Attachment 2

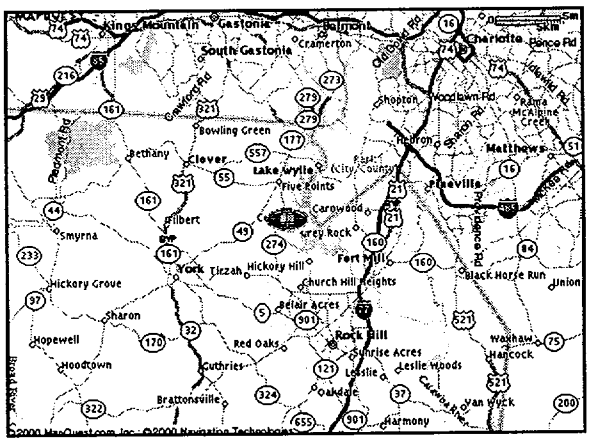
Catawba River System
and
Catawba Nuclear Plant

October 22, 2001

Catawba Nuclear Station
The Future of Nuclear Power

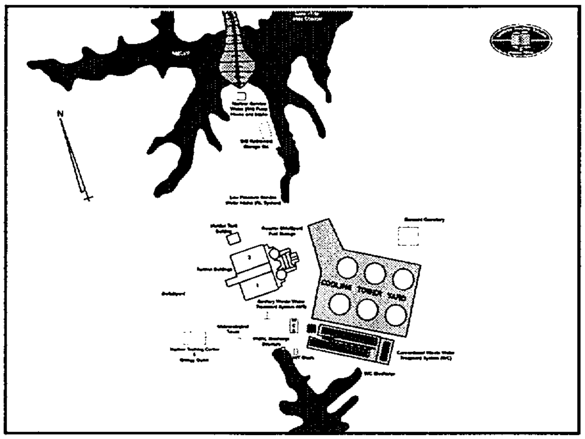
Catawba Nuclear Station

York, S.C.



- Two unit Westinghouse PWR
- 1,129 megawatts each
- ~20% of Duke's generation
- Cooling towers
- Ice condensers
- 391 acre site

- June 1974 - Construction began
- June 1985 - Unit 1 began commercial operation
- August 1986 - Unit 2 began commercial operation
- Gary Peterson VP since 7/97
- ~1200 employees



Catawba Nuclear Owner's Group

- NC Electric Membership Corporation
- NC Municipal Power Agency No. 1
- Piedmont Municipal Power Agency
- Saluda River Electric Cooperative, Inc.
- Duke Energy

Catawba Performance

Capacity Factor	Unit 1	Unit 2	CNS Site
1998	90.03	87.69	88.86
1999	91.75	89.54	90.64
2000	89.98	90.56	90.27
2001 YTD	100.29	95.79	98.04

Catawba Performance Cont.

- CNS Unit 2 463-day continuous run
- CNS dual-unit run - 238 days
- Lowest nuclear fuel cost in the U.S. from 1998 - 2000
- INPO rating - consecutive "1" ratings (since 1998)
- NRC performance indicators - all green
- CNS's shortest RFO to date is 28-days
- Continuous improvement

Catawba Environmental Management Organization Chart

Cheryl Peed
Catawba EHS Manager
BS Chemistry, CHMM, SC Water/Dual Wastewater Certified,
NC & SC Pesticide Certified
19 yrs experience in EHS/Chm Mngt @ CNS

Water – DABain/MARott
- 2 Scientists (in rotation w/Chm)
- BS Biology
- CHMM
- AWWA
- SC Water/Dual Wastewater Certified
- Combo 34 yrs experience in Env/Chm @ CNS

Chemicals – JEReece
- 1 Scientist
- BS Environmental Engineering
- CHMM
- SC Water/Dual Wastewater Certified
- NC & SC Pesticide Certification
- EPA Refrigerant Certified
- Asbestos Supervisor Certified
- 20 yrs experience in Env/Chm @ CNS

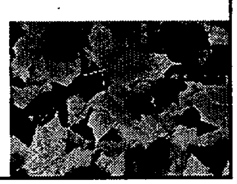
Waste – JTHarris
- 1 Scientist
- BS Management/ Biology Minor
- CHMM
- SC Water/Dual Wastewater Certified
- 24 yrs experience in Env/Chm @ CNS

Air & DOT – KARowland
- 1 Engineer
- BS Engineering
- SC Registered PE - Civil
- Asbestos Supervisor Certified
- EPA Refrigerant Certified
- 12 yrs experience in Eng/Env @ CNS

Chemical Coordinator – JLFaile
- 1 Technical Specialist
- BS Education
- MEd Counseling
- 13 yrs experience in Commodities/Env @ CNS

Catawba Environmental Management

- Regulatory compliance oversight and guidance for the site
- Interface with regulatory agencies and inspectors
- Manage environmental permits and documents
- Develop and integrate site environmental processes and tools (Environmental Work Practices)
- Assess compliance



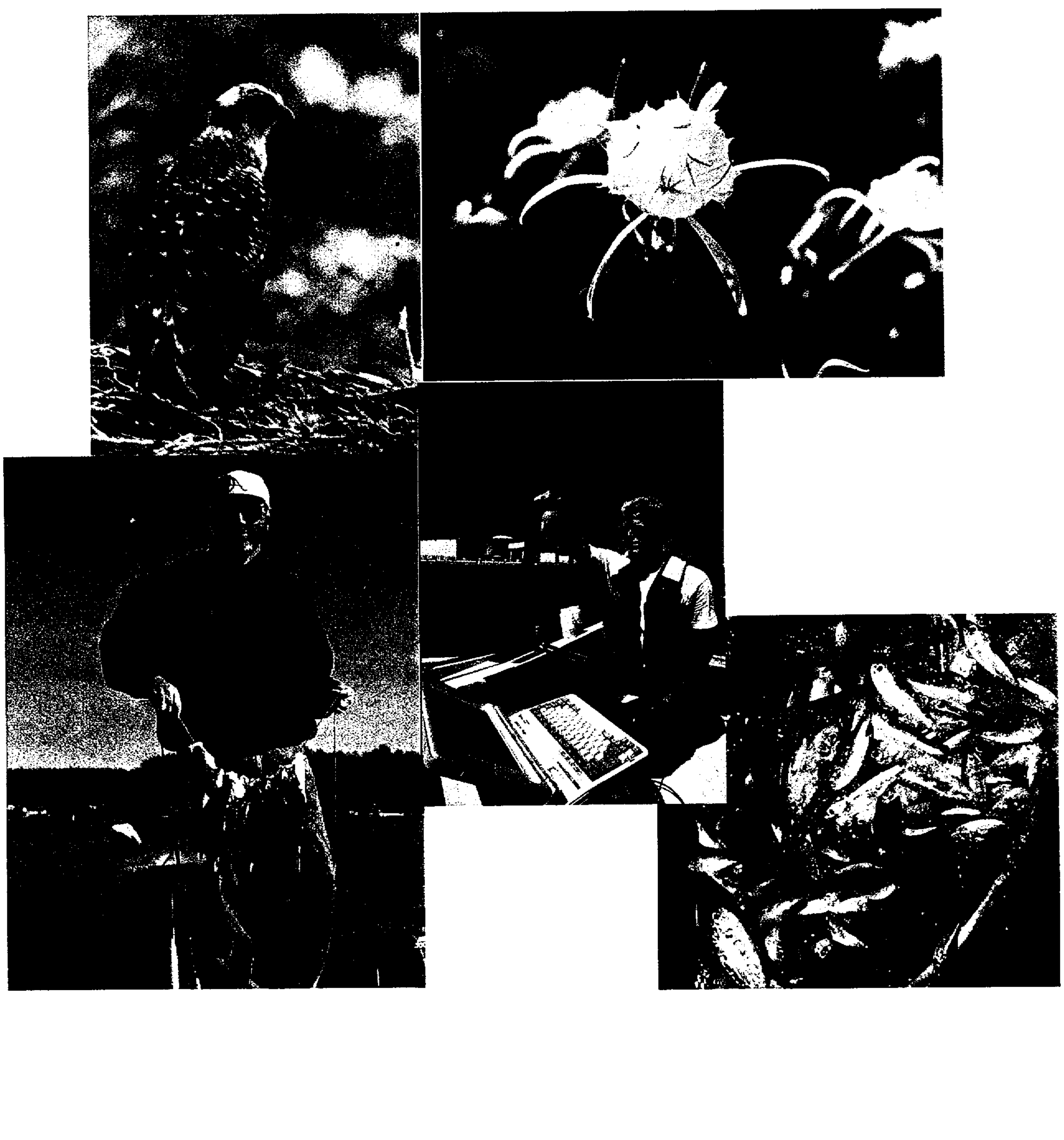
Catawba
Environmental Excellence

- Wildlife and Industry Together certification by the S.C. Wildlife Federation is in the final stages of the approval process
- Nature trail, bluebird boxes, deer and quail food plots, butterfly garden, outdoor classroom, native wild flower plot, and Osprey towers

Duke Power®
A Duke Energy Company

THE CATAWBA

An update on the Catawba River Basin and the Catawba reservoirs



The quality of water in the Catawba River is important to Duke Power. We believe in protecting and preserving the Catawba River. Fifty percent of Duke Power's capacity for electric generation relies on the Catawba, so we invest time, resources and our scientific expertise in balancing our customers' demand for electricity with protecting our natural resources.

We also carry this effort out through numerous partnerships. Duke Power has a long-standing tradition of monitoring water quality and the biological communities that live in the lakes and the river and we routinely share this information with state agencies and other partners along the Catawba River. **This publication helps us to do just that by providing you with five years of key water quality data we've collected in the Catawba River reservoirs.**

Taking care of natural resources also requires that we anticipate the future, so that we can begin to take proper steps to preserve and protect those resources now. For instance, Duke Power took a lead role in developing, with other stakeholders, a watershed computer model that mimics water quality and predicts how future growth and development will impact water quality in the Catawba River. The model, Watershed Analysis Risk Management Framework (WARMF), part of an Electric Power Research Institute study, contains a module that helps stakeholders reach a consensus about a vision and management plan for the Catawba River.

For more information about Duke Power and its efforts to protect natural resources visit www.dukepower.com.

October 2000

Eleven major reservoirs are located on the Catawba River in North and South Carolina. Uppermost Lake James is formed by Bridgewater Dam, located 206 river miles upstream of the lowermost Lake Wateree Dam. Construction of the chain of reservoirs, owned and operated by Duke Power, spanned about 60 years. Lake Wylie was the earliest reservoir, impounded in 1904, while Lake Norman was the latest, completed in 1963. About 42 of the Catawba's total 225 river miles upstream of Lake Wateree Dam remain free-flowing, with about 18 miles below Lake James, and about 24 miles downstream of Lake Wylie. The Catawba reservoirs change in elevation from 1200 feet above mean sea level (msl) at Lake James to 147.5 feet msl in the Wateree tailwater.

What's in the report?

This report provides information for nine of the largest Catawba reservoirs. Each reservoir is described individually with a summary page of general information, including a map, hydromorphometry data, electric generation, watershed and land use characteristics, a typical summer water column profile of temperature and dissolved oxygen, and various other summary environmental statistics. Following each reservoir summary page, text and graphics provide a more detailed overview of information from 1993 through 1997.

Topics addressed are water quality, trophic status, phytoplankton and zooplankton populations, the littoral fish community, and the fish health index. A final section integrates information from each of the Catawba reservoirs to provide an overview of how the system of reservoirs changes as one proceeds down river from Lake James through Lake Wateree. A discussion of water quality trends, fisheries and wildlife, threatened and endangered species, and reservoir aging is also included.

Watershed data provided in this report are presented primarily in English measurement units, while environmental data are generally presented in metric units. A table of measurement unit conversions and a glossary of scientific terms used in this report are included (pages 48-50) to assist the reader.

CONTENTS

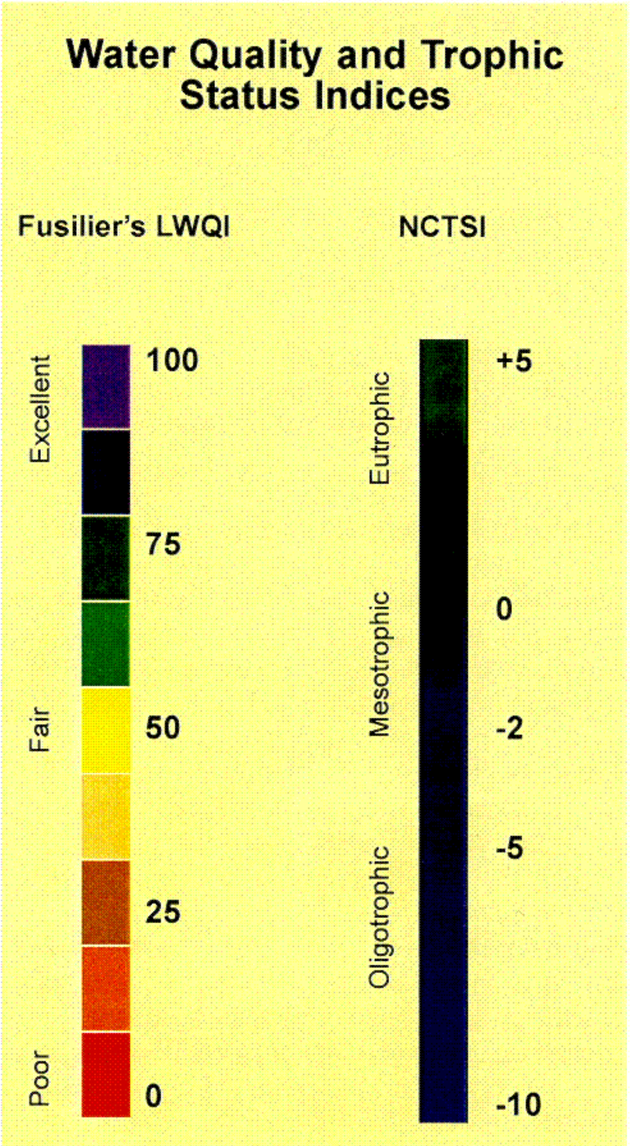
Measuring...and defining...Catawba River water quality

Water quality is a highly subjective concept that can be appreciated in any number of ways, all stemming from a wide variety of end uses. For example, reservoirs may be used for hydroelectric power generation, flood control, steam-electric plant cooling water, withdrawals to drinking water or industrial systems, crop irrigation, and for recreational purposes, including fishing, swimming and boating. All potential users of the resource have an interest in water quality, but often from different perspectives. As an example, in order to reduce treatment costs, drinking water system operators would like their "raw" water to be of high clarity, free of harmful contaminants, and low in dissolved organic material. Anglers, on the other hand, desire high productivity waters, capable of supporting a large sport fishery. It is not unusual for different "user groups" to end up with somewhat opposing ideas of what constitutes "good" water quality, and thereby, incongruent management goals for the resource.

It is not unusual for different "user groups" to end up with somewhat opposing ideas of what constitutes "good" water quality...

A challenging undertaking

Numerous physical, chemical and biological measurements have been used by scientists to characterize water quality. However, the data accumulated from a large array of measurement techniques can be overwhelming and technical in nature, making communication of water quality information to a diverse audience a challenging undertaking. Therefore, indices that condense a lot of water quality measurements into a simple, single value have been developed to help communicate an overall picture of the "environmental health" of waterbodies to environmental management professionals, policy makers, and the public. Indices can still hold important value as a rapid communication tool for diverse audiences despite the inevitable loss of detailed, parameter-specific information in such indices (i.e., information that water quality professionals typically utilize to recognize and most efficiently address specific causes of water quality problems).



An assortment of quality indices

Water quality indices fall into two general categories. One addresses water quality from the perspective of public health and resource use impairment (e.g., is the water drinkable, fishable, swimmable, etc?). The other category addresses

C01

waterbody deviates from a defined "background" state, normally intended to represent unimpaired or pristine conditions. A criticism of water quality indices of the latter type has been that they often do not properly account for regional differences in defining this "background" condition. Nonetheless, there is value to be gained from the use of indices because they enable rapid evaluation of water quality in a relatively consistent way over a wide geographic area. In order to fully appreciate what an index communicates, an understanding of the individual measurements employed in the calculation of an index, and the management assumptions about these parameters (e.g., what levels of each constituent are judged to be optimal or detrimental to the intended management goals) is needed.

Human-influenced nutrient enrichment of aquatic ecosystems is one of the principal environmental problems facing the world today.

Realizing the broad role that water quality indices could play in communicating routine water quality assessments, Duke Power evaluated 26 different indices in order to select one which would be most suitable and informative when used on the Catawba reservoirs. Since 1994, Duke has employed Fusilier's Lake Water Quality Index, or Fusilier's LWQI, to summarize water quality data collected on a quarterly basis from the Catawba reservoirs.

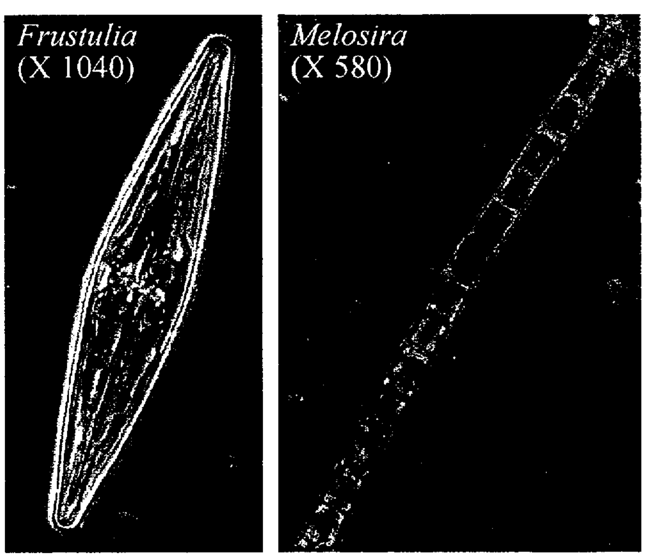
What factors are used to calculate the Lake Water Quality Index?

Fusilier's LWQI is a non-weighted, multiplicative index that integrates nine commonly measured water quality variables into an indexed value that can be compared graphically on an index scale (see figure on page 2). Measurements of water temperature, dissolved oxygen saturation, pH, conductivity, chlorophyll *a* (a relative indicator of algal density), total phosphorus, nitrates, alkalinity, and Secchi depth (depth of light transmission) are each individually scored on a separate opinion-derived scale of 0 (poor) to 100 (excellent) units; then these nine individual quality ratings are multiplied. The ninth root, or geometric mean, is then taken to arrive at the LWQI. Mapping the LWQI to a colored scale (depicted on page 2) is useful when examining a large amount of data for trends.

Assessing trophic status and cultural eutrophication

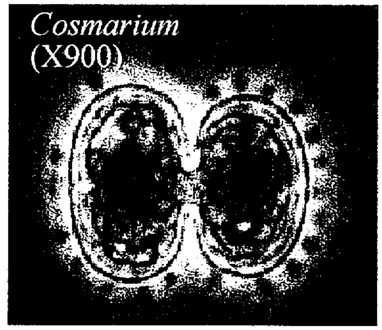
Human-influenced nutrient enrichment of aquatic ecosystems is one of the principal environmental problems facing the world today. This process, classically termed "cultural eutrophication," is tightly coupled to human population growth and development, and often leads to significant water quality deterioration and impaired use of the affected waterbody.

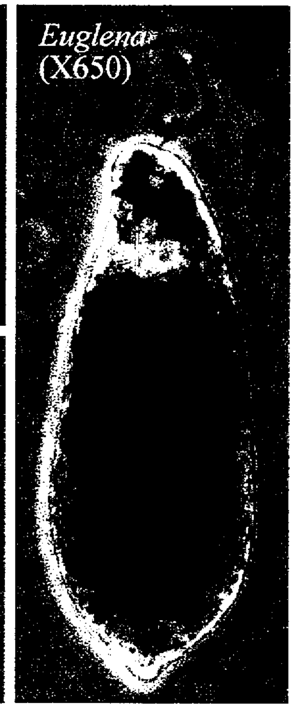
Biological productivity of most freshwaters is limited by aqueous nutrient concentrations, especially phosphorus and nitrogen. When these compounds become readily available through either point source discharges or non-point origins, significant changes occur in the physical, chemical and biological characteristics of these waterbodies. Most notable is an increase in algal biomass, which at moderate levels can be biologically beneficial to higher trophic levels, but at elevated levels can result in oxygen-limiting conditions detrimental to the biota.



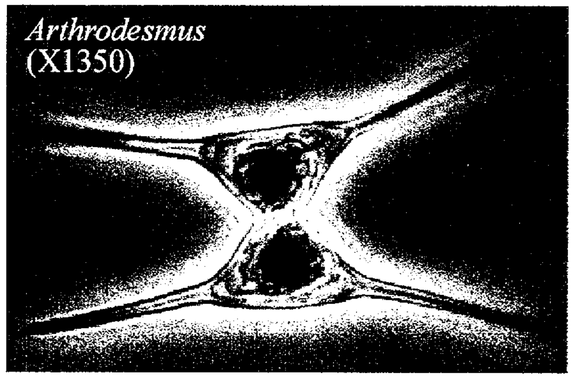
Phytoplankton (two types of diatoms).

Common trophic classifications



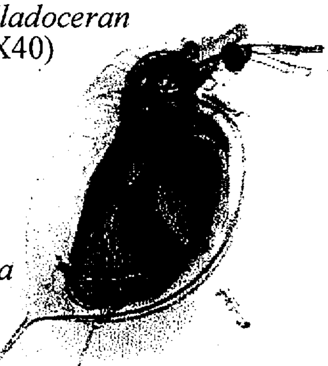


Three trophic status classifications are commonly employed to characterize surface waters. Waterbodies that exhibit low concentrations of nutrients and algal biomass and high levels of hypolimnetic dissolved oxygen and vertical light penetration are classified as *oligotrophic*. Those that have intermediate or moderate levels of these parameters are termed *mesotrophic*. *Eutrophic* waterbodies are those that exhibit exceedingly high concentrations of both nutrients and algae, in addition to decreased water clarity and low hypolimnion levels of dissolved oxygen. Over time, eutrophic waters tend to produce undesirable ecological communities that are dominated by organisms which tolerate turbid waters and low dissolved oxygen content.



Counterclockwise from upper right: an euglenoid alga (Euglena) and two types of desmids (Cosmarium and Arthrodesmus). At right, a zooplankton.

Cladoceran
(X40)



Daphnia

Various specific biological, chemical, and physical measurements have been employed to classify a waterbody according to its appropriate trophic status or degree of eutrophication. These measurements typically include algal pigment assessments (chlorophyll *a*), Secchi depth, phosphorus and nitrogen concentrations, and both concentration and rate of depletion of hypolimnion dissolved oxygen. For the main Catawba reservoirs, Duke Power has adopted the use of the North Carolina Trophic State Index (NCTSI), which utilizes measurements of total organic nitrogen, total phosphorus, Secchi depth, and chlorophyll *a* in calculating a trophic status index (see page 2). In this document, chlorophyll *a* and the NCTSI were examined to assess the temporal and spatial variability in the trophic status of the various reservoirs throughout the Catawba River.

Biological assessment methods

Characterizing phytoplankton and zooplankton communities

The algal community of a waterbody changes in direct response to changes in nutrient concentrations. Some algal species are found more often in nutrient poor waters; others are found in nutrient rich waters; while still others have a broad range of tolerance and are not especially restricted by nutrients. Species of blue-green algae (Myxophyceae) are commonly associated with high nutrients while desmids, a subgroup of green algae, are typically associated with nutrient poor waters. Duke Power has adopted the use of the Myxophycean Index (determined from the number of blue-green algal species divided by the number of desmid algal species) as a biological indicator to assist in tracking general trends in the phytoplankton community, and thereby provide inference on the trophic status of lakes. Over time, the Myxophycean Index has been gradually "fine tuned" for

use in the Catawba Lakes. In the Catawba Basin, low index values (< 1) typically correspond to oligotrophic status; intermediate values (1 to 3) correspond to mesotrophic conditions, and higher index values (> 3) are usually consistent with eutrophic conditions.

The planktonic (i.e., freely drifting or swimming) algae (*phytoplankton*) and animals (*zooplankton*) were sampled from each of the main Catawba reservoirs seasonally from 1993-1997. Samples were collected from forebay locations in all lakes, and uplake samples were collected from Lakes Wateree, Wylie, and Norman. All plankton samples were later examined microscopically in order to evaluate taxa collected at each location.

Phytoplankton samples were obtained from discrete depths and preserved. Taxonomic data were used to calculate the Myxophycean Index, as previously described. Zooplankton were collected from the water column with a standard net lowered to a depth of 10 meters (or one meter above the bottom in the shallower reservoirs) and towed to the surface. Zooplankton samples were rinsed into collection jars and preserved. Zooplankton taxa were subcategorized into one of three major groups — cladocerans, copepods, and rotifers — for presentation in this report.

Sampling and evaluating fisheries in the Catawba reservoirs

Fish were collected from Catawba River reservoirs using boat-mounted electrofishing equipment, and were released after data collection. Samples were collected during daylight hours along standard 300-meter shoreline transects in the spring, when water temperatures generally ranged from 15 to 20 °C. Transects were selected to include all the various habitat types found in the reservoirs that could be effectively sampled. The only areas excluded were shallow flats where the boat could not effectively access the shoreline.

Ten transects were sampled in Lakes Rhodhiss, Lookout Shoals, Mountain Island, and Fishing Creek; 20 in Lakes Hickory and Wateree; and 30 in Lakes James, Norman, and Wylie. Lakes Norman, Mountain Island, and Wylie were sampled annually in 1993-97, while the remaining reservoirs were sampled annually in 1994-97. All fish collected were identified to species, and total number and total weight were obtained for each species. In this report, the combined biomass of fish collected from these littoral zone samples at each location is presented.

Assessing largemouth bass health

The fish health assessment index (FHAI) procedure is an autopsy-based field procedure involving observation and gross evaluation of various organs, structures and blood. Initially developed to assess hatchery-reared fish stocks, the FHAI has been modified and is now used routinely to assist in the evaluation of wild populations. The FHAI, while not a diagnostic procedure, provides a method to identify areas where further study may be directed, and a consistent means to compare fish health over time or among sites.

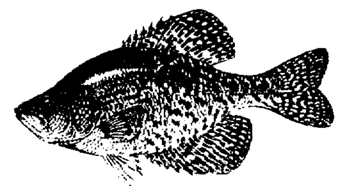
The FHAI procedure numerically scores deviations from the "normal" appearance or value for a list of metrics, which are then summed to produce one number describing the health of the population. Higher scores indicate relatively poorer health.

Catawba River FHAI methods involved examination of electrofished largemouth bass (*Micropterus salmoides*) ranging from 250 to 450 mm total length. Fifteen fish were collected from each site, characterizing fisheries from the Catawba reservoirs and four sections of free-flowing river.

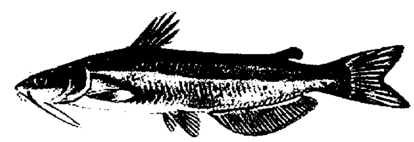
The FHAI procedure numerically scores deviations from the "normal" appearance or value for a list of metrics, which are then summed to produce one number describing the health of the population. Higher scores indicate relatively poorer health.

Principal Sport Fish of the Catawba Reservoirs

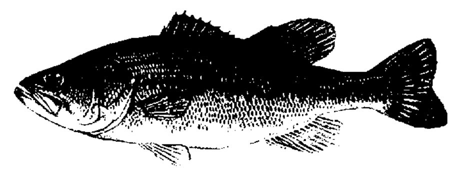
Black Crappie
(Pomoxis nigromaculatus)



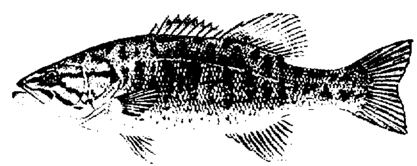
Channel Catfish
(Ictalurus punctatus)



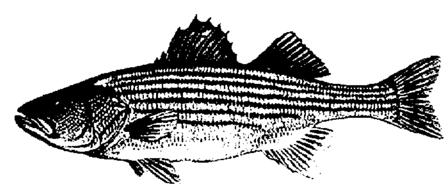
Largemouth Bass
(Micropterus salmoides)



Smallmouth Bass
(Micropterus dolomieu)



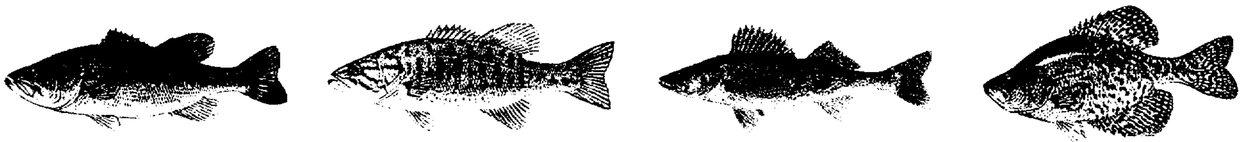
Striped Bass
(Morone saxatilis)



Walleye
(Stizostedion vitreum)

The above images appear in the following lake-by-lake summaries (pages 7-42) as an indication of the primary sought-after sport fish in the largest nine Catawba reservoirs.

LAKE JAMES



Lake James At A Glance

Hydromorphometry

Surface Elevation:	1,200 feet above MSL
Surface Area:	6,510 acres
Volume:	288,800 acre-feet
Retention Time:	224 days (average)
Average River Flow	
Bridgewater Dam:	420 MGD
Maximum Depth:	141 feet
Average Depth:	44.3 feet
Length (Main Channel):	14.8 miles
Shoreline:	150 miles
Maximum Drawdown:	40 feet

Duke Power Electric Generation

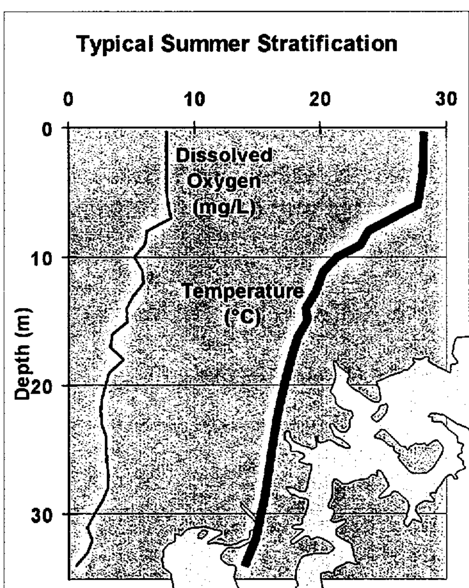
Bridgewater Hydro:	20 MW
Total Electric Capacity:	20 MW

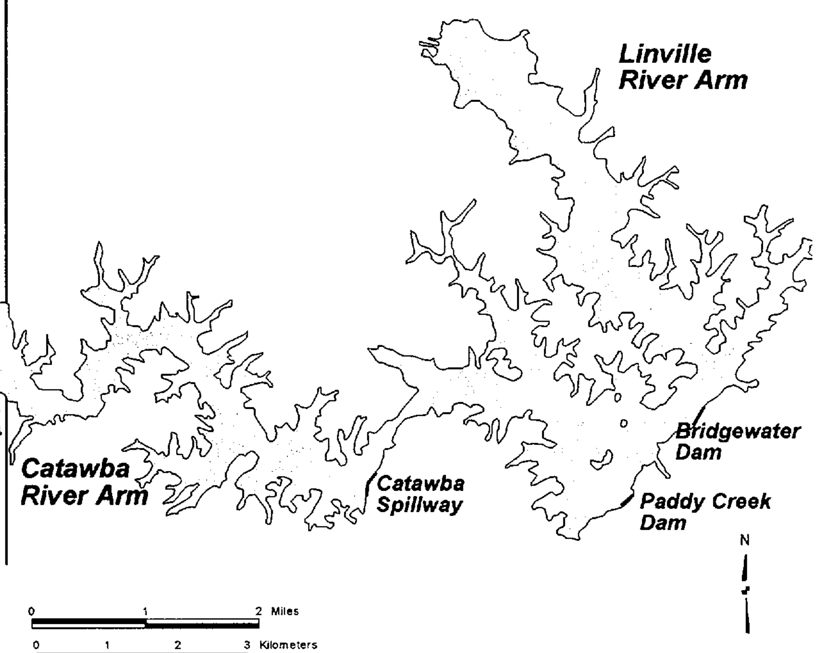
Watershed Characteristics

Year Impounded:	1923
Drainage Area:	380 square miles
Sub-Basin Population	23,622 (1990)
Watershed Land Cover:	0.6% urban
	7.4% cultivated
	91.7% forested
	0.3% other undeveloped

Shoreline Use

Residential and Commercial:	11.8%
Recreational:	0.6%
Other:	2.1%
Undeveloped:	85.5%

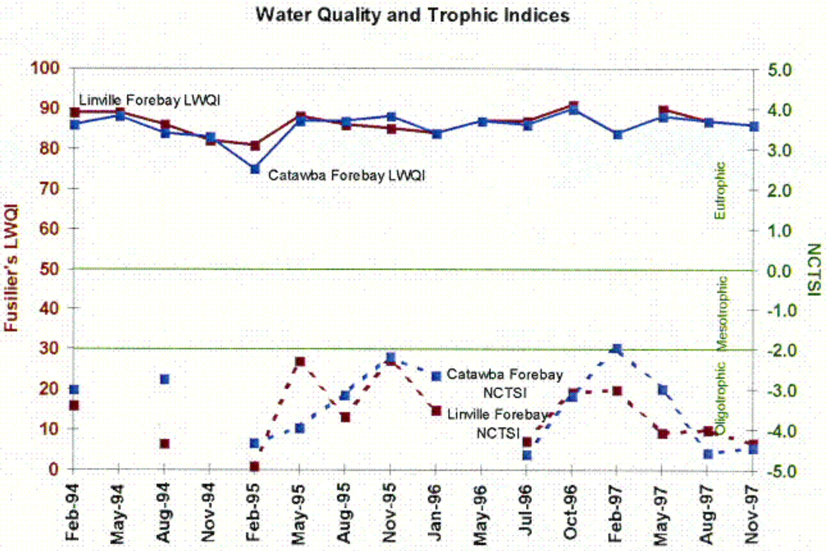




Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll *a* (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	**86**	**-3.5**	**2.8**	**41**	**20**
Rhodhiss	70	-1.5	12.8	63	32
Hickory	78	-1.5	8.4	55	29
Lookout Shoals	77	-1.9	7.1	54	22
Norman	80	-2.5	8.1	55	26
Mountain Island	82	-2.4	4.6	57	28
Wylie	72	-1.1	10.3	92	23
Fishing Creek	42	+0.6	17.2	165	44
Wateree	50	+0.4	22.7	146	24

Water quality

Fusilier's Lake Water Quality Index was calculated from quarterly sampling data. Lake James consistently yields the best water quality of all the Catawba reservoirs.



The LWQI ranged between 75 and 91 over the period 1994-1997, with an average score of 86. No clear year-to-year trend was evident in the index.

Minimal seasonal variability was observed in the LWQI, except that slightly reduced scores were generally observed during the winter. Water quality, as measured by the LWQI, was similar at both the Linville forebay and the Catawba forebay, with only marginally higher LWQI scores observed at the former location.

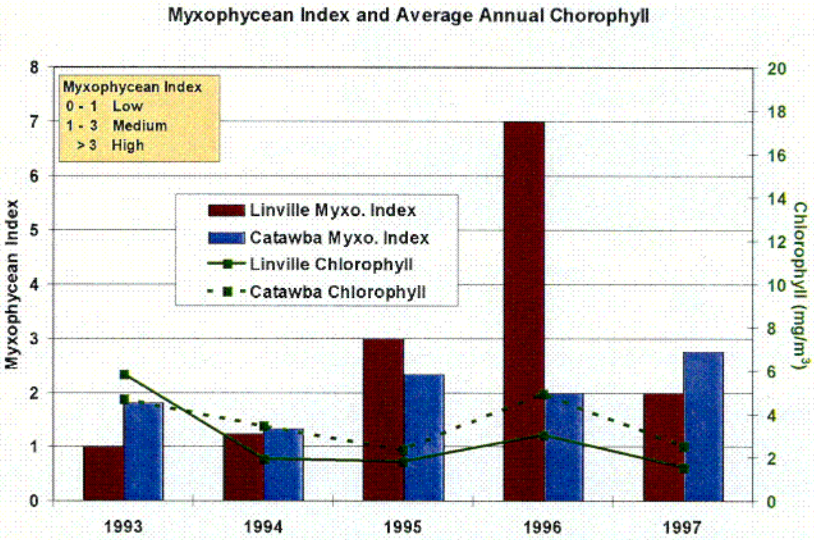
Trophic status

Application of the North Carolina Trophic State Index to Lake James data classified the lake as oligotrophic during 1994-97. Lake James NCTSI scores only occasionally approached the lowest mesotrophic status, due to infrequent, minor increases in nutrient (total organic nitrogen and total phosphorus) concentrations. Like the Fusilier's LWQI, no clear overall trend was observed in the NCTSI for 1994 through 1997.

Phytoplankton productivity

The phytoplankton community of Lake James was characteristic of low productivity waters. The annual average chlorophyll values for the two arms of the lake were in the oligtrophic to the very low mesotrophic range.

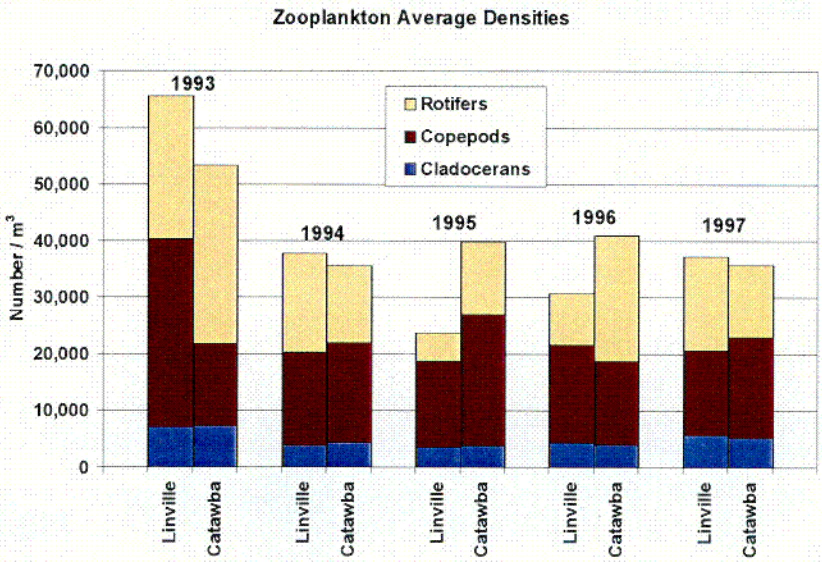
The Linville arm tended to have lower chlorophyll *a* concentrations than did the Catawba arm. No long-term trend was evident. Based on the Myxophycean Index, Lake James fell into the intermediate productivity range. The high value in the Linville arm during1996 was due to the relatively high number of blue-green algal species versus desmid species, and low population densities of blue-green algae.



Zooplankton

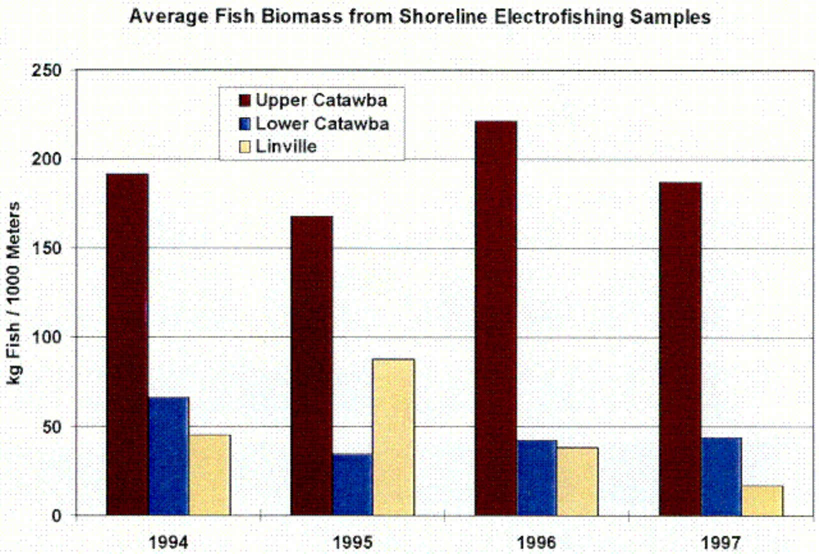
Overall, zooplankton densities were low, reflecting the low productivity of the lake. The zooplankton densities in the Linville arm of Lake James exhibited greater annual variation than did those in the Catawba arm.

The percentage of cladocerans and copepods to rotifers was much greater in Lake James than in the other lakes. This may have been due to the lack of suitably sized phytoplankton on which the rotifers feed. *Keratella longisetta*, a rotifer generally found in oligotrophic waters, was found periodically in Lake James, confirming the low trophic status of the reservoir.



Littoral fish community

Littoral fish community assessments of Lake James were conducted annually using shoreline electrofishing during the spring of 1994-1997. Estimated mean total biomass was considerably higher in the upper Catawba River arm than in either the lower Catawba River arm or the Linville River arm. Mean total biomass was estimated to be 192, 47, and 39 kg of fish per 1,000 m of sampled shoreline in the upper Catawba River arm, the lower Catawba River arm, and the Linville River arm, respectively. Common carp, suckers, and sunfish composed most of the biomass collected in the upper Catawba River arm, while sunfish composed most of the biomass in the lower Catawba River and Linville River arms.



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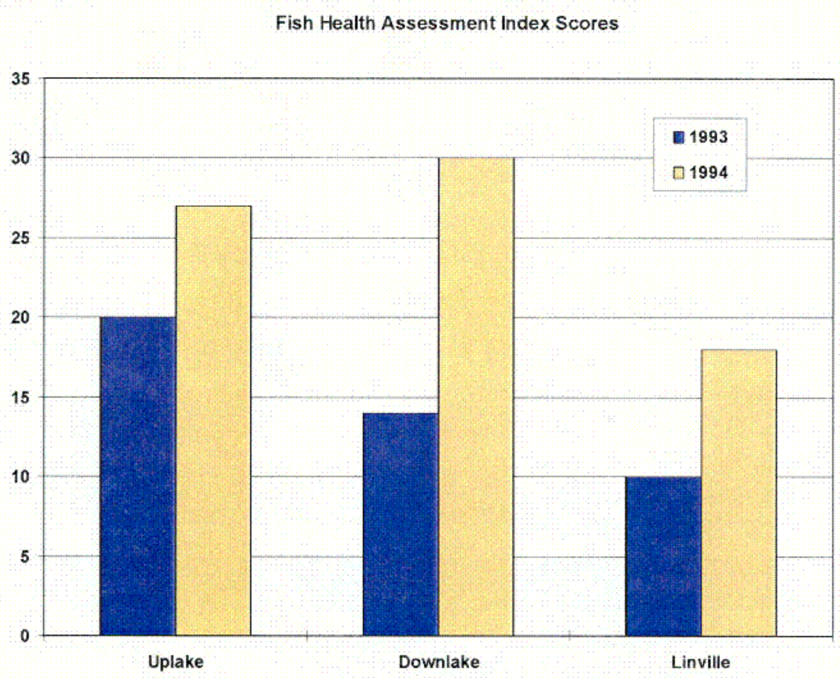
Fish health assessment index

Health of Lake James largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. Lower FHAI scores indicate relatively good health. Lake James FHAI scores averaged 20 for the two years and three locations sampled, and constituted the lowest average FHAI score on the Catawba River.



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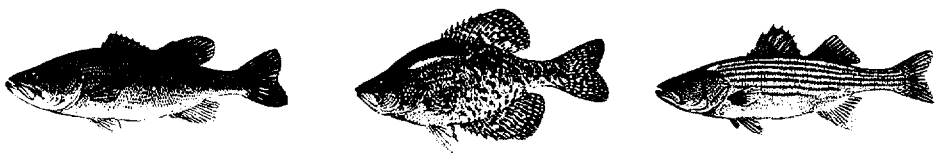
LAKE RHODHISS



Lake Rhodhiss At A Glance

Hydromorphometry

Surface Elevation:	995.1 feet above MSL
Surface Area:	2,578 acres
Volume:	67,600 acre-feet
Retention Time:	20 days (average)
Average River Flow Rhodhiss Dam:	1,099 MGD
Maximum Depth:	47.9 feet
Average Depth:	20.7 feet
Length (Main Channel):	17.0 miles
Shoreline:	90 miles
Maximum Drawdown:	10 feet

Duke Power Electric Generation

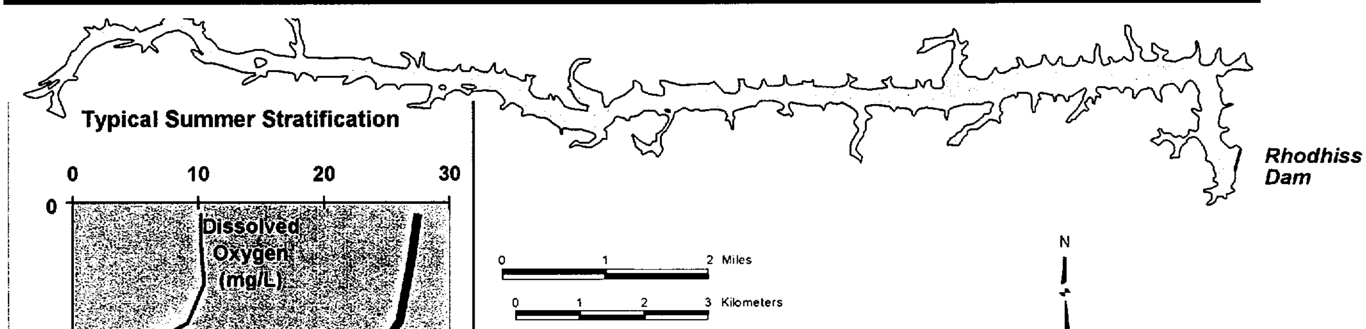
Rhodhiss Hydro:	25.5 MW
Total Electric Capacity:	25.5 MW

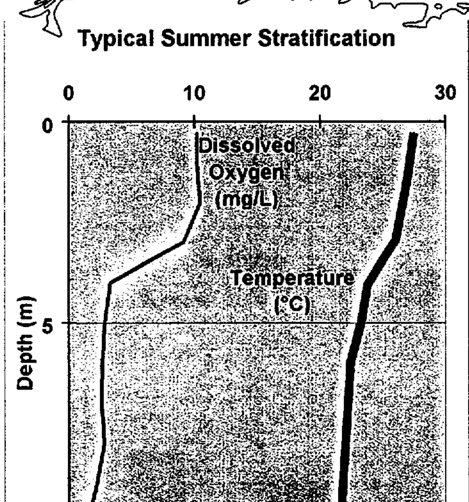
Watershed Characteristics

Year Impounded:	1925
Drainage Area:	1,090 square miles
Sub-Basin Population	110,326 (1990)
Watershed Land Cover:	2.5% urban 11.4% cultivated 85.5% forested 0.6% other undeveloped

Shoreline Use

Residential and Commercial:	0.5%
Recreational:	0.3%
Other:	2.9%
Undeveloped:	96.3%

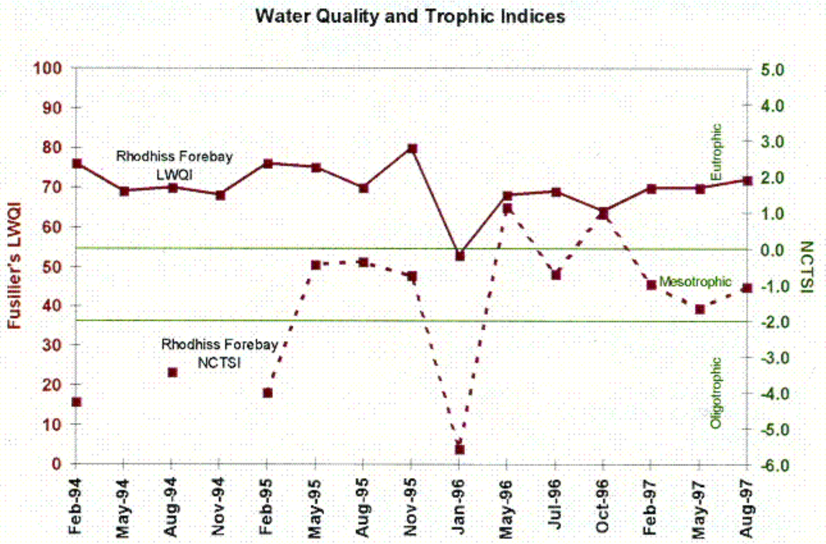




Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll *a* (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	86	-3.5	2.8	41	20
Rhodhiss	**70**	**-1.5**	**12.8**	**63**	**32**
Hickory	78	-1.5	8.4	55	29
Lookout Shoals	77	-1.9	7.1	54	22
Norman	80	-2.5	8.1	55	26
Mountain Island	82	-2.4	4.6	57	28
Wylie	72	-1.1	10.3	92	23
Fishing Creek	42	+0.6	17.2	165	44
Wateree	50	+0.4	22.7	146	24

Water quality

Fusilier's Lake Water Quality Index was calculated from Lake Rhodhiss quarterly sampling data. The LWQI ranged between 53 and 80 over the period 1994-1997, with an average of 70 units. No clear year-to-year trend was evident in the index. Little seasonal variability was observed in the Fuslier's index with the exception of a winter 1996 sampling. This minimum score appears to have been influenced by elevated nutrient input and increased turbidity attributable to heavy rainfall and snow melt runoff in the days prior to sampling.

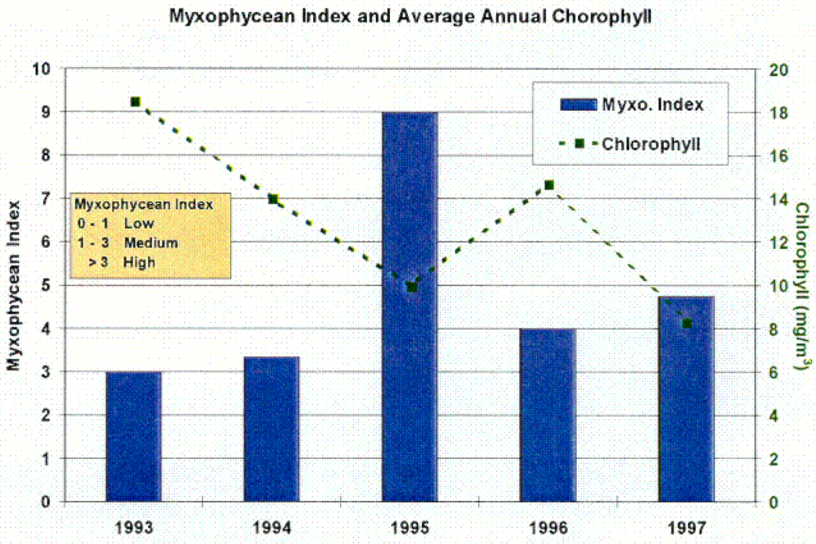


Trophic status

Application of the North Carolina Trophic State Index to Duke's data showed that Lake Rhodhiss, a relatively shallow and riverine system, transitions among all the trophic classifications over time, depending on the influences of the climatologic and hydrologic conditions immediately prior to the sampling date. Most NCTSI scores during 1994-97 fell into the mesotrophic classification. Eutrophic classifications were observed for Lake Rhodhiss in the spring of 1996 and the fall of 1996 and 1997. The lowest observed NCTSI score during January 1996 was influenced at least in part by an exceptionally low chlorophyll *a* concentration (0.8 mg/m^3). Like the Fusilier's LWQI, no definitive overall trend was observed in the NCTSI for 1994 through 1997.

Phytoplankton productivity

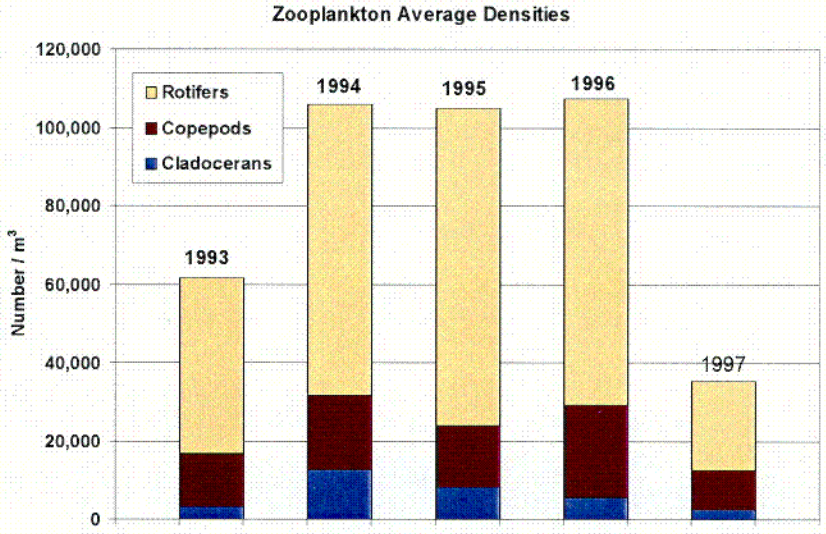
Lake Rhodhiss was the most productive of the upper Catawba lakes. Average chlorophyll concentrations were above 8 mg/m^3 from 1993 through 1997. With the exception of 1996, there appeared to be a downward trend in annual chlorophyll concentrations over the five-year period; the 1996 increase may have been related to the low rainfall in the upper Catawba in that year. The Myxophycean Index remained at or above the intermediate range throughout the period, with no clear trend evident. Blue-green algae became very abundant during the warmer months of the year, and at times, they were the dominant phytoplankton group.



C05

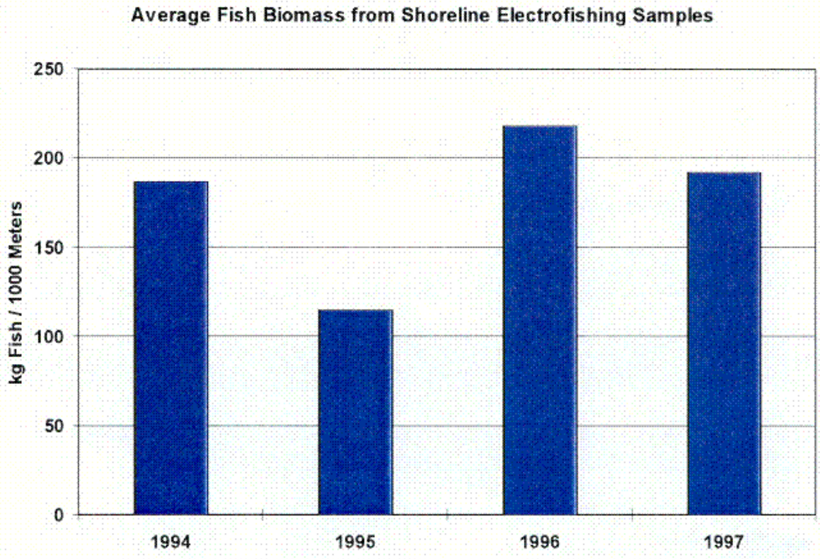
Zooplankton

The zooplankton populations were generally high, as would be expected due to the high productivity of the lake. The extremely low average populations for 1997 were due to unusually low numbers of zooplankton collected in February and May samples. This was probably influenced by reservoir flushing caused by greater than normal precipitation, and resulting higher flows through the reservoir in advance of sampling. Lake Rhodhiss zooplankton populations were dominated by rotifers. Several species of rotifers belonging to the genera *Brachionus* and *Hexarthra*, indicators of eutrophic conditions, appeared regularly in the Lake Rhodhiss zooplankton.



Littoral fish community

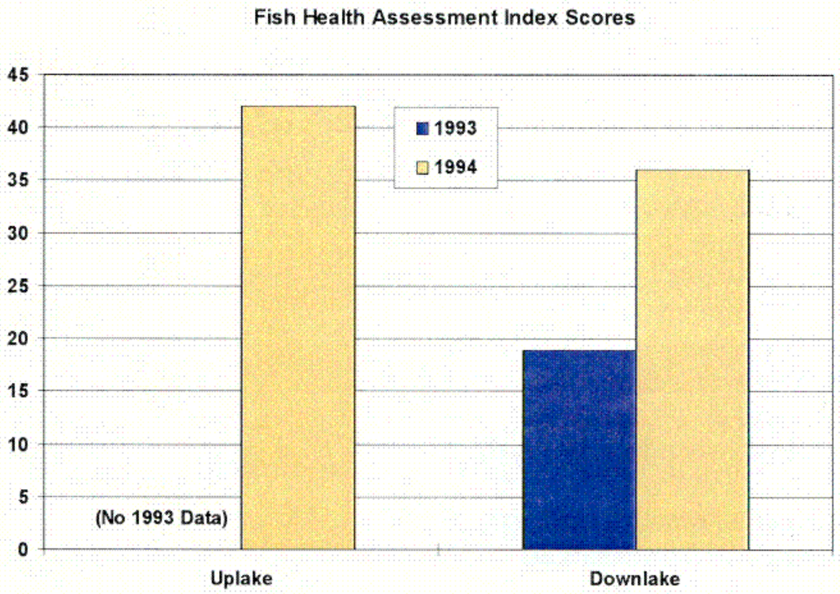
Shoreline electrofishing was conducted annually during the spring of 1994-1997 to assess the littoral fish community in Lake Rhodhiss. This reservoir supported an estimated mean total biomass of 178 kg of fish per 1,000 m of sampled shoreline. Sunfish and common carp composed most of the biomass.



C06

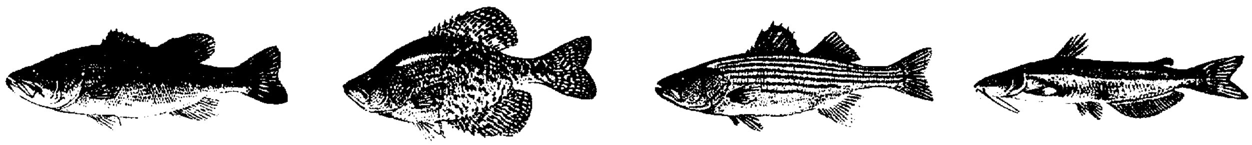
Fish health assessment index

Health of Lake Rhodhiss largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. Lake Rhodhiss FHAI scores averaged 32 for the two years and two locations sampled.



C07

LAKE HICKORY



Lake Hickory At A Glance

Hydromorphometry

Surface Elevation:	935 feet above MSL
Surface Area:	3,463 acres
Volume:	127,500 acre-feet
Retention Time:	32 days (average)
Average River Flow Oxford Hydro:	1,309 MGD
Maximum Depth:	85 feet
Average Depth:	31.2 feet
Length (Main Channel):	17.6 miles
Shoreline:	105 miles
Maximum Drawdown:	10 feet

Duke Power Electric Generation

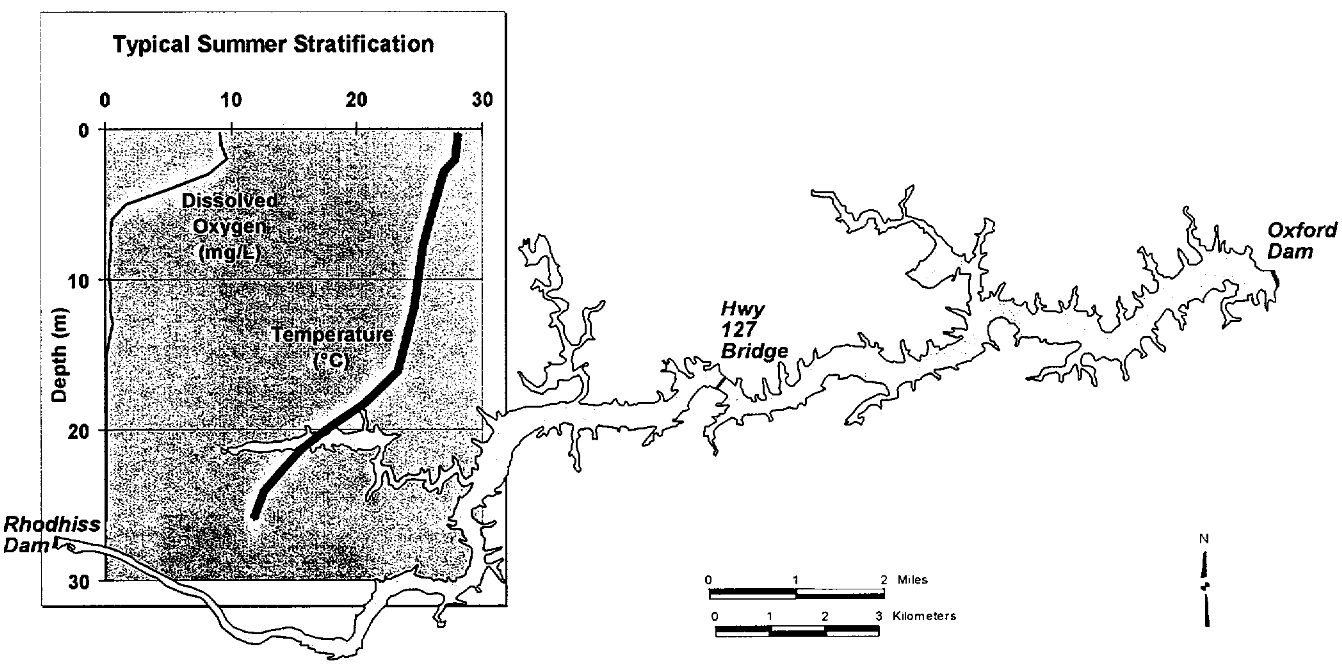
Oxford Hydro:	36 MW
Total Electric Capacity:	36 MW

Watershed Characteristics

Year Impounded:	1927
Drainage Area:	1,310 square miles
Sub-Basin Population	76,070 (1990)
Watershed Land Cover:	5.5% urban 33% cultivated 61.1% forested 0.4% other undeveloped

Shoreline Use

Residential and Commercial:	48.3%
Recreational:	0.9%
Other:	2.8%
Undeveloped:	48.0%

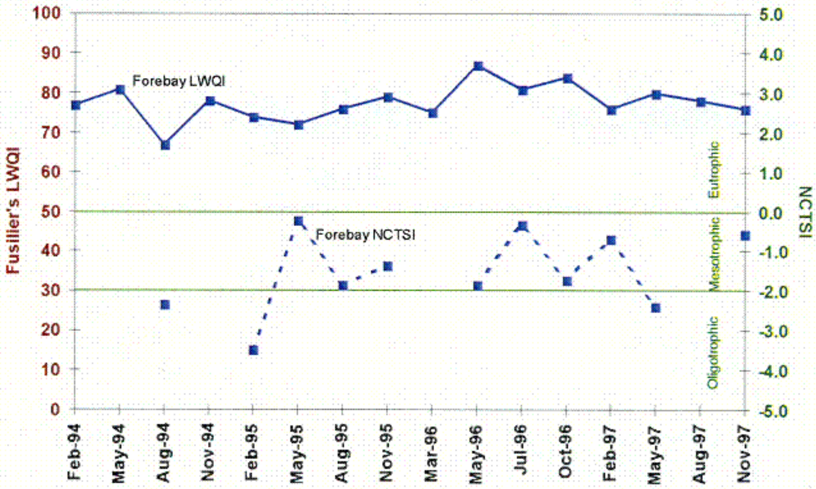


Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll *a* (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	86	-3.5	2.8	41	20
Rhodhiss	70	-1.5	12.8	63	32
Hickory	**78**	**-1.5**	**8.4**	**55**	**29**
Lookout Shoals	77	-1.9	7.1	54	22
Norman	80	-2.5	8.1	55	26
Mountain Island	82	-2.4	4.6	57	28
Wylie	72	-1.1	10.3	92	23
Fishing Creek	42	+0.6	17.2	165	44
Wateree	50	+0.4	22.7	146	24

Water quality

Fusilier's Lake Water Quality Index was calculated from Lake Hickory quarterly sampling data. The LWQI ranged between 67 and 87 over the period 1994-1997, with an average score of 78. The data showed that water quality in the lower end of Lake Hickory (forebay area) was markedly improved relative to Lake Rhodhiss, the immediately upstream reservoir. Lake Hickory LWQI scores were relatively consistent over time, and no clear year-to-year or seasonal trends were evident.

Water Quality and Trophic Indices



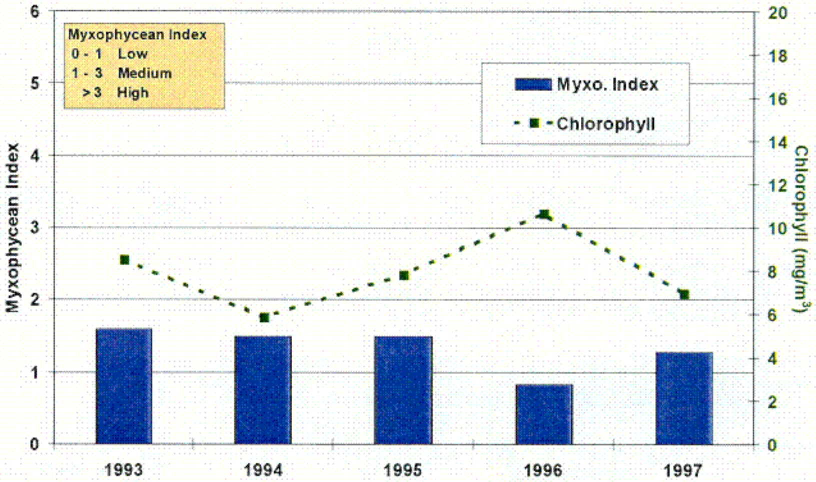
Trophic status

Application of the North Carolina Trophic State Index to Duke's data resulted in Lake Hickory being classified primarily as mesotrophic, although scores occasionally fell into the oligotrophic range. Like the Fusilier's LWQI, no clearly discernable seasonal or year-to-year trend was observed in the NCTSI for 1994 through 1997.

Phytoplankton productivity

The phytoplankton community in the forebay of Lake Hickory was typical of mesotrophic conditions. The chlorophyll concentrations ranged from about 6 to 10 mg/m3 for 1993-1997. There were no major year-to-year changes and no trend was evident. The Myxophycean Index remained mostly in the intermediate productivity range. Blue-green algae were abundant in the summer months, but they never became the dominant form, as in Lake Rhodhiss.

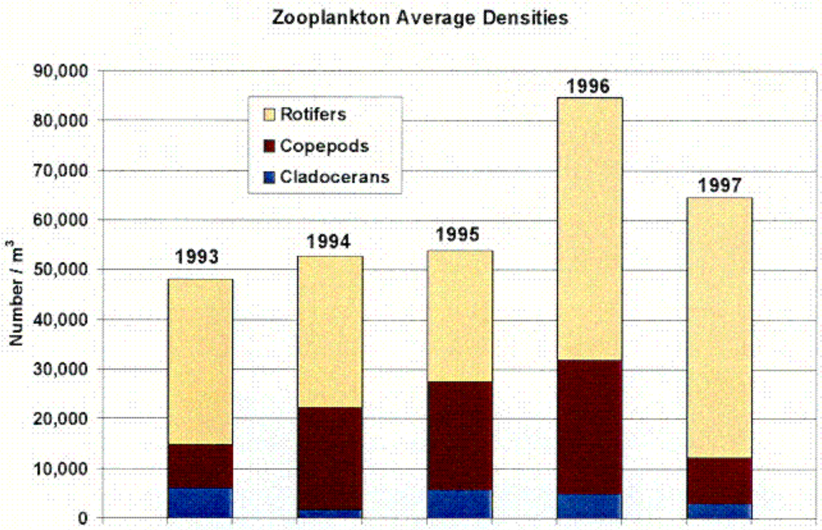
Myxophycean Index and Average Annual Chorophyll



C08

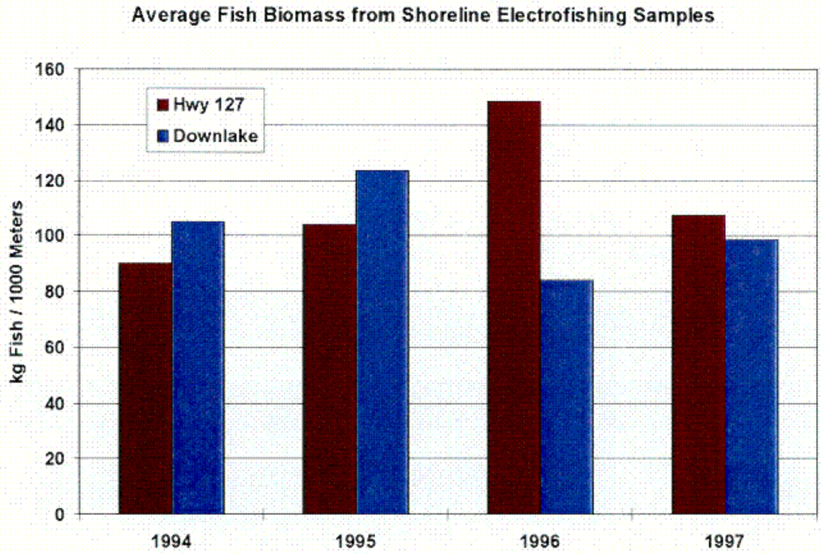
Zooplankton

Zooplankton densities were relatively high, reflecting the mesotrophic conditions of Lake Hickory. Rotifers were the dominant group for all years. Even though the total populations changed little over the years, the percentage composition of rotifers and copepods varied considerably from year to year. *Brachionus* and *Hexarthra*, indicators of eutrophic conditions, were present in some years.



Littoral fish community

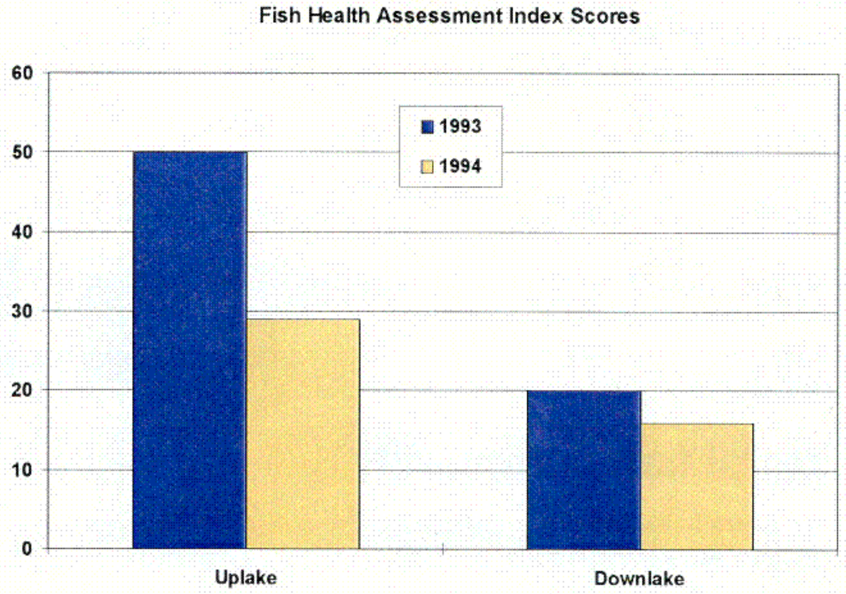
Lake Hickory's littoral fish community was assessed by annual shoreline electrofishing conducted in two areas (upstream of Highway 127 and downlake) of the reservoir during the spring of 1994-1997. Estimated mean total biomass of the two areas was similar, with 113 kg of fish per 1,000 m of sampled shoreline being collected near Highway 127, and 103 kg of fish per 1,000 m being collected downlake. Sunfish, common carp, and catfish composed most of the biomass in each area.



C09

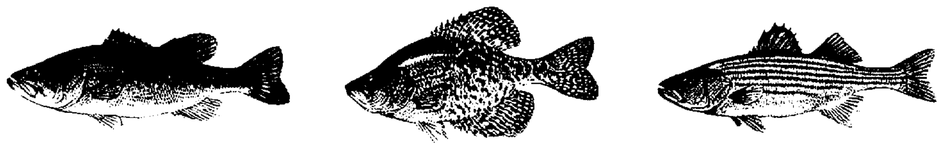
Fish health assessment index

Health of Lake Hickory largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. Lower FHAI scores indicate relatively good health. Lake Hickory FHAI scores averaged 29 for the two years and two locations sampled.



C10

LOOKOUT SHOALS LAKE



Lookout Shoals Lake At A Glance

Hydromorphometry

Surface Elevation:	838.1 feet above MSL
Surface Area:	835 acres
Volume:	26,841 acre-feet
Retention Time:	6 days (average)
Average River Flow	
Lookout Shoals Dam:	1,487 MGD
Maximum Depth:	60 feet
Average Depth:	30.4 feet
Length (Main Channel):	9.5 miles
Shoreline:	39 miles
Maximum Drawdown:	10 feet

Duke Power Electric Generation

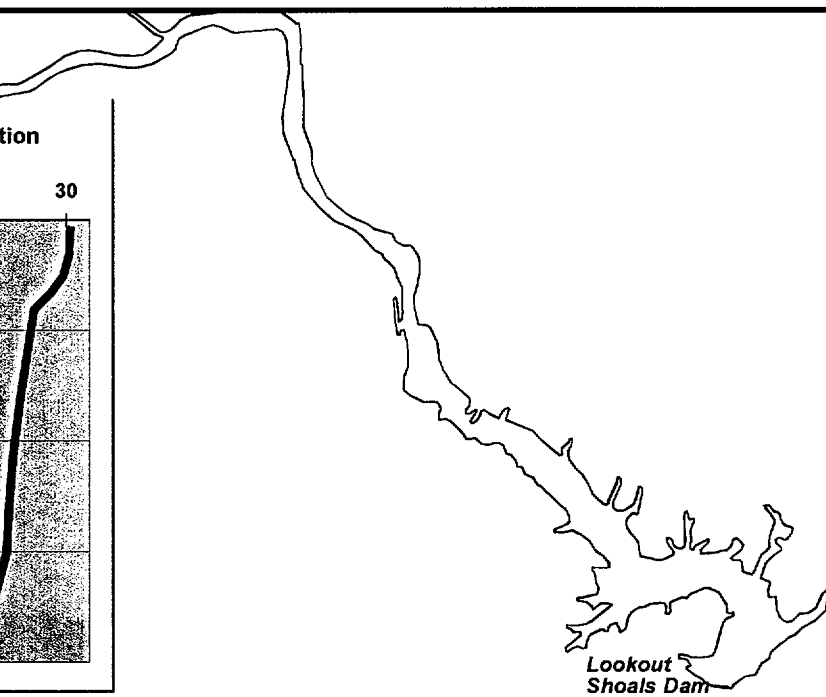
Lookout Shoals Hydro:	18.72 MW
Total Electric Capacity:	18.72 MW

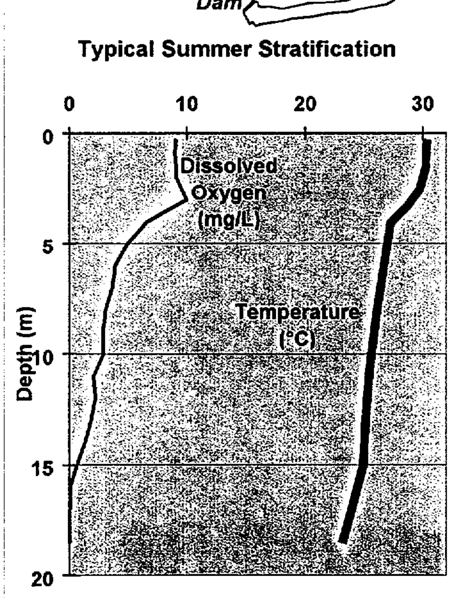
Watershed Characteristics

Year Impounded:	1915
Drainage Area:	1,450 square miles
Sub-Basin Population	13,714 (1990)
Watershed Land Cover:	0.8% urban
	42.1% cultivated
	57.1% forested

Shoreline Use

Residential and Commercial:	20.4%
Recreational:	0.3%
Other:	6.9%
Undeveloped:	72.4%

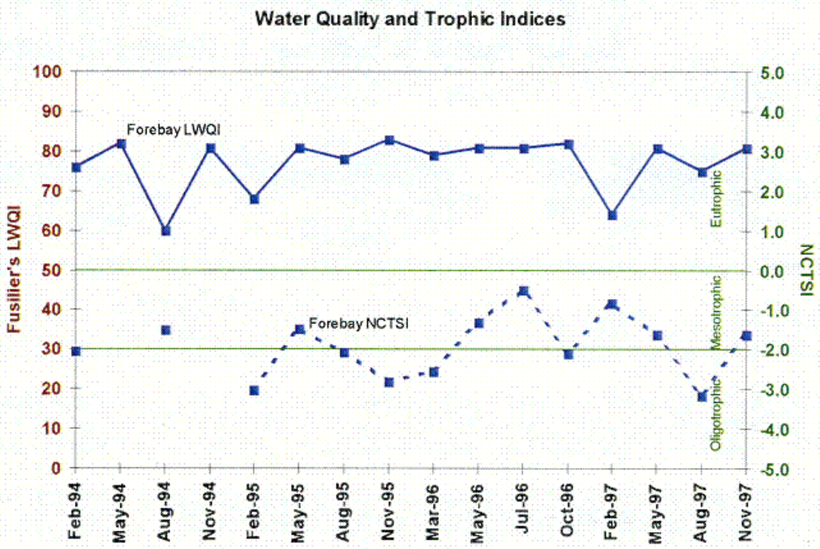




Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll *a* (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	86	-3.5	2.8	41	20
Rhodhiss	70	-1.5	12.8	63	32
Hickory	78	-1.5	8.4	55	29
Lookout Shoals	**77**	**-1.9**	**7.1**	**54**	**22**
Norman	80	-2.5	8.1	55	26
Mountain Island	82	-2.4	4.6	57	28
Wylie	72	-1.1	10.3	92	23
Fishing Creek	42	+0.6	17.2	165	44
Wateree	50	+0.4	22.7	146	24

Water quality

Fusilier's Lake Water Quality Index was calculated from Lookout Shoals quarterly sampling data. The LWQI ranged between 60 and 83 over the period 1994-1997, with an average score of 77. No clear year-to-year or seasonal trend was evident in the index, which showed a notable degree of stability over the 1995-1996 time frame. Lower LWQI scores in August 1994 and February 1997 were influenced in part by slightly elevated nitrate and total phosphorus concentrations.

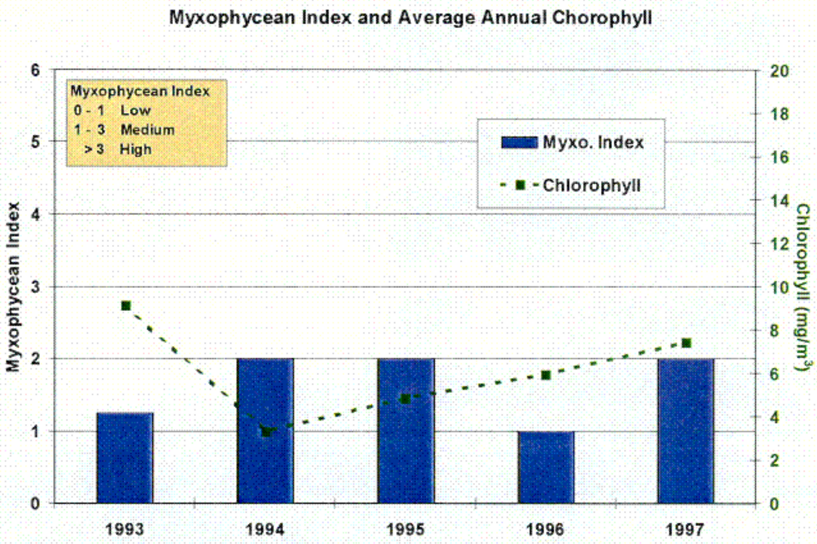


Trophic status

Application of the North Carolina Trophic State Index to the Lookout Shoals water quality data showed that the reservoir fluctuated frequently between oligotrophic and mesotrophic status. Samplings that led to a mesotrophic classification were influenced by somewhat higher nutrient (total organic nitrogen and total phosphorus) concentrations. Like the Fusilier's LWQI, no overall trend was observed in the NCTSI for 1994 through 1997.

Phytoplankton productivity

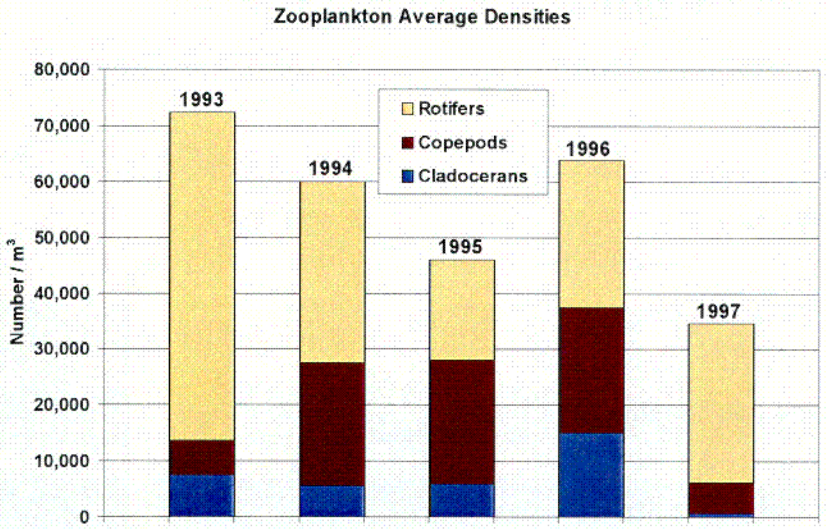
The phytoplankton community of Lookout Shoals was very similar to that of Lake Hickory, except the population densities were lower. The average chlorophyll concentrations ranged from nearly 10 to less than 4 mg/m³, placing the lake in the mesotrophic range. The Myxophycean Index was in the intermediate range for 1993-1997. Even though average chlorophyll concentrations had consistently increased since 1994, by 1997 they had not reached the high values attained in 1993. Blue-green algae were present in very low numbers, and there was no indication that they were increasing in abundance.



C11

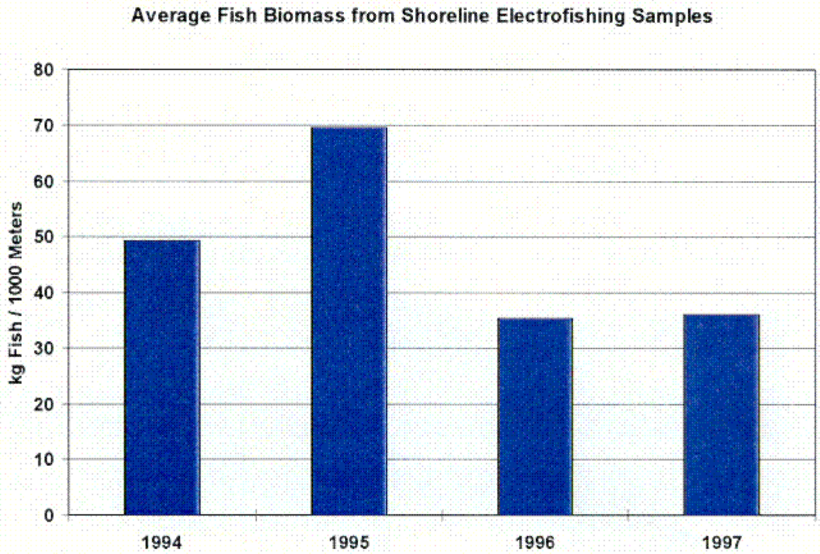
Zooplankton

Overall, Lookout Shoals zooplankton densities were less than those of Lake Hickory, but the annual fluctuation in total number and percent composition of the major groups was considerable. In 1997, cladocerans were almost absent from samples. Total 1997 zooplankton densities were also the lowest ever observed, probably due to reservoir flushing, which was driven by greater than normal precipitation in advance of sampling events. The low retention time of Lookout Shoals (averaging only 6 days, but even shorter following significant precipitation in the upper Catawba watershed) amplifies the effects of reservoir flushing relative to most other Catawba River reservoirs, and likely contributed to the large annual zooplankton population fluctuations observed.



Littoral fish community

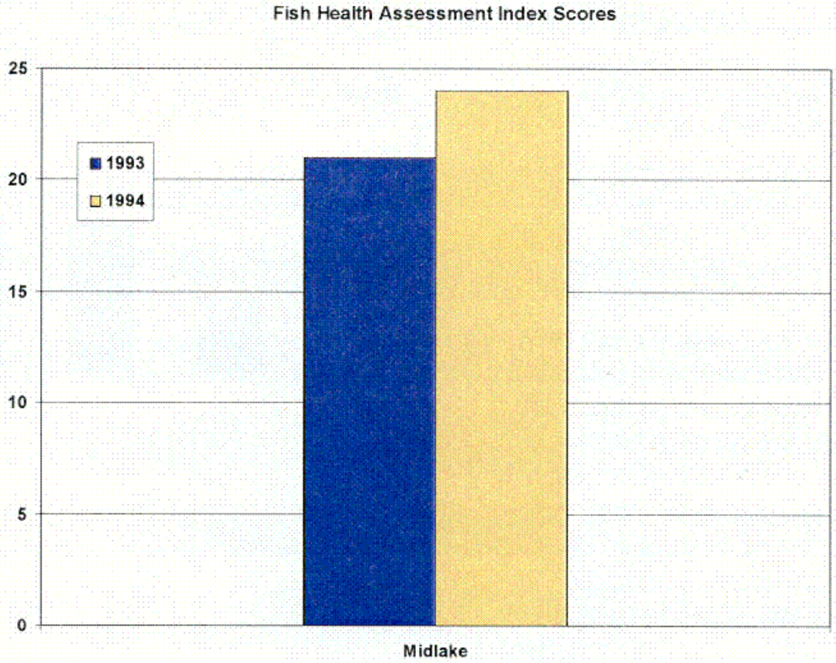
The littoral fish community in Lookout Shoals Lake was assessed using shoreline electrofishing. Samples were collected annually in the spring of 1994-1997. Estimated mean total biomass for the four-year period was 48 kg of fish per 1,000 m of sampled shoreline. Sunfish, common carp, and catfish composed most of the biomass.



C12

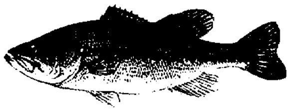
Fish health assessment index

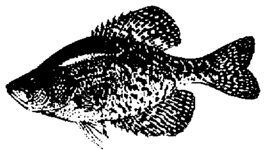
Health of Lookout Shoals largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. Lookout Shoals FHAI scores averaged 22 for the two years and one location sampled and constituted the second lowest average score on the Catawba River.

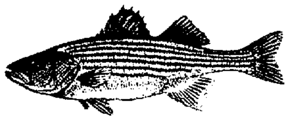


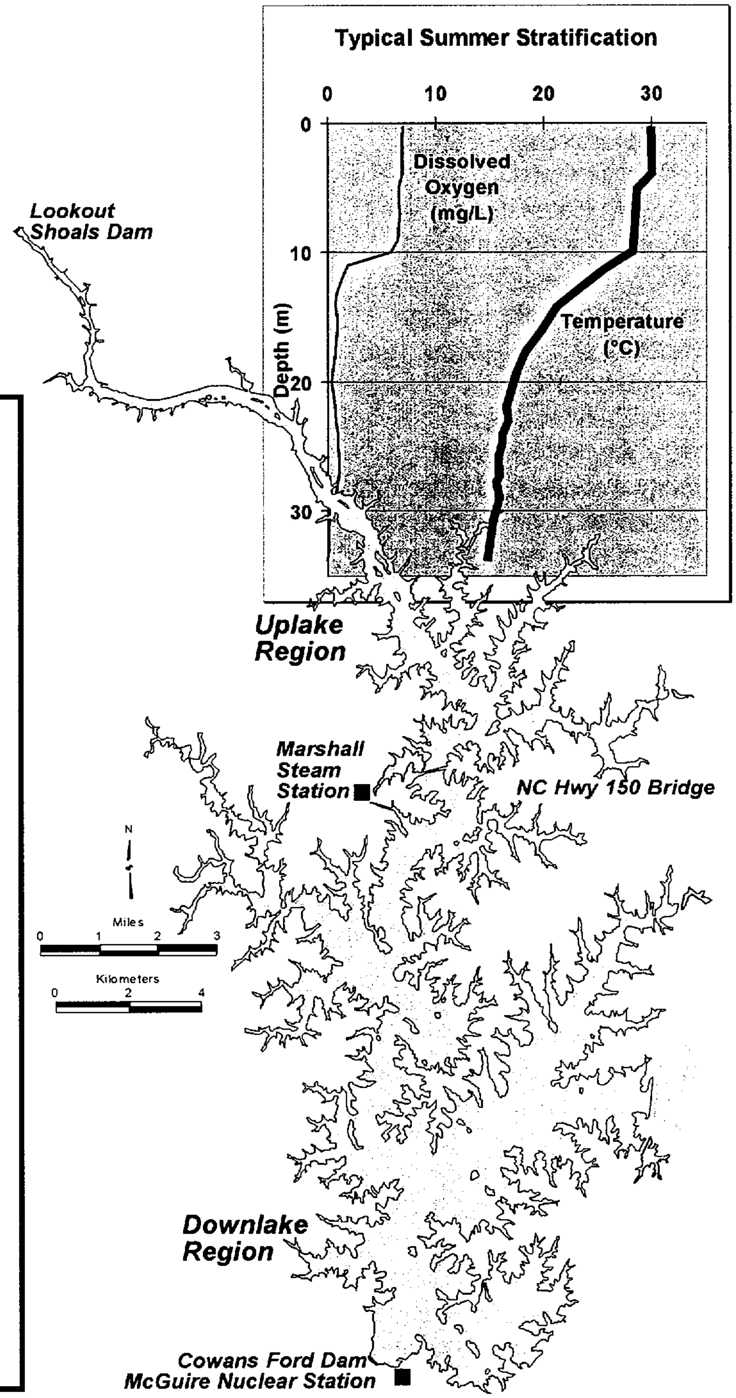
C13

LAKE NORMAN









Lake Norman At A Glance

Hydromorphometry

Surface Elevation:	760 feet above MSL
Surface Area:	32,510 acres
Volume:	1,093,600 acre-feet
Retention Time:	207 days (average)
Average River Flow	
Cowans Ford:	1,726 MGD
Maximum Depth:	110 feet
Average Depth:	33.5 feet
Length (Main Channel):	33.6 miles
Shoreline:	520 miles
Maximum Drawdown:	15 feet

Duke Power Electric Generation

Cowans Ford Hydro:	350 MW
Marshall Steam Station:	2,090 MW
McGuire Nuclear Station:	2,258 MW
Total Electric Capacity:	4,698 MW

Watershed Characteristics

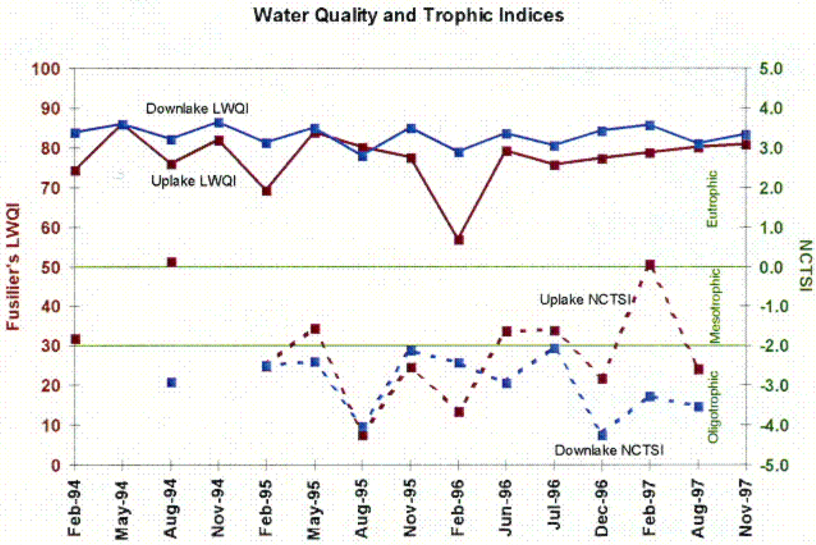
Year Impounded:	1963
Drainage Area:	1,790 square miles
Sub-Basin Population	65,564 (1990)
Watershed Land Cover:	3.3% urban 38.5% cultivated 58.2% forested

Shoreline Use

Residential and Commercial:	56.8%
Recreational:	0.4%
Other:	3.7%
Undeveloped:	39.1%

Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll a (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	86	-3.5	2.8	41	20
Rhodhiss	70	-1.5	12.8	63	32
Hickory	78	-1.5	8.4	55	29
Lookout Shoals	77	-1.9	7.1	54	22
Norman	**80**	**-2.5**	**8.1**	**55**	**26**
Mountain Island	82	-2.4	4.6	57	28
Wylie	72	-1.1	10.3	92	23
Fishing Creek	42	+0.6	17.2	165	44
Wateree	50	+0.4	22.7	146	24

Water quality

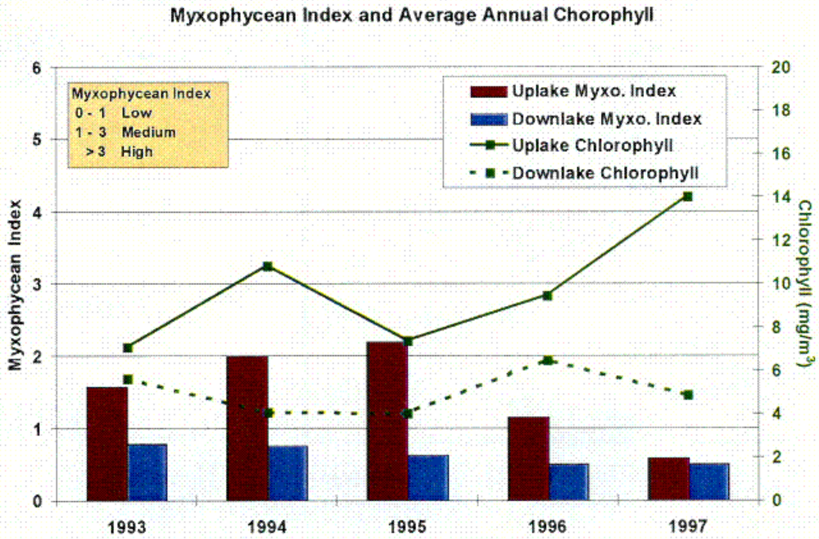


Fusilier's Lake Water Quality Index was calculated from Lake Norman quarterly sampling data. The LWQI ranged between 57 and 86 over the period 1994-1997, with an average of 80 units. No clear year-to-year trend was evident in the index. Water quality, as measured by the LWQI, was slightly improved at downlake locations (downstream of the Highway 150 bridge) relative to the uplake locations on Lake Norman. Very little seasonal variability was observed in the Fuslier's index with the exception of a February 1996 uplake sampling, which was influenced by an elevated concentration of total phosphorus. In general, downlake LWQI values varied slightly less from sample-to-sample than did uplake values.

Trophic status

Applying the North Carolina Trophic State Index to Duke's data resulted in the downlake region of Lake Norman being classified primarily as oligotrophic, while the uplake region fluctuated between oligotrophic and mesotrophic status, depending on the sampling date. Borderline eutrophic classifications for the uplake region in August 1994 and February 1997 were influenced by unusually elevated total organic nitrogen concentrations. Like the Fusilier's LWQI, no overall trend was observed in the NCTSI for 1994 through 1997.

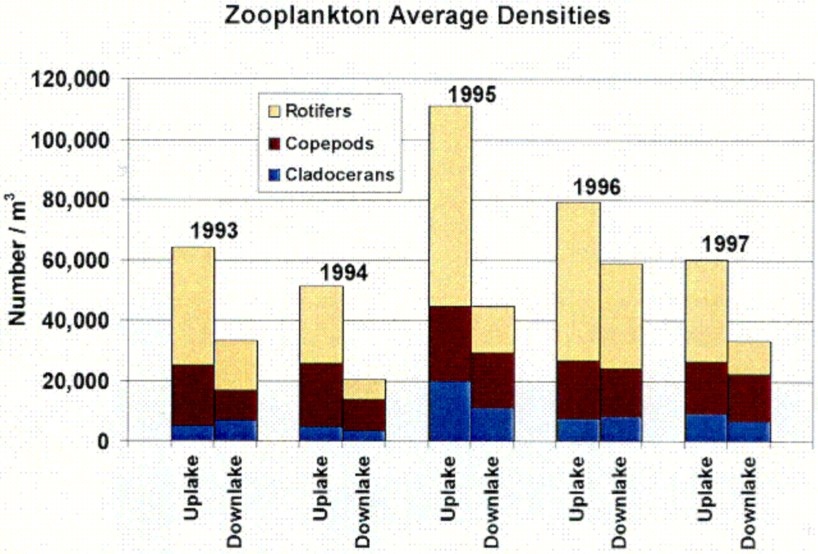
Phytoplankton productivity



The phytoplankton of Lake Norman were characterized by large uplake-to-downlake differences. The uplake area was more productive than the downlake area. The Myxophycean Index and chlorophyll data showed the differences between the two regions of the lake and also highlighted the differences between years. Annual differences were influenced by interannual changes in temperature, sunlight, and rainfall. Abundant nutrients were available during the cooler months, but the phytoplankton were not able to utilize them efficiently. Overall, however, Lake Norman was not very productive. The lower lake Myxophycean Index was consistently in the low range, while the upper lake was just barely in the intermediate range. Over the years, "nuisance" species such as blue-green algae have occasionally been abundant, especially in the late summer to early fall, but they have never been the dominant forms.

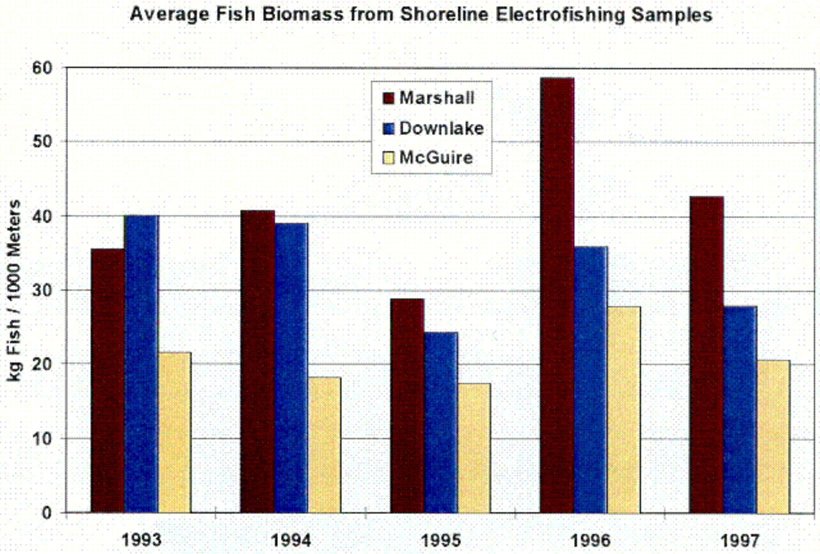
C14

Zooplankton



Lake Norman zooplankton densities exhibited an uplake-to-downlake pattern similar to that of phytoplankton. Since zooplankton are dependent on phytoplankton as a source of food, it follows that the zooplankton distribution would mirror that of the phytoplankton. Zooplankton densities were low overall in Lake Norman, reflecting the low productivity of the lake. There were considerable year-to-year variations in the total numbers and the percentage composition of the various taxonomic groups. An unusual feature was the smaller percentage rotifers relative to cladocerans and copepods, especially at the downlake location, than held true for most other Catawba reservoirs. A possible cause might have been a lack of suitably sized phytoplankton on which the rotifers feed. Lake Norman zooplankton samples had very few species typically associated with eutrophic conditions.

Littoral fish community

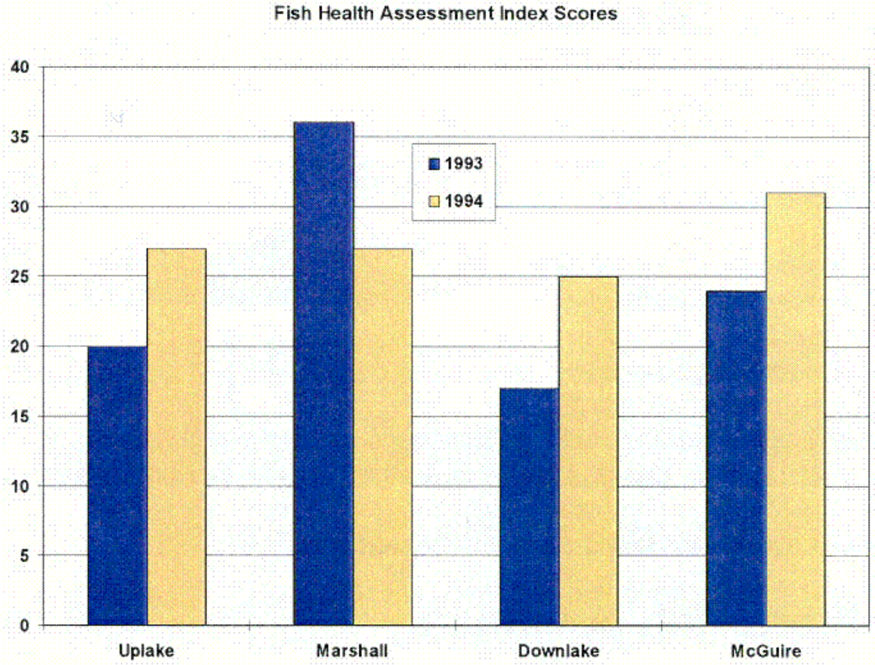


Lake Norman's littoral fish community was assessed annually by shoreline electrofishing in the spring of 1993-1997. Sampling was conducted near Marshall Steam Station, midway between Marshall Steam Station and McGuire Nuclear Station, and near McGuire Nuclear Station. Among these sites, estimated mean total biomass declined progressively moving downstream. Mean total biomass was 41, 28, and 21 kg of fish per 1,000 m of sampled shoreline near Marshall Steam Station, midway between the two stations, and near McGuire Nuclear Station, respectively. Sunfish and common carp composed most of the biomass collected at all locations.

C15

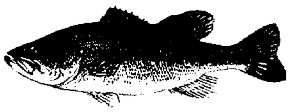
Fish health assessment index

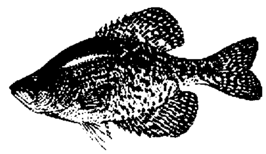
Health of Lake Norman largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. With lower scores indicating relatively good health, Lake Norman fish scores averaged 25 for the two years and four locations.



C16

MOUNTAIN ISLAND LAKE





Mountain Island Lake At A Glance

Hydromorphometry

Surface Elevation:	647.5 feet above MSL
Surface Area:	2,788 acres
Volume:	57,300 acre-feet
Retention Time:	11 days (average)
Average River Flow	
Mountain Island Hydro:	1,745 MGD
Maximum Depth:	58.4 feet
Average Depth:	17.7 feet
Length (Main Channel):	14.7 miles
Shoreline:	61 miles
Maximum Drawdown:	10 feet

Duke Power Electric Generation

Mountain Island Hydro:	60 MW
Riverbend Steam Station:	188 MW
Total Electric Capacity:	248 MW

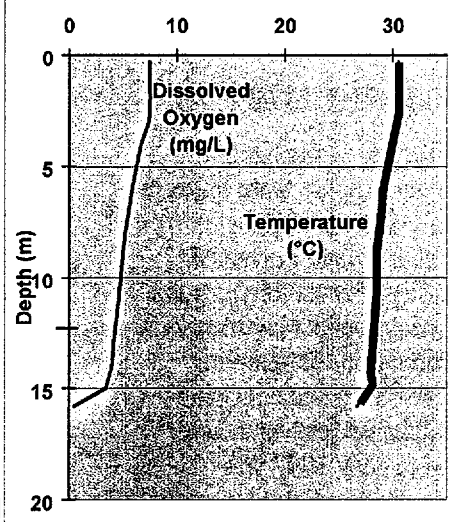
Watershed Characteristics

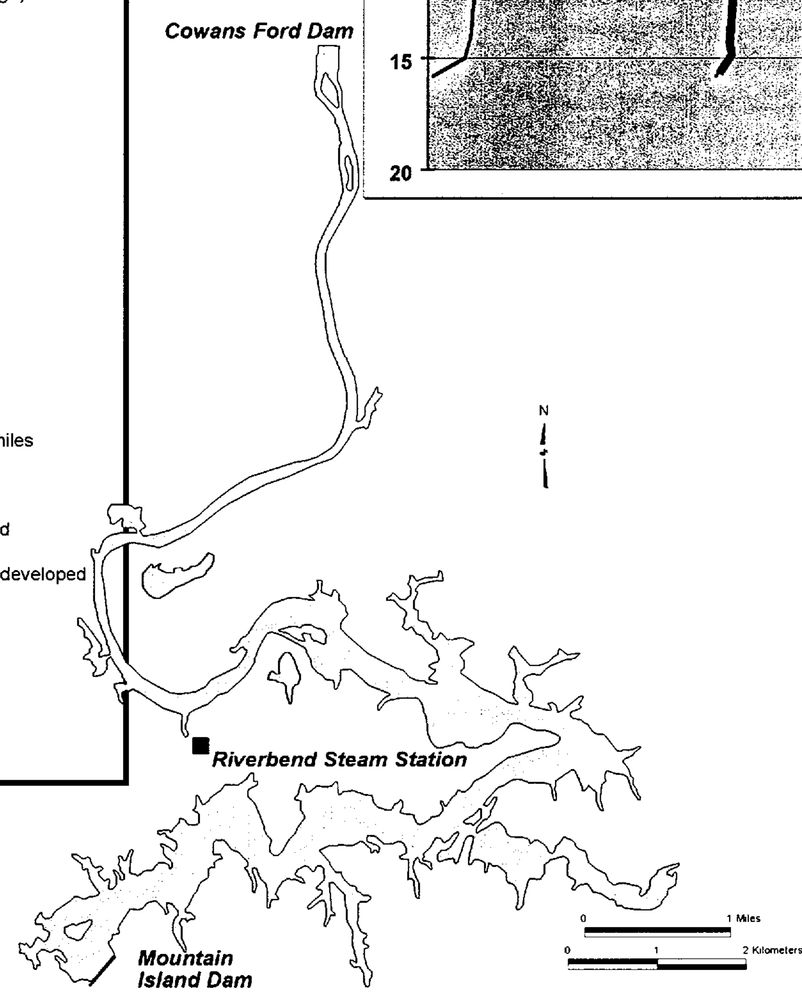
Year Impounded:	1924
Drainage Area:	1,860 square miles
Sub-Basin Population	11,825 (1990)
Watershed Land Cover:	3.3% urban
	26.8% cultivated
	69.5% forested
	0.1% other undeveloped

Shoreline Use

Residential and Commercial:	9.3%
Recreational:	0.4%
Other:	13.5%
Undeveloped:	76.8%

Typical Summer Stratification





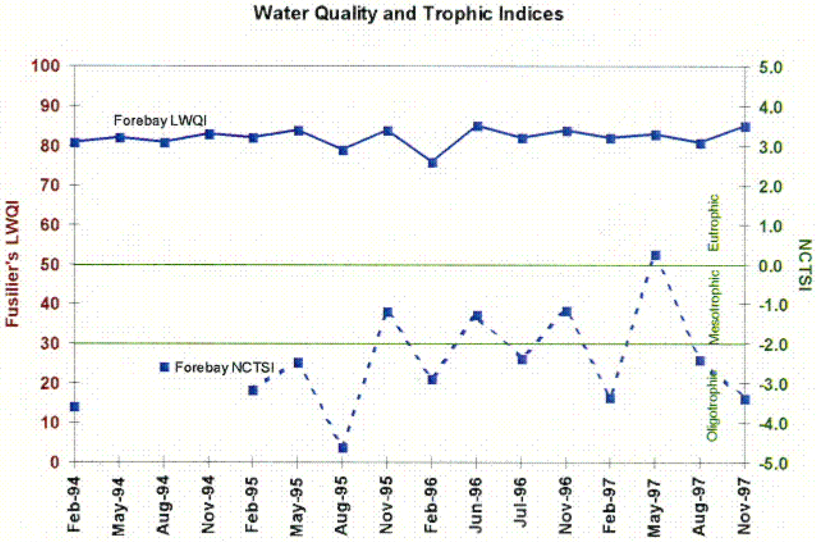
Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll a (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	86	-3.5	2.8	41	20
Rhodhiss	70	-1.5	12.8	63	32
Hickory	78	-1.5	8.4	55	29
Lookout Shoals	77	-1.9	7.1	54	22
Norman	80	-2.5	8.1	55	26
Mountain Island	**82**	**-2.4**	**4.6**	**57**	**28**
Wylie	72	-1.1	10.3	92	23
Fishing Creek	42	+0.6	17.2	165	44
Wateree	50	+0.4	22.7	146	24

Water quality

Fusilier's Lake Water Quality Index was calculated from Mountain Island Lake quarterly sampling data. The LWQI ranged between 76 and 85 during 1994-1997, with an average score of 82. The LWQI was extremely stable during the four-year sampling period, with no year-to-year or seasonal trends evident. It is notable that the Mountain Island LWQI was very consistent with comparable data collected from the Lake Norman forebay location, just upstream.

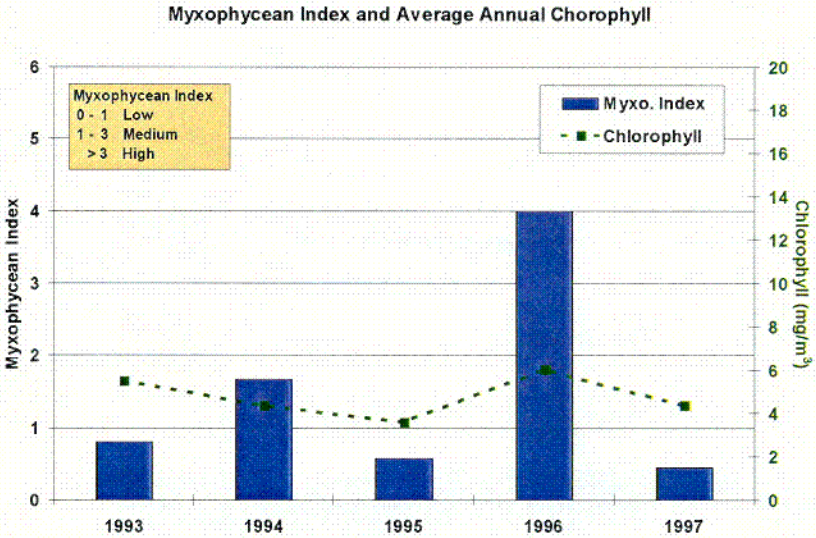
Trophic status

Application of the North Carolina Trophic State Index to Duke's data showed that Mountain Island fluctuated primarily between oligotrophic and mesotrophic classifications, depending on the sampling date. A borderline eutrophic classification for Mountain Island in May 1997 was influenced by slightly elevated total organic nitrogen and total phosphorus concentrations at that time. Like the Fusilier's LWQI, no overall trend was observed in the NCTSI for 1994 through 1997.



Phytoplankton productivity

The phytoplankton community of Mountain. Island was very similar to that of the downlake location of Lake Norman. The similarity between the two locations was most apparent in annual average chlorophyll concentrations, which classified Mountain Island as mesotrophic. A factor that contributed to the similarity in these locations is a skimmer weir, located immediately upstream of Cowans Ford Dam, which limits releases into Mountain Island exclusively from the surface of Lake Norman. Mountain Island's Myxophycean Index, however, showed considerable year-to-year variation with readings indicating low to high productivity. This was due to shifts in species composition in relation to hydraulic characteristics, nutrient loading, and interactions with zooplankton.



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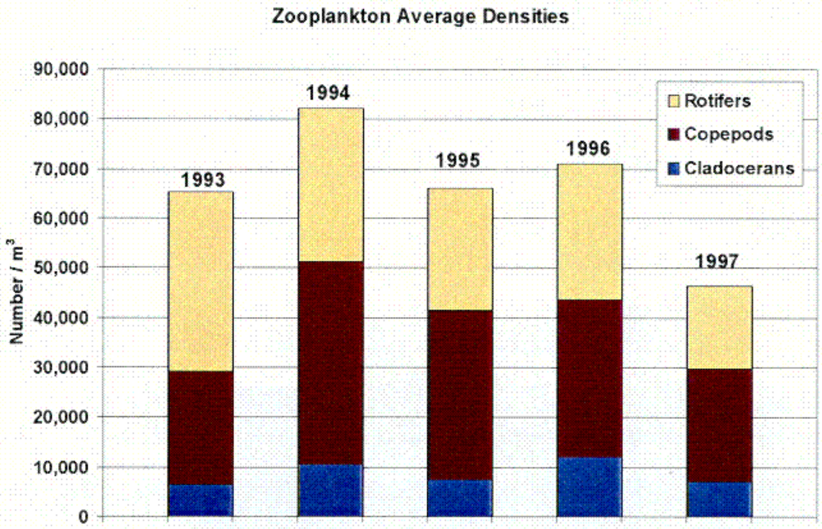
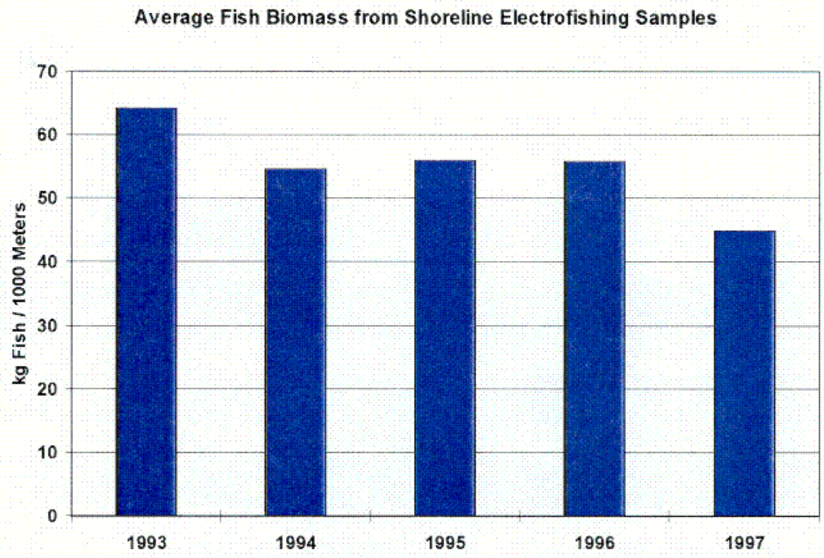
Zooplankton

The Mountain Island zooplankton community was somewhat different from downlake Lake Norman. Annual average densities in Mountain Island were comparatively higher, and more typical of mesotrophic lakes. The percentage composition of cladocerans and copepods to rotifers, however, was similar to that of downlake Lake Norman. Year-to-year variation in zooplankton densities was considerable. Very few zooplankton species indicative of eutrophic conditions were found in Mountain Island Lake.



Littoral fish community

Annual spring assessments of the littoral fish community of Mountain Island Lake were conducted using shoreline electrofishing in 1993-1997. Estimated mean total biomass was 55 kg of fish per 1,000 m of sampled shoreline. Common carp and sunfish composed most of the biomass.



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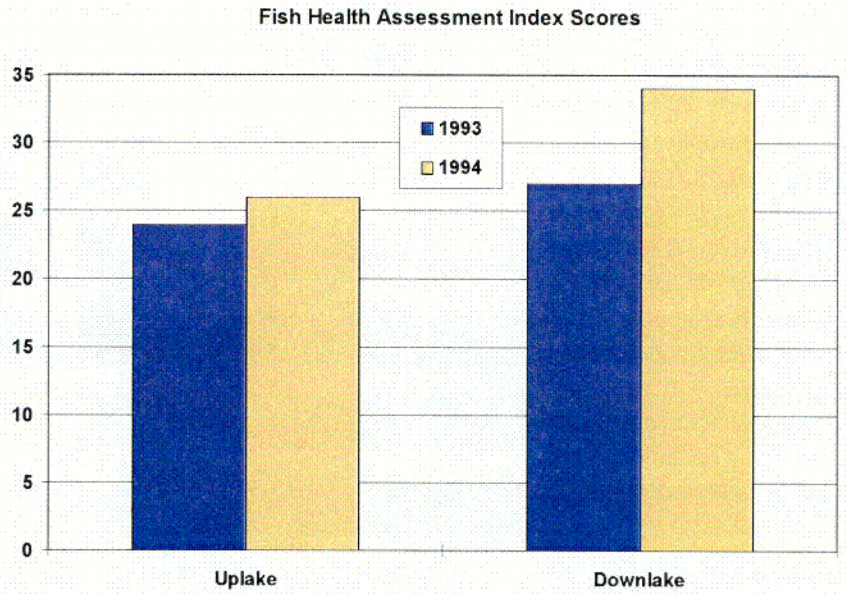
Fish health assessment index

Health of Mountain Island Lake largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. Mountain Island FHAI scores averaged 28 for the two years and two locations sampled.



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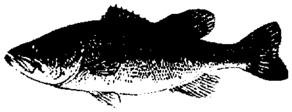
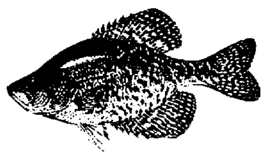
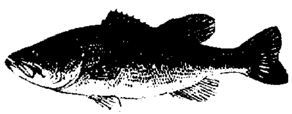
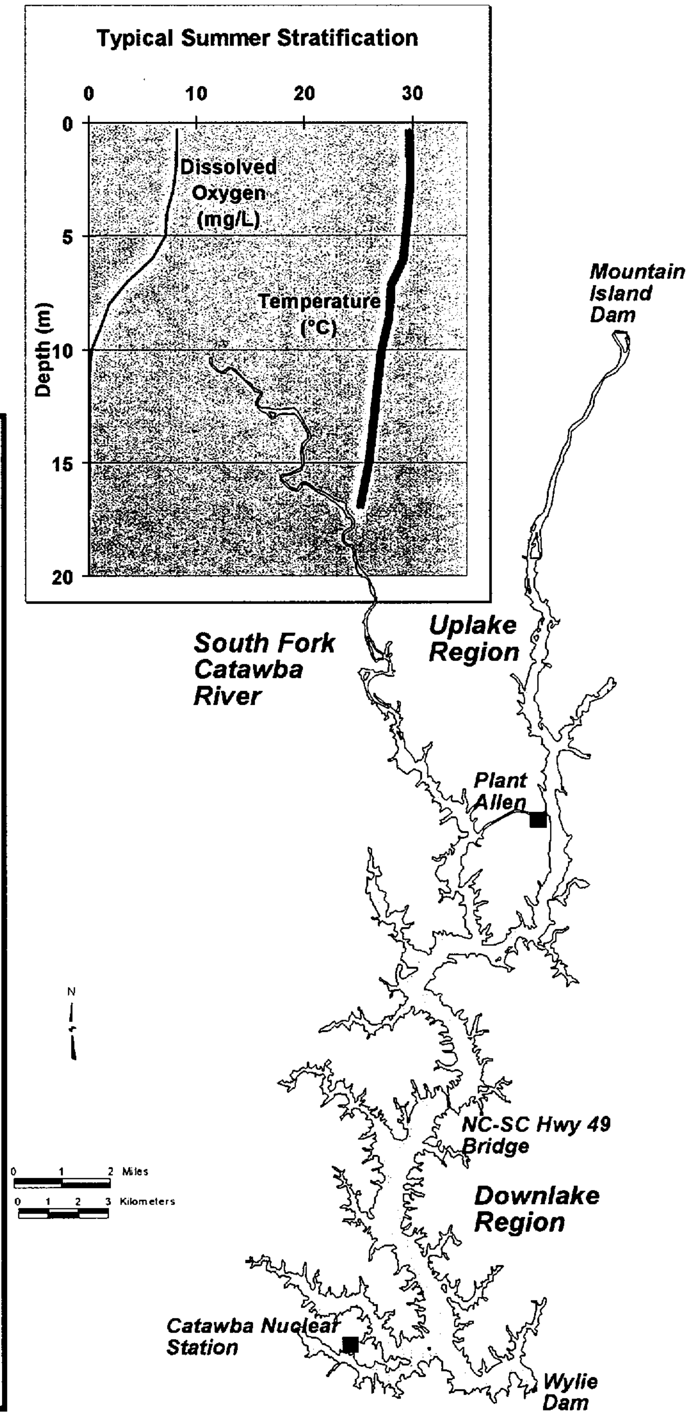
LAKE WYLIE









Lake Wylie At A Glance

Hydromorphometry

Surface Elevation:	569.4 feet above MSL
Surface Area:	12,139 acres
Volume:	281,900 acre-feet
Retention Time:	35 days (average)
Average River Flow Wylie Dam:	2,650 MGD
Maximum Depth:	93.2 feet
Average Depth:	23 feet
Length (Main Channel):	28.0 miles
Shoreline:	327 miles
Maximum Drawdown:	10 feet

Duke Power Electric Generation

Wylie Hydro:	60 MW
Plant Allen:	1,140 MW
Catawba Nuclear Station:	2,258 MW
Total Electric Capacity:	3,458 MW

Watershed Characteristics

Year Impounded:	1904, expanded 1924
Drainage Area:	3,020 square miles
Sub-Basin Population	334,763 (1990)
Watershed Land Cover:	5.7% urban 31.7% cultivated 62.4% forested 0.2% other undeveloped

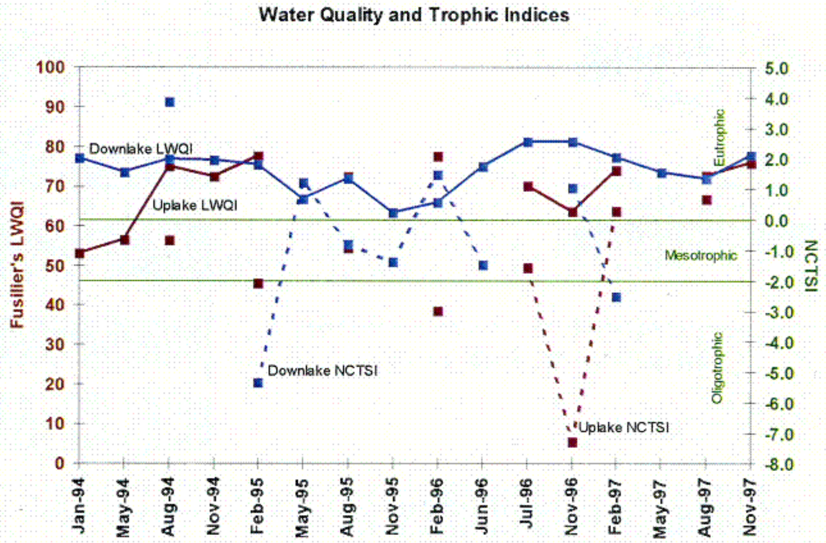
Shoreline Use

Residential and Commercial:	42.2%
Recreational:	1.1%
Other:	5.6%
Undeveloped:	51.1%

Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll a (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	86	-3.5	2.8	41	20
Rhodhiss	70	-1.5	12.8	63	32
Hickory	78	-1.5	8.4	55	29
Lookout Shoals	77	-1.9	7.1	54	22
Norman	80	-2.5	8.1	55	26
Mountain Island	82	-2.4	4.6	57	28
Wylie	**72**	**-1.1**	**10.3**	**92**	**23**
Fishing Creek	42	+0.6	17.2	165	44
Wateree	50	+0.4	22.7	146	24

Water quality

Fusilier's Lake Water Quality Index was calculated from Lake Wylie quarterly sampling data. The LWQI ranged between 53 and 81 over the period 1994-1997, with an average score of 72. No clear year-to-year or seasonal trends were evident in the index. Lake Wylie water quality was on average only slightly improved at a downlake location (forebay area) relative to an uplake location (near Plant Allen) sampled on the same date. Notably poorer water quality of the South Fork Catawba River, entering Lake Wylie between the uplake and downlake locations, almost completely negated the improvement in water quality normally expected as one moves downstream in a reservoir of this size. Minimal LWQI scores uplake during the first two samplings in 1994 were influenced by elevated total phosphorus concentrations and increased turbidity.

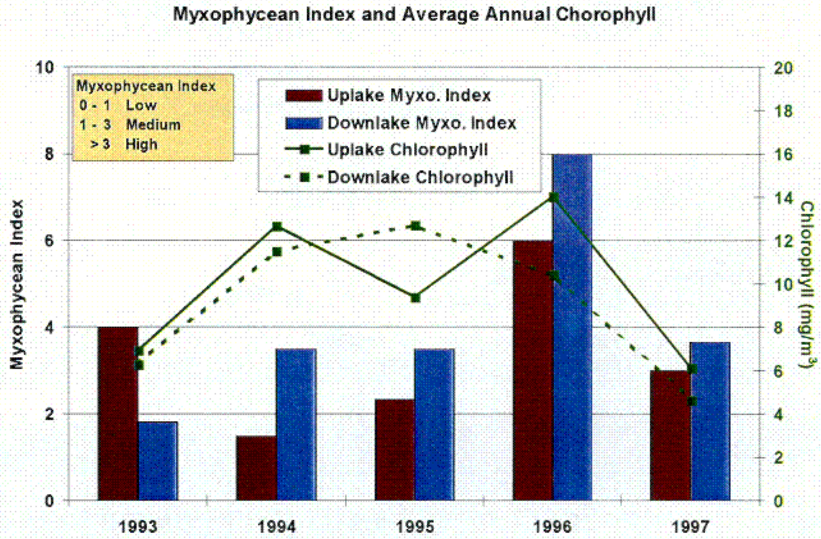


Trophic status

Applying the North Carolina Trophic State Index to Duke's data showed that both the uplake and downlake regions of Lake Wylie changed frequently, from occasionally oligotrophic to mesotrophic, and even borderline eutrophic status. Due to domestic, agricultural and industrial wastewater loading and runoff from the expansive South Fork Catawba River watershed, Lake Wylie's nutrient classification is even more closely tied to short term climatologic and hydrologic events than are the Catawba reservoirs immediately upstream. Like the Fusilier's LWQI, no definitive trend was observed in the NCTSI for 1994 through 1997.

Phytoplankton productivity

The phytoplankton community in Lake Wylie was influenced by the physical features of the lake. The uplake location was shallow and a current was noticeable. The downlake location was deeper and currents were very minimal. The South Fork Catawba River, a major tributary and significant source of high nutrients, discernably affected the lower lake. It was the influence of the South Fork that made the uplake-downlake differences of chlorophyll in Lake Wylie less

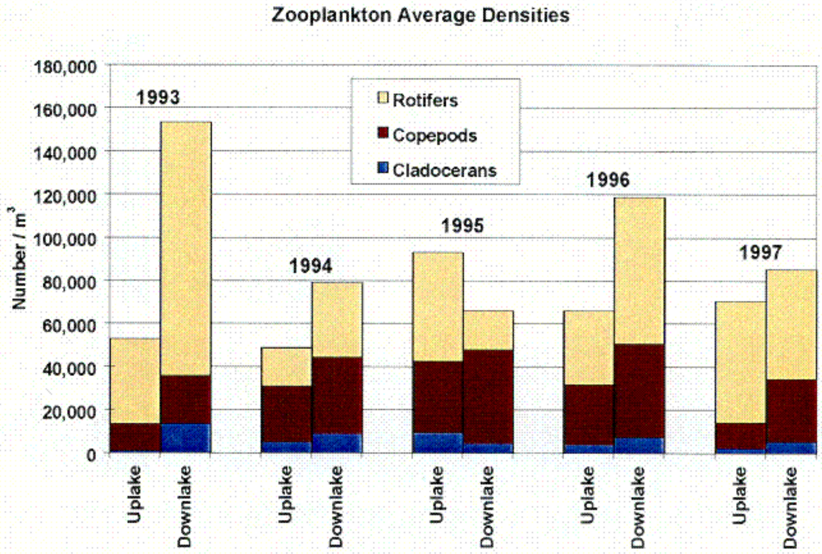


C20

pronounced than in Lake Norman. The Myxophycean Index, however, reflected intra-lake differences in species composition. The downlake area had greater densities and more species of blue-green algae than did the uplake area.

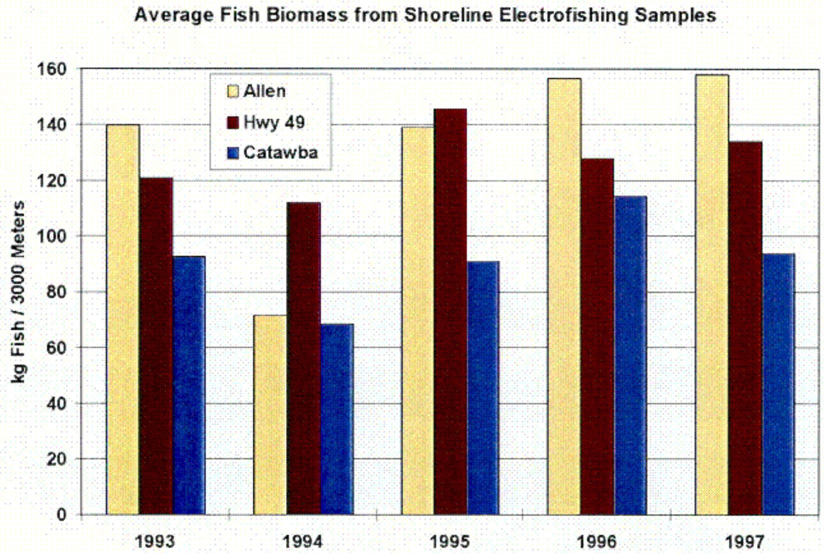
Zooplankton

Lake Wylie zooplankton populations exhibited the reverse of the situation typical of reservoirs — downlake had higher densities than uplake. Overall populations were very high, reflecting the trophic conditions of the lake. The annual variation in total numbers and the percentage composition of the major zooplankton groups were large. An unusual feature of the zooplankton community was the very low percentage of cladocerans. Species of *Brachionus*, indicators of eutrophic conditions, were found downlake, attaining large populations in years when productivity was greatest; these species were rarely found uplake.



Littoral fish community

The littoral fish community of Lake Wylie was assessed annually by shoreline electrofishing in the spring of 1993-1997. Sampling was conducted in three areas of the reservoir—near Plant Allen discharge in the South Fork River arm, near the Highway 49 bridge, and near Catawba Nuclear Station. Mean total biomass estimates declined progressively downstream and were 136, 128, and 92 kg of fish per 1,000 m of sampled shoreline near Plant Allen , Highway 49, and Catawba Nuclear Station, respectively. Sunfish, catfish, and common carp composed most of the biomass collected at these stations.



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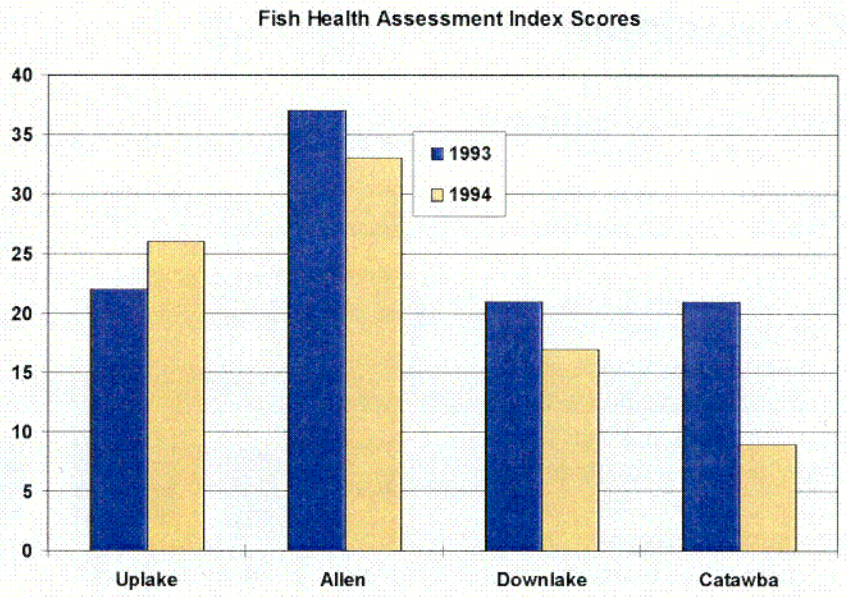
Fish health assessment index

Health of Lake Wylie largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. Lower FHAI scores indicate relatively good health. Lake Wylie FHAI scores averaged 23 for the two years and four locations sampled.



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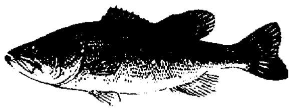
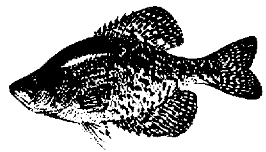
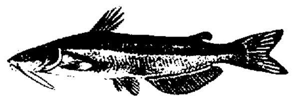
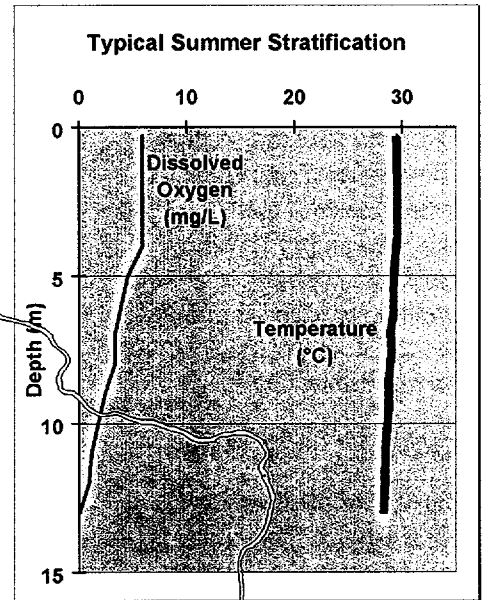
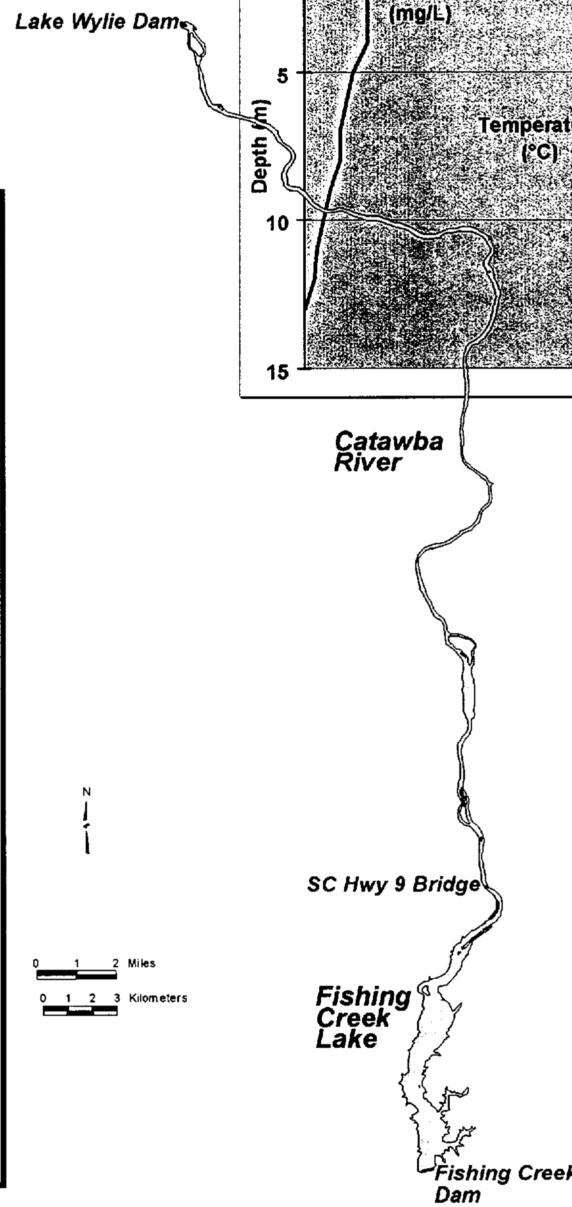
FISHING CREEK LAKE











Fishing Creek Lake At A Glance

Hydromorphometry

Surface Elevation:	417.2 feet above MSL
Surface Area:	3,370 acres
Volume:	60,000 acre-feet
Retention Time:	6 days (average)
Average River Flow	
Fishing Creek Hydro:	3,141 MGD
Maximum Depth:	89.6 feet
Average Depth:	17.7 feet
Length (Main Channel):	13.8 miles
Shoreline:	36 miles
Maximum Drawdown:	10 feet

Duke Power Electric Generation

Fishing Creek Hydro:	36.72 MW
Total Electric Capacity:	36.72 MW

Watershed Characteristics

Year Impounded:	1916
Drainage Area:	3,810 square miles
Sub-Basin Population	519,698 (1990)
Watershed Land Cover:	17.4% urban 17.4% cultivated 64.9% forested 0.3% other undeveloped

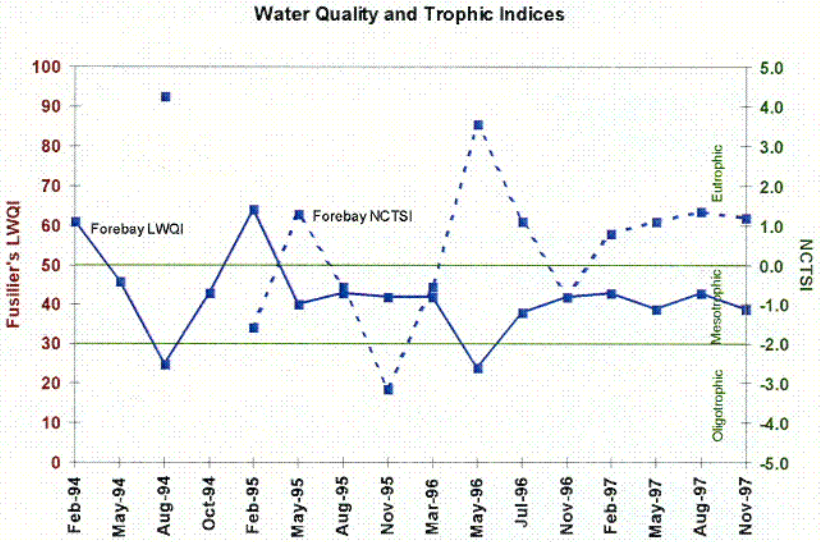
Shoreline Use

Residential and Commercial:	4.7%
Recreational:	0.3%
Other:	2.5%
Undeveloped:	92.5%

Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll *a* (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	86	-3.5	2.8	41	20
Rhodhiss	70	-1.5	12.8	63	32
Hickory	78	-1.5	8.4	55	29
Lookout Shoals	77	-1.9	7.1	54	22
Norman	80	-2.5	8.1	55	26
Mountain Island	82	-2.4	4.6	57	28
Wylie	72	-1.1	10.3	92	23
Fishing Creek	**42**	**+0.6**	**17.2**	**165**	**44**
Wateree	50	+0.4	22.7	146	24

Water quality

Fusilier's Lake Water Quality Index was calculated from Fishing Creek quarterly sampling data. The LWQI ranged between 24 and 64 over the period 1994-1997, with an average score of 42. No clear year-to-year or seasonal trends were evident in the LWQI. Substantial variability in the index could be attributed to the relatively short average hydrologic retention time of this reservoir. The four-year average of the LWQI for Fishing Creek indicated that the most substantial degradation of Catawba River water quality occurs in this reservoir and the short section of free-flowing river immediately upstream. Elevated total phosphorus combined with increased chlorophyll concentrations were the primary causes of the lower LWQI scores for Fishing Creek.

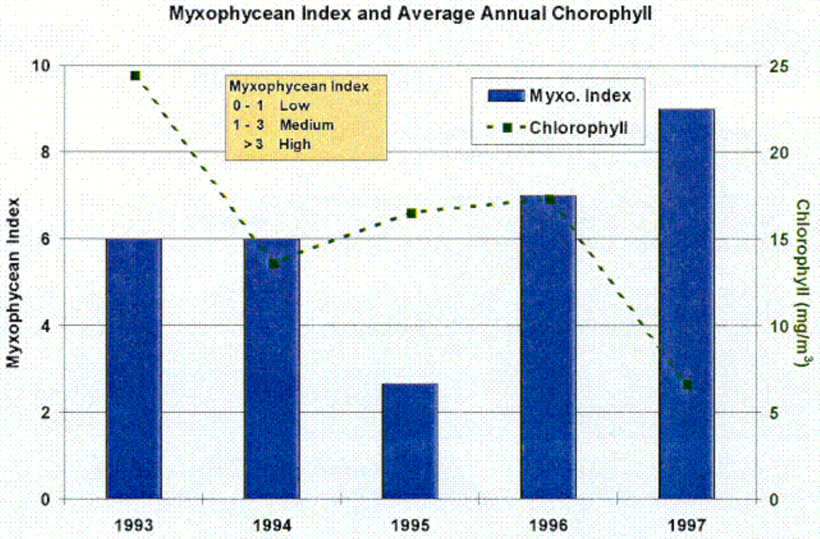


Trophic status

Application of the North Carolina Trophic State Index to Duke's data classified Fishing Creek as primarily eutrophic to mesotrophic, depending on the sampling date. Borderline oligotrophic status was attained on one occasion (November 1995). Over the four years, spring and summer sampling tended to reveal a eutrophic status, while fall or winter sampling tended more to result in a mesotrophic classification. Like the Fusilier's LWQI, no long-term trend was observed in the NCTSI for 1994 through 1997.

Phytoplankton productivity

The very low retention time (averaging 6 days) of Fishing Creek had a measurable effect on the phytoplankton community. Annual chlorophyll concentrations indicated mesotrophic to eutrophic conditions. The unusually low 1997 chlorophyll value was probably due to extremely high flushing that occurred during the week prior to the May sampling. The entire reservoir volume was replaced every 2.6 days during that period. May 1997 phytoplankton densities were the lowest observed during 1993-1997, as was the May chlorophyll concentration, which was only one third the typical value. The Myxophycean Index yielded a high productivity value for four of the five years, confirming the eutrophic nature of Fishing Creek Lake.



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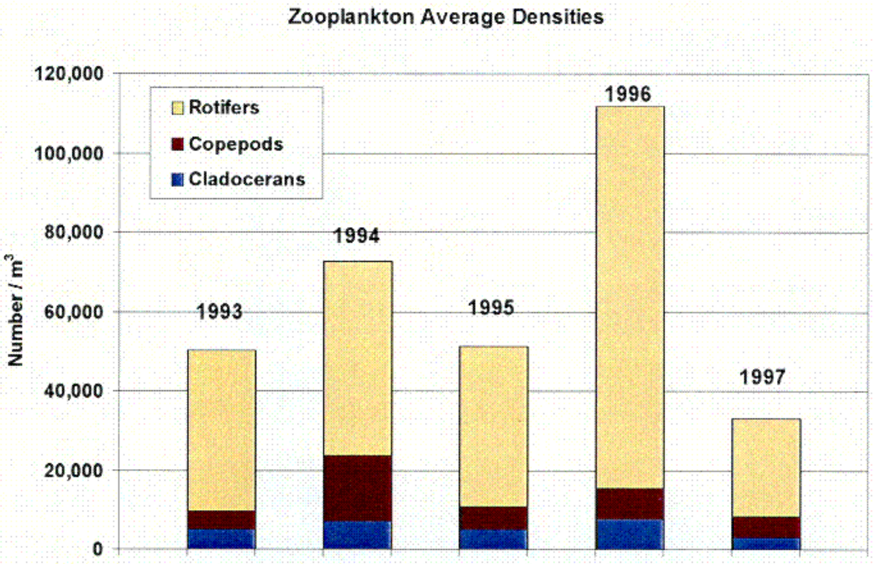
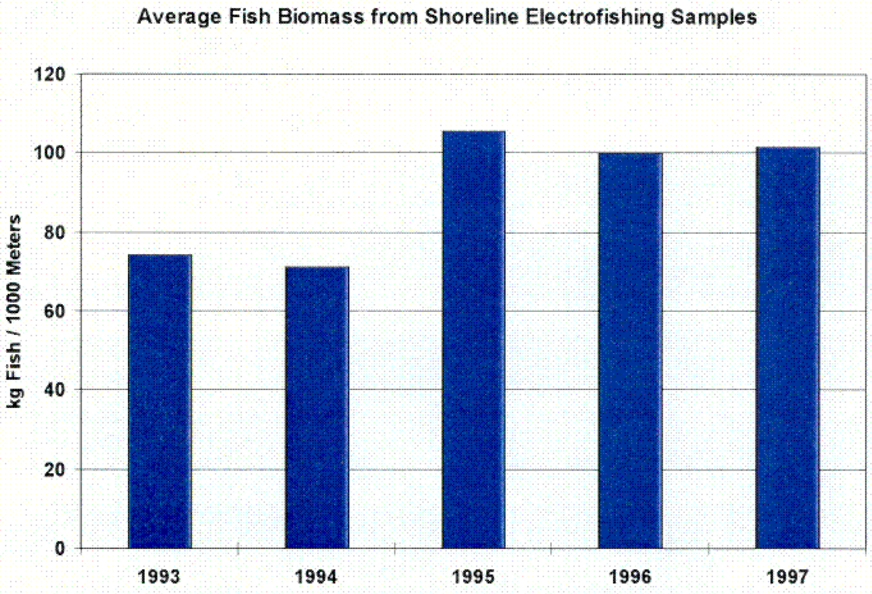
Zooplankton

The Fishing Creek zooplankton community exhibited extreme fluctuations in densities between years. The low retention time and resulting high rate of reservoir flushing prevented the zooplankton community from attaining greater densities. The percentage composition of rotifers to cladocerans and copepods was extremely high. There were many zooplankton indicators of eutrophy (five species of *Brachionus* and one species of *Hexarthra*).



Littoral fish community

Fishing Creek's littoral fish community was assessed annually in the spring of 1993-1997 using shoreline electrofishing. Estimated mean total biomass was 91 kg of fish per 1,000 m of sampled shoreline. Sunfish, common carp, and catfish composed most of the biomass.



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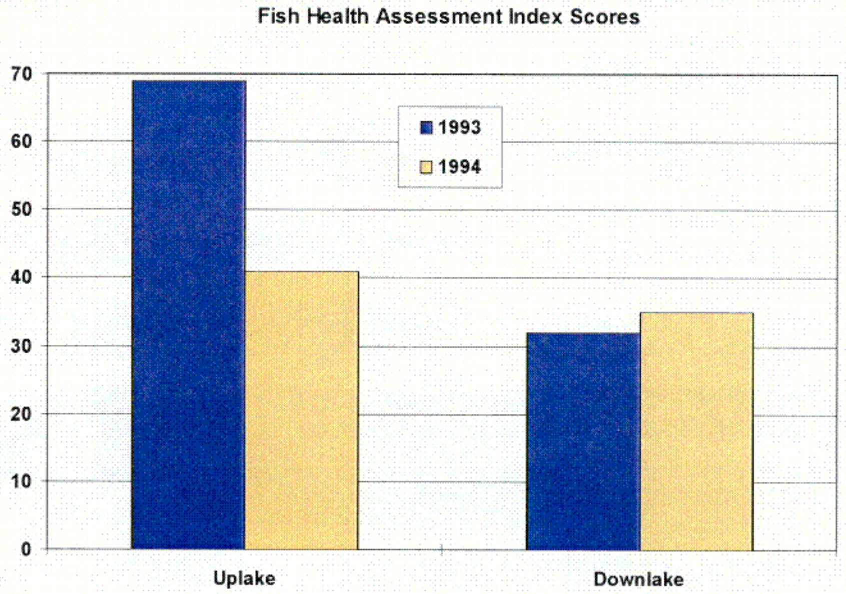
Fish health assessment index

Health of Fishing Creek Lake largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. Fishing Creek FHAI scores averaged 44 for the two years and two locations sampled and constituted the highest average score on the Catawba River.



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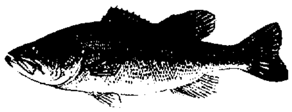
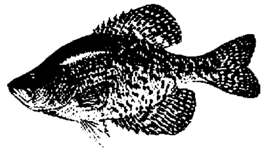
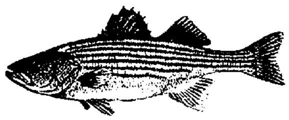
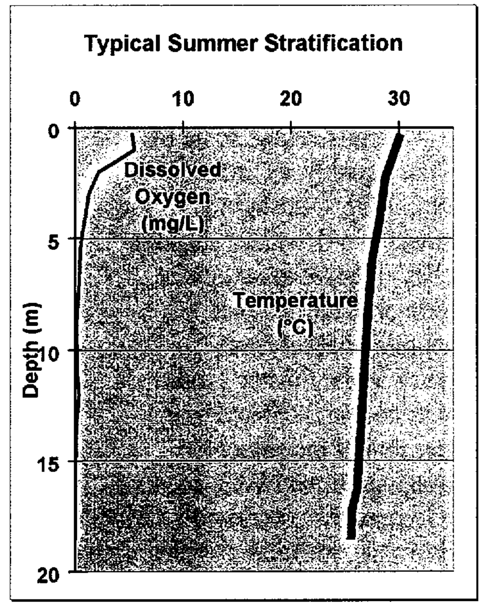
LAKE WATEREE









Lake Wateree At A Glance

Hydromorphometry

Surface Elevation:	225.5 feet above MSL
Surface Area:	13,250 acres
Volume:	303,900 acre-feet
Retention Time:	26 days (average)
Average River Flow	
Wateree Hydro:	3,765 MGD
Maximum Depth:	64 feet
Average Depth:	22.6 feet
Length (Main Channel):	22 miles
Shoreline:	190 miles
Maximum Drawdown:	10 feet

Duke Power Electric Generation

Wateree Hydro:	56 MW
Total Electric Capacity:	56 MW

Watershed Characteristics

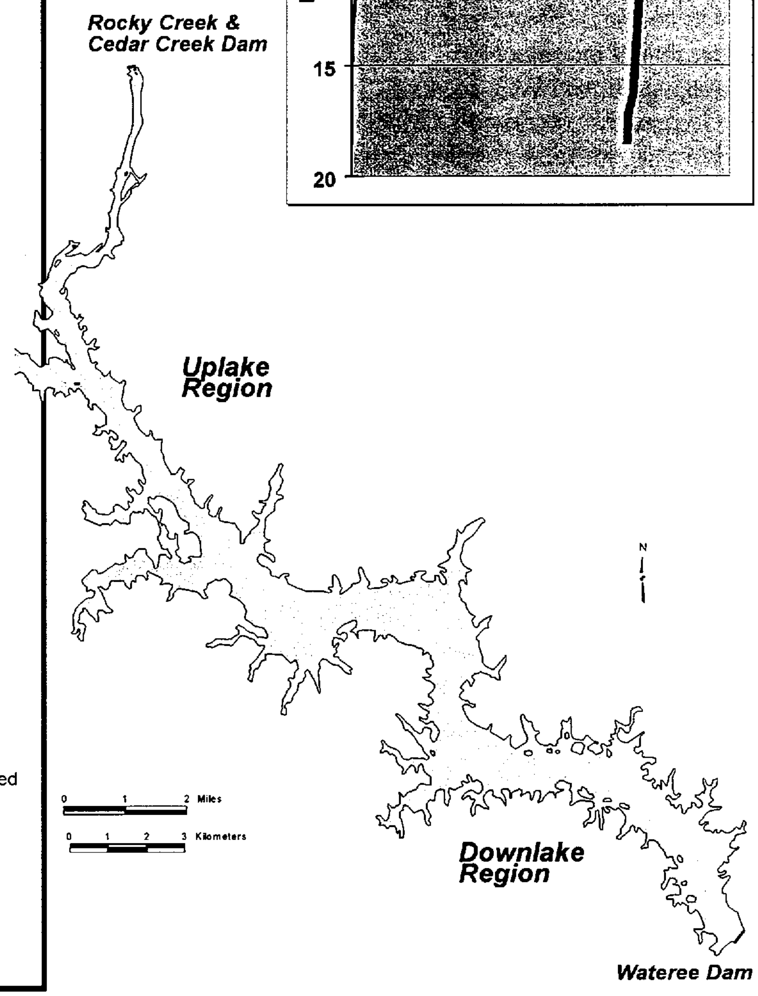
Year Impounded:	1920
Drainage Area:	4,750 square miles*
Sub-Basin Population	69,009* (1990)

*(includes Great Falls & Cedar Creek sub-basins)

Watershed Land Cover:	0.7% urban
	2.3% cultivated
	96.9% forested
	0.1% other undeveloped

Shoreline Use

Residential and Commercial:	39.1%
Recreational:	0.3%
Other:	1.4%
Undeveloped:	59.2%



Lake	Fuslier's LWQ Index	NC Trophic State Index	Chlorophyll a (mg/m3)	Conductance (µS/cm)	Fish Health Assessment Index
James	86	-3.5	2.8	41	20
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Wylie	72	-1.1	10.3	92	23
Fishing Creek	42	+0.6	17.2	165	44
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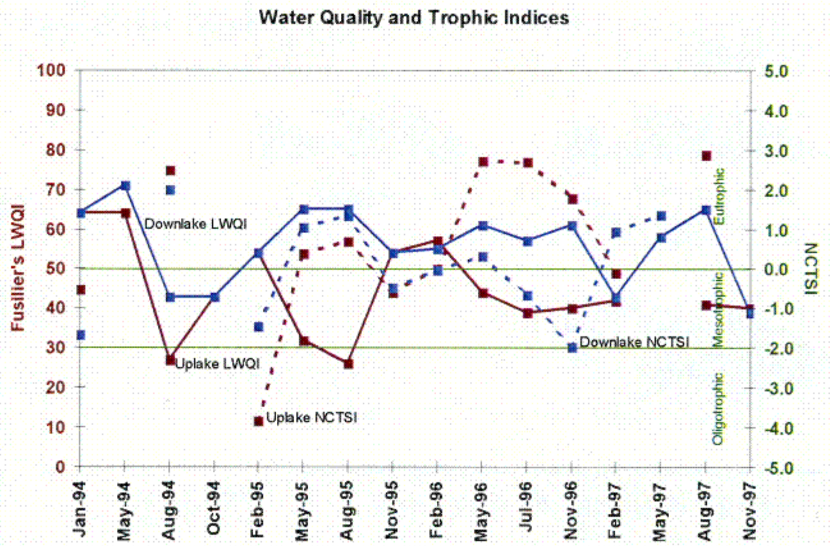
Water quality

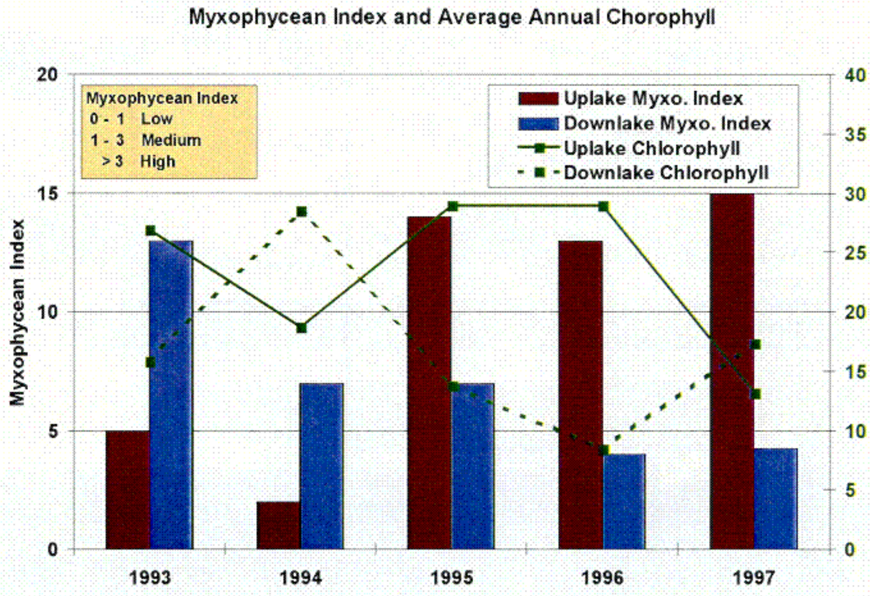


Fusilier's Lake Water Quality Index was calculated from Lake Wateree quarterly sampling data. The LWQI ranged between 26 and 71 over the period 1994-1997, with an average score of 50. Water quality, as measured by the LWQI, was slightly improved at a downlake location (forebay) relative to an uplake location on Lake Wateree. Temporal variability was observed in the Fuslier's index, but was not easily linked to the progression of the seasons. Although minimal LWQI scores were frequently experienced during a summer sampling for the uplake location, that was not necessarily true for the downlake location. No clear long-term trend was evident in the LWQI.

Trophic status

Applying the North Carolina Trophic State Index to Duke's data showed Lake Wateree fluctuated regularly between mesotrophic and eutrophic status, depending on the sampling date. Trophic status changes generally reflected seasonal changes in nutrient concentrations in the reservoir, with maximal concentrations (leading to increased eutrophication) occurring mostly during the spring and summer samplings. No long-term trend was observed in the NCTSI over the four-year sampling interval for Lake Wateree.

Phytoplankton productivity

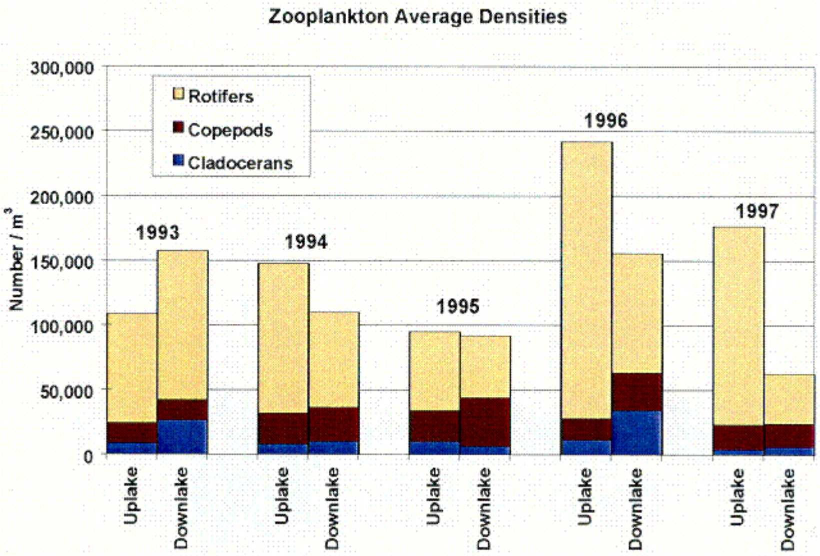


Lake Wateree was the most eutrophic of the Catawba lakes, as evidenced by the high algal population densities. The trend of uplake being more productive than downlake held true, in general, for Lake Wateree. Annual chlorophyll concentrations showed considerable year-to-year variation, but on average, the uplake values were greater than downlake during 1993-1997. The Myxophycean Index showed similarity to the uplake-downlake trend noted for chlorophyll; the index was generally increased uplake and decreased downlake during 1993-1997.

C26

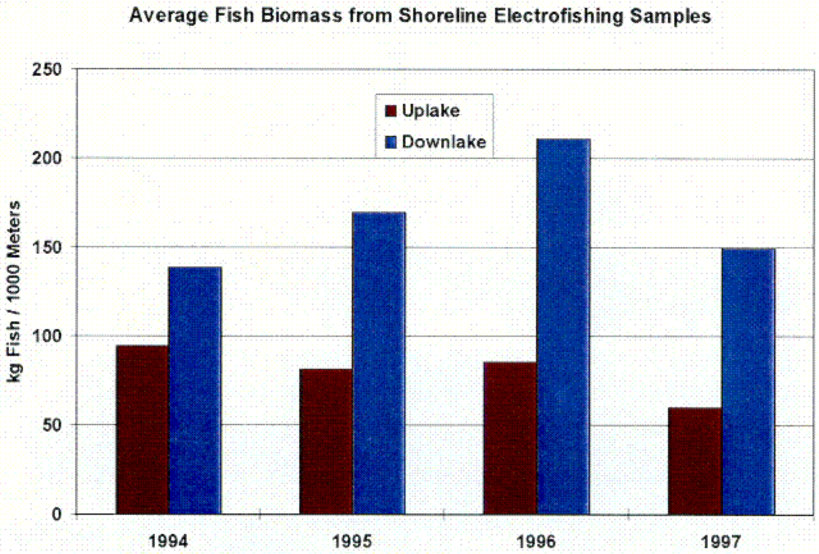
Zooplankton

The zooplankton densities mirrored the high productivity of Lake Wateree; they were the highest of all the Catawba lakes. Annual average uplake densities (except for 1993) were higher than the downlake densities. The ratio of rotifers to copepods and cladocerans was very high, as was the case in Fishing Creek. Biological indicators of eutrophic status were a constant feature of the Lake Wateree zooplankton community.



Littoral fish community

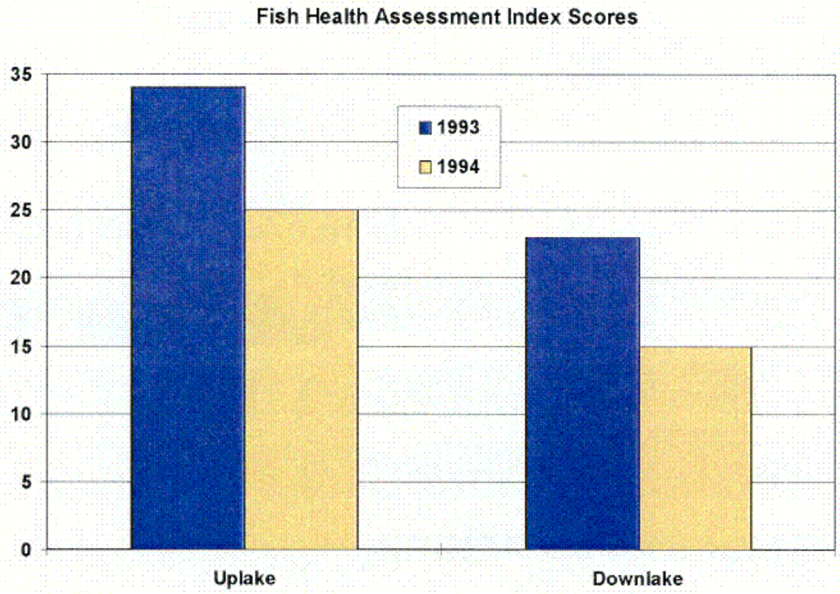
The littoral fish community in Lake Wateree was assessed annually in the spring of 1994-1997 at uplake and downlake locations. Estimated mean total biomass was considerably higher downlake (167 kg of fish per 1,000 m of sampled shoreline) than uplake (80 kg of fish per 1,000 m of shoreline). Sunfish and common carp composed most of the biomass in each of the sampled areas.



C27

Fish health assessment index

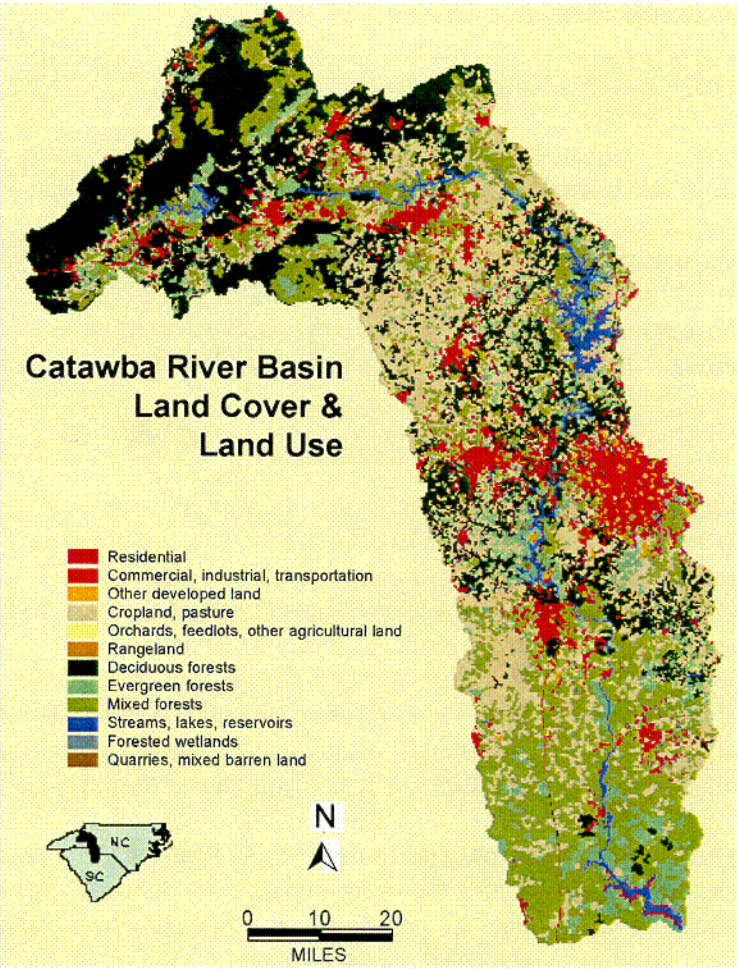
Health of Lake Wateree largemouth bass was assessed by the Fish Health Assessment Index (see page 5) during 1993 and 1994. Lower FHAI scores indicate relatively good health. Lake Wateree FHAI scores averaged 24 for the two years and two locations sampled.



C28

THE CATAWBA BASIN

The Blue Ridge to Wateree Dam
. . . A snapshot of the Catawba



Population and land use

Land use in the Catawba River watershed is an important contributor to the water quality of the river. As land use changes from wooded to agriculture to urban, related changes in water quality are observed. These changes are associated with sediment and nutrient inputs related to non-point agriculture activities, and point and non-point sediment, nutrient, trace metals and man-made organic inputs related to urban, commercial and industrial activities.

Land use patterns in flux

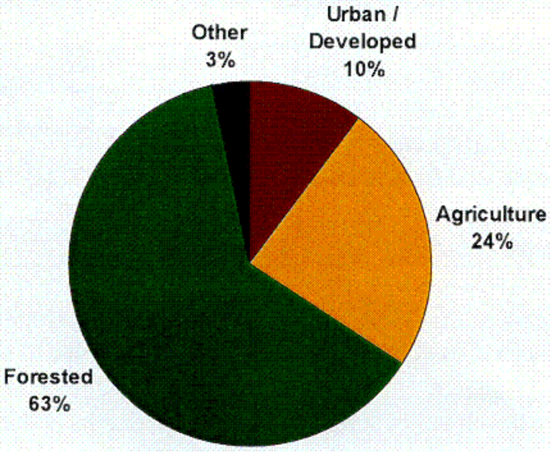
Land use characteristics throughout the watershed for the period 1989 to 1992 can be sub-categorized into four distinct types. These four classifications, and their individual percentages of the total watershed land area for the entire Catawba River basin area are shown below. A direct comparison with available land use data from1982 is difficult because of the different techniques used to measure and interpret the information. However, information presented in the 1995 *Catawba River Basinwide Water Quality Management Plan for North Carolina* indicates an approximate three percent loss of cropland, an approximate loss of two percent of forest land, and an increase in urban areas of approximately six percent during the preceding ten-year span. The decrease of agriculture and forest lands was due to ever increasing urban development in the North Carolina urban areas of Hickory-Newton-Conover, Charlotte-Mecklenburg, Mooresville, and Gastonia and the Rock Hill-Fort Mill area of South Carolina.

Increasing population and pressures

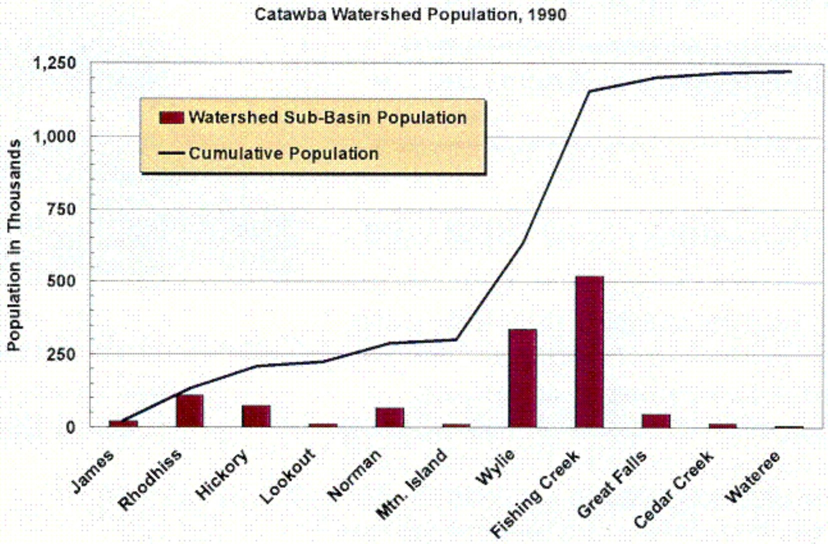
Major development pressures have been exerted along many of the Piedmont Lakes. The watersheds draining to Lakes Hickory, Norman, Mountain Island and Wylie have experienced unprecedented population growth since the 1980 census. This growth has included residential development along the shorelines of these lakes as well as residential, commercial and industrial growth along tributaries draining to these lakes.

Based on population estimates from 1980 and 1990 census data, population in the Catawba basin increased

Catawba River Basin Land Use



C29

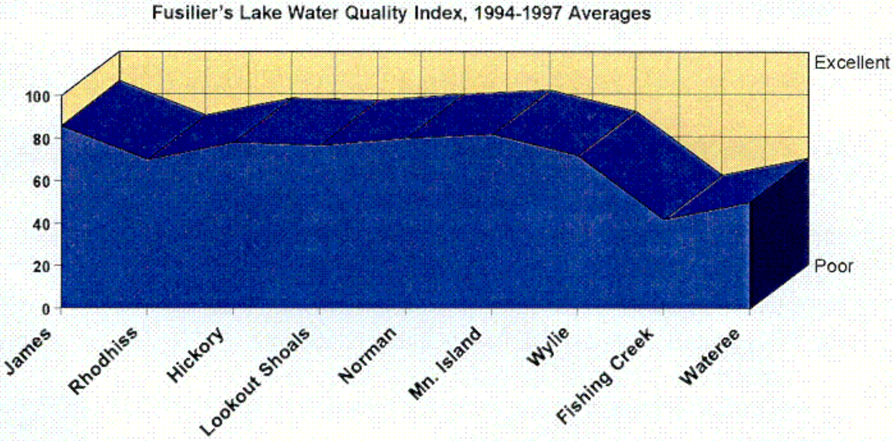


approximately 25 percent during this period. Most of the increase in population has occurred in the urban areas draining to Lakes Hickory, Norman, Mountain Island, Wylie and Fishing Creek. These urban areas have experienced growth rates ranging from 19 percent in the Fishing Creek drainage basin to 66 percent in the Lake Hickory drainage basin. Most of the population is located in the lower-middle portion of the basin (Mecklenburg and Gaston Counties); however, the reach of urbanization is extending northward to the Hickory-Newton-Conover area and Mooresville-Davidson areas and southward to the areas surrounding Fort Mill and Rock Hill, South Carolina.

As urban sprawl continues to claim more agriculture and forest lands, water quality of the Catawba River Basin will be threatened. Further water quality impairment may result from increased amounts of traditional pollutants, such as non-point sediment runoff and nutrient loadings from agriculture or new development. Additional impacts may be associated with increased or newly permitted municipal and industrial wastewater discharges, as well as urban stormwater runoff. Potentially increased inputs from various sources will advance concerns for trace metals, man-made organics, oxygen depleting materials and a variety of other potential pollutants. Water quality can be maintained only if perceptive planning, effective regulation, and commitment of resources are implemented in a timely manner.

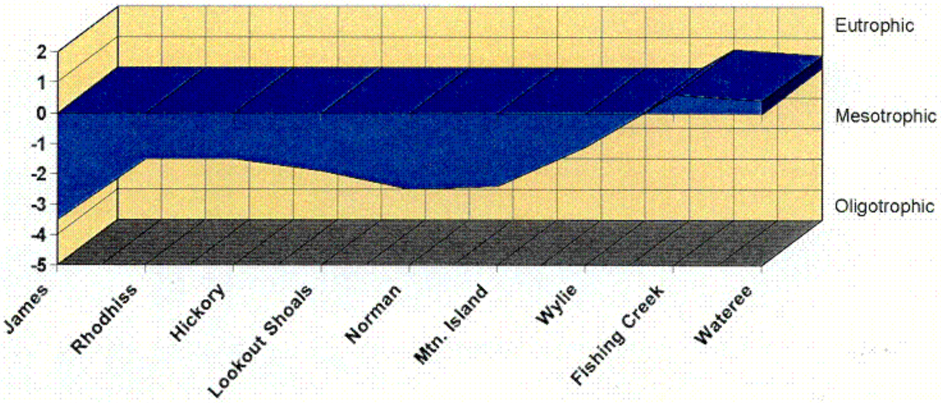
Water quality and trophic status

Appreciable seasonal and interannual variability in LWQI and NCTSI values was observed in all reservoirs within the Catawba River watershed. Most reservoirs also exhibited marked differences between uplake and downlake locations. Generally, the shallower, uplake locations of each waterbody exhibited greater seasonal variations in water quality and trophic status parameters than the deeper, downlake locations. Similarly, the smaller and shallower reservoirs tended to exhibit a greater temporal range in water quality and trophic status parameters than did the larger, deeper reservoirs. The larger reservoirs tended to exhibit trophic status index values ranging from oligotrophic to mesotrophic, whereas values for the smaller waterbodies typically ranged from mesotrophic to eutrophic. Clearly, the waterbodies with smaller surface areas, shallower depths and less water volume tended to be more spatially and temporally dynamic than did those with larger surface areas, deeper depths and larger volumes.



C30

North Carolina Trophic Status Index, 1994-1997 Averages



Despite considerable seasonal and temporal variability in water quality and trophic status parameters, no distinct increasing or decreasing trend in either LWQI or the NCTSI was observed in any one reservoir during 1994-1997. In contrast, marked differences were observed in trophic status parameters among reservoirs, with a tendency for those waterbodies that are smaller, shallower and with larger drainage areas to exhibit higher values. To a slightly lesser extent, such an upstream-to-downstream trend was also reflected in the average LWQI scores, where the smaller, shallower waterbodies with larger drainage areas exhibited lower water quality scores. This observation, that the larger, deeper reservoirs assimilate and process imported nutrients more effectively than their smaller and shallower counterparts, has been corroborated by numerous other investigations.

Plankton indicators

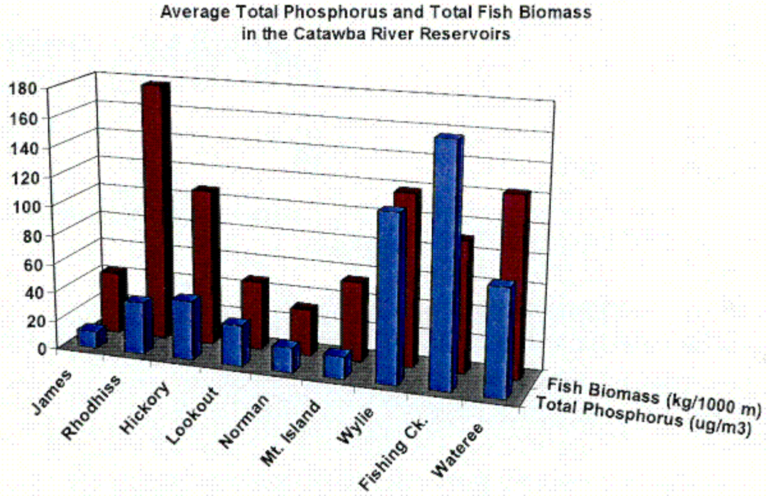
Plankton densities and species, and the Myxophycean Index mirrored the nutrient trends observed from Lake James to Lake Wateree. In general, the indicator species of eutrophication became more abundant in the lakes where nutrient concentrations were greater. Plankton populations and eutrophication indicator species were more abundant in Lakes Rhodhiss, Hickory, Lookout Shoals, Fishing Creek and Wateree, where the nutrient concentrations were somewhat elevated. Nutrient concentrations of waters entering Lake Norman had decreased so that plankton populations had also decreased, especially in the lower lake. In terms of plankton populations and indicators of eutrophication, Lakes James and Norman were least productive while Fishing Creek and Wateree were the most productive of the Catawba reservoirs.

A second trend was evident within the larger reservoirs. The upper reaches of Lakes Norman, Wylie and Wateree usually had greater plankton populations than did the waters in the downlake areas of these lakes. This phenomenon is typical of larger reservoirs. The upper portions of reservoirs receive inputs of particulate materials which remain suspended due to currents. As the in-flowing waters reach the wider and deeper portions of the reservoir downlake, the currents slow and the suspended matter and some of the associated nutrients settle out, thus making the surface waters less productive. This is especially evident in Lake Norman where the upper lake locations have much greater plankton populations than do the downlake locations.

C31

Littoral fish populations

The biomass of littoral fish populations sampled during the spring varied considerably in Catawba River reservoirs. Overall, Lake Rhodhiss exhibited the highest biomass of fish and Lake Norman the lowest. While fish biomass in reservoirs is influenced by many biological and physicochemical interactions, regression analyses indicated that variations in fish biomass among the Catawba River reservoirs was primarily related to the amount of total phosphorus available in each reservoir. The availability of this element explained about 50 percent of the variations noted.



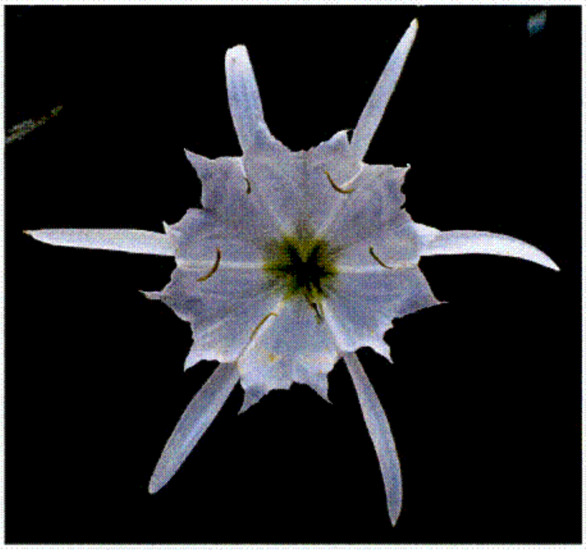
Generally, phosphorus has a positive influence on fish biomass in reservoirs by supporting the growth of abundant fish food organisms at the lower trophic levels. Phosphorus is often the limiting factor in fish production in reservoirs. However, excess phosphorus can degrade reservoir water quality to the extent that fish production is impacted. Phosphorus concentrations in Catawba River reservoirs do not appear to be at levels sufficient to adversely impact fish biomass because the mesotrophic and eutrophic reservoirs continue to support the highest biomass of fish.

Threatened and endangered species

The Catawba River, with its associated diverse habitats, is home to a number of threatened or endangered species. Detailed county-by-county databases on these federally and state listed plants and animals are maintained by North Carolina (Heritage Trust Program - NC Department of Environment and Natural Resources) and South Carolina (Heritage Trust Program- SC Department of Natural Resources). Several of the more noteworthy species are mentioned below.

Bald Eagle — Recently federally down-listed from endangered to threatened, there are several known nest sites along the SC portion of the river. Eagles, although not commonplace anywhere along the river, are increasingly sighted along such reservoirs as James, Rhodhiss, Hickory, Fishing Creek, and Wateree.

Rocky Shoals Spider Lily — This well-known emergent aquatic plant of striking beauty is restricted primarily to the Landsford Canal section of the Catawba River because of the lily's extremely specific habitat requirements; swift flowing water over rocky shoals with an open canopy. Nationally this plant is listed as a Species of Concern; in South Carolina it is listed as "imperiled state-wide" because of its extremely restricted distribution.



Rocky Shoals Spider Lily

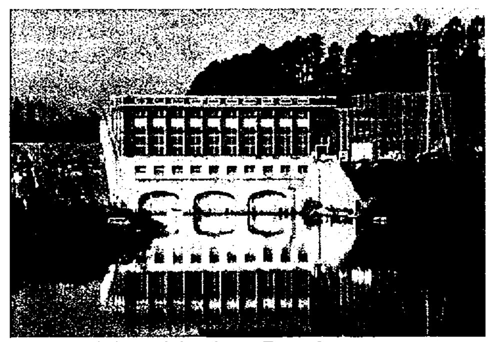
C32

Mollusks — Freshwater mussels such as the Carolina Heelsplitter, Eastern Creekshell and the Carolina Elktoe are found in Mecklenburg County, NC and are listed as critically imperiled state-wide. These invertebrates, when found, are generally in small streams and the interface area of feeder streams as they join the Catawba River. Because these invertebrates are seldom seen. To date little attention or protections have been afforded them. Clams are extremely sensitive indicators of water pollution, and when stream water quality improves, an associated increase in these organisms is anticipated and welcome.

Schweinitz's Sunflower — This federally endangered species is relatively common in the Lancaster and York County, SC. Although found adjacent to the Catawba River, the plants are also quite common in upland areas, including transmission corridors and highway right-of-ways.

Reservoir aging and siltation

The Catawba reservoirs range in age from about 37 to 97 years. When reservoirs are first created they go through a very productive period due to the release of nitrogen and phosphorous from the newly flooded soils. These nutrients promote the growth of phytoplankton that serve as food for zooplankton. Aquatic insect and fish populations increase in response to the increased food supply of plankton. As the initial stocks of sediment-derived nutrients are depleted, the in-flowing waters become more important sources of nutrients. In undisturbed watersheds with little human influence, the in-flowing waters are low in nutrients and the reservoir becomes low in nutrients, or oligotrophic. In such situations, the biomass (plankton, fish, and insects) the reservoir can support is small. In reservoirs where the watershed is more developed and abundant nutrients enter the reservoir, productivity is greatly increased. All the Catawba reservoirs have aged to the point where their nutrient supply is no longer influenced by the original inundated soils, but by inputs from their watersheds.



Rhodhiss Hydro Station

Another factor affecting reservoirs as they age is the process of sedimentation. Flowing waters carry sediments into reservoirs. The state of the watershed determines the amount of sediment transported into the reservoir; undisturbed watersheds yield little sediment, while highly disturbed watersheds produce significant amounts of sediment. As a stream enters a reservoir its velocity decreases. Sediment particles settle out; heavier particles settle out faster while lighter particles settle out; heavier particles settle out faster, while lighter particles settle out more slowly. The overall result is that the reservoir fills in, and over time additional shallow water habitat and oxygen-consuming conditions are created. The shallow, silty areas are ideal habitat for aquatic plants, and in turn, the combination of shallow water and aquatic plants provides an ideal habitat for mosquitoes. Sediments entering the reservoir also contain organic matter that is oxidized in the lake. This results in oxygen depletion of the deeper waters that leads to other undesirable chemical reactions. Aquatic animals will not inhabit these oxygen deficient areas

Reservoirs go through several distinct phases as they age. The Catawba reservoirs have aged to the point where the primary influence on the water quality is input from the watershed.

Sources of information used in this report

All data presented in this report were obtained from Duke Power with the following exceptions:

Watershed land cover imagery was obtained from the U.S. Department of Commerce's Landsat Thematic Mapper imagery, 1993-1995. South Carolina land cover imagery came from SPOT Image Corporation's multispectral imagery, 1989-1990. Census results published by the U.S. Department of Commerce were used to supply the data for population trending. Watershed land use data for 1992 were obtained from the 1995 *Catawba River Basinwide Water Quality Management Plan for North Carolina (Final Draft)*. Information on NPDES permitted discharges was obtained from the NC Division of Environmental Management (1996) and the Catawba Regional Planning Commission (1992). Shoreline use data were obtained from Duke Power's draft 1998 *Shoreline Management Plan for the Catawba-Wateree Hydro Project (FERC Number 2232)*.

Measurement unit conversions

Measurement	Metric unit (abbreviation)	English equivalent (abbreviation)
Distance	kilometer (km)	0.621 miles (mi)
Depth or Length	meter (m)	3.281 feet (ft)
Area	hectare (ha) (= 0.01 square km)	2.471 acres (a)
	square kilometer (sq km)	0.386 square miles (sq mi)
Volume	cubic meter (cu m)	264.2 gallons (gal)
	1000 cu m	0.811 acre foot
	1000 cu m	0.264 million gallons
Flow	cubic meter/second (cu m/s)	22.827 million gallons/day (MGD)
Temperature	0 degrees Celsius (°C)	32 degrees F (°F)
	37.8 °C	100 °F
Weight	kilogram (kg)	2.203 pounds (lb)
	milligram (mg) (= 0.001 kg)	0.0000353 ounce (oz)

Glossary

biomass - mass (kg) or weight (lbs) of biological organisms in a defined area or unit volume

chlorophyll *a* - a pigment found in the chloroplasts of green plants and algae that is instrumental in the conversion of sunlight into chemically stored energy; often used as an estimate of algal biomass

conductance - an indication (measured in mS/cm standard units) of the ability of water to carry an electric current; pure water has a very low conductance, while waters with differing amounts of dissolved minerals yield proportionately greater conductance values

epilimnion - upper, warmest region in a thermally stratified lake or reservoir

eutrophic - condition where a waterbody has elevated nutrient (usually nitrogen and phosphorus) concentrations that can result in undesirably high densities of phytoplankton or aquatic vegetation

Fusilier's Lake Water Quality Index (LWQI) - an index of water quality which integrates the opinion-derived scores of nine separate water quality measurements; a maximum score of 100 represents excellent water quality, while a score of 0 indicates extremely poor water quality (see page 3)

forebay - area of an impoundment (lake or reservoir) immediately upstream of the dam

hypolimnion - lower, coolest region in a thermally stratified lake or reservoir, usually oxygen-deficient

limnetic - of or relating to the open waters of a lake of reservoir

littoral - of or relating to the shoreline areas of a lake or reservoir

macrophytes - multicellular, vascular plants

mesotrophic - condition where a waterbody's nutrient (usually nitrogen and phosphorus) concentrations and biological productivity are intermediate between eutrophic and oligotrophic status

metalimnion - region of a thermally stratified lake or reservoir situated above the hypolimnion and below the epilimnion, usually associated with the maximum temperature-depth gradient observed during stratification

Myxophycean Index - a biological indicator of lake trophic status, derived from the number of blue-green algal (Myxophycean) species divided by the number of desmid algal species; low index values correspond to oligotrophic conditions, while higher index values correspond to eutrophic conditions.

North Carolina Trophic State Index (NCTSI) - a numerical index developed by the NC Division of Environmental Management to characterize the trophic status of waterbodies; the NCTSI integrates measurements of available nutrients, water clarity, and chlorophyll, with higher index values being indicative of greater eutrophication (see page 4)

oligotrophic - condition where a waterbody has very low nutrient (usually nitrogen and phosphorus) concentrations that normally result in minimal densities of phytoplankton or aquatic vegetation

phytoplankton - algae found in the water column, as opposed to algae attached to sediment or a substrate

Secchi depth - depth to which visible incident light penetrates in a waterbody, estimated by lowering and raising a Secchi disk (six-inch diameter white disk) in the water column and determining the depth where the disk disappears and reappears

tailrace - area immediately downstream of a dam

trophic status - a relative classification of waterbodies that relates their nutrient concentrations and biological productivity (e.g., oligotrophic, mesotrophic, eutrophic)

zooplankton - small, free-swimming invertebrates (e.g., rotifers, cladocerans and copepods) that feed on phytoplankton and other zooplankton in the water column

Catawba Nuclear Station

Facts About: **Catawba Nuclear Station**

Owners

Duke Power
North Carolina Electric Membership Corp.
North Carolina Municipal Power Agency No. 1
Piedmont Municipal Power Agency
Saluda River Electric Cooperative, Inc.

Capacity

1129 megawatts for each of the two units. In a typical year, Catawba supplies roughly 20% of Duke Power's total generation.

Size and Location

391 acres located on scenic Lake Wylie. Catawba is about 19 miles south of Charlotte, N.C., and six miles north of Rock Hill, S.C.

Fuel

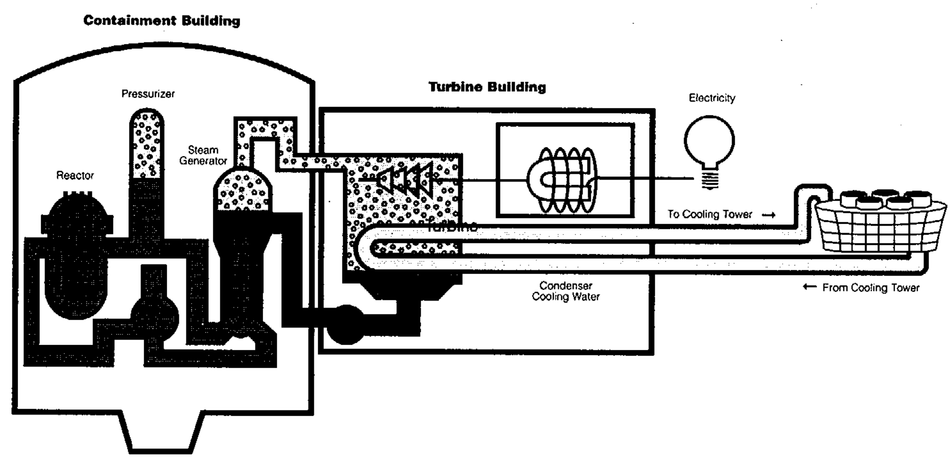
Uranium dioxide pellets (about the size of pencil erasers) enclosed in metal rods. Each pellet contains about as much energy as a ton of coal. There are approximately 230 pellets per rod, 264 fuel rods in a fuel assembly, and 193 fuel assemblies in a reactor core. Each fuel assembly is used in the reactor for about three years.

Operating History

June 1974 – Construction began

June 1985 – Unit 1 began commercial operation

August 1986 – Unit 2 began commercial operation

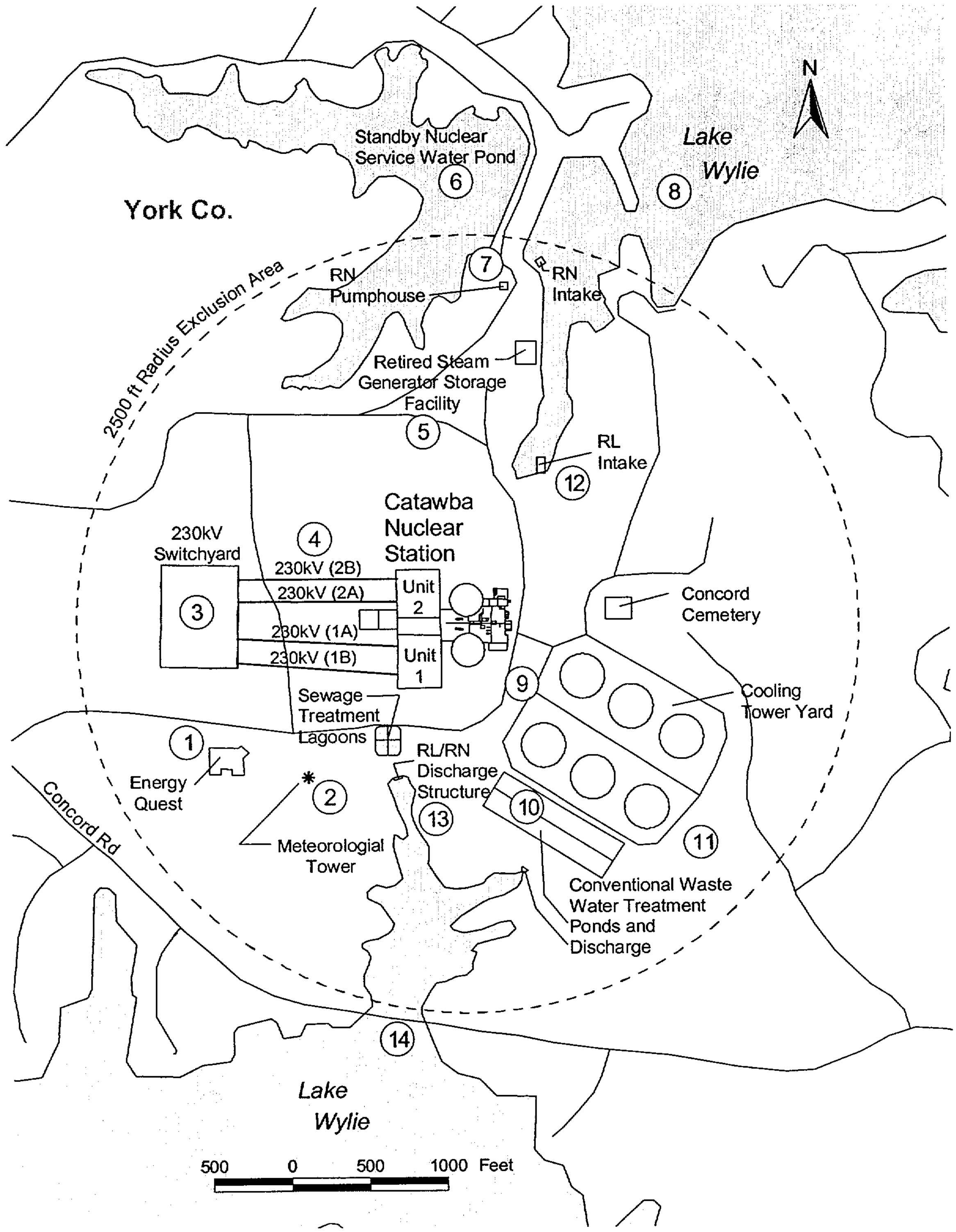


How Catawba Makes Electricity

Catawba Nuclear Station uses uranium as its fuel. Each uranium pellet, less than an inch long, contains about the same amount of energy as a ton of coal. In a process called nuclear fission, uranium atoms split, releasing heat which turns water into steam. Here's how it works:

1. A system of water circulates through the nuclear fuel, or core, inside the reactor. This water picks up heat given off through fission. The water is heated to about 600F, but doesn't boil because it is kept under pressure.
2. Fission is controlled by raising or lowering control rods inside the reactor. When the control rods are fully inserted, the reactor shuts down.
3. Water heated in the reactor flows through thousands of tubes inside the steam generators. Another water system outside the tubes picks up the heat and turns into steam. The steam then travels to the turbine, and the first system of water returns to the reactor to be reheated.
4. The turbine, a large fan-like device, spins when hit by steam.
5. The turbine is connected to a magnet that spins inside a generator, producing electricity.
6. Steam is cooled back into water in the condenser and the entire cycle is repeated. Condenser cooling water, used to cool the steam, comes from six cooling towers.

Catawba Nuclear Station
License Renewal – NRC Environmental Site Audit
Site Bus Tour – October 22, 2001



n Photo/Location Number

Location 1. View of Plant
Photo 1

The Catawba plant consists of two Reactor Buildings, one Auxiliary Building, two Turbine Buildings, two Diesel Generator Buildings, one shared Service Building, one Water Chemistry Building and six Mechanical Draft Cooling Towers. The Intake Structure, Discharge Structure and Standby Nuclear Service Water Pond are shared features. In addition to these buildings and features, there are additional office buildings and other facilities at the site used for support staff at Catawba.

Each generating unit is designed to operate at core power levels up to 3411 MW(t), which corresponds to a net electrical output of approximately 1129 MW(e). All core physics and core thermal-hydraulic information are based on the reference core design of 3411 MW(t). Unit 1 began commercial operation in June 1985. Unit 2 began commercial operation in August 1986.

Location 2. Met Tower/Instrument House

Photo 2

The current meteorological tower became operational on June 11, 1996 at hour 1900. The previous MET system was located on the nearby microwave tower.

The tower has instruments at 2 levels (approximately 10m and 60m), as well as a rain gauge on the ground.

The building at the base of the microwave tower houses the instrument signal processors, which also send the data signals to the plant computer (OAC). Data is displayed in the control room digitally and on stripchart. The building also houses a backup datalogger, which can be accessed remotely via dial-up.

Instruments at 10m	Instruments at 60m
Wind Speed	Wind Speed
Wind Direction	Wind Direction
Temperature	Temperature
Dew Point Temperature	

Archived Data Available = 1-hour average or total

Wind Speeds at 10m & 60m
Wind Directions at 10m & 60m
Ambient Temperature at 10m
Dew Point Temperature at 10m
Delta-T = vertical temperature gradient (60m reading - 10m reading)
Sigma-Theta = standard deviation of horizontal wind direction at 10m level
1-hour total Precipitation

Location 3. 230 kV Switchyard
See Photo 3

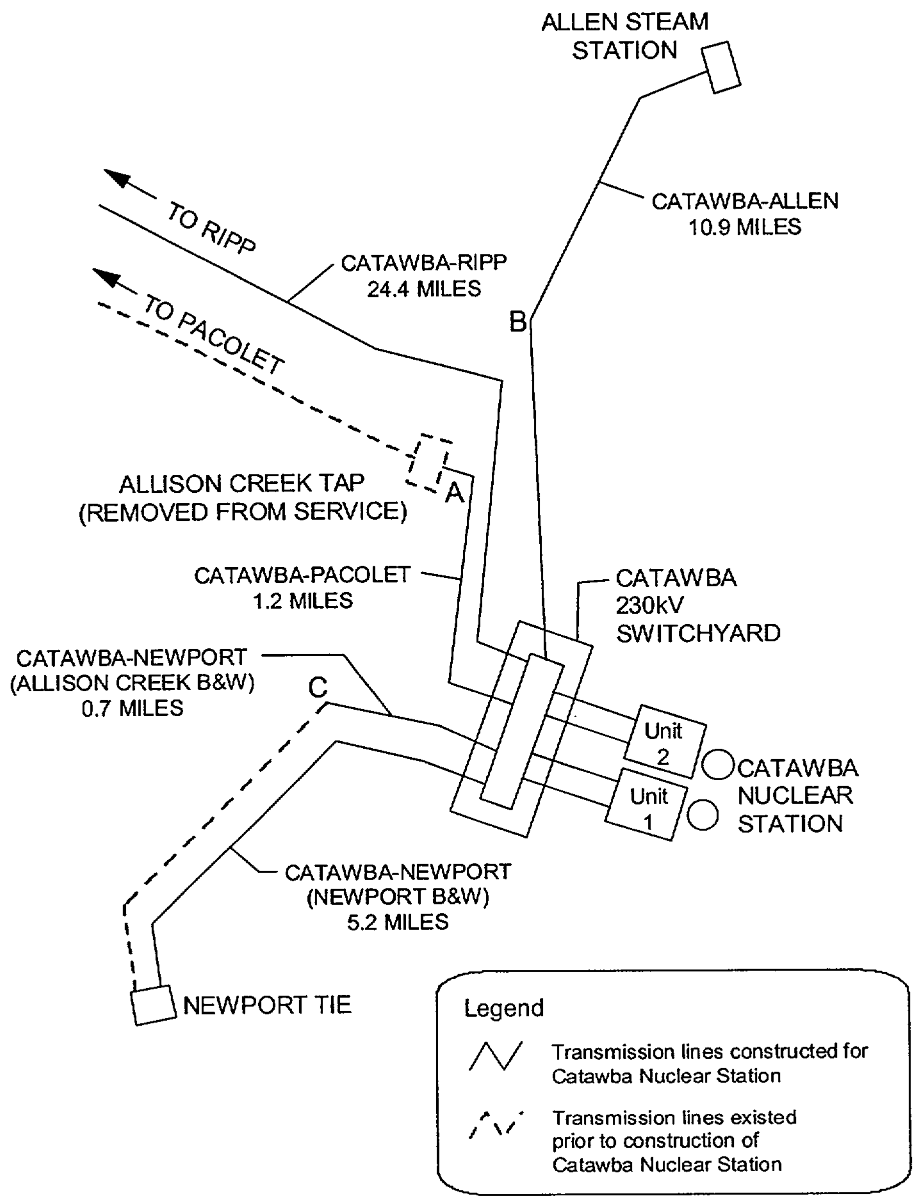
Two separate and physically independent overhead transmission line circuits are provided to connect each Catawba unit to the 230kV transmission network via the 230 kV switchyard as shown in Figure 3-2. Four lines connect the plant to the switchyard. Each line is 230kV, three phase with an average length from the transformer yard to the 230kV switchyard of approximately 1,000 feet. Due to the short length of these lines, supporting towers are not required between the station and the switchyard. These 230kV transmission lines are designed to withstand the heavy loading conditions defined in the 1973 edition of the National Electric Safety Code

ER Figure 3-2 shows these lines and the lengths are presented in ER Table 3-1.

ER Table 3-1 Power Transmission Lines Related to the License Renewal for Catawba Nuclear Station

Name of Line	Total Right-of-Way Length	Comments
Catawba-Allen	10.9 miles (17.5 km)	9.6 miles (15.5 km) rebuilt; 1.3 miles (2.1 km) new
Catawba-Ripp	24.4 miles (39.3 km)	24.4 miles(39.3 km) all new
Catawba-Pacolet	1.2 miles (2.1 km)	Extended line 1.2 miles (2.1 km) from former Allison Creek tie; no work performed on remainder of line
Catawba-Newport (Allison Creek B&W (Black &White))	0.7 miles (8.4 km)	0.7 miles (1.1 km) new line; total length 5.2 miles (8.4 km) from Catawba to Newport tie
Catawba-Newport (Newport B&W)	5.2 miles (8.4 km)	5.2 miles (8.4 km) all new
Total Length	**42.4 miles (75.7 km)**	

ER Figure 3-2 Catawba Transmission Lines



Location 4. Monitor Tank Building
See Photo 4

Used for processing low level radioactive liquids. Basically an empty building with lines coming from the WL system collections tanks and going to the release point to Lake Wylie. In between these lines, various equipment can be connected in the processing area as needed to maximize liquid cleanup (resin beds, filters, ultrafiltration, RO, etc.). After processing, the liquid is collected in one of three Aux. Monitor Tanks (AMTs) where it is sampled and then released to the RL system and ultimately Lake Wylie (Outfall 004).

The building also contains tanks to accept spent processing media (carbon, resin, etc.).

The facility is self contained. It has its own control room, ventilation systems, fire protection, etc.

Location 5. Retired Steam Generator Storage Building
See Photo 5

- All 4 Unit 1 Steam Generators replaced in 1996.
- Main concern was history of tube corrosion/cracking.
- No plan to change Unit 2 steam generators- different manufacturing process used from SG's originally in Unit 1.
- Building is basically an empty concrete box.
- Steam Generators were placed horizontally.
- Front of building was then placed and sealed.

Radiation Protection enters semi-annually to perform surveys.

Location 6. Standby Nuclear Service Water Pond (SNSWP)
See Photo 6

Catawba does not use cooling ponds for normal operation. However, Catawba does have a Standby Nuclear Service Water Pond (SNSWP). The purpose of this pond is to provide an ultimate heat sink in the event of a loss of access to Lake Wylie. In this function the pond would supply cooling and service water to selected plant heat exchangers and other equipment required to bring the plant to a safe shutdown condition. The SNSWP has a volume of approximately 570 ac-ft. at a full pond surface area of approximately 44 acres. The pond is isolated from the plant service water during normal plant operations.

The SNSWP is normally overflowing at 574 ft above MSL and has a minimum allowable water level of 571 ft.

The SNSWP has a net inflow from runoff and subsurface interflow.

The Standby Nuclear Service Water Pond is typically in a "standby mode" for greater than 95% of the fuel cycle. The Nuclear Service Water System is only aligned to the SNSWP to facilitate "testing" or other "maintenance" activities. The duration for Pond operation to support testing is typically one (1) to twelve (12) hours. The duration for maintenance activities is usually four (4) to twenty-four (24) hours.

Location 7. RN Pumphouse

See Photo 7

The Nuclear Service Water System (RN) provides essential auxiliary support functions to Engineered Safety Features of the station. The system is designed to supply cooling water to various heat loads in both the safety and non-safety portions of each unit. Provisions are made to ensure a continuous flow of cooling water to those systems and components necessary for plant safety during normal operation and under accident conditions.

The RN Pumphouse is a Class 1 seismically designed structure that contains two separate pits from which two independent and redundant channels of RN pumps take suction. Each pit can be supplied from both the normal source and also the assured source of water. Either pit is capable of passing the flow needed for a simultaneous unit LOCA and unit cooldown. Flow spreaders in front of all the intake pipe entrances prevent vortices and flow irregularities while removable lattice screens protect the RN pumps from solid objects.

The operation of any two pumps on either or both supply lines is sufficient to supply all cooling water requirements for unit startup, cooldown, and refueling and post-accident operation of two units. However, one pump has sufficient capacity to supply all cooling water requirements during normal power operation of both units or during post accident conditions if the unaffected unit is already in cold shutdown.

NUCLEAR SERVICE WATER PUMPS

Number per unit	2
Type	Vertical, wet pit, mixed flow with above floor discharge
Design Pressure, psig	150
Design Temperature, F	105
Design Flow, gpm	20,900
Design Head, ft.	174
Shutoff Head, ft.	260
Min. Flow Rate, gpm	8600 (continuous), 4000 (Intermittent, up to 2 hr per 10 hours)

The RN pumps can take suction from Lake Wylie throughout the entire range of lake levels from 592.4 ft. above MSL (maximum calculated flood elevation corresponding to a seismic failure of Cowans Ford Dam coincident with a Standard Project Flood) down to the maximum lake drawdown of 559.4 ft above MSL.

The Nuclear Service Water Intake Structure is located in the cove in front of the pumphouse, near the Standby Nuclear Service Water Pond Dam. This intake withdraws water through a single 48" diameter pipe at Elevation 540 feet msl.

Location 8. **Lake Wylie – Main Channel**
See Photo 8

Lake Wylie serves as the cooling water source for Catawba Nuclear Station.
Lake Wylie extends 28 miles in length between Mountain Island Dam and Wylie Dam. Lake Wylie was formed from the impoundment of the Catawba River and initially achieved full pond in 1904. The lake was expanded in 1924.

Mountain Island Lake and Lake Wylie are part of the Catawba-Wateree Project and are owned and operated by Duke Power, a division of Duke Energy, and licensed by the Federal Energy Regulatory Commission (FERC) as FERC Project 2232. The Catawba-Wateree Project consists of 11 lakes on the Catawba River, which are operated for hydroelectric power. Lake Wylie is the third largest lake in the Catawba chain. The major tributaries for Lake Wylie are the Catawba River, Allison Creek, Crowders Creek and the South Fork River. See the Figure on the following page.

Lake Wylie Summary Data

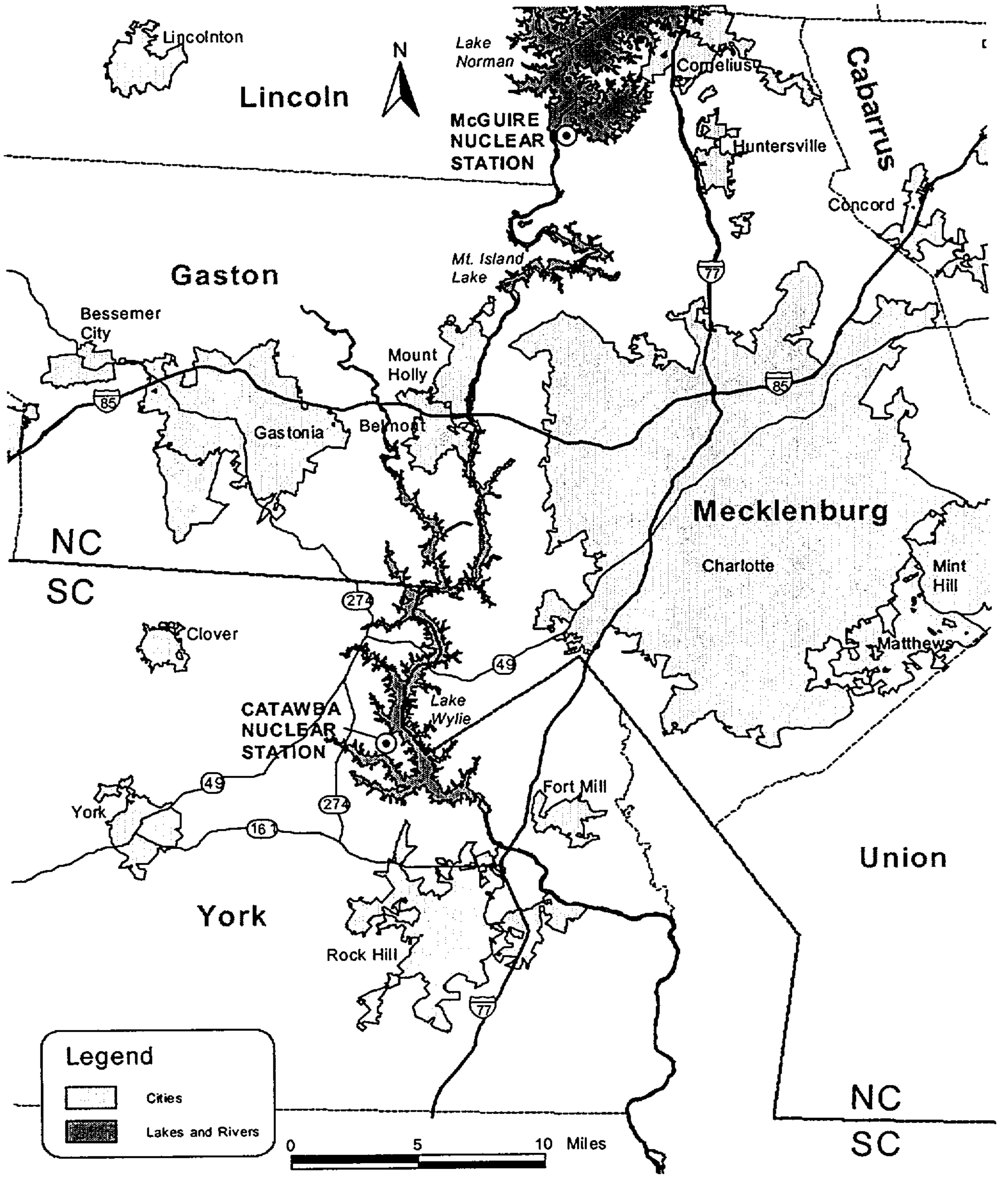
Full Pond Elevation	569.4 feet (mean sea level)
Maximum Drawdown	10 feet
Full Pond Surface Area	12,139 acres
Full Pond Volume	281,900 acre-feet
Shoreline Length	327 miles
Mean Depth	23 feet
Maximum Depth	93.2 feet
Drainage Area	3020 square miles
Annual Mean Flow (at Wylie Dam)	3774 cubic feet/second
Minimum Average Daily Flow (FERC)	411 cubic feet/second

In addition to serving the needs of the nuclear and hydroelectric power plants, Lake Wylie is a source of municipal drinking water for several cites in the region. The South Carolina Department of Health and Environmental Control (SCDHEC) and the FERC are responsible for permitting withdrawals from Lake Wylie for drinking water. Lake Wylie experiences extensive recreational use by fishermen, boaters, skiers and swimmers.

Duke Power operates three power generation stations on Lake Wylie.

	# of Units	kW Produced
Allen Fossil	5	1,140,000
Catawba Nuclear	2	2,258,000
Wylie Hydro	4	62,000

A handout briefly describing the Catawba River lakes is located in the back of this handout.


Lincolnton
Lincoln
N
Lake Norman
McGUIRE NUCLEAR STATION
Cornelius
Huntersville
Cabarrus
Concord
Gaston
Mt. Island Lake
Bessemer City
Mount Holly
85
Gastonia
Belmont
77
85
Mecklenburg
Charlotte
Mint Hill
Matthews
NC
SC
274
Clover
49
CATAWBA NUCLEAR STATION
Lake Wylie
49
Fort Mill
York
16
274
Union
York
Rock Hill
77
Legend
Cities
Lakes and Rivers
0
5
10 Miles
NC
SC

Location 9. View of Reactor Buildings and Spent Fuel Pools
See Photo 9

Each of the two essentially identical units employs a pressurized water reactor Nuclear Steam Supply System (NSSS) with four coolant loops which is furnished by Westinghouse Electric Corporation. These units are similar to those of the McGuire Nuclear Station. The nuclear steam supply system for each unit is housed in a separate freestanding steel containment structure within a reinforced concrete shield building. The containment employs the ice condenser pressure-suppression concept. Westinghouse Electric Corporation supplied the Nuclear Steam Supply System for each unit. Catawba Unit 1 steam generators were replaced in 1996. Babcock & Wilcox International provided the replacement steam generators.

Fuel and Fuel Handling Systems
The fuel used at Catawba is low-enriched (up to 4.73 percent by weight) uranium dioxide in the form of ceramic pellets contained in zirconium alloy fuel rods (tubes fitted with welded end caps).

Catawba has several different fuel designs being used for the production of electricity. The Mark-BW design has a maximum fuel assembly burnup of 55,000 megawatt-days/metric tons of uranium (MWd/MTU) and a maximum licensed fuel pin burnup of 60,000 MWd/MTU. For the Westinghouse RFA (Robust Fuel Assembly) design, there is no maximum fuel assembly burnup limit; however, this burnup value would be limited by the maximum licensed fuel pin burnup limit of 60,000 MWd/MTU.

The enrichment and burnup conditions for fuel used at Catawba are less than those evaluated in 10 CFR §51.52, Table S-4.

Each unit has a separate fuel handling facility, including the spent fuel pool and a new fuel storage facility. New fuel assemblies are removed from the rail car or truck and stored dry in the new fuel storage racks located in the New Fuel Storage Building or are stored in the Fuel Pool. Spent fuel is removed from the reactor core and placed in the fuel transfer mechanism by the Reactor Building manipulator crane. This transfer mechanism passes the fuel assembly through the transfer tube into the Fuel Pool Transfer Canal. Spent fuel is handled and stored under water. The current status of the fuel storage facilities at Catawba is briefly described below:

Spent Fuel Pool Status
There are two spent fuel pools at Catawba, one each for Unit One and Unit Two. The Unit 1 Spent Fuel Pool has a capacity to store 1,419 assemblies and currently has an inventory of 861 assemblies. The Unit 2 Spent Fuel Pool has a total capacity of 1419 assemblies, with a current inventory of 758 assemblies.

Dry Storage
Duke plans to add an independent spent fuel storage installation (ISFSI) at Catawba in order to expand the storage capacity. Plans for implementation of ISFSI are presently in the early stages of development.

Location 10. Conventional Wastewater Treatment System Ponds
See Photo 10

The Conventional Wastewater (WC) System receives wastewater from various plant sumps on the secondary side of the plant and receives stormwater from the powerhouse yard and most outlying areas. Before discharge to Lake Wylie, these wastes are treated aeration, settling, mixing, pH adjustment, chemical addition (coagulation, oxidation, etc.), and oil skimming. The treatment system ponds consist of:

(1) A single concrete lined 300,000 gallon Initial Holdup Pond .
(2) Two earthen lined 5,000,000 gallon settling basins.
(3) A single, polymer lined, 1,500,000 gallon Final Holdup Pond.

The system is operated in a batch mode with one basin in service and one basin in release or standby mode. The discharge from the system is NPDES Outfall #002.

Four groundwater monitoring wells are associated with these basins; a control well, located upgradient of the basins and 3 down gradient monitoring wells. These wells are monitored semi-annually.

Location 11. Cooling Towers

See Photo 11

The Condenser Circulating Water System (RC) supplies water to the main condenser and the cooling towers. The water for the RC system is supplied by the RL system. The heated condenser cooling water is cooled by a closed cycle system using three round, mechanical draft, cross-flow Marley cooling towers per unit.

Cooling tower makeup to replace evaporation, drift and blowdown losses from the system is provided from the Conventional Low Pressure Service Water System to the cooling tower basins. Cooling tower blowdown is extracted from the cooling tower outlet header and is normally returned to the Conventional Low Pressure Service Water System discharge piping, which returns the blowdown to the lake.

The normal chemical additives for the Cooling Towers are A) Sulfuric Acid for pH Control, B) an Algaecide (e.g., Sodium Hypochlorite/Bromine) for biological control and C) a silt dispersant for silt control. If required, a dechlorination agent may be added to the Cooling Towers prior to blowing down to Lake Wylie. Provisions are made to comply with applicable environmental guidelines concerning NPDES discharge limits.

UFSAR Table 10-9 provides information on the system design parameters.

Table 10-9. Condenser Circulating Water System Component Design Parameters

CONDENSER CIRCULATING WATER PUMPS	
Manufacturer	Allis-Chalmers
Quantity	4 per unit
Type	Francis Wheel
Model	84 x 72 SSCV
Number of Stages	1
Design Flow	172,500 GPM
Design Head	110 Ft.
Speed	293 RPM
Design Brake Horsepower	5320 HP
COOLING TOWERS	
Manufacturer	Marley
Quantity	3 per unit
Type	Round Mechanical Draft
Model	700
Design Flow per Unit	690,000 GPM
Design Wet Bulb Temperature	76°F
Design Approach	12.6°F
Design Range	22.9°F

Location 12. RL Intake
See Photo 12

The Low Pressure Service Water System (RL) Intake Structure is located on the Beaver Dam Creek arm of Lake Wylie. Trash racks and traveling screens are used to remove trash and debris from the intake water. Water from the backwash system is returned to Lake Wylie. The RL Intake Structure is designed to withdraw water from the lake to a pool elevation of 559.4 feet msl, or ten feet below the maximum pool elevation of 569.4 feet msl. The structure is designed for a maximum water velocity of 0.5 feet/second in front of the trashracks/screens at maximum drawdown.

The Nuclear Service Water Intake Structure is located in the same cove, further north, near the Standby Nuclear Service Water Pond Dam. This intake withdraws water through a single 48" diameter pipe at Elevation 540 feet msl.

Location 13. Discharge Structure
See Photo 13

The discharge structure is located on the Big Allison Creek arm of Lake Wylie. This structure is designed to allow warm discharge water to float on the surface with a minimum amount of mixing. The RN, RL, cooling tower blowdown, and liquid radwaste systems discharge through this structure.

Catawba Units 1 and 2 had a combined annual capacity factor of 90% in 2000. The monthly average discharge temperature ranged from 59.6° F in February to 92.2° F in July. The operation of Catawba during the period of the extended license is expected to be similar to recent performance.

The thermal discharge is regulated by NPDES permit # SC0004278. The monthly average NPDES thermal discharge limitations are a temperature rise (from intake to discharge) of 10.0 degrees F for the months of April through September and 14.0 degrees F for the months of October through March. These limits were based on the successful completion of a 316 (a) demonstration, which shows that the operation of Catawba Nuclear Station had no adverse impact to the balanced indigenous aquatic community of Lake Wylie.

Location 14. View of CNS Discharge Structure from Allison Creek Arm of Lake Wylie

See Photo 14

Photo 1- View of Plant from Energy Quest

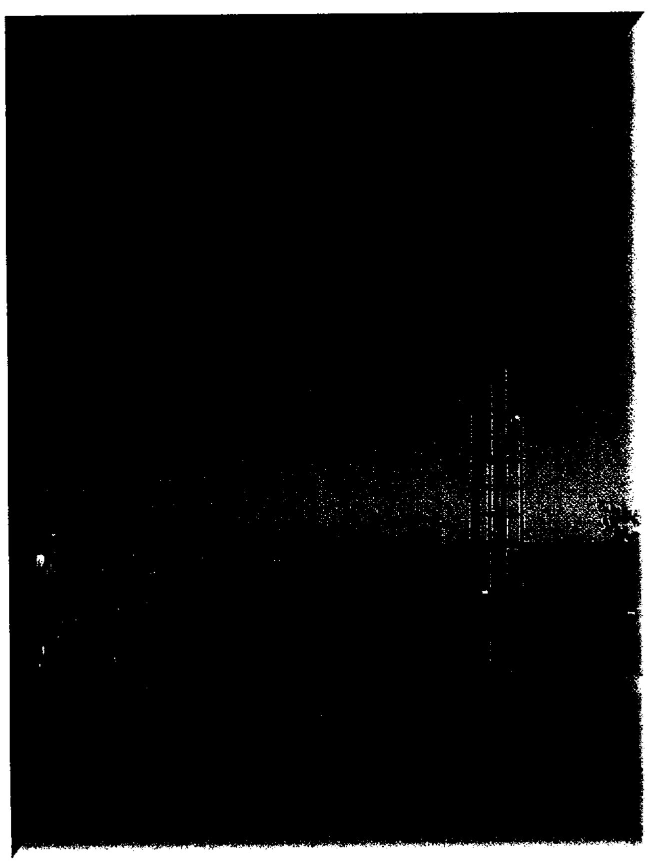


Photo 2- Met Tower

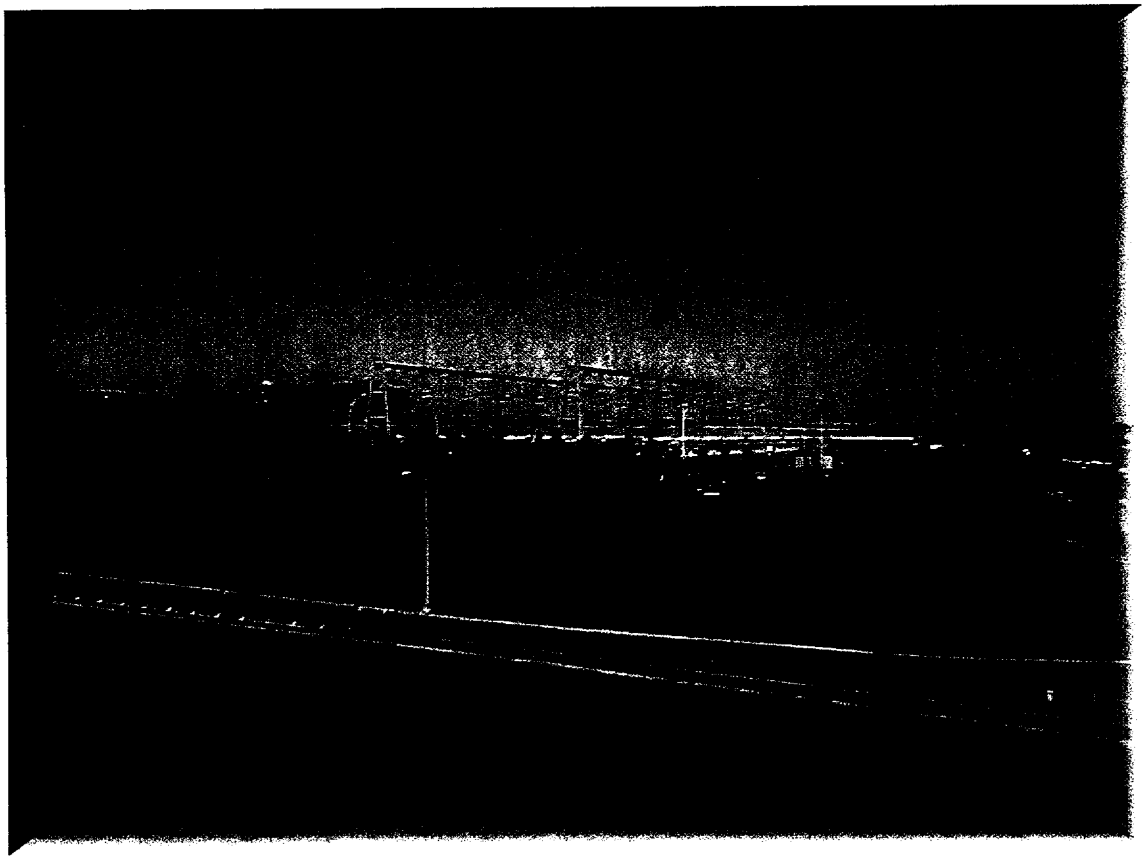


Photo 3- 230 kV Switchyard

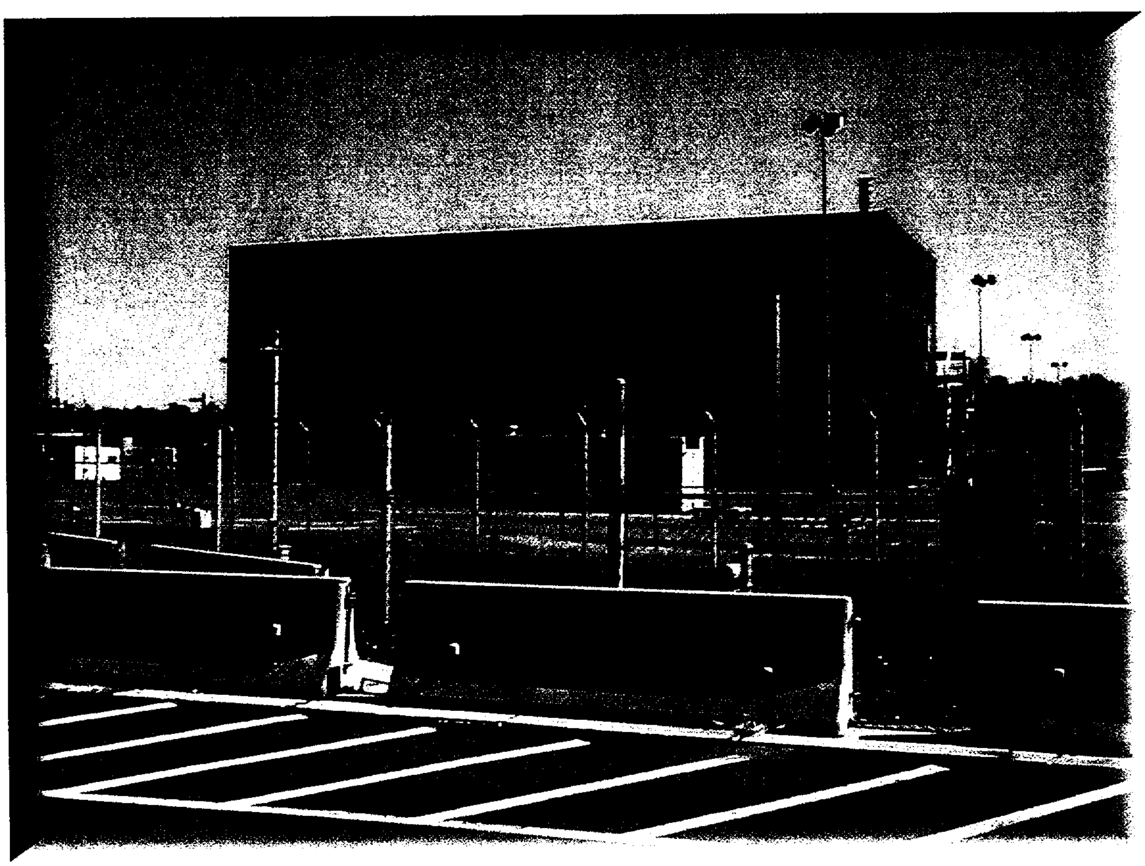


Photo 4- Monitor Tank Building

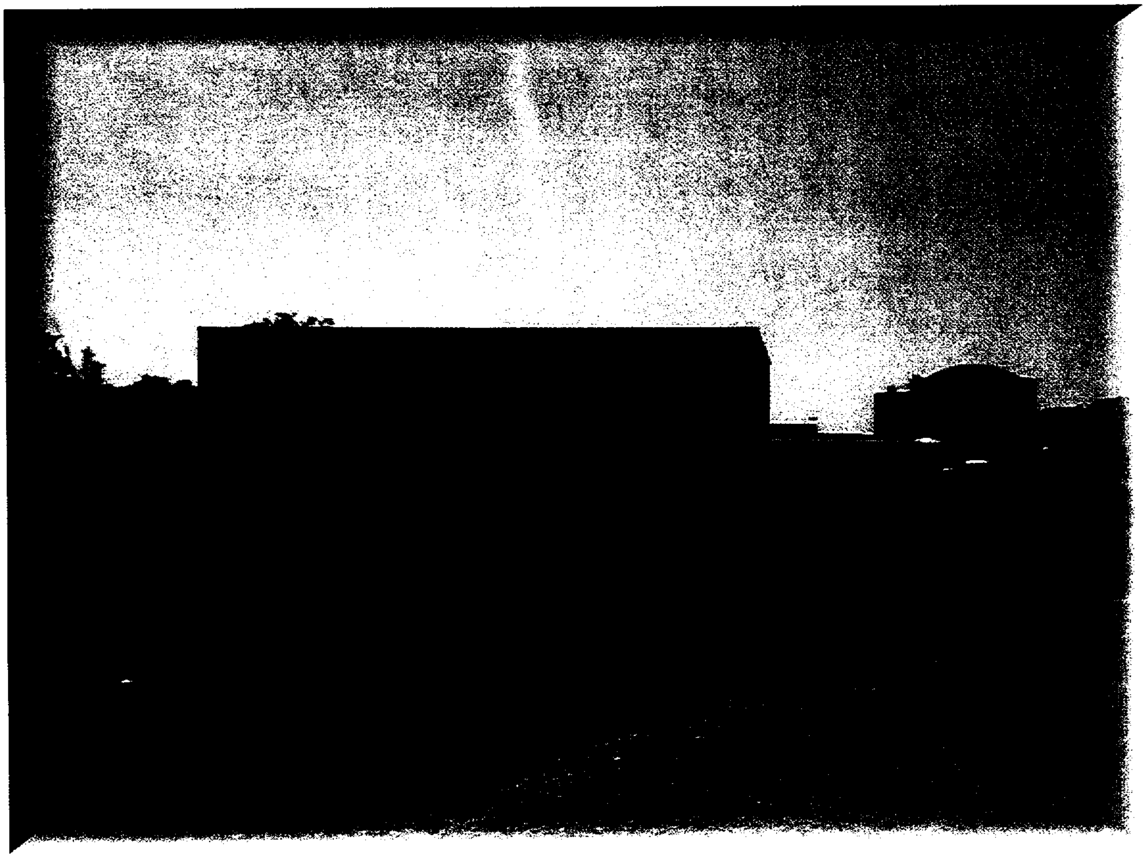


Photo 5- Retired Steam Generator Storage Building

Photo 6- Standby Nuclear Service Water Pond (SNSWP)

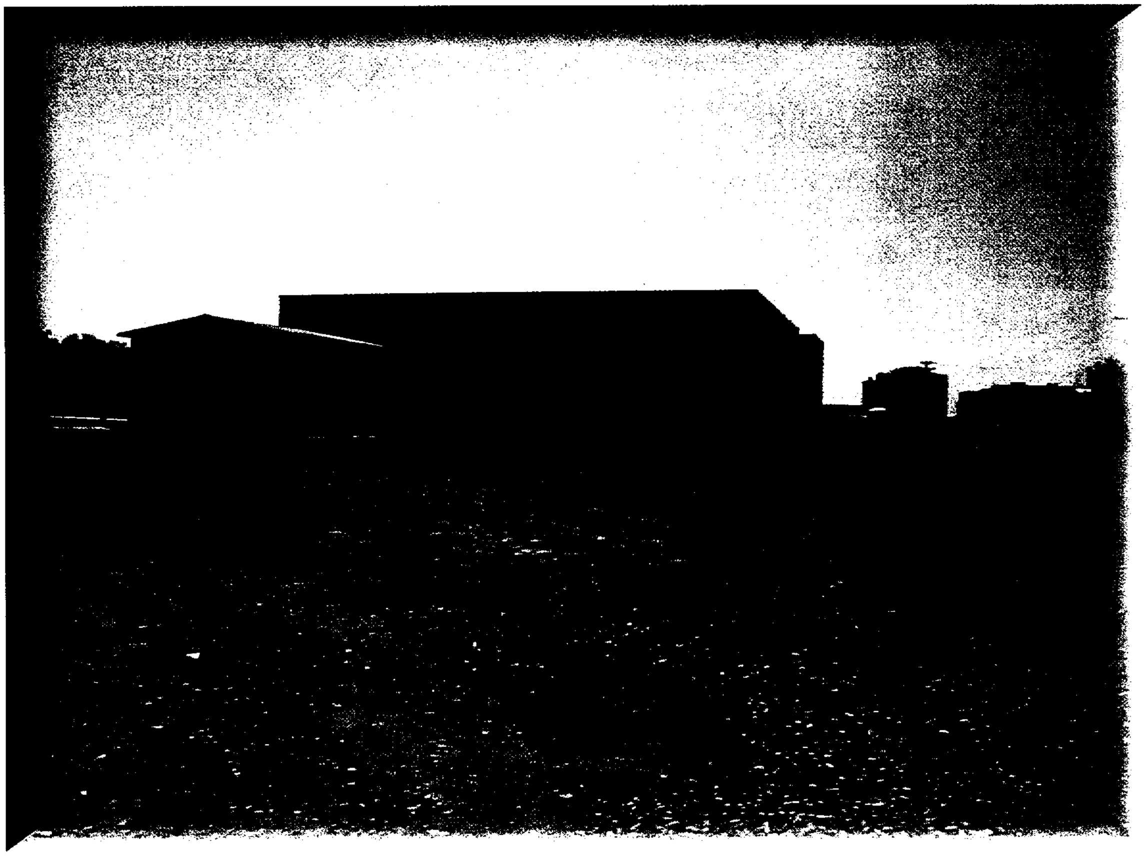


Photo 7- Nuclear Service Water (RN) Pumphouse

Photo 8- Lake Wylie-View of Main Channel (from SNSWP Dam)

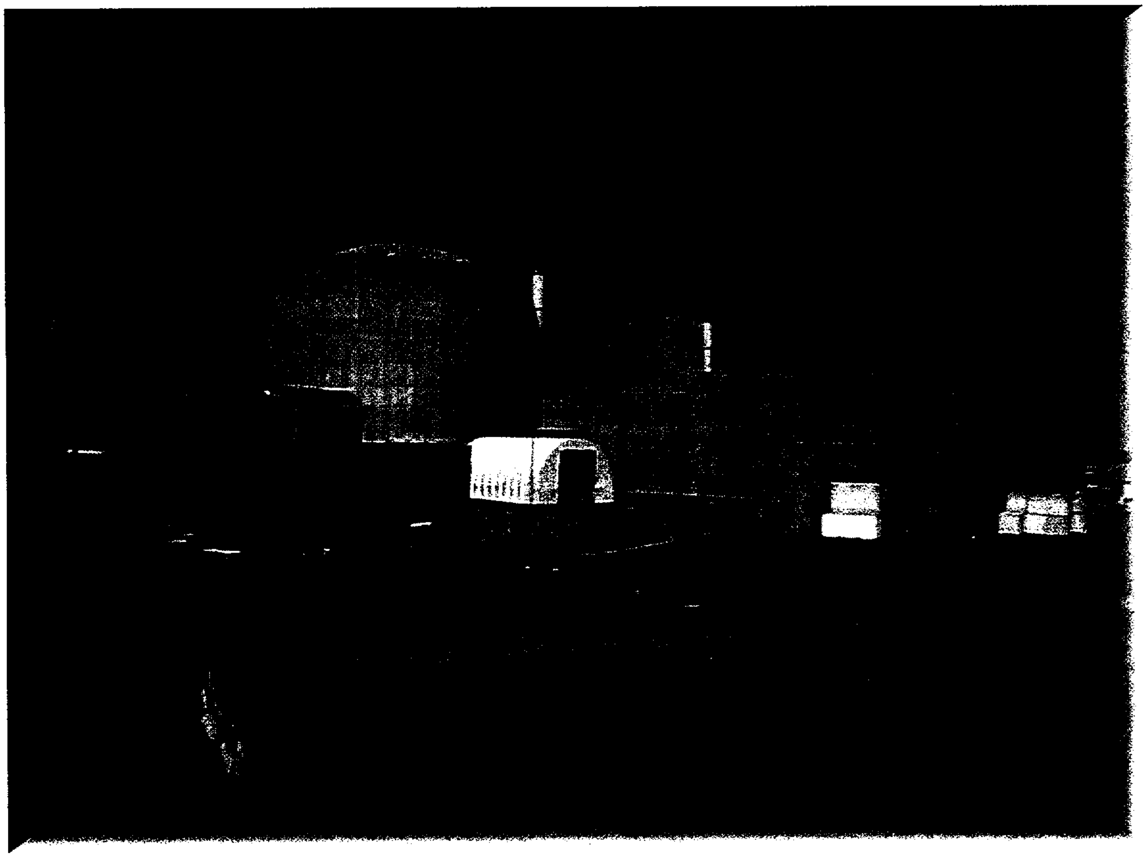


Photo 9- View of Plant-RB's,Spent Fuel Pools

Photo10- Conventional Wastewater (WC) Treatment Basins

Photo11- Cooling Towers

Photo12- Low Pressure Service Water (RL) Intake

Photo13- Discharge Structure (RL & RN)

Photo14- View of Discharge from Allison Creek Arm

The Catawba River and its Water Quality

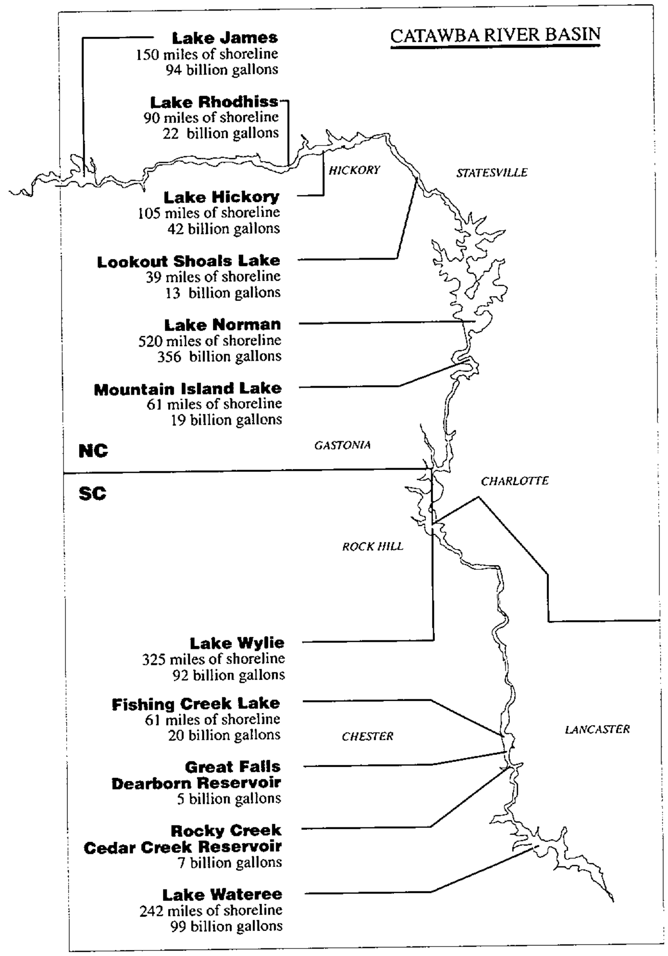
The Catawba River is in many ways the lifeblood of piedmont North Carolina and South Carolina. For more than 20 years, Duke Power has been monitoring the water quality of the river and its lakes at its Applied Science Center on Lake Norman, one of the largest and best equipped state-certified laboratories of its kind in the nation. This type of long-term data takes into account variable weather patterns and is critical to drawing an accurate conclusion about the river's water quality.

The following information is a description of some of the basic parameters we study and an overview of our findings about the Catawba's water quality from Lake James at the headwaters in the mountains of North Carolina to Lake Wateree in central South Carolina.

- **Turbidity** is a measure of the suspended particles in the water that make it look muddy or cloudy.
- **Dissolved Solids** are the solids that remain in the water after the suspended particles have been removed.
- **Phosphorus** is a nutrient that helps algae grow.
- **pH** is a measure of acidity in the water.
- **Chloride** is the primary component, along with sodium, that makes up salt.
- **Chlorophyll** is an essential component of algae.

Lake James has 150 miles of shoreline in McDowell and Burke counties and is considered the most pristine lake on the Catawba chain. By retaining its water for an average of more than 200 days, the lake settles out many of the solids in the water. Every parameter in the lake's main body shows little influence of human activity and the water quality is considered excellent.

Lake Rhodhiss is about 18 miles downstream from Lake James' dam and is in Burke and Caldwell counties. It is a long slender lake with 90 miles of shoreline and retains its water for an average of 21 days. It did have high turbidity levels in the 1970s during extensive agricultural and forestry activities, but this has improved. As is the case with all Catawba lakes, the water is generally more turbid as it enters the impoundment and clearer towards the dam. The lake's water quality is generally considered good.



Lake Hickory is just below Lake Rhodhiss in Alexander, Caldwell and Catawba counties and has 105 miles of shoreline. It is similar to Rhodhiss in size and shape, but is deeper and has a longer retention time of 33 days. Although the lake has shown high chlorophyll levels during the summer months, its water quality is similar to Lake Rhodhiss and generally considered good.

Lookout Shoals Lake is about 10 miles downstream from Lake Hickory's dam and is in Alexander and Iredell counties. It is one of the smallest lakes in the Catawba chain with only 39 miles of shoreline and has a retention time of only seven days. It periodically has high turbidity, which is due to the lake's short retention time. The water quality is considered good, with most parameters being very similar to Lake Hickory and Rhodhiss.

Lake Norman is in Catawba, Iredell, Mecklenburg and Lincoln counties and is by far the largest lake in the Catawba chain with 520 miles of shoreline. Due to its tremendous size and retention time of more than 235 days, it settles out much of the turbidity, phosphorus and chlorophyll (nutrients) more prevalent in the lakes upstream. Lake Norman's water quality is generally considered very good.

Mountain Island Lake is a long slender lake shaped like an S just below Norman's dam and is in Gaston and Mecklenburg counties. It has 61 miles of shoreline and, although it has a short retention time of only 12 days, its water quality is considered very good. This is because approximately 97 percent of its water comes from Lake Norman, which has already settled out many of the solids and nutrients in the water.

Lake Wylie begins roughly 20 miles below the Mountain Island dam in Gaston and Mecklenburg counties in North Carolina and York county in South Carolina and has a shoreline of 325 miles and a retention time of 39 days. The water is influenced in large part by the South Fork tributary of the Catawba, which supplies a large portion of Wylie's water at the upper end of the lake. The South Fork generally has a negative effect on Wylie's water quality due to the massive size of its watershed and extensive agricultural and industrial activities on and around the tributary upstream. These high levels -- which are consistently seen in most of the parameters we test -- tend to improve as the water progresses toward the dam. Overall, Lake Wylie's water quality is considered good.

Fishing Creek Lake begins roughly 25 miles downstream from Lake Wylie's dam and is in South Carolina's Chester and Lancaster counties. It is a long slender lake with a shoreline of 61 miles and has a relatively short retention time of six days. While the lake provides some settling effect, its water is more turbid and shows higher levels of dissolved solids, phosphorus and chlorophyll than in the lakes upstream. Fishing Creek's water quality is considered acceptable to good depending in large part on the weather.

Great Falls Reservoir is essentially a run-of-the-river reservoir (which means it is similar in appearance to the river) with a retention time of only one day and is located just below Fishing Creek in Chester, Fairfield and Lancaster counties. Since the reservoir does not offer an opportunity to settle out the solids and nutrients found upstream, the reservoir's water quality is very similar to Fishing Creek.

Rocky Creek Reservoir also is a run-of-the-river reservoir with a retention time of only two days. It is about the same size as Great Falls Reservoir and its water quality is very similar to the two water bodies upstream.

Lake Wateree begins just below Rocky Creek's dam and is in Fairfield and Kershaw counties. It is a large lake with 242 miles of shoreline and has a retention time of 27 days. Due to its size and relatively long retention time, Wateree settles out much of the turbidity, phosphorus and chlorophyll found upstream. Its water quality is considered good. Below Lake Wateree's dam the Catawba River's name changes to the Wateree River.

Summary

Our research helps us draw several conclusions about the Catawba River's water quality. While we do see the normal effects of urbanization, there are no long-term trends that are surprising or alarming.

For more information, contact Energy Explorium at 1-800-777-0003.

Duke Power's
EnergyExplorium
At Lake Norman