent of the median. Although regional patterns are often observed, there may be large geographical variation within the state and a single sampling period.



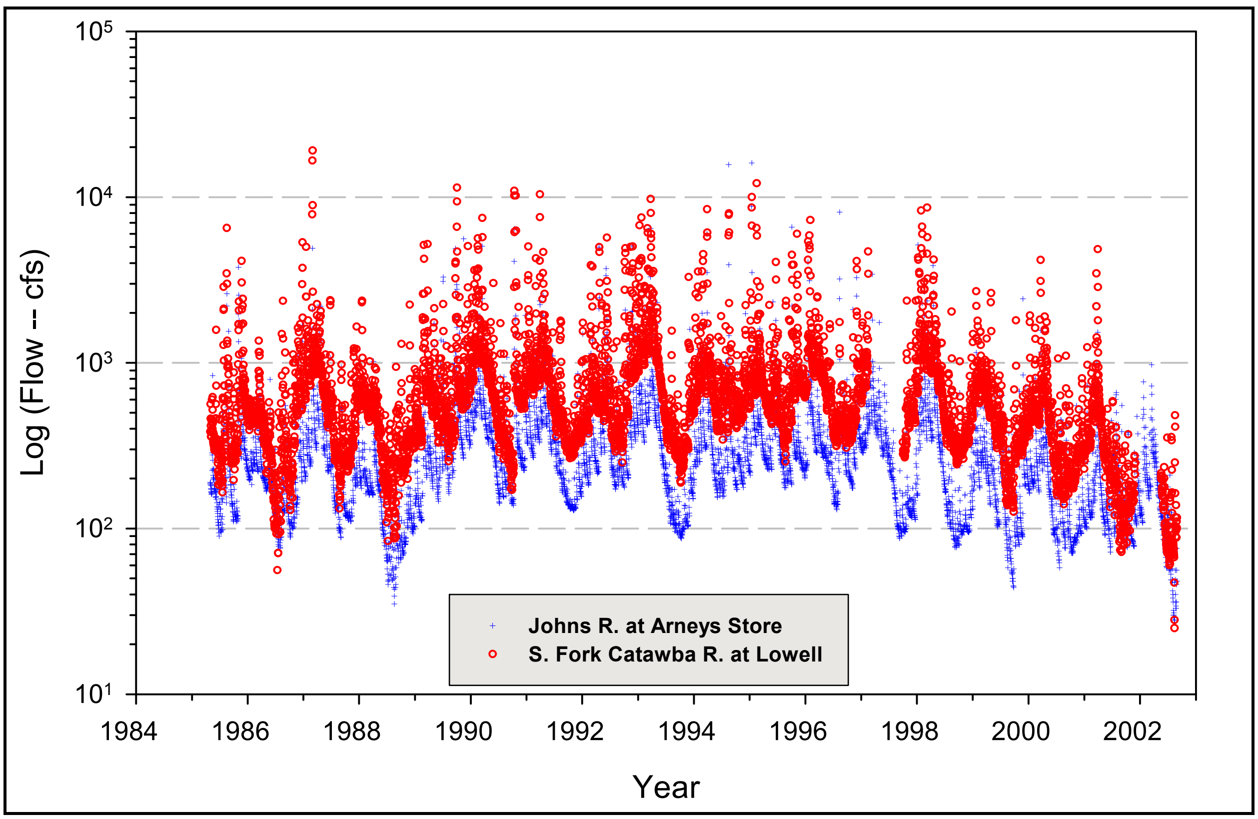
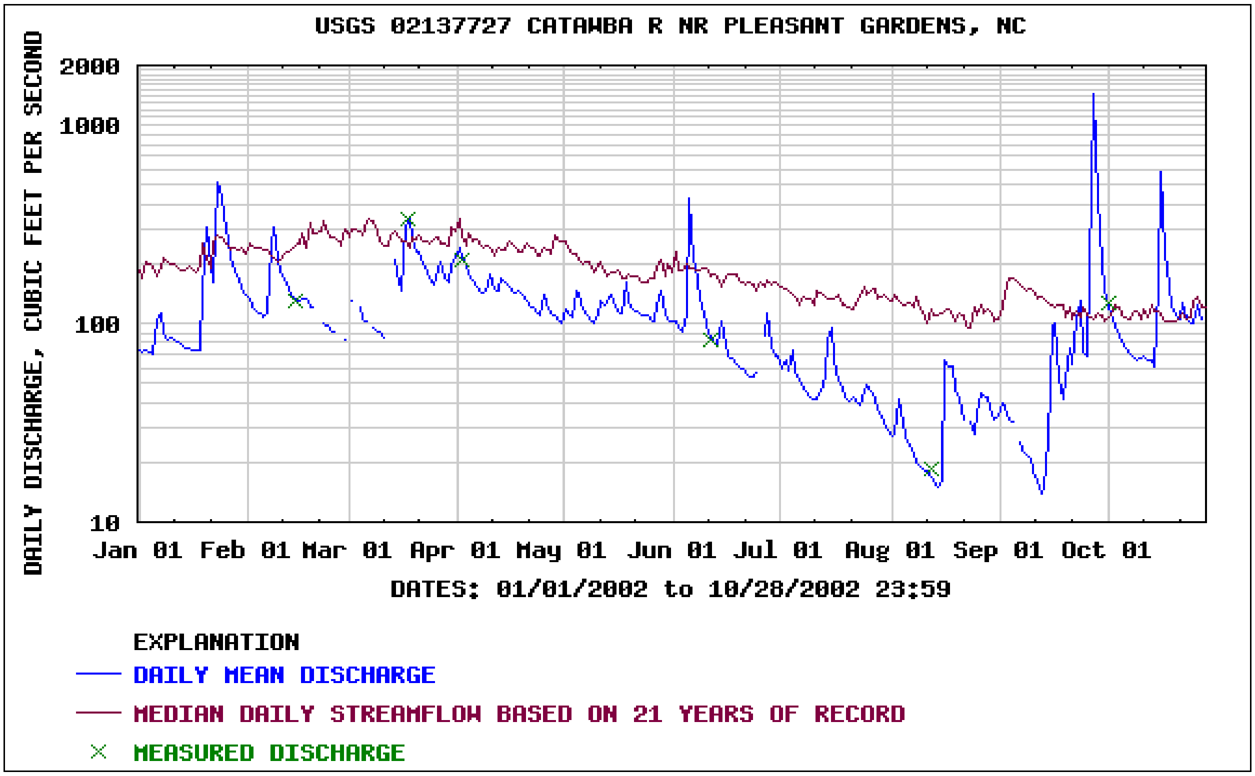


Figure 1. **Flows (raw and log transformed data) of the Johns and South Fork Catawba Rivers, 1985 - 2002.**



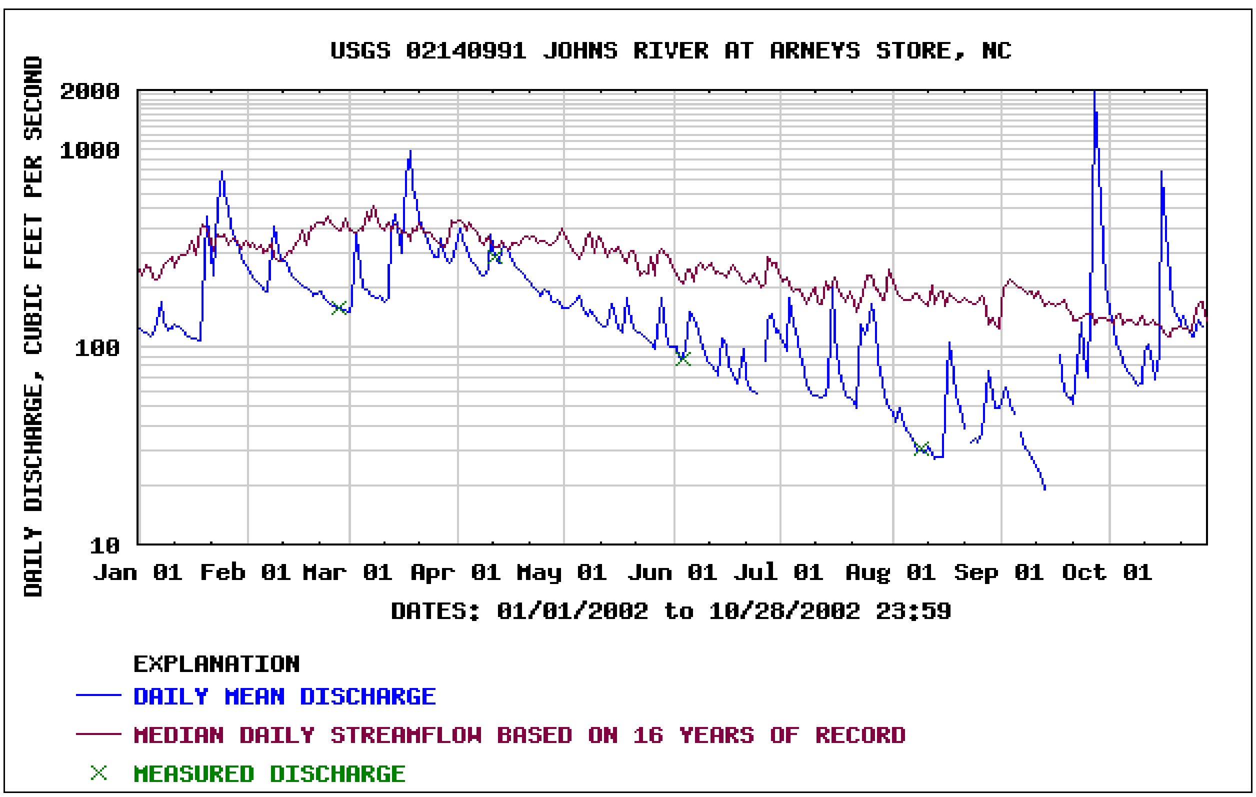
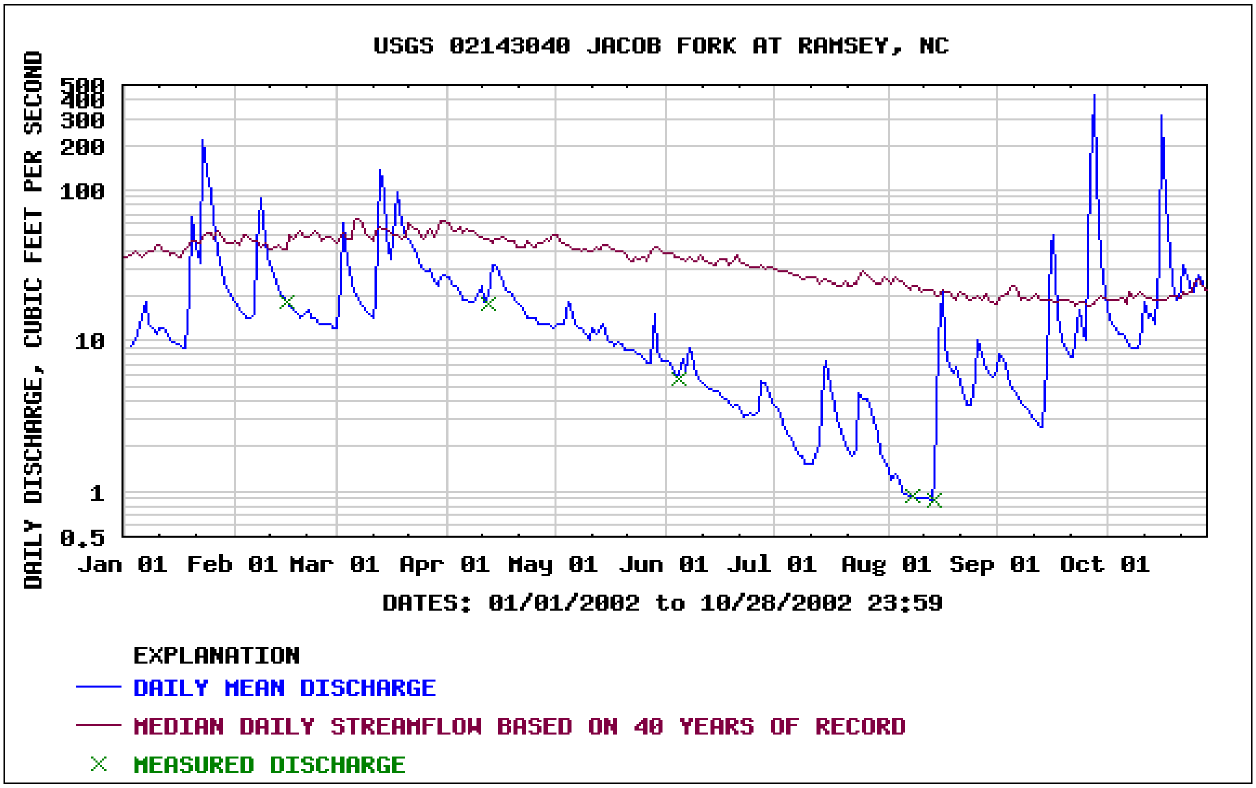


Figure 2. **Flows of the Catawba River (top) and the Johns River (bottom), January 01, 2002 – October 28, 2002.**



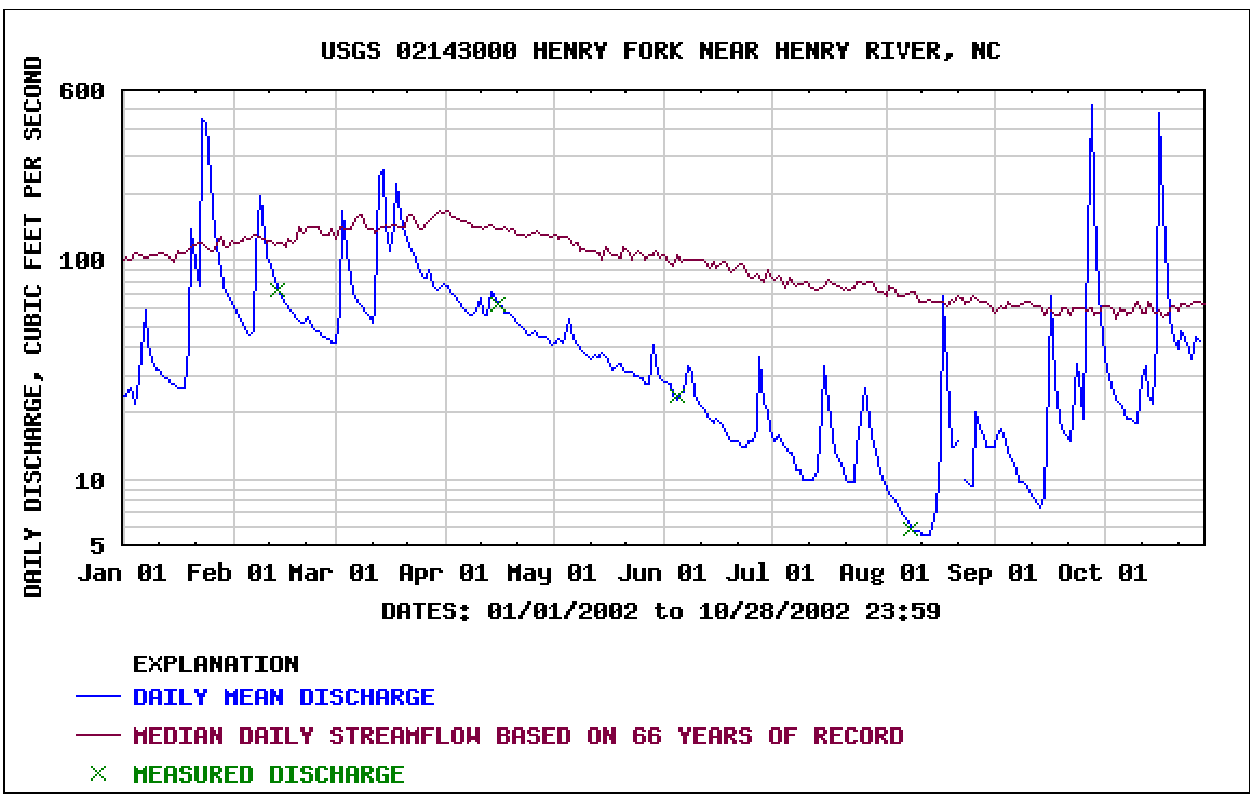
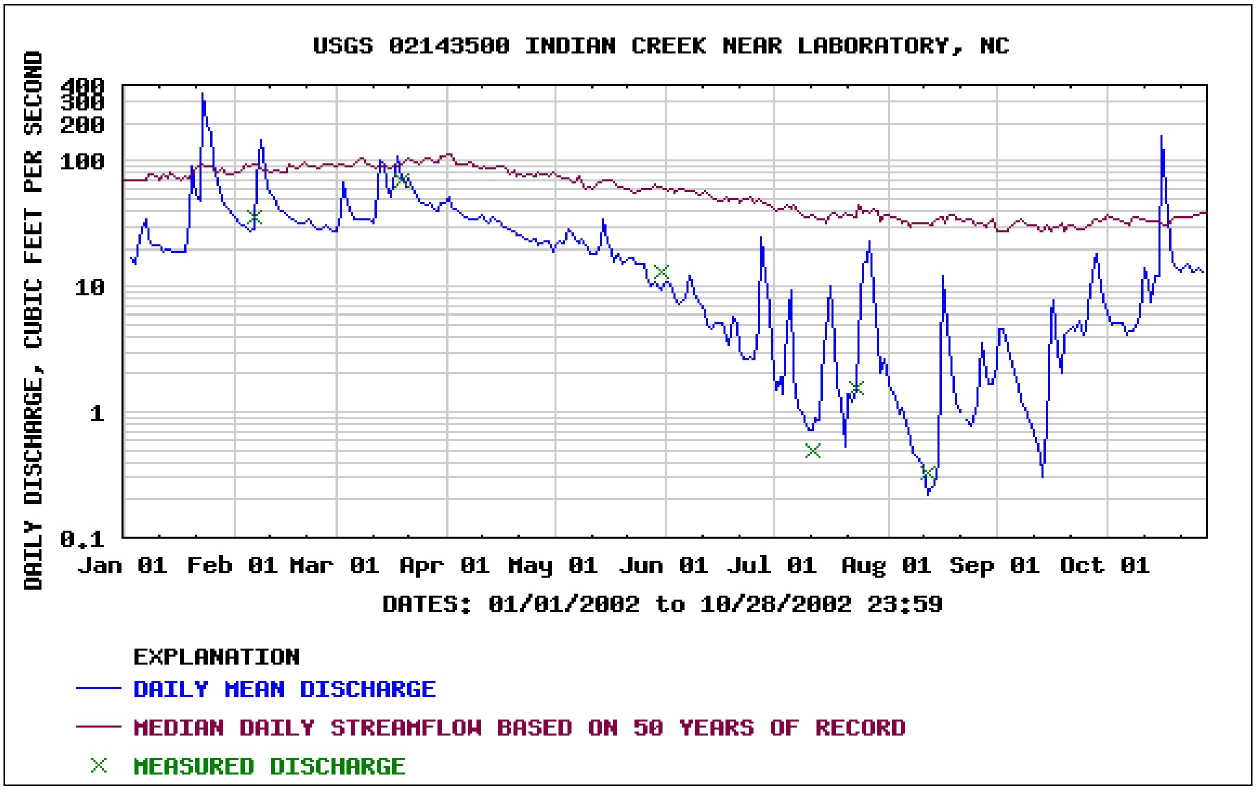


Figure 3. **Flows of Jacob Fork (top) and Henry Fork (bottom), January 01, 2002 – October 28, 2002.**



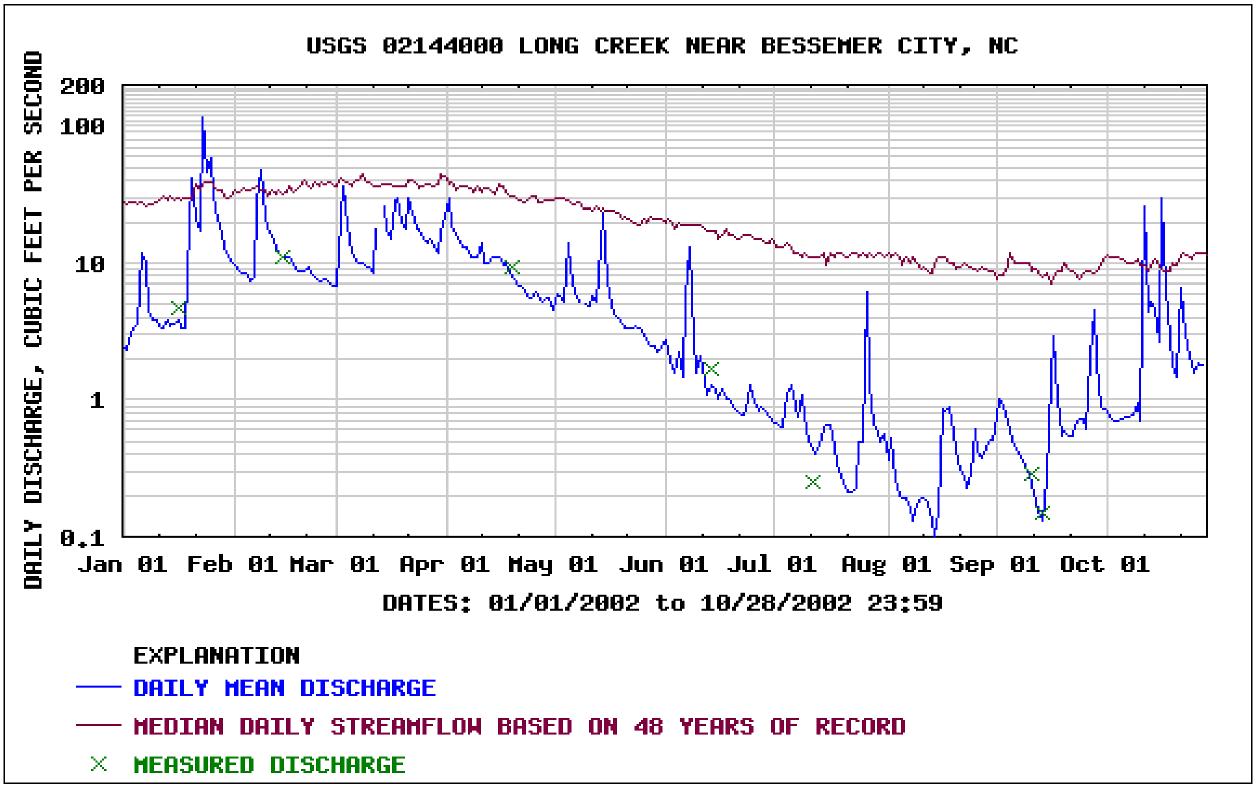
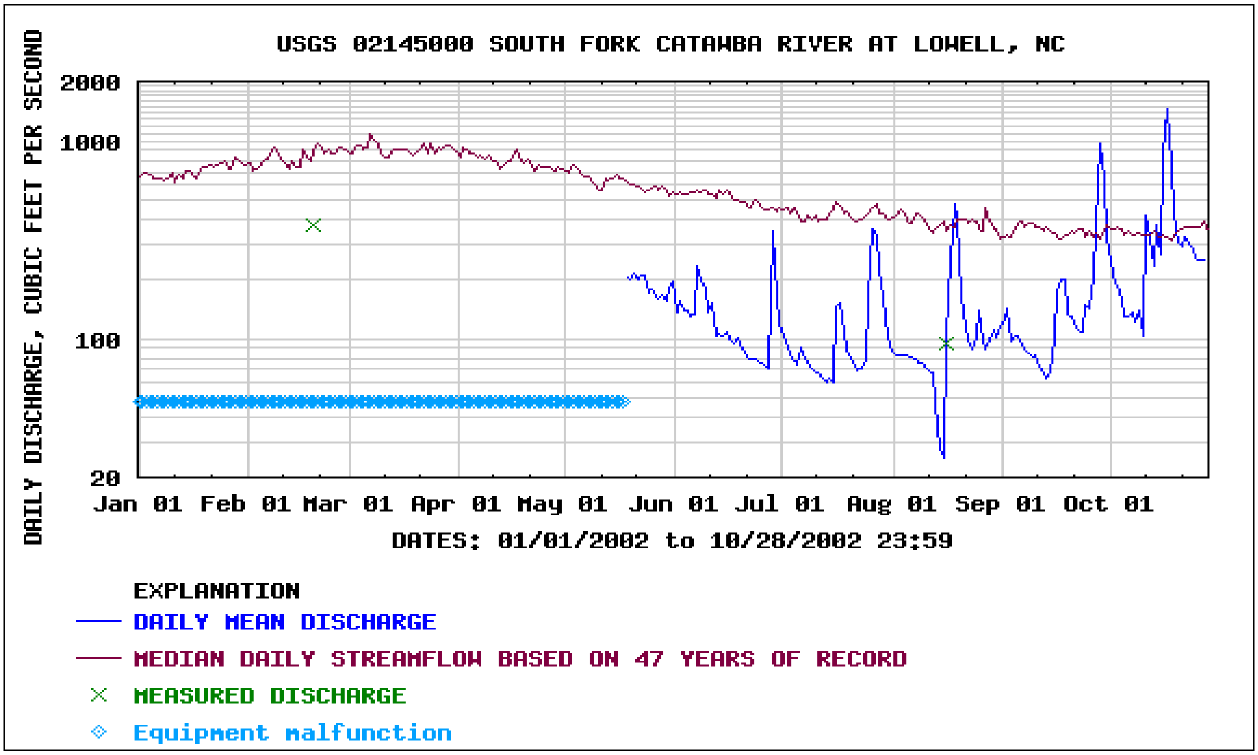


Figure 4. **Flows of Indian Creek (top) and Long Creek (bottom, January 01, 2002 – October 28, 2002.**



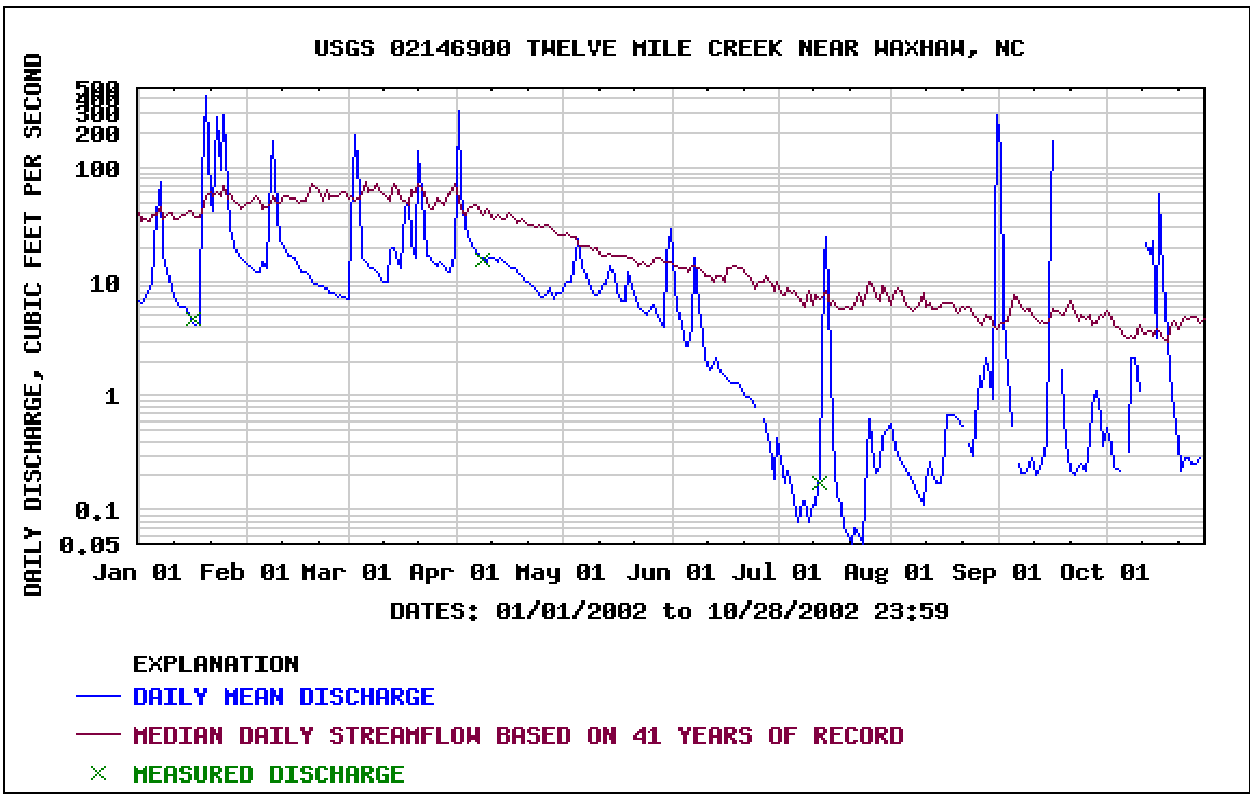


Figure 5. **Flows of South Fork Catawba River (top) and Twelvemile Creek (bottom), January 01, 2002 – October 28, 2002.**

Appendix 2. Habitat evaluations and stream and riparian habitats at fish community monitoring sites.

An assessment form has been developed by the Biological Assessment Unit to better evaluate the physical habitat of a stream (NCDENR 2001a). The habitat score, which ranges between 1 and 100, is based on the evaluation of channel modification, amount of instream habitat, type of bottom substrate, pool variety, bank stability, light penetration, and riparian zone width. Higher numbers suggest better habitat quality, but criteria have not been developed to assign impairment ratings. Habitat metric scores for all benthic macroinvertebrate and fish community sites in the Catawba River basin which were evaluated in 2002 and 1997 are listed in Appendices 3 - 5.

In 2002, fish community sampling was conducted within 8 of the 9 subbasins in the basin. Habitat scores ranged from 38 to 87 (Irish and Paddy Creeks, respectively) (Appendix 3). With a few exceptions, streams with high to moderately high habitats (scores ≥ 65) were found in the upper reaches of Subbasins 30 and 32. Characteristics these streams share are:

- instream habitats composed of rocks, sticks, leafpacks, snags and logs, and undercut banks and root mats (Figure 1);
- a substrate of gravel, cobble, and boulders with low embeddedness;
- frequent pools and riffles of varying depths and widths; and
- stable banks with a good tree canopy, and a medium to wide riparian zone with no or rare breaks in the zone (Figure 2).

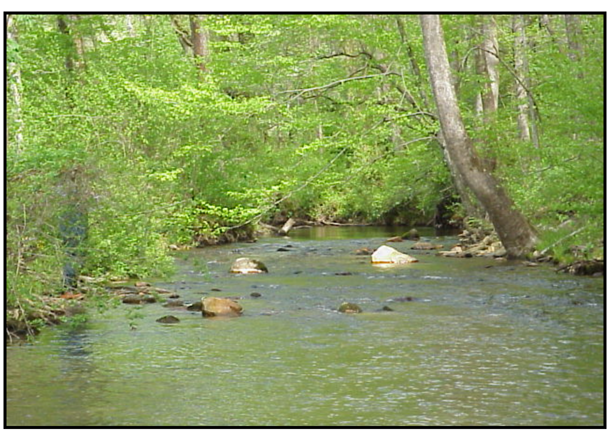


Figure 1. Instream habitats composed of rocks, sticks, leafpacks, snags and logs, and undercut banks and root mats (Curtis Creek at US 70, McDowell County).

Figure 2. Stable banks with a good tree canopy and a wide riparian zone (Crooked Creek at SR 1135, McDowell County).

These streams had better instream habitats, substrates, riffles, and bank stabilities than streams with low to moderate habitat scores (scores < 65) (Table 1). These low scores are attributable to erosion and nonpoint source sedimentation.

Table 1. Mean habitat scores for 29 fish community sites in the Catawba River basin, 2002.

Habitat characteristics	Low - Poor Quality Habitat	Moderate - High Quality Habitat	Max. score
Channel modification	4.4	4.8	5
Instream habitat	10.5	15.8	20
Substrate	3.3	8.0	15
Pool	5.0	7.7	10
Riffle	1.4	10.6	16
Bank stability (right and left)	6.2	10.1	14
Shade	9.4	8.4	10
Riparian width (right and left)	6.6	7.5	10

In contrast, streams with low to poor quality instream and riparian habitats (habitat scores < 65) are found in the other subbasins (Appendix 3). In these subbasins, the shallow streams have a predominantly sandy substrate. Other characteristics of these streams are:

- the channel and stream bottom is filled with shifting sand and bar development is evident (Figure 3);

- there is often a lack of cobble riffles, if riffles are present, they are usually caused by embedded, coarse woody debris in the current;
- the streams are deeply entrenched and detached from their original flood plains except at extremely high flows with easily erodible and unstable vertical banks (Figure 4); and
- livestock frequently have access to the stream causing bank erosion, trampling of riparian vegetation, fecal contamination and nutrient deposition.

Figure 3. Shifting sand and bar development, Hoyle Creek at SR 1836, Gaston County.

Figure 4. Entrenchment and vertical eroding banks, Catawba Creek, SR 2435, Gaston County.

Eighty-two fish community samples with associated habitat evaluations have been collected throughout the basin since 1997. This data set showed that as instream and riparian habitat deteriorated, so did the fish community ratings (Figure 5). Median habitat scores for Excellent and Good sites were 80 and 65, respectively. Good-Fair, Fair, and Poor sites had median habitat scores between 41 and 56.

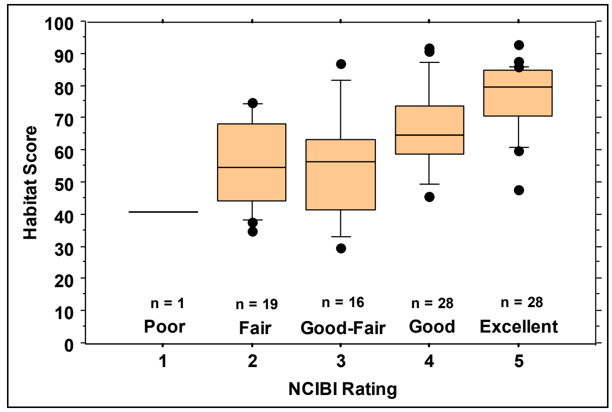


Figure 5. Relationships between habitat scores and NCIBI ratings in the Catawba River basin, 1997 - 2002. Note: other sites in the basin have been rated Poor but were located below permitted discharges and were influenced more by the discharges than by the habitats.

In 2002, with a few exceptions, fish communities rated Excellent were found in streams with moderate to high quality habitats (Table 2 and Appendix 3). Conversely, communities rated Good-Fair, Fair, or Poor were generally found in low to poor quality habitats.

Table 2. NCIBI ratings and habitat quality in the Catawba River basin, 2002.

NCIBI Rating	Waterbodies with Low to Poor Quality Habitat (Score < 65)	Waterbodies with Moderate to High Quality Habitat (Score ≥ 65)
Excellent	Silver	Curtis, Crooked, Smoky, Middle Little
Good	South Muddy, Elk Shoal	Canoe, North Muddy, Duck, Beaverdam, Pott
Good-Fair	Lower, Killian, Upper Little, Hoyle, Long, Twelvemile	Catawba R, Paddy
Fair	Irish, McGalliard, Hunting, Lower Little, Catawba Cr., Sixmile	Indian
Poor	McDowell	

The one Excellent fish community, at Silver Creek, where the habitat was of low to poor quality is existing perhaps because the overall water quality is still good. The are no NPDES permitted facilities above the site and the southern part of its watershed drains the northwest slopes of the South Mountains.

The Catawba River, Paddy Creek, and Indian Creek had moderate to high quality habitat but were rated either Good-Fair or Fair. Livestock have access to the Paddy Creek and the Catawba River sites and the riparian zones along at least one shoreline have been altered and are narrow. The fish community in the Catawba River declined slightly from Good in 1997 to Good-Fair in 2002. (NCIBI = 50 and 46, respectively).

Although the Indian Creek monitoring site is about 8 miles below the Town of Cherryville's WWTP (2 MGD) and about 15 miles below the West Lincoln High School WWTP (0.01 MGD), the fish community has been rated Fair in 1997 and 2002 despite having moderate quality habitats.

Appendix 3. Habitat evaluations at 29 basinwide fish community sites in the Catawba River basin, 2002.

Subbasin/ Ecoregion	Stream	Location	County	Width (m)	Channel	Instream Habitat	Substrate	Pools	Riffles	Bank Stability-L	Bank Stability-R	Shade	Riparian Zone-L	Riparian Zone-R	Total Score
03-08-30															
MT	Catawba R	SR 1110	McDowell	6	5	16	8	10	14	3	3	3	1	3	66
MT	Curtis Cr	US 70	McDowell	13	5	18	10	6	14	5	7	8	4	5	82
MT	Crooked Cr	SR 1135	McDowell	12	5	14	10	6	7	6	6	7	5	5	71
MT	Paddy Cr	NC 126	Burke	7	5	20	12	10	16	5	6	10	0	3	87
P	North Muddy Cr	SR 1760	McDowell	12	5	18	8	10	3	6	6	9	5	4	74
P	South Muddy Cr	SR 1764	McDowell	10	4	11	4	4	3	3	3	10	2	2	46
P	Canoe Cr	SR 1250	Burke	6	4	16	8	4	5	5	5	10	3	5	65
03-08-31															
P	Silver Cr	SR 1149	Burke	8	4	10	4	4	0	3	3	10	5	5	48
P	Irish Cr	SR 1439	Burke	9	3	11	3	8	3	2	2	4	1	1	38
P	Hunting Cr	SR 1512	Burke	10	5	7	3	6	0	4	4	9	3	3	44
P	Lower Cr	SR 1501	Burke	11	4	10	3	4	0	3	3	10	3	3	43
P	Smoky Cr	SR 1515	Burke	6	5	12	8	6	12	6	2	10	5	5	71
P	McGalliard Cr	SR 1538	Burke	6	5	12	4	4	3	4	4	10	5	4	55
03-08-32															
P	Upper Little R	SR 1786	Caldwell	12	5	14	3	10	2	6	5	7	5	4	61
P	Middle Little R	SR 1002	Alexander	8	5	16	8	10	10	6	7	10	5	5	82
P	Duck Cr	NC 90	Alexander	7	5	16	4	8	12	6	3	10	5	1	70
P	Lower Little R	SR 1318	Alexander	12	4	12	4	5	10	5	6	7	2	4	59
P	Elk Shoal Cr	SR 1605	Alexander	5	5	13	4	4	3	2	5	10	0	5	51
03-08-33															
P	McDowell Cr	SR 2136	Mecklenburg	5	4	10	3	2	0	2	2	10	3	5	41
P	Killian Cr	NC 73	Lincoln	5	4	11	3	1	1	3	3	10	2	2	40
03-08-35															
P	Pott Cr	SR 1217	Lincoln	8	5	14	3	8	7	4	4	10	5	5	65
P	Indian Cr	SR 1252	Lincoln	12	4	16	8	10	12	3	3	8	4	2	70
P	Beaverdam Cr	SR 1609	Gaston	10	4	14	3	8	5	6	6	9	5	5	65
P	Hoyle Cr	SR 1836	Gaston	7	5	11	3	10	7	3	2	10	5	3	59
03-08-36															
P	Long Cr	US 321	Gaston	10	5	12	3	10	5	2	3	10	4	3	57
03-08-37															
P	Catawba Cr	SR 2435	Gaston	6	4	11	3	6	3	2	2	10	3	1	45
P	Crowders Cr	SR 1108	Gaston	6	5	11	3	6	0	2	2	10	3	3	45
03-08-38															
P	Twelvemile Cr	NC 16	Union	12	4	10	4	10	0	4	4	10	3	4	53
P	Sixmile Cr	SR 1312	Union	6	4	11	3	10	2	2	2	10	0	5	45
	Maximum possible score				**5**	**20**	**15**	**10**	**16**	**7**	**7**	**10**	**5**	**5**	**100**

Appendix 4. Habitat evaluations at 32 basinwide fish community sites in the Catawba River basin, 1997. Note: the metrics and the possible scores were changed between 1997 and 2002.

Subbasin/ Ecoregion	Stream	Location	County	Width (m)	Channel	Instream Habitat	Substrate	Pools	Riffles	Bank Stability	Bank Vegetation Left	Bank Vegetation Right	Shade	Riparian Zone Left	Riparian Zone Right	Total Score
03-08-30																
MT	Catawba R	SR 1110	McDowell	7	10	10	10	10	10	10	4	4	4	2	4	78
MT	Armstrong Cr	SR 1456	McDowell	11	8	10	8	6	10	14	5	5	7	3	3	79
MT	Paddy Cr	NC 126	Burke	6	10	10	10	10	10	5	3	3	7	3	4	75
P	North Muddy Cr	SR 1760	McDowell	12	8	10	6	6	5	6	4	4	10	3	4	66
P	South Muddy Cr	SR 1764	McDowell	8	10	10	3	6	3	6	4	3	10	2	2	63
P	Canoe Cr	SR 1250	Burke	7	8	10	8	6	8	6	4	4	10	4	4	72
03-08-31																
MT	Upper Cr	SR 1439	Burke	12	8	10	8	410	10	14	4	3	10	4	2	83
MT	Mulberry Cr	NC 90	Caldwell	12	8	10	8	10	10	6	4	4	7	1	2	70
P	Lower Cr	SR 1501	Burke	9	8	5	3	4	0	4	3	3	5	0	0	35
P	McGalliard Cr	SR 1538	Burke	6	10	10	3	4	5	6	4	3	10	4	3	62
03-08-32																
P	Middle Little R	SR 1002	Alexander	8	10	13	4	8	6	6	4	4	9	4	4	72
P	Duck Cr	NC 90	Alexander	6	10	10	4	6	6	5	3	2	7	3	0	56
P	Lower Little R	SR 1318	Alexander	12	8	5	3	4	3	5	3	3	7	2	3	46
P	Elk Shoal Cr	SR 1605	Alexander	6	10	10	3	4	3	3	3	2	7	2	1	48
P	Lyle Cr	US 70	Catawba	9	10	12	3	10	8	5	3	3	10	5	4	73
P	Buffalo Shoals	SR 1503	Iredell	8	8	15	5	4	7	6	4	4	10	5	3	71
03-08-33																
P	McDowell Cr	SR 2136	Mecklenburg	7	4	10	3	4	0	6	3	3	2	4	3	42
P	Leepers Cr	NC 73	Lincoln	10	8	14	3	6	3	6	4	4	10	3	1	62
P	Killian Cr	NC 73	Lincoln	9	8	3	3	4	3	10	4	4	10	2	2	53
03-08-34																
P	Sugar Cr	SR 1156	Mecklenburg	10	10	10	8	10	8	10	4	4	7	4	4	79
P	Little Sugar Cr	NC 51	Mecklenburg	12	3	3	3	4	3	6	4	4	2	2	1	35
03-08-35																
MT	Henry Fk	SR 1916	Burke	14	8	14	8	6	10	10	4	4	7	4	5	80
MT	Jacob Fk	SR 1924	Burke	10	8	14	8	8	10	12	5	5	7	4	4	85
P	Pott Cr	SR 1217	Lincoln	7	9	14	3	10	3	10	4	4	10	3	4	74
P	Indian Cr	SR 1252	Lincoln	10	8	14	6	10	6	6	4	4	10	4	3	75
P	Hoyle Cr	SR 1836	Gaston	9	6	6	3	5	3	6	3	3	8	3	4	50
03-08-36																
P	Long Cr	US 321	Gaston	9	10	13	3	6	5	6	4	4	10	4	2	67
03-08-37																
P	Catawba Cr	SR 2435	Gaston	7	9	10	3	4	5	5	3	2	10	1	4	56
P	Crowders Cr	SR 1108	Gaston	9	8	10	3	4	3	6	4	3	10	4	4	59
03-08-38																
P	Twelvemile Cr	NC 16	Union	12	6	16	3	8	0	4	3	3	10	5	5	63
P	Sixmile Cr	SR 1312	Union	7	3	14	3	10	0	4	3	3	10	0	5	55
P	Waxhaw Cr	SR 1103	Union	8	10	14	3	10	6	6	3	3	8	5	5	74
	Maximum possible score				**10**	**14**	**10**	**10**	**10**	**14**	**5**	**5**	**10**	**5**	**5**	**100**

Appendix 5. Habitat evaluations at 50 basinwide benthic macroinvertebrate community sites in the Catawba River basin, 2002.

Subbasin/ Ecoregion	Stream	Location	County	Width (m)	Channel	Instream Habitat	Substrate	Pools	Riffles	Bank Stability-L	Bank Stability-R	Shade	Riparian Zone-L	Riparian Zone-R	Total Score
03-08-30															
	Catawba R	SR 1274	McDowell	4	5	11	12	10	14	5	5	8	4	1	75
	Catawba R	SR 1234	McDowell	12	5	20	8	6	14	7	7	10	5	5	87
	Catawba R	SR 1221	McDowell	30	4	12	12	2	2	3	5	2	2	2	46[1]
	Curtis Cr	SR 1227	McDowell	6	5	18	12	10	16	7	7	10	5	5	95
	Crooked Cr	SR 1135	McDowell	7	5	19	8	4	14	3	3	10	5	2	73
	Mackey Cr	SR 1453	McDowell	3	5	18	8	4	10	7	7	10	5	5	79
	Buck Cr	NC 80	McDowell	10	5	16	15	6	12	7	7	10	5	4	87
	L Buck Cr	SR 1436	McDowell	5	5	20	12	4	16	7	7	10	5	5	89
	Toms Cr	SR 1434	McDowell	3	5	11	15	10	16	6	6	10	5	5	89
	N Fk Catawba R	SR 1573	McDowell	10	5	19	12	4	12	7	7	7	3	3	79
	N FK Catawba R	SR 1560	McDowell	11	5	20	8	6	7	7	7	10	1	1	72
	Armstrong Cr	FS Road	McDowell	7	5	20	12	10	14	7	7	10	5	5	95
	Linville R	US 221	Avery	8	5	15	3	2	16	7	7	7	2	2	66
	Linville R	NC 126	Burke	15	5	19	12	6	7	7	7	2	5	5	75
	Catawba R	SR 1147	Burke	60	4	12	8	4	10	7	6	2	4	5	62
	N Muddy Cr	SR 1750	McDowell	8	4	14	12	4	12	7	7	7	4	4	75
	Youngs Fork	SR 1819	McDowell	5	5	16	3	4	7	3	3	10	5	5	61
	S Muddy Cr	SR 1764	McDowell	6	5	19	4	4	14	3	3	10	3	3	68
	Canoe Cr	SR 1250	Burke	4	5	14	6	0	12	6	6	10	2	2	63
03-08-31															
	Catawba R	NC 181	Burke	35	5	13	8	10	7	5	5	4	4	4	65
	Silver Cr	SR 1149/1127	Burke	6	5	16	7	0	12	6	6	10	1	1	64
	Warrior Fk	SR 1440	Burke	14	5	16	8	4	7	5	6	7	1	1	60
	Johns R	SR 1356	Burke	15	5	16	12	10	15	7	7	7	5	2	86
	Johns R	SR 1438	Burke	22	5	16	12	0	14	6	6	7	4	5	75
	Wilson Cr	SR 1335/1338	Caldwell	15	5	19	12	10	14	6	6	5	1	5	85
	Lower Cr	SR 1501	Burke	9	2	11	3	4	0	3	3	7	3	2	38
	Smokey Cr	SR 1515	Burke	5	5	12	5	4	12	3	3	10	4	4	62
	McGalliard Cr	SR 1538	Burke	6	5	12	3	4	0	6	6	8	3	3	50
03-08-32															
	Gunpowder Cr	SR 1718	Caldwell	9	5	12	3	0	3	6	6	10	2	1	48
	Upper Little R	SR 1740	Caldwell	13	5	12	10	6	14	7	7	7	5	5	78
	Middle Little R	SR 1153	Alexander	7	5	10	3	4	0	3	5	10	3	3	45
	Duck Cr	NC 127	Alexander	5	5	12	8	8	16	7	7	10	5	5	83
	Lower Little R	SR 1131	Alexander	11	5	16	12	8	14	5	6	7	4	4	81
	Muddy Fk	SR 1313	Alexander	4	4	10	3	4	2	3	3	7	1	1	38
	Elk Shoal Cr	SR 1605	Alexander	4	4	12	3	0	2	2	2	10	2	1	38
	Lyle Cr	US 64/70	Catawba	9	4	13	4	4	3	5	3	10	4	3	53
	McLin Cr	SR 1722	Catawba	5	5	12	4	4	7	3	3	10	4	3	55
03-08-33															
	McDowell Cr	SR 2128	Mecklenburg	4	4	8	3	2	0	3	3	7	2	5	37
	Dutchmans Cr	SR 1918	Gaston	7	4	12	8	4	12	6	6	9	3	4	68
	Killian Cr	SR 1511	Lincoln	4	4	12	8	4	10	6	6	9	4	4	67

Appendix 5 (continued).

Subbasin/ Ecoregion	Stream	Location	County	Width (m)	Channel	Instream Habitat	Substrate	Pools	Riffles	Bank Stability-L	Bank Stability-R	Shade	Riparian Zone-L	Riparian Zone-R	Total Score
03-08-34															
	Sugar Cr	SC 160	York, SC	20	4	11	4	3	6	5	5	3	5	5	51
	Sugar Cr	SR 1156	Mecklenburg	9	4	11	8	4	14	6	6	7	3	3	66
	Little Sugar Cr	Polk St	Mecklenburg	7	3	11	4	4	7	5	2	3	2	2	43
	McAlpine Cr	NC 51	Mecklenburg	14	5	14	3	4	0	2	2	7	5	5	47
03-08-35															
	Henry Fk	SR 1124	Catawba	17	4	12	8	4	7	7	7	7	5	3	64
	Jacob Fk	SR 1924	Burke	6	5	16	12	6	14	7	7	8	5	5	85
	Howards Cr	SR 1200	Lincoln	6	4	11	3	4	3	5	6	7	3	5	51
	Clark Cr	SR 1008	Lincoln	8	5	19	8	10	16	3	3	10	3	3	80
	Indian Cr	SR 1177	Lincoln	4	5	15	3	8	3	3	3	10	5	5	60
03-08-37															
	Crowders Cr	SC 564	York, SC	7	5	15	3	10	3	3	3	10	5	5	62
Maximum possible scores					**5**	**20**	**15**	**10**	**16**	**7**	**7**	**10**	**5**	**5**	**100**

Appendix 6. Benthic macroinvertebrate sampling methods and criteria.

Freshwater wadeable and flowing waters
Benthic macroinvertebrates can be collected from wadeable, freshwater, flowing waters using two sampling procedures. The Biological Assessment Unit's standard qualitative sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs (NCDENR 2001a). The samples are picked "on-site". The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1 - 2 specimens), Common (3 - 9 specimens), or Abundant (≥ 10 specimens).

Benthic macroinvertebrates can also be collected using an EPT sampling procedure. [Note: "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect groups that are generally intolerant of many kinds of pollution.] Four rather than 10 composite qualitative samples are taken at each site: 1 kick, 1 sweep, 1 leafpack and visual collections. Only EPT groups are collected and identified, and only EPT criteria are used to assign a bioclassification.

Several data-analysis summaries (metrics) can be produced from standard qualitative and EPT samples to detect water quality problems (Tables 1 and 2). These metrics are based on the idea that unstressed streams and rivers have many invertebrate taxa and are dominated by intolerant species. Conversely, polluted streams have fewer numbers of invertebrate taxa and are dominated by tolerant species. The diversity of the invertebrate fauna is evaluated using taxa richness counts; the tolerance of the stream community is evaluated using a biotic index.

For standard qualitative samples, EPT S (EPT S) is used with NCDWQ criteria to assign water quality scores. Higher EPT S values usually indicate better water quality. Water quality ratings also are based on the relative tolerance of the macroinvertebrate community as summarized by the North Carolina Biotic Index (NCBI or BI).

Table 1. Benthos classification criteria for flowing water systems in the mountain ecoregion.

Metric	Sample type	Bioclass	Score
EPT S	10-sample Qualitative	Excellent	> 41
		Good	32 - 41
		Good-Fair	22 - 31
		Fair	12 - 21
		Poor	0 - 11
	4-sample EPT	Excellent	> 35
		Good	28 - 35
		Good-Fair	19 - 27
		Fair	11 - 18
		Poor	0 - 10
Biotic Index (range 0 – 10)	10-sample Qualitative	Excellent	< 4.05
		Good	4.06 - 4.88
		Good-Fair	4.89 - 5.74
		Fair	5.75 - 7.00
		Poor	> 7.00

Table 2. Benthos classification criteria for flowing water systems in the piedmont ecoregion.

Metric	Sample type	Bioclass	Score
EPT S	10-sample Qualitative	Excellent	> 31
		Good	24 – 31
		Good-Fair	16 - 23
		Fair	8 – 15
		Poor	0 - 7
	4-sample EPT	Excellent	> 27
		Good	21 - 27
		Good-Fair	14 - 20
		Fair	7 - 13
		Poor	0 - 6
Biotic Index (range 0 – 10)	10-sample Qualitative	Excellent	< 5.19
		Good	5.19 - 5.78
		Good-Fair	5.79 - 6.48
		Fair	6.49 - 7.48
		Poor	> 7.48

Tolerance values for individual species and the final biotic index values have a range of 0-10, with higher numbers indicating more tolerant species or more polluted conditions. Water quality scores assigned with the biotic index numbers are combined with EPT S scores to produce a final bioclassification, using criteria for coastal plain streams. EPT N and Total S calculations also are used to help examine between-site differences in water quality. If the EPT S score and the BI differ by one, the EPT N value is used to determine the final site rating.

EPT S and BI values also can be affected by seasonal changes. DWQ criteria for assigning bioclassification are based on summer sampling: June - September. For samples collected outside summer, EPT S can be adjusted by subtracting out winter/spring Plecoptera or other adjustment based on resampling of summer site. The BI values also are seasonally adjusted for samples outside the summer season.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is not assessed as well by a taxa richness analysis.

Small Streams

Benthic studies in unimpacted mountain ecoregion watersheds have shown naturally reduced EPT S in small streams (less than 4 meters width), but similar studies have not been done in piedmont small streams or small streams that have disturbance in the watershed. For this reason, samples taken from sites with a width less than 4 meters are currently being listed as Not Impaired for use support evaluations, if the bioclassification would be Good-Fair or better using standard EPT criteria. Because such ratings are minimum ratings (no stream size correction factor has yet been developed), small stream sites that would be at least Poor or Fair, are listed as Not Rated to reflect the possibility that such sites might have higher ratings if a size correction was used. In Appendix 7, this Not Impaired or Not Rated terminology is applied to data that will be used for use support (collected since September 1996), and has not been retrofitted to all of the older data from small streams.

Appendix 7. Benthic macroinvertebrate data, Catawba River basin, 1983 - 2002. Current basinwide sites are in bold font.

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
03-08-30									
Catawba R	SR 1274 at end	McDowell	11-(1)	8/8/02	---	26	---	2.75	Good-Fair
		McDowell		8/7/97	---	24	---	2.88	Good-Fair
Catawba R	SR 1273	McDowell	11-(1)	4/18/85	99	49	4.24	2.97	Good
Mill Cr	at Graphite ab RR	McDowell	11-7	8/7/97	---	31	---	1.63	Excellent
				7/9/92	85	49	2.62	2.13	Excellent
				2/10/92	---	39	1.65	1.65	Good
Mill Cr	SR 1400/1407	McDowell	11-7	1/12/98	---	40	---	2.49	Good
				6/15/94	81	43	3.40	2.33	Excellent
Mill Cr	SR 1401	McDowell	11-7	1/12/98	---	37	---	2.73	Good
				8/7/97	---	18	---	3.26	Fair
Swannanoa Cr	SR 1400/1407	McDowell	11-7-9	8/8/02	---	31	---	2.26	Excellent
				1/12/99	---	35	---	2.75	Excellent
				1/12/98	---	16	---	2.31	Fair
				4/8/97	---	18	---	1.34	Fair
				6/15/94	---	35	---	1.90	Excellent
Catawba R	off SR 1234	McDowell	11-(8)	4/18/85	82	39	4.51	3.17	Good-Fair
Catawba R	I-40, be Old Fort	McDowell	11-(8)	7/23/87	74	30	5.75	4.66	Good-Fair
Catawba R	SR 1234	McDowell	11-(8)	8/8/02	89	36	4.72	3.55	Good
				8/7/97	70	31	5.32	4.18	Good-Fair
				7/9/92	102	41	4.13	3.20	Good
				7/26/90	84	38	4.43	3.71	Good
				4/18/85	86	28	6.29	4.02	Fair
Catawba R	SR 1221	McDowell	11-(8)	8/7/02	73	27	5.38	4.11	Good-Fair
				8/6/97	75	35	4.46	3.89	Good
				7/8/92	90	42	4.42	3.60	Good
				7/26/90	77	43	4.27	3.77	Good
				8/11/88	86	31	5.60	4.74	Good-Fair
				7/28/88	---	27	---	3.88	Good-Fair
				7/21/86	78	26	5.74	4.11	Good-Fair
				8/15/85	73	24	5.50	4.38	Good-Fair
				8/23/84	63	23	4.99	4.42	Good-Fair
				8/9/83	70	27	5.64	4.61	Good-Fair
Curtis Cr	off SR 1227	McDowell	11-10-(6)	8/8/02	---	30	---	3.35	Good
				8/7/97	---	34	---	2.46	Good
				2/10/92	---	42	2.13	2.10	Good
				4/19/85	97	44	3.86	2.37	Good
Curtis Cr	US 70 below WWTP	McDowell	11-10-(14)	6/15/94	---	30	---	2.65	Good
				4/18/85	56	25	5.76	3.11	Fair
Crooked Cr	SR 1135	McDowell	11-12	8/7/02	74	32	4.41	3.65	Good
				8/6/97	69	38	4.25	3.74	Good
				7/8/92	---	32	---	3.02	Good
Mackey Cr	SR 1453	McDowell	11-15-(3.5)	8/8/02	---	23	---	3.32	Not Impaired
				8/6/97	---	29	---	2.92	Good
				2/11/92	---	45	---	1.98	Excellent
Mackey Cr	above US 70	McDowell	11-15-(3.5)	3/25/98	68	37	3.60	2.72	Good
				10/2/96	68	30	4.36	3.82	Good
Mackey Cr	below US 70	McDowell	11-15-(3.5)	8/6/02	67	30	4.24	3.68	Good
				3/25/98	29	15	4.44	3.92	Fair
				10/2/96	43	25	4.90	4.47	Good-Fair
Buck Cr	off NC 80	McDowell	11-19-(1)	8/5/02	---	31	---	3.03	Good
				8/6/97	---	38	---	2.58	Excellent
				6/14/94	75	41	3.28	2.47	Excellent
				2/10/92	---	42	---	2.19	Excellent
Buck Cr	US 70	McDowell	11-19-(14)	6/14/94	58	20	4.64	3.40	Good-Fair

Appendix 7 (continued).

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
L Buck Cr	SR 1436	McDowell	11-19-11	8/6/02	---	35	---	2.74	Good
				8/6/97	---	37	---	2.44	Excellent
				2/10/92	---	43	---	2.00	Excellent
				7/9/91	60	37	2.75	2.31	Good
Toms Cr	SR 1434	McDowell	11-21-(2)	8/5/02	---	26	---	2.41	Not Impaired
				8/4/97	62	33	3.17	2.59	Good
				7/7/92	75	37	3.54	2.68	Excellent
				2/10/92	---	49	---	2.29	Excellent
N Fk Catawba R	Linville Falls	McDowell	11-24-(1)	1/9/91	---	37	---	1.89	Good
N Fk Catawba R	US 221	McDowell	11-24-(1)	1/9/91	---	42	---	2.57	Good
N Fk Catawba R	SR 1573	McDowell	11-24-(1)	8/6/02	---	28	---	3.78	Good
				8/8/97	---	37	---	2.74	Excellent
				1/9/91	---	37	---	2.83	Good
N Fk Catawba R	SR 1560	McDowell	11-24-(1)	8/6/02	74	23	5.90	4.92	Fair
				8/5/97	81	39	3.89	3.09	Good
				7/7/92	95	41	4.19	3.30	Good
				1/9/91	---	44	---	2.60	Excellent
N Fk Catawba R	below Sevier	McDowell	11-24-(1)	8/5/97	84	39	4.52	3.48	Good
				7/7/92	88	43	4.03	3.27	Excellent
Laurel Br	US 221	McDowell	11-24-3	1/8/91	---	32	---	1.37	Good
Pond Br	SR 1560	McDowell	11-24-4	1/9/91	---	24	---	1.54	Good
Stillhouse Br	SR 1560	McDowell	11-24-6	1/9/91	---	25	---	1.55	Good
Honeycutt Cr	US 221	McDowell	11-24-8	1/9/91	---	44	---	2.60	Good
Pepper Cr	US 221	McDowell	11-24-10	1/8/91	---	42	---	2.53	Good
Armstrong Cr	end of FS Rd	McDowell	11-24-14-(1.5)	8/6/02	---	38	---	2.80	Excellent
				8/5/97	---	36	---	2.15	Excellent
				7/7/92	---	38	---	2.10	Excellent
Three Mile Cr	SR 1443	McDowell	11-24-14-10	6/14/94	---	40	---	2.17	Excellent
Cox Cr	OFF NC 226	McDowell	11-24-14-12	6/14/94	---	37	---	2.89	Excellent
Armstrong Cr	off NC 226		11-24-14-(13.5)	6/14/94	99	48	3.47	2.60	Excellent
Paddy Cr	NC 126	Burke	11-29	5/19/99	---	36	---	2.80	Good
Linville R	off NC 105 ab golf course	Avery	11-29-(1)	6/9/97	60	32	2.90	1.86	Good
Linville R	NC 105, near Briery Knob	Avery	11-29-(1)	6/9/97	---	32	---	2.18	Good
				11/8/89	---	27	---	3.30	Good-Fair
Linville R	US 221	Avery	11-29-(1)	8/6/02	---	28	---	3.90	Good
				8/5/97	---	27	---	3.25	Good-Fair
				6/10/97	---	24	---	3.24	Good-Fair
				7/6/92	---	30	---	3.27	Good
				11/8/89	---	22	---	3.98	Good-Fair
L Grassy Cr	off NC 105 ab golf course	Avery	11-29-2	6/9/97	60	37	1.83	1.06	Excellent
W Fk Linville R	SR 1349	Avery	11-29-4	11/8/89	---	39	---	1.76	Good
Grandmother Cr	SR 1511	Avery	11-29-5-(2)	11/7/89	---	30	---	2.62	Good
Linville R	NC 126	Burke	11-29-(23)	8/23/02	91	48	4.21	3.47	Excellent
				8/7/02	90	47	3.98	3.20	Excellent
				8/4/97	107	53	4.05	3.11	Excellent
				7/7/92	108	48	4.14	3.14	Excellent
				7/9/91	84	43	4.03	3.02	Excellent
				1/8/91	---	48	---	2.51	Excellent
				10/24/90	94	47	3.81	2.75	Excellent
				7/27/90	104	46	4.22	3.13	Excellent
				4/10/90	113	54	3.70	2.39	Excellent
				1/22/90	---	49	---	2.14	Excellent
				1/22/90	94	56	3.45	2.50	Excellent
				11/7/89	100	54	3.42	2.62	Excellent
				11/7/89	---	48	---	2.52	Excellent
				8/8/89	---	45	---	3.10	Excellent
				8/8/89	99	46	3.93	2.75	Excellent

Appendix 7 (continued).

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
				3/29/89	89	43	3.67	3.18	Good
				2/15/89	113	59	3.83	2.88	Excellent
				2/15/89	---	41	---	2.77	Excellent
				8/3/87	---	42	---	3.30	Excellent
				7/23/87	113	48	4.52	3.32	Excellent
				8/16/85	101	41	5.11	3.69	Good
				8/10/83	105	45	4.61	3.45	Good
Catawba R	SR 1147	Burke	11-(31)	8/8/02	60	21	4.03	2.97	Good
				8/8/97	66	30	4.25	3.21	Good
				8/12/88	79	34	4.83	3.36	Good
N Muddy Cr	SR 1750	McDowell	11-32-1-(0.5)	8/5/02	77	32	5.53	4.61	Good-Fair
				8/4/97	63	33	4.76	4.26	Good
				7/8/92	80	32	4.95	4.46	Good-Fair
				4/17/85	85	35	5.48	4.16	Good-Fair
Youngs Fk	SR 1819	McDowell	11-32-1-4	8/7/02	66	22	5.79	4.65	Good-Fair
				4/9/01	52	15	5.36	4.73	Fair
				8/8/97	---	16	---	5.02	Fair
				9/12/90	55	17	6.11	5.36	Fair
				4/17/85	64	19	6.67	4.80	Fair
Youngs Fk	off NC 226	McDowell	11-32-1-4	4/9/01	30	5	7.46	6.52	Poor
Jacktown Cr	US 226	McDowell	11-32-1-4-1	4/9/01	54	19	4.88	3.93	Fair
Youngs Fk	SR 1794	McDowell	11-32-1-4	4/9/01	62	16	6.20	4.16	Fair
				9/12/90	44	8	7.16	6.61	Poor
				4/17/85	58	17	6.62	4.60	Fair
S Muddy Cr	SR 1764	McDowell	11-32-2-(8.5)	8/5/02	---	23	---	4.21	Good-Fair
		McDowell		8/4/97	---	24	---	3.67	Good-Fair
		McDowell		7/8/92	---	27	---	3.64	Good-Fair
High Shoals Cr	SR 1798	McDowell	11-32-2-6	7/22/86	76	32	4.30	2.91	Good
Canoe Cr	SR 1250	Burke	11-33-(2)	8/21/02	---	28	---	3.50	Good
				8/04/97	---	19	---	4.05	Good-Fair
				8/03/92	---	25	---	3.13	Good-Fair
03-08-31									
Catawba R	NC 181	Burke	11-(31)	08/22/02	46	21	4.44	3.54	Good-Fair
				08/04/97	57	23	4.56	3.12	Good-Fair
				07/06/92	76	30	4.79	3.71	Good
Silver Cr	SR 1127	Burke	11-34-(0.5)	08/21/02	---	25	---	3.74	Good-Fair
Silver Cr	SR 1149	Burke	11-34-(0.5)	08/04/97	73	32	5.26	4.48	Good-Fair
				08/03/92	71	29	5.53	4.46	Good-Fair
Clear Cr	Ab Hospital Reservoir	Burke	11-34-6-(1)	12/12/91	---	30	---	2.38	Good
Bailey Fork	SR 1102	Burke	11-34-8-(2)	08/03/92	---	24	---	3.30	Good-Fair
Warrior Fk	SR 1440	Burke	11-35-(1)	08/21/02	---	34	---	3.30	Good
				08/04/97	---	41	---	3.25	Excellent
Upper Cr	NC 181	Burke	11-35-2-(1)	09/22/88	---	46	---	2.38	Excellent
Upper Cr	USFS Rd 128	Burke	11-35-2-(1)	03/29/89	---	44	---	2.53	Good
				10/24/88	---	34	---	2.73	Good
				09/21/88	---	26	---	3.37	Good-Fair
Upper Cr	Ab USFS Rd 982	Burke	11-35-2-(1)	06/13/94	100	51	3.58	2.60	Excellent
				06/08/93	94	47	3.54	2.61	Excellent
UT Upper Cr	Ab Timbered Br	Burke	11-35-2-(1)	06/13/94	56	27	3.30	2.20	Excellent
				06/08/93	63	27	3.69	2.15	Excellent
Timbered Br	USFS Road 982	Burke	11-35-2-9	06/13/94	79	47	2.86	2.28	Not Rated
				06/08/93	74	38	3.15	2.10	Not Rated
				09/21/88	---	20	---	2.98	Good-Fair
Upper Cr	Be USFS Rd 982	Burke	11-35-2-(8.5)	06/13/94	103	57	3.45	2.63	Excellent
				06/08/93	108	58	3.44	2.38	Excellent
Upper Cr	At Optimist's Park	Burke	11-35-2-(10)	09/21/88	108	45	4.47	3.12	Excellent
Steels Cr	USFS Rd 128	Burke	11-35-2-12-(1)	05/17/90	---	48	---	1.73	Excellent
				09/22/88	---	38	---	2.70	Excellent

Appendix 7 (continued).

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
Gingercake Cr	USFS Rd 496	Burke	11-35-2-12-3	05/17/90	---	39	---	1.68	Excellent
				10/25/88	---	31	---	1.38	Excellent
Buck Cr	Ab Steels Cr	Burke	11-35-2-12-4	05/17/90	---	40	---	1.78	Excellent
Little Fork	USFS Rd 128	Burke	11-35-2-12-6	09/21/88	---	38	---	2.45	Excellent
				03/19/86	102	45	3.27	2.38	Excellent
Steels Cr	Ab NC 181	Burke	11-35-2-12-(7)	05/17/90	---	49	---	2.12	Excellent
				09/22/88	105	43	4.50	3.33	Good
Upper Cr	SR 1407	Burke	11-35-2-(13)	10/25/88	---	34	---	3.35	Good
Upper Cr	SR 1439	Burke	11-35-2-(13)	09/20/88	100	42	4.77	3.60	Good
Johns R	SR 1367	Caldwell	11-38-(1)	03/28/89	---	45	---	2.25	Good
Johns R	SR 1356	Caldwell	11-38-(9)	08/22/02	---	42	---	3.46	Excellent
				08/05/97	---	49	---	2.56	Excellent
				08/03/92	---	43	---	3.15	Excellent
				03/28/89	---	40	---	2.69	Good
				10/30/84	108	48	4.10	2.85	Excellent
Gragg Pr	SR 1462	Caldwell	11-38-10	03/27/89	---	47	---	2.34	Good
Anthony Cr	Ab Gragg Pr	Caldwell	11-38-10-3	03/27/89	---	30	---	2.30	Good-Fair
Johns R	SR 1438	Burke	11-38-(28)	08/22/02	---	35	---	3.44	Good
				03/28/89	116	63	3.90	2.76	Excellent
				08/10/83	89	43	4.04	3.31	Excellent
Mulberry Cr	SR 1368	Caldwell	11-38-32-(11)	03/27/89	---	53	---	2.59	Excellent
Mulberry Cr	SR 1310	Caldwell	11-38-32-(15)	03/27/89	---	43	---	2.86	Good
Wilson Cr	US 221	Avery	11-38-34	07/23/90	65	32	2.65	1.32	Excellent
				08/08/88	81	37	3.16	1.63	Excellent
				07/24/86	67	36	2.58	1.54	Excellent
				08/28/84	38	20	2.64	1.19	Good
Wilson Cr	SR 1358	Caldwell	11-38-34	07/09/91	92	50	3.78	2.88	Excellent
				03/29/89	---	57	---	2.14	Excellent
				07/24/86	106	49	3.68	2.65	Excellent
Wilson Cr	off SR 1328 Be Mortimer	Caldwell	11-38-34	08/22/02	85	45	3.33	2.48	Excellent
Wilson Cr	SR 1335	Caldwell	11-38-34	08/05/97	---	47	---	2.68	Excellent
Harper Cr	SR 1328	Caldwell	11-38-34-14	08/22/02	---	42	---	2.78	Excellent
N Harper Cr	USFS Rd 58	Avery	11-38-34-14-2	08/06/86	90	43	3.68	2.36	Excellent
Lower Cr	NC 90	Caldwell	11-39-(0.5)	09/09/02	45	9	6.46	5.35	Poor
				06/10/97	51	22	5.21	4.50	Good-Fair
Lower Cr	Harrisburg St, Lenoir	Caldwell	11-39-(0.5)	09/15/87	65	22	5.92	4.73	Fair
Lower Cr	SR 1303, Fairview Rd	Caldwell	11-39-(0.5)	09/10/02	57	13	6.67	5.53	Fair
				06/10/97	43	18	5.36	4.35	Fair
Zacks Fk Cr	SR 1531	Caldwell	11-39-1	09/09/02	54	19	5.67	5.02	Not Impaired
Zacks Fk Cr	NC 18/321A	Caldwell	11-39-1	09/10/02	32	6	6.87	6.15	Not Rated
				06/10/97	---	18	---	4.54	Fair
				09/15/87	55	19	6.05	5.39	Fair
Spainhour Cr	SR 1303	Caldwell	11-39-3	06/11/97	---	14	---	5.03	Fair
Spainhour Cr	NC 18 Bus	Caldwell	11-39-3	09/09/02	49	15	6.46	5.82	Fair
UT Spainhour Cr	SR 1513	Caldwell	11-39-3	09/09/02	32	13	4.66	4.38	Not Rated
Blair Fk	NC 90	Caldwell	11-39-3-1	09/09/02	24	5	6.42	5.58	Not Rated
Greasy Cr	NC 18	Caldwell	11-39-4	09/10/02	45	14	5.70	5.19	Not Rated
				06/11/97	---	15	---	4.31	Fair
Greasy Cr	SR 1305	Caldwell	11-39-4	09/10/02	47	13	4.86	3.99	Not Rated
Abingdon Cr	NC 18 Bypass	Caldwell	11-39-6	09/10/02	57	20	5.60	5.11	Not Impaired
Lower Cr	SR 1142, Calico Rd	Caldwell	11-39-(6.5)	09/10/02	50	11	6.52	5.54	Fair
				06/11/97	39	16	5.91	4.86	Fair
Lower Cr	SR 1501	Burke	11-39-(6.5)	09/11/02	55	14	6.14	4.96	Fair
				06/10/97	46	19	5.52	4.87	Fair
				08/03/92	55	20	5.85	4.80	Fair
				07/10/90	62	19	6.59	5.23	Fair
				07/23/87	61	18	6.82	4.85	Fair
				08/07/84	60	20	6.39	5.00	Fair
Celia Cr		Caldwell	11-39-7-1-(1)	09/11/02	39	10	5.78	4.77	Not Rated

Appendix 7 (continued).

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
Husband Cr	Old NC 18	Caldwell	11-39-7-(2)	09/11/02	59	24	5.28	4.54	Not Impaired
Husband Cr	NC 18	Caldwell	11-39-7-(2)	09/11/02	36	14	5.24	4.34	Not Rated
				06/11/97	---	20	---	4.77	Good-Fair
Bristol Cr	NC 18	Caldwell	11-39-8	09/11/02	55	12	5.56	4.39	Not Rated
				06/10/97	---	15	---	4.61	Fair
White Mill Cr	Piney Rd	Caldwell	11-39-8-1-(2)	09/11/02	37	12	4.74	3.06	Not Rated
Smoky Cr	SR 1515	Burke	11-41-1	08/21/02	---	26	---	3.55	Good-Fair
				08/05/97	---	32	---	3.58	Good
				08/04/92	---	30	---	3.22	Good
McGalliard Cr	SR 1538	Burke	11-44-(0.5)	08/21/02		16	---	5.09	Fair
				08/05/97	---	21	---	4.81	Good-Fair
				08/04/92	66	22	5.60	4.56	Good-Fair
03-08-32									
Huffman Br	Sta 2, be Huffman Finishing	Burke	11-(51)-1	10/11/84	13	0	9.30	---	Poor
Huffman Br	Sta 3	Burke	11-(51)-1	10/11/84	19	1	9.25	6.22	Poor
Huffman Br	Sta 4	Burke	11-(51)-1	10/11/84	20	0	8.94	N/A	Poor
Horseford Cr	16th Ave NW	Catawba	11-54-(0.5)	09/12/02	32	8	6.58	6.34	Fair
Gunpowder Cr	SR 1718	Caldwell	11-55-(1.5)	08/21/02	---	23	---	4.68	Good-Fair
Gunpowder Cr	SR 1002	Caldwell	11-55-(1.5)	08/05/97	---	25	---	4.27	Good-Fair
Upper Little R	SR 1740	Caldwell	11-58-(5.5)	08/20/02	83	33	4.91	3.93	Good
				08/06/97	90	39	4.35	3.47	Good
				08/04/92	74	38	4.17	3.55	Good
Middle Little R	SR 1153	Alexander	11-62	08/20/02		18	---	3.74	
				08/06/97	---	26	---	3.95	Good-Fair
				08/04/92	32	32	4.14	4.14	Good
Duck Cr	NC 127	Alexander	11-62-2-(4)	08/20/02	---	33	---	3.76	Good
				08/06/97	---	26	---	3.93	Good-Fair
				O8/04/92	---	26	---	3.42	Good-Fair
Lower Little R	SR 1313	Alexander	11-69	07/28/88	87	32	5.19	3.51	Good-Fair
				08/27/88	---	29	---	4.42	Good
				08/08/85	53	18	5.78	5.42	Fair
Lower Little R	SR 1131	Alexander	11-69	08/20/02	61	28	4.85	3.92	Good-Fair
				08/06/97	74	34	4.94	4.19	Good
				08/04/92	70	29	4.60	3.85	Good
Muddy Fk	Ab Schneider Mills	Alexander	11-69-4	06/17/92	70	19	5.53	4.46	Good-Fair
Muddy Fk	NC 16, Be WWTP	Alexander	11-69-4	06/16/92	66	19	6.79	4.92	Fair
Muddy Fk	SR 1313	Alexander	11-69-4	08/19/02	---	12	---	6.05	Fair
				08/06/97	76	22	6.26	5.42	Good-Fair
Elk Shoal Cr	SR 1605	Alexander	11-73-(0.5)	08/20/02	---	16	---	5.03	Good-Fair
				08/07/97	---	18	---	4.48	Good-Fair
				08/05/92	---	15	---	4.92	Good-Fair
Lyle Cr	US 64/70	Catawba	11-76-(3.5)	08/19/02	---	22	---	4.69	Good-Fair
				09/07/97	51	23	4.95	4.22	Good-Fair
				08/05/92	62	22	5.66	4.88	Good-Fair
McLin Cr	SR 1722	Catawba	11-76-5-(0.7)	08/19/02	---	23	---	5.14	Good-Fair
				08/07/97	57	27	5.17	4.33	Good-Fair
03-08-33									
McDowell Cr	SR 2128	Mecklenburg	11-115-(1)	8/20/02	48	8	6.6	5.7	Fair
				9/13/90	54	17	6.2	5.4	Good-Fair
McDowell Cr	SR 2136	Mecklenburg	11-115-(1.5)	9/13/90	55	15	6.5	5.8	Fair
Gar Cr	SR 2074	Mecklenburg	11-116-(1)	8/20/97	---	21	---	4.9	Good
				6/8/94	64	20	5.6	4.9	Good
				8/20/92	87	24	5.5	4.6	Good
Dutchmans Cr	SR 1918	Gaston	11-119-(0.5)	8/21/02	---	19	---	5.0	Good-Fair
				8/19/97	73	33	5.2	4.5	Good
				6/8/94	66	26	5.1	4.5	Good
				8/6/92	77	33	5.6	4.7	Good
				7/26/88	83	34	5.3	4.7	Excellent
Leepers Cr	SR 1354	Lincoln	11-119-1-(1)	6/9/94	---	31	---	3.4	Excellent
Leepers Cr	NC 73	Lincoln		6/9/94	71	30	5.0	4.3	Excellent
Leepers Cr	NC 150	Lincoln		6/12/84	86	30	4.9	4.3	Excellent

Appendix 7 (continued).

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
Leepers Cr	SR 1820	Gaston	11-119-1-(12)	6/8/94	---	29	---	4.3	Excellent
Killian Cr	SR 1511	Lincoln	11-119-2-(0.5)	8/20/02	---	12	---	5.0	Fair
				8/19/97	---	24	---	3.9	Good
				6/8/94	82	33	5.1	4.9	Excellent
				8/5/92	---	28	---	4.9	Excellent
03-08-34									
Long Cr	SR 2042	Mecklenburg	11-120-(7)	7/12/879	65	17	6.1	5.7	Good-Fair
Sugar Cr	SC 160	York, SC	11-137	8/19/02	34	7	6.4	6.1	Fair
				8/21/97	57	12	6.9	6.1	Fair
				8/19/92	58	21	6.7	5.6	Good-Fair
				7/8/91	49	14	6.7	6.1	Fair
				7/24/90	39	7	7.0	5.6	Fair
				7/25/88	53	9	7.9	6.6	Poor
				7/23/86	40	2	8.5	8.9	Poor
				8/6/84	45	9	8.0	6.1	Poor
				11/8/83	30	3	8.2	6.1	Poor
Sugar Cr	SR 1156	Mecklenburg	11-137-1	8/20/02	---	5	---	7.0	Poor
				8/21/97	---	7	---	6.1	Fair
Irwin Cr	I-77	Mecklenburg	11-137-1	8/18/92	55	8	7.7	6.7	Poor
Irwin Cr	SR 2523	Mecklenburg	11-137-1	2/28/90	52	17	6.0	5.0	Good-Fair
Irwin Cr	Ab Landfill	Mecklenburg	11-137-1	10/17/84	50	13	7.4	6.1	Fair
Irwin Cr	Bel Landfill	Mecklenburg	11-137-1	10/17/84	36	11	7.6	6.0	Fair
Irwin Cr	Ab WWTP	Mecklenburg	11-137-1	11/9/83	23	2	8.2	6.9	Poor
Stewart Cr	SR 2050	Mecklenburg	11-137-1-2	2/27/90	37	14	6.6	3.9	Not Rated
McCullough Br	NC 51	Mecklenburg	11-137-7	2/27/90	34	5	7.6	6.9	Not Rated
L Sugar Cr	Polk Street	Mecklenburg	11-137-8	8/19/02	---	6	---	6.7	Poor
L Sugar Cr	NC 51	Mecklenburg	11-137-8	8/21/97	---	7	---	6.9	Fair
				9/19/92	43	3	8.1	6.3	Poor
L Sugar Cr	Archdale Rd	Mecklenburg	11-137-8	11/9/83	15	1	8.8	7.4	Poor
UT Edwards Br	Shefield Park	Mecklenburg	11-137-8-2-1	8/10/00	10	0	7.1	0	Not Rated
Edwards Br	Campbell St	Mecklenburg	11-137-8-2-1	8/10/00	13	3	7.7	7.5	Not Rated
Edwards Br	Shefield St	Mecklenburg	11-137-8-2-1	8/10/00	14	3	7.8	6.7	Not Rated
McAlpine Cr	NC 51	Mecklenburg	11-137-9	8/19/02	43	7	7.0	6.0	Fair
				8/21/97	59	17	6.9	6.0	Fair
				8/19/92	55	9	7.2	5.7	Fair
McAlpine Cr	Dorman Rd	York, SC	11-137-9	8/19/92	40	11	7.0	6.3	Fair
McAlpine Cr	Ab WWTP	Mecklenburg	11-137-9	3/26/87	33	5	7.5	5.3	Poor
McAlpine Cr	Bel WWTP	Mecklenburg	11-137-9	3/26/87	18	2	7.8	3.7	Poor
McAlpine Cr	Sardis Rd	Mecklenburg	11-137-9	3/26/87	45	12	6.1	5.0	Fair
				11/9/83	61	12	6.7	5.8	Fair
McAlpine Cr	NC 521	Mecklenburg	11-137-9	11/9/83	24	3	8.5	6.4	Poor
Walker Br	NC 49	Mecklenburg	11-137-10-1	2/27/90	68	18	6.1	5.5	Good-Fair
03-08-35									
S Fk Catawba R	NC 10	Catawba	11-129-(0.5)	8/18/97	60	25	5.56	4.70	Good
				8/17/92	75	24	6.20	5.05	Good-Fair
				7/9/90	56	16	6.57	5.27	Fair
				7/28/88	67	24	6.25	5.07	Good-Fair
				7/21/86	49	12	6.59	4.68	Fair
				8/7/84	67	26	5.28	4.15	Good-Fair
S Fk Catawba R	NC 27	Lincoln	11-129-(3.5)	9/10/84	77	29	5.58	4.17	Good
Henry Fk	SR 1854	Burke	11-129-1-(1)	9/13/01	38	18	5.5	5.2	Fair
Henry Fk	SR 1803	Burke	11-129-1-(1)	9/12/01	79	33	5.1	4.3	Good-Fair
Henry Fk	SR 1918	Burke	11-129-1-(1)	4/18/88	106	53	3.29	2.11	Excellent
Henry Fk	SR 1922	Burke	11-129-1-(2)	4/19/88	116	62	3.59	2.52	Excellent
Henry Fk	NC 18	Burke	11-129-1-(2)	4/20/88	127	65	3.84	2.68	Excellent
UT Henry Fk	SR 1915	Burke		4/20/88	110	52	3.83	2.33	Good
He Cr	Ab Water Intake	Burke	11-129-1-4-(1)	4/20/88	---	45	---	2.01	Excellent
Ivy Cr	SR 1919	Burke	11-129-1-6	4/19/88	---	42	---	2.36	Good
Long Br	SR 1917	Burke	11-129-1-8	4/19/88	---	46	---	2.87	Excellent
Rock Cr	SR 1915	Burke	11-129-1-12	4/19/88	---	43	---	2.84	Good

Appendix 7 (continued).

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
Henry Fk	SR 1124	Catawba	11-129-1-(12.5)	8/22/02	95	38	4.7	3.3	Good
				8/18/97	76	38	3.90	3.30	Good
				8/22/92	74	38	4.58	3.75	Good
				7/10/89	64	27	4.65	4.22	Good
				7/22/87	73	25	5.09	4.01	Good-Fair
				7/21/86	79	28	5.39	3.88	Good-Fair
Henry Fk	SR 1008	Catawba	11-129-1-(12.5)	11/16/83	27	5	6.87	4.20	Poor
UT Henry Fk	SR 1213	Catawba		6/20/85	29	8	6.34	4.23	Fair
				6/20/85	31	7	6.24	2.71	Fair
UT Henry Fk	SR 1148	Burke		2/9/87	---	36	---	2.13	Excellent
UT Henry Fk	US 64	Burke		2/9/87	---	0	---	0	Poor
UT Henry Fk	Be Discharge	Burke		2/9/87	---	5	---	5.96	Poor
UT Henry Fk	I-40	Burke		2/9/87	---	17	---	3.40	Good-Fair
Jacob Fk	S Mt St Pk	Burke	11-129-2-(1)	5/18/90	---	42	---	2.49	Excellent
Jacob Fk	SR 1904	Burke	11-129-2-(1)	5/18/90	---	42	---	2.31	Excellent
Jacob Fk	SR 1924	Burke	11-129-2-(1)	8/22/02	---	35	---	3.3	Good
				8/18/97	99	47	4.06	3.20	Excellent
				8/20/92	104	48	4.48	3.32	Excellent
				10/24/90	102	50	3.95	2.60	Excellent
				7/10/90	92	45	4.77	4.01	Excellent
				5/18/90	---	48	---	2.56	Excellent
				1/25/90	86	55	3.41	2.87	Excellent
				7/22/87	96	35	4.96	3.76	Good
				8/6/85	75	32	5.14	3.99	Good-Fair
Shinny Cr	S Mt St Pk	Burke	11-129-2-3	5/18/90	---	41	---	2.13	Excellent
Jacob Fk	NC 27	Catawba	11-129-2-(9.5)	11/16/83	79	35	---	---	Good
Jacob Fk	SR 1139	Catawba	11-129-2-(9.5)	11/16/83	69	23	---	---	Good-Fair
Hop Cr	SR 1131	Catawba	11-129-2-14	6/19/85	86	36	4.56	3.44	Good
Howards Cr	SR 1200	Lincoln	11-129-4	8/21/02	---	17	---	4.5	Good-Fair
				8/19/97	---	25	---	4.15	Good
				8/17/92	---	25	---	4.33	Good
Clark Cr	US 64	Catawba	11-129-5-(0.3)	9/12/84	57	15	6.14	5.15	Good-Fair
Clark Cr	SR 1149	Catawba	11-129-5-(0.3)	4/17/01	49	20	5.6	4.6	Good-Fair
				7/26/00	37	13	6.0	5.6	Fair
				8/5/92	---	16	---	5.74	Good-Fair
				9/12/84	60	16	6.65	5.81	Good-Fair
Clark Cr	SR 2014	Catawba	11-129-5-(0.3)	9/12/90	50	13	7.16	6.46	Fair
				9/12/84	59	15	6.79	6.17	Fair
				6/12/84	59	16	6.25	5.80	Good-Fair
Clark Cr	SR 2012	Catawba	11-129-5-(0.3)	7/26/00	38	13	6.0	5.6	Fair
				9/12/90	40	6	7.11	5.33	Fair
				9/12/84	64	19	7.11	6.26	Good-Fair
				6/12/84	46	14	6.51	5.81	Good-Fair
Clark Cr	SR 1274	Catawba	11-129-5-(9.5)	9/12/84	70	16	6.92	6.06	Fair
Clark Cr	16th St	Catawba	11-129-5-(9.5)	4/17/01	28	9	7.2	5.7	Not Rated
Clark Cr	Sweetwater Rd	Catawba	11-129-5-(9.5)	4/17/01	19	3	7.6	6.5	Not Rated
				7/18/00	22	8	6.6	6.4	Not Rated
Clark Cr	20th Ave	Catawba	11-129-5-(9.5)	8/14/00	42	10	6.5	6.0	Fair
Clark Cr	SR 1008	Lincoln	11-129-5-(9.5)	8/21/02	47	9	6.2	5.1	Fair
				8/19/97	48	16	5.72	5.16	Good-Fair
				8/5/92	48	10	6.67	5.63	Fair
				7/27/88	54	11	6.78	6.11	Fair
				8/5/85	48	13	7.14	6.25	Fair
				9/11/84	79	27	6.62	5.40	Good
				11/16/83	38	9	---	---	Fair
Cline Cr	SR 1164	Catawba	11-129-5-2	7/26/00	37	16	5.5	5.2	Not Rated
				9/12/84	50	11	7.16	6.21	Fair
Town Cr	US 321	Catawba	11-129-5-4	8/14/00	49	14	5.6	5.4	Good-Fair
Pinch Gut Cr	SR 2007	Catawba	11-129-5-7	4/17/01	76	29	5.3	4.3	Good
Maiden Cr	SR 1858	Catawba	11-129-5-7-2-(1)	3/18/93	55	22	4.85	4.02	Good

Appendix 7 (continued).

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
Maiden Cr	SR 1810	Catawba	11-129-5-7-2-(3)	8/21/02	31	5	7.1	6.4	Fair
				3/18/93	67	26	4.93	4.26	Good
Maiden Cr	SR 2007	Catawba	11-129-5-7-2-(3)	9/11/84	86	18	6.55	5.76	Good-Fair
Shady Br	SR 2005	Catawba	11-129-5-7-3	9/11/84	32	1	8.86	7.37	Poor
Carpenter Cr	US 321	Lincoln	11-129-5-9	4/17/01	57	27	4.6	4.4	Not Rated
Carpenter Cr	US 301	Lincoln	11-129-5-9	6/9/94	64	28	4.47	3.90	Good
				9/11/84	85	30	4.94	4.61	Excellent
Walker Cr	SR 1405	Lincoln	11-129-5-10	9/11/84	75	18	7.09	6.11	Good-Fair
Indian Cr	SR 1177	Lincoln	11-129-8-(5)	8/21/02	---	13	---	4.8	Fair
Indian Cr	SR 1252	Lincoln	11-129-8-(5)	8/19/97	73	24	5.23	4.63	Good
				8/17/92	79	29	6.06	5.38	Good
				7/22/87	67	18	6.33	5.52	Good-Fair
				7/23/86	77	18	6.58	5.40	Good-Fair
				11/16/83	50	6	6.90	5.36	Fair
				8/12/83	51	12	6.39	6.00	Good-Fair
Hoyle Cr	SR 1836	Gaston	11-129-15-(4)	11/15/83	50	15	6.12	4.88	Good-Fair
Mauney Cr	SR 1831	Gaston	11-129-15-5	5/13/97	49	11	6.73	5.34	Fair
03-08-36									
S Fk Catawba R	SR 2003	Gaston	11-129-(15.5)	8/11/83	49	19	6.51	5.65	Good-Fair
S Fk Catawba R	NC 7	Gaston	11-129-(15.5)	8/20/97	61	16	6.02	5.05	Good-Fair
				8/18/92	63	18	6.70	5.40	Good-Fair
				7/11/89	62	15	6.32	4.72	Good-Fair
				7/20/87	65	23	6.50	5.43	Good-Fair
				8//585	55	16	7.02	5.34	Fair
				11/15/83	7	2	7.82	5.64	Poor
Limekiln Cr	Kiser Dairy	Gaston	11-129-16-2	5/21/01	60	6	7.4	3.2	Not Rated
Limekiln Cr	SR 1409	Gaston	11-129-16-2	4/20/98	71	22	5.2	4.3	Good
Long Cr	SR 1409	Gaston	11-129-16-(2.3)	4/18/95	67	14	5.84	4.78	Good-Fair
Long Cr	SR 1408	Gaston	11-129-16-(2.3)	4/4/94	81	29	5.28	4.39	Good
Long Cr	SR 1405	Gaston	11-129-16-(2.3)	4/5/93	83	31	5.21	3.80	Good
				4/11/92	73	26	5.47	4.43	Good
				4/3/91	63	24	5.53	4.55	Good
				4/18/95	---	22	---	5.07	Good-Fair
				4/4/94	89	29	5.63	4.70	Good
Long Cr	NC 274	Gaston	11-129-16-(4)	4/5/93	75	28	4.90	3.95	Good
				4/2/92	73	25	5.58	4.91	Good
				4/3/91	63	21	5.69	4.90	Good-Fair
				4/19/95	79	19	5.82	5.22	Good-Fair
				4/5/95	90	24	6.35	4.92	Good-Fair
Long Cr	SR 1443	Gaston	11-129-16-(4)	4/5/94	90	37	5.09	4.35	Good
Long Cr	SR 1446	Gaston	11-129-16-(4)	4/6/93	98	35	5.22	4.40	Good
				4/11/92	65	25	5.30	4.80	Good
				4/4/91	54	20	5.58	4.87	Good-Fair
				4/4/94	76	24	6.20	5.40	Good-Fair
				4/3/93	70	23	5.52	4.68	Good
Long Cr	SR 1448	Gaston	11-129-16-(4)	4/1/92	76	26	4.97	4.19	Good
				4/4/91	62	22	5.57	4.89	Good-Fair
				4/19/95	80	23	5.82	5.15	Good
				4/4/94	86	30	5.83	5.04	Good
Long Cr	NC 275	Gaston	11-129-16-(4)	4/5/93	89	31	5.51	4.54	Good
				4/1/92	59	21	5.45	5.0	Good
				4/5/91	51	21	5.55	5.07	Good-Fair
				4/18/95	72	20	6.36	5.47	Good-Fair
				4/4/94	84	21	6.26	5.17	Good-Fair
Long Cr	SR 1456	Gaston	11-129-16-(4)	8/20/97	62	21	5.81	4.79	Good-Fair
				7/25/90	67	18	6.42	5.39	Good-Fair
				7/20/87	71	19	6.59	5.61	Good-Fair
				8/6/84	62	17	6.25	5.44	Good-Fair
Long Cr	SR 2003	Gaston	11-129-16-(4)	7/25/90	54	14	7.33	6.30	Fair
				11/15/83	20	3	8.61	4.93	Poor

Appendix 7 (continued).

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Rating
UT Long Cr	SR 1446	Gaston	11-129-16-(4)	4/5/94	---	26	---	4.89	Good-Fair
				4/4/91	76	25	5.46	4.39	Good
UT Long Cr	SR 1456	Gaston	11-129-16-(4)	4/5/91	55	26	4.44	4.25	Good
UT Long Cr	Dallas WWTP	Gaston	11-129-16-(4)	6/17/92	42	10	6.45	6.11	Good-Fair
UT Long Cr	SR 2275	Gaston	11-129-16-(4)	6/17/92	39	8	7.60	6.40	Fair
Kiser Br	Kiser Dairy	Gaston	11-129-16-(4)	5/21/01	60	6	7.4	3.2	Not Rated
				4/20/98	60	10	6.7	4.0	Fair
				6/13/96	59	8	7.09	6.13	Fair
Kaglor Br	Rankin Park	Gaston	11-129-16-5	4/20/98	33	9	6.3	5.4	Not Rated
				6/13/96	55	8	6.29	5.8	Not Rated
03-08-37									
Catawba Cr	SR 2446	Gaston	11-130	7/26/90	42	10	6.94	6.66	Fair
				5/8/85	55	16	7.09	6.13	Fair
Catawba Cr	SR 2439	Gaston	11-130	7/25/90	43	1	8.12	7.40	Poor
				5/8/85	38	5	8.55	6.07	Poor
Catawba Cr	SR 2435	Gaston	11-130	5/8/85	43	6	8.44	6.50	Poor
Crowders Cr	SR 1118	Gaston	11-135	5/21/02	31	10	5.1	5.0	Not Rated
				9/12/89	50	14	6.02	4.73	Good-Fair
Crowders Cr	SR 1125	Gaston	11-135	5/21/02	63	21	5.4	5.1	Good-Fair
				9/12/89	55	13	7.07	6.11	Fair
Crowders Cr	SR 1131	Gaston	11-135	5/22/02	54	14	6.2	5.3	Fair
				9/13/89	46	7	7.69	7.00	Fair
Crowders Cr	NC 321	Gaston	11-135	9/13/89	46	10	6.81	5.64	Fair
Crowders Cr	SR 2424	Gaston	11-135	9/13/89	51	15	6.86	5.87	Fair
Crowders Cr	SC 564	York, SC	11-135	5/20/02	57	14	6.3	5.9	Fair
				8/20/97	67	11	6.56	5.94	Fair
				8/18/92	66	18	6.55	5.65	Good-Fair
				9/14/89	61	15	6.83	6.13	Fair
				7/26/88	43	4	8.30	7.50	Poor
McGill Cr	Ab WWTP	Gaston	11-135-2	9/12/89	---	4	---	7.43	Poor
McGill Cr	SR 1300	Gaston	11-135-2	9/12/89	---	6	---	7.09	Poor
Abernethy Cr	SR 1302 Ab UT	Gaston	11-135-4	5/21/02	56	18	5.5	5.1	Not Impaired
				3/23/93	56	20	5.76	4.95	Good-Fair
				9/12/89	---	12	---	4.93	Fair
				6/10/87	67	13	7.40	5.81	Fair
Abernethy Cr	SR 1302 Bel UT	Gaston	11-135-4	5/21/02	38	12	6.4	5.7	Fair
				3/23/93	51	19	6.49	5.39	Good-Fair
				6/10/87	43	4	7.78	7.53	Poor
Abernethy Cr	Ab WWTP	Gaston	11-135-4	9/12/89	---	3	---	6.90	Poor
Abernethy Cr	Bel WWTP	Gaston	11-135-4	9/12/89	---	1	---	6.57	Poor
UT Abernethy Cr	Bel Lithium	Gaston	11-135-4	5/21/02	44	12	5.7	3.5	Not Rated
				3/23/93	40	5	7.77	7.52	Poor
				6/10/87	25	0	7.90	0	Poor
Blackwood Cr	Davis Park Rd	Gaston	11-135-7	5/21/02	35	8	6.3	6.2	Not Rated
S Fk Crowders Cr	SC 148	York, SC	11-135-10	5/20/02	---	13	---	4.7	Fair
S Fk Crowders Cr	SC 79	York, SC	11-135-10	5/20/02	---	19	---	4.3	Good-Fair
S Crowders Cr	SR 1103	Gaston	11-135-10-1	5/9/85	89	31	5.31	4.41	Good-Fair
S Crowders Cr	SR 1109	Gaston	11-135-10-1	5/20/02	59	18	5.7	5.1	Good-Fair
				9/13/89	---	16	---	5.56	Good-Fair
UT Crowders Cr	SR 2416	Gaston		5/20/02	67	15	6.2	5.1	Good-Fair
				9/13/89	---	11	---	6.62	Fair
03-08-38									
Twelvemile Cr	NC 16	Union	11-138	2/27/90	---	30	---	4.93	Good-Fair
				7/11/89	71	20	6.25	5.37	Good-Fair
				11/8/83	50	7	7.15	6.33	Fair
Sixmile Cr	SR 3445	Mecklenburg	11-138-3	3/26/87	67	22	5.26	3.58	Good-Fair
Waxhaw Cr	SR 1103	Union	11-139	8/19/92	---	14	---	5.53	Good-Fair
				11/8/83	38	6	6.82	5.39	Fair

Appendix 8. Water quality measurements at benthic macroinvertebrate basinwide sites in the Catawba River basin, 2002.

Subbasin/ Waterbody	Location	County	Date	Temperature (˚C)	Specific conductance (µmhos/cm)	Dissolved oxygen (mg/L)	pH (s.u.)
03-08-30							
Catawba R	SR 1274 at end	McDowell	08/08/02	20	50	8.7	---
Catawba R	SR 1234	McDowell	08/08/02	21	153	8.2	---
Catawba R	SR 1221	McDowell	08/07/02	25	94	7.3	---
Curtis Cr	Off SR 1227	McDowell	08/08/02	21	20	8.9	---
Crooked Cr	SR 1135	McDowell	08/07/02	24	50	7.7	---
Mackey Cr	SR 1453	McDowell	08/08/02	22	30	7.5	---
Buck Cr	Off NC 80	McDowell	08/05/02	24	32	8.1	7.1
L Buck Cr	SR 1436	McDowell	08/06/02	23	25	7.6	---
Toms Cr	SR 1434	McDowell	08/05/02	22	25	7.6	7.1
N Fk Catawba R	SR 1573	McDowell	08/06/02	24	576	7.6	7.1
N Fk Catawba R	SR 1560	McDowell	08/06/02	25	400	7.2	-
Armstrong Cr	end Of FS Rd	McDowell	08/06/02	20	36	8.3	7.1
Linville R	US 221	Avery	08/06/02	---	---	---	---
Linville	NC 126	Burke	08/07/02	22	50	7	---
Catawba R	SR 1147	Burke	08/08/02	17	58	8.3	---
N Muddy Cr	SR 1750	McDowell	08/05/02	23	106	8.6	7.1
Youngs Fk	SR 1819	McDowell	08/07/02	21	130	8.5	---
S Muddy Cr	SR 1764	McDowell	08/05/02	23	35	8.1	7.1
Canoe Cr	SR 1250	Burke	08/21/02	23	69	8.0	7.6
03-08-31							
Catawba R	NC 181	Burke	08/22/02	21	70	8.4	7.5
Silver Cr	SR 1127	Burke	08/21/02	23	58	8.3	7.7
Warrior Fk	SR 1440	Burke	08/21/02	24	33	7.5	7.1
Johns R	SR 1356	Caldwell	08/22/02	26	41	8.0	7.9
Johns R	SR 1438	Burke	08/22/02	24	36	8.2	8.1
Wilson Cr	off SR 1328	Caldwell	08/22/02	25	22	8.4	7.5
Lower Cr	SR 1501	Caldwell	09/11/02	21	161	5.6	7.1
Smoky Cr	SR 1515	Burke	08/21/02	21	42	9.0	7.7
McGalliard Cr	SR 1538	Burke	08/21/02	22	144	7.3	7.5
03-08-32							
Gunpowder Cr	SR 1718	Caldwell	08/21/02	21	158	7.8	7.6
Upper Little R	SR 1740	Caldwell	08/20/02	25	31	7.6	7.6
Middle Little R	SR 1153	Alexander	08/20/92	24	41	7.9	7.4
Duck Cr	NC 127	Alexander	08/20/02	22	49	8.5	7.6
Lower Little R	SR 1131	Alexander	08/20/02	23	86	7.6	7.3
Muddy Fk	SR 1313	Alexander	08/19/02	25	116	6.3	7.4
Elk Shoal Cr	SR 1605	Alexander	08/20/02	25	75	7.0	---
Lyle Cr	US 64/70	Catawba	08/19/02	24	94	7.8	7.3
McLin Cr	SR 1722	Catawba	08/19/02	24	111	7.0	7.4
03-08-33							
McDowell Cr	SR 2128	Mecklenburg	8/20/02	23	117	4.8	7.2
Dutchmans Cr	SR 1918	Gaston	8/21/02	28	133	4.4	7.4
Killian Creek	SR 1511	Lincoln	8/20/02	25	30	5.2	7.5
03-08-34							
Sugar Cr	SC 160	York, SC	8/19/02	29	306	5.0	7.3
Sugar Cr	SR 1156	Mecklenburg	8/20/02	25	332	5.5	7.4
Little Sugar Cr	Polk Street	Mecklenburg	8/19/02	30	412	6.3	7.3
McAlpine Cr	NC 51	Mecklenburg	8/19/02	27	85	5.2	7.1
03-08-35							
Henry Fk	SR 1124	Catawba	8/22/02	24	27	6.0	7.2
Jacob Fk	SR 1924	Burke	8/22/02	23	29	5.0	7.1
Howards Cr	SR 1200	Lincoln	8/21/02	23	60	5.0	7.5
Clark Cr	SR 1008	Lincoln	8/21/02	23	520	6.0	7.5
Indian Cr	SR 1177	Lincoln	8/21/02	23	135	5.4	7.3
03-08-37							
Crowders Cr	SC 564	York, SC	5/20/02	15	477	7.0	7.7

Appendix 9. New species and distributional records for the benthic macroinvertebrate fauna of the Catawba River basin.

Records are compiled mainly from DWQ collections, but also include data from the Natural Heritage Program (Table 1). "Hot spots" for rare species include Wilson Creek, the Linville River, and Jacobs Fork. There also are records of rare mussels from the lower part of the basin. However, freshwater mussels can be difficult to collect during routine water quality surveys. The most complete source of information is summarized by the North Carolina Nongame and Endangered Wildlife Program (http://www.ncwildlife.org/). At least five species in need of protection occur in the basin (Table 2).

Table 2. Mussels listed as endangered, of special concern, or significantly rare in the Catawba River basin.

Species	Common Name	Status[1]
Lasmigona decorata	Carolina heelsplitter	FE
Alasmidonta varicosa	Brook floater	SE
Villosa vaughaniana	Carolina creekshell	SE
Villosa constricta	Notched rainbow	SC
Villosa delumbis	Eastern creekshell	SR

[1]FE = federally endangered; SE = state endangered; SC = special concern; and SR = significantly rare.

- *Lasmigona decorata* is known from four populations in North Carolina and is presently known in the basin only from Waxhaw Creek.
- *Alasmidonta varicosa* also occurs in one area in the basin (Burke County) with the most stable population in the lower Linville River.
- *Villosa vaughaniana* is found mostly in the Yadkin River basin, but one population is found in Six Mile Creek.

Table 1. Rare or unusual species and distributional records for the benthic macroinvertebrate fauna of the Catawba River basin.

Group/Taxon	No. DWQ Records	No. DWQ Basin Records	Locales in Catawba River basin
Mayflies			
Ephemerella berneri	15	6	Subbasins 30 and 31; Wilson Creek in April 2003
E. floripara	< 10	2	Wilson Creek and Linville River (status of this species uncertain)
Barbaetis benfieldi	4	1	Jacob Fork
Paracleoedes n. sp.	< 10	2	Crowders Creek (Subbasin 37) and Little Sugar Creek (Subbasin 34)
Acerpenna macdunnoughi	?	1	Wilson Creek, 1st confirmed NC record
Homoeoneuria cahabensis		3	South Fork Catawba River (Subbasin 35)
Stenonema n. sp.	2	2	Wilson Creek and the Linville River
Nixe nr. *inconspicua*	2	2	Wilson Creek watershed in 2002
Macdunnoa brunnea	13	1	Leepers Creek in June 1994 (Subbasin 33).
Rhithrogena sp	2	2	Jacob Fork, Wilson Creek, possible new species
Baetisca lacustris	1	1	Wilson Creel
B. laurentina	1	1	Jacob Fork (Subbasin 35)
Stoneflies			
Bolotoperla rossi	8	3	Subbasins 30 and 31
Diploperla morgani	28	12	Subbasins 30, 31, and 35
Paragnetina n. sp.	1	1	Wilson Creek in April 2003
Caddisflies			
Stactobiella sp.	16	1	Johns River (Subbasin 31) in March 1989
Ceraclea menteia	254	4	Johns River and Warrior Fork (Subbasin 31)
C. slossonae	4	1	Wilson Creek in April 2003
Micrasema sprulesi	15	3	Subbasins 30 and 31
Palaeagepetus celsus	2	1	Headwaters of Wilson Creek in August 1984
Dragonflies			From Natural Heritage Program database
Ophiogomphus edmundo			Streams in Burke and Caldwell counties (including Wilson Creek)
O. howei			Rivers in Burke County
Gomphus consanguis brimleyi			Small streams in Burke County
Aeshna tuberculifera			Marshy, boggy ponds in Burke County
A. verticalis			Marshy, boggy ponds in Burke County
Cordulia shutleffi			Ponds and lakes in Burke County
Chironomidae (Midges)			
Cricoptopus (Nostococladius) sp	3	1	Wilson Creek in large numbers inside *Nostoc* colonies
Cricotopus n. sp.	1	1	Wilson Creek; mimics *C. nostocicola* and lives in the *Nostoc* colonies

Appendix 10. Fish community sampling methods and criteria.

In 2002, fish community assessments were performed at 29 sites in the Catawba River basin. Twenty-one of the 32 sites which had been previously sampled in 1997 were sampled again, including some which are the 2000 303 (d) impaired streams list (Table 1), one site which had not been sampled since 1993 was sampled again, and the remaining seven sites represented new monitoring locales. Some sites that were sampled during the second cycle of basinwide monitoring in 1997 were not resampled in 2002 because there were already sufficient data collected since 1998 to assess the fish community in these streams; no change in the community was expected, or the waters were classified by the North Carolina Wildlife Resources Commission as Collection Sensitive Waters where sampling is strictly controlled. The seven new sites were selected:

- to represent possible regional reference sites; or
- to represent typical streams draining rural or urban watersheds and which may be impacted primarily by nonpoint source pollution.

Table 1. Fish community sites monitored in 2002 that are on the state's 303(d) list of impaired waters (NCDENR 2000).

Subbasin/ Waterbody	Reach Affected	Suspected Cause
03-08-31		
Lower Cr	From Zack's Fk to Lake Rhodhiss	Turbidity, habitat degradation, and historical listing for "sediment" based on biological impairment from potential sources such as urban runoff, storm sewers, municipal point sources, and non-urban development
03-08-33		
McDowell Cr	From US 21 to Mountain Island Lake	Cause Unknown and historical listing for "sediment" based on biological impairment
03-08-37		
Catawba Cr	From source to Lake Wylie	Cause Unknown and historical listing for "sediment" based on biological impairment from potential
Crowders Cr	From source to state line	Cause Unknown and fecal coliform from potential sources such as industrial point sources, urban runoff/storm sewers

Sampling Methods
At each sample site, a 600 ft. section of stream was selected and measured. The fish in the delineated stretch of stream were then collected using two backpack electrofishing units and two persons netting the stunned fish. After collection, all readily identifiable fish were examined for sores, lesions, fin damage, or skeletal anomalies, measured (total length to the nearest 1 mm), and then released. Those fish that were not readily identifiable were preserved and returned to the laboratory for identification, examination, and total length measurement. Detailed descriptions of the sampling methods may be found at: http://www.esb.enr.state.nc.us/BAU.html.

NCIBI Analysis
The assessment of biological integrity using the North Carolina Index of Biotic Integrity (NCIBI) 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, or 5 scale. A score of 5 represents conditions which would be expected for undisturbed reference streams in the specific river basin or ecoregion, while a score of 1 indicates that the conditions deviate greatly from those expected in undisturbed streams of the region. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score. Finally, the score (an even number between 12 and 60) is then used to determine the ecological integrity class of the stream from which the sample was collected.

The NCIBI has recently been revised (NCDENR 2001b). Currently, the focus of using and applying the NCIBI has been restricted to wadeable streams that can be sampled by a crew of four persons. The bioclassifications and criteria have also been recalibrated against regional reference site data (Biological Assessment Unit Memorandum 20000922) (Tables 2 – 5).

Table 2. Revised scores and classes for evaluating the fish community of a wadeable stream using the North Carolina Index of Biotic Integrity (NCIBI) in the Broad, Catawba, Savannah, and Yadkin River basins.

NCIBI Scores	NCIBI Classes
> 54	Excellent
48 - 52	Good
42 - 46	Good-Fair
36 - 40	Fair
≤ 34	Poor

Table 3. Regional reference sites/samples used in calibrating the North Carolina Index of Biotic Integrity in the Catawba River basin.

Subbasin/ Waterbody	Station	County	Date
03-08-30			
Armstrong Cr	SR 1456	McDowell	05/07/97
Armstrong Cr	SR 1456	McDowell	04/15/99
Armstrong Cr	SR 1456	McDowell	06/22/99
Armstrong Cr	SR 1456	McDowell	09/23/99
Canoe Cr	SR 1250	Burke	05/10/93
Canoe Cr	SR 1250	Burke	05/05/97
Mill Cr	SR 1400	McDowell	06/08/99
03-08-31			
Gragg Prong	SR 1367	Caldwell	10/01/98
Gragg Prong	SR 1367	Caldwell	05/25/99
Mulberry Cr	NC 90	Caldwell	05/08/97
Mulberry Cr	NC 90	Caldwell	04/16/99
Mulberry Cr	NC 90	Caldwell	06/21/99
Mulberry Cr	NC 90	Caldwell	09/22/99
Upper Cr	SR 1439	Burke	07/01/97
Upper Cr	SR 1439	Burke	04/16/99
Upper Cr	SR 1439	Burke	06/21/99
Upper Cr	SR 1439	Burke	09/22/99
03-08-32			
Middle Little R	SR 1102	Alexander	05/11/93
Middle Little R	SR 1002	Alexander	05/08/97
03-08-35			
Henry Fork	SR 1916	Burke	05/06/97
Henry Fork	SR 1922	Burke	09/28/98
03-08-38			
Waxhaw Cr	SR 1103	Union	06/11/97

Criteria and ratings applicable only to wadeable streams in the mountain and piedmont regions of the Catawba River basin are the same as those for the Broad, Savannah, and Yadkin River basins. The definition of the mountain and piedmont for these four river basins is based on a map of North Carolina watersheds by Fels (1997). Metrics and ratings should not be applied to non-wadeable streams and trout streams in each of these basins. These streams, along with streams draining the Sandhills ecoregion in the southeast corner of the Yadkin River basin, are currently not rated.

Blackspot Disease

Black spot disease is a naturally occurring, common infection of fish by an immature stage of flukes. The life cycle involves fish, snails, and piscivorous birds or mammals. Although heavy, acute infections can be fatal, especially to small fish, fish can carry amazingly high worm burdens without any apparent ill effects (Noga 1996). The infections may often be disfiguring and render the fish unpalatable or aesthetically unpleasing (Figure 1).

Figure 1. Heavy infestation of blackspot disease on creek chub.

Although some researchers incorporate the incidence of black spot incidence into indices of biotic integrity (e.g., Steedman 1991), others, because of a lack of a consistent, inverse relationship to environmental quality, do not (e.g., Sanders *et al*. 1999). The disease is not considered in Metric 11 of the NCIBI because it is widespread, affecting fish in all types of streams ranging from Fair to Excellent.

In the Catawba River basin in 2002, the incidence of blackspot disease seemed to be especially prevalent in the Catawba and Upper Little Rivers and Crooked, McGalliard, Duck, and Beaverdam Creeks. The disease was especially prevalent in the central stoneroller, warpaint shiner, fieryblack shiner, greenhead shiner, and bluehead chub.

Table 4 **Scoring criteria for the NCIBI for wadeable streams in the mountain and piedmont ecoregions of the Broad, Catawba, Savannah, and Yadkin River basins with watershed drainage areas ranging between 2.8 and 245 mi^2.**

No.	Metric		Score
1	**No. of species**		
	where Y is the number of species in the sample and X is the stream's drainage area in mi^2:		
	$Y \geq 9.5 * Log_{10}X + 1.6$		5
	$4.8 * Log_{10}X + 0.8 \leq Y < 9.5 * Log_{10}X + 1.6$		3
	$Y < 4.8 * Log_{10}X + 0.8$		1
2	**No. of fish**		
	Mountains	Piedmont	
	≥ 300 fish	≥ 150 fish	5
	200-299 fish	100-149 fish	3
	< 200 fish	< 100 fish	1
3	**No. of species of darters**		
	where Y is the number of species of darters in the sample and X is the stream's drainage area in mi^2.		
	$Y \geq 1.6 * Log_{10}X$		5
	$0.8 * Log_{10}X \leq Y < 1.6 * Log_{10}X$		3
	$Y < 0.8 * Log_{10}X$		1
	If the drainage area is > 70 mi^2, then ≥ 3 species = 5		
4	**No. of species of sunfish, bass, and trout**		
	≥ 3 species		5
	2 species		3
	0 or 1 species		1
5	**No. of species of suckers**		
	≥ 2 species		5
	1 species		3
	0 species		1
6	**No. of intolerant species**		
	Mountains	Piedmont	
	≥ 3 species	≥ 1 species	5
	1or 2 species	(no middle criteria or score)	3
	0 species	0 species	1
7	**Percentage of tolerant individuals**		
	Mountains	Piedmont	
	≤ 12%	≤ 25%	5
	13-25%	26-35%	3
	> 25%	> 35%	1
8	**Percentage of omnivorous and herbivorous individuals**		
	10-35%		5
	36-50%		3
	> 50%		1
	< 10%		1
9	**Percentage of insectivorous individuals**		
	60-90%		5
	45-59%		3
	< 45%		1
	> 90%		1
10	**Percentage of piscivorous individuals**		
	≥ 1.0%		5
	0.25-1.0%		3
	≤ 0.24%		1
11	**Percentage of diseased fish (DELT = diseased, fin erosion, lesions, and tumors)**		
	< 0.75%		5
	0.76-1.25%		3
	> 1.25%		1
12	**Percentage of species with multiple age groups**		
	Mountains	Piedmont	
	≥ 65% of all species have multiple age groups	≥ 55% of all species have multiple age groups	5
	45-64% all species have multiple age groups	35-54% all species have multiple age groups	3
	< 45% all species have multiple age groups	< 35% all species have multiple age groups	1

Table 5. Tolerance ratings and adult trophic guild assignments for fish in the Catawba River basin.

Family/ Species	Common Name	Tolerance Rating	Trophic Guild of Adults
Lepisosteidae	**Gars**		
Lepisosteus osseus	Longnose gar	Tolerant	Piscivore
Amiidae	**Bowfins**		
Amia calva	Bowfin	Tolerant	Piscivore
Anguillidae	**Eels**		
Anguilla rostrata	American eel	Intermediate	Piscivore
Clupeidae	**Herrings and shads**		
Dorosoma cepedianum	Gizzard shad	Intermediate	Omnivore
D. petenense	Threadfin shad	Intermediate	Omnivore
Salmonidae	**Trouts and Chars**		
Oncorhynchus mykiss	Rainbow trout	Intolerant	Insectivore
Salmo trutta	Brown trout	Intermediate	Piscivore
Salvelinus fontinalis	Brook trout	Intolerant	Insectivore
Esocidae	**Pikes**		
Esox americanus americanus	Redfin pickerel	Intermediate	Piscivore
Cyprinidae	**Minnows**		
Campostoma anomalum	Stoneroller	Intermediate	Herbivore
Carassius auratus	Goldfish	Tolerant	Omnivore
Clinostomus funduloides	Rosyside dace	Intermediate	Insectivore
Ctenopharyngodon idella	Grass carp	Tolerant	Herbivore
Cyprinella chloristia	Greenfin shiner	Intermediate	Insectivore
C. galactura	Whitetail shiner	Intermediate	Insectivore
C. labrosa	Thicklip chub	Intolerant	Insectivore
C. nivea	Whitefin shiner	Intermediate	Insectivore
C. pyrrhomelas	Fieryblack shiner	Intolerant	Insectivore
C. zanema	Thinlip chub	Intolerant	Insectivore
Cyprinus carpio	Common carp	Tolerant	Omnivore
Hybognathus regius	Silvery minnow	Intermediate	Herbivore
Hybopsis hypsinotus	Highback chub	Intolerant	Insectivore
Luxilus coccogenis	Warpaint shiner	Intermediate	Insectivore
Lythrurus ardens	Rosefin shiner	Intermediate	Insectivore
Nocomis leptocephalus	Bluehead chub	Intermediate	Omnivore
Notemigonus crysoleucas	Golden shiner	Tolerant	Omnivore
Notropis alborus	Whitemouth shiner	Intermediate	Insectivore
N. altipinnis	Highfin shiner	Intermediate	Insectivore
N. chiliticus	Redlip shiner	Intermediate	Insectivore
N. chlorocephalus	Greenhead shiner	Intermediate	Insectivore
N. cummingsae	Dusky shiner	Intermediate	Insectivore
N. hudsonius	Spottail shiner	Intermediate	Omnivore
N. leuciodus	Tennessee shiner	Intermediate	Insectivore
N. procne	Swallowtail shiner	Intermediate	Insectivore
N. rubricroceus	Saffron shiner	Intermediate	Insectivore
N. scepticus	Sandbar shiner	Intermediate	Insectivore
N. spectrunculus	Mirror shiner	Intermediate	Insectivore
N. telescopus	Telescope shiner	Intolerant	Insectivore
Phoxinus oreas	Mountain redbelly dace	Intermediate	Herbivore
Pimephales promelas	Fathead minnow	Tolerant	Omnivore
Rhinichthys atratulus	Blacknose dace	Intermediate	Insectivore
R. cataractae	Longnose dace	Intermediate	Insectivore
Semotilus atromaculatus	Creek chub	Tolerant	Insectivore
Catostomidae	**Suckers**		
Carpiodes cyprinus	Quillback	Intermediate	Omnivore
C. velifer complex	Highfin carpsucker	Intermediate	Insectivore
Catostomus commersoni	White sucker	Tolerant	Omnivore
Erimyzon oblongus	Creek chubsucker	Intermediate	Omnivore
Hypentelium nigricans	Northern hogsucker	Intermediate	Insectivore
Ictiobus bubalus	Smallmouth buffalo	Intermediate	Omnivore

Table 5 (continued).

Family/ Species	Common Name	Tolerance Rating	Trophic Guild of Adults
I. cyprinellus	Bigmouth buffalo	Intermediate	Insectivore
Moxostoma collapsum	Notchlip redhorse	Intermediate	Insectivore
M. macrolepidotum	Shorthead redhorse	Intermediate	Insectivore
M. pappillosum	V-lip redhorse	Intermediate	Insectivore
Scartomyzon rupiscartes	Striped jumprock	Intermediate	Insectivore
S. sp. cf. *lachneri*	Brassy jumprock	Intermediate	Insectivore
Ictaluridae	**Catfishes**		
Ameiurus brunneus	Snail bullhead	Intermediate	Insectivore
A. catus	White catfish	Tolerant	Omnivore
A. melas	Black bullhead	Tolerant	Insectivore
A. nebulosus	Brown bullhead	Tolerant	Omnivore
A. platycephalus	Flat bullhead	Tolerant	Insectivore
Ictalurus furcatus	Blue catfish	Intermediate	Piscivore
I. punctatus	Channel catfish	Intermediate	Omnivore
Noturus insignis	Margined madtom	Intermediate	Insectivore
Pylodictis olivaris	Flathead catfish	Intermediate	Piscivore
Aphredoderidae	**Pirate perches**		
Aphredoderus sayanus	Pirate perch	Intermediate	Insectivore
Fundulidae	**Topminnows**		
Fundulus rathbuni	Speckled killifish	Intermediate	Insectivore
Poeciliidae	**Livebearers**		
Gambusia holbrooki	Eastern mosquitofish	Tolerant	Insectivore
Moronidae	**Temperate basses**		
Morone americana	White perch	Intermediate	Piscivore
M. chrysops	White bass	Intermediate	Piscivore
M. saxatilis	Striped bass	Intermediate	Piscivore
Centrarchidae	**Sunfishes and Black Basses**		
Ambloplites rupestris	Rock bass	Intolerant	Piscivore
Lepomis auritus	Redbreast sunfish	Tolerant	Insectivore
L. cyanellus	Green sunfish	Tolerant	Insectivore
L. gibbosus	Pumpkinseed	Intermediate	Insectivore
L. gulosus	Warmouth	Intermediate	Insectivore
L. macochirus	Bluegill	Intermediate	Insectivore
L. marginatus	Dollar sunfish	Intermediate	Insectivore
L. microlophus	Redear sunfish	Intermediate	Insectivore
Lepomis sp.	Hybrid sunfish	Tolerant	Insectivore
Micropterus coosae	Redeye bass	Intermediate	Piscivore
M. dolomieu	Smallmouth bass	Intolerant	Piscivore
M. punctulatus	Spotted bass	Intermediate	Piscivore
M. salmoides	Largemouth bass	Intermediate	Piscivore
Pomoxis annularis	White crappie	Intermediate	Piscivore
P. nigromaculatus	Black crappie	Intermediate	Piscivore
Percidae	**Darters and Perches**		
Etheostoma collis	Carolina darter	Intermediate	Insectivore
E. flabellare	Fantail darter	Intermediate	Insectivore
E. fusiforme	Swamp darter	Intermediate	Insectivore
E. olmstedi	Tessellated darter	Intermediate	Insectivore
E. thalassinum	Seagreen darter	Intolerant	Insectivore
Perca flavescens	Yellow perch	Intermediate	Piscivore
Percina crassa	Piedmont darter	Intolerant	Insectivore
Stizostedion vitreum	Walleye	Intermediate	Piscivore

Appendix 11. Fish community structure data collected in the Catawba River basin, 1993 - 2002. Current basinwide sites are in bold font.

Subbasin/Waterbody	Location	County	Index No.	Date	NCIBI Score	NCIBI Rating
03-08-30						
Catawba R	SR 1110	McDowell	11-1	04/29/02	46	Good-Fair
				05/07/97	50	Good
Mill Cr	SR 1400	McDowell	11-7-(0.5)	06/08/99	58	Excellent
Curtis Cr	US 70	McDowell	11-10	04/30/02	60	Excellent
Crooked Cr	SR 1135	McDowell	11-12	04/30/02	56	Excellent
Mackey Cr	US 70/SR 1413	McDowell	11-15-(3.5)	03/25/98	48	Good
Mackey Cr	US 70	McDowell	11-15-(3.5)	04/29/02	52	Good
				03/25/98	18	Poor
Armstrong Cr	SR 1456	McDowell	11-24-14-(1)	09/23/99	54	Excellent
				06/22/99	56	Excellent
				04/15/99	54	Excellent
				05/07/97	56	Excellent
Paddy Cr	NC 126	Burke	11-28	05/01/02	46	Good-Fair
				05/05/97	40	Fair
North Muddy Cr	SR 1760	McDowell	11-32-1	04/30/02	48	Good
				05/07/97	52	Good
Corpening Cr	SR 1794	McDowell	11-32-1-4	09/23/02	40	Fair
South Muddy Cr	SR 1764	McDowell	11-32-2	05/01/02	48	Good
				07/02/97	50	Good
				06/28/93	50	Good
Canoe Cr	SR 1250	Burke	11-33-(2)	05/02/02	50	Good
				05/05/97	54	Excellent
				05/10/93	46	Good-Fair
03-08-31						
Silver Cr	SR 1149	Burke	11-34-(0.5)	05/01/02	60	Excellent
Upper Cr	SR 1439	Burke	11-35-2-(13)	09/22/99	56	Excellent
				06/21/99	54	Excellent
				04/16/99	56	Excellent
				07/01/97	54	Excellent
Irish Cr	SR 1439	Burke	11-35-3-(2)	05/02/02	38	Fair
Hunting Cr	SR 1512	Burke	11-36-(0.3)	05/01/02	38	Fair
Gragg Prong	SR 1367	Caldwell	11-38-10	05/25/99	56	Excellent
				10/01/98	56	Excellent
Mulberry Cr	NC 90	Caldwell	11-38-32-(15)	09/22/99	60	Excellent
				06/21/99	58	Excellent
				04/16/99	56	Excellent
				05/08/97	60	Excellent
Lower Cr	SR 1142	Caldwell	11-39-(6.5)	05/10/93	44	Good-Fair
Lower Cr	SR 1501	Burke	11-39-(6.5)	05/02/02	42	Good-Fair
				10/24/97	44	Good-Fair
Smoky Cr	SR 1515	Burke	11-41-(1)	05/03/02	58	Excellent
McGalliard Cr	SR 1538	Burke	11-44-(0.5)	05/03/02	40	Fair
				05/06/97	48	Good
				05/10/93	38	Fair
03-08-32						
Upper Little R	SR 1786	Caldwell	11-58-(5.5)	05/24/02	42	Good-Fair
Middle Little R	SR 1002	Alexander	11-62	05/23/02	56	Excellent
				05/08/97	52	Good
				05/11/93	46	Good-Fair
Duck Cr	NC 90	Alexander	11-62-2-(1)	05/23/02	48	Good
				05/08/97	48	Good
				05/11/93	40	Fair
Lower Little R	SR 1318	Alexander	11-69-(0.5)	05/23/02	38	Fair
				05/09/97	48	Good
				05/11/93	28	Poor
Elk Shoal Cr	SR 1605	Alexander	11-73-(0.5)	05/23/02	48	Good
				05/09/97	54	Excellent
				05/11/93	48	Good
Lyle Cr	US 70	Catawba	11-76-(3.5)	07/01/97	48	Good
				05/11/93	50	Good
Buffalo Shoals Cr	SR 1503	Iredell	11-78-(0.5)	06/04/97	58	Excellent

Appendix 11 (continued).

Subbasin/Waterbody	Location	County	Index No.	Date	NCIBI Score	NCIBI Rating
03-08-33						
McDowell Cr	SR 2136	Mecklenburg	11-115-(1.5)	05/20/02	22	Poor
				06/12/97	40	Fair
Dutchmans Cr	SR 1918	Gaston	11-119-(0.5)	06/30/93	50	Good
Leepers Cr	NC 73	Lincoln	11-119-1-(1)	05/20/97	52	Good
				06/29/93	56	Excellent
Killian Cr	NC 73	Lincoln	11-119-2-(0.5)	05/21/02	46	Good-Fair
				05/20/97	52	Good
Killian Cr	SR 1511	Lincoln	11-119-2-(0.5)	06/29/93	56	Excellent
03-08-34						
Sugar Cr	SR 1156	Mecklenburg	11-137-1	04/15/99	28	Poor
				06/30/97	32	Poor
				06/30/93	18	Poor
Little Sugar Cr	NC 51	Mecklenburg	11-137-8	04/15/99	42	Good-Fair
				06/30/97	40	Fair
03-08-35						
Henry Fork	SR 1922	Burke	11-129-1-(2)	09/28/98	52	Good
Henry Fork	SR 1916	Burke	11-129-1-(2)	05/06/97	46	Good-Fair
Jacob Fork	SR 1924	Burke	11-129-2-(4)	05/03/99	54	Excellent
				09/28/98	52	Good
				05/06/97	56	Excellent
Pott Cr	SR 1217	Lincoln	11-129-3-(0.7)	05/21/02	50	Good
				05/21/97	50	Good
Maiden Cr	SR 1858	Catawba	11-129-5-7-2-(1)	03/18/93	42	Good-Fair
Maiden Cr	off SR 1892	Catawba	11-129-5-7-2-(1)	03/18/93	30	Poor
Indian Cr	SR 1252	Lincoln	11-129-8-(6.5)	05/21/02	38	Fair
				07/01/97	38	Fair
Beaverdam Cr	SR 1609	Gaston	11-129-9-(0.7)	05/21/02	50	Good
Hoyle Cr	SR 1836	Gaston	11-129-15-(1.5)	05/22/02	42	Good-Fair
				06/12/97	48	Good
03-08-36						
Long Cr	US 321	Gaston	11-129-16-(4)	05/22/02	46	Good-Fair
				05/20/97	40	Fair
				06/30/93	30	Poor
03-08-37						
Catawba Cr	SR 2435	Gaston	11-130	05/22/02	40	Fair
				05/19/97	42	Good-Fair
Crowders Cr	SR 1108	Gaston	11-135	05/22/02	38	Fair
				05/19/97	36	Fair
03-08-38						
Twelvelmile Cr	NC 16	Union	11-138	05/20/02	42	Good-Fair
				06/11/97	48	Good
Sixmile Cr	SR 1312	Union	11-138-3	05/20/02	38	Fair
				06/11/97	40	Fair
Waxhaw Cr	SR 1103	Union	11-139	06/11/97	56	Excellent

Appendix 12. Fish community metric values from 29 wadeable streams in the Catawba River basinwide monitoring program, 2002.[1]

Subbasin Waterbody	Location	County	Eco-region	d. a. (mi^2)	Date	No. Species	No. Fish	No. Sp. Darters	No. Sp. Sunfish + Bass + Trout	No. Sp. Suckers	No. Intol. Sp.	% Tolerant	% Omni. +Herb.	% Insect.	% Pisc.	% DELT	% MA
03-08-30																	
Catawba R	SR 1110	McDowell	MT	14.1	04/29/02	16	798	2	2	3	1	7	56	43	0.5	0.13	75
Curtis Cr	US 70	McDowell	MT	16.7	04/30/02	19	481	2	4	4	3	6	24	72	4.6	0.00	79
Crooked Cr	SR 1135	McDowell	MT	28.1	04/30/02	22	508	3	3	4	3	7	46	49	4.9	0.00	68
Paddy Cr	NC 126	Burke	MT	6.7	05/01/02	13	401	1	2	3	1	15	47	52	1.0	0.00	69
North Muddy Cr	SR 1760	McDowell	P	45.7	04/30/02	19	399	3	2	4	1	6	51	49	0.0	0.00	79
South Muddy Cr	SR 1764	McDowell	P	33.5	05/01/02	14	334	3	1	3	1	5	37	63	0.0	0.00	79
Canoe Cr	SR 1250	Burke	P	12.4	05/02/02	12	828	2	1	2	0	11	21	50	29.2	0.00	100
03-08-31																	
Silver Cr	SR 1149	Burke	P	26.1	05/01/02	19	384	3	4	2	2	9	33	66	1.0	0.00	63
Irish Cr	SR 1439	Burke	MT	33.9	05/02/02	17	166	1	5	4	2	18	39	52	9.0	1.81	53
Hunting Cr	SR 1512	Burke	P	23.4	05/01/02	15	198	2	2	2	0	21	47	53	0.0	2.02	53
Lower Cr	SR 1501	Burke	P	89.5	05/02/02	18	211	1	4	2	0	21	28	59	13.3	2.84	50
Smoky Cr	SR 1515	Burke	P	7.6	05/03/02	16	277	2	4	2	1	8	32	67	0.4	0.00	69
McGalliard Cr	SR 1538	Burke	P	7.5	05/03/02	9	143	0	3	1	0	57	26	68	6.3	0.00	44
03-08-32																	
Upper Little R	SR 1786	Caldwell	P	25.9	05/24/02	11	723	1	1	2	0	6	19	81	0.0	0.00	82
Middle Little R	SR 1002	Alexander	P	16.3	05/23/02	13	448	2	3	2	1	9	24	75	0.9	0.00	85
Duck Cr	NC 90	Alexander	P	14.6	05/23/02	10	1666	2	1	1	2	6	27	73	0.0	0.00	80
Lower Little R	SR 1318	Alexander	P	44.0	05/23/02	10	394	1	1	1	1	5	52	48	0.0	0.00	70
Elk Shoal Cr	SR 1605	Alexander	P	13.6	05/23/02	10	263	2	1	2	1	31	19	81	0.0	0.00	70
03-08-33																	
McDowell Cr	SR 2136	Mecklenburg	P	10.2	05/20/02	5	81	1	2	0	0	63	0	100	0.0	0.00	40
Killian Cr	NC 73	Lincoln	P	12.1	05/21/02	10	314	2	2	1	0	18	24	76	0.0	0.32	60
03-08-35																	
Pott Cr	SR 1217	Lincoln	P	21.0	05/21/02	20	265	2	4	3	3	20	45	55	0.4	0.00	45
Indian Cr	SR 1252	Lincoln	P	69.2	05/21/02	11	207	0	2	2	0	29	49	51	0.0	0.00	73
Beaverdam Cr	SR 1609	Gaston	P	23.0	05/21/02	13	357	2	3	3	2	46	24	76	0.6	0.28	69
Hoyle Cr	SR 1836	Gaston	P	27.5	05/22/02	15	600	3	1	2	2	5	52	48	0.0	0.00	53
03-08-36																	
Long Cr	US 321	Gaston	P	41.7	05/22/02	12	290	1	4	1	1	33	16	84	0.3	0.34	42
03-08-37																	
Catawba Cr	SR 2435	Gaston	P	23.4	05/22/02	11	348	1	3	1	0	16	45	55	0.0	0.29	73
Crowders Cr	SR 1108	Gaston	P	40.7	05/22/02	12	280	1	2	0	1	10	52	48	0.0	0.00	58
03-08-38																	
Twelvemile Cr	NC 16	Union	P	76.5	05/20/02	15	111	0	7	1	0	27	12	86	2.7	0.00	40
Sixmile Cr	SR 1312	Union	P	20.3	05/20/02	12	141	1	4	0	0	31	9	89	2.1	0.00	50

[1]Abbreviations are d. a. = drainage area, No. = number, Sp. = species, Intol. = intolerants, Omni. + Herb. = omnivores+herbivores, Insect. = insectivores, Pisc. = piscivores, DELT = disease, erosion, lesions, and tumors, and MA = species with multiple age groups.

Appendix 13. Fish distributional records for the Catawba River basin.

In 2002, the most widely distributed species (collected at 28 of the 29 sites) were the bluehead chub and the redbreast sunfish. The bluehead chub and redbreast sunfish were not collected from McDowell and Canoe Creeks, respectively. The bluehead chub was also the most abundant species; representing 30 percent of all the fish collected. The dominance by this species also reflected that many of the sites had an elevated percentage of omnivores, indicative of an abundance of nutrients. Other abundant species included the greenhead shiner and the rosyside dace. Collectively, these three species accounted for 61 percent of all the fish collected.

Based upon Menhinick (1991), NC DWQ's data, and data from other researchers, 93 species of fish are known from the Catawba River basin in North Carolina. Two of these species have been given special protection status by the U. S. Department of the Interior, the NC Wildlife Resources Commission, or the NC Natural Heritage Program under the NC State Endangered Species Act (G.S. 113-331 to 113-337) (LeGrand *et al*. 2001; Menhinick and Braswell 1997) (Table 1). Both species are considered as "Special Concern" at the state level.

Table 1. Species of fish listed as endangered or of special concern in the Catawba River basin.

Species	Common Name	State Rank
Carpiodes velifer	Highfin carpsucker	S2
Etheostoma collis pop. 1	Carolina darter	S3

[1]S2 = Imperiled in North Carolina because of rarity or because of some factor(s) making it very vulnerable to extirpation from North Carolina. S3 = rare or uncommon in North Carolina (LeGrand *et al*. 2001).

In 2002, as part of the NC DWQ's fish community monitoring program, new distributional county records included:

- Fathead minnow - McDowell,
- Snail bullhead - Burke,
- Green sunfish – Burke and Lincoln, and
- Warmouth – McDowell.

No exotic species were collected in 1997 and 2002 from North Muddy, South Muddy, McGalliard, Pott, and Duck Creeks and from the Lower Little and Middle Little Rivers. No exotic species were collected from Hunting and Beaverdam Creeks and from the Upper Little River which were sampled for the first time in 2002.

Appendix 14. Water quality at fish community sites in the Catawba River basin, 2002.

As mentioned throughout this report, most stream flows during 2002 were very low and have been for several years due to the prolonged drought (Appendix 1). Under drought conditions, many of the streams were shallow and generally clear with conductivity readings between 12 and 185 µmhos/cm (Table 1). Except for one site, the conductivity was equal to or slightly greater in 2002 than in 1997 (Figure 1). In 1997, conductivity was 293 µmhos/cm at Catawba Creek; in 2002 it was 148 µmhos/cm. The difference was due to the re-routing of the effluent from one of the City of Gastonia's wastewater treatment plants to the Long Creek WWTP. Conductivity was also greater in the more developed watersheds than in the more forested and rural watersheds.

Ninety-one fish community samples with associated conductivity measurements have been collected throughout the basin, primarily since 1997. [Two data points – Smoky Creek (1993) and Mackey Creek (1998 below a toxic point source) were not included in this data set.] This data set showed that as conductivity increased, the fish community ratings declined (Figure 2). Median measurements for Excellent, Good, Good-Fair, Fair, and Poor sites were 34, 46, 91, 103, and 409 µmhos/cm, respectively.

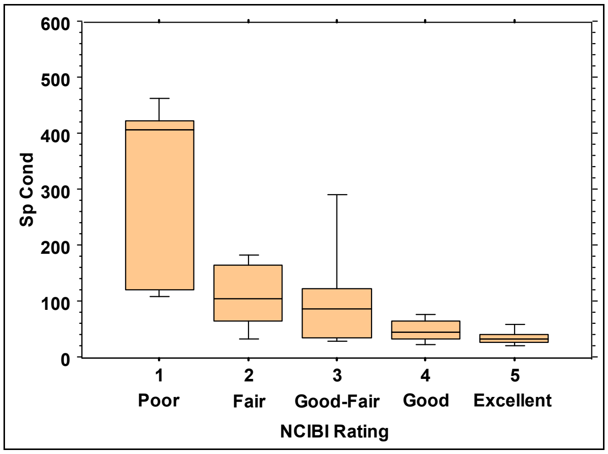


Figure 2. Relationships between conductivity (µmhos/cm) and NCIBI ratings in the Catawba River basin, 1993 - 2002.

Table 1. Water quality at 29 basinwide fish community sites in the Catawba River basin, 2002.

Subbasin/ Waterbody	Location	County	Date	Temperature (˚C)	Conductivity (µmhos/cm)	Dissolved oxygen (mg/L)	Saturation (%)	pH (s.u.)
03-08-30								
Catawba R	SR 1110	McDowell	04/29/02	19.2	50	6.9	74.7	6.6
Curtis Cr	US 70	McDowell	04/30/02	11.7	18	8.6	79.3	6.5
Crooked Cr	SR 1135	McDowell	04/30/02	13.7	40	9.7	93.5	6.6
Paddy Cr	NC 126	Burke	05/01/02	14.5	12	7.4	72.6	6.3
North Muddy Cr	SR 1760	McDowell	04/30/02	17.1	77	9.8	101.6	7.1
South Muddy Cr	SR 1764	McDowell	05/01/02	15.2	44	7.4	73.7	6.6
Canoe Cr	SR 1250	Burke	05/02/02	17.0	49	7.0	72.5	6.9
03-08-31								
Silver Cr	SR 1149	Burke	05/01/02	18.4	49	8.6	91.6	7.0
Irish Cr	SR 1439	Burke	05/02/02	18.0	35	6.6	69.7	6.8
Hunting Cr	SR 1512	Burke	05/01/02	19.9	81	7.3	80.2	6.9
Lower Cr	SR 1501	Burke	05/02/02	20.4	102	6.0	66.5	6.9
Smoky Cr	SR 1515	Burke	05/03/02	17.7	39	7.8	81.9	6.9
McGalliard Cr	SR 1538	Burke	05/03/02	18.6	107	6.3	67.4	6.8
03-08-32								
Upper Little R	SR 1786	Caldwell	05/24/02	13.0	36	9.5	90.2	7.2
Middle Little R	SR 1002	Alexander	05/23/02	14.0	31	10.2	99.0	7.1
Duck Cr	NC 90	Alexander	05/23/02	16.0	42	9.5	96.3	7.1
Lower Little R	SR 1318	Alexander	05/23/02	12.0	42	10.8	100.2	7.1
Elk Shoal Cr	SR 1605	Alexander	05/23/02	10.0	58	10.6	93.9	7.0
03-08-33								
McDowell Cr	SR 2136	Mecklenburg	05/20/02	17.0	125	8.5	88.0	7.2
Killian Cr	NC 73	Lincoln	05/21/02	12.0	131	9.5	88.2	7.1

Table 1 (continued).

Subbasin/ Waterbody	Location	County	Date	Temperature (˚C)	Conductivity (µmhos/cm)	Dissolved oxygen (mg/L)	Saturation (%)	pH (s.u.)
03-08-35								
Pott Cr	SR 1217	Lincoln	05/21/02	12.0	55	9.7	90.0	7.2
Indian Cr	SR 1252	Lincoln	05/21/02	14.0	75	9.7	94.2	7.1
Beaverdam Cr	SR 1609	Gaston	05/21/02	14.0	67	9.6	93.2	7.1
Hoyle Cr	SR 1836	Gaston	05/22/02	10.0	88	10.6	93.9	6.9
03-08-36								
Long Cr	US 321	Gaston	05/22/02	17.0	93	8.7	90.0	7.1
03-08-37								
Catawba Cr	SR 2435	Gaston	05/22/02	13.0	148	10.1	95.9	7.2
Crowders Cr	SR 1108	Gaston	05/22/02	15.0	172	9.5	94.2	7.1
03-08-38								
Twelvelmile Cr	NC 16	Union	05/20/02	13.5	141	8.3	79.7	7.1
Sixmile Cr	SR 1312	Union	05/20/02	15.0	185	8.2	81.3	7.0

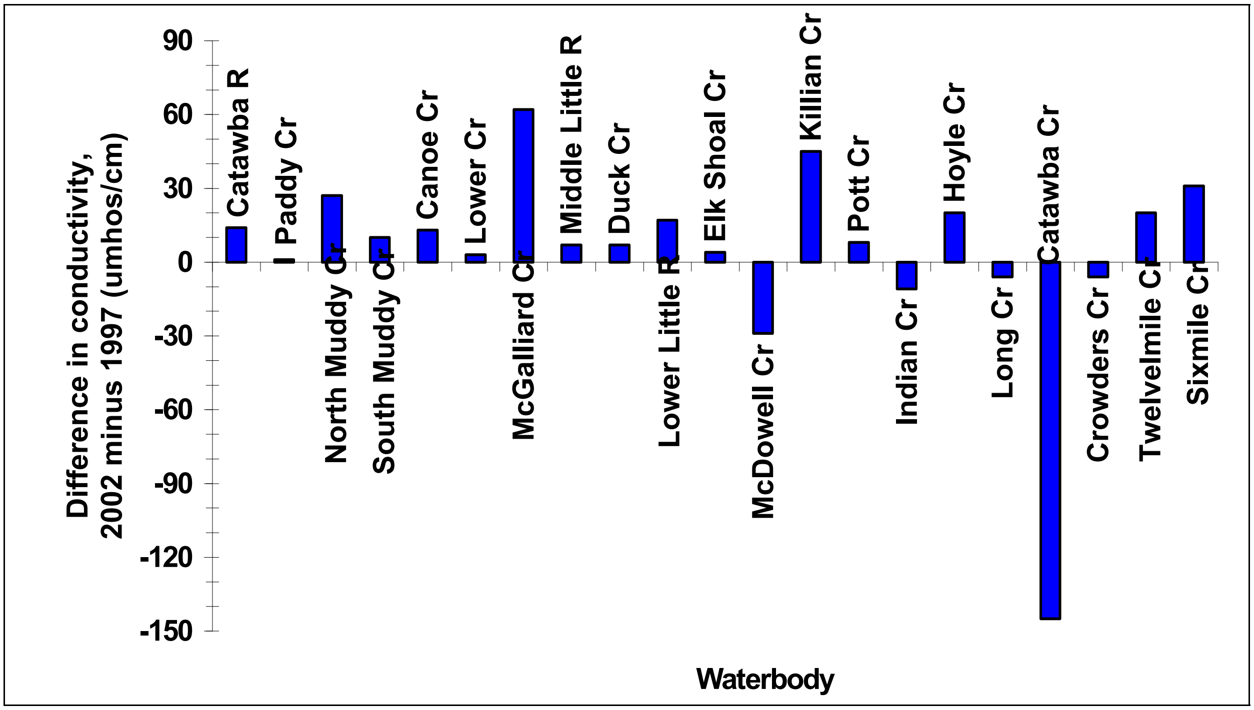


Figure 1. **A comparison of the conductivity at 29 fish community sites in the Catawba River basin, 1997 *vs*. 2002. A positive difference meant that conductivity was greater in 2002 than in 1997; a negative difference meant that conductivity was greater in 1997 than in 2002.**

Appendix 15. Lake assessment program.

Lakes Monitored

Ten lakes in the basin were monitored as part of the Lakes Assessment program in 2002 (Table 1). Surface physical and photic zone chemistry data collected from 1997 through 2002 (from 1992 for Newton City and Bessemer City Lakes) are presented in Appendix 18.

Lake Sampling Methods

Lake monitoring stations are sited to provide representative samples of lake water quality based on morphology, size, and site-specific features such as coves and tributaries. Physical field measurements (dissolved oxygen, pH, water temperature and conductivity) are made with a calibrated Hydrolab™. Readings are taken at the surface of the lake (0.15 meters) and at one-meter increments to the bottom of the lake. Secchi depths are measured at each sampling station with a weighted Secchi disk attached to a rope marked off in centimeters. Surface water samples are collected for chloride, hardness, fecal coliform bacteria and metals.

A Labline™ sampler is used to composite water samples within the photic zone (a depth equal to twice the Secchi depth). Nutrients, chlorophyll *a*, solids, turbidity and phytoplankton are collected at this depth. Nutrients and chlorophyll *a* from the photic zone are used to calculate the North Carolina Trophic State Index score. The Labline™ sampler is also used to collect a grab water samples near the bottom of the lake for nutrients. Water samples are collected and preserved in accordance with specified protocols (NCDEHNR 1996 and subsequent updates).

Data Interpretation

The North Carolina water quality standards per 15A NCAC 2B .0200 are used in determining if a lake is meeting its designated uses. Table 5 (in the Introduction to Program Methods Section) lists the standards applicable to the various use classifications (designated uses) associated with lakes and streams. In addition to data collected through field sampling efforts, lake water quality assessments are also based on information obtained from other lake monitoring programs such as those implemented by municipalities and major hydroelectric companies. Observations and comments from citizens, local government personnel, water treatment facility staff, etc. are also considered in the assessment process.

Table 1. Lakes monitored in the Catawba River basin during the 2001 – 2002 sampling effort.

Subbasin/ Lake	County	Classification	Surface Area (Ac)	Mean Depth (ft.)	Volume ($X10^6m^3$)	Watershed (mi^2)	Retention Time (days)
03-08-30							
Lake Tahoma	McDowell	WS-II, B Tr, HQW	1,61	30	0.7	23	
Lake James	Burke	WS-IV, V, B Tr	6,510	46	36.9	380	228
03-08-31							
Lake Rhodhiss	Burke-Caldwell	WS-IV, B, CA	3,515	20	36.7	1,090	21
03-08-32							
Lake Hickory	Alexander-Catawba	WS-IV, V, B, CA	4,100	33	17.0	1,310	33
Lookout Shoals Lake	Catawba Iredell	WS-IV, V, B, CA	1,270	30	4.6	1,450	9
Lake Norman	Mecklenburg - Lincoln	WS-IV, B, CA	32,510	33	131.5	1,790	206
03-08-33							
Mountain Island Lake	Mecklenburg - Gaston	WS-IV, B, CA	3,235	16	71.0	1,860	12
03-08-34							
Lake Wylie	Mecklenburg - York, SC	WS-IV, V, B, CA	12,450	23	35.3	3,020	32
03-08-35							
Newton City Lake	Catawba	WS-III, CA	17	10	0.1	100	
03-08-36							
Bessemer City Lake	Gaston	WS-II, HQW, CA	15	10	0.02	0.4	

In addition to determining use support, data collected during ambient lakes monitoring are used to evaluate the trophic state of lakes. An index was developed specifically for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NCDNRCD 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 used to produce a NCTSI score for each lake, using the equations:

TON_{Score} = ((Log (TON) + 0.45)/0.24)*0.90

TP_{Score} = ((Log (TP) + 1.55)/0.35)*0.92

SD_{Score} = ((Log (SD) – 1.73)/0.35)*-0.82

CHL_{Score} = ((Log (CHL) – 1.00)/0.48)*0.83

NCTSI = TON_{Score} + TP_{Score} + SD_{Score} + CHL_{Score}

In general, NCTSI scores relate to trophic classifications (Table 2). When scores border between classes, best professional judgment is used to assign an appropriate classification. Scores may be skewed by highly colored water typical of dystrophic lakes. Some variation in the trophic state between years is not unusual because of the variability of data collections, which usually involve sampling a limited number of times during the growing season.

Table 2. Lakes classification criteria.

NCTSI Score	Trophic classification
< -2.0	Oligotrophic
-2.0 – 0.0	Mesotrophic
0.0 – 5.0	Eutrophic
> 5.0	Hypereutrophic

Oligotrophic lakes are characteristically found in the mountains or in undisturbed watersheds. Many mesotrophic and eutrophic lakes are found in the central piedmont. There are a few hypereutrophic lakes where point or nonpoint sources of pollution contribute to high levels of nutrients.

Appendix 16. Surface physical water data and photic zone chemistry data collected from lakes in the Catawba River basin, 1992 – 2002.

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (µg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
08-03-30																	
Lake Tahoma																	
8/21/2002	CTBLT1	8.3	27.2	7.9	25	4.0	<0.02	0.1	0.01	0.01	0.11	0.09	0.02	5	32	<2.0	
8/21/2002	CTBLT2	8.2	27.3	7.4	25	4.5	<0.02	0.1	0.01	0.01	0.11	0.09	0.02	3	41	<2.0	1.6
7/30/2002	CTBLT1	8.2	29.8	8.0	24	3.7	<0.02	0.1	0.01	0.01	0.11	0.09	0.02	2	37	<2.0	1.2
7/30/2002	CTBLT2	8.2	29.9	7.8	24	4.2	<0.02	0.1	0.01	0.01	0.11	0.09	0.02	3	30	2.0	1.1
6/5/2002	CTBLT1	8.0	24.8	7.3	23	3.6	0.01	0.1	<0.01	0.03	0.13	0.10	0.04	1	25	<2.5	2.2
6/5/2002	CTBLT2	8.0	24.7	6.8	23	5.0	0.01	0.1	<0.01	<0.01	0.11	0.10	0.01	1	20	<3.3	1.3
7/27/1992	CTBLT1	7.8	27.0	7.0	17	4.3	0.01	0.2	0.03	<0.01	0.21	0.17	0.04	4	19	1.0	1.4
7/27/1992	CTBLT2	7.6	27.6	7.3	9	4.0	<0.01	0.1	0.03	<0.01	0.11	0.07	0.04	1	25	2.0	<1.0
Lake James																	
08/21/2002	CTB013B	9.7	30.5	8.3	96	0.3	0.02	0.34	<0.02	0.06	0.40	0.33	0.07	12	100	5.0	5.6
08/21/2002	CTB013C	8.5	29.0	7.7	64	3.8	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	1	59	<2.0	<1.0
08/21/2002	CTB015A	7.9	28.7	7.8	58	4.3	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	1	50	<2.0	1.6
08/21/2002	CTB015C	8.6	29.5	7.6	53	4.2	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	1	57	<2.0	1.4
08/21/2002	CTB023A1	8.3	28.7	7.9	49	1.8	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	3	42	2.0	2.6
08/21/2002	CTB023B	8.6	28.9	7.8	51	4.7	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	1	46	<2.0	1.2
07/30/2002	CTB013B	9.4	30.4	8.6	97	0.8	0.05	0.27	<0.02	0.10	0.37	0.26	0.11	11	79	5.0	6.1
07/30/2002	CTB013C	8.0	28.6	8.1	58	3.8	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	2	49	<2.0	1.7
07/30/2002	CTB015A	7.4	29.8	7.9	57	3.4	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	1	50	<2.0	2.0
07/30/2002	CTB015C	7.8	29.6	8.0	51	3.4	<0.02	<0.2	<0.02	0.02	0.12	0.09	0.03	1	46	<2.0	1.9
07/30/2002	CTB023A1	7.6	29.5	7.7	46	2.6	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	2	49	<2.0	1.9
07/30/2002	CTB023B	7.7	29.5	7.7	48	4.0	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	1	45	<2.0	1.4
06/05/2002	CTB013B	9.5	27.4	8.1	69	1.0	0.02	<0.2	0.01	0.04	0.14	0.09	0.05	8	53	3.0	3.9
06/05/2002	CTB013C	8.1	26.8	7.2	58	3.0	<0.02	<0.2	0.09	<0.01	0.11	0.01	0.10	2	42	<3.3	1.6
06/05/2002	CTB015A	8.1	26.5	7.1	56	3.8	<0.02	<0.2	0.04	0.04	0.14	0.06	0.08	1	43	<2.5	1.1
06/05/2002	CTB015C	8.3	26.5	7.9	53	6.0	<0.2	<0.2	<0.01	0.04	0.14	0.10	0.05	1	36	<2.5	<1.0
06/05/2002	CTB023A1	8.4	27.1	7.0	49	3.5	<0.02	<0.2	<0.01	0.04	0.14	0.10	0.05	2	45	<2.5	2.1
06/05/2002	CTB023B	8.4	26.3	7.0	51	6.5	<0.02	<0.2	0.02	0.04	0.14	0.08	0.06	2	32	<2.5	<1.0
08/21/2001	CTB013B	8.8	28.8	8.4	64	1.6	0.02	0.24	0.01	<0.01	0.25	0.23	0.02	7	51	4.0	2.4
08/21/2001	CTB013C	8.3	28.5	8.0	59	3.6	0.01	0.10	0.01	<0.01	0.11	0.09	0.02	2	22	1.0	1.0
08/21/2001	CTB015A	8.0	28.5	7.5	58	5.1	0.01	0.10	<0.01	<0.01	0.11	0.10	0.01	2	43	1.0	1.1
08/21/2001	CTB015C	7.8	28.8	7.7	54	6.2	0.01	0.10	<0.01	<0.01	0.11	0.10	0.01	<1	34	1.0	0.5
08/21/2001	CTB023A1	8.3	29.0	7.6	49	2.1	0.01	0.10	<0.01	<0.01	0.11	0.10	0.01	3	37	1.0	1.2
08/21/2001	CTB023B	7.8	29.1	7.6	52	6.0	0.01	0.10	0.02	<0.01	0.11	0.08	0.03	1	40	1.0	0.5
08/07/2001	CTB013B	8.3	28.9	8.1	61	2.2	0.02	0.20	0.02	0.02	0.22	0.18	0.04	7	50	2.5	
08/07/2001	CTB013C	8.2	28.6	8.1	60	4.1	0.01	0.10	0.02	0.03	0.13	0.08	0.05	5	48	1.5	1.5
08/07/2001	CTB015A	7.8	28.4	7.3	57	4.3	0.01	0.10	0.02	0.02	0.12	0.08	0.04	4	52	1.5	1.1
08/07/2001	CTB015C	7.9	29.6	7.5	53	5.1	0.01	0.10	0.02	0.02	0.12	0.08	0.04	2	45	1.5	1.1
08/07/2001	CTB023A1	8.0	29.0	7.0	48	3.5	0.10	0.10	0.01	<0.01	0.11	0.09	0.02	2	41	2.5	1.3
08/07/2001	CTB023B	7.7	28.7	7.6	50	5.0	0.01	0.24	0.03	0.01	0.25	0.21	0.04	2	40	1.5	5.0
07/24/2001	CTB013B	8.7	28.4	8.1	66	2.1	0.02	0.35	0.08	<0.01	0.36	0.27	0.09	7	48	1.5	2.2
07/24/2001	CTB013C	8.1	28.5	7.4	62	4.8	0.01	0.28	0.07	<0.01	0.29	0.21	0.08	2	53	1.5	0.5
07/24/2001	CTB015A	7.8	27.9	7.6	57	4.8	0.01	0.10	0.02	<0.01	0.11	0.08	0.03	2	53	1.5	1.4
07/24/2001	CTB015C	8.1	27.9	7.6	54	5.4	0.01	0.20	0.07	<0.01	0.21	0.13	0.08	1	37	1.5	0.5
07/24/2001	CTB023A1	8.2	28.2	7.7	51	3.0	0.01	0.42	0.04	<0.01	0.43	0.38	0.05	3	33	1.5	2.4
07/24/2001	CTB023B	8.0	27.7	7.5	52	5.2	0.01	0.22	0.03	<0.01	0.23	0.19	0.04	2	38	1.5	0.5
07/10/2001	CTB013B	8.3	28.8	7.3	69	1.4	0.03	0.43	0.12	0.02	0.45	0.31	0.14	8	37	5.0	5.4
07/10/2001	CTB013C	7.7	27.6	6.9	63	3.7	0.02	0.31	0.03	0.01	0.32	0.28	0.04	4	56	1.5	1.4
07/10/2001	CTB015A	8.0	27.7	7.1	55	4.7	0.02	0.45	0.04	0.07	0.52	0.41	0.11	2	57	1.5	1.8

Appendix 16 (continued).

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (µg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
07/10/2001	CTB015C	7.7	27.8	7.7	52	5.1	0.01	0.66	0.51	0.03	0.69	0.15	0.54	2	44	1.5	2.1
07/10/2001	CTB023A1	8.2	27.2	7.3	48	3.7	0.01	0.28	0.06	<0.01	0.29	0.22	0.07	4	40	1.5	3.5
07/10/2001	CTB023B	8.2	27.7	7.1	51	5.7	0.01	0.22	0.03	0.02	0.24	0.19	0.05	2	38	1.5	1.0
08/11/1997	CTB013B	8.7	26.5	8.1	60	1.1	0.03	0.40	<0.01	<0.01	0.41	0.40	0.01		63	7.0	6.4
08/11/1997	CTB013C	8.3	26.8	8.0	55	2.0	0.03	0.10	<0.01	0.01	0.11	0.10	0.02		58	3.0	3.1
08/11/1997	CTB015A	7.7	27.0	6.9	47	3.5	<0.01	0.20	<0.01	0.06	0.26	0.20	0.07		57	2.0	2.0
08/11/1997	CTB015C	7.8	28.6	7.2	41	5.0	0.02	0.20	0.01	0.07	0.27	0.19	0.08		48	1.0	2.1
08/11/1997	CTB023A1	8.0	27.3	7.3	36	3.6	<0.01	0.10	<0.01	<0.01	0.11	0.10	0.01		41	2.0	1.6
08/11/1997	CTB023B	7.9	27.6	7.1	39	4.6	<0.01	0.10	0.02	0.06	0.16	0.08	0.08		44	1.0	2.2
07/07/1997	CTB013B	8.4	26.6	7.2	53	1.0	0.04	0.10	0.01	0.17	0.27	0.09	0.18		43	8.0	9.5
07/07/1997	CTB013C	8.0	27.5	7.2	48	2.6	0.01	0.20	0.03	0.11	0.31	0.17	0.14		71	4.0	4.9
07/07/1997	CTB015A	7.7	27.4	6.8	43	4.0	<0.01	0.10	0.01	0.10	0.20	0.09	0.11		39	1.0	1.9
07/07/1997	CTB015C	7.7	27.0	6.7	40	4.8	<0.01	0.20	<0.01	0.16	0.36	0.20	0.17		38	<1.0	
07/07/1997	CTB023A1	7.8	27.2	6.8	37	4.7	0.01	0.60	0.02	0.17	0.77	0.58	0.19		49	2.0	1.7
07/07/1997	CTB023B	7.7	27.2	6.8	38	5.0	<0.01	0.10	<0.01	0.17	0.27	0.10	0.18		46	1.0	1.2
06/09/1997	CTB013B	8.7	18.4	7.0	47	1.4	0.02	0.10	<0.01	0.12	0.22	0.10	0.13		69	13.0	4.6
06/09/1997	CTB013C	8.8	18.9	7.2	45	3.1	0.01	0.10	0.01	0.07	0.17	0.09	0.08		60	3.0	2.5
06/09/1997	CTB015A	8.3	18.7	6.8	43	4.4	<0.01	0.20	0.01	0.13	0.33	0.19	0.14		52	2.0	1.2
06/09/1997	CTB015C	8.7	18.8	6.9	41	5.9	<0.01	0.20	0.01	0.14	0.34	0.19	0.15		55	2.0	0.5
06/09/1997	CTB023A1	8.8	18.7	7.0	36	4.2	0.02	0.20	<0.01	0.15	0.35	0.20	0.16		56	2.0	2.6
06/09/1997	CTB023B	8.7	18.7	6.9	39	5.4	<0.01	0.20	<0.01	0.15	0.35	0.20	0.16		35	1.0	1.4
08-03-31																	
Lake Rhodhiss																	
08/29/2002	CTB040B	4.8	25.1	7.6	93	1.5	0.03	0.50	0.10	0.12	0.43	0.23	0.20	12			3.2
08/29/2002	off Granite WTP	3.6	25.0	7.4	95	1.4	0.03	0.34	0.12	0.14	0.48	0.22	0.26	12			3.8
08/29/2002	off Lenoir WTP	4.9	25.3	7.5	90	1.3	0.03	0.36	0.11	0.11	0.47	0.25	0.22	17			4.7
08/29/2002	CTB040A	5.7	25.6	7.6	91	1.0	0.03	0.38	0.10	0.08	0.46	0.28	0.18	16			6.1
08/29/2002	off Valdese WWTP	5.6	25.5	7.6	130	0.4	0.11	0.40	0.12	0.08	0.48	0.28	0.20	18			11.0
08/29/2002	off Valdese WTP	5.8	25.1	7.7	82	0.4	0.04	0.36	0.13	0.07	0.43	0.23	0.20	21			10.0
08/29/2002	CTB034A	8.1	20.5	7.6	60	0.2	0.10	0.24	0.06	0.42	0.66	0.18	0.48	2			17.0
07/16/2002	CTB040B	9.7	26.6	8.8	76	0.9	0.03	0.46	<0.02	<0.02	0.47	0.45	0.02	18			4.3
07/16/2002	off Granite WTP	9.7	26.6	8.6	76	0.7	0.02	0.41	<0.02	<0.02	0.42	0.40	0.02	15			4.5
07/16/2002	off Lenoir WTP	9.9	26.3	8.8	77	0.7	0.02	0.48	<0.02	<0.02	0.49	0.47	0.02	19			3.9
07/16/2002	CTB040A	10.7	26.6	9.9	78	0.6	0.02	0.35	<0.02	<0.02	0.36	0.34	0.02	15			4.5
07/16/2002	off Valdese WWTP	10.7	26.8	8.9	78	0.6	0.02	0.39	<0.02	<0.02	0.40	0.38	0.02	22			5.3
07/16/2002	off Valdese WTP	10.6	27.0	9.9	78	0.6	0.02	0.40	<0.02	<0.02	0.41	0.39	0.02	17			5.2
07/16/2002	CTB034A	8.2	21.9	7.5	52	0.4	0.05	<0.2	0.02	0.23	0.33	0.08	0.25	1			24.0
07/16/2002	DS Morganton WWTP	2.8	20.8	7.2	51	0.4	0.05	<0.2	0.03	0.30	0.40	0.07	0.33	1			17.0
05/29/2002	CTB040B	14.1	24.3	9.7	89	0.7	0.02	0.24	<0.01	<0.01	0.25	0.24	0.01	50			10.0
05/29/2002	off Granite WTP	14.2	24.2	9.4	86	0.6	0.02	0.32	<0.01	<0.01	0.33	0.32	0.01	44			12.0

Appendix 16 (continued).

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (μmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (μg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
05/29/2002	off Lenoir WTP	13.8	24.2	9.7	92	0.8	0.02	0.34	<0.01	<0.01	0.35	0.34	0.01	39			9.5
05/29/2002	CTB040A	14.7	24.0	9.6	89	0.8	0.02	0.28	<0.01	<0.01	0.29	0.28	0.01	35			9.0
05/29/2002	off Valdese WWTP	14.1	24.1	9.6	86	0.9	0.02	0.23	<0.01	<0.01	0.24	0.23	0.01	27			8.4
05/29/2002	off Valdese WTP	14.4	24.2	9.6	87	1.0	0.03	0.25	<0.01	<0.01	0.26	0.25	0.01	27			7.8
05/29/2002	CTB034A	7.8	21.6	8.1	54	0.5	0.06	0.20	0.04	0.34	0.54	0.16	0.38	3			17.0
05/29/2002	DS Morganton WWTP	8.0	21.1	8.1	52	0.5	0.06	<0.2	0.02	0.28	0.38	0.08	0.30	4			13.0
08/23/2001	CTB034A	8.3	26.1	7.2	59	0.6	0.08	0.25	0.07	0.29	0.54	0.18	0.36	7			8.6
08/23/2001	CTB040A	10.7	28.0	9.0	66	0.8	0.03	0.36	0.02	<0.01	0.37	0.34	0.03	10			2.2
08/23/2001	CTB040B	10.2	28.5	9.0	69	1.0	0.02	0.30	0.03	<0.01	0.31	0.27	0.04	8			2.0
08/23/2001	DS Morganton WWTP	8.1	23.9	7.2	61	0.6	0.06	0.10	0.10	0.26	0.36	0.00	0.36	2			6.5
08/23/2001	off Granite WTP	9.9	28.7	9.1	69	1.0	0.02	0.41	0.02	<0.01	0.42	0.39	0.03	8			1.9
08/23/2001	off Lenoir WTP	10.0	28.5	8.7	67	1.0	0.03	0.35	0.02	<0.01	0.36	0.33	0.03	8			1.8
08/23/2001	off Valdese WTP	10.8	17.7	9.0	62	0.7	0.03	0.35	0.02	<0.01	0.36	0.33	0.03	10			3.4
08/23/2001	off Valdese WWTP	10.7	28.1	9.0	65	0.7	0.02	0.38	0.07	<0.01	0.39	0.31	0.08	9			2.3
08/08/2001	CTB034A	9.5	27.9	8.7	66	1.1	0.03	0.26	0.01	<0.01	0.27	0.25	0.02	9			2.1
08/08/2001	CTB040A	8.2	26.9	8.4	61	0.7	0.03	0.30	0.02	<0.01	0.31	0.28	0.03	9			2.9
08/08/2001	CTB040B	10.0	28.2	9.0	70	1.3	0.03	0.10	<0.01	<0.01	0.11	0.10	0.01	11			2.1
08/08/2001	DS Morganton WWTP	8.3	21.6	7.2	53	0.6	0.08	0.22	0.06	0.31	0.53	0.16	0.37	3			7.6
08/08/2001	Mouth of Freemason Cr	9.1	27.8	8.7	64	0.6	0.05	0.50	0.02	<0.01	0.51	0.48	0.03	20			4.0
08/08/2001	off Granite WTP	8.7	28.5	8.8	68	1.2	0.03	0.39	0.02	<0.01	0.40	0.37	0.03	9			2.6
08/08/2001	off Lenoir WTP	10.1	27.7	8.9	69	1.1	0.03	0.30	<0.01	<0.01	0.31	0.30	0.01	10			2.6
08/08/2001	off Valdese WTP	8.9	28.0	8.7	64	1.1	0.04	1.00	<0.01	<0.01	1.01	1.00	0.01	10			2.4
08/08/2001	off Valdese WWTP	8.8	28.0	8.5	65	1.0	0.03	0.27	0.02	<0.01	0.28	0.25	0.03	9			2.7
07/25/2001	CTB034A	7.5	22.0	7.2	59	0.5	0.03	0.33	0.07	0.30	0.63	0.26	0.37	16			12.0
07/25/2001	CTB040A	9.2	27.0	8.5	66	1.0	0.03	0.46	0.07	<0.01	0.47	0.39	0.08	17			2.4
07/25/2001	CTB040B	9.5	26.1	8.3	68	1.3	0.02	0.50	0.02	<0.01	0.51	0.48	0.03	13			2.2
07/25/2001	DS Morganton WWTP	7.4	21.4	6.9	65	0.4	0.08	0.41	0.16	0.39	0.80	0.25	0.55	6			12.0
07/25/2001	off Granite WTP	9.8	26.6	8.6	69	1.0	0.02	0.54	0.04	<0.01	0.55	0.50	0.05	11			2.5
07/25/2001	off Lenoir WTP	9.6	27.1	8.7	69	1.1	0.03	0.52	0.03	<0.01	0.53	0.49	0.04	14			2.5

Appendix 16 (continued).

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (µg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
07/25/2001	off Valdese WTP	8.8	27.1	8.6	64	1.2	0.04	0.40	0.04	<0.01	0.41	0.36	0.05	18			3.1
07/25/2001	off Valdese WWTP	8.7	27.2	8.6	65	1.0	0.04	0.48	0.06	<0.01	0.49	0.42	0.07	14			2.6
07/11/2001	CTB034A	8.2	25.6	7.8	56	0.4								15			12.0
07/11/2001	CTB040A	7.8	27.3	8.4	60	0.6	0.04	0.25	0.03	0.03	0.28	0.22	0.06	16			8.8
07/11/2001	CTB040B	9.4	27.6	8.8	70	1.0	0.04	0.42	0.03	<0.01	0.43	0.39	0.04	19			3.0
07/11/2001	DS Morganton WWTP	6.9	23.7	7.3	57	0.3	0.09	0.25	0.17	0.33	0.58	0.08	0.50	3			15.0
07/11/2001	Mouth of Freemason Cr	9.1	27.1	8.6	65	0.7	0.04	0.34	0.05	0.02	0.36	0.29	0.07	22			5.2
07/11/2001	off Granite WTP	9.3	27.8	8.8	68	1.1	0.04	0.51	0.04	<0.01	0.52	0.47	0.05	17			3.1
07/11/2001	off Lenoir WTP	9.5	27.3	9.0	65	0.8	0.04	0.27	0.03	<0.01	0.28	0.24	0.04	20			5.8
07/11/2001	off Valdese WTP	8.8	28.0	8.8	59	0.6	0.04	0.29	0.03	0.02	0.31	0.26	0.05	20			9.3
07/11/2001	off Valdese WWTP	8.5	28.0	8.8	59	0.5	0.05	0.33	0.03	0.04	0.37	0.30	0.07	26			10.0
06/06/2001	CTB034A	7.6	21.8	7.5	56	0.4	0.15	0.44	0.26	0.29	0.73	0.18	0.55	7			
06/06/2001	CTB040A	10.8	26.8	9.0	75	1.2	0.05	0.30	0.10	0.08				20			3.3
06/06/2001	CTB040B	9.1	27.0	8.7	67	1.8	<0.01	0.03	0.10	0.08				13			2.6
06/06/2001	DS Morganton WWTP	8.5	17.9	7.4	61	0.2	0.16		0.22	0.31			0.53	2			5.4
06/06/2001	Mouth of Freemason Cr	9.8	27.0	8.8	71	1.2					0.00	0.00	0.00				
06/06/2001	Mouth of Hoyle Creek	10.9	27.9	8.9	73	0.8					0.00	0.00	0.00				
06/06/2001	off Granite WTP	9.3	27.3	8.8	68	1.6	0.05	0.30	0.10	0.08				13			3.7
06/06/2001	off Lenoir WTP	10.3	26.9	9.9	71	1.4	0.05	0.30	0.10	0.75				15			3.2
06/06/2001	off Valdese WTP	9.6	28.4	9.0	70	1.0	0.05		0.10	0.08				20			4.3
06/06/2001	off Valdese WWTP	10.7	28.5	8.9	74	1.1	0.05	0.30	0.10	0.08				16			3.5
08/12/1997	CTB034A	7.1	23.4	6.4	58	0.8	0.07	0.20	0.12	0.35	0.55	0.08	0.47		78	10.0	8.6
08/12/1997	CTB040A	10.2	28.4	8.6	69	1.4	<0.01	0.20	<0.01	0.09	0.29	0.20	0.10		120	4.0	2.6
08/12/1997	CTB040B	10.2	27.4	8.6	70	1.4	0.03	0.30	0.04	0.05	0.35	0.26	0.09		65	3.0	2.4
07/08/1997	CTB034A	7.6	20.1	6.8	45	1.0	0.05	0.10	0.01	0.27	0.37	0.09	0.28		60	13.0	12.0
07/08/1997	CTB040A	10.0	26.4	8.5	54	1.7	0.03	0.10	<0.01	0.14	0.24	0.10	0.15		54	7.0	8.5
07/08/1997	CTB040B	9.1	26.8	8.3	58	1.7	0.03	0.10	<0.01	0.05	0.15	0.10	0.06		66	3.0	4.2
06/10/1997	CTB034A	9.0	14.5	6.5	42	1.2	0.02	0.10	0.03	0.20	0.30	0.07	0.23		78	12.0	6.8
06/10/1997	CTB040A	8.9	18.1	6.6	55	1.0	0.02	0.20	<0.01	0.14	0.34	0.20	0.15		57	6.0	9.0
06/10/1997	CTB040B	9.1	17.9	6.7	53	0.5	0.03	0.10	0.01	0.16	0.26	0.09	0.17		54	6.0	11.0

Appendix 16 (continued).

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (µg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
08-03-32																	
Lake Hickory																	
08/28/2002	CTB048A	5.3	25.7	7.4	81	0.6	0.04	0.43	0.13	0.09	0.52	0.30	0.22	31	84	8.0	8.5
08/28/2002	CTB056A	4.8	27.3	7.4	73	1.2	0.02	0.35	0.08	0.03	0.38	0.27	0.11	24	60	4.0	4.6
08/28/2002	CTB058C	5.3	27.1	7.4	71	1.4	0.02	0.30	0.04	0.02	0.32	0.26	0.06	25	59	4.0	3.4
08/28/2002	CTB058D	5.4	27.0	7.5	68	1.8	0.02	0.29	0.03	<0.02	0.30	0.26	0.04	22	62	4.0	3.5
07/15/2002	CTB048A	7.6	27.1	7.1	70	0.8	0.03	0.63	0.08	0.16	0.79	0.55	0.24	26	68	12.0	7.2
07/15/2002	CTB056A	9.1	28.1	7.9	64	1.0	<0.02	0.31	<0.02	<0.02	0.32	0.30	0.02	16	59	3.0	3.4
07/15/2002	CTB058C	7.5	29.0	7.1	62	1.5	<0.02	0.29	<0.02	0.02	0.31	0.28	0.03	9	61	<3.3	3.2
07/15/2002	CTB058D	7.3	28.2	7.2	61.7	1.5	<0.02	0.29	<0.02	0.02	0.31	0.28	0.03	7	59	<2.5	3.1
05/29/2002	DS Rhodhiss Dam	6.5	24.0	8.2	69	1.1											
05/29/2002	At Hickory WTP Intake	11.2	24.7	9.1	63	1.2											
05/29/2002	CTB048A	11.1	24.6	9.0	61	1.2	0.04	0.33	<0.01	<0.01	0.34	0.33	0.01	29	94	4.0	5.0
05/29/2002	CTB056A	9.5	24.6	51.0	1.7	1.7	0.02	0.22	<0.01	<0.01	0.23	0.22	0.01	11	50	4.0	2.9
05/29/2002	CTB058C	9.5	24.5	8.4	49	1.7	<0.02	0.10	<0.01	<0.01	0.11	0.10	0.01	11	62	4.0	3.1
05/29/2002	CTB058D	9.4	24.7	9.0	51	1.8	0.02	0.20	<0.01	<0.01	0.21	0.20	0.01		56	4.0	2.7
08/12/1997	CTB048A	7.8	26.6	6.9	56	0.7	0.05	0.20	0.07	0.18	0.38	0.13	0.25		110	11.0	10.0
08/12/1997	CTB056A	8.9	27.5	7.8	49	1.5	0.02	0.10	0.04	0.03	0.13	0.06	0.07		70	3.0	2.5
08/12/1997	CTB058C	9.1	27.8	8.0	49	1.7	0.02	0.10	0.03	0.02	0.12	0.07	0.05		55	3.0	2.6
08/12/1997	CTB058D	8.9	28.0	7.9	46	1.7	0.02	0.20	0.03	0.04	0.24	0.17	0.07		71	2.0	2.2
07/08/1997	CTB048A	9.7	27.8	8.1	52	1.3	0.02	0.20	0.02	0.14	0.34	0.18	0.16		73	4.0	5.8
07/08/1997	CTB056A	9.1	28.3	7.6	47	1.6	<0.01	0.20	<0.01	0.05	0.25	0.20	0.06		55	2.0	3.2
07/08/1997	CTB058C	8.5	29.1	7.3	44	1.8	<0.01	0.10	0.01	0.08	0.18	0.09	0.09		63	3.0	3.1
07/08/1997	CTB058D	8.6	28.4	7.5	43	1.7	<0.01	0.40	<0.01	<0.01	0.41	0.40	0.01		57	3.0	2.7
06/10/1997	CTB048A	7.3	17.8	6.4	49	0.8	0.06	0.30	0.11	0.23	0.53	0.19	0.34		77	5.0	15.0
06/10/1997	CTB056A	9.2	19.5	6.7	46	1.2	0.03	0.10	<0.01	0.15	0.25	0.10	0.16		57	3.0	4.1
06/10/1997	CTB058C	8.6	19.4	6.5	46	1.8	0.02	0.20	0.01	0.15	0.35	0.19	0.16		56	3.0	5.1
06/10/1997	CTB058D	8.6	19.4	6.5	46	1.7	0.01	0.20	<0.01	0.14	0.34	0.20	0.15		50	2.0	3.7
Lookout Shoals Lake																	
08/07/2002	CTB0581F	7.1	28.1	7.0	63	1.0	0.02	0.24	0.02	0.02	0.26	0.24	0.04	5	50	<2.5	3.4
08/07/2002	CTB058F	8.1	28.4	7.2	61	1.8	<0.02	0.25	<0.02	<0.02	0.26	0.31	0.02	7	50	<5	3.1
08/07/2002	CTB058G	8.3	28.7	7.9	60	2.2	<0.02	0.24	<0.02	<0.02	0.26	0.31	0.02	7	50	<2.5	3.0
07/24/2002	CTB0581F	7.3	27.6	7.2	62	1.0	0.04	0.25	<0.02	0.03	0.28	0.24	0.04	5	55	<2.5	4.2
07/24/2002	CTB058F	7.9	28.7	7.3	60	1.2	0.03	0.32	<0.02	<0.02	0.33	0.31	0.02	8	47	2.0	3.6
07/24/2002	CTB058G	8.4	28.7	7.8	60	1.2	0.03	0.32	<0.02	<0.02	0.33	0.31	0.02	7	55	3.3	3.2
06/20/2002	CTB0581F	4.6	22.3	6.6	59	2.4	<0.02	<0.2	0.04	0.15	0.25	0.06	0.19	4	95	<2.5	2.9
06/20/2002	CTB058F	8.7	26.1	7.6	53	1.5	<0.02	<0.2	<0.01	0.03	0.13	0.10	0.04	10	50	4.0	3.9
06/20/2002	CTB058G	8.3	26.1	8.0	53	1.6	<0.02	<0.2	<0.01	0.02	0.12	0.10	0.03	7	53	3.0	4.3
08/18/1997	CTB0581F	8.3	30.9	7.2	48	1.0	0.02	0.20	<0.01	0.23	0.43	0.20	0.24		62	5.0	5.5
08/18/1997	CTB058F	8.5	30.7	7.4	47	1.5	0.01	0.20	<0.01	0.24	0.44	0.20	0.25		37	3.0	4.8
08/18/1997	CTB058G	9.0	30.3	8.2	46	2.0	<0.01	0.20	<0.01	0.16	0.36	0.20	0.17		40	1.0	2.2
07/07/1997	CTB0581F	5.6	25.2	6.1	54	1.5	0.02	0.30	0.06	0.30	0.60	0.24	0.36		66	4.0	5.8
07/07/1997	CTB058F	8.9	27.8	7.1	50	1.5	0.02	0.20	0.03	0.27	0.47	0.17	0.30		62	4.0	5.0
07/07/1997	CTB058G	8.9	27.5	7.2	50	1.5	0.02	0.20	<0.01	0.24	0.44	0.20	0.25		46	4.0	4.0
06/10/1997	CTB0581F	7.1	19.7	6.3	48	2.0	0.01	0.20	0.07	0.22	0.42	0.13	0.29		63	5.0	6.8
06/10/1997	CTB058F	7.9	20.3	6.4	47	2.0	0.02	0.30	0.05	0.22	0.52	0.25	0.27		56	3.0	5.1
06/10/1997	CTB058G	10.0	19.8	7.1	45	1.8	0.01	0.10	<0.01	0.17	0.27	0.10	0.18		56	3.0	3.8

Appendix 16 (continued).

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (µg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
Lake Norman																	
08/22/2002	CTB079A	8.8	30.1	8.2	69	1.2	<0.02	<0.2	0.02	0.01	0.11	0.08	0.03	7	53	2.0	2.6
08/22/2002	CTB82A	9.4	30.4	7.8	70	1.6	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	7	56	2.0	2.5
08/22/2002	CTB082B	7.5	30.9	7.7	71	2.1	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	9	56	3.0	3.2
08/22/2002	CTB082M	7.8	30.0	7.8	7.3	1.9	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	3	57	2.0	2.3
08/22/2002	CTB082Q	7.9	29.9	7.7	7.3	2.7	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	3	49	<2.0	2.1
08/22/2002	CTB082R	7.4	31.0	7.4	73	2.3	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	3	59	<2.0	1.9
08/22/2002	CTB082AA	7.7	31.9	8.1	73	2.3	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	6	65	2.0	2.4
08/22/2002	CTB082BB	7.1	32.9	7.6	73	2.0	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	4	54	<5.0	2.0
07/31/2002	CTB079A	8.7	31.4	8.4	65	2.5	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	7	50	3.0	3.2
07/31/2002	CTB82A	8.6	31.8	8.3	66	2.8	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	6	57	3.0	3.0
07/31/2002	CTB082B	7.9	31.3	7.9	67	1.4	<0.02	<0.2	<0.02	0.03	0.13	0.09	0.04	7	54	2.0	3.1
07/31/2002	CTB082M	7.9	31.2	7.9	68	2.4	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	4	57	2.0	2.6
07/31/2002	CTB082Q	7.5	31.2	7.9	69	3.1	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	3	54	<2.0	1.9
07/31/2002	CTB082R	7.6	32.2	7.8	69	3.2	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	3	53	<2.0	
07/31/2002	CTB082AA	7.4	33.1	7.8	69	3.0	<0.02	0.23	<0.02	<0.02	0.24	0.22	0.02	4	53	<5.0	2.3
07/31/2002	CTB082BB	6.9	32.9	7.5	69	2.4	<0.02	0.20	<0.02	<0.02	0.21	0.19	0.02	3	61	<2.0	1.7
06/06/2002	CTB079A	9.5	28.5	8.3	68	2.3	<0.02	<0.2	<0.01	0.02	0.12	0.10	0.03	4	46	2.5	2.1
06/06/2002	CTB82A	8.8	28.5	8.2	72	1.8	<0.02	<0.2	<0.01	0.08	0.18	0.10	0.09	4	48	3.0	2.3
06/06/2002	CTB082B	7.3	28.5	7.1	71	1.5	<0.02	<0.2	0.08	0.14	0.24	0.02	0.22	4	48	<3.3	2.7
06/06/2002	CTB082M	8.2	28.6	7.6	71	1.4	<0.02	<0.2	<0.01	0.08	0.18	0.10	0.09	3	47	<2.5	1.6
06/06/2002	CTB082Q	8.2	27.4	7.4	72	3.6	<0.02	<0.2	<0.01	0.06	0.16	0.10	0.07	1	47	<2.5	1.5
06/06/2002	CTB082R	8.2	27.9	7.4	72	3.4	<0.02	<0.2	<0.01	0.07	0.17	0.10	0.08	2	55	<2.5	1.4
06/06/2002	CTB082AA	7.8	28.9	7.3	73	1.9	<0.02	<0.2	<0.01	0.06	0.16	0.10	0.07	1	57	<2.5	1.7
06/06/2002	CTB082BB	8.3	26.8	7.7	72	3.4	<0.02	<0.2	<0.01	0.07	0.17	0.10	0.08	2	52	<2.5	1.3
08/13/1997	CTB079A	8.6	29.7	8.2	54	1.4	0.01	0.20	<0.01	0.13	0.33	0.20	0.14		56	10.0	8.3
08/13/1997	CTB082AA	6.9	30.9	6.8	54	2.7	<0.01	0.10	<0.01	0.02	0.12	0.10	0.03		40	2.0	1.9
08/13/1997	CTB082B	4.6	29.6	6.2	57	1.3	0.01	0.20	0.04	0.12	0.32	0.16	0.16		47	4.0	3.4
08/13/1997	CTB082BB	7.2	29.1	6.7	54	2.6	<0.01	0.10	<0.01	0.04	0.14	0.10	0.05		56	3.0	1.4
08/13/1997	CTB082M	7.8	29.2	7.5	53	2.4	<0.01	0.10	<0.01	<0.01	0.11	0.10	0.01		42	3.0	1.7
08/13/1997	CTB082Q	7.0	28.8	6.8	54	3.0	<0.01	0.10	<0.01	0.02	0.12	0.10	0.03		39	5.0	1.7
08/13/1997	CTB082R	7.0	28.8	6.8	54	3.0	<0.01	0.10	<0.01	<0.01	0.11	0.10	0.01		37	4.0	1.6
08/13/1997	CTB82A	7.8	29.1	7.2	54	1.5	<0.01	0.20	<0.01	0.02	0.22	0.20	0.03		43	2.0	2.0
07/09/1997	CTB079A	8.3	28.7	7.5	51	1.5	0.03	0.20	<0.01	0.13	0.33	0.20	0.14		51	7.0	6.6
07/09/1997	CTB082AA	7.0	30.9	6.8	53	2.7	0.02	0.10	<0.01	0.16	0.26	0.10	0.17		32	1.0	2.3
07/09/1997	CTB082B	7.5	28.9	6.8	52	1.4	0.01	0.10	<0.01	0.07	0.17	0.10	0.08		39	5.0	2.9
07/09/1997	CTB082BB	7.3	29.4	6.7	53	2.6	0.01	0.20	<0.01	0.13	0.33	0.20	0.14		31	5.0	2.3
07/09/1997	CTB082M	8.2	29.0	7.8	51	1.5	<0.01	0.10	<0.01	<0.01	0.11	0.10	0.01		40	5.0	3.2
07/09/1997	CTB082Q	7.5	29.2	7.0	53	2.3	0.01	0.10	<0.01	0.12	0.22	0.10	0.13		31	5.0	2.2
07/09/1997	CTB082R	7.6	29.1	7.2	53	2.3	0.02	0.20	<0.01	0.10	0.30	0.20	0.11		36	3.0	2.4
07/09/1997	CTB82A	8.0	29.3	8.1	52	1.6	0.02	0.20	<0.01	<0.01	0.21	0.20	0.01		29	5.0	2.9
06/11/1997	CTB079A	9.3	21.1	7.0	53	1.3	0.03	0.20	<0.01	0.21	0.41	0.20	0.22		40	4.0	4.8
06/11/1997	CTB082AA	8.1	24.5	6.8	58	2.8	<0.01	0.20	<0.01	0.22	0.42	0.20	0.23		27	1.0	2.2
06/11/1997	CTB082B	9.5	21.9	8.0	53	1.6	<0.01	0.20	<0.01	0.04	0.24	0.20	0.05		28	4.0	2.9
06/11/1997	CTB082BB	7.9	24.3	6.6	58	2.7	<0.01	0.20	<0.01	0.21	0.41	0.20	0.22		33	<1.0	1.9
06/11/1997	CTB082M	9.1	21.8	7.9	53	1.4	0.01	0.20	<0.01	0.03	0.23	0.20	0.04		29	8.0	2.5
06/11/1997	CTB082Q	8.2	22.8	6.9	57	2.7	<0.01	0.20	<0.01	0.14	0.34	0.20	0.15		30	3.0	2.5
06/11/1997	CTB082R	7.9	23.4	6.8	57	2.7	0.01	0.30	<0.01	0.14	0.44	0.30	0.15		34	3.0	2.7
06/11/1997	CTB82A	9.6	21.8	8.2	54	1.3	0.01	0.20	<0.01	0.04	0.24	0.20	0.05		26	5.0	3.4

Appendix 16 (continued).

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (µg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
08-03-33																	
Mountain Island Lake																	
08/07/2002	CTB083B	7.6	31.0	7.6	77	1.0	<0.02	<0.2	<0.02	0.03	0.13	0.09	0.04	5	70	4.0	5.4
08/07/2002	CTB086A	7.7	31.3	7.7	75	1.4	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	6	62	3.0	5.5
08/07/2002	CTB086B	7.2	31.5	7.4	71	2.0	<0.02	0.20	0.02	<0.02	0.21	0.18	0.03	4	61	2.5	3.4
08/07/2002	CTB086C	7.4	31.2	7.4	70	2.0	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	3	63	<2.5	4.3
08/07/2002	CTB087	7.1	32.3	7.2	70	2.2	<0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	3	58	7.0	2.4
08/07/2002	CTB087A	7.1	32.2	7.4	70	2.2	<0.02	0.23	0.06	0.04	0.27	0.17	0.10	4	55	<2.5	2.2
07/24/2002	CTB083B	6.6	29.6	7.8	76	0.5	0.02	0.22	<0.02	<0.02	0.23	0.21	0.02	3	64	8.0	4.1
07/24/2002	CTB086A	7.2	30.2	7.7	77	1.1	0.03	0.23	<0.02	<0.02	0.24	0.22	0.02	3	66	7.0	5.0
07/24/2002	CTB086B	7.2	31.7	7.6	74	1.9	0.02	0.10	<0.02	<0.02	0.11	0.09	0.02	2	57	3.0	2.7
07/24/2002	CTB086C	7.1	31.4	7.6	74	1.9	0.02	0.21	<0.02	<0.02	0.22	0.20	0.02	3	72	3.0	3.0
07/24/2002	CTB087	6.8	33.7	7.1	73	2.1	0.02	0.10	<0.02	<0.02	0.11	0.09	0.02	3	50	2.0	2.2
07/24/2002	CTB087A	7.0	31.7	7.3	74	2.3	0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	4	57	2.0	2.3
06/20/2002	CTB083B	7.6	27.5	7.3	73	1.8	<0.02	<0.2	<0.01	0.04	0.14	0.01	0.05	2	62	<2.5	3.5
06/20/2002	CTB086A	8.1	28.1	7.8	78	1.2	<0.02	<0.2	<0.01	0.07	0.17	0.01	0.08	5	62	5.0	7.4
06/20/2002	CTB086B	7.5	28.1	7.5	72	1.4	<0.02	<0.2	<0.01	0.04	0.14	0.01	0.05	3	53	<2.5	3.9
06/20/2002	CTB086C	7.4	28.5	7.4	73	1.8	<0.02	<0.2	<0.01	0.03	0.13	0.01	0.04	4	64	<2.5	4.0
06/20/2002	CTB087	7.7	30.7	6.9	70	1.7	<0.02	<0.2	<0.01	0.05	0.15	0.01	0.06	3	59	3.0	3.6
06/20/2002	CTB087A	7.9	29.4	7.4	70	2.0	<0.02	<0.2	<0.01	0.05	0.15	0.01	0.06	2	58	<2.5	3.1
08/18/1997	CTB083B	6.7	30.0	6.5	49	2.2	<0.01	0.10	<0.01	0.09	0.19	0.10	0.10		54	1.0	2.0
08/18/1997	CTB086A	8.6	30.8	7.7	74	0.7	0.05	0.20	<0.01	0.42	0.62	0.20	0.43		57	6.0	5.6
08/18/1997	CTB086B	6.8	31.7	6.5	48	2.0	<0.01	0.10	<0.01	0.10	0.20	0.10	0.11		45	3.0	3.0
08/18/1997	CTB086C	6.9	31.6	6.5	48	1.7	<0.01	0.10	<0.01	0.06	0.16	0.10	0.07		35	3.0	4.1
08/18/1997	CTB087	6.0	34.2	6.4	49	2.1	<0.01	0.10	<0.01	0.09	0.19	0.10	0.10		44	3.0	2.0
08/18/1997	CTB087A	7.5	30.5	6.9	48	2.2	<0.01	0.20	<0.01	0.08	0.28	0.20	0.09		39	1.0	1.7
07/10/1997	CTB083B	6.4	26.1	6.3	54	2.0	0.01	0.20	0.04	0.17	0.37	0.16	0.21		29	<1.0	2.4
07/10/1997	CTB086A	6.8	27.4	6.5	70	0.8	0.04	0.20	<0.01	0.54	0.74	0.20	0.55		61	7.0	9.5
07/10/1997	CTB086B	7.1	29.2	6.5	54	1.6	<0.01	0.20	0.01	0.18	0.38	0.19	0.19		42	<1.0	3.3
07/10/1997	CTB086C	7.0	29.1	6.5	54	1.8	<0.01	0.20	0.01	0.17	0.37	0.19	0.18		35	1.0	4.2
07/10/1997	CTB087	6.8	29.7	6.4	54	1.7	<0.01	0.20	0.02	0.18	0.38	0.18	0.20		41	1.0	3.5
07/10/1997	CTB087A	7.4	29.3	6.5	54	2.2	<0.01	0.10	0.01	0.18	0.28	0.09	0.19		39	<1.0	2.9
06/12/1997	CTB083B	7.2	21.0	6.3	54	2.6	<0.01	0.20	<0.01	0.22	0.42	0.20	0.23	<1	38	3.0	3.2
06/12/1997	CTB086A	9.0	23.0	7.0	71	1.2	<0.01	0.20	<0.01	0.55	0.75	0.20	0.56		48	6.0	8.6
06/12/1997	CTB086B	7.7	22.3	6.4	56	1.8	0.01	0.10	<0.01	0.25	0.35	0.10	0.26		42	3.0	5.1
06/12/1997	CTB086C	8.2	22.6	6.5	56	2.0	<0.01	0.10	<0.01	0.26	0.36	0.10	0.27		45	3.0	5.7
06/12/1997	CTB087	8.2	22.6	6.5	57	2.0	<0.01	0.10	0.03	0.27	0.37	0.07	0.30		46	3.0	6.0
06/12/1997	CTB087A	8.2	22.6	6.5	57	2.6	0.01	0.10	<0.01	0.29	0.39	0.10	0.30		42	2.0	3.7
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08/06/2002	CTB103	7.2	30.5	7.3	89	0.4	0.03	0.21	<0.02	0.02	0.23	0.20	0.03	10	78	5.0	7.9
08/06/2002	CTB105B	7.3	31.1	7.3	107	1.1	0.02	0.23	<0.02	<0.02	0.24	0.22	0.02	12	94	4.0	4.9
08/06/2002	CTB174	6.6	35.2	7.4	109	1.2	0.04	0.28	0.02	<0.02	0.29	0.26	0.03	18	100	6.0	6.5
08/06/2002	CTB177	8.2	32.2	7.9	112	1.0	0.03	0.26	<0.02	<0.02	0.27	0.25	0.02	21	100	4.0	4.6
08/06/2002	CTB178	8.2	31.6	7.6	112	1.4	0.02	0.26	<0.02	<0.02	0.27	0.25	0.02	14	67	3.0	3.0
08/06/2002	CTB198B5	8.9	31.4	8.6	260	0.6	0.07	0.42	0.02	<0.02	0.43	0.40	0.03	28	170	10.0	13.0
08/06/2002	CTB198C5	8.9	31.8	8.5	147	1.3	0.05	0.29	<0.02	<0.02	0.30	0.28	0.02	17	88	5.0	4.0
08/06/2002	CTB198D	8.7	31.8	8.6	121	1.7	0.04	0.31	0.02	<0.02	0.32	0.29	0.03	13	68	<5.0	2.5
07/23/2002	CTB103	7.1	30.4	7.5	85	1.1	0.06	0.31	<0.02	0.03	0.34	0.30	0.04	10	62	6.0	7.0
07/23/2002	CTB105B	7.7	31.0	7.8	104	1.2	0.04	0.43	<0.02	<0.02	0.44	0.42	0.02	13	74	4.0	3.5
07/23/2002	CTB174	6.9	35.8	7.4	109	1.0	0.05	0.43	<0.02	0.02	0.45	0.42	0.03	16	78	6.0	6.9
07/23/2002	CTB177	7.7	31.9	7.8	110	1.3	0.04	0.46	<0.02	<0.02	0.47	0.45	0.02	22	75	5.0	4.5

Appendix 16 (continued).

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (µg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
07/23/2002	CTB178	7.9	31.1	8.3	114	1.8	0.04	0.35	<0.02	<0.02	0.36	0.34	0.02	9	69	<3.3	2.6
07/23/2002	CTB198B5	8.9	31.5	8.5	169	0.4	0.05	0.62	<0.02	<0.02	0.63	0.61	0.02	24	110	9.0	11.0
07/23/2002	CTB198C5	9.0	31.7	8.6	148	1.1	0.04	0.58	<0.02	<0.02	0.59	0.57	0.02	19	100	4.0	3.7
07/23/2002	CTB198D	8.8	30.7	8.6	127	1.5	0.03	0.36	<0.02	<0.02	0.37	0.35	0.02	10	63	2.0	2.2
06/19/2002	CTB103	7.8	28.1	7.9	85	0.8	0.03	<0.2	<0.01	0.06	0.16	0.10	0.07	10	100	9.0	13.0
06/19/2002	CTB105B	8.2	28.2	8.7	112	1.5	<0.02	<0.2	<0.01	<0.01	0.11	0.10	0.01	17	140	5.0	7.7
06/19/2002	CTB174	7.9	32.3	8.0	120	0.9	0.02	<0.2	0.01	0.04	0.14	0.09	0.05	18	120	5.0	8.6
06/19/2002	CTB177	9.0	29.7	8.4	121	1.1	0.02	0.25	<0.01	<0.01	0.26	0.25	0.01	23	120	4.0	6.1
06/19/2002	CTB178	8.3	28.5	8.4	122	1.8	<0.02	<0.2	<0.01	<0.01	0.11	0.10	0.01	16	130	3.0	3.1
06/19/2002	CTB198B5	10.4	29.8	9.1	194	0.7	0.04	0.24	<0.01	<0.01	0.25	0.24	0.01	52	180	22.0	13.0
06/19/2002	CTB198C5	9.3	28.7	8.8	143	1.2	<0.02	<0.2	<0.01	<0.01	0.21	0.20	0.01	16	140	4.0	4.3
06/19/2002	CTB198D	9.2	28.5	8.4	125	1.3	<0.02	0.24		<0.01	0.25			15	150	4.0	4.0
09/12/2001	CTB103	7.2	27.4	7.1	81	1.0	0.07	0.35	0.02	0.08	0.43	0.33	0.10	4	86	6.0	5.0
09/12/2001	CTB105B	7.8	27.6	7.2	99	1.0	0.04	0.27	<0.01	<0.01	0.28	0.27	0.01	10	88	6.0	4.2
09/12/2001	CTB174	7.7	32.0	7.3	107	0.8	0.06	0.49	0.04	0.06	0.55	0.45	0.10	11	91	4.0	3.5
09/12/2001	CTB177	8.5	28.3	7.5	105	0.5	0.05	0.39	<0.01	<0.01	0.40	0.39	0.01	13	97	8.0	5.8
09/12/2001	CTB178	7.7	28.1	7.2	106	1.4	0.02	0.33	<0.01	<0.01	0.34	0.33	0.01	12	84	3.0	1.8
09/12/2001	CTB198B5	9.9	27.6	8.4	148	0.6	0.08	0.64	<0.01	0.02	0.66	0.64	0.03	22	120	8.0	4.8
09/12/2001	CTB198C5	8.7	28.1	7.8	121	2.4	0.02	0.31	<0.01	<0.01	0.32	0.31	0.01	11	93	4.0	1.8
09/12/2001	CTB198D	8.2	27.6	7.4	102	2.7	0.07	0.10	<0.01	<0.01	0.11	0.10	0.01	7	81	1.5	1.1
09/12/2001	CTBLW25	8.0	27.7	7.3	101	1.9	0.02	0.28	<0.01	<0.01	0.29	0.28	0.01	6	87	3.0	1.2
08/28/2001	CTB103	7.9	29.6	7.6	83	0.7	0.06	0.29	<0.01	0.01	0.30	0.29	0.02	8		6.0	4.7
08/28/2001	CTB105B	8.8	30.9	8.4	102	1.3	0.03	0.36	0.08	<0.01	0.37	0.28	0.09	8	86	4.0	1.9
08/28/2001	CTB174	7.6	34.7	7.6	105	1.1	0.04	0.40	0.21	<0.01	0.41	0.19	0.22	13	89	4.0	2.7
08/28/2001	CTB177	8.7	30.2	8.3	102	1.2	0.04	0.40	0.01	<0.01	0.41	0.39	0.02		95	5.0	3.5
08/28/2001	CTB178	8.6	30.3	8.3	101	1.4	0.02	0.30	0.01	<0.01	0.31	0.29	0.02		86	3.0	1.6
08/28/2001	CTB198B5	9.6	29.9	8.4	164	0.8	0.07	0.70	0.02	<0.01	0.71	0.68	0.03		160	10.0	7.0
08/28/2001	CTB198C5	7.5	29.1	7.6	120	1.0	0.02	0.32	<0.01	<0.01	0.33	0.32	0.01		100	3.0	2.0
08/28/2001	CTB198D	8.5	29.3	8.0	104	0.9	0.02	0.28	0.02	<0.01	0.29	0.26	0.03		89	1.5	1.4
08/28/2001	CTBLW25	8.6	29.5	8.2	100	1.8	0.03	0.27	0.01	<0.01	0.28	0.26	0.02	8		2.0	1.4
08/15/2001	CTB103	7.4	29.7	7.5	87	1.2	0.08	0.37	<0.01	0.07	0.44	0.37	0.08	6	70	5.0	4.4
08/15/2001	CTB105B	7.5	30.9	7.5	93	1.2	0.04	0.38	<0.01	<0.01	0.39	0.38	0.01	13	70	5.0	3.9
08/15/2001	CTB174	7.2	35.3	7.6	99	1.3	0.06	0.36	0.05	0.04	0.40	0.31	0.09	11	73	4.0	3.3
08/15/2001	CTB177	8.1	30.7	8.4	98	1.2	0.06	0.39	0.01	<0.01	0.40	0.38	0.02	21	69	4.0	3.8
08/15/2001	CTB178	8.4	31.0	8.0	96	1.4	0.04	0.35	<0.01	<0.01	0.36	0.35	0.01	14	69	4.0	2.2
08/15/2001	CTB198B5	11.5	29.8	8.7	208	0.4	0.13	0.94	<0.01	0.04	0.98	0.94	0.05	61	170	14.0	14.0
08/15/2001	CTB198C5	8.0	29.6	7.6	117	1.2	0.04	0.55	0.12	<0.01	0.56	0.43	0.13	17	92	7.0	4.2
08/15/2001	CTB198D	8.6	30.0	8.2	105	1.7	0.02	0.42	<0.01	<0.01	0.43	0.42	0.01	9	73	2.5	1.2
08/15/2001	CTBLW25	8.7	30.5	8.2	99	1.5	0.03	0.34	<0.01	<0.01	0.35	0.34	0.01	18	71	4.0	2.0
07/18/2001	CTB103	7.5	29.9	7.7	92	1.2								10	58	5.0	5.0
07/18/2001	CTB105B	7.9	29.1	7.5	80	1.2	0.04	0.36	0.02	<0.01	0.37	0.34	0.03	16	78	4.0	4.0
07/18/2001	CTB174	7.6	34.1	7.9	93	0.9	0.06	0.44	0.08	0.06	0.50	0.36	0.14	19	77	5.0	4.8
07/18/2001	CTB177	8.7	30.1	8.8	100	0.8	0.06	0.50	0.14	<0.01	0.51	0.36	0.15	24	76	5.0	3.8
07/18/2001	CTB178	7.2	29.5	7.5	98	1.7	0.02	0.37	0.06	<0.01	0.38	0.31	0.07	14	75	2.0	1.6
07/18/2001	CTB198B5	10.5	30.1	8.9	136	0.7	0.10	0.72	0.03	<0.01	0.73	0.69	0.04		110	8.0	5.5
07/18/2001	CTB198C5	8.8	30.4	8.6	115	0.7	0.04	0.78	0.07	<0.01	0.79	0.71	0.08	19	99	7.0	5.9
07/18/2001	CTB198D	8.8	29.7	8.6	103	1.6	0.03	0.49	0.14	<0.01	0.50	0.35	0.15	12	90	2.0	1.6
07/18/2001	CTBLW25	7.6	29.0	7.7	101	1.8	0.02	0.30	0.02	<0.01	0.31	0.28	0.03	11	76	1.5	1.5
09/15/1997	CTB103	8.5	27.6	7.4	98	0.6	0.07	0.20	<0.01	0.05	0.25	0.20	0.06		60	9.0	7.0
09/15/1997	CTB105B	7.7	27.4	7.2	124	1.0	0.03	0.20	<0.01	0.03	0.23	0.20	0.04		80	7.0	4.8
09/15/1997	CTB174	7.6	30.8	7.3	144	1.0	0.05	0.20	<0.01	0.16	0.36	0.20	0.17		100	4.0	4.5
09/15/1997	CTB177	9.1	28.3	8.1	135	1.0	0.04	0.20	<0.01	0.01	0.21	0.20	0.02		90	3.0	3.0

Appendix 16 (continued).

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/L)	Water temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/L)	TKN (mg/L)	NH_3 (mg/L)	NO_x (mg/L)	TN (mg/L)	TON (mg/L)	TIN (mg/L)	CHL *a* (µg/L)	Total Solids (mg/L)	Susp. Solids (mg/L)	Turbidity (NTU)
09/15/1997	CTB178	7.5	27.6	7.2	129	1.1	0.03	0.20	<0.01	0.08	0.28	0.20	0.09		80	4.0	3.3
09/15/1997	CTB198B5	11.8	27.3	8.8	184	0.5	0.14	0.40	<0.01	0.56	0.96	0.40	0.57		150	15.0	8.6
09/15/1997	CTB198C5	10.0	27.8	8.5	123	1.1	0.04	0.20	<0.01	<0.01	0.21	0.20	0.01		94	4.0	2.7
09/15/1997	CTB198D	8.4	27.4	7.7	108	1.6	0.02	0.20	<0.01	0.07	0.27	0.20	0.08		72	3.0	1.8
08/27/1997	CTB103	9.0	28.1	7.5	100	0.9	0.05	0.10	<0.01	0.07	0.17	0.10	0.08		70	8.0	5.3
08/27/1997	CTB105B	9.0	29.7	8.0	110	0.9	0.02	0.10	<0.01	0.05	0.15	0.10	0.06		89	5.0	
08/27/1997	CTB174	8.2	32.3	7.4	122	1.0	0.04	0.20	<0.01	0.11	0.31	0.20	0.12			6.0	3.6
08/27/1997	CTB177	8.1	29.6	7.2	123	1.0	0.04	0.10	<0.01	0.14	0.24	0.10	0.15		84	6.0	2.9
08/27/1997	CTB178	7.4	28.7	7.0	109	1.5	0.02	0.20	<0.01	0.08	0.28	0.20	0.09		73	4.0	2.1
08/27/1997	CTB198B5	10.9	29.4	8.6	144	0.8	0.10	0.80	0.37	0.84	1.64	0.43	1.21		140	8.0	4.9
08/27/1997	CTB198C5	9.8	29.5	8.3	110	1.3	<0.01	0.40	0.02	0.04	0.44	0.38	0.06		84	6.0	3.3
08/27/1997	CTB198D	8.9	29.1	7.8	102	1.5	0.02	0.10	<0.01	0.07	0.17	0.10	0.08		76	24.0	17.0
08/12/1997	CTB103	8.7	30.5	7.5	90	0.9	0.03	0.20	<0.01	0.08	0.28	0.20	0.09		110	24.0	12.0
08/12/1997	CTB105B	8.8	29.6	7.7	102	1.0	0.07	0.30	<0.01	0.03	0.33	0.30	0.04		92	32.0	25.0
08/12/1997	CTB174	8.9	33.2	7.9	114	0.8	0.07	0.20	<0.01	0.06	0.26	0.20	0.07		120	45.0	15.0
08/12/1997	CTB177	9.7	31.0	8.3	113	1.0	0.08	0.30	0.01	0.06	0.36	0.29	0.07		130	44.0	29.0
08/12/1997	CTB178	8.1	29.6	7.2	106	1.4	0.02	0.20	<0.01	0.16	0.36	0.20	0.17		69	3.0	3.0
08/12/1997	CTB198B5	10.7	30.4	8.2	146	0.7	0.07	0.40	0.02	0.42	0.82	0.38	0.44		130	9.0	6.3
08/12/1997	CTB198C5	8.5	28.8	7.6	108	1.1	0.04	0.30	<0.01	0.04	0.34	0.30	0.05		79	6.0	3.5
08/12/1997	CTB198D	8.5	29.8	7.3	98	1.6	0.01	0.20	<0.01	0.12	0.32	0.20	0.13		63	4.0	2.1
06/30/1997	CTB103	7.2	27.2	7.0	71	0.5	0.04	0.10	<0.01	0.21	0.31	0.10	0.22		71	12.0	18.0
06/30/1997	CTB105B	10.3	28.9	8.3	81	0.8	0.05	0.20	<0.01	0.05	0.25	0.20	0.06		77	8.0	6.9
06/30/1997	CTB174	7.0	32.0	7.1	91	0.6	0.07	0.30	<0.01	0.30	0.60	0.30	0.31		100	8.0	11.0
06/30/1997	CTB177	8.3	31.5	7.5	95	0.6	0.07	0.20	<0.01	0.27	0.47	0.20	0.28		83	7.0	14.0
06/30/1997	CTB178	7.8	28.6	7.2	89	0.9	0.05	0.20	<0.01	0.20	0.40	0.20	0.21		77	6.0	6.7
06/30/1997	CTB198D	9.8	28.3	8.3	94	1.0	0.03	0.10	<0.01	0.06	0.16	0.10	0.07		89	5.0	3.2
08-03-35																	
Newton City Lake																	
08/19/2002	CTBNCL1	7.4	30.3	7.0	40	1.1	<0.02	0.22	0.05	0.15	0.37	0.17	0.20	4	50	<3.3	11.0
07/08/2002	CTBNCL1	8.7	29.9	7.5	40	0.8	0.02	<0.2	<0.02	0.19	0.29	0.09	0.20	4	74	4.0	17.0
06/10/2002	CTBNCL1	6.8	28.6	7.0	37	1.4	<0.02	<0.2	0.06	0.21	0.31	0.04	0.27	<1	41	3.0	9.4
08/12/1992	CTBNCL1	7.9	27.4	7.5	43	1.8	<0.01	0.30	0.04	1.00	1.30	0.26	1.04	3	46	5.0	2.4
08-03-36																	
Bessemer City Lake																	
08/19/2002	CTBBCL1	7.2	29.0	7.6	90	2.4	<0.02	0.30	<0.02	<0.02	0.31	0.29	0.02	5	71	2.0	2.6
07/08/2002	CTBBCL1	7.9	29.4	8.0	89	3.0	<0.02	<0.2	<0.02	<0.02	0.11	0.09	0.02	17	80	3.0	5.3
06/10/2002	CTBBCL1	7.8	28.3	7.8	83	2.4	<0.02	<0.2	<0.01	<0.01	0.11	0.10	0.01	2	64	<2.5	2.2
08/11/1992	CTBBCL1	8.2	28.1	7.8	82	2.4	0.01	0.30	0.04	<0.01	0.31	0.26	0.05	4	63	1.0	3.0

[1]Abbreviations are TP = total phosphorus, TKN = total Kjeldahl nitrogen, NH_3 = ammonia nitrogen, NO_x = nitrate + nitrite nitrogen, TON = total organic nitrogen, TIN = total inorganic nitrogen, and Chl *a* = chlorophyll *a*.

Appendix 17. Ambient water quality summaries for the Catawba River basin, September 1997 – August 2002.

Subbasin Station Number	Location	County	Class
03-08-30			
C0145000	Catawba R at SR 1234 near Greenlee	McDowell	C
C0250000	Catawba R at SR 1221 near Pleasant Gardens	McDowell	C
C0550000	N Fork Catawba R at SR 1552 near Hankins	McDowell	C
C1000000	Linville R at NC 126 near Nebo	Burke	B HQW
C1210000	Catawba R at SR 1147 near Glen Alpine Marion	Burke	WS-IV
03-08-31			
C1370000	Wilson Cr at US 221 near Gragg	Avery	B Tr ORW
C1750000	Lower Cr at SR 1501 near Morganton Marion	Burke	WS-IV
C2030000	Lake Rhodhiss at SR 1001 near Baton Marion	Burke	WS-IV & B CA
03-08-32			
C2600000	Lake Hickory at NC 127 near Hickory	Catawba	WS-V&B
C2818000	Lower Little R at SR 1313 near All Healing Springs	Alexander	C
C3420000	Lake Norman at SR 1004 near Mooresville	Iredell	WS-IV&B CA
03-08-33			
C3699000	Mountain Island Lake Above Gar Cr near Croft	Gaston	WS-IV&B CA
C3860000	Dutchmans Cr at SR 1918 at Mountain Island	Gaston	WS-IV
C3900000	Catawba R at NC 27 near Thrift	Mecklenburg	WS-IV CA
03-08-34			
C4040000	Long Cr at SR 2042 near Paw Creek	Gaston	WS-IV
C4220000	Catawba R at powerline crossing at S Belmont	Mecklenburg	WS-IV&B CA
C7500000	Lake Wylie at NC 49 near Oak Grove	Mecklenburg	WS-V&B
C8896500	Irwin Cr at Irwin Cr WWTP near Charlotte	Mecklenburg	C
C9050000	Sugar Cr at NC 51 at Pineville	Mecklenburg	C
C9210000	Little Sugar Cr at NC 51 at Pineville	Mecklenburg	C
C9370000	McAlpine Cr at SR 3356 Sardis Rd near Charlotte	Mecklenburg	C
C9680000	McAlpine Cr at SC SR 2964 near Camp Cox SC	Lancaster	FW
C9790000	Sugar Cr at SC 160 near Fort Mill SC	Mecklenburg	FW
03-08-35			
C4300000	Henry Fork R at SR 1124 near Henry River	Catawba	C
C4360000	Henry Fork R at SR 1143 near Brookford	Catawba	C
C4370000	Jacob Fork at SR 1924 at Ramsey	Burke	WS-III ORW
C4380000	S Fork Catawba R at NC 10 near Startown	Catawba	WS-IV
C4800000	Clark Cr at SR 1008 Grove St at Lincolnton	Lincoln	WS-IV
C5170000	Indian Cr at SR 1252 near Laboratory	Lincoln	WS-IV
03-08-36			
C5900000	Long Cr at SR 1456 near Bessemer City	Gaston	C
C6500000	S Fork Catawba R at NC 7 at Mcadenville	Gaston	WS-V
C7000000	S Fork Catawba R at SR 2524 near South Belmont	Gaston	WS-V&B
03-08-37			
C7400000	Catawba Cr at SR 2302 at SC State Line	Gaston	C
C8660000	Crowders Cr at SC 564, near Bowling Green, SC	York	FW
03-08-38			
C9819500	Twelve Mile Cr at NC 16 near Waxhaw	Union	C

Location:	Catawba R at SR 1234 near Greenlee			**Station:**	C0145000
Classification:	C			**Subbasin:**	CTB30
Period:	9/11/1997	to	8/14/2002		

Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**< or > Eval. Level N**	**%**	**Percentiles Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	57	0	<4	0	0.0	7.4	8.9	9.8	11.4	12.5	13.6	17.2
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	57	na	.	.	.	14	47	55	80	105	172	308
Temperature (°C)	56	na	.	.	.	1	5	7	13	18	21	24
pH (s.u.)	56	na	<6	0	0.0	6.0	6.6	6.8	7.1	7.3	7.5	7.7
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	.	.	.	.	.	.	.
TSS	39	13	>10	2	5.1	1	1	1	2	3	6	16
			>20	0	0.0							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	1	>50	1	1.7	1	1	2	2	4	4	140
			>25	1	1.7	.	.	.	.	.	.	.
			>10	3	5.2	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	45	22	.	.	.	0.01	0.01	0.01	0.01	0.03	0.07	0.20
TKN as N	44	7	.	.	.	0.01	0.10	0.10	0.10	0.20	0.30	0.60
NO_2+NO_3 as N	44	1	>10	0	0.0	0.01	0.09	0.12	0.18	0.24	0.32	0.71
Total Phosphorus	45	2	>0.05	23	51.1	0.01	0.02	0.04	0.06	0.08	0.11	0.18
Metals (µg/L)												
Aluminum (Al)	42	10	.	.	.	50	50	51	85	118	185	650
Arsenic (As)	42	42	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	42	42	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	42	42	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	42	24	>7	6	14.3	2	2	2	2	3	8	19
Iron (Fe)	42	0	>1000	1	2.4	85	99	123	190	220	295	1100
Lead (Pb)	42	39	>25	1	2.4	10	10	10	10	10	10	28
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	42	42	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	42	42	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	42	24	>50	2	4.8	10	10	10	10	15	34	560

Bacteria (#/100 ml)

Fecal coliform 58 N>200= 10 N>400= 5 %>400= 8.6 Geometric mean= 25.3

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location: Catawba R at SR 1221 near Pleasant Gardens **Station:** C0250000
Classification: C **Subbasin:** CTB30
Period: 9/11/1997 to 8/14/2002

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	< or > Eval. Level %	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	57	0	<4	0	0.0	7.6	8.6	9.3	10.8	12.2	13.4	16.1
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	57	na	.	.	.	29	49	52	63	71	100	135
Temperature (°C)	57	na	.	.	.	1	5	7	14	19	22	25
pH (s.u.)	57	na	<6	0	0.0	6.4	6.8	7.0	7.2	7.3	7.4	7.5
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	. .		.	.	.	.	.
TSS	40	9	>10	4	10.0	1	1	2	4	6	10	26
			>20	1	2.5							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	57	0	>50	1	1.8	1	2	3	4	7	14	120
			>25	5	8.8	.	.	.	.	.	.	.
			>10	7	12.3	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	45	13	.	.	.	0.01	0.01	0.01	0.02	0.06	0.08	0.22
TKN as N	44	4	.	.	.	0.10	0.10	0.10	0.20	0.20	0.37	0.60
NO_2+NO_3 as N	44	1	>10	0	0.0	0.01	0.12	0.16	0.21	0.26	0.30	0.40
Total Phosphorus	45	4	>0.05	9	20.0	0.01	0.01	0.02	0.04	0.05	0.06	0.10
Metals (µg/L)												
Aluminum (Al)	42	2	.	.	.	50	63	100	205	420	489	1500
Arsenic (As)	42	42	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	42	42	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	42	42	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	42	27	>7	3	7.1	2	2	2	2	3	7	14
Iron (Fe)	42	0	>1000	2	4.8	170	210	245	380	560	639	1600
Lead (Pb)	42	35	>25	1	2.4	10	10	10	10	10	12	42
Manganese (Mn)	1	0	.	.	.	24	24	24	24	24	24	24
Mercury (Hg)	42	42	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	42	38	>88	0	0.0	10	10	10	10	10	10	44
Zinc (Zn)	42	28	>50	1	2.4	10	10	10	10	13	25	59

Bacteria (#/100 ml)

Fecal coliform	57	N>200= 10	N>400= 4	%>400= 7.0	Geometric mean= 26.7

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	N Fork Catawba R at SR 1552 near Hankins	Station:	C0550000
Classification:	C	Subbasin:	CTB30
Period:	9/11/1997 to 8/14/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	< or > Eval. Level %	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	56	0	<4	0	0.0	6.7	9.2	9.9	11.5	12.8	13.8	14.9
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	56	na	.	.	.	43	73	85	107	143	167	229
Temperature (°C)	56	na	.	.	.	3	7	9	16	20	24	27
pH (s.u.)	56	na	<6	0	0.0	7.3	7.5	7.6	7.9	8.2	8.5	9.2
			>9	1	1.8	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	.	.	.	.	.	.	.
TSS	38	11	>10	1	2.6	1	1	1	2	3	6	22
			>20	1	2.6							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	55	0	>50	2	3.6	1	2	2	4	5	11	380
			>25	4	7.3	.	.	.	.	.	.	.
			>10	6	10.9	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	44	20	.	.	.	0.01	0.01	0.01	0.02	0.06	0.08	0.20
TKN as N	43	3	.	.	.	0.10	0.10	0.10	0.10	0.20	0.30	0.80
NO_2+NO_3 as N	42	0	>10	0	0.0	0.02	0.11	0.18	0.32	0.47	0.67	0.82
Total Phosphorus	44	2	>0.05	33	75.0	0.01	0.04	0.06	0.09	0.12	0.16	0.21
Metals (µg/L)												
Aluminum (Al)	41	3	.	.	.	50	56	73	98	200	250	2600
Arsenic (As)	41	41	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	41	41	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	41	41	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	41	18	>7	3	7.3	2	2	2	2	5	6	15
Iron (Fe)	41	0	>1000	1	2.4	110	130	160	200	290	390	2200
Lead (Pb)	41	34	>25	1	2.4	10	10	10	10	10	13	26
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	41	41	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	41	41	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	41	27	>50	0	0.0	10	10	10	10	13	19	50

Bacteria (#/100 ml)					
Fecal coliform	55	N>200= 5	N>400= 2	%>400= 3.6	Geometric mean= 18.3

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Linville R at NC 126 near Nebo	**Station:**	C1000000
Classification:	B HQW	**Subbasin:**	CTB30
Period:	9/11/1997 to 8/14/2002		

				< or > Eval. Level		Percentiles						
Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**N**	**%**	**Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	56	0	<4	0	0.0	8.0	9.0	9.7	10.9	12.4	13.6	16.5
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	56	na	.	.	.	21	33	36	42	44	47	50
Temperature (°C)	56	na	.	.	.	3	5	7	15	20	24	27
pH (s.u.)	56	na	<6	0	0.0	6.7	7.0	7.1	7.3	7.5	7.7	8.1
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	.	.	.	.	.	.	.
TSS	37	16	>10	0	0.0	1	1	1	2	2	3	9
			>20	0	0.0							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	55	10	>50	0	0.0	1	1	1	2	3	5	34
			>25	1	1.8	.	.	.	.	.	.	.
			>10	3	5.5	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	44	17	.	.	.	0.01	0.01	0.01	0.01	0.04	0.09	0.23
TKN as N	43	5	.	.	.	0.10	0.10	0.10	0.20	0.20	0.38	0.60
NO_2+NO_3 as N	43	2	>10	0	0.0	0.01	0.06	0.14	0.18	0.26	0.30	0.38
Total Phosphorus	44	16	>0.05	2	4.5	0.01	0.01	0.01	0.01	0.02	0.03	0.10
Metals (µg/L)												
Aluminum (Al)	40	9	.	.	.	50	50	51	76	120	173	370
Arsenic (As)	40	40	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	40	40	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	40	40	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	40	26	>7	1	2.5	2	2	2	2	2	4	17
Iron (Fe)	40	0	>1000	0	0.0	71	85	100	140	203	234	550
Lead (Pb)	40	35	>25	2	5.0	10	10	10	10	10	11	51
Manganese (Mn)	3	2	.	.	.	10	10	10	10	11	11	11
Mercury (Hg)	40	40	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	40	40	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	40	30	>50	1	2.5	10	10	10	10	10	36	100

Bacteria (#/100 ml)

Fecal coliform 55 N>200= 0 N>400= 0 %>400= 0.0 Geometric mean= 3.5

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Catawba R at SR 1147 near Glen Alpine Marion	Station:	C1210000
Classification:	WS-IV	Subbasin:	CTB30
Period:	9/11/1997 to 8/20/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	< or > Eval. Level %	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	57	0	<4	0	0.0	7.7	8.7	9.6	11.0	12.3	13.1	15.0
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	57	na	.	.	.	33	47	51	57	59	61	63
Temperature (°C)	57	na	.	.	.	4	8	10	14	17	18	21
pH (s.u.)	57	na	<6	1	1.8	5.8	6.8	6.9	7.1	7.3	7.4	8.1
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	30	0	>500	0	.	19	27	41	50	58	63	76
TSS	41	7	>10	7	17.1	1	1	2	4	9	19	53
			>20	3	7.3							
Chloride	30	0	>250	0	0.0	2	3	3	3	4	5	21
Turbidity (NTU)	56	1	>50	0	0.0	1	2	3	4	6	8	50
			>25	1	1.8	.	.	.	.	.	.	.
			>10	4	7.1	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	45	25	.	.	.	0.01	0.01	0.01	0.01	0.04	0.09	0.20
TKN as N	43	5	.	.	.	0.10	0.10	0.10	0.10	0.20	0.30	1.50
NO2+NO3 as N	44	1	>10	0	0.0	0.02	0.10	0.14	0.19	0.22	0.24	0.31
Total Phosphorus	45	15	>0.05	2	4.4	0.01	0.01	0.01	0.01	0.02	0.04	0.09
Metals (µg/L)												
Aluminum (Al)	42	2	.	.	.	50	72	88	220	408	708	2700
Arsenic (As)	42	42	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	42	42	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	42	42	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	42	27	>7	0	0.0	2	2	2	2	3	4	5
Iron (Fe)	42	0	>1000	3	7.1	68	151	220	360	538	841	2900
Lead (Pb)	42	38	>25	1	2.4	10	10	10	10	10	10	28
Manganese (Mn)	35	0	>200	1	2.9	12	18	21	29	42	73	220
Mercury (Hg)	42	42	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	42	26	>50	0	0.0	10	10	10	10	12	19	42

Bacteria (#/100 ml)

Fecal coliform	56	N>200= 2	N>400= 0	%>400= 0.0	Geometric mean= 9.4

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Wilson Cr at US 221 near Gragg	**Station:**	C1370000
Classification:	B Tr ORW	**Subbasin:**	CTB31
Period:	9/30/1997 to 8/20/2002		

Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**< or > Eval. Level N**	**%**	**Percentiles Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	57	0	<4	0	0.0	7.7	9.2	9.9	11.1	12.3	13.9	16.6
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	57	na	.	.	.	12	17	19	22	24	25	30
Temperature (°C)	56	na	.	.	.	2	4	7	11	14	17	22
pH (s.u.)	57	na	<6	10	17.5	4.8	5.6	6.4	6.7	6.9	7.0	9.2
			>9	1	1.8	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0			.	23	23	23	23	23	23	23
TSS	41	31	>10	1	2.4	1	1	1	1	3	3	34
			>20	1	2.4							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	55	30	>50	0	0.0	1	1	1	1	1	2	14
			>25	0	0.0	.	.	.	.	.	.	.
			>10	1	1.8	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	43	22	.	.	.	0.01	0.01	0.01	0.01	0.03	0.10	0.20
TKN as N	42	4	.	.	.	0.10	0.10	0.10	0.10	0.20	0.39	0.52
NO_2+NO_3 as N	43	5	>10	0	0.0	0.01	0.03	0.11	0.18	0.29	0.35	0.43
Total Phosphorus	44	25	>0.05	2	4.5	0.01	0.01	0.01	0.01	0.02	0.02	0.50
Metals (µg/L)												
Aluminum (Al)	41	2	.	.	.	50	55	65	85	120	190	1300
Arsenic (As)	41	41	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	41	41	>0.4	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	41	41	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	41	33	>7	2	4.9	2	2	2	2	2	4	8
Iron (Fe)	41	31	>1000	1	2.4	50	50	50	50	50	110	1400
Lead (Pb)	41	38	>25	1	2.4	10	10	10	10	10	10	48
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	41	41	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	41	41	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	41	28	>50	1	2.4	10	10	10	10	11	16	100

Bacteria (#/100 ml)

Fecal coliform 55 N>200= 0 N>400= 0 %>400= 0.0 Geometric mean= 1.4

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Lower Cr at SR 1501 near Morganton Marion		**Station:**	C1750000
Classification:	WS-IV		**Subbasin:**	CTB31
Period:	9/30/1997 to 8/20/2002			

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	< or > Eval. Level %	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	56	0	<4	0	0.0	6.6	7.5	8.3	9.8	11.6	13.0	16.0
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	56	na	.	.	.	30	69	81	93	112	126	160
Temperature (°C)	56	na	.	.	.	2	6	9	15	20	22	24
pH (s.u.)	56	na	<6	0	0.0	6.1	6.7	6.8	7.0	7.1	7.2	7.4
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0	>500	0	.	76	76	76	76	76	76	76
TSS	38	1	>10	30	78.9	3	8	13	22	48	110	580
			>20	21	55.3							
Chloride	0	0	>250	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	54	0	>50	12	22.2	4	7	10	20	37	140	1400
			>25	20	37.0	.	.	.	.	.	.	.
			>10	39	72.2	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	56	1	.	.	.	0.02	0.04	0.08	0.11	0.23	0.34	0.69
TKN as N	54	1	.	.	.	0.20	0.30	0.36	0.40	0.58	0.70	61.00
NO2+NO3 as N	56	0	>10	0	0.0	0.31	0.51	0.65	0.80	0.99	1.10	1.30
Total Phosphorus	57	5	>0.05	41	71.9	0.01	0.04	0.05	0.10	0.20	0.30	0.50
Metals (µg/L)												
Aluminum (Al)	42	0	.	.	.	200	406	558	1150	2550	7670	25000
Arsenic (As)	42	42	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	42	42	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	42	42	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	42	13	>7	10	23.8	2	2	2	2	6	10	20
Iron (Fe)	42	0	>1000	30	71.4	400	736	948	1600	2475	6980	21000
Lead (Pb)	42	35	>25	0	0.0	10	10	10	10	10	16	17
Manganese (Mn)	3	0	>200	0	0.0	23	38	60	97	124	139	150
Mercury (Hg)	42	42	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	42	5	>50	2	4.8	10	10	12	16	24	32	81

Bacteria (#/100 ml)

Fecal coliform	54	N>200= 30	N>400= 21	%>400= 38.9	Geometric mean= 252.7

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Lake Rhodhiss at SR 1001 near Baton Marion		**Station:**	C2030000
Classification:	WS-IV & B CA		**Subbasin:**	CTB31
Period:	9/30/1997 to	5/17/2000		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	23	0	<4	0	0.0	8.0	8.9	9.4	10.5	12.0	13.7	15.4
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	23	na	.	.	.	50	58	62	71	84	114	138
Temperature (°C)	23	na	.	.	.	6	8	12	14	21	23	28
pH (s.u.)	23	na	<6	0	0.0	6.3	6.8	7.0	7.2	8.2	8.9	9.2
			>9	1	4.3	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	22	0	>500	0	.	33	46	53	62	70	76	98
TSS	22	0	>10	2	9.1	2	3	3	4	7	9	15
			>20	0	0.0							
Chloride	22	0	>250	0	0.0	2	4	5	9	16	22	49
Turbidity (NTU)	22	0	>50	0	0.0	3	4	4	6	10	10	31
			>25	1	4.5	.	.	.	.	.	.	.
			>10	2	9.1	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	33	7	.	.	.	0.01	0.01	0.01	0.04	0.08	0.12	0.23
TKN as N	33	0	.	.	.	0.10	0.10	0.20	0.20	0.30	0.40	0.50
NO2+NO3 as N	33	4	>10	0	0.0	0.01	0.01	0.02	0.17	0.25	0.28	0.46
Total Phosphorus	33	0	>0.05	11	33.3	0.02	0.02	0.04	0.05	0.07	0.09	0.23
Metals (µg/L)												
Aluminum (Al)	33	0	.	.	.	67	102	160	220	450	1180	9600
Arsenic (As)	33	33	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	33	33	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	33	33	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	33	22	>7	2	6.1	2	2	2	2	3	6	12
Iron (Fe)	33	0	>1000	5	15.2	110	162	210	370	580	1180	8000
Lead (Pb)	33	32	>25	0	0.0	10	10	10	10	10	10	14
Manganese (Mn)	32	4	>200	0	0.0	10	10	13	27	35	44	95
Mercury (Hg)	33	33	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	33	33	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	33	19	>50	0	0.0	10	10	10	10	17	25	33

Bacteria (#/100 ml)					
Fecal coliform	22	N>200= 0	N>400= 0	%>400= 0.0	Geometric mean= 2.5

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Lake Hickory at NC 127 near Hickory	Station:	C2600000
Classification:	WS-V&B	Subbasin:	CTB32
Period:	9/3/1997 to 8/27/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	48	0	<4	0	0.0	4.4	6.5	7.9	8.5	9.6	10.6	13.3
(DO; mg/L)			<5	1	2.1	.	.	.	.	.	.	.
Conductivity	48	na	.	.	.	51	58	61	66	70	74	83
Temperature (°C)	48	na	.	.	.	1	8	13	21	27	28	31
pH (s.u.)	48	na	<6	0	0.0	6.4	6.7	6.9	7.2	7.9	8.4	8.7
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	35	0	>500	0	.	24	35	45	54	59	67	74
TSS	42	6	>10	1	2.4	1	1	1	2	3	5	11
			>20	0	0.0							
Chloride	35	0	>250	0	0.0	4	4	4	5	6	7	9
Turbidity (NTU)	52	0	>50	0	0.0	1	2	2	2	6	7	37
			>25	1	1.9	.	.	.	.	.	.	.
			>10	4	7.7	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	43	10	.	.	.	0.01	0.01	0.02	0.04	0.08	0.11	0.34
TKN as N	42	0	.	.	.	0.10	0.10	0.20	0.20	0.30	0.40	0.90
NO2+NO3 as N	43	11	>10	0	0.0	0.01	0.01	0.04	0.16	0.25	0.29	0.33
Total Phosphorus	43	7	>0.05	3	7.0	0.01	0.01	0.01	0.02	0.04	0.05	0.10
Metals (µg/L)												
Aluminum (Al)	43	3	.	.	.	50	56	84	120	200	336	1200
Arsenic (As)	43	43	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	43	43	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	43	43	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	43	24	>7	3	7.0	2	2	2	2	3	4	14
Iron (Fe)	43	0	>1000	0	0.0	65	77	110	170	260	388	790
Lead (Pb)	43	43	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	42	4	>200	0	0.0	10	10	14	19	26	32	37
Mercury (Hg)	43	43	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	43	43	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	43	30	>50	1	2.3	10	10	10	10	14	29	100

Bacteria (#/100 ml)

Fecal coliform	55	N>200= 0	N>400= 0	%>400= 0.0	Geometric mean= 7.5

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Lower Little R at SR 1313 near All Healing Springs			**Station:**	C2818000
Classification:	C			**Subbasin:**	CTB32
Period:	9/10/1997	to	8/6/2002		

				< or >								
		Num.	Eval.	Eval. Level					Percentiles			
Parameter	**N**	**< R.L.**	**Level**	**N**	**%**	**Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	59	0	<4	0	0.0	7.2	7.7	8.2	9.7	11.4	12.4	14.1
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	35	40	41	45	49	51	220
Temperature (°C)	59	na	.	.	.	2	6	8	16	20	23	26
pH (s.u.)	59	na	<6	0	0.0	6.2	6.4	6.7	7.0	7.1	7.3	7.7
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0			.	63	63	63	63	63	63	63
TSS	43	4	>10	10	23.3	1	1	2	3	10	36	560
			>20	7	16.3							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	59	0	>50	2	3.4	2	3	4	5	10	20	400
			>25	6	10.2	.	.	.	.	.	.	.
			>10	14	23.7	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	46	25	.	.	.	0.01	0.01	0.01	0.01	0.06	0.15	0.50
TKN as N	45	5	.	.	.	0.10	0.10	0.10	0.20	0.30	0.40	1.10
NO_2+NO_3 as N	46	1	>10	0	0.0	0.16	0.26	0.33	0.38	0.44	0.49	0.66
Total Phosphorus	46	7	>0.05	7	15.2	0.01	0.01	0.01	0.02	0.04	0.10	1.40
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	97	123	200	270	833	2510	12000
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	43	>50	0	0.0	25	25	25	25	25	25	40
Copper (Cu)	44	28	>7	5	11.4	2	2	2	2	3	13	63
Iron (Fe)	44	0	>1000	9	20.5	230	319	420	495	865	2080	12000
Lead (Pb)	44	43	>25	0	0.0	10	10	10	10	10	10	23
Manganese (Mn)	1	0	.	.	.	26	26	26	26	26	26	26
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	43	>88	0	0.0	10	10	10	10	10	10	15
Zinc (Zn)	44	30	>50	3	6.8	10	10	10	10	14	34	78

Bacteria (#/100 ml)

Fecal coliform 59 N>200= 31 N>400= 25 %>400= 42.4 Geometric mean= 199.6

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.

Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Lake Norman at SR 1004 near Mooresville									**Station:**		C3420000
Classification:	WS-IV&B CA									**Subbasin:**		CTB32
Period:	9/3/1997	to	8/27/2002									

				< or >								
		Num.	**Eval.**	**Eval. Level**		**Percentiles**						
Parameter	**N**	**< R.L.**	**Level**	**N**	**%**	**Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	48	0	<4	0	0.0	6.0	7.3	8.1	8.9	9.9	11.4	12.3
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	48	na	.	.	.	55	59	63	66	70	73	77
Temperature (°C)	48	na	.	.	.	6	9	13	21	28	29	31
pH (s.u.)	48	na	<6	0	0.0	6.3	6.7	6.9	7.2	7.9	8.6	9.2
			>9	3	6.3	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	36	0	>500	0	.	29	41	49	58	68	80	150
TSS	42	3	>10	2	4.8	1	1	2	5	6	8	38
			>20	1	2.4							
Chloride	35	0	>250	0	0.0	3	4	5	5	6	7	15
Turbidity (NTU)	53	0	>50	1	1.9	2	3	3	5	8	14	75
			>25	1	1.9	.	.	.	.	.	.	.
			>10	10	18.9	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	44	9	.	.	.	0.01	0.01	0.01	0.04	0.07	0.15	0.36
TKN as N	42	0	.	.	.	0.10	0.10	0.10	0.20	0.30	0.40	1.00
NO2+NO3 as N	44	4	>10	0	0.0	0.01	0.02	0.14	0.23	0.30	0.36	0.41
Total Phosphorus	44	8	>0.05	3	6.8	0.01	0.01	0.01	0.02	0.03	0.05	0.13
Metals (µg/L)												
Aluminum (Al)	43	0	.	.	.	50	86	125	180	385	654	5200
Arsenic (As)	43	43	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	43	43	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	43	43	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	43	27	>7	2	4.7	2	2	2	2	3	4	19
Iron (Fe)	43	0	>1000	2	4.7	81	132	190	290	460	694	3700
Lead (Pb)	43	43	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	42	0	>200	0	0.0	12	22	26	34	42	52	87
Mercury (Hg)	43	43	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	43	43	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	43	27	>50	2	4.7	10	10	10	10	14	22	68

Bacteria (#/100 ml)					
Fecal coliform	54	N>200= 5	N>400= 3	%>400= 5.6	Geometric mean= 13.8

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Mountain Island Lake Above Gar Cr near Croft	**Station:**	C3699000
Classification:	WS-IV&B CA	**Subbasin:**	CTB33
Period:	9/9/1997 to 6/26/2002		

				< or > Eval. Level		Percentiles						
Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**N**	**%**	**Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	44	0	<4	0	0.0	6.5	7.2	7.9	8.4	9.4	10.3	12.0
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	45	na	.	.	.	51	56	60	69	74	78	79
Temperature (°C)	43	na	.	.	.	9	10	14	20	28	30	32
pH (s.u.)	43	na	<6	0	0.0	6.4	6.8	7.0	7.2	7.4	7.4	7.8
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	34	0	>500	0	.	23	36	41	49	55	58	66
TSS	41	6	>10	3	7.3	1	1	1	2	3	6	78
			>20	1	2.4							
Chloride	33	0	>250	0	0.0	1	4	4	5	6	6	9
Turbidity (NTU)	48	0	>50	0	0.0	2	2	2	3	3	6	9
			>25	0	0.0	.	.	.	.	.	.	.
			>10	0	0.0	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	41	19	.	.	.	0.01	0.01	0.01	0.01	0.04	0.09	0.20
TKN as N	39	0	.	.	.	0.10	0.10	0.10	0.20	0.20	0.30	0.50
NO2+NO3 as N	40	2	>10	0	0.0	0.01	0.02	0.05	0.12	0.16	0.19	0.30
Total Phosphorus	41	19	>0.05	3	7.3	0.01	0.01	0.01	0.01	0.02	0.04	0.30
Metals (µg/L)												
Aluminum (Al)	41	2	.	.	.	50	59	91	130	220	300	770
Arsenic (As)	41	41	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	41	41	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	41	41	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	41	11	>7	2	4.9	2	2	2	3	4	6	76
Iron (Fe)	41	1	>1000	0	0.0	50	73	100	140	210	300	930
Lead (Pb)	41	41	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	41	1	>200	0	0.0	10	14	17	20	26	29	60
Mercury (Hg)	41	41	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	41	41	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	41	29	>50	1	2.4	10	10	10	10	11	23	66

Bacteria (#/100 ml)

Fecal coliform	46	N>200= 0	N>400= 0	%>400= 0.0	Geometric mean= 9.8

<u>Abbreviations:</u> N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
<u>Evaluation Levels</u> (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Dutchmans Cr at SR 1918 at Mountain Island	Station:	C3860000
Classification:	WS-IV	Subbasin:	CTB33
Period:	9/4/1997 to 8/8/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	< or > Eval. Level %	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	58	0	<4	1	1.7	2.6	7.7	8.1	9.7	11.6	13.6	14.5
(DO; mg/L)			<5	1	1.7	.	.	.	.	.	.	.
Conductivity	58	na	.	.	.	65	72	79	87	100	124	234
Temperature (°C)	58	na	.	.	.	0	5	9	16	22	24	26
pH (s.u.)	58	na	<6	0	0.0	6.4	7.1	7.2	7.4	7.6	7.8	8.4
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	34	0	>500	0	.	38	74	79	86	96	110	130
TSS	44	2	>10	6	13.6	1	2	3	5	9	14	46
			>20	3	6.8							
Chloride	34	0	>250	0	0.0	2	2	3	3	4	4	4
Turbidity (NTU)	59	0	>50	1	1.7	3	4	5	7	10	16	190
			>25	3	5.1	.	.	.	.	.	.	.
			>10	14	23.7	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	45	21	.	.	.	0.01	0.01	0.01	0.02	0.05	0.10	0.34
TKN as N	44	3	.	.	.	0.10	0.10	0.10	0.20	0.20	0.40	0.80
NO2+NO3 as N	45	0	>10	0	0.0	0.03	0.04	0.10	0.21	0.27	0.33	0.45
Total Phosphorus	46	3	>0.05	15	32.6	0.01	0.02	0.03	0.05	0.06	0.10	0.50
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	73	113	188	315	548	1058	3400
Arsenic (As)	44	43	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	30	>7	1	2.3	2	2	2	2	2	4	15
Iron (Fe)	44	0	>1000	18	40.9	540	683	765	995	1300	1470	3400
Lead (Pb)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	44	0	>200	4	9.1	51	61	73	83	120	197	350
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	31	>50	2	4.5	10	10	10	10	11	24	120

Bacteria (#/100 ml)

Fecal coliform 59 N>200= 17 N>400= 6 %>400= 10.2 Geometric mean= 125.3

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Catawba R at NC 27 near Thrift	Station:	C3900000
Classification:	WS-IV CA	Subbasin:	CTB33
Period:	9/9/1997 to 8/28/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	45	0	<4	0	0.0	5.3	5.8	6.5	8.1	9.4	10.2	10.8
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	45	na	.	.	.	6	55	62	68	75	79	99
Temperature (°C)	45	na	.	.	.	8	12	16	21	28	29	32
pH (s.u.)	44	na	<6	0	0.0	6.3	6.6	6.8	7.0	7.3	7.4	7.5
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	33	0	>500	0	.	25	40	43	49	52	59	150
TSS	42	6	>10	1	2.4	1	1	1	1	3	5	42
			>20	1	2.4							
Chloride	34	0	>250	0	0.0	3	4	4	5	5	6	6
Turbidity (NTU)	51	0	>50	0	0.0	1	1	2	3	4	8	18
			>25	0	0.0	.	.	.	.	.	.	.
			>10	1	2.0	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	42	13	.	.	.	0.01	0.01	0.01	0.04	0.08	0.10	0.20
TKN as N	40	0	.	.	.	0.10	0.10	0.20	0.20	0.20	0.30	0.50
NO2+NO3 as N	42	1	>10	0	0.0	0.03	0.04	0.08	0.12	0.16	0.22	0.33
Total Phosphorus	42	19	>0.05	2	4.8	0.01	0.01	0.01	0.01	0.02	0.03	0.10
Metals (µg/L)												
Aluminum (Al)	41	1	.	.	.	50	81	100	130	170	310	700
Arsenic (As)	41	40	>50	0	0.0	10	10	10	10	10	10	12
Cadmium (Cd)	41	41	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	41	41	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	41	15	>7	2	4.9	2	2	2	3	4	6	10
Iron (Fe)	41	0	>1000	0	0.0	58	80	100	140	180	270	690
Lead (Pb)	41	41	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	37	0	>200	0	0.0	11	13	16	21	34	41	53
Mercury (Hg)	41	41	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	41	41	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	41	29	>50	1	2.4	10	10	10	10	13	27	80

Bacteria (#/100 ml)

Fecal coliform 48 N>200= 0 N>400= 0 %>400= 0.0 Geometric mean= 11.3

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Long Cr at SR 2042 near Paw Creek		Station:	C4040000
Classification:	WS-IV		Subbasin:	CTB34
Period:	9/4/1997	to 8/8/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Min.	10	25	50	75	90	Max.
						Percentiles						
Field												
Dissolved Oxygen	58	0	<4	1	1.7	2.9	5.9	6.8	8.6	10.3	12.2	13.4
(DO; mg/L)			<5	1	1.7	.	.	.	.	.	.	.
Conductivity	58	na	.	.	.	111	125	143	164	178	185	203
Temperature (°C)	58	na	.	.	.	1	5	9	15	20	23	24
pH (s.u.)	58	na	<6	0	0.0	6.6	7.1	7.3	7.4	7.5	7.7	8.0
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	35	0	>500	0	.	110	120	130	140	160	176	220
TSS	44	3	>10	7	15.9	1	1	2	4	7	19	64
			>20	4	9.1							
Chloride	34	0	>250	0	0.0	3	4	5	6	7	7	13
Turbidity (NTU)	59	0	>50	6	10.2	2	4	5	11	23	55	220
			>25	14	23.7	.	.	.	.	.	.	.
			>10	30	50.8	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	45	17	.	.	.	0.01	0.01	0.01	0.02	0.04	0.08	0.20
TKN as N	44	2	.	.	.	0.10	0.10	0.10	0.20	0.30	0.40	0.60
NO2+NO3 as N	45	5	>10	0	0.0	0.01	0.01	0.09	0.18	0.29	0.42	0.68
Total Phosphorus	46	6	>0.05	13	28.3	0.01	0.02	0.03	0.04	0.06	0.11	0.50
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	55	97	185	425	1275	3610	8500
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	14	>7	5	11.4	2	2	2	3	5	7	13
Iron (Fe)	44	0	>1000	14	31.8	250	453	590	785	1325	2540	6800
Lead (Pb)	44	43	>25	0	0.0	10	10	10	10	10	10	12
Manganese (Mn)	44	0	>200	5	11.4	54	70	83	100	140	198	880
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	23	>50	3	6.8	10	10	10	10	17	29	82

Bacteria (#/100 ml)					
Fecal coliform	59	N>200= 38	N>400= 23	%>400= 39.0	Geometric mean= 324.2

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Catawba R at Powerline Crossing at S Belmont X R	Station:	C4220000
Classification:	WS-IV&B CA	Subbasin:	CTB34
Period:	9/9/1997 to 6/26/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	< or > Eval. Level %	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	50	0	<4	0	0.0	6.5	7.2	8.1	9.0	10.2	10.5	11.0
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	50	na	.	.	.	59	65	85	95	105	114	128
Temperature (°C)	49	na	.	.	.	8	11	15	21	28	30	33
pH (s.u.)	49	na	<6	0	0.0	6.1	6.7	6.8	7.3	7.5	8.0	8.7
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	35	0	>500	0	.	47	56	60	72	79	89	120
TSS	42	2	>10	4	9.5	1	1	3	5	7	10	300
			>20	3	7.1							
Chloride	34	0	>250	0	0.0	4	5	6	8	10	11	15
Turbidity (NTU)	50	0	>50	1	2.0	3	4	5	6	9	13	55
			>25	4	4.0	.	.	.	.	.	.	.
			>10	9	18.0	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	42	12	.	.	.	0.01	0.01	0.01	0.02	0.07	0.10	0.20
TKN as N	40	0	.	.	.	0.10	0.10	0.20	0.20	0.20	0.30	0.41
NO2+NO3 as N	42	6	>10	0	0.0	0.01	0.01	0.08	0.15	0.18	0.28	0.39
Total Phosphorus	42	4	>0.05	10	23.8	0.01	0.01	0.02	0.03	0.05	0.06	0.11
Metals (µg/L)												
Aluminum (Al)	42	0	.	.	.	85	141	193	265	498	933	4600
Arsenic (As)	42	42	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	42	42	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	42	42	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	42	5	>7	6	14.3	2	2	2	3	4	8	140
Iron (Fe)	42	0	>1000	3	7.1	170	220	253	335	475	679	3600
Lead (Pb)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	42	0	>200	0	0.0	21	24	26	34	41	47	71
Mercury (Hg)	42	41	>0.012	1	2.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	42	27	>50	1	2.4	10	10	10	10	13	29	98

Bacteria (#/100 ml)

Parameter	N				
Fecal coliform	47	N>200= 1	N>400= 1	%>400= 2.1	Geometric mean= 10.6

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Lake Wylie at NC 49 near Oak Grove									Station:		C7500000
Classification:	WS-V&B									Subbasin:		CTB34
Period:	9/11/1997 to 8/28/2002											

				< or >								
		Num.	Eval.	Eval. Level		Percentiles						
Parameter	N	< R.L.	Level	N	%	Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	55	0	<4	0	0.0	4.1	6.7	7.7	8.4	10.1	11.2	13.2
(DO; mg/L)			<5	1	1.8	.	.	.	.	.	.	.
Conductivity	55	na	.	.	.	62	77	105	117	130	138	149
Temperature (°C)	55	na	.	.	.	7	10	16	21	28	31	32
pH (s.u.)	55	na	<6	0	0.0	6.6	6.9	7.1	7.3	8.2	8.8	9.2
			>9	1	1.8	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	35	0	>500	0	.	57	62	74	84	95	110	180
TSS	42	5	>10	0	0.0	1	1	1	3	5	6	8
			>20	0	0.0							
Chloride	34	0	>250	0	0.0	6	7	8	11	12	15	17
Turbidity (NTU)	54	0	>50	0	0.0	1	2	2	3	6	10	22
			>25	0	0.0	.	.	.	.	.	.	.
			>10	5	9.3	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	42	13	.	.	.	0.01	0.01	0.01	0.04	0.09	0.14	0.51
TKN as N	42	1	.	.	.	0.10	0.10	0.20	0.30	0.35	0.40	0.61
NO2+NO3 as N	43	6	>10	0	0.0	0.01	0.01	0.05	0.18	0.29	0.33	0.68
Total Phosphorus	41	2	>0.05	6	14.6	0.01	0.01	0.02	0.03	0.05	0.06	0.12
Metals (µg/L)												
Aluminum (Al)	42	2	.	.	.	50	84	103	165	370	478	760
Arsenic (As)	42	42	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	42	42	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	42	42	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	42	3	>7	7	16.7	2	3	3	5	6	8	11
Iron (Fe)	42	1	>1000	0	0.0	50	81	123	190	370	558	700
Lead (Pb)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	42	2	>200	0	0.0	10	13	15	22	28	51	160
Mercury (Hg)	42	42	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	42	27	>50	1	2.4	9	10	10	10	12	24	67

Bacteria (#/100 ml)

Fecal coliform	53	N>200= 0	N>400= 0	%>400= 0.0	Geometric mean= 7.6

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Irwin Cr at Irwin Cr WWTP near Charlotte			**Station:**	C8896500
Classification:	C			**Subbasin:**	CTB34
Period:	9/16/1997	to	8/13/2002		

Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**< or > Eval. Level N**	**%**	**Percentiles Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	59	0	<4	0	0.0	5.2	6.6	7.9	9.5	10.7	11.8	15.8
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	101	128	176	191	225	243	258
Temperature (°C)	59	na	.	.	.	4	7	11	16	24	25	26
pH (s.u.)	59	na	<6	0	0.0	6.7	7.0	7.2	7.6	7.9	8.1	9.0
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0			.	110	110	110	110	110	110	110
TSS	44	6	>10	10	22.7	1	1	2	3	7	33	130
			>20	8	18.2							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	0	>50	3	5.2	1	1	2	5	9	37	150
			>25	9	15.5	.	.	.	.	.	.	.
			>10	14	24.1	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	45	11	.	.	.	0.01	0.01	0.01	0.07	0.16	0.28	0.53
TKN as N	43	0	.	.	.	0.10	0.20	0.20	0.30	0.40	0.58	1.30
NO_2+NO_3 as N	45	0	>10	0	0.0	0.17	0.47	0.55	0.71	0.96	1.26	1.80
Total Phosphorus	46	3	>0.05	19	41.3	0.01	0.02	0.03	0.05	0.10	0.22	0.50
Metals (µg/L)												
Aluminum (Al)	44	4	.	.	.	50	54	76	180	758	2530	7900
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	43	>2	1	2.3	2	2	2	2	2	2	4
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	13	>7	10	22.7	2	2	2	3	6	11	48
Iron (Fe)	44	0	>1000	12	27.3	110	140	218	370	1200	2810	8800
Lead (Pb)	44	37	>25	3	6.8	10	10	10	10	10	15	1400
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	44	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	10	>50	7	15.9	10	10	12	23	35	63	920

Bacteria (#/100 ml)

Fecal coliform 59 N>200= 44 N>400= 29 %>400= 49.2 Geometric mean= 592.0

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Sugar Cr at NC 51 at Pineville	**Station:**	C9050000
Classification:	C	**Subbasin:**	CTB34
Period:	9/18/1997 to 8/1/2002		

				< or >								
		Num.	**Eval.**	**Eval. Level**		**Percentiles**						
Parameter	**N**	**< R.L.**	**Level**	**N**	**%**	**Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	59	0	<4	0	0.0	5.1	6.3	6.7	8.1	9.7	11.2	12.4
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	109	211	250	324	369	408	443
Temperature (°C)	59	na	.	.	.	3	6	11	17	23	25	27
pH (s.u.)	59	na	<6	0	0.0	6.7	7.1	7.2	7.4	7.5	7.6	7.7
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0			.	290	290	290	290	290	290	290
TSS	42	1	>10	11	26.2	1	1	4	6	11	26	2000
			>20	8	19.0							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	57	0	>50	4	7.0	2	3	4	7	17	39	1100
			>25	11	19.3	.	.	.	.	.	.	.
			>10	21	36.8	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	57	11	.	.	.	0.01	0.01	0.03	0.05	0.09	0.17	1.50
TKN as N	56	5	.	.	.	0.10	0.20	0.38	0.50	0.60	0.90	5.50
NO_2+NO_3 as N	57	0	>10	3	5.3	0.27	2.12	3.30	5.30	8.50	9.72	25.00
Total Phosphorus	56	1	>0.05	55	98.2	0.05	0.26	0.35	0.53	0.82	1.20	1.40
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	77	153	220	370	965	1740	58000
Arsenic (As)	44	43	>50	0	0.0	10	10	10	10	10	10	11
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	43	>50	1	2.3	25	25	25	25	25	25	120
Copper (Cu)	44	0	>7	15	34.1	2	4	5	6	8	10	170
Iron (Fe)	44	0	>1000	14	31.8	220	346	435	660	1225	2440	#####
Lead (Pb)	44	42	>25	1	2.3	10	10	10	10	10	10	110
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	43	>88	0	0.0	10	10	10	10	10	10	64
Zinc (Zn)	44	0	>50	7	15.9	14	22	28	32	45	55	440

Bacteria (#/100 ml)

Fecal coliform	58	N>200= 33	N>400= 21	%>400= 36.2	Geometric mean= 308.6

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Little Sugar Cr at NC 51 at Pineville	Station:	C9210000
Classification:	C	Subbasin:	CTB34
Period:	9/18/1997 to 8/1/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Min.	Percentiles 10	25	50	75	90	Max.
Field												
Dissolved Oxygen	59	0	<4	0	0.0	5.2	6.4	7.5	8.5	9.9	10.6	12.6
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	65	253	343	423	503	536	613
Temperature (°C)	59	na	.	.	.	7	9	13	19	26	28	31
pH (s.u.)	59	na	<6	0	0.0	6.0	7.2	7.3	7.4	7.6	7.7	8.2
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0			.	300	300	300	300	300	300	300
TSS	43	4	>10	11	25.6	1	1	3	4	11	27	410
			>20	6	14.0							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	0	>50	2	3.4	1	2	3	4	9	25	200
			>25	6	10.3	.	.	.	.	.	.	.
			>10	14	24.1	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	57	6	.	.	.	0.01	0.01	0.04	0.13	0.24	0.57	1.70
TKN as N	56	1	.	.	.	0.20	0.40	0.57	0.75	1.00	1.20	4.60
NO_2+NO_3 as N	57	1	>10	1	1.8	0.15	2.28	3.70	5.40	7.40	8.64	12.00
Total Phosphorus	56	1	>0.05	56	100.0	0.38	0.72	1.30	2.40	3.80	4.60	16.00
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	72	113	170	230	430	717	20000
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	1	>7	7	15.9	2	3	4	5	6	11	42
Iron (Fe)	44	0	>1000	5	11.4	220	253	325	415	590	1064	23000
Lead (Pb)	44	43	>25	1	2.3	10	10	10	10	10	10	42
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	43	>88	0	0.0	10	10	10	10	10	10	22
Zinc (Zn)	44	0	>50	4	9.1	14	19	22	28	36	43	230

Bacteria (#/100 ml)					
Fecal coliform	58	N>200= 24	N>400= 17	%>400= 29.3	Geometric mean= 233.5

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	McAlpine Cr at SR 3356 Sardis Rd near Charlotte	Station:	C9370000
Classification:	C	Subbasin:	CTB34
Period:	9/24/1997 to 8/5/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	59	0	<4	0	0.0	4.3	5.8	6.9	8.4	10.6	12.4	14.5
(DO; mg/L)			<5	1	1.7	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	78	107	144	173	196	212	224
Temperature (°C)	59	na	.	.	.	1	6	10	17	24	26	28
pH (s.u.)	59	na	<6	0	0.0	6.1	7.1	7.3	7.5	7.6	7.8	8.1
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	.	.	.	.	.	.	.
TSS	44	3	>10	9	20.5	1	1	3	4	8	16	98
			>20	3	6.8							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	0	>50	3	5.2	2	5	6	8	16	37	190
			>25	10	17.2	.	.	.	.	.	.	.
			>10	24	41.4	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	46	11	.	.	.	0.01	0.01	0.01	0.07	0.16	0.23	0.50
TKN as N	45	2	.	.	.	0.10	0.20	0.20	0.30	0.40	0.66	1.00
NO_2+NO_3 as N	46	1	>10	0	0.0	0.01	0.16	0.23	0.34	0.49	0.69	3.10
Total Phosphorus	46	3	>0.05	22	47.8	0.01	0.03	0.04	0.05	0.08	0.12	0.50
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	66	123	185	325	868	2040	16000
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	15	>7	6	13.6	2	2	2	3	4	8	28
Iron (Fe)	44	0	>1000	15	34.1	430	536	645	905	1300	2080	14000
Lead (Pb)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	1	0	.	.	.	120	120	120	120	120	120	120
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	43	>88	0	0.0	10	10	10	10	10	10	32
Zinc (Zn)	44	22	>50	1	2.3	10	10	10	10	16	30	160

Bacteria (#/100 ml)

Fecal coliform 59 N>200= 33 N>400= 24 %>400= 40.7 Geometric mean= 287.9

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	McAlpine Cr at Sc SR 2964 near Camp Cox Sc			Station:	C9680000
Classification:	FW			Subbasin:	CTB34
Period:	9/16/1997	to	8/1/2002		

				< or > Eval. Level		Percentiles						
Parameter	N	Num. < R.L.	Eval. Level	N	%	Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	59	0	<4	0	0.0	4.2	5.0	6.0	6.9	8.1	9.3	10.4
(DO; mg/L)			<5	6	10.2	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	131	245	318	399	447	496	541
Temperature (°C)	59	na	.	.	.	6	11	15	19	24	26	27
pH (s.u.)	57	na	<6	0	0.0	6.5	7.0	7.2	7.2	7.4	7.5	7.8
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	.	.	.	.	.	.	.
TSS	43	1	>10	20	46.5	1	5	6	9	19	26	99
			>20	9	20.9							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	0	>50	2	3.4	2	4	4	8	22	39	180
			>25	12	20.7	.	.	.	.	.	.	.
			>10	22	37.9	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	57	4	.	.	.	0.01	0.04	0.07	0.19	0.45	0.74	4.10
TKN as N	56	0	.	.	.	0.50	0.75	0.93	1.15	1.50	2.15	8.90
NO_2+NO_3 as N	57	1	>10	8	14.0	0.15	3.16	4.60	7.20	8.80	11.40	18.00
Total Phosphorus	56	1	>0.05	56	100.0	0.47	0.93	1.48	2.35	3.23	4.20	5.20
Metals (µg/L)												
Aluminum (Al)	44	1	.	.	.	50	193	280	445	1025	1500	7200
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	50
Cadmium (Cd)	44	43	>2	1	2.3	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	1	>7	6	13.6	2	3	3	4	5	8	13
Iron (Fe)	44	0	>1000	19	43.2	260	433	518	825	1400	2270	5200
Lead (Pb)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	43	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	0	>50	5	11.4	11	19	25	31	37	51	84

Bacteria (#/100 ml)

Fecal coliform	58	N>200= 27	N>400= 15	%>400= 25.9	Geometric mean= 230.5

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Sugar Cr at Sc 160 near Fort Mill, SC	**Station:**	C9790000
Classification:	FW	**Subbasin:**	CTB34
Period:	9/16/1997 to 8/1/2002		

				< or > Eval. Level		Percentiles						
Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**N**	**%**	**Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	59	0	<4	1	1.7	3.4	6.0	6.9	7.7	9.4	10.6	11.3
(DO; mg/L)			<5	1	1.7	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	120	214	260	349	419	465	522
Temperature (°C)	59	na	.	.	.	5	8	11	18	25	27	28
pH (s.u.)	59	na	<6	0	0.0	7.0	7.1	7.3	7.5	7.6	7.6	8.1
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0			.	300	300	300	300	300	300	300
TSS	44	1	>10	25	56.8	1	3	9	18	30	52	270
			>20	20	45.5							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	0	>50	6	10.3	3	5	7	12	27	58	220
			>25	16	27.6	.	.	.	.	.	.	.
			>10	33	56.9	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	46	4	.	.	.	0.01	0.03	0.06	0.12	0.25	1.30	2.80
TKN as N	45	1	.	.	.	0.10	0.50	0.60	0.80	0.90	2.76	8.00
NO_2+NO_3 as N	46	0	>10	1	2.2	0.46	2.05	3.85	5.55	7.18	8.40	11.00
Total Phosphorus	45	1	>0.05	45	100.0	0.09	0.66	1.20	1.50	2.40	2.80	3.80
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	150	233	468	765	1575	2870	9300
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	0	>7	9	20.5	3	4	4	5	7	9	30
Iron (Fe)	44	0	>1000	26	59.1	370	460	668	1300	2050	3000	11000
Lead (Pb)	44	42	>25	0	0.0	10	10	10	10	10	10	16
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	44	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	0	>50	4	9.1	12	17	21	26	36	45	73

Bacteria (#/100 ml)					
Fecal coliform	58	N>200= 37	N>400= 19	%>400= 32.8	Geometric mean= 325.0

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Henry Fork R at SR 1124 near Henry River	Station:	C4300000
Classification:	C	Subbasin:	CTB35
Period:	9/23/1997 to 8/6/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	59	0	<4	0	0.0	6.9	7.4	8.1	9.4	11.5	12.5	14.6
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	21	25	28	31	33	35	40
Temperature (°C)	59	na	.	.	.	0	5	7	15	20	24	26
pH (s.u.)	59	na	<6	1	1.7	5.9	6.3	6.6	6.9	7.1	7.3	7.7
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0			.	61	61	61	61	61	61	61
TSS	43	3	>10	7	16.3	1	1	2	4	8	14	94
			>20	3	7.0							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	0	>50	4	6.9	1	2	3	6	9	17	150
			>25	4	6.9	.	.	.	.	.	.	.
			>10	9	15.5	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	45	21	.	.	.	0.01	0.01	0.01	0.01	0.07	0.12	0.81
TKN as N	44	3	.	.	.	0.10	0.10	0.10	0.20	0.20	0.30	0.60
NO_2+NO_3 as N	45	0	>10	0	0.0	0.04	0.10	0.14	0.16	0.19	0.21	0.55
Total Phosphorus	45	16	>0.05	6	13.3	0.01	0.01	0.01	0.01	0.02	0.08	0.58
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	57	92	128	270	540	1108	5900
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	28	>7	0	0.0	2	2	2	2	3	4	7
Iron (Fe)	44	0	>1000	6	13.6	150	265	403	615	763	1270	5700
Lead (Pb)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	44	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	30	>50	0	0.0	10	10	10	10	13	25	40

Bacteria (#/100 ml)

Fecal coliform	57	N>200= 7	N>400= 5	%>400= 8.8	Geometric mean= 43.1

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Henry Fork R at SR 1143 near Brookford	**Station:**	C4360000
Classification:	C	**Subbasin:**	CTB35
Period:	9/23/1997 to 8/6/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	58	0	<4	0	0.0	5.5	6.6	8.0	9.0	11.0	12.3	13.7
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	58	na	.	.	.	39	80	106	132	158	265	384
Temperature (°C)	59	na	.	.	.	1	6	8	16	21	24	27
pH (s.u.)	59	na	<6	0	0.0	6.6	6.8	7.0	7.1	7.2	7.3	8.1
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	1	0			.	250	250	250	250	250	250	250
TSS	42	4	>10	18	42.9	1	2	4	8	17	40	140
			>20	10	23.8							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	57	0	>50	3	5.3	2	3	5	7	16	29	300
			>25	8	14.0	.	.	.	.	.	.	.
			>10	21	36.8	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	44	12	.	.	.	0.01	0.01	0.01	0.06	0.20	0.26	0.44
TKN as N	43	2	.	.	.	0.10	0.10	0.20	0.20	0.30	0.42	0.60
NO_2+NO_3 as N	44	0	>10	0	0.0	0.10	0.30	0.34	0.43	0.53	0.64	0.81
Total Phosphorus	44	3	>0.05	34	77.3	0.01	0.03	0.06	0.11	0.23	0.36	0.51
Metals (µg/L)												
Aluminum (Al)	43	0	.	.	.	120	140	250	520	1055	2500	7300
Arsenic (As)	43	43	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	43	43	>2	1	2.3	2	2	2	2	2	2	10
Chromium (Cr)	43	43	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	43	9	>7	5	11.6	2	2	2	3	4	7	14
Iron (Fe)	43	0	>1000	17	39.5	300	424	655	870	1500	2360	9200
Lead (Pb)	43	43	>25	1	2.3	10	10	10	10	10	10	50
Manganese (Mn)	1	0	.	.	.	79	79	79	79	79	79	79
Mercury (Hg)	43	43	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	43	43	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	43	6	>50	0	0.0	10	10	13	18	23	28	49

Bacteria (#/100 ml)					
Fecal coliform	56	N>200= 22	N>400= 9	%>400= 16.1	Geometric mean= 124.6

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Jacob Fork at SR 1924 at Ramsey	**Station:**	C4370000
Classification:	WS-III ORW	**Subbasin:**	CTB35
Period:	12/9/1997 to 8/12/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	< or > Eval. Level %	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	48	0	<4	0	0.0	8.4	9.2	9.7	11.0	12.7	14.1	16.6
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	49	na	.	.	.	12	20	23	26	30	31	34
Temperature (°C)	48	na	.	.	.	0	6	8	16	20	22	24
pH (s.u.)	46	na	<6	2	4.3	5.8	6.2	6.4	6.7	6.8	7.0	7.5
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	26	0	>500	0	.	6	24	28	32	40	44	45
TSS	34	15	>10	0	0.0	1	1	1	2	3	4	7
			>20	0	0.0							
Chloride	24	0	>250	0	0.0	1	1	2	2	3	4	10
Turbidity (NTU)	48	2	>50	0	0.0	1	2	2	3	4	6	9
			>25	0	0.0	.	.	.	.	.	.	.
			>10	0	0.0	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	37	15	.	.	.	0.01	0.01	0.01	0.01	0.04	0.08	0.50
TKN as N	36	3	.	.	.	0.10	0.10	0.10	0.20	0.20	0.60	1.00
NO2+NO3 as N	37	4	>10	0	0.0	0.01	0.02	0.03	0.06	0.11	0.16	0.50
Total Phosphorus	37	17	>0.05	4	10.8	0.01	0.01	0.01	0.01	0.02	0.05	0.50
Metals (µg/L)												
Aluminum (Al)	35	5	.	.	.	50	50	74	120	140	242	460
Arsenic (As)	35	35	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	35	35	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	35	35	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	34	29	>7	0	0.0	2	2	2	2	2	2	4
Iron (Fe)	34	0	>1000	0	0.0	97	113	140	190	258	304	490
Lead (Pb)	35	34	>25	1	2.9	10	10	10	10	10	10	28
Manganese (Mn)	29	22	>200	0	0.0	10	10	10	10	10	12	28
Mercury (Hg)	35	35	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	35	35	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	35	28	>50	0	0.0	10	10	10	10	10	14	33

Bacteria (#/100 ml)

Fecal coliform	47	N>200= 2	N>400= 0	%>400= 0.0	Geometric mean= 8.8

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	S Fork Catawba R at NC 10 near Startown	Station:	C4380000
Classification:	WS-IV	Subbasin:	CTB35
Period:	9/23/1997 to 8/6/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	< or > Eval. Level %	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	57	0	<4	0	0.0	4.5	6.9	7.8	8.9	10.9	11.8	14.1
(DO; mg/L)			<5	1	1.8	.	.	.	.	.	.	.
Conductivity	57	na	.	.	.	37	62	73	90	123	185	262
Temperature (°C)	57	na	.	.	.	1	5	9	15	21	24	26
pH (s.u.)	57	na	<6	0	0.0	6.5	6.7	6.9	7.1	7.2	7.3	7.6
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	36	0	>500	0	.	49	58	69	77	99	130	180
TSS	43	0	>10	17	39.5	1	1	5	8	14	23	50
			>20	5	11.6							
Chloride	35	0	>250	0	0.0	3	5	7	11	13	22	44
Turbidity (NTU)	58	0	>50	2	3.4	3	3	4	7	14	24	280
			>25	5	8.6	.	.	.	.	.	.	.
			>10	21	36.2	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	45	14	.	.	.	0.01	0.01	0.01	0.03	0.07	0.16	0.35
TKN as N	44	2	.	.	.	0.10	0.10	0.10	0.20	0.30	0.30	0.60
NO2+NO3 as N	45	0	>10	0	0.0	0.23	0.30	0.34	0.40	0.44	0.50	0.61
Total Phosphorus	45	3	>0.05	27	60.0	0.01	0.03	0.04	0.08	0.11	0.22	0.55
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	82	113	208	460	715	1300	2600
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	21	>7	2	4.5	2	2	2	2	3	5	13
Iron (Fe)	44	0	>1000	16	36.4	330	390	635	915	1200	1600	3000
Lead (Pb)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	43	0	>200	0	0.0	28	32	41	51	63	80	90
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	20	>50	0	0.0	10	10	10	11	16	31	50

Bacteria (#/100 ml)					
Fecal coliform	57	N>200= 18	N>400= 7	%>400= 12.3	Geometric mean= 144.9

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Clark Cr at SR 1008 Grove St at Lincolnton			**Station:**	C4800000
Classification:	WS-IV			**Subbasin:**	CTB35
Period:	9/4/1997	to	8/8/2002		

Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**< or > Eval. Level N**	**< or > Eval. Level %**	**Percentiles Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	58	0	<4	0	0.0	5.8	6.7	7.1	8.5	10.2	11.1	12.6
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	58	na	.	.	.	139	171	240	326	421	559	1340
Temperature (°C)	58	na	.	.	.	2	6	10	16	20	23	24
pH (s.u.)	58	na	<6	0	0.0	6.4	7.1	7.3	7.6	7.7	7.8	8.5
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	36	0	>500	0	.	32	140	168	205	253	305	320
TSS	44	1	>10	22	50.0	2	3	7	11	14	34	190
			>20	6	13.6							
Chloride	35	0	>250	0	0.0	15	20	28	36	51	68	83
Turbidity (NTU)	59	0	>50	2	3.4	2	4	6	9	13	28	130
			>25	8	13.6	.	.	.	.	.	.	.
			>10	21	35.6	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	56	3	.	.	.	0.01	0.03	0.07	0.11	0.18	0.25	0.43
TKN as N	55	4	.	.	.	0.10	0.20	0.30	0.40	0.52	0.70	0.90
NO2+NO3 as N	56	0	>10	0	0.0	0.98	1.20	1.50	2.20	3.33	4.40	7.60
Total Phosphorus	57	2	>0.05	57	100.0	0.12	0.15	0.25	0.37	0.50	0.81	1.10
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	110	172	295	575	890	2450	16000
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	5	>7	6	13.6	2	2	3	4	6	8	15
Iron (Fe)	44	0	>1000	20	45.5	460	583	665	1000	1400	3060	14000
Lead (Pb)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	44	0	>200	1	2.3	34	48	59	74	91	107	240
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	13	>50	1	2.3	10	10	10	13	20	30	71

Bacteria (#/100 ml)					
Fecal coliform	59	N>200= 46	N>400= 25	%>400= 42.4	Geometric mean= 361.7

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Indian Cr at SR 1252 near Laboratory	Station:	C5170000
Classification:	WS-IV	Subbasin:	CTB35
Period:	9/4/1997 to 8/8/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	58	0	<4	0	0.0	6.0	7.6	8.2	9.8	11.3	12.7	14.5
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	58	na	.	.	.	61	74	88	110	145	211	383
Temperature (°C)	58	na	.	.	.	1	6	9	16	21	23	25
pH (s.u.)	58	na	<6	0	0.0	6.7	7.0	7.1	7.4	7.5	7.7	8.3
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	36	0	>500	0	.	55	71	83	100	145	170	300
TSS	44	2	>10	3	6.8	1	1	3	4	6	9	81
			>20	1	2.3							
Chloride	33	0	>250	0	0.0	2	4	4	4	5	6	10
Turbidity (NTU)	59	0	>50	1	1.7	2	3	4	6	9	12	90
			>25	1	1.7	.	.	.	.	.	.	.
			>10	12	20.3	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	45	10	.	.	.	0.01	0.01	0.01	0.04	0.08	0.22	0.80
TKN as N	45	2	.	.	.	0.10	0.20	0.20	0.30	0.40	0.56	1.00
NO2+NO3 as N	45	0	>10	0	0.0	0.04	0.73	0.83	0.98	1.20	1.56	2.80
Total Phosphorus	46	2	>0.05	43	93.5	0.04	0.08	0.11	0.17	0.24	0.42	3.30
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	90	120	188	240	435	587	8000
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	1	2.3	2	2	2	2	2	2	10
Chromium (Cr)	44	44	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	44	14	>7	5	11.4	2	2	2	3	4	8	17
Iron (Fe)	44	0	>1000	10	22.7	490	640	690	855	1000	1470	6400
Lead (Pb)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	43	0	>200	0	0.0	19	27	45	54	68	80	150
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	44	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	23	>50	1	2.3	10	10	10	10	18	22	90

Bacteria (#/100 ml)

Parameter	N				
Fecal coliform	59	N>200= 27	N>400= 8	%>400= 13.6	Geometric mean= 188.7

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Long Cr at SR 1456 near Bessemer City				**Station:**	C5900000
Classification:	C				**Subbasin:**	CTB36
Period:	9/18/1997	to	8/13/2002			

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Min.	10	25	50	75	90	Max.
						Percentiles						
Field												
Dissolved Oxygen	59	0	<4	3	5.1	2.3	6.4	7.2	9.0	10.5	12.2	13.4
(DO; mg/L)			<5	3	5.1	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	71	94	106	114	141	169	226
Temperature (°C)	59	na	.	.	.	3	7	9	14	21	22	26
pH (s.u.)	59	na	<6	1	1.7	5.4	6.8	7.0	7.2	7.3	7.5	8.3
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	.	.	.	.	.	.	.
TSS	43	4	>10	9	20.9	1	1	2	5	9	16	80
			>20	4	9.3							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	0	>50	3	5.2	3	3	5	7	12	22	170
			>25	6	10.3	.	.	.	.	.	.	.
			>10	18	31.0	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	55	16	.	.	.	0.01	0.01	0.01	0.04	0.12	0.18	0.50
TKN as N	53	8	.	.	.	0.10	0.10	0.20	0.20	0.30	0.40	1.00
NO_2+NO_3 as N	55	2	>10	0	0.0	0.01	0.17	0.31	0.39	0.52	0.57	0.85
Total Phosphorus	56	4	>0.05	32	57.1	0.02	0.03	0.04	0.06	0.08	0.13	0.52
Metals (µg/L)												
Aluminum (Al)	43	0	.	.	.	67	122	155	290	665	2040	3900
Arsenic (As)	43	43	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	43	43	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	43	43	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	43	28	>7	3	7.0	2	2	2	2	4	6	18
Iron (Fe)	43	0	>1000	17	39.5	400	550	650	900	1300	2500	4400
Lead (Pb)	43	43	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	43	43	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	43	43	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	43	30	>50	2	4.7	10	10	10	10	12	27	83

Bacteria (#/100 ml)

Fecal coliform	58	N>200= 42	N>400= 22	%>400= 37.9	Geometric mean= 349.6

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	S Fork Catawba R at NC 7 at McAdenville	**Station:**	C6500000
Classification:	WS-V	**Subbasin:**	CTB36
Period:	9/16/1997 to 8/13/2002		

				< or > Eval. Level		Percentiles						
Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**N**	**%**	**Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	59	0	<4	0	0.0	5.2	7.1	7.7	9.2	10.9	12.4	14.0
(DO; mg/L)			<5	0	0.0	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	53	95	159	195	250	298	430
Temperature (°C)	59	na	.	.	.	2	7	10	16	23	26	28
pH (s.u.)	59	na	<6	0	0.0	6.5	7.3	7.4	7.5	7.7	7.9	8.3
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	32	0	>500	1	.	48	89	120	140	180	199	1500
TSS	44	2	>10	20	45.5	1	4	6	10	14	26	60
			>20	6	13.6							
Chloride	35	0	>250	0	0.0	5	9	15	20	30	37	54
Turbidity (NTU)	59	0	>50	3	5.1	5	6	8	10	14	28	800
			>25	9	15.3	.	.	.	.	.	.	.
			>10	26	44.1	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	56	3	.	.	.	0.01	0.03	0.06	0.10	0.14	0.26	0.56
TKN as N	54	0	.	.	.	0.20	0.20	0.30	0.40	0.54	0.71	1.10
NO2+NO3 as N	56	0	>10	0	0.0	0.42	0.66	0.77	0.94	1.10	1.30	1.90
Total Phosphorus	57	3	>0.05	56	98.2	0.04	0.10	0.13	0.18	0.23	0.28	1.70
Metals (µg/L)												
Aluminum (Al)	44	0	.	.	.	110	245	365	585	930	1810	37000
Arsenic (As)	44	44	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	44	44	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	44	43	>50	0	0.0	25	25	25	25	25	25	26
Copper (Cu)	44	8	>7	5	11.4	2	2	2	3	4	9	350
Iron (Fe)	44	0	>1000	25	56.8	460	670	785	1100	1300	1800	28000
Lead (Pb)	44	43	>25	1	2.3	10	10	10	10	10	10	35
Manganese (Mn)	44	0	>200	1	2.3	30	42	52	68	85	99	1000
Mercury (Hg)	44	44	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	44	43	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	44	21	>50	2	4.5	10	10	10	11	17	40	120

Bacteria (#/100 ml)

Fecal coliform 56 N>200= 8 N>400= 4 %>400= 7.1 Geometric mean= 63.1

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	S Fork Catawba R at SR 2524 near South Belmont		Station:	C7000000
Classification:	WS-V&B		Subbasin:	CTB36
Period:	9/11/1997	to 8/28/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	54	0	<4	1	1.9	3.4	6.5	7.3	8.9	9.8	11.1	12.2
(DO; mg/L)			<5	1	1.9	.	.	.	.	.	.	.
Conductivity	54	na	.	.	.	55	83	108	119	134	142	171
Temperature (°C)	54	na	.	.	.	6	12	19	25	31	34	37
pH (s.u.)	54	na	<6	0	0.0	6.7	6.9	7.0	7.5	8.2	8.6	9.0
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	35	0	>500	0	.	57	71	78	90	100	110	240
TSS	42	5	>10	2	4.8	1	1	3	5	6	8	140
			>20	1	2.4							
Chloride	34	0	>250	0	0.0	5	7	10	11	14	16	19
Turbidity (NTU)	55	0	>50	2	3.6	1	4	5	6	10	15	200
			>25	3	5.5	.	.	.	.	.	.	.
			>10	13	23.6	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH3 as N	43	12	.	.	.	0.01	0.01	0.01	0.05	0.09	0.18	0.40
TKN as N	43	1	.	.	.	0.10	0.10	0.20	0.30	0.34	0.40	0.60
NO2+NO3 as N	43	5	>10	0	0.0	0.01	0.02	0.10	0.23	0.34	0.38	0.59
Total Phosphorus	43	2	>0.05	19	44.2	0.01	0.03	0.04	0.05	0.07	0.09	0.26
Metals (µg/L)												
Aluminum (Al)	42	0	.	.	.	85	140	190	310	470	871	2600
Arsenic (As)	42	42	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	42	42	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	42	42	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	42	2	>7	34	81.0	2	6	8	9	11	13	36
Iron (Fe)	42	0	>1000	3	7.1	170	221	263	465	550	777	2900
Lead (Pb)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	42	0	>200	0	0.0	12	26	31	39	45	59	170
Mercury (Hg)	42	42	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	42	19	>50	1	2.4	10	10	10	11	17	30	60

Bacteria (#/100 ml)

Fecal coliform	53	N>200= 2	N>400= 1	%>400= 1.9	Geometric mean= 12.8

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Catawba Cr at SR 2302 at NC-SC State Line									**Station:**		C7400000
Classification:	C									**Subbasin:**		CTB37
Period:	9/11/1997 to 8/28/2002											

Parameter	**N**	**Num. < R.L.**	**Eval. Level**	**< or > Eval. Level N**	**%**	**Percentiles Min.**	**10**	**25**	**50**	**75**	**90**	**Max.**
Field												
Dissolved Oxygen	55	0	<4	0	0.0	4.2	6.7	8.0	9.2	10.2	11.1	13.6
(DO; mg/L)			<5	1	1.8	.	.	.	.	.	.	.
Conductivity	55	na	.	.	.	65	90	108	121	132	140	151
Temperature (°C)	55	na	.	.	.	8	10	15	22	28	31	34
pH (s.u.)	53	na	<6	0	0.0	6.8	7.0	7.3	7.6	8.7	8.9	9.2
			>9	4	7.5	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	9	0			.	65	74	86	91	96	100	100
TSS	42	1	>10	1	2.4	1	2	3	4	5	8	11
			>20	0	0.0							
Chloride	8	0	>230	0	0.0	7	8	9	11	12	14	15
Turbidity (NTU)	55	0	>50	0	0.0	2	3	4	5	7	10	21
			>25	0	0.0	.	.	.	.	.	.	.
			>10	5	9.1	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	43	14	.	.	.	0.01	0.01	0.01	0.05	0.09	0.12	0.43
TKN as N	43	1	.	.	.	0.10	0.20	0.20	0.30	0.40	0.49	0.70
NO_2+NO_3 as N	43	10	>10	0	0.0	0.01	0.01	0.02	0.16	0.28	0.35	0.58
Total Phosphorus	43	2	>0.05	13	30.2	0.01	0.03	0.03	0.05	0.06	0.07	0.10
Metals (µg/L)												
Aluminum (Al)	42	0	.	.	.	54	120	143	260	388	459	1400
Arsenic (As)	42	42	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	42	42	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	42	42	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	42	2	>7	8	19.0	2	2	4	5	6	10	13
Iron (Fe)	42	0	>1000	0	0.0	84	141	175	275	398	506	990
Lead (Pb)	42	42	>25	0	0.0	10	10	10	10	10	10	10
Manganese (Mn)	11	0	.	.	.	15	23	26	36	43	52	91
Mercury (Hg)	42	42	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	42	42	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	42	27	>50	2	4.8	10	10	10	10	15	22	69

Bacteria (#/100 ml)					
Fecal coliform	52	N>200= 0	N>400= 0	%>400= 0.0	Geometric mean= 8.9

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Crowders Cr at SC 564 Ridge Rd near Bowling Green, SC	Station:	C8660000
Classification:	FW	Subbasin:	CTB37
Period:	9/18/1997 to 8/13/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Percentiles Min.	10	25	50	75	90	Max.
Field												
Dissolved Oxygen	59	0	<4	1	1.7	3.6	6.6	7.4	8.7	10.7	11.7	13.0
(DO; mg/L)			<5	2	3.4	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	114	193	297	378	568	802	1670
Temperature (°C)	59	na	.	.	.	4	8	10	16	22	23	26
pH (s.u.)	59	na	<6	0	0.0	6.7	7.0	7.3	7.5	7.8	7.9	8.2
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	.	.	.	.	.	.	.
TSS	43	3	>10	11	25.6	1	2	3	6	12	24	200
			>20	5	11.6							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	58	0	>50	1	1.7	2	3	4	6	10	19	220
			>25	5	8.6	.	.	.	.	.	.	.
			>10	12	20.7	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	55	4	.	.	.	0.01	0.03	0.06	0.12	0.46	1.96	5.20
TKN as N	53	1	.	.	.	0.20	0.30	0.40	0.60	1.10	2.38	5.60
NO_2+NO_3 as N	55	0	>10	0	0.0	0.09	0.81	1.10	1.70	2.70	3.72	6.50
Total Phosphorus	56	3	>0.05	54	96.4	0.03	0.11	0.14	0.28	0.50	0.67	3.80
Metals (µg/L)												
Aluminum (Al)	43	0	.	.	.	80	142	230	420	710	1600	9800
Arsenic (As)	43	43	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	43	43	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	43	43	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	43	6	>7	8	18.6	2	2	3	4	5	8	21
Iron (Fe)	43	0	>1000	10	23.3	270	430	510	660	1000	1680	17000
Lead (Pb)	43	42	>25	0	0.0	10	10	10	10	10	10	11
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	43	43	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	43	42	>88	0	0.0	10	10	10	10	10	10	12
Zinc (Zn)	43	7	>50	4	9.3	10	10	12	16	25	36	74

Bacteria (#/100 ml)

Fecal coliform	58	N>200= 34	N>400= 13	%>400= 22.4	Geometric mean= 224.1

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.

Location:	Twelve Mile Cr at NC 16 near Waxhaw	Station:	C9819500
Classification:	C	Subbasin:	CTB38
Period:	9/24/1997 to 8/5/2002		

Parameter	N	Num. < R.L.	Eval. Level	< or > Eval. Level N	%	Min.	Percentiles 10	25	50	75	90	Max.
Field												
Dissolved Oxygen	58	0	<4	6	10.3	0.6	4.1	5.8	7.4	10.1	11.9	13.4
(DO; mg/L)			<5	9	15.5	.	.	.	.	.	.	.
Conductivity	59	na	.	.	.	65	86	110	122	134	150	216
Temperature (°C)	59	na	.	.	.	1	5	8	15	21	23	24
pH (s.u.)	59	na	<6	0	0.0	6.3	6.8	7.0	7.1	7.2	7.4	7.6
			>9	0	0.0	.	.	.	.	.	.	.
Other (mg/L)												
Total Residue	0	0			.	.	.	.	.	.	.	.
TSS	43	3	>10	10	23.3	1	1	2	4	10	20	530
			>20	5	11.6							
Chloride	0	0	>230	0	.	.	.	.	.	.	.	.
Turbidity (NTU)	55	0	>50	7	12.7	3	6	8	15	33	60	500
			>25	20	36.4	.	.	.	.	.	.	.
			>10	34	61.8	.	.	.	.	.	.	.
Nutrients (mg/L)												
NH_3 as N	56	13	.	.	.	0.01	0.01	0.01	0.06	0.14	0.29	0.60
TKN as N	55	2	.	.	.	0.10	0.20	0.25	0.40	0.56	0.92	1.50
NO_2+NO_3 as N	56	6	>10	0	0.0	0.01	0.02	0.08	0.32	0.46	0.56	3.00
Total Phosphorus	56	3	>0.05	42	75.0	0.03	0.04	0.06	0.07	0.10	0.18	0.97
Metals (µg/L)												
Aluminum (Al)	43	0	.	.	.	65	132	260	560	1350	2400	14000
Arsenic (As)	43	43	>50	0	0.0	10	10	10	10	10	10	10
Cadmium (Cd)	43	43	>2	0	0.0	2	2	2	2	2	2	2
Chromium (Cr)	43	43	>50	0	0.0	25	25	25	25	25	25	25
Copper (Cu)	43	16	>7	5	11.6	2	2	2	3	4	7	17
Iron (Fe)	43	0	>1000	30	69.8	410	714	1000	1400	1900	2600	21000
Lead (Pb)	43	42	>25	0	0.0	10	10	10	10	10	10	11
Manganese (Mn)	0	0	.	.	.	.	.	.	.	.	.	.
Mercury (Hg)	43	43	>0.012	0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel (Ni)	43	43	>88	0	0.0	10	10	10	10	10	10	10
Zinc (Zn)	43	30	>50	2	4.7	10	10	10	10	13	24	79

Bacteria (#/100 ml)

Fecal coliform	57	N>200= 38	N>400= 18	%>400= 31.6	Geometric mean= 285.9

Abbreviations: N = number of samples; Num. < R.L. = number < Reporting Level; < or > refers to "less than or greater than"; TSS = Total Suspended Solids; conductivity measured as µmhos/cm; na = not applicable.
Evaluation Levels (Eval. Level) are presented to facilitate review. Some levels refer to water quality standards; others may be used for ecological or Action Level review.