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Duke Power Company

CATAWBA NUCLEAR STATION

UNITS 1 and 2

Environmental Report

5596

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1 INTRODUCTION

Duke Power Company's concern to maintain and improve the quality of the environment dates back to 1923 when Duke's first full-time Environmental Department was established, headed by a public health physician. Additional groups of full-time environmental specialists have subsequently been formed and are continuing to work toward assuring that the Piedmont Carolinas area is
1 indeed an attractive place to live.

Duke's commitment to environmental quality is for two fundamental reasons. First, the type of environment directly affects the quality of life of the people who live in the Company's service area, and it is recognized that no electric utility can long succeed serving an area marred by blight. Secondly, man has yet to devise a way to generate large quantities of electricity needed to meet the public demand without involving land, water and air resources. To minimize adverse impact on the environment and even to enhance its quality wherever possible has been a fundamental consideration in the Company's planning of generation facilities for many years. In support of these objectives, the Company has long engaged in environmental research and investigations.

Plans for Catawba Nuclear Station on Lake Wylie, known as Lake Catawba prior to the late 1960's, in York County, South Carolina have been supported by long-term environmental studies, as well as continuing programs. In 1959 Duke began water quality studies in Lake Wylie. An array of water quality sampling stations includes 13 synoptic stations from the tailrace of Mountain Island to that of Wylie Hydroelectric Station. A continuous lake temperature profile recorder is located in Lake Wylie north of the dam. Dissolved oxygen and temperature determinations are made at each synoptic station and detailed chemical analyses are made at selected stations. From the environmental studies completed so far, it is concluded that Catawba Nuclear Station including use of lake cooling will be environmentally compatible in all significant respects; will fully conform to current environmental quality standards of the cognizant governmental regulatory agencies; and any adverse environmental impact will be minimal when compared to alternative modes of generating electricity. Figure 1-1 is a topographic map of the area within a
1 50 mile radius of the site showing existing, proposed and alternate generating facilities, transmission line corridors, substations and ties, existing, proposed and alternates, terrestrial ecological sampling stations and meteorological stations.

Catawba's power generation is essential to meet the power requirements of the Duke Service Area due to population growth coupled with the increased usage per capita. Only with additional energy can there be gains in production, comfort, health care, education, communications, the economic status of people in the area and even environmental quality. Failure to provide additional generating capacity <u>when needed</u> can have traumatic consequences on human and environmental values.

During the preoperational and operational periods, studies and monitoring programs associated with Catawba Nuclear Station will continue. If subtle adverse effects should be identified from these programs, timely appropriate corrective action will be taken.

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1 INTRODUCTION

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2 DESCRIPTION OF CATAWBA NUCLEAR STATION

2.1 STATION AND CYCLE DESCRIPTION

The Catawba Nuclear Station will have two units each with electrical output of about 1180 MW (1MW = 1000 kw). The Westinghouse Electric Corporation will furnish the Nuclear Steam Systems, some of the Engineered Safety Features and most of the waste disposal equipment for the station. The Nuclear Steam Systems are of the four-loop pressurized water design similar to a number of other four-loop plants, including Duke's McGuire Nuclear Station, which precede Catawba. The waste disposal equipment will be the very latest and most efficient available A description of the radioactive waste disposal system's performance can be found in Section 4.2.

In the pressurized water design (see Figure 2.1-1), a closed system of water, known as the Primary Coolant is circulated through the fuel elements in the reactor vessel. This water picks up heat produced by the nuclear reaction but is kept under sufficient pressure that, even though it rises to about 600 F, it does not boil but remains liquid.

This hot water is then pumped into adjacent "steam generators." There the water flows through thousands of U shaped tubes and gives up its heat to another, entirely separate water system, called the Secondary Coolant. The Primary Coolant is then pumped back into the reactor vessel where it is used over and over.

The Secondary Coolant flows around the tubes carrying the hot Primary Coolant in the Steam Generator, picking up the heat from the Primary Coolant. The Secondary Coolant boils and produces steam to drive the turbine.

After doing its work in the turbine, this steam is condensed into water and pumped back into the steam generator, forming the second closed cycle. The waters of these two systems do not contact each other.

A third water system is used to condense the Secondary Coolant steam back into water as it leaves the turbine. This cooling water is taken from Lake Wylie and is discharged back to the lake. This system is separated from the reactor by the two closed cycles, the Primary and Secondary Coolant systems.

The cost of the two units to be installed at Catawba and the significant economic impact of this investment in York County are discussed in Section 4.7.

2.2 SITE DESCRIPTION

The Catawba Nuclear Station will be located in York County, South Carolina approximately four and one-half miles from Duke's Wylie Dam and 19 miles southwest of Charlotte, North Carolina. The plant site is situated on a peninsula between Beaver Dam Creek on the north, Big Allison Creek to the south and Lake Wylie to the east, as shown on Figure 2.2-1. The peninsula, a tract of approximately 2000 acres, is essentially owned by Duke. All the property in the immediate vicinity of
1 the site, except for six acres of Concord Church property, is owned by Duke. Access to the site is provided by a county road off S. C. Highway 274. An access railroad will be constructed to the site from near Tirzah, South Carolina.

The intersection of the center line between the two Reactor Buildings is located at Latitude 35 degrees - 03 minutes - 05 seconds north and Longitude 81 degrees - 4 minutes - 10 seconds west. The corresponding universal transverse mercator coordinates are E 493, 660 and N 3, 878, 558.

The Exclusion Area[1] lies within a 2500 foot radius, centered at the intersection of the Reactor Building center lines mentioned above. The low population zone[1] for this site will be defined by a 20,000 foot radius from the intersection. There are 13 population centers within 100 miles of the site (Figure 2.2-2). The largest of these are:

Population Center	1970 Population	Distance From Site Miles	Direction From Site
Charlotte, N. C.	241 178	19	Northeast
Winston-Salem, N. C.	132 913	87	Northeast
Greensboro, N. C.	144 076	100	Northeast
Columbia, S. C.	113 542	70	South-southeast

The Exclusion Area will be posted and a security fence will be erected around the immediate site area. A plot plan showing major plant features in the Exclusion Area, the site boundary, the construction plant layout and the controlled access areas within the site boundary is shown on Figure 2.2-3. Transmission lines and rights-of-way in the site area are discussed in Subsection 4.4.2.

1 Figure 2.2-4 is a perspective drawing of the plant site.

[1]As defined by Code of Federal Regulations, Title 10, Part 100.

2.3 BASIS OF NEED

At the present, Duke has a total generating capacity of 7839 MW including long term firm purchases. Short term purchases of 211 MW result in total net resources of 8050 MW. The generation capacity and peak load on the Duke system during the period 1963 through 1972 are given in Table 2.3-1.

1 The demand for electricity in Duke's service area is increasing at a rapid rate. During the 10-year period ending 1972, the annual increase in peak load averaged slightly more than 8.8 percent. For the next eight-year period ending 1980, the peak load growth is expected to continue at about the same rate. This forecast is based on estimates of population, the average number of persons per household, trends in household consumption, the projected Gross National Product, and probable load additions indicated by general economic conditions and the level of activity in site investigations for new industrial plants.

Table 2.3-2 shows the forecasted peak loads for future years through 1980. This table also demonstrates the need for the two Catawba 1180 MWe units to go in service in 1979 and 1980.

By 1979, there will be five nuclear units in service on the system (Oconee
1 1-2-3 and McGuire 1-2), each of which will require an annual refueling time
of four weeks. The scheduled outages of these units in addition to required maintenance of all the other units on the system, makes it reasonable to assume a large unit will be scheduled out of service throughout the year. Also, although large units are not now scheduled for outage during the peak periods of the year, experience has shown that unscheduled outages do occur, and the system must be designed for that contingency. Table 2.3-2 shows the reserve capacity criteria including the effect of severe weather and load forecast error as well as unit outages. It is evident that the Catawba units are required in 1979 and 1980 to maintain system reserves at levels reasonably in accord with the prudent reserve requirements.

Duke Power is and has for many years been interconnected with:

Appalachian Power Company (AEP System)
1 Carolina Power & Light Company
South Carolina Electric & Gas Company
Georgia Power Company (Southern Co. System)
Yadkin, Inc.
SEPA

These comprise all of the major bulk power suppliers or agencies adjacent to the Duke service area. Duke's transmission system design is coordinated with those of the above systems to provide for transfer of large blocks of power between any of the systems as required for emergency assistance and for economy interchanges when permitted by available generation.

During the period beginning in May, 1967, and continuing through most of 1970, Duke along with SCE&G, CP&L, VEPCO, operated as the Carva Pool. This pooling agreement required that each of the companies would schedule generation additions as dictated by the combined needs of all of the companies and that the total pool reserve would be assigned on an equal percentage basis to each of the companies. Equalization of reserve capacity was accomplished by sale and/or purchase of capacity as necessary. In 1970, the four Carva Pool companies joined with other utilities and bulk power suppliers in the southeast to form the Southeastern Electric Reliability Council. With the larger regional organization in being, the reliability aspects of the Pool were no longer of benefit and the contractual obligations of the Pool were replaced by bi-lateral company to company agreements.

In its April, 1972, response to FPC Order 383-2, the Virginia-Carolinas Subregion of the Southeastern Electric Reliability Council estimated the regional reserves would be 7938 MW or 19.18 percent for the summer of 1979 if the planned total of 26 large new units having a combined capability of 22 210 MW could be completed as scheduled. The Order 383-2 response also showed the
1 estimated 1979 reserves within the Southern Companies Subregion would be 5876 MW or 19.4 percent assuming the successful completion of 14 large new units. Since this information was filed however, Carolina Power & Light Company has announced a one-year delay in its Harris Nuclear Plant. This delay will reduce the Virginia-Carolinas 1979 reserves to 7038 MW. Projected reserve levels within other reliability areas are equally either too inadequate or uncertain to provide firm replacement for the Catawba units.

Thus, although strongly interconnected with neighboring utilities, the possibility of replacement capacity for the Catawba units from foreign systems is not an acceptable alternative. Such capacity would have to be constructed as additions to existing schedules and would unduly jeopardize future supply to Duke's consumers. If such capacity could be constructed, there is no logical basis for assuming it would be competitive economically with Catawba.

2.3.1 CONSTRUCTION SCHEDULE

Schedule highlights are tabulated below:

Unit 1	Unit 2	
March 1974	With Unit 1	Receive construction permit
1 March 1974	With Unit 1	Break ground and start preconstruction earthmoving, complete road relocation
January 1975	-	Access railroad complete
April 1975	With Unit 1	Start concrete foundation
September 1976	June 1977	Set Reactor Vessel
October 1977	November 1978	Start Turbine-Generator erection
April 1978	April 1979	Start pre-critical testing
October 1978	October 1979	Load fuel
March 1979	March 1980	Begin commercial operation

2.4 NATURAL ENVIRONMENT OF THE SITE

2.4.1 METEOROLOGY

Local meteorology of the proposed plant is considered from the standpoint of design (i.e. structural and engineered safeguards for gaseous release) and that of possible modification(s) from plant operation. The following paragraphs summarize in some detail the factors pertinent to these considerations.

General Climate

Local climatic conditions are characterized by cool temperatures in winter, warm summers and moderate precipitation[1]. Temperatures range from the 30's and 40's in January to the 70's and 80's in July. Average monthly rainfalls vary only slightly from month to month, with lower totals in the fall (near 2 inches) and higher amounts during the summer (about 4 inches).

Major snowstorms are a comparative rarity. Ice storms, however, occurring with greater frequency, can result in considerable damage over limited areas. Thunderstorms, quite active on summer afternoons, occur about 40-50 days a year[1]. For the areas of North Carolina, South Carolina and their coastal waters, an average of one tropical storm per year and one hurricane every other year has been computed for a period covering 63 years[2]. Winds associated with these storms are moderated somewhat as they move inland but records in the local area have shown speeds of near 80 mph (fastest mile)[3]. Accompanying rainfall in the local area can also be of significance as 24 hour totals have been observed near 9 inches. Tornado history in the vicinity of the proposed plant has been evaluated for the period 1916-1955[4]. In terms of tornado probability for a point (at the proposed plant) the recurrence interval is once in 3676 years.[5]

1 A summary of selected parameters is presented in Table 2.4-6 and Figures 2.4-6 and 2.4-7, Sheets 1 through 4.

Impact on Local Meteorology

Consideration has been given to possible environmental effects associated with heat dissipation from the cooling pond (Lake Wylie, vicinity of proposed plant).

[1]Local Climatological Data, Annual Summary with Comparative Data, Charlotte, North Carolina. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, 1971.

[2]Tropical Cyclones of the North Atlantic Ocean, United States Department of Commerce, Weather Bureau, Technical Paper No. 55, 1965.

[3]Climate of the States, South Carolina, Climatography of the United States No. 60-31, United States Department of Commerce, Weather Bureau, December 1959.

[4]Tornado Occurrences in the United States, United States Department of Commerce, Weather Bureau, Technical Paper No. 20, 1960.

[5]"Tornado Probabilities," Monthly Weather Review, H.C.S. Thom, October-December, 1963.

Conclusions drawn in this regard are based on both a review of literature and years of operating experience to date and suggest that effect of fogging and icing are minimal for the properly designed cooling pond. Neither increased density of natural fog nor the occurrence of "steam fog" is expected to penetrate farther than the downwind periphery of the cooling pond area. Highest frequencies of both natural fog and steam fog occur during winter, giving rise to some potential for contact icing along downwind shorelines. No significant icing, however, has been observed at existing Duke Power plants, where cooling water is circulated via the cooling pond.

The options of cooling condensing water by mechanical draft or natural draft cooling towers have also been evaluated with respect to possible modification of local meteorology. Cooling towers concentrate waste heat dissipation to a point source with emphasis on evaporative cooling, whereas heat dissipation by a cooling lake is distributed over thousands of acres. Two consequences of some concern relate to the vapor effluents from these towers and their potential to increase fogging and icing. Numerous estimates concerning such effects have been made for a variety of atmospheric and operating conditions. An attempt to assess the likelihood of cooling tower fogging and contact icing at the proposed plant incorporates the results of recent modeling studies applicable, in general, to large steam-generating stations, with certain other information specific to the site itself.[6]

In the case of mechanical draft towers, analysis shows (from Table 2.4-1 and Table 2.4-2) a possible increase in natural occurring fog from about 20 days per year (over general area) to about 243 days per year in the local area immediately downwind of the plant. Contact icing could occur on about 15 days per year (from Table 2.4-3). No appreciable increase in ground fog from natural draft cooling towers is expected since bouyancy factors would take tower plumes well above the relatively flat terrain surrounding the plant. Drift loss in either case would only involve water from a once through system. Salt build-up and subsequent blowdown, therefore, are eliminated. Augmentation of low cloudiness associated with these towers is not considered in these analyses, although the natural draft tower would contribute to low cloud formation.

For the purpose of first approximation assessments, a closed cycle cooling system is examined in the following paragraphs. Drift effects evaluated for a reference tower (drift rate 0.00375 percent) cited in the Forked River Nuclear Station Environmental Report can be extrapolated to Catawba Nuclear Station by modifying levels of dissolved solids in the circulating water flow.

1 The Forked River natural draft reference tower was analyzed as to wake effect, drift rate, drift droplet size distribution and fall speeds. Maximum short period (8 hours) air concentrations of tower salt were estimated at 10 micrograms per meter^3 within 1.55 miles of the tower. For Catawba towers, with a heat load requiring two towers instead of one and a salt concentration of 550 ppm (entirely dissolved solids) as versus 45,000 ppm, the maximum short term air concentration translates to 0.24 micrograms per meter^3. Air concentrations of salt on an annual basis, therefore, will not be appreciable in magnitude at

[6] Feasibility of Alternate Means of Cooling for Thermal Power Plants Near Lake Michigan, U. S. Department of the Interior, September 1970.

only a fraction of the short period maximum. Fall speeds applicable to the reference tower ranged from 0.9 to 35 cm per second. Assuming high relative humidity and fall speeds characteristic of largest drop sizes, a maximum deposition rate (8 hours) for Catawba can be postulated at 2.08 lbs. per acre per month.

Drift effects from a closed mechanical draft system would be affected by a
1 higher drift rate (estimated at near 0.10 percent) and a distribution influenced by a lower level point of release (approximately 20 meters). The higher drift loss of the mechanical tower, about 26.6 times greater than on the natural draft tower, accompanied by a much lower release height implies, assuming other factors remain the same, downwind concentrations with higher maxima at closer distances to the tower. This effect may be ameliorated by careful positioning of tower structures.

Diffusion Meteorology

Atmospheric dispersion characteristics at the proposed plant have been evaluated from on-site meteorological measurements. Computer analyses yield diffusion factors representative of any time period appropriate for various types of gaseous release.[7] Table 2.4-4 depicts diffusion factors for each type of release at selected distances and percentile values (probability of occurrence).

[7] Catawba Nuclear Station, PSAR

2.4.2 GEOLOGY

Studies of site and regional geology have been made to identify the general and specific features underlying the site and surrounding areas and to determine the suitability of the site for construction of project works including the safety related structures. Further investigations will be continued in the future to meet detail design needs.

In general, the site is located in the Charlotte Belt within the Piedmont Geologic Province. This belt consists of metamorphosed sedimentary and volcanic rocks of which granitic gneiss is the principal intrusive unit. At a later time gabro, diorite and syntite were intruded into the Charlotte Belt rocks. Figure 2.4-1 shows the location of ancient faults mapped in this region as also inferred faults, the nearest being within the Kings Mountain Belt about 17 miles from the site. None of the known faults have been active since the end of the Triassic Period, about 180 million years ago. Air photo studies were made of the general vicinity to verify and supplement geologic features shown on published maps and described in the published literature. These studies of the regional and vicinity geology revealed no geologic structures which would adversely affect the site.

Over 80 borings have been made at the site to determine subsurface conditions under the major structures, and the suitability of those underlying materials for site development. An examination of rock cores from these sources and a petrographic analysis of rock samples generally confirmed the published literature relative to emplacement order, age and rock types. The predominant rock underlying the site is adamellite, which is very uniform in texture and mineralogy. Basic dike rocks, ranging in composition from olivine basalt to quartz diorite occur as numerous dikes across the site. Pegmatite also occurs in dikes at scattered intervals. There are no features in evidence, which might present problems in the design, construction and future operation or safety of the plant.

Appendix 2C, PSAR describes the geology in detail.

2.4.3 SEISMOLOGY

The regional ancient faults and geologic structures have not been active during the past 180 million years. The historical record of earthquakes in the southeast indicates that there is no known relationship between known faults and historic earthquakes.

Detailed studies of the larger earthquakes near the site have been made using newspaper accounts, interviews with older residents, examination of damage which is still visible and a study of local geologic conditions. These studies indicate that the greatest seismic intensity the site has experienced due to these larger earthquakes is between VI and VII, Modified Mercalli Scale from the Charleston earthquake, August 31, 1886, located 150 miles southeast of the site.

Five earthquake epicenters have been reported within 50 miles of the site; all of these are reported to have produced an epicentral intensity of V, Modified Mercalli Scale. Thirteen epicenters of intensity V MM or more have been reported within a 100 mile radius and 48 within a 200 mile radius of the site.

No identifiable active faults that could be expected to produce surface displacement have been recognized within 200 miles of the site or anywhere within the Piedmont Geologic Region of the site.

The foundations of the Reactor and Auxiliary Buildings will be located on rock with excellent strength properties. Based on seismic study conducted for this site, the following conservative values for acceleration at top of rock will be used for design:

Operating Basis Earthquake	-	8 percent of acceleration due to gravity
Safe Shutdown Earthquake	-	15 percent of acceleration due to gravity

The site is well suited for a nuclear station on seismic considerations.

Details of seismic study are furnished in Appendix 2E, PSAR.

2.4.4 HYDROLOGY

Hydrology studies for site suitability included characteristics of vicinity
1 streams and their associated drainage areas, Catawba River flood studies and
site groundwater (References consulted are found at the end of this subsection).

The principal stream which drains the site is the Catawba River. The Catawba River begins at the Eastern Continental Divide near Old Fort, North Carolina, and flows in an easterly direction to a point near Millersville, North Carolina. It then flows in a southerly direction and becomes the Wateree River near Camden, South Carolina. The Catawba upstream of Wateree Dam has a length of approximately 240 miles and a drainage area of approximately 4750 square miles. Lake Wylie and Wylie Dam are a part of Duke's Catawba River hydroelectric system containing eleven hydroelectric reservoirs and dams, and extending along
approximately 220 miles of the Catawba River. Lake Wylie forms the tailwater
of Mountain Island Dam, located 28 miles upstream from Wylie Dam. Daily flow
at Mountain Island Dam since 1963 is given in Table 2.4-5. Below Wylie Dam,
the Catawba River flows in its natural channel for approximately 25 miles be-
1 fore reaching the headwaters of Fishing Creek Reservoir. Fishing Creek Dam
is located 39 miles downstream from Wylie Dam (Figure 2.4-2). Cross sections
of the Catawba River below Wylie Dam are shown in Figure 2.4-5.

A United States Geological Survey gaging station is located 3-1/2 miles downstream from Wylie Dam. The average discharge past this point for a period of record of 35 years (September 1895 to September 1903 and April 1942 to September 1969) and a drainage area of 3050 square miles is 4455 cubic feet per second (cfs). Adjusted to a drainage of 3020 square miles at Wylie Dam, the average discharge is 4400 cfs. The maximum flow recorded at this point is 151,000 cfs on May 23, 1901, and the minimum recorded flow is 102 cfs on October 31, 1961. On July 16, 1916, the river reached a known flood stage of 44.1 feet at the USGS gage near Catawba, N. C. It has been estimated that this storm produced a flow of 299,400 cfs at Wylie Dam. In August 1940, another storm occurred over the Catawba River Basin resulting in an estimated flow of 166,300 cfs at Wylie Dam.

Lake Wylie, with a drainage area of approximately 3020 square miles, has a surface area of 12,455 acres and a volume of 281,900 acre feet at a surface elevation of 569.4 feet above mean sea level (msl). Wylie Dam's spillway

consists of a curved uncontrolled crest separating two end sections which are gate controlled. One section has five 30 foot by 45 foot wide gates, while the other section has six gates of this size plus a 19 foot by 25 foot trash gate (Figure 2.4-3). The total design capacity of the spillway is 277, 500 cfs with the upstream water surface elevation at 569.4 msl. Lake Wylie is
drawn down about five feet on an annual basis. Drawdowns of up to ten feet
1 are estimated to occur once in 20 years and drawdowns up to 15 feet have a
probability of near zero (Figure 2.4-8). Normal operation of the condenser
2 cooling water pumps is not affected by a ten foot drawdown.

Wylie and Mountain Island Hydroelectric Stations operate as peaking plants with load factors of approximately 25 percent. This operation is normally spread over the five weekdays and operated on weekends only if required. There are four turbines at Wylie and discharges range between 2800 cfs for
1 one turbine to 11,200 cfs for four turbines. There are four turbines at
Mountain Island and discharges range between 2400 cfs for one turbine to 9600 cfs for four turbines. Normal weekday operation at both plants will vary from three to 14 hours of use depending on system load. The only interaction between thermal plants on Lake Wylie and any of the hydroelectric stations insofar as power generation is concerned is that hydro stations are used to backstand the sudden outage of a thermal unit until other sources can be scheduled. Details of Mountain Island Dam and Powerhouse are shown on Figure 2.4-4.

The proposed site lies within the Piedmont Groundwater Province. All groundwater in this area is derived from precipitation. The depth to the water table depends primarily on topography and rock weathering. The level of the water table varies from the ground surface in the valleys to more than 100 feet below the surface on sharply rising hills.

Factors affecting groundwater at the site are the water level in Lake Wylie, the topography and the permeability of the soil and rock. The elevation of the groundwater varies from about 10 to 40 feet below ground surface near the proposed site and approaches the lake surface elevation near the shore. Groundwater movement is from the plant area toward the lake to the north and to the south of the site.

There is no potential for harmful radioactive contamination of well water supplies via introduction of Lake Wylie waters into groundwater. The concentration of radioactivity in Lake Wylie is shown in Section 4.2 to be a small fraction of the limits imposed by AEC regulations. The concentrations would be further reduced by the ion exchange action of the soil through which the groundwater flows. Chemical analyses were made to determine the cation exchange capacity of the soils at the site. The results of these analyses have shown that any radioactive contaminant will move less rapidly through the soil than the groundwater (by a factor of 46 to 1 for strontium) because of the absorption of the contaminant by the soil particles.

Groundwater studies indicate that the groundwater conditions, including local wells used for water supply, will not be adversely affected by the construction of Catawba Nuclear Station.

References

1) Water Resources Data for South Carolina, U. S. Department of the Interior, Geological Survey, 1970.

2) South Carolina Streamflow Characteristics, Low-Flow Frequency and Flow Duration, U. S. Department of the Interior, Geological Survey, 1967.

3) Water-Supply Characteristics of North Carolina Streams, Geological Survey
1 Water-Supply Paper 1761.

4) Compilation of Records of Surface Waters of the United States, October 1950 to September 1960, Part 2A, Geological Survey Water-Supply Paper 1723.

5) Surface Water Supply of the United States, Part 2, Volume 1, Geological Survey Water-Supply Paper 1904.

ER Table 2.3-1
Generation Capacity and Peak Load on
Duke System 1963 Through 1972

Year	Maximum Generation Capacity MW	Peak Load MW
1963	3872	3370
1964	3872	3522
1965	4222	3826
1966	4603	4440
1967	4716	4579
1968	4837	5364
1969	5670	5614
1970	6463	6284
1971	7249	6622
1972	7839	7450

ER Table 2.3-2
SYSTEM LOAD, CAPACITY, AND RESERVE (MW)
1973-1980

	1973		1974		1975		1976		1977	1978	1979	1980
	SUMMER	WINTER	SUMMER	WINTER	SUMMER	WINTER	SUMMER	WINTER	SUMMER	SUMMER	SUMMER	SUMMER
Peak Load - Average Weather[1]	8 101	8 185	8 838	8 879	9 635	9 621	10 496	10 418	11 426	12 428	13 509	14 672
System Capability:[2]												
before capacity additions	7 839	8 725	9 611	10 980	11 866	13 314	13 314	14 494	14 494	15 674	15674	16 854
Capacity Additions:												
Cliffside												
Oconee	886	886		886								
Jocassee			305		305							
Belews Creek			1 143		1 143							
McGuire							1 180		1 180			
Catawba											1 180	1 180
Tiger, Gwd., Buzzard Roost			-79									
Capability:												
after additions	8 725	9 611	10 980	11 866	13 314	13 314	14 494	14 494	15 674	15 674	16 854	18 034
External Purchases:												
Asheville	38	38	18	18								
Wateree 2	122	122	122	122	122	122	122	122				
APS												
AEP												
Southern Company												
VACAR Limited Term												
Total Capability	8 88,	9 771	11 120	12 006	13 436	13 436	14 616	14 616	15 674	15 674	16 854	18 034
Reserve - MW	784	1 586	2 282	3 127	3 801	3 815	4 120	4 198	4 248	3 248	3 345	3 362
- %	9.7	19.4	25.8	35.2	39.4	39.7	39.3	40.3	37.?	26.1	24.8	22.9
Reserve Criteria:												
Extreme Weather	346	437	392	484	443	536	500	592	563	632	708	792
Largest Unit	886	886	1 143	1 143	1 143	1 143	1 180	1 180	1 180	1 180	1 180	1 180
Other Outages and Reductions	302	347	386	431	488	488	545	545	604	604	663	722
Forecast error or second contingency outage	886	886	1 143	1 143	1 143	1 143	1 180	1 130	1 180	1 180	1 180	1 180
Nuclear Refueling	(AFTER 1980)											
TOTAL - MW	2 420	2 555	3 064	3 201	3 217	3 310	3 405	3 497	3 527	3 596	3 731	3 874
- %	29.9	31.2	34.7	36.1	33.4	34.4	32.4	33.6	30.9	28.9	27.6	26.4

(1) From 1972 thru 1976, the winter peak load including the effect of extreme weather exceeds the previous summer peak load. For 1977 and thereafter, the summer peak load is dominant.

(2) System capability includes peak rating of all steam units.

FWB:mac
7-6-72
1-19-73 McGuire Capacity and criteria for "other outages and reductions" revised.

ER Table 2.4-1
Charlotte Airport Data
Period of January 1960 - December 1964 All Temperatures

PERCENT OF RECORDS BY WIND DIRECTION AND SPEED WITHIN ZONES OF PROBABILITY OF FOG DUE TO COOLING TOWER (Mechanical Draft)

	ZONE A HI PROBABILITY WIND SPEED IN KNOTS			ZONE B LO PROBABILITY WIND SPEED IN KNOTS			ZONE C VERY LO PROBABILITY WIND SPEED IN KNOTS		
DIRECTION	<7	<16	>15	<7	<16	>15	<7	<16	>15
NORTH	00.77	00.58	00.03	00.35	00.25	00.01	02.95	03.04	00.09
NORTH-NORTHEAST	00.43	00.88	00.09	00.19	00.33	00.04	01.98	04.46	00.27
NORTHEAST	00.58	00.60	00.06	00.25	00.31	00.01	03.60	03.92	00.05
EAST-NORTHEAST	00.30	00.23	00.02	00.21	00.12	00.01	01.98	01.57	00.01
EAST	00.34	00.16	00.01	00.17	00.04	00.00	01.83	00.86	00.00
EAST-SOUTHEAST	00.26	00.13	00.01	[illegible]	00.03	00.00	01.28	00.68	00.00
SOUTHEAST	00.39	00.19	00.00	00.16	00.05	00.00	01.70	00.61	00.01
SOUTH-SOUTHEAST	00.43	00.25	00.00	00.14	00.06	00.00	01.40	00.71	00.01
SOUTH	00.77	00.58	00.02	00.24	00.17	00.01	02.71	02.03	00.07
SOUTH-SOUTHWEST	00.59	00.70	00.02	00.22	00.22	00.00	01.82	03.16	00.10
SOUTHWEST	00.89	00.74	00.02	00.34	00.24	00.01	03.04	04.83	00.41
WEST-SOUTHWEST	00.48	00.34	00.00	00.17	00.10	00.01	01.60	02.49	00.29
WEST	00.44	00.11	00.00	00.12	00.04	00.00	01.28	01.13	00.12
WEST-NORTHWEST	00.32	00.09	00.00	00.10	00.03	00.00	01.33	01.45	00.17
NORTHWEST	00.59	00.14	00.00	00.24	00.04	00.00	02.34	02.08	00.16
NORTH-NORTHWEST	00.57	00.20	00.01	00.25	00.37	00.00	02.20	01.61	00.09
PERCENT BY SPEED	06.15	05.93	00.29	03.26	02.13	00.11	33.03	34.64	01.85
PERCENT CALM RECORDS		02.30			01.27			07.03	
PERCENT RECORDS / ZONE		16.67			06.78			76.54	

ER Table 2.4-2

Charlotte Airport Data

Period of June 1961 - August 1961 All Temperatures

PERCENT OF RECORDS BY WIND DIRECTION AND SPEED WITHIN ZONES OF PROBABILITY OF FOG DUE TO COOLING TOWER (Mechanical Draft)

	ZONE A HI PROBABILITY WIND SPEED IN KNOTS			ZONE B LO PROBABILITY WIND SPEED IN KNOTS			ZONE C VERY LO PROBABILITY WIND SPEED IN KNOTS		
DIRECTION	<7	<16	>15	<7	<16	>15	<7	<16	>15
NORTH	01.49	00.59	00.05	00.36	00.14	00.00	01.59	01.13	00.05
NORTH-NORTHEAST	01.13	00.95	00.09	00.09	00.09	00.00	01.77	02.76	00.05
NORTHEAST	00.95	0C.32	00.00	00.14	00.23	00.00	02.90	02.08	00.00
EAST-NORTHEAST	00.54	00.00	00.00	00.05	00.00	00.00	00.95	00.36	00.00
EAST	00.50	00.00	00.00	00.05	00.00	00.00	01.40	00.36	00.00
EAST-SOUTHEAST	00.27	00.00	00.00	00.09	00.00	00.00	01.13	00.54	00.00
SOUTHEAST	00.91	00.23	00.00	00.27	00.00	00.00	01.77	00.50	00.00
SOUTH-SOUTHEAST	01.00	00.23	00.00	00.09	00.00	00.00	01.00	00.54	00.00
SOUTH	01.31	00.77	00.05	00.77	00.14	00.00	02.90	01.63	00.05
SOUTH-SOUTHWEST	01.49	00.86	00.05	00.18	00.27	00.00	01.86	03.40	00.00
SOUTHWEST	03.44	00.77	00.00	00.86	00.18	00.00	05.34	07.52	00.00
WEST-SOUTHWEST	00.68	00.23	00.05	00.09	00.09	00.00	01.90	02.26	00.05
WEST	00.54	00.05	00.00	00.18	00.09	00.00	01.31	00.77	00.00
WEST-NORTHWEST	00.27	00.00	00.00	00.05	00.00	00.00	00.95	00.23	00.00
NORTHWEST	00.86	00.09	00.00	00.18	00.05	00.00	01.40	00.68	00.00
NORTH-NORTHWEST	01.00	00.05	00.00	00.23	00.05	00.00	01.31	00.23	00.00
PERCENT BY SPEED	16.39	05.12	00.27	03.67	01.31	00.00	29.48	25.00	00.18
PERCENT CALM RECORDS		10.37			01.68			06.52	
PERCENT RECORDS / ZONE		32.15			06.66			61.18	

5244

ER Table 2.4-2
Charlotte Airport Data
Period of September 1961 - November 1961 All Temperatures

PERCENT OF RECORDS BY WIND DIRECTION AND SPEED WITHIN ZONES OF PROBABILITY OF FOG DUE TO COOLING TOWER (Mechanical Draft)

DIRECTION	ZONE A HI PROBABILITY WIND SPEED IN KNOTS			ZONE B LO PROBABILITY WIND SPEED IN KNOTS			ZONE C VERY LO PROBABILITY WIND SPEED IN KNOTS		
	<7	<16	>15	<7	<16	>15	<7	<16	>15
NORTH	00.14	00.05	00.00	00.23	00.14	00.05	05.77	04.21	00.05
NORTH-NORTHEAST	00.14	00.32	00.00	00.09	00.32	00.00	03.21	04.95	00.27
NORTHEAST	00.14	00.05	00.00	00.41	00.00	00.00	05.49	04.72	00.05
EAST-NORTHEAST	00.00	00.00	00.00	00.23	00.00	00.00	02.56	01.79	00.00
EAST	00.05	00.00	00.00	00.09	00.00	00.00	01.92	00.55	00.00
EAST-SOUTHEAST	00.09	00.00	00.00	00.00	00.14	00.00	01.51	00.73	00.00
SOUTHEAST	00.05	00.09	00.00	00.14	00.09	00.00	01.47	00.60	00.00
SOUTH-SOUTHEAST	00.23	00.14	00.00	00.05	00.23	00.00	01.24	00.92	00.00
SOUTH	00.60	00.23	00.00	00.00	00.18	00.00	01.97	01.01	00.05
SOUTH-SOUTHWEST	00.27	00.09	00.00	00.32	00.09	00.00	01.33	01.10	00.05
SOUTHWEST	00.18	00.14	00.00	00.23	00.14	00.00	02.15	02.24	00.05
WEST-SOUTHWEST	00.00	00.09	00.00	00.14	00.00	00.00	01.42	01.24	00.05
WEST	00.18	00.05	00.00	00.09	00.00	00.00	01.24	00.69	00.00
WEST-NORTHWEST	00.05	00.00	00.00	00.00	00.00	00.00	01.33	00.87	00.00
NORTHWEST	00.23	00.09	00.00	00.14	00.05	00.00	02.84	01.69	00.00
NORTH-NORTHWEST	00.18	00.09	00.00	00.18	00.00	00.00	02.79	02.34	00.00
PERCENT BY SPEED	02.52	01.42	00.00	02.34	01.37	00.05	38.23	29.62	00.55
PERCENT CALM RECORDS		02.70			02.43			18.77	
PERCENT RECORDS / ZONE		06.64			06.18			87.18	

ER Table 2.4-2

Charlotte Airport Data

Period of December 1960 - February 1961 All Temperatures

PERCENT OF RECORDS BY WIND DIRECTION AND SPEED WITHIN ZONES OF PROBABILITY OF FOG DUE TO COOLING TOWER (Mechanical Draft)

DIRECTION	ZONE A HI PROBABILITY WIND SPEED IN KNOTS			ZONE B LO PROBABILITY WIND SPEED IN KNOTS			ZONE C VERY LO PROBABILITY WIND SPEED IN KNOTS		
	<7	<16	>15	<7	<16	>15	<7	<16	>15
NORTH	00.28	00.46	00.00	00.56	00.74	00.00	02.92	02.36	00.09
NORTH-NORTHEAST	00.19	00.74	00.00	00.14	00.23	00.00	02.18	02.73	00.19
NORTHEAST	00.51	01.02	00.05	00.42	00.83	00.00	03.66	03.52	00.05
EAST-NORTHEAST	00.14	00.09	00.00	00.32	00.14	00.05	01.90	00.93	00.00
EAST	00.09	00.05	00.00	00.00	00.00	00.00	01.48	00.42	00.00
EAST-SOUTHEAST	00.09	00.00	00.00	00.00	00.00	00.00	00.79	00.14	00.00
SOUTHEAST	00.19	00.09	00.00	00.09	00.05	00.00	01.06	00.32	00.00
SOUTH-SOUTHEAST	00.05	00.09	00.00	00.32	00.00	00.00	00.79	00.14	00.00
SOUTH	00.19	00.32	00.05	00.23	00.05	00.00	02.41	01.02	00.05
SOUTH-SOUTHWEST	00.23	00.23	00.05	00.23	00.14	00.00	01.94	01.94	00.09
SOUTHWEST	00.51	00.37	00.00	00.14	00.28	00.00	04.31	04.17	00.93
WEST-SOUTHWEST	00.37	00.46	00.00	00.28	00.23	00.00	02.92	03.43	00.60
WEST	00.56	00.05	00.00	00.05	00.00	00.00	01.76	00.79	00.00
WEST-NORTHWEST	00.42	00.09	00.00	00.05	00.05	00.00	01.20	01.44	00.09
NORTHWEST	00.42	00.05	00.00	00.23	00.05	00.00	01.81	03.01	00.09
NORTH-NORTHWEST	00.14	00.28	00.00	00.14	00.09	00.00	02.05	01.71	00.05
PERCENT BY SPEED	04.35	04.40	00.14	03.19	02.87	00.05	33.15	28.06	02.22
PERCENT CALM RECORDS		02.82			02.22			16.53	
PERCENT RECORDS / ZONE		11.71			08.33			79.96	

ER Table 2.4-2
Charlotte Airport Data
Period of March 1961 - May 1961 All Temperatures

5238

PERCENT OF RECORDS BY WIND DIRECTION AND SPEED WITHIN ZONES OF PROBABILITY OF FOG DUE TO COOLING TOWER (Mechanical Draft)

	ZONE A HI PROBABILITY WIND SPEED IN KNOTS			ZONE B LO PROBABILITY WIND SPEED IN KNOTS			ZONE C VERY LO PROBABILITY WIND SPEED IN KNOTS		
DIRECTION	<7	<16	>15	<7	<16	>15	<7	<16	>15
NORTH	00.63	00.63	00.05	00.41	00.32	00.00	02.31	01.49	00.05
NORTH-NORTHEAST	00.14	02.17	00.14	00.18	00.18	00.05	01.22	03.26	00.05
NORTHEAST	00.23	00.32	00.00	00.09	00.18	00.00	01.86	03.44	00.09
EAST-NORTHEAST	00.18	00.18	00.00	00.18	00.09	00.00	00.91	01.54	00.00
EAST	00.36	00.18	00.05	00.05	00.00	00.00	01.40	01.31	00.00
EAST-SOUTHEAST	00.00	00.45	00.05	00.00	00.05	00.00	01.27	00.63	00.05
SOUTHEAST	00.14	00.14	00.00	00.09	00.05	00.00	01.54	00.36	00.00
SOUTH-SOUTHEAST	00.36	00.14	00.00	00.09	00.00	00.00	01.36	00.68	00.00
SOUTH	00.27	00.41	00.05	00.27	00.09	00.00	02.63	02.04	00.00
SOUTH-SOUTHWEST	00.59	01.18	00.00	00.18	00.32	00.00	02.17	04.57	00.18
SOUTHWEST	00.50	00.54	00.00	00.14	00.36	00.05	02.76	09.24	01.36
WEST-SOUTHWEST	00.45	00.32	00.00	00.05	00.05	00.05	01.04	03.44	00.95
WEST	00.14	00.14	00.00	00.18	00.05	00.00	00.45	01.22	00.05
WEST-NORTHWEST	00.23	00.05	00.00	00.05	00.00	00.00	01.54	02.63	00.45
NORTHWEST	00.68	00.09	00.00	00.18	00.00	00.00	01.90	03.13	00.45
NORTH-NORTHWEST	00.45	00.09	00.00	00.09	00.00	00.00	01.90	01.99	00.00
PERCENT BY SPEED	05.34	07.02	00.32	02.22	01.72	00.14	26.27	40.99	03.67
PERCENT CALM RECORDS		02.40			01.31			08.61	
PERCENT RECORDS / ZONE		15.08			05.39			79.53	

ER Table 2.4-3
Charlotte Airport Data
Period of January 1960 - December 1964 Temperature equal to or less than 32 F

PERCENT OF RECORDS BY WIND DIRECTION AND SPEED WITHIN ZONES OF PROBABILITY OF FOG DUE TO COOLING TOWER (Mechanical Draft)

DIRECTION	ZONE A HI PROBABILITY WIND SPEED IN KNOTS			ZONE B LO PROBABILITY WIND SPEED IN KNOTS			ZONE C VERY LO PROBABILITY WIND SPEED IN KNOTS		
	<7	<16	>15	<7	<16	>15	<7	<16	>15
NORTH	00.05	00.04	00.01	00.07	00.05	00.00	00.35	00.24	00.00
NORTH-NORTHEAST	00.02	00.10	00.00	00.03	00.07	00.01	00.21	00.39	00.02
NORTHEAST	00.02	00.04	00.00	00.02	00.05	00.00	00.32	00.27	00.00
EAST-NORTHEAST	00.02	00.01	00.00	00.01	00.01	00.00	00.15	00.06	00.00
EAST	00.00	00.01	00.00	00.01	00.01	00.00	00.06	00.01	00.00
EAST-SOUTHEAST	00.00	00.00	00.00	00.01	00.00	00.00	00.04	00.00	00.00
SOUTHEAST	00.01	00.00	00.00	00.01	00.00	00.00	00.07	00.01	00.00
SOUTH-SOUTHEAST	00.01	00.00	00.00	00.01	00.00	00.00	00.07	00.00	00.00
SOUTH	00.04	00.01	00.00	00.03	00.00	00.00	00.14	00.03	00.00
SOUTH-SOUTHWEST	00.03	00.01	00.00	00.03	00.01	00.00	00.07	00.07	00.00
SOUTHWEST	00.05	00.03	00.00	00.05	00.02	00.00	00.13	00.08	00.01
WEST-SOUTHWEST	00.02	00.03	00.00	00.05	00.02	00.00	00.12	00.10	00.00
WEST	00.06	00.01	00.00	00.03	00.00	00.00	00.11	00.06	00.01
WEST-NORTHWEST	00.03	00.00	00.00	00.02	00.00	00.00	00.09	00.13	00.03
NORTHWEST	00.03	00.01	00.00	00.04	00.00	00.00	00.16	00.22	00.03
NORTH-NORTHWEST	00.04	00.02	00.00	00.05	00.02	00.00	00.23	00.18	00.02
PERCENT BY SPEED	00.42	00.32	00.02	00.47	00.27	00.01	02.32	01.88	00.13
PERCENT CALM RECORDS		00.25			00.33			00.85	
PERCENT RECORDS / ZONE		01.01			01.08			05.18	

ER Table 2.4-4

Diffusion Factors for Accident and Routine Releases

	Type of Release	Distance to Receptor (meters)	Diffusion Factor (X/Q sec m^{-3})	Percentile Value
	0 - 2 hours	762	1.30×10^{-3}	95
	0 - 2 hours	762	1.30×10^{-4}	50
	0 - 30 days	---	---	--
	0 - 8 hours	6097	1.65×10^{-4}	--
	8 - 24 hours	6097	9.50×10^{-6}	--
	1 - 4 days	6097	3.25×10^{-6}	--
	4 - 30 days	6097	6.50×10^{-7}	--
	1 year	762 at 035 degrees	2.28×10^{-5}	100
1 2	1 year	1900 at 300 degrees (at nearest farm)	*5.55×10^{-7}	100

Note: Exclusion Area Radius - 762 meters (2500 feet)
Low Population Zone Radius - 6097 meters (20,000 feet)

1 *Adjusted for plume depletion of ^{131}I assuming deposition rate per average concentration is equal to 1 cm per second.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1963

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	253.	903.	253.	5369.	729.	1357.	1321.	2136.	80.	1667.	1581.	80.
2	253.	441.	253.	3226.	700.	3103.	3298.	2259.	80.	3536.	823.	3846.
3	253.	253.	253.	3832.	816.	4460.	2035.	1133.	664.	2858.	419.	3168.
4	253.	636.	419.	3846.	491.	4294.	2829.	830.	2656.	3962.	1436.	2454.
5	253.	592.	340.	6408.	455.	4640.	80.	2995.	2353.	3262.	2288.	3731.
6	607.	253.	1191.	138.	1638.	4416.	80.	1285.	1545.	80.	1610.	3745.
7	672.	253.	210.	1321.	1242.	1480.	80.	1884.	80.	4164.	1905.	888.
8	592.	253.	253.	5174.	1653.	80.	491.	1898.	80.	1689.	996.	80.
9	448.	253.	253.	3918.	1653.	80.	1530.	2288.	1292.	2230.	80.	3940.
10	354.	253.	253.	3702.	1610.	2699.	2952.	765.	2338.	700.	80.	2245.
11	571.	253.	376.	3688.	1379.	2533.	2273.	80.	2786.	80.	2836.	3009.
12	253.	253.	253.	2952.	340.	2223.	1357.	1595.	2353.	2093.	5701.	2908.
13	253.	253.	347.	80.	1653.	2843.	80.	1400.	1696.	80.	6148.	268.
14	1509.	253.	253.	390.	1913.	1783.	80.	1025.	80.	2151.	3853.	1198.
15	448.	253.	253.	3774.	1509.	188.	917.	2201.	80.	2331.	3615.	809.
16	419.	253.	253.	2382.	1422.	80.	1631.	2136.	1400.	2079.	109.	3594.
17	477.	253.	253.	1970.	773.	1307.	2021.	2540.	1718.	470.	80.	2309.
18	361.	253.	1574.	599.	80.	1148.	1725.	80.	2728.	672.	4265.	4315.
19	628.	253.	2151.	780.	80.	1956.	318.	578.	2468.	246.	4373.	3853.
20	253.	253.	3947.	448.	520.	3291.	224.	1126.	1588.	60.	3039.	3110.
21	253.	549.	3507.	434.	672.	1415.	80.	1747.	80.	1270.	1458.	1696.
22	260.	679.	3587.	1249.	1105.	174.	1631.	1653.	80.	1436.	556.	80.
23	253.	253.	3817.	470.	1797.	181.	1797.	1206.	376.	1624.	80.	159.
24	369.	253.	3529.	802.	1617.	917.	4438.	1631.	1357.	1263.	80.	80.
25	2064.	1025.	3644.	874.	1711.	1422.	246.	989.	4539.	498.	5066.	1422.
26	895.	917.	4236.	607.	1675.	1566.	758.	1581.	2721.	80.	5051.	3089.
27	253.	816.	4250.	434.	1646.	1451.	1891.	1494.	3709.	80.	2425.	2389.
28	866.	311.	4351.	491.	4185.	1537.	513.	1631.	924.	866.	80.	3594.
29	737.		3969.	1112.	4409.	80.	1105.	1379.	715.	729.	159.	80.
30	340.		477.	1054.	4683.	80.	1840.	1494.	224.	2382.	80.	4965.
31	852.		123.		4488.		3514.	80.		1220.		4070.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1964

	DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	1	311.	859.	794.	3341.	5066.	765.	246.	1941.	5347.	4993.	6061.	7281.
	2	3370.	542.	3846.	3233.	1855.	2021.	246.	455.	6278.	4258.	5600.	7252.
	3	2064.	3312.	4120.	1638.	1234.	2281.	2122.	6761.	6602.	2447.	8211.	7281.
	4	195.	2778.	3334.	700.	4575.	1927.	253.	6184.	5361.	448.	8897.	5426.
	5	636.	3579.	3377.	318.	5131.	3320.	268.	2071.	1985.	333.	9063.	2014.
	6	4431.	1689.	3890.	1941.	3017.	1249.	232.	5701.	975.	80.	9113.	1436.
	7	5621.	80.	1653.	80.	2028.	203.	239.	4892.	3240.	268.	9063.	4690.
	8	1487.	311.	960.	1004.	845.	2418.	419.	599.	6422.	484.	4070.	6848.
	9	744.	80.	4221.	80.	80.	5347.	1487.	628.	4719.	6249.	6379.	6559.
	10	664.	4589.	3680.	80.	181.	5903.	1285.	4770.	2591.	8875.	8789.	4366.
	11	1451.	2807.	3500.	195.	2504.	4575.	268.	6379.	5852.	3074.	8240.	3276.
	12	1083.	2706.	2952.	599.	2447.	152.	304.	6884.	2201.	6213.	8644.	975.
2	13	5693.	607.	1509.	4784.	1703.	369.	3197.	5549.	1206.	8096.	6841.	80.
	14	2468.	1169.	80.	4027.	1487.	80.	3320.	4755.	3673.	5838.	412.	3731.
	15	3890.	1061.	80.	4366.	1119.	4077.	3348.	491.	4719.	2872.	636.	4741.
	16	4416.	1422.	383.	4142.	80.	607.	2555.	434.	2187.	3053.	5304.	4149.
	17	1451.	1393.	960.	4705.	498.	419.	2180.	823.	2136.	8781.	3226.	5333.
	18	282.	80.	1025.	787.	1855.	737.	260.	1617.	1711.	4344.	2677.	3926.
	19	145.	80.	426.	1602.	3009.	881.	296.	6444.	268.	6819.	2966.	3651.
	20	3103.	1343.	426.	5037.	2786.	758.	1025.	5335.	138.	4748.	2382.	2569.
	21	3125.	94.	924.	5535.	2014.	296.	4409.	5347.	946.	5152.	361.	6047.
	22	2937.	80.	982.	6328.	722.	3225.	4120.	390.	1638.	6905.	102.	1314.
	23	3478.	982.	2966.	5845.	80.	426.	426.	80.	1891.	7360.	3096.	1537.
	24	1891.	3752.	3233.	5333.	80.	1141.	5419.	4741.	1083.	7302.	2908.	672.
	25	80.	4777.	2944.	1206.	3348.	787.	1220.	3255.	1783.	3449.	1097.	253.
	26	80.	4813.	159.	1357.	2367.	1913.	967.	1653.	246.	6198.	80.	80.
	27	87.	5369.	397.	5397.	2093.	246.	5924.	1963.	361.	7714.	4409.	80.
	28	2483.	3233.	80.	6509.	2692.	246.	6357.	1905.	2144.	8168.	4561.	874.
2	29	1119.	462.	80.	7403.	816.	246.	6877.	195.	4236.	9019.	2028.	246.
	30	1148.		4654.	7353.	80.	260.	6732.	80.	4561.	9120.	6025.	2605.
	31	80.		3500.		80.		2447.	2317.		9077.		5888.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1965

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	6061.	5044.	4589.	6162.	210.	2035.	513.	80.	4654.	1133.	3276.	5333.
2	6083.	1934.	2194.	5823.	80.	2180.	3832.	3428.	3118.	953.	4351.	1458.
3	6220.	2562.	123.	2973.	3406.	441.	527.	5578.	2973.	80.	3118.	131.
4	7490.	1624.	80.	1350.	2180.	174.	80.	5448.	152.	2071.	2194.	138.
5	7504.	1213.	1480.	5830.	2100.	80.	80.	5094.	80.	3695.	2252.	80.
6	7490.	513.	5138.	5881.	3255.	80.	80.	1559.	80.	4438.	715.	1869.
7	7836.	80.	758.	2201.	1436.	2627.	4950.	80.	3262.	4084.	210.	3197.
8	7663.	2533.	2735.	6393.	80.	311.	5830.	80.	4885.	4496.	4120.	3356.
9	4322.	5232.	2576.	7533.	80.	585.	6372.	5340.	4467.	3486.	2353.	1307.
10	1191.	5037.	787.	3752.	1739.	2093.	2129.	4921.	5513.	80.	4063.	1328.
11	5982.	4568.	2475.	1076.	3103.	1141.	80.	4330.	3890.	4647.	2374.	3190.
12	7288.	4878.	1364.	5722.	1408.	80.	80.	3529.	80.	5044.	2598.	80.
13	7288.	2382.	1552.	5614.	354.	80.	3529.	2447.	4907.	2851.	672.	498.
14	7273.	80.	80.	5484.	3204.	470.	4380.	1537.	2879.	3312.	80.	2699.
15	7851.	5996.	1025.	5931.	1011.	80.	5311.	80.	2764.	2778.	3002.	2771.
16	7706.	7403.	369.	4250.	80.	80.	4734.	4322.	3204.	2151.	1032.	3543.
17	434.	5022.	2511.	2807.	4553.	2223.	3608.	5138.	3724.	80.	2418.	1220.
18	5794.	5585.	80.	80.	3139.	2598.	80.	2490.	1624.	5304.	4135.	1949.
19	7230.	3767.	246.	2035.	3695.	1884.	4258.	3363.	80.	4561.	1725.	282.
20	7223.	903.	152.	2800.	3853.	80.	4359.	4135.	5448.	4445.	289.	4359.
21	5282.	80.	751.	4849.	3305.	5325.	4755.	1819.	4979.	1018.	80.	1090.
22	2367.	80.	1400.	2295.	924.	5802.	5369.	80.	1371.	2396.	960.	1920.
23	1155.	2742.	715.	1689.	80.	5354.	1754.	3074.	2317.	1422.	1826.	874.
24	80.	5491.	217.	1206.	6126.	1920.	823.	4763.	1545.	80.	3666.	80.
25	5621.	5102.	188.	80.	1891.	246.	80.	5094.	80.	4582.	152.	80.
26	5563.	787.	80.	426.	5462.	1040.	2778.	3118.	80.	2879.	1581.	80.
27	5903.	80.	1364.	217.	4654.	80.	2713.	4705.	80.	2432.	80.	960.
28	7107.	80.	80.	1523.	2461.	4943.	1112.	2158.	520.	2281.	80.	1718.
29	2930.		5643.	3428.	744.	5390.	5131.	80.	3182.	1350.	5167.	2692.
30	2136.		6660.	1545.	80.	5195.	5253.	3666.	2829.	953.	5203.	845.
31	1004.		6725.		102.		2699.	3767.		80.		895.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1966

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	80.	1285.	2346.	830.	80.	3377.	304.	354.	3983.	80.	700.	5188.
2	80.	1364.	80.	744.	636.	722.	340.	318.	4423.	80.	2281.	5571.
3	1169.	1682.	419.	253.	758.	1119.	131.	311.	217.	2447.	3803.	3536.
4	2923.	1631.	80.	563.	1595.	333.	260.	260.	80.	4120.	2057.	318.
5	3536.	1920.	80.	1292.	1487.	80.	239.	361.	80.	1711.	520.	5765.
6	1220.	102.	80.	3118.	1256.	448.	599.	80.	2338.	2346.	80.	5506.
7	1884.	347.	2757.	910.	1040.	4496.	340.	102.	1040.	1920.	1451.	5881.
8	4698.	542.	1804.	729.	80.	2194.	1422.	304.	758.	643.	4308.	5852.
9	434.	542.	2050.	80.	4539.	361.	253.	311.	304.	80.	3918.	5513.
10	4200.	426.	3781.	80.	2995.	664.	80.	802.	347.	3947.	3197.	80.
11	1415.	866.	5224.	296.	1162.	383.	6314.	1307.	549.	3615.	2309.	80.
12	3514.	369.	5571.	1732.	455.	80.	9084.	347.	1739.	1869.	311.	5585.
13	2526.	80.	2829.	917.	1646.	823.	7483.	80.	1588.	2208.	80.	5845.
14	1913.	1061.	7100.	2591.	311.	1501.	6040.	80.	397.	1270.	5758.	2692.
15	3680.	527.	7230.	794.	80.	2923.	5924.	1999.	4532.	80.	5513.	6335.
16	80.	80.	7216.	253.	369.	2281.	318.	5188.	1198.	159.	5311.	5123.
17	1242.	80.	7223.	80.	672.	354.	80.	3911.	311.	2374.	5138.	1465.
18	2021.	80.	5866.	2685.	1169.	333.	1552.	1941.	80.	3904.	5765.	80.
19	2952.	1227.	1631.	513.	2612.	80.	4979.	758.	2786.	1869.	232.	5600.
20	3074.	1097.	80.	643.	347.	412.	3175.	347.	1335.	1862.	145.	5376.
21	3882.	3421.	3940.	859.	282.	2302.	318.	80.	4048.	830.	5722.	5087.
22	556.	3464.	2252.	520.	80.	2980.	275.	2677.	3550.	210.	6004.	5138.
23	80.	5260.	3255.	874.	405.	3796.	318.	5852.	1018.	80.	6638.	621.
24	2793.	2281.	3457.	80.	354.	3954.	80.	2461.	506.	3861.	3384.	80.
25	3053.	131.	3478.	318.	722.	3348.	2468.	2439.	80.	2266.	1343.	585.
26	2649.	4308.	3529.	672.	2425.	80.	1862.	347.	2107.	3110.	4315.	80.
27	2764.	2324.	210.	903.	3226.	5260.	2281.	340.	4582.	1631.	80.	5116.
28	1076.	2259.	5167.	2367.	4229.	3334.	4972.	80.	3305.	3969.	4842.	5549.
29	1473.		4322.	1004.	80.	3334.	2930.	282.	2822.	203.	6032.	4409.
30	3406.		6487.	1350.	4409.	3522.	340.	347.	910.	80.	6133.	2360.
31	3125.		1588.		4972.		80.	643.		2793.		816.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1967

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	80.	2699.	2692.	80.	260.	246.	80.	1833.	4763.	80.	4243.	1155.
2	232.	3211.	4063.	80.	253.	253.	80.	3168.	80.	4474.	6047.	434.
3	2317.	2757.	535.	383.	268.	80.	275.	3536.	80.	2122.	383.	80.
4	4669.	181.	80.	340.	325.	80.	260.	2562.	2172.	4524.	80.	1696.
5	3796.	80.	80.	239.	253.	260.	253.	80.	1559.	3810.	80.	830.
6	2548.	1610.	1263.	1732.	80.	239.	246.	80.	4070.	5159.	6530.	1422.
7	498.	1379.	888.	2136.	80.	253.	246.	1675.	4618.	1754.	7786.	816.
8	80.	6292.	1119.	80.	260.	253.	94.	3356.	3175.	80.	6711.	232.
9	1249.	4929.	1898.	80.	253.	960.	109.	3781.	3774.	3789.	5419.	80.
10	2273.	2591.	412.	311.	239.	80.	982.	2959.	80.	6063.	1646.	80.
11	5369.	80.	80.	195.	3348.	80.	3486.	253.	4200.	2858.	80.	4236.
12	5672.	145.	80.	628.	1234.	2520.	3522.	80.	7288.	1905.	80.	1004.
13	1776.	2064.	311.	361.	80.	1703.	325.	80.	8031.	1612.	1444.	636.
14	80.	2324.	260.	246.	80.	361.	340.	296.	3825.	260.	4575.	434.
15	80.	1032.	275.	80.	1304.	268.	412.	3666.	4734.	80.	7107.	787.
16	4099.	1285.	2511.	80.	1458.	542.	80.	3009.	159.	4936.	7937.	80.
17	2605.	2252.	1270.	3449.	268.	80.	1855.	2540.	80.	4864.	3673.	80.
18	1393.	80.	1076.	2656.	967.	80.	3550.	1797.	5499.	3320.	116.	3767.
19	4041.	80.	664.	239.	3002.	253.	426.	80.	5866.	1747.	80.	2591.
20	2800.	1826.	5405.	289.	253.	268.	1083.	80.	6061.	1884.	5729.	2295.
21	426.	4524.	289.	311.	80.	246.	1619.	1018.	5434.	787.	4820.	903.
22	80.	917.	253.	80.	4359.	260.	80.	260.	491.	80.	1581.	246.
23	80.	2021.	239.	80.	1927.	253.	80.	434.	224.	3846.	434.	80.
24	217.	3529.	333.	455.	838.	80.	4993.	80.	80.	5535.	787.	650.
25	340.	3839.	80.	253.	224.	80.	3399.	80.	1711.	4496.	80.	80.
26	1227.	174.	80.	1804.	1018.	239.	2721.	571.	1689.	6263.	80.	260.
27	715.	4416.	260.	1905.	80.	253.	1610.	4474.	2836.	1862.	1739.	5390.
28	765.	794.	1545.	311.	80.	275.	1826.	1985.	3529.	282.	6595.	4070.
29	80.		1032.	80.	1602.	253.	80.	3954.	268.	80.	6249.	823.
30	1141.		1011.	80.	268.	246.	80.	4835.	80.	5131.	2144.	1068.
31	3399.		636.		253.		405.	4813.		3904.		376.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1968

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1177.	5030.	5268.	773.	2360.	80.	5729.	1970.	80.	3688.	1285.	159.
2	6927.	4835.	80.	3962.	1162.	80.	4553.	3327.	253.	2144.	924.	2057.
3	8428.	3565.	80.	5600.	1480.	3283.	275.	80.	823.	4373.	80.	2923.
4	8017.	621.	794.	1826.	80.	3269.	80.	80.	3096.	1718.	5080.	3911.
5	6689.	4979.	289.	232.	80.	3356.	80.	5967.	4726.	268.	1285.	4019.
6	6206.	5571.	224.	708.	354.	1992.	1191.	7331.	4286.	80.	1790.	2346.
7	412.	5361.	1429.	80.	2728.	419.	80.	9250.	441.	1076.	1574.	975.
8	6942.	5693.	1184.	939.	275.	80.	296.	8305.	80.	4914.	1761.	462.
9	5600.	5116.	80.	2504.	2800.	87.	253.	3067.	1797.	4063.	1162.	5989.
10	5268.	282.	80.	2302.	3146.	5715.	2511.	167.	268.	3074.	434.	5275.
11	2728.	80.	282.	903.	1119.	1206.	4517.	80.	1011.	527.	6249.	4662.
12	2713.	7043.	138.	1191.	210.	1545.	3529.	311.	260.	80.	9308.	1797.
13	109.	8392.	102.	80.	5477.	282.	80.	282.	592.	80.	9236.	268.
14	80.	5910.	80.	60.	2569.	4200.	318.	3103.	80.	3644.	5765.	549.
15	1487.	1768.	542.	260.	282.	3659.	5931.	4539.	80.	3190.	693.	448.
16	888.	2865.	80.	939.	2064.	80.	2050.	4380.	3125.	4142.	80.	5102.
17	390.	80.	80.	2908.	1689.	2815.	4142.	159.	3154.	6105.	80.	2649.
18	3255.	80.	253.	4828.	282.	268.	3579.	80.	1090.	3962.	1083.	3291.
19	4597.	5167.	390.	282.	80.	2649.	3356.	5773.	3947.	131.	3341.	361.
20	1285.	1711.	304.	152.	412.	2151.	520.	5412.	1920.	80.	2223.	823.
21	80.	4387.	325.	80.	765.	325.	80.	5693.	80.	607.	1545.	787.
22	2158.	4683.	383.	2988.	2908.	80.	4438.	7512.	80.	535.	607.	80.
23	2483.	3962.	304.	2879.	2627.	80.	5073.	7309.	3471.	1335.	448.	333.
24	6574.	80.	80.	2086.	6119.	5542.	5809.	2757.	5080.	1408.	513.	80.
25	3637.	80.	2237.	1054.	1877.	2908.	7706.	80.	7454.	621.	636.	260.
26	4712.	2504.	1509.	527.	80.	4496.	3760.	2569.	3017.	758.	1364.	239.
27	4568.	2858.	1155.	693.	361.	318.	80.	390.	1133.	441.	260.	260.
28	498.	3132.	2144.	80.	563.	390.	80.	253.	80.	2959.	80.	1559.
29	4344.	6097.	21[illegible]1.	3002.	282.	80.	282.	246.	80.	2692.	246.	80.
30	4719.		80.	325.	253.	80.	253.	253.	2425.	4993.	1105.	3175.
31	5131.		80.		260.		1227.	80.		3688.		1776.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1969

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2865.	80.	758.	2800.	4265.	80.	1638.	80.	693.	5686.	80.	3305.
2	3933.	664.	80.	3197.	3399.	2901.	260.	80.	599.	7656.	80.	3146.
3	1270.	1314.	6292.	3478.	686.	333.	3774.	80.	1797.	4460.	4705.	3312.
4	3283.	3796.	3384.	3125.	80.	260.	419.	397.	1328.	80.	8435.	4286.
5	693.	361.	3442.	80.	3998.	260.	1436.	484.	3493.	80.	5289.	4524.
6	6812.	556.	1487.	80.	4770.	1927.	383.	470.	80.	462.	2677.	1213.
7	4048.	260.	1083.	1242.	6076.	253.	5282.	874.	80.	4474.	643.	419.
8	3500.	210.	80.	3608.	2107.	253.	6444.	5816.	5484.	6530.	80.	6566.
9	989.	80.	80.	3738.	2317.	5145.	1523.	3283.	2504.	4575.	80.	2490.
10	4178.	903.	2952.	2367.	80.	390.	3918.	80.	3680.	527.	2778.	3190.
11	758.	585.	722.	874.	80.	4799.	3168.	3969.	758.	80.	3853.	383.
12	80.	441.	2208.	80.	3594.	8702.	1242.	578.	751.	80.	3890.	1263.
13	5188.	2490.	1509.	80.	1047.	8197.	80.	260.	80.	3608.	6559.	1227.
14	5094.	3486.	722.	6061.	3572.	1112.	4027.	268.	80.	5823.	2115.	80.
15	2908.	470.	80.	4120.	3175.	80.	4524.	253.	2627.	946.	6335.	592.
16	2317.	116.	405.	2035.	253.	6509.	5939.	2766.	5607.	1415.	2483.	3983.
17	2410.	282.	549.	1747.	80.	1487.	6314.	253.	6739.	1032.	5614.	4416.
18	80.	3175.	3572.	787.	80.	4734.	5672.	5679.	8255.	664.	3247.	4106.
19	80.	1610.	686.	80.	1112.	3947.	80.	8428.	2887.	80.	2822.	253.
20	4027.	1270.	506.	80.	5412.	419.	80.	5268.	80.	253.	4214.	145.
21	1191.	448.	881.	224.	4395.	2807.	3565.	2851.	80.	549.	5664.	80.
22	715.	405.	1862.	3392.	2317.	80.	1985.	260.	542.	4351.	1739.	1032.
23	253.	80.	383.	3341.	3767.	5888.	3168.	260.	4207.	4481.	498.	1234.
24	80.	3060.	758.	4322.	758.	7959.	1105.	80.	1761.	5282.	1638.	80.
25	376.	2656.	2107.	4077.	80.	7742.	4481.	304.	1112.	1090.	5123.	80.
26	80.	2447.	4106.	1566.	3796.	10109.	80.	975.	4553.	80.	1270.	318.
27	4250.	1119.	3370.	80.	2006.	9438.	80.	260.	318.	6602.	614.	390.
28	3363.	1285.	607.	3969.	4055.	3558.	3522.	441.	80.	7822.	253.	246.
29	2064.		167.	5022.	5369.	217.	1761.	419.	3558.	7403.	80.	3269.
30	260.		80.	4698.	1682.	1444.	3789.	80.	5347.	5195.	80.	2605.
31	268.		1610.		4236.		1920.	109.		888.		2504.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1970

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2865.	80.	80.	1328.	3226.	903.	5859.	4178.	9510.	268.	80.	859.
2	4719.	253.	1516.	260.	80.	2764.	9322.	80.	7576.	80.	318.	268.
3	737.	1970.	1206.	585.	80.	4957.	1032.	5780.	6119.	80.	441.	628.
4	405.	6754.	217.	80.	672.	1068.	3740.	4431.	4871.	80.	333.	253.
5	6841.	3695.	80.	80.	549.	924.	80.	2194.	80.	260.	1047.	1112.
6	7223.	383.	477.	1242.	253.	80.	260.	296.	80.	311.	1812.	80.
7	7014.	80.	80.	2439.	1530.	80.	614.	253.	80.	260.	80.	3312.
8	12912.	80.	80.	260.	2872.	1090.	686.	80.	2418.	260.	80.	1970.
9	10948.	275.	80.	636.	80.	2136.	2396.	80.	2382.	80.	1379.	1509.
10	7887.	3211.	289.	924.	80.	946.	80.	80.	5397.	80.	434.	1083.
11	794.	1133.	282.	80.	5874.	2403.	80.	80.	5982.	80.	520.	434.
12	2006.	2273.	506.	80.	6451.	2900.	80.	80.	80.	628.	657.	80.
13	2483.	1422.	852.	1090.	8745.	80.	3803.	80.	80.	376.	881.	80.
14	2620.	80.	80.	2230.	9741.	80.	4265.	5340.	5145.	260.	80.	2584.
15	2511.	311.	275.	253.	5419.	253.	4012.	1357.	7988.	260.	80.	1040.
16	2685.	5181.	6942.	260.	80.	260.	4546.	664.	9611.	260.	693.	426.
17	80.	4929.	7598.	260.	80.	4409.	636.	6227.	9597.	80.	3356.	650.
18	80.	80.	2944.	80.	982.	5765.	80.	7879.	9077.	80.	3702.	780.
19	924.	131.	5347.	80.	80.	9445.	80.	5975.	4337.	260.	3767.	253.
20	5470.	1133.	4027.	289.	2966.	80.	3911.	6516.	80.	268.	946.	80.
21	7656.	1083.	80.	275.	6530.	80.	260.	6675.	9099.	260.	80.	2021.
22	9315.	80.	80.	3276.	9265.	3839.	253.	650.	13836.	412.	80.	253.
23	7071.	275.	6812.	2194.	484.	628.	253.	80.	10715.	260.	3031.	4207.
24	80.	967.	7396.	296.	80.	3810.	3024.	498.	9597.	80.	7425.	268.
25	80.	354.	1804.	80.	3146.	2706.	80.	260.	6768.	80.	6516.	260.
26	260.	6790.	2172.	80.	3175.	275.	80.	1105.	80.	253.	903.	1545.
27	260.	2410.	664.	4705.	1501.	80.	4929.	2771.	80.	405.	268.	275.
28	246.	80.	80.	5008.	1126.	80.	9240.	2439.	260.	253.	80.	3298.
29	80.		260.	6271.	260.	260.	5653.	80.	260.	311.	80.	3745.
30	253.		260.	8514.	80.	2014.	9474.	80.	253.	325.	311.	2273.
31	80.		3731.		80.		6978.	7432.		80.		3262.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1971

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	4359.	6927.	3868.	1234.	181.	5405.	6588.	80.	542.	3514.	6242.	5758.
2	102.	8067.	3392.	5188.	80.	5679.	1169.	607.	1126.	174.	6097.	5333.
3	80.	8449.	5174.	80.	917.	5369.	80.	1783.	3154.	80.	7714.	6184.
4	1357.	5491.	5556.	80.	484.	8009.	80.	1711.	80.	5729.	5361.	455.
5	239.	2317.	2497.	260.	1739.	6234.	80.	1270.	80.	5982.	5737.	1581.
6	4402.	722.	434.	5296.	2338.	80.	232.	715.	80.	2634.	1617.	888.
7	5830.	470.	664.	3529.	3190.	6920.	253.	80.	3637.	686.	1278.	1826.
8	4972.	2555.	6610.	1119.	80.	9157.	2418.	80.	910.	1804.	6162.	2302.
9	2079.	3817.	4647.	347.	80.	5253.	1588.	2454.	3146.	744.	6963.	4236.
10	80.	3067.	2959.	80.	1357.	2339.	304.	2526.	3327.	80.	5996.	5708.
11	2266.	3327.	1119.	80.	650.	5037.	1646.	1040.	903.	2035.	6718.	80.
12	2555.	1696.	80.	260.	4950.	1004.	167.	80.	80.	866.	664.	80.
13	4849.	311.	80.	3550.	2309.	80.	700.	498.	253.	614.	1566.	4041.
14	1646.	102.	80.	397.	2180.	6234.	5123.	80.	549.	3067.	354.	6292.
15	2079.	1754.	765.	628.	3341.	9315.	2057.	80.	4770.	4142.	2901.	5888.
16	2374.	434.	1689.	2107.	80.	7454.	1068.	80.	4510.	80.	4178.	6372.
17	80.	823.	3291.	80.	2425.	87.	981.	1588.	1913.	80.	5008.	6458.
18	4835.	419.	3579.	80.	4452.	253.	80.	1141.	80.	1068.	3991.	3962.
19	7165.	592.	3060.	3348.	5123.	80.	1141.	2439.	80.	2396.	4128.	325.
20	3168.	80.	1566.	4921.	5116.	80.	5015.	4561.	5333.	982.	2259.	6083.
21	1978.	304.	80.	1040.	4864.	6040.	866.	2966.	6285.	5361.	80.	4965.
22	2685.	275.	2028.	2136.	3247.	6400.	253.	188.	1141.	6559.	3348.	6458.
23	838.	1501.	2706.	6068.	2605.	2389.	246.	2468.	1263.	217.	5210.	6963.
24	80.	304.	3954.	1032.	5513.	6249.	80.	246.	260.	260.	6119.	787.
25	1978.	672.	6631.	80.	4589.	9229.	80.	542.	1234.	5520.	2245.	80.
26	2584.	491.	7129.	708.	5094.	4099.	260.	325.	80.	5931.	2519.	80.
27	6790.	203.	80.	1314.	3926.	80.	253.	260.	3940.	6170.	982.	491.
28	7136.	80.	80.	2988.	167.	6198.	253.	80.	5318.	6263.	80.	614.
29	1270.		527.	1451.	693.	9561.	253.	80.	5701.	7475.	4005.	3211.
30	289.		3810.	1090.	823.	6898.	311.	636.	4092.	1429.	4301.	1891.
31	311.		599.		2064.		80.	2706.		80.		260.

DAILY FLOW, IN CUBIC FEET PER SECOND, AT MOUNTAIN ISLAND DAM SINCE 1963

1972

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1617.	5159.	3053.	289.	989.	1501.	1574.	4683.	2302.	80.	2822.	5780.
2	1040.	4726.	5888.	347.	1220.	4084.	390.	2122.	664.	2230.	1747.	859.
3	4344.	823.	5224.	253.	260.	80.	2569.	4589.	1047.	1458.	1335.	80.
4	5058.	2454.	3442.	1703.	1833.	80.	2930.	7331.	3118.	5195.	1364.	571.
5	4524.	2980.	80.	3363.	1631.	5688.	4395.	80.	260.	708.	239.	845.
6	5556.	1956.	4957.	563.	80.	4171.	2533.	80.	1480.	2201.	3781.	859.
7	5477.	4546.	1083.	599.	80.	989.	80.	4748.	535.	80.	4315.	4799.
8	3413.	845.	4777.	2122.	3702.	253.	1776.	5066.	260.	80.	3738.	3081.
9	816.	6184.	5145.	80.	3998.	4524.	80.	2555.	80.	3392.	2540.	1415.
10	1790.	5592.	2908.	3428.	3507.	866.	1321.	296.	80.	2944.	1739.	80.
11	80.	3550.	2014.	513.	5094.	80.	2966.	253.	975.	1826.	816.	765.
12	80.	4986.	80.	1242.	2576.	203.	5203.	563.	2973.	1292.	491.	3384.
13	80.	1732.	722.	3882.	361.	4597.	4193.	80.	3291.	729.	5744.	1299.
14	636.	2158.	260.	1335.	80.	5145.	1321.	2151.	3774.	80.	2793.	1408.
15	592.	2605.	1393.	1169.	4799.	5794.	1400.	1869.	4647.	80.	4864.	1855.
16	5354.	3168.	1992.	80.	4221.	4070.	397.	109.	3846.	3428.	6682.	3933.
17	6473.	4423.	2721.	3572.	5289.	715.	1848.	2237.	1985.	852.	3825.	2930.
18	3644.	3428.	1588.	1949.	5513.	80.	2887.	2223.	6357.	2309.	2548.	6372.
19	3890.	6335.	80.	2771.	5708.	535.	3233.	5376.	5138.	2793.	80.	3002.
20	3406.	3882.	3110.	4337.	5874.	5477.	3926.	448.	3608.	4135.	3500.	3190.
21	2447.	5188.	2454.	1458.	3991.	11348.	6942.	527.	80.	794.	5167.	2317.
22	4012.	5484.	2086.	3255.	6105.	10759.	7028.	1956.	1386.	268.	6595.	80.
23	80.	7728.	3666.	80.	4402.	8197.	1509.	3688.	224.	3817.	758.	80.
24	5058.	5535.	3493.	2490.	5621.	7533.	5058.	4618.	80.	5397.	3031.	80.
25	5903.	1552.	2757.	636.	6364.	6711.	3017.	2309.	3406.	2447.	3255.	80.
26	5780.	1004.	80.	506.	2656.	8219.	1574.	2692.	5369.	3002.	80.	751.
27	4597.	80.	4575.	982.	1364.	6963.	571.	80.	5845.	3103.	4019.	1350.
28	3615.	5167.	1761.	123.	80.	5376.	260.	2879.	3161.	816.	2735.	737.
29	1097.	1934.	1545.	80.	4705.	5787.	80.	1941.	2483.	80.	4965.	1537.
30	80.		2656.	80.	3305.	4777.	80.	2324.	253.	3767.	6747.	268.
31	4236.		4351.		4012.		1335.	2035.		2894.		239.

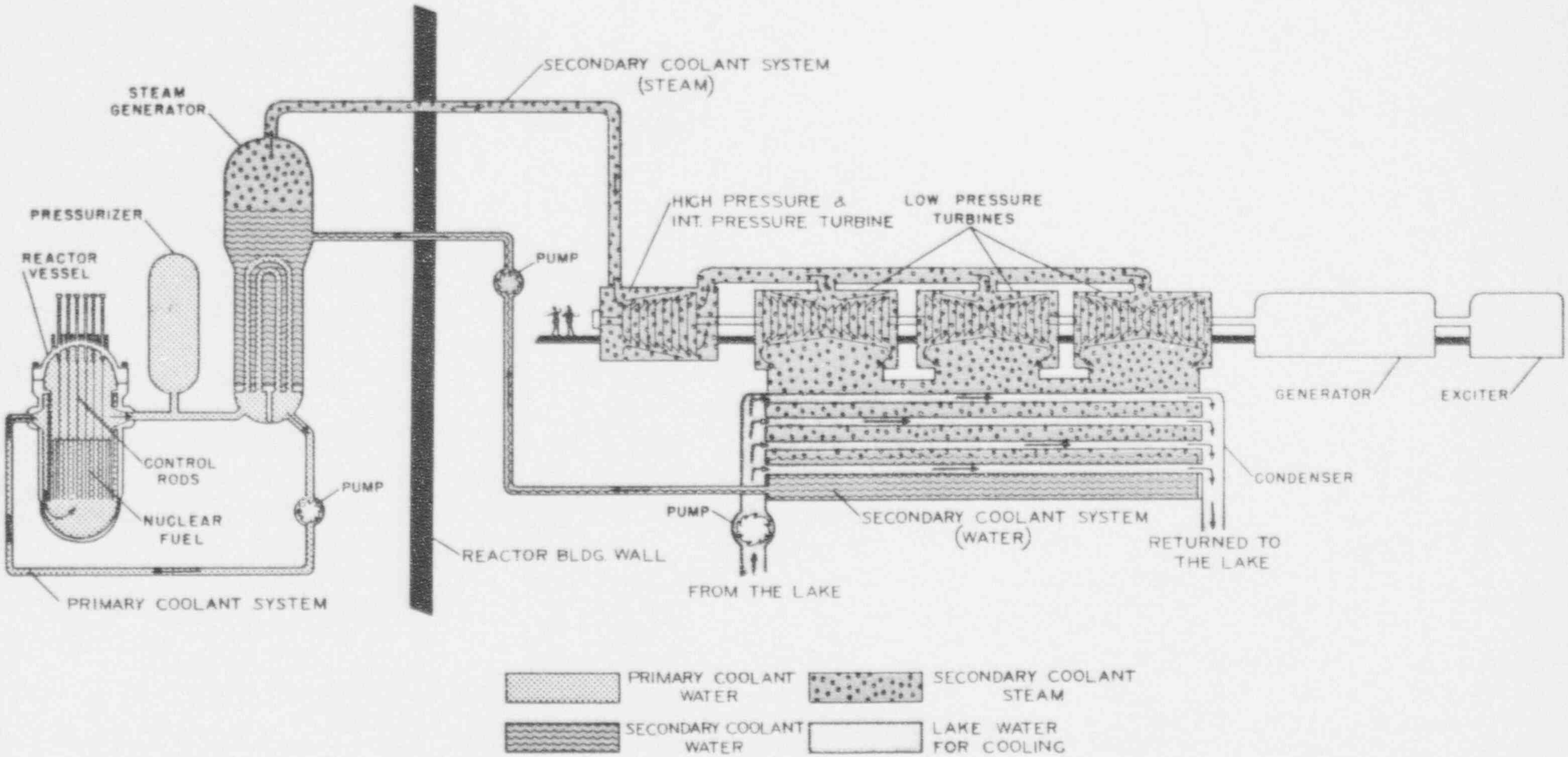
ER Table 2.4-6

Climatology From NOAA Station In The Vicinity Of Catawba Nuclear Station*

Month	Rainfall[1] (1931-1960) Mean (Inches)	Dew Point Temperature[1] (1951-1970) (°F) Mean	Standard Deviation	Solar Radiation[2] (1951-1970) (Ly/Day) Mean	Standard Deviation
Jan	3.53	30.1	4.6	214.5	26.6
Feb	3.55	31.5	6.1	278.5	37.9
Mar	4.39	36.5	4.6	375.8	44.7
Apr	3.49	46.6	3.0	462.1	45.5
May	3.11	56.7	2.9	529.8	37.4
Jun	3.61	64.3	3.0	548.5	46.5
Jul	4.88	68.1	1.8	523.4	47.7
Aug	4.22	67.7	1.9	481.8	57.1
Sep	3.49	61.8	2.4	409.1	50.3
Oct	2.96	50.4	2.9	329.0	45.6
Nov	2.53	39.2	3.3	240.7	28.0
Dec	3.62	31.6	5.0	191.1	25.6

[1]Charlotte Airport
[2]Greensboro Airport

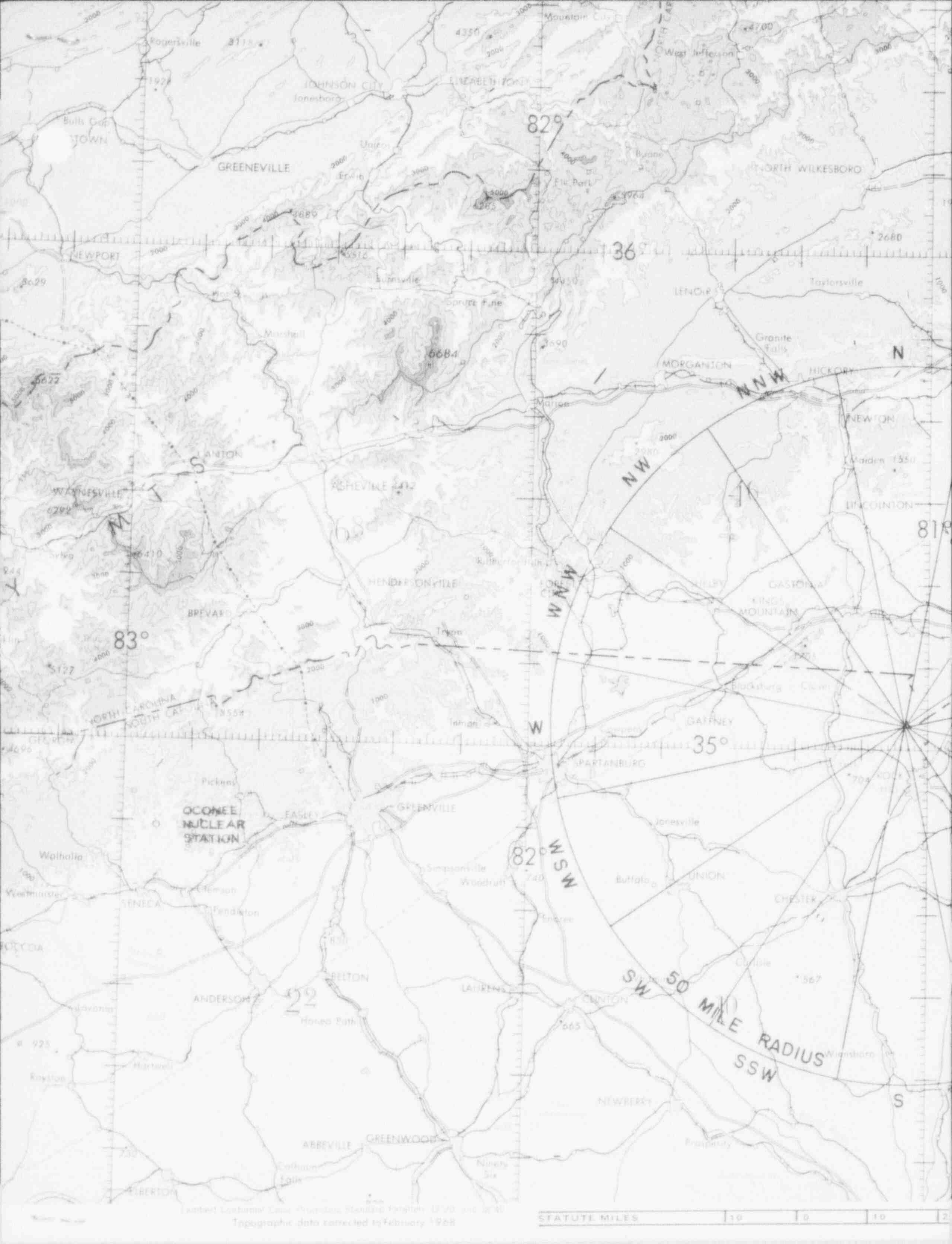
*NOAA - National Oceanographic and Atmospheric Administration



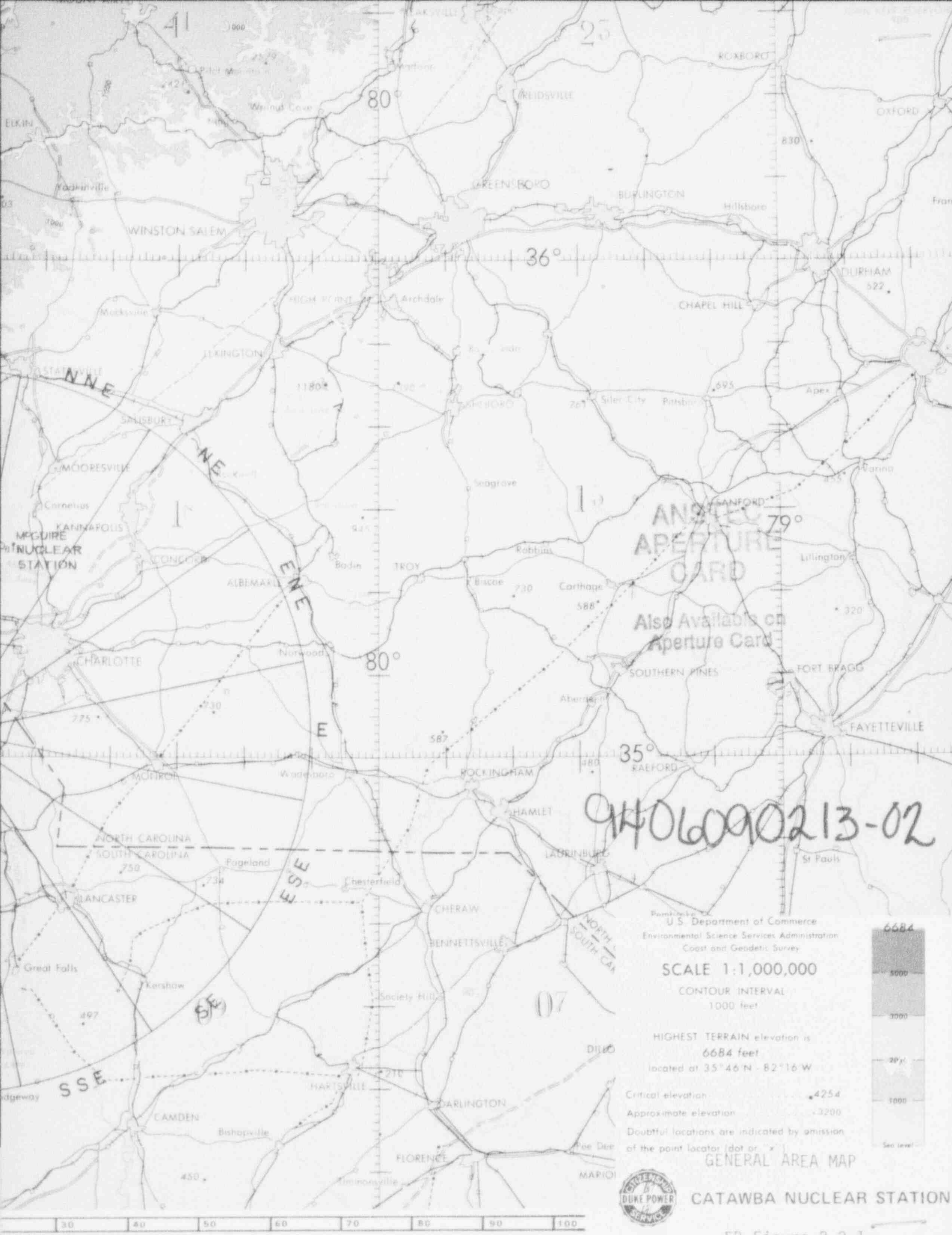
SIMPLIFIED FLOW DIAGRAM

CATAWBA NUCLEAR STATION

ER Figure 2.1-1



Mountain City
Rogersville
West Jefferson
JOHNSON CITY
ELIZABETHTON
Jonesboro
Bulls Gap
GREENEVILLE
Unicoi
Erwin
Boone
NORTH WILKESBORO
Elk Park
NEWPORT
36°
Burnsville
Spruce Pine
LENOIR
Taylorsville
Marshall
6684
Granite Falls
MORGANTON
HICKORY
Marion
NEWTON
N
NNW
NW
Maiden
ASHEVILLE
WAYNESVILLE
LINCOLNTON
81°
HENDERSONVILLE
SHELBY
GASTONIA
KINGS MOUNTAIN
BREVARD
WNW
83°
Tryon
Blacksburg
GAFFNEY
NORTH CAROLINA
SOUTH CAROLINA
Inman
W
35°
SPARTANBURG
Pickens
OCONEE NUCLEAR STATION
EASLEY
GREENVILLE
Jonesville
Walhalla
82°
WSW
Simpsonville
Woodruff
Buffalo
UNION
Westminster
SENECA
Clemson
Pendleton
CHESTER
Enoree
TOCCOA
BELTON
ANDERSON
LAURENS
CLINTON
SW
50 MILE RADIUS
SSW
Honea Path
Winnsboro
Royston
Hartwell
NEWBERRY
S
ABBEVILLE
GREENWOOD
Calhoun Falls
Ninety Six
ELBERTON
Prosperity
Topographic data corrected to February 1968
STATUTE MILES
10
0
10

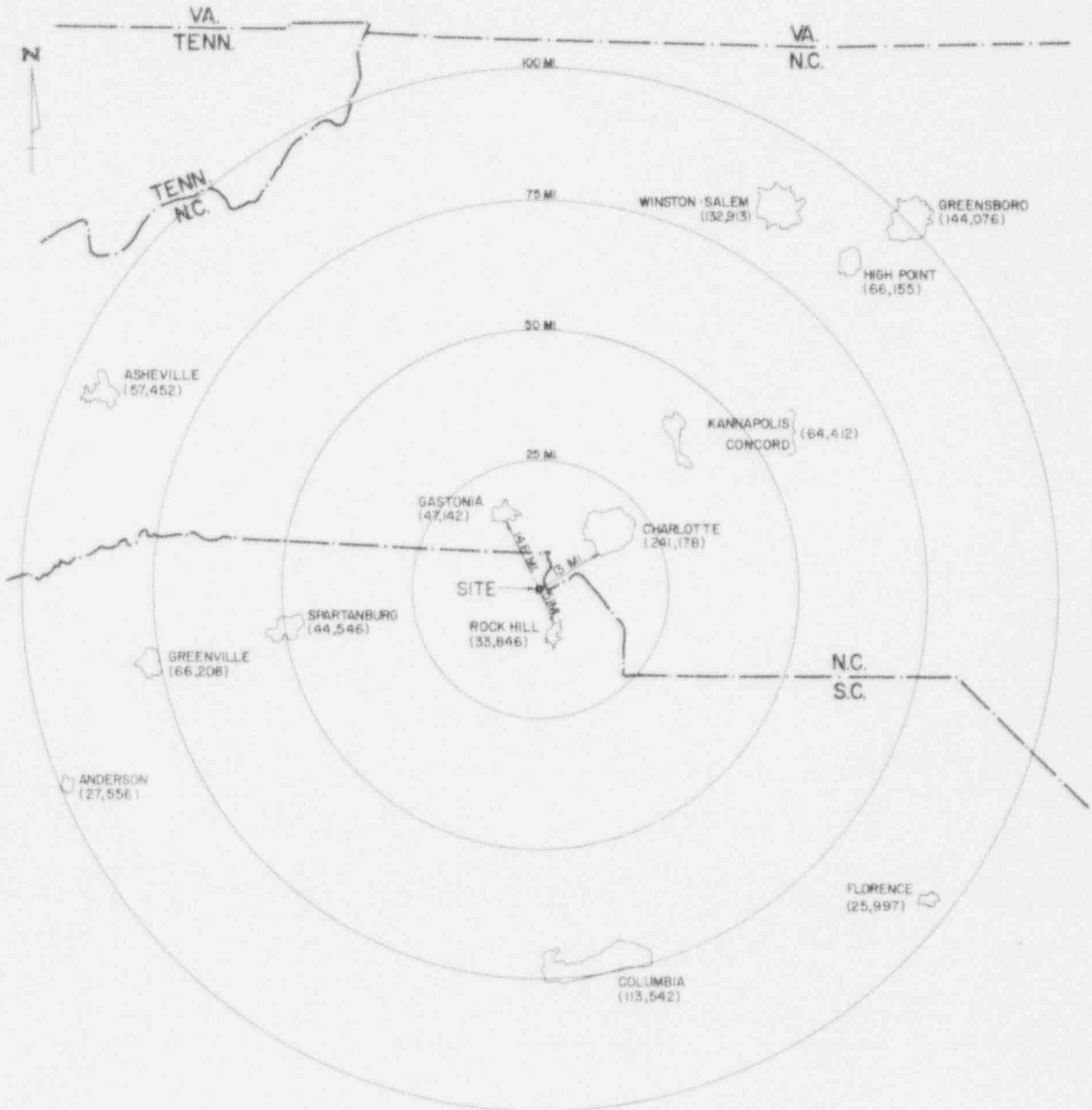


GENERAL AREA MAP

CATAWBA NUCLEAR STATION

ER Figure 2.2-1

POPULATION CENTER DISTANCES
WITHIN
A 100 MILE RADIUS



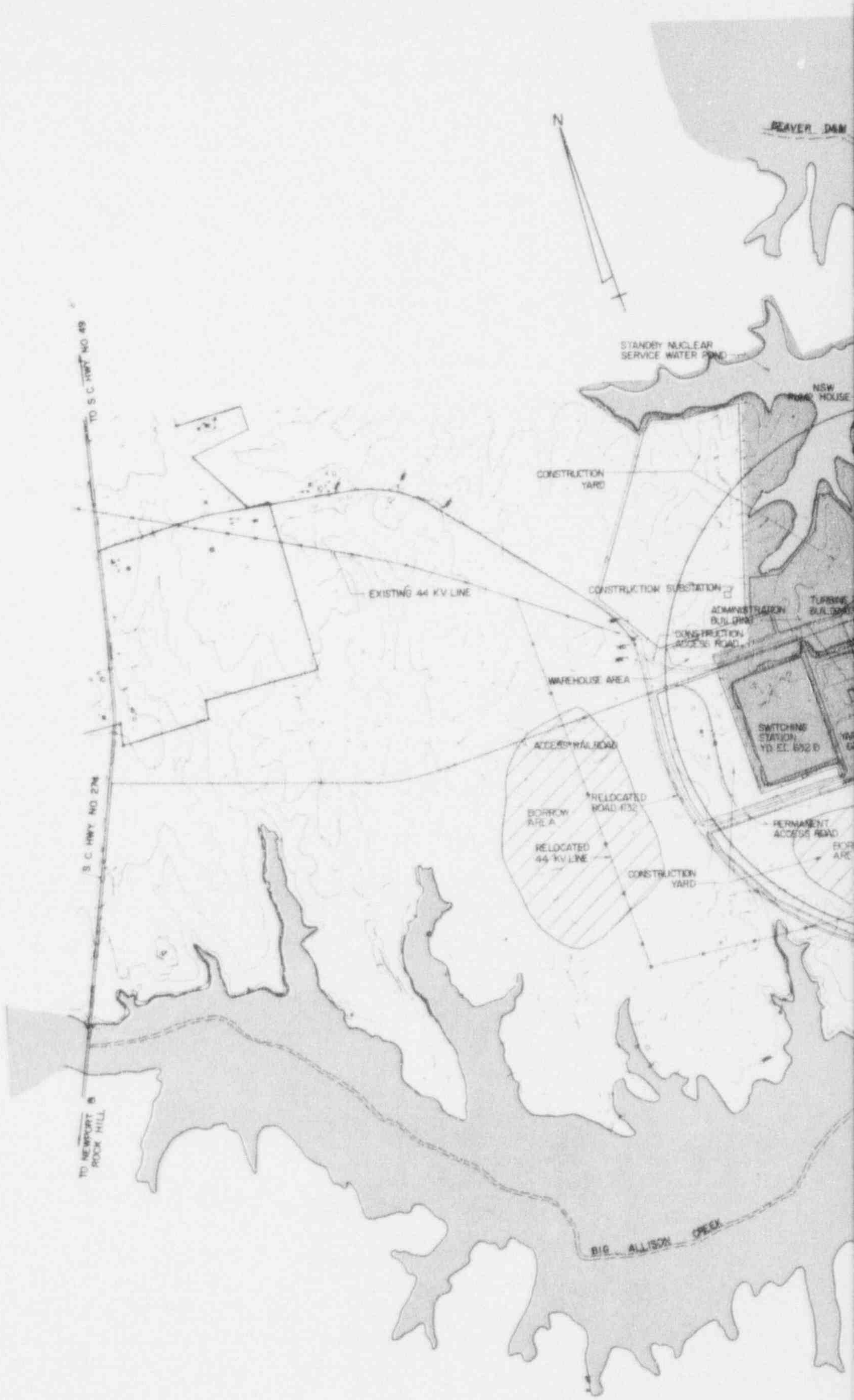
SOURCE: 1970 U.S. CENSUS
FINAL COUNT

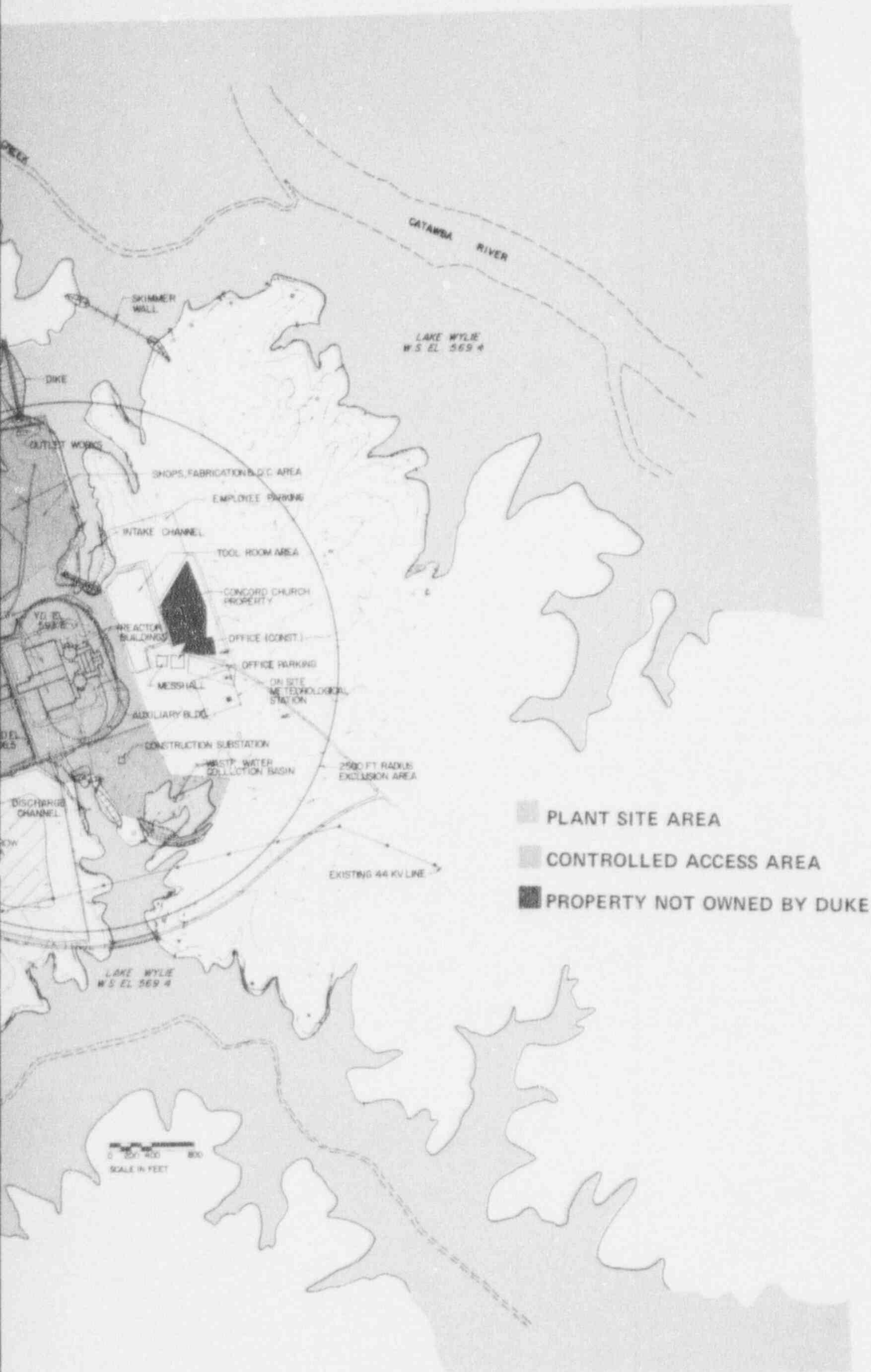
POPULATION CENTER DISTANCES
WITHIN A 100 MILE RADIUS

DUKE POWER

CATAWBA NUCLEAR STATION

ER Figure 2.2-2

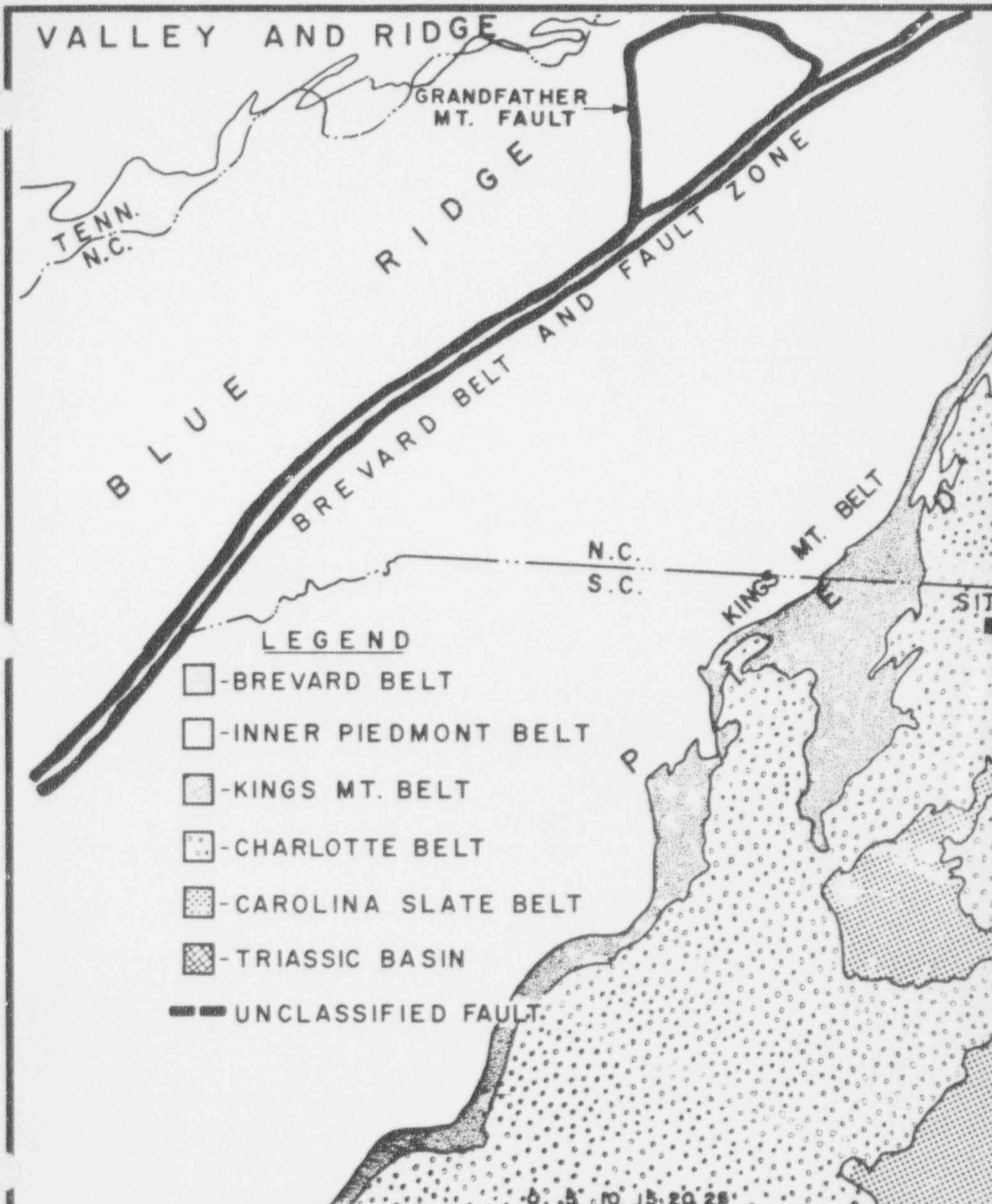

N
STANDBY NUCLEAR SERVICE WATER POND
CONSTRUCTION YARD
EXISTING 44 KV LINE
CONSTRUCTION SUBSTATION
ADMINISTRATION BUILDING
CONSTRUCTION ACCESS ROAD
WAREHOUSE AREA
SWITCHING STATION
ACCESS RAILROAD
BORROW AREA
RELOCATED 44 KV LINE
CONSTRUCTION YARD
PERMANENT ACCESS ROAD
TO S.C. HWY NO 49
S.C. HWY NO 274
TO NEWPORT & ROCK HILL
BIG ALLISON CREEK



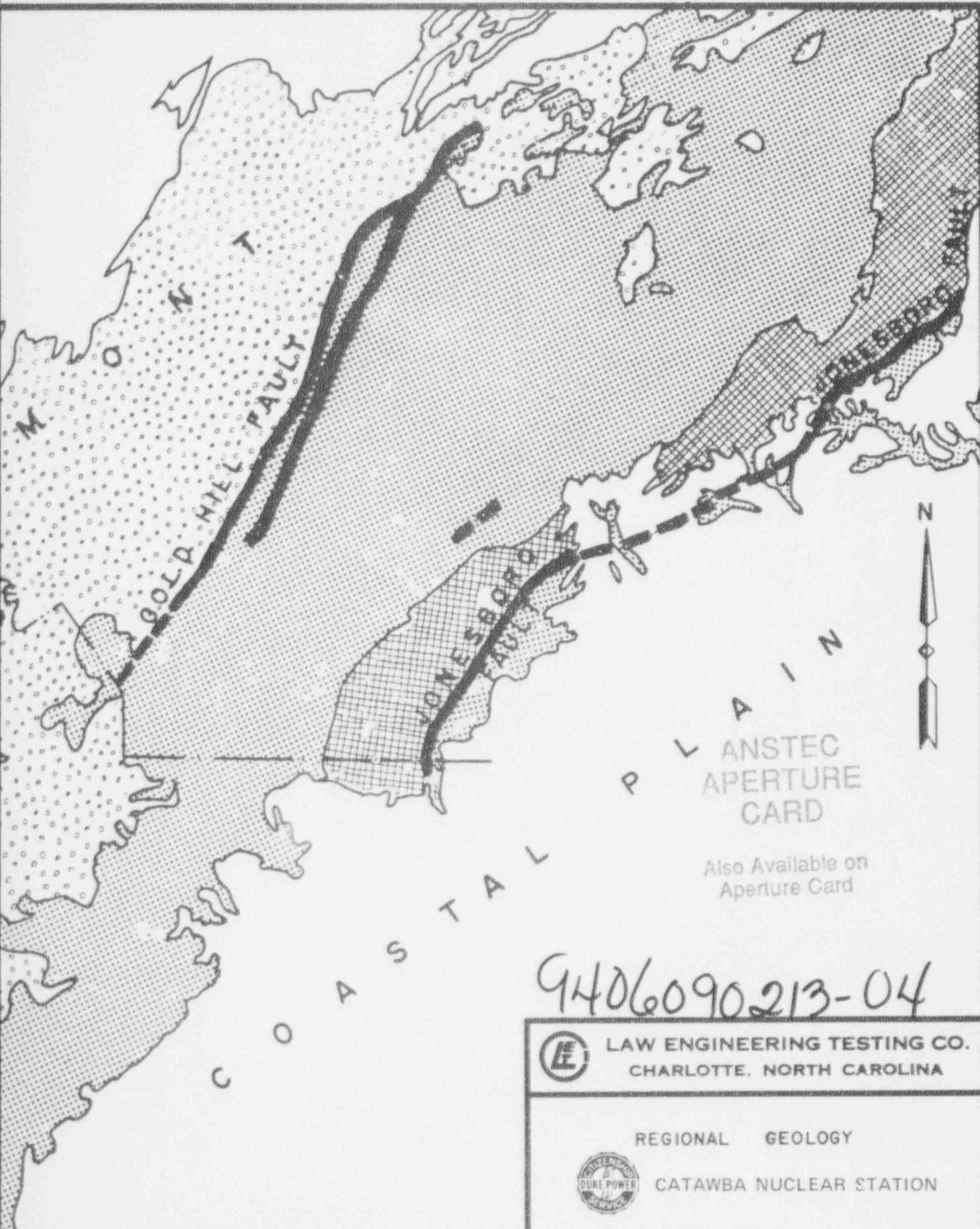
PLOT PLAN AND SITE BOUNDARY

CATAWBA NUCLEAR STATION

ER Figure 2.2-3



VALLEY AND RIDGE
GRANDFATHER MT. FAULT
TENN.
N.C.
BLUE RIDGE
BREVARD BELT AND FAULT ZONE
KINGS MT. BELT
N.C.
S.C.
PIEDMONT
SIT
LEGEND
-BREVARD BELT
-INNER PIEDMONT BELT
-KINGS MT. BELT
-CHARLOTTE BELT
-CAROLINA SLATE BELT
-TRIASSIC BASIN
UNCLASSIFIED FAULT
0 5 10 15 20 25
SCALE IN MILES



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LAW ENGINEERING TESTING CO.
CHARLOTTE, NORTH CAROLINA

REGIONAL GEOLOGY

CATAWBA NUCLEAR STATION

FIGURE 2.4-1

OVERSIZE DOCUMENT PAGE PULLED

SEE APERTURE CARDS

NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARDS 1

9406090213-05

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RECORDS AND REPORTS MANAGEMENT BRANCH

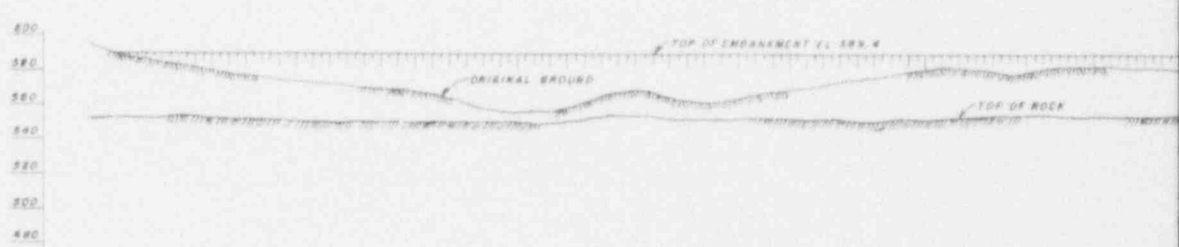

LAKE WYLIE
DIKE
STANDBY NUCLEAR SERVICE WATER POND
PUMP HOUSE & INTAKE

PERSPECTIVE DRAWING

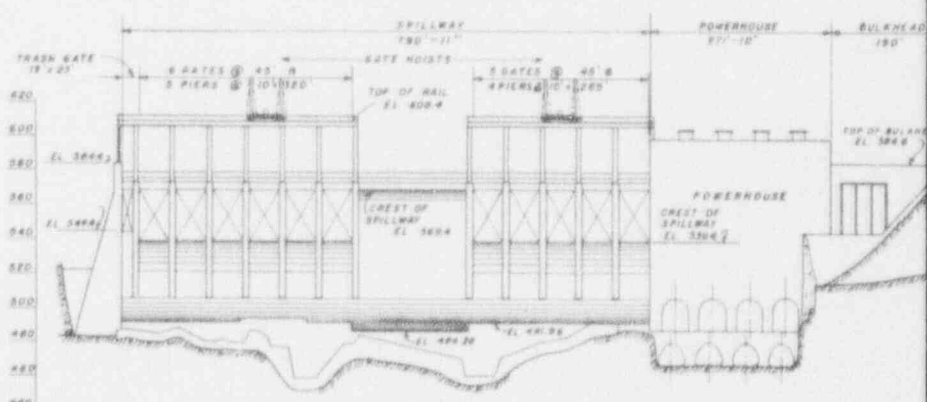
CATAWBA NUCLEAR STATION
Figure 2.2-4

Amendment 1 (New)

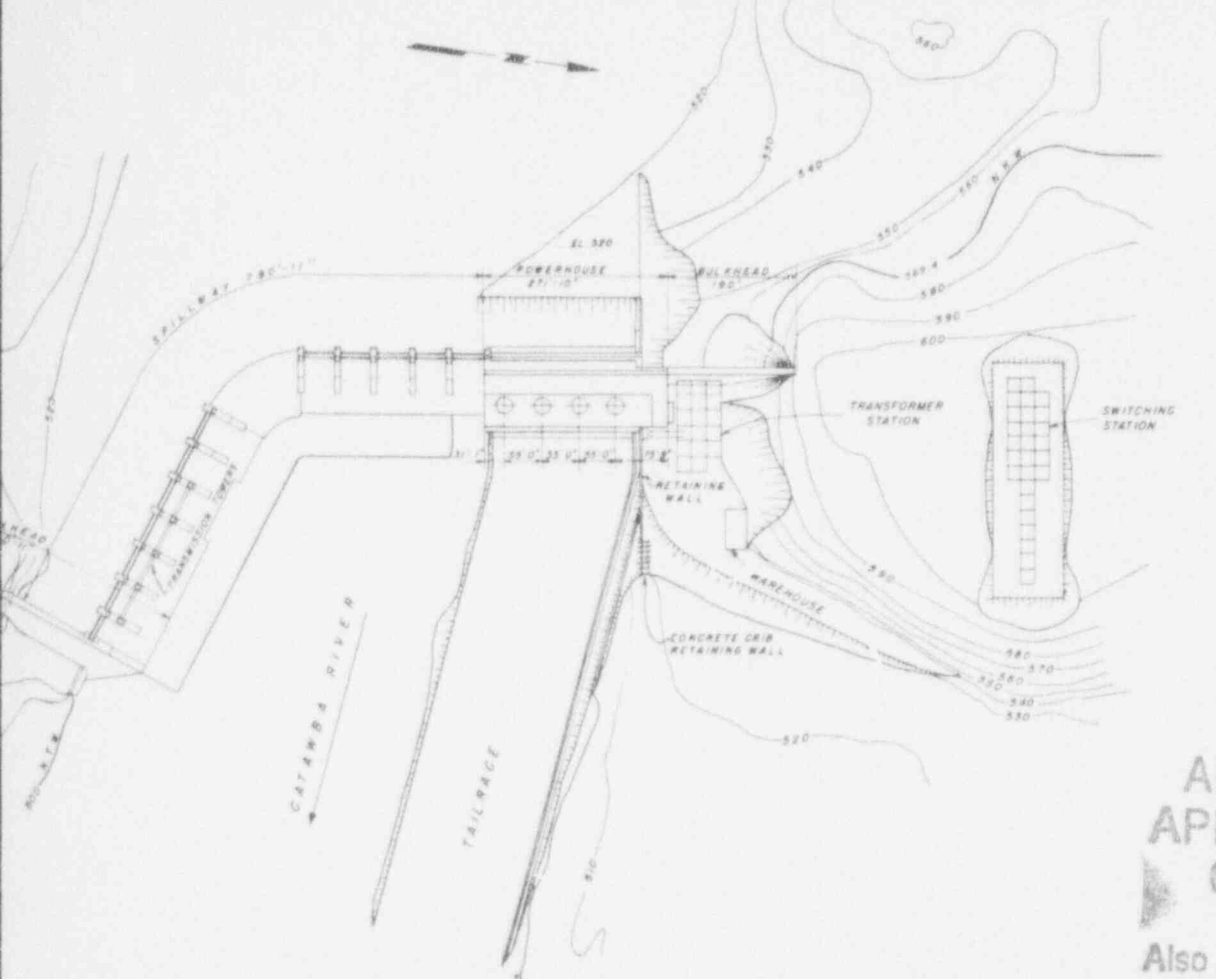
PLAN

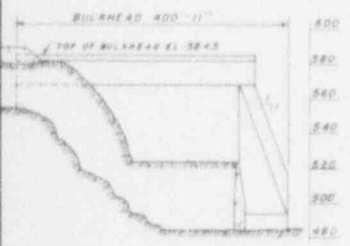


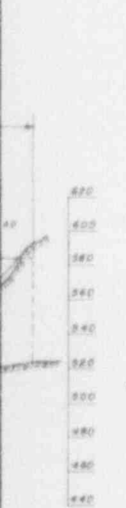
ELEV OF EMBANKMENT AND SOUTH BULKHEAD
(LOOKING UPSTREAM)

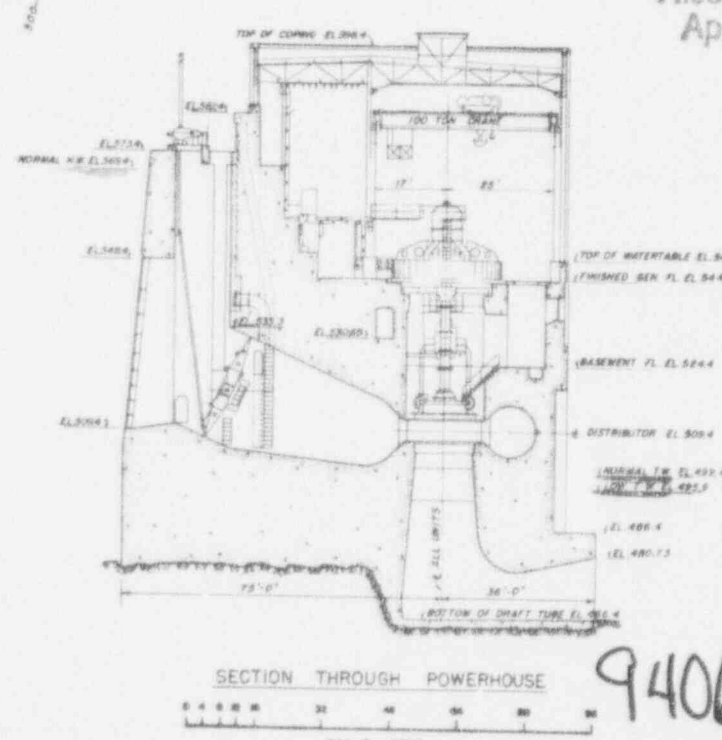


ELEVATION OF SPILLWAY AND POWERHOUSE
(LOOKING UPSTREAM)









NOTE -
Elevations shown are local USGS datum.

SECTION THROUGH POWERHOUSE

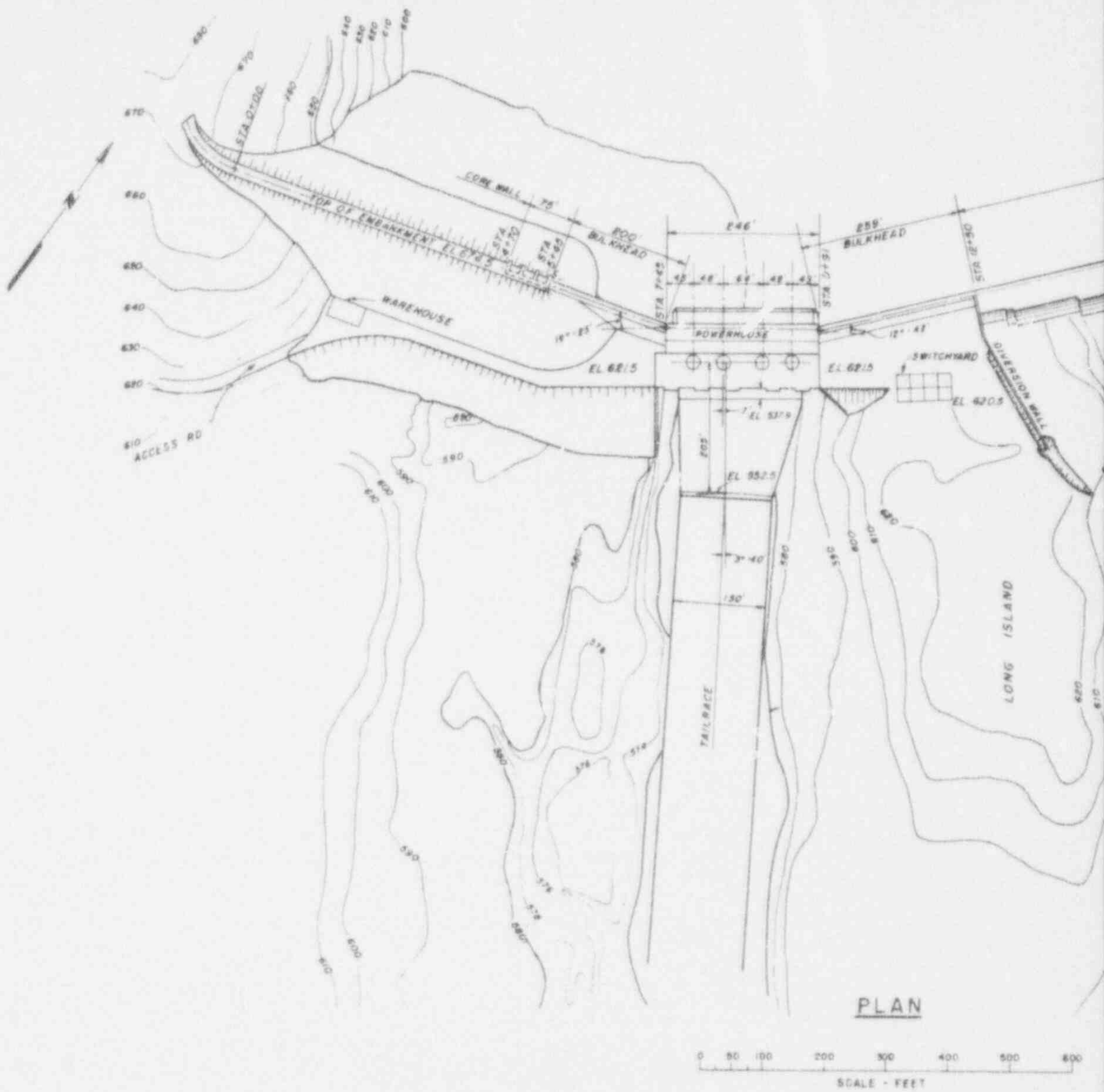
SCALE - FEET

WYLIE DAM & POWERHOUSE

CATAWBA NUCLEAR STATION

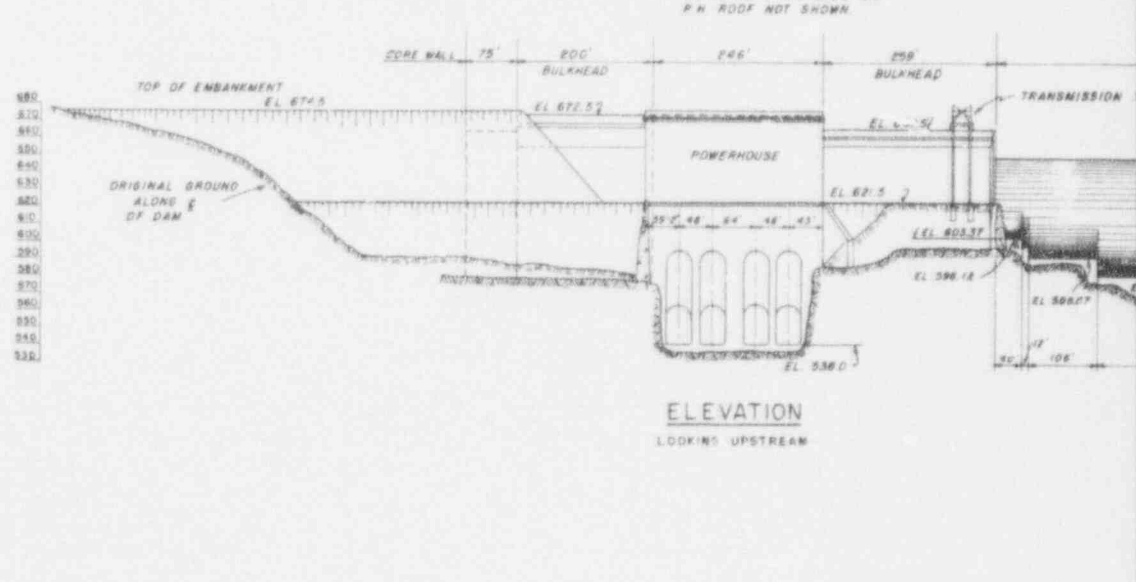
ER Figure 2.4-3

Amendment 1



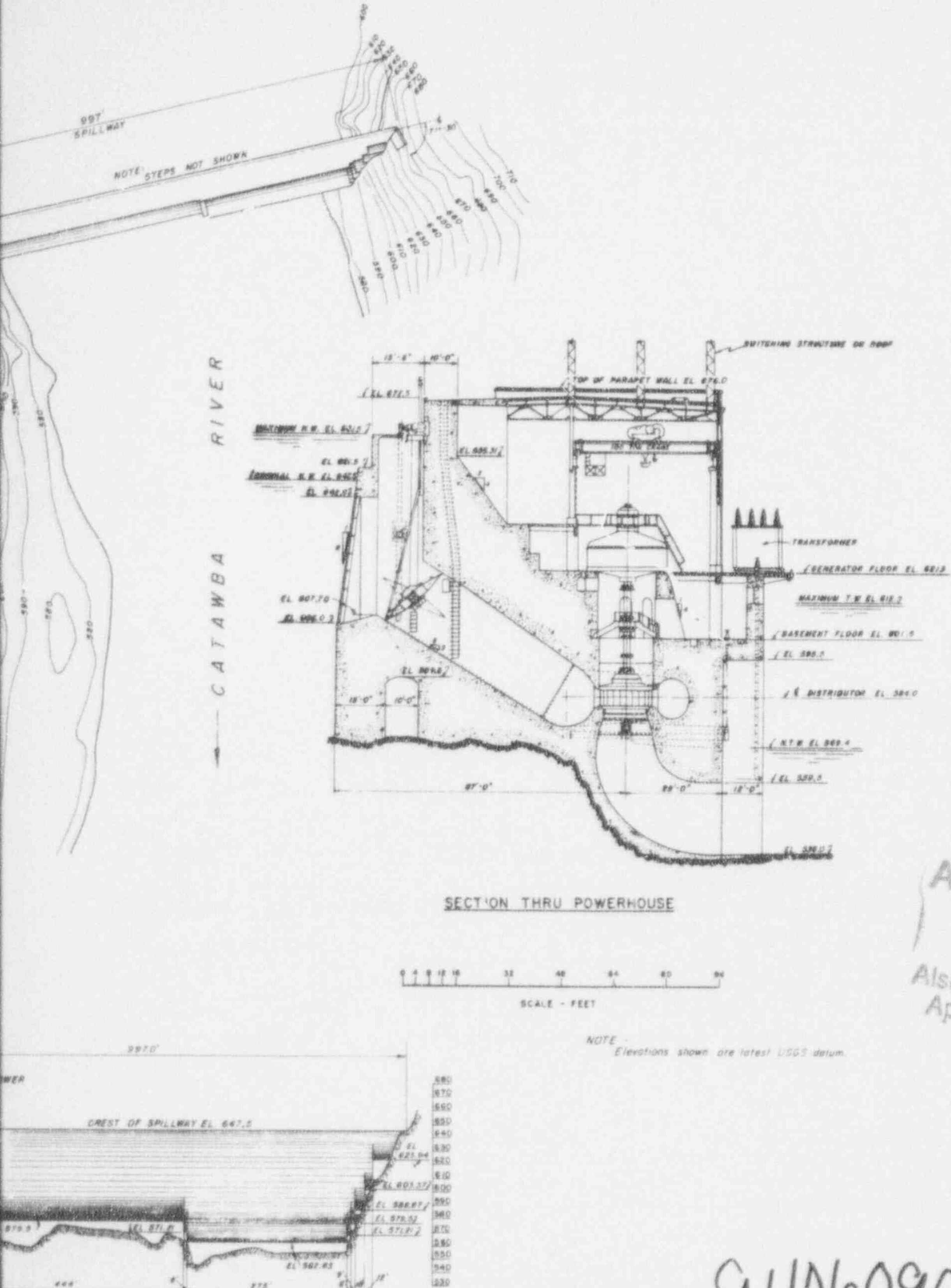
PLAN

NOTE:
SWITCHING STRUCTURES ON
P.H. ROOF NOT SHOWN.



ELEVATION

LOOKING UPSTREAM



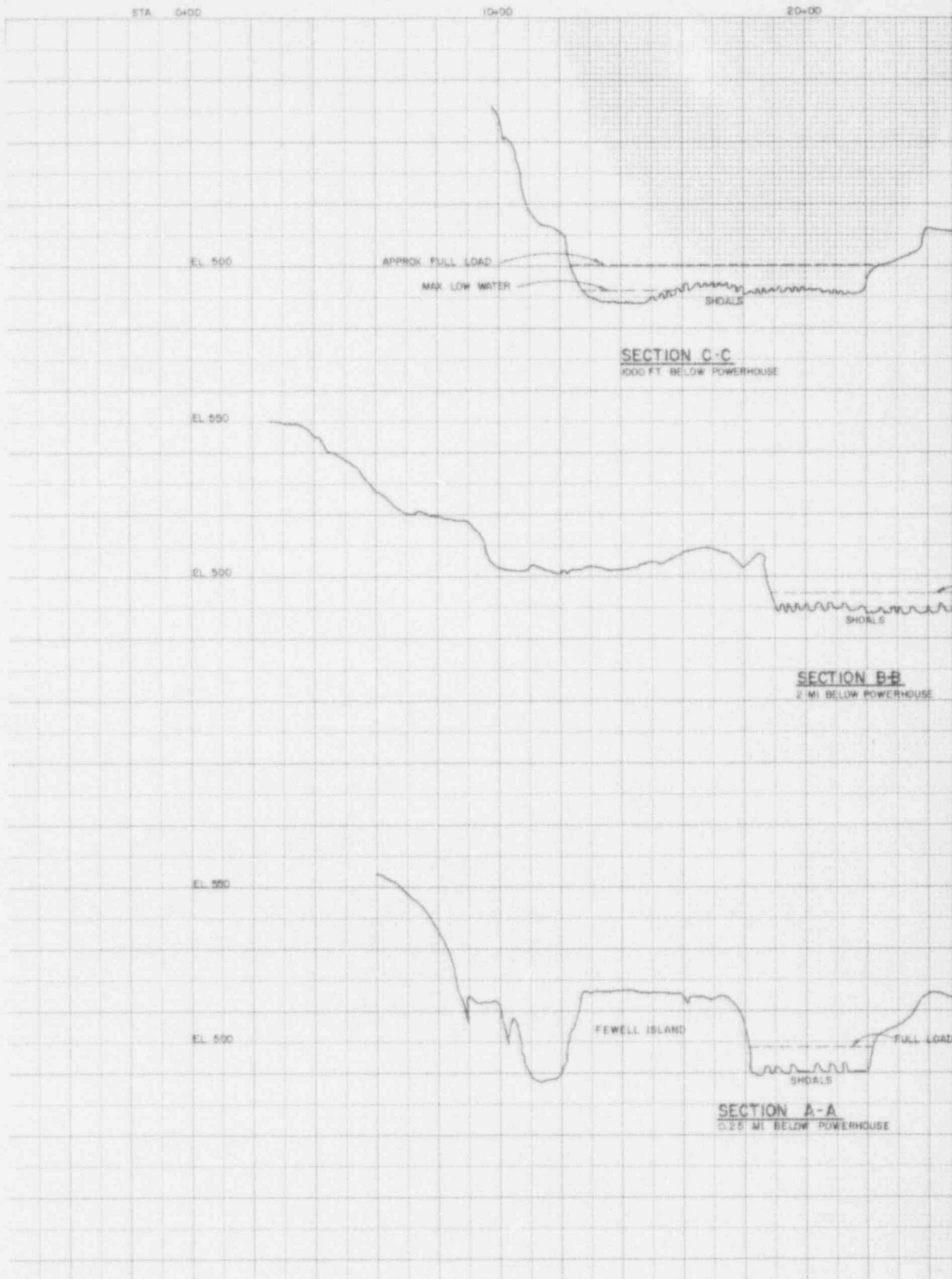
9406090213-08

MT. ISLAND DAM & POWERHOUSE

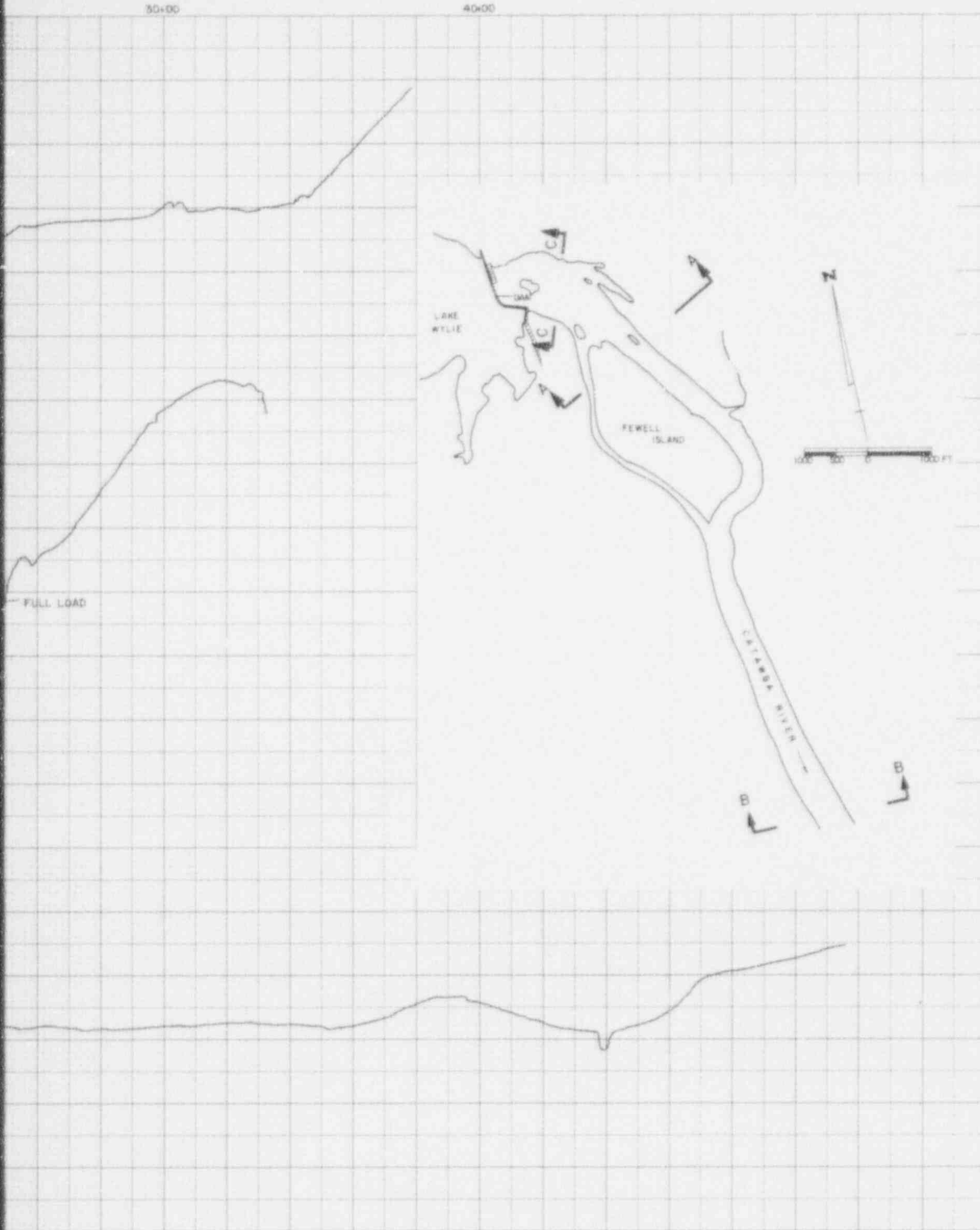
CATAWBA NUCLEAR STATION

ER Figure 2.4-4

Amendment 1
(New)



STA 0+00
10+00
20+00
EL 500
APPROX FULL LOAD
MAX LOW WATER
SHOALS
SECTION C-C
1000 FT. BELOW POWERHOUSE
EL 550
EL 500
SHOALS
SECTION B-B
2 MI. BELOW POWERHOUSE
EL 550
EL 500
FEWELL ISLAND
FULL LOAD
SHOALS
SECTION A-A
0.25 MI. BELOW POWERHOUSE



CROSS SECTIONS BELOW WYLIE STATION

9406090213-09

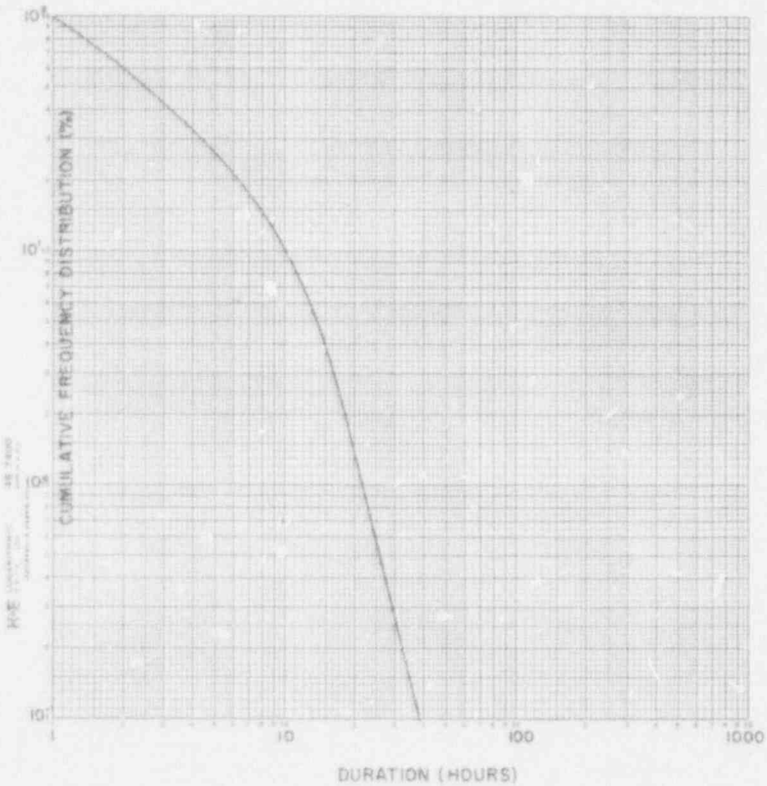
CROSS SECTIONS BELOW WYLIE STATION

DUKE POWER

CATAWBA NUCLEAR STATION

ER Figure 2.4-5

Amendment 1
(New)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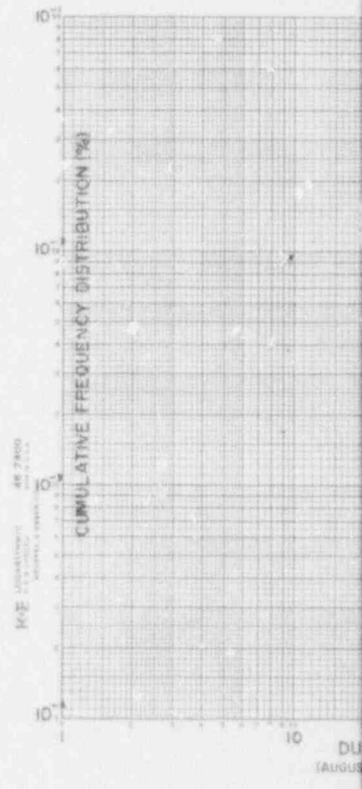
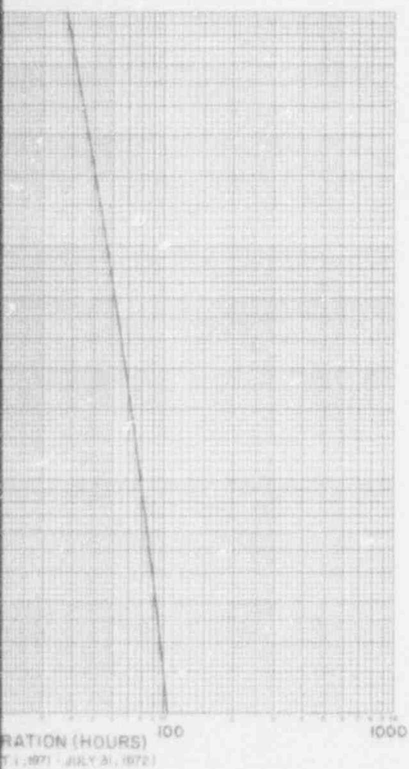
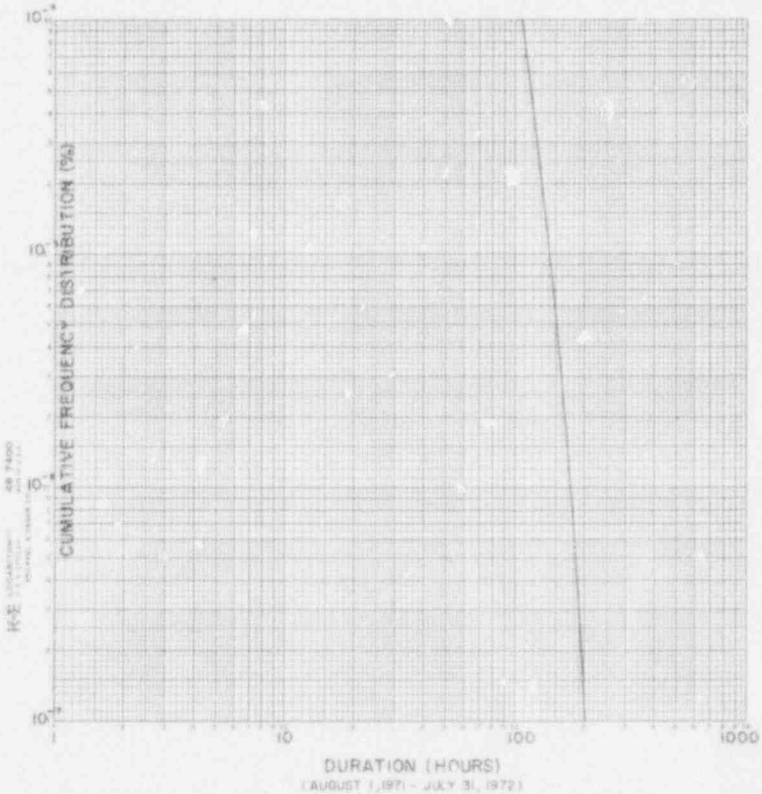
1
10
100
1000
DURATION (HOURS)
(AUGUST 1, 1971 - JULY 31, 1972)


CUMULATIVE FREQUENCY DISTRIBUTION (%)
1
10





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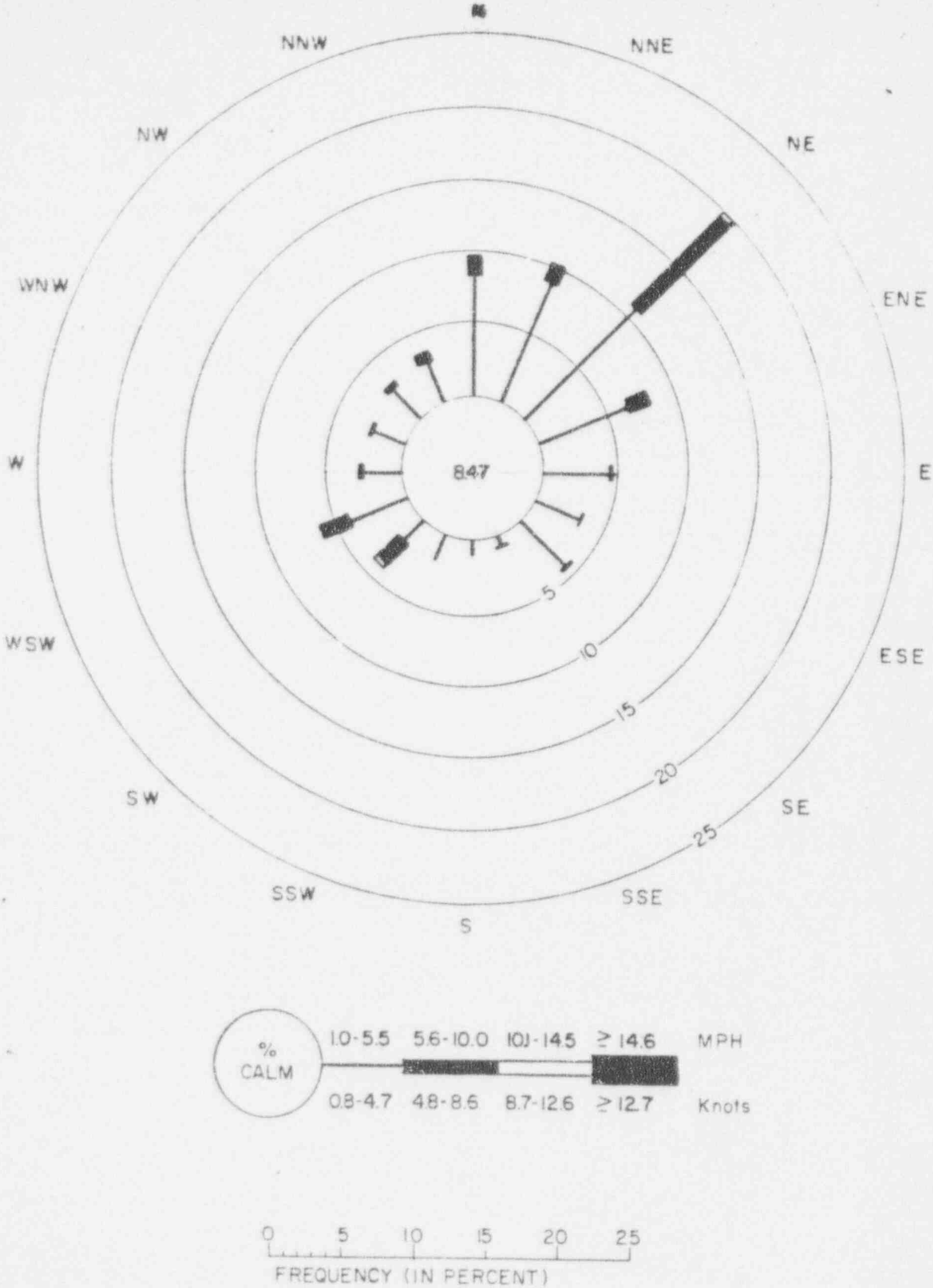
9406090213-10

PERSISTANCE PROBABILITIES OF WIND SPEEDS
<3MPH AT CATAWBA NUCLEAR STATION

CATAWBA NUCLEAR STATION
ER Figure 2.4-6

Amendment 1
(New)

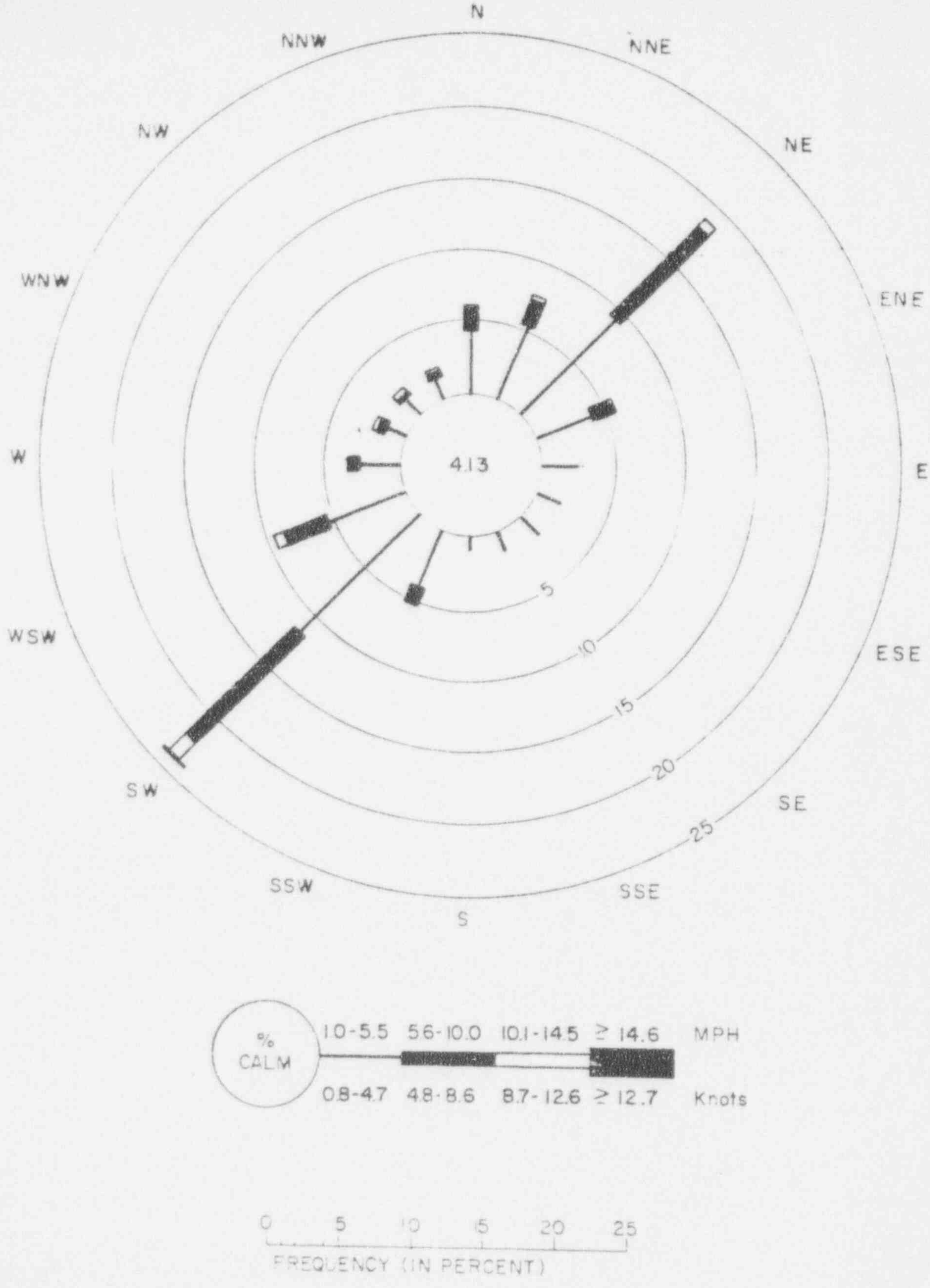


SEASONAL SURFACE WIND ROSE
SEPT. 1, 1971 - NOV. 30, 1971

CATAWBA NUCLEAR STATION

ER Figure 2.4-7 (1 of 4)

Amendment 1
(New)

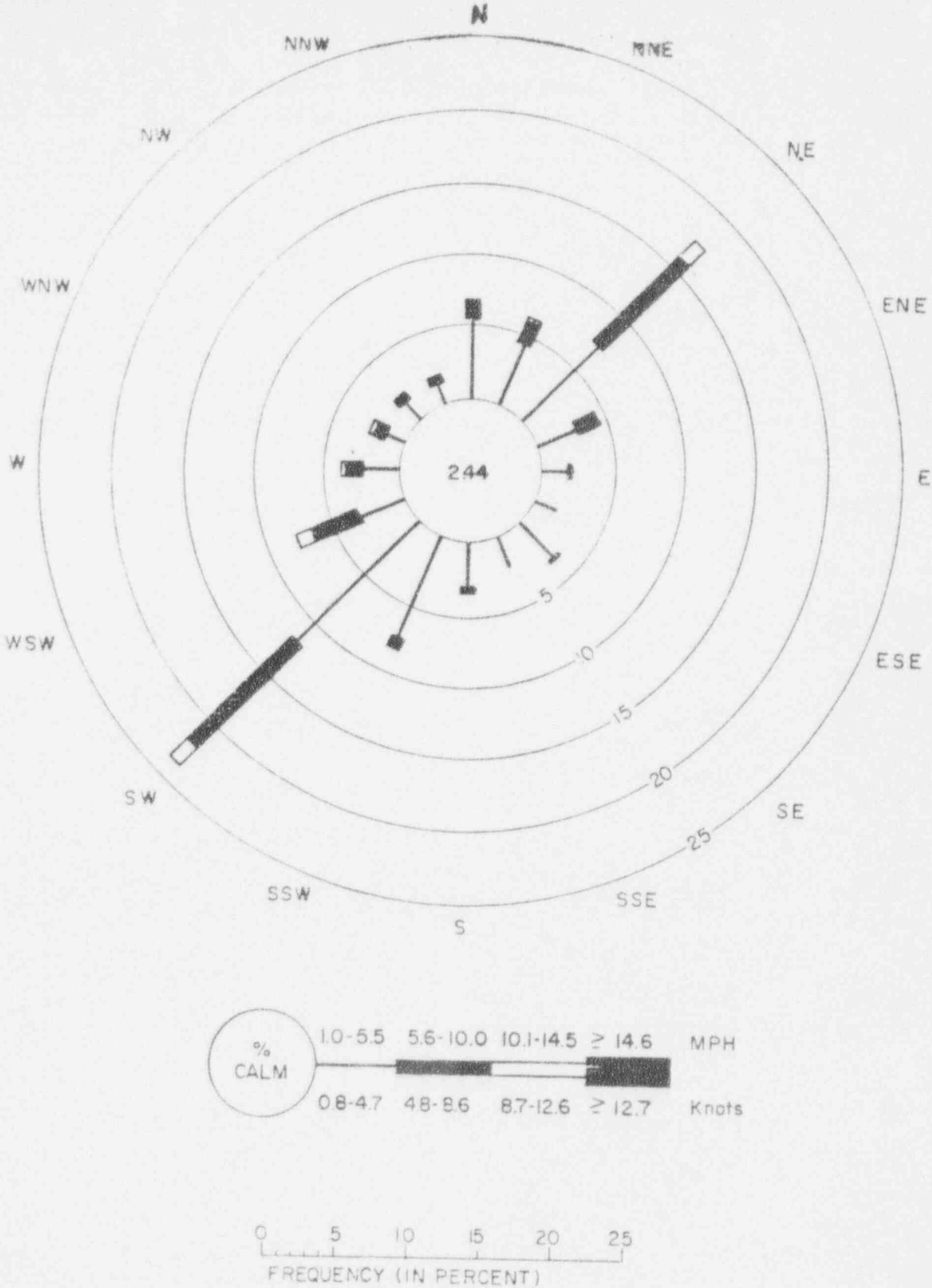


SEASONAL SURFACE WIND ROSE
DEC. 1, 1971 - FEB. 29, 1972

CATAWBA NUCLEAR STATION

ER Figure 2.4-7 (2 of 4)

Amendment 1
(New)

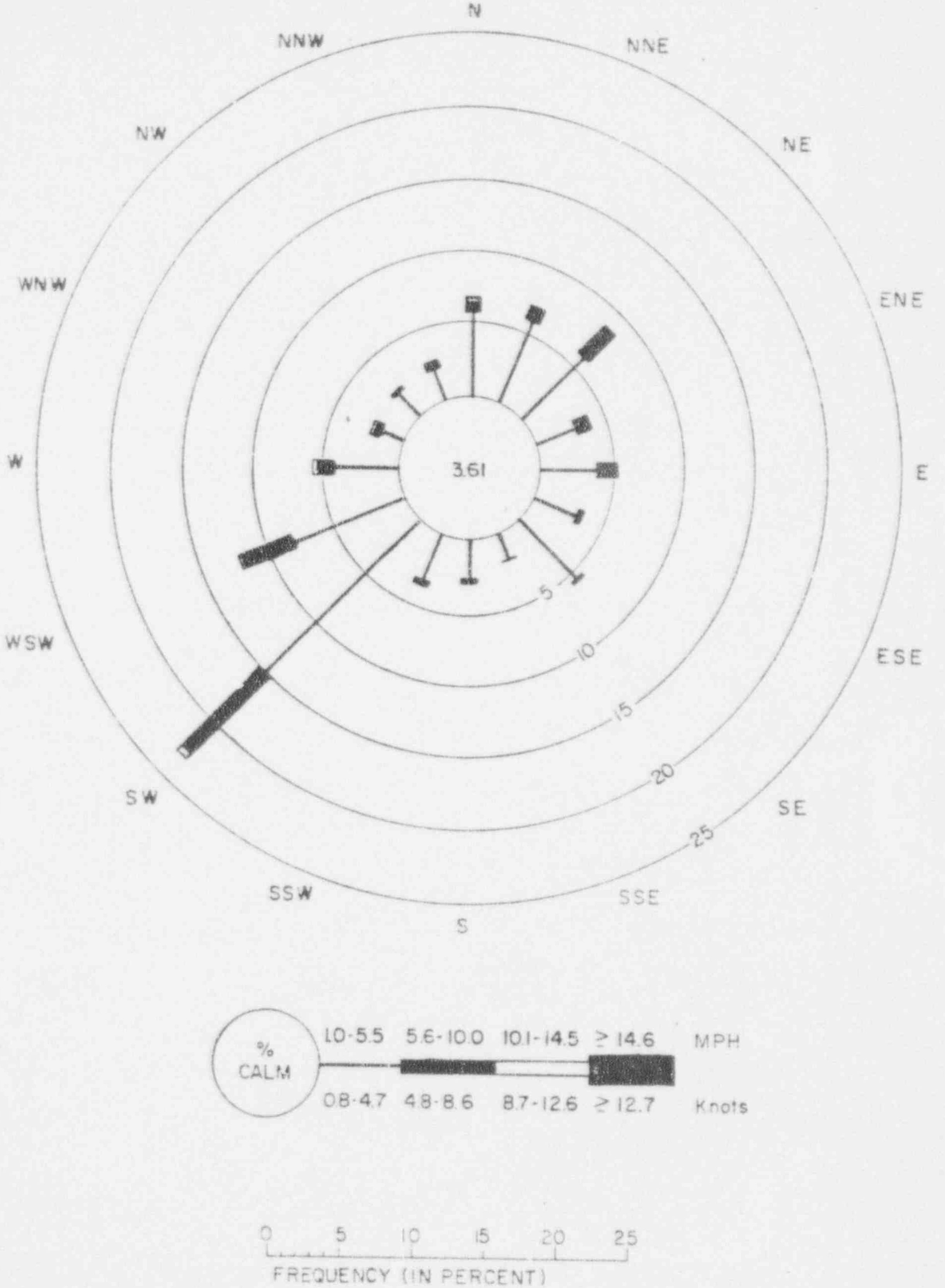


SEASONAL SURFACE WIND ROSE
MAR. 1, 1972 - MAY 31, 1972

CATAWBA NUCLEAR STATION

ER Figure 2.4-7 (3 of 4)

Amendment 1
(New)



SEASONAL SURFACE WIND ROSE
JUNE 1, 1972 - AUG. 31, 1972

CATAWBA NUCLEAR STATION

ER Figure 2.4-7 (4 of 4)

Amendment 1
(New)

CATAWBA NUCLEAR STATION

ER Figure 2.4-8

Amendment 2
(New)

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3 LAKE WYLIE GENERATING FACILITIES AND ENVIRONMENT

3.1 DESCRIPTION AND MULTIPLE USE FEATURES

Wylie Dam was one of the steps in a comprehensive plan to develop the hydro-electric power potential of the Catawba-Wateree river system in North and South Carolina. The plan was conceived by Duke's founders in the early 1900's and was implemented in stages between 1904 and 1967 with the construction of eleven reservoirs and thirteen hydroelectric generating plants having a total installed capacity of 804,940 kw.

Lake Wylie and its impounding structure, Wylie Dam, were originally completed by Duke Power Company in 1904. In 1924 and 1925, the dam was raised approximately 50 feet; the old powerplant was dismantled and the structures were incorporated into the new dam.

In 1935, the extent of the basin's development was recognized by Mr. A. E. Morgan, then Chairman of the Board of the Tennessee Valley Authority. Mr. Morgan wrote in the December, 1935, issue of Civil Engineering: "On the Catawba River in North and South Carolina, the Duke Power Company has worked out a completely unified development for power with results, I understand, that reflect great credit on the technical skill involved in that great undertaking."

Figure 2.4-2, Plan and Profile of the Catawba River shows the completed hydro development scheme which utilizes 86 percent of the available head in the included reach of the river.

Beginning in the 1920's and continuing through current engineering design for Catawba Nuclear Station, Duke has further developed the water resources of the Catawba Valley by using three of the hydro reservoirs for condenser cooling water at four large steam-electric generating plants. Catawba Station will be the fifth such plant on Catawba reservoirs and the second on Lake Wylie. Duke's 1155 MW Allen Steam Station has been operating on Lake Wylie since 1957.

Catawba Nuclear Station is geographically and electrically near the center of the Duke service area and of the Piedmont section of North and South Carolina. This area is recognized as one of the fastest growing market and population regions in the United States and yet it is considered one of the most desirable areas in which to live and work. Duke's continued contribution to an orderly and prudent development of the water resources of the Catawba Valley is deemed to be in the best interests of maintaining a high quality environment in the geographic region served by Duke Power Company.

3.1.1 ALLEN STEAM STATION

Plant Allen uses ten pumps in its intake structure (Figure 3.1-1) on the
1 Catawba River arm of Lake Wylie to circulate a maximum of 1334 cfs of water through the plant's condensers. The discharge structure (Figure 3.1-2) is located on the South Fork arm of the lake.

Units 1 and 2 condensers share a single intake pipe and four pumps. Discharge from Units 1 and 2 is also through a common pipe. Units 3 and 4 use four pumps and a similar piping arrangement. Unit 5 uses two pumps.

The flow through the condenser cooling water system and the residence times from the condenser inlet to the end of the discharge pipe vary with the combination of pumps being used. See Table 3.1-1.

Intake velocities at the trashracks and screens are listed in Table 3.1-3.

General operating information for Plant Allen's condenser cooling water system is as follows:

1 a. Average monthly inlet, Delta T, and outlet temperature for the period January 1968 to October 1972 are given in Table 3.1-2.

b. The lowest monthly Delta T used for the above period was 11.8 F in June 1972.

c. Condenser tubes are cleaned by periodically isolating half of the condenser, air drying the tubes, and forcing rubber plugs or metal tube cleaners through the condenser. A sponge rubber ball system is being installed on Allen's Unit 5. Water pressure is used to force the rubber plugs through the condenser tubes, and this water along with the removed film is transferred by sump pump to the condenser cooling water discharge. These systems eliminate the need for chlorine and biocide treatment.

3.2 COORDINATED PLANNING

In 1957, a second steam generating plant on Lake Wylie was included in the long range plan to meet the increased power demand in Duke's service area and its site was indicated at the present location in the license application to FPC for Catawba-Wateree Project (FPC Project 2232).

Lands required for this plant on the lakeside were purchased prior to 1920, when the area had a predominantly agricultural economy. Every endeavor was then made by Duke to help relocate the entire operations of farmers, who did not find it economical to part with only a portion of their holdings, by buying the less valuable uplands also.

Where necessary, Duke will relocate and replace public highways and other public facilities, in consultation with the South Carolina State Highway Commission and other Federal, State and County agencies.

Careful coord nation will also be maintained with the appropriate State and County Departments in matters of public health, water supply, mosquito control and disposal of solid waste, sewage, wildlife resources, recreation and uses of land over which Duke has control.

3.3 RECREATION

Duke Power Company has encouraged recreation at Lake Wylie in several ways. Within five miles of Catawba Nuclear Station, Duke has provided, free to the public, seven access areas and one public fishing area (Figure 3.3-2). Through leasing agreements it has provided six waterfront areas for quasi-public recreational use, 992 waterfront lots for cottage sites, and three waterfront sites for commercial facilities. It has provided two sites for quasi-public recreational facilities by the sale of land. Figure 3.3-1 provides a chart showing facilities available at each recreation area on Lake Wylie.

The seven access areas are managed jointly by Duke, York County, and the South Carolina Wildlife Resources Commission under a cooperative agreement. All of these areas have boat launching ramps and parking areas; six have toilet facilities; six have paved roads; four have picnic facilities; and two have protected swimming areas. The total area within these sites is 35.1 acres. It is estimated that 580,254 visits were made to these seven sites in 1970.

The Public Fishing Area, containing 1.6 acres, offers an opportunity for free bank fishing. It has been left in its natural state except for signs posted around the area noting that it is open free to the public for fishing. Parking is provided at an adjacent access area.

Duke began about 1935 to offer waterfront lots by lease to individuals for recreational use, and continued to offer leases to the public until 1952, and to its own employees until 1961. No additional leases have been offered since then, but lessees have been permitted to transfer leases. Most of these lots are now occupied by cottages. The estimated use for these 992 lots in 1970 was 447,090 visits.

Regarding the areas leased for quasi-public use, Elks Park, in addition to serving the large membership of the Elks Club of Rock Hill, S. C. has an area set aside to furnish a camping experience to needy boys. Estimated use in 1970 was 27,610 visits.

Joslin Park was built by a large textile plant primarily for use of its employees, but the facilities are often made available to civic groups. Visits for the year 1970 are estimated at 93,000.

The Commodore Yacht Club and the Catawba Yacht Club provide boat storage exclusively for their membership. Guests of members are permitted other uses of the areas. The Catawba Yacht Club is primarily a sailing club, and the Commodore serves powered cabin cruisers.

Camp Steere is a Boy Scouts of America facility and in 1970 its scouting program accounted for 21,250 visits.

Camp Catawba is a Girl Scouts facility and in 1970 its program accounted for 8,062 visits by scouts.

The three areas leased for commercial use are operated as Joyner's, Pier 49, and The Hungry Fisherman.

Joyner's is primarily a restaurant but offers boat services on a small scale, that is, gas, oil, and some storage.

The Hungry Fisherman is a restaurant, and like Joyner's, offers food service to people on the lake as well as to the public at large.

Pier 49 specializes in boat services, including repairs, storage, fuel and supplies.

All of the above mentioned leases were originally initiated by Duke Power Company on its own lands. In 1969 title to lands embracing all these sites save 47 cottage site lots was passed to Crescent Land & Timber Corporation. Crescent has followed the same administrative practices used by Duke.

In 1937 Duke Power sold 119.23 acres on the waterfront to Mr. Curtis B. Johnson, a newspaper publisher, to enable him to establish the Observer Fresh Air Camp for underprivileged boys. Camp Thunderbird is now operated by the Y.M.C.A. on slightly less acreage for essentially the same purposes. The childrens' use of the camp in 1970 amounted to 21,250 visits.

In the same year, Duke sold 21.3 acres to the Red Fez Club, Inc. The Shriner's still maintain this area for their members and provide a Club House, boat storage, a launching ramp, and picnic facilities.

1

Recreational opportunities within five miles of the Catawba Nuclear Station will be enhanced by two developments that are planned for the future.

Mecklenburg County has announced that its Lake Wylie Park will be relocated to a 136 acre tract of land that is being provided to the county by Crescent Land & Timber Corporation, to replace the present 68.8 acre site. The county has engaged professional planners to plan the new park, so there will be an improvement not only in size but in design.

Duke plans to build a fishing deck nearby the Catawba Nuclear Station. When Road 1132 is relocated, it will span an area of Lake Wylie by bridge. The fishing deck will be built along one side of the bridge. Although it will be outside the plant site, it will be only a few hundred feet from the warm water discharge and within the warm water zone favored by many fishermen. York County has expressed a desire to participate in this recreation development through the construction of parking and picnicking facilities, and by providing caretaker services.

Duke does not plan to build a permanent public information station in the immediate vicinity of Catawba Nuclear Station.

Appendix 3A "Lake Norman - The Inland Sea" describes the type of boating, fishing and water sports usage typical of the Company's lakes, public access and recreational areas, fishing and boating regulations and water safety rules, parks, campgrounds and access areas.

3.4 WILDLIFE

3.4.1 FLORA

The Allison Creek area is situated in the Piedmont Plateau region of South Carolina. The area is characterized by a rolling topography with an elevation ranging from approximately 569.4 feet (full pond elevation of Lake Wylie) 640 feet above sea level. The climate is temperate with distinct summer and winter seasons. Precipitation averages 43.4 inches annually (based on weather data for Charlotte, N. C.)[1]

The Eastern Deciduous Forest is the principal forest formation of this region. Dominant tree species are of the oak-hickory association. *Quercus alba*, *Quercus rubra*, *Quercus velutina*, *Quercus stellata*, *Quercus marilandica*, *Carya cordiformis*, *Carya ovata* and *Carya tomentosa* are species which occur consistently in this oak-hickory climax forest. In the understory sourwood (*Oxydendrum arboreum*), dogwood (*Cornus florida*), black gum (*Nyssa sylvatica*), sweet gum (*Liquidambar styraciflua*) and wild cherry (*Prunus serotina*) are typical representatives. Characteristic shrubs consist of huckleberry (*Vaccinium vacillans*), greenbrier (*Smilax bona-nox*), blackberry (*Rubus cuneifolius*), Virginia creeper (*Parthenocissus quinquefolia*), poison ivy (*Rhus radicans*), strawberry bush (*Euonymous americana*), and muscadine (*Vitis rotundifolia*). Common herbs are ferns (*Pteridium aquilinum*, *Polystichum acrostichoides*, *Asplenium platyneuron*), Solomon's Seal (*Polygonatum biflorum*), five-fingers (*Potentilla canadensis*), bluets (*Houstonia caerulea*) Japanese honeysuckle (*Lonicera japonica*), coral honeysuckle (*Lonicera sempervirens*), and pussy-toes (*Antennaria solitaria*). The forest floor is also partly covered with raindeer moss (*Cladonia*) and moss (*Leucobryum*).

The Allison Creek environs have undergone environmental changes in the past two centuries. Because of abandoned farm land throughout this area, old field succession is particularly noticeable and subclimax pine stands are conspicuous. Short-leaf pine (*Pinus echinata*) and loblolly pine (*Pinus taeda*), usually in pure stands, precede the climax in secondary succession on uplands. Successional trees in the lowlands include sweet gum (*Liquidambar styraciflua*), tulip poplar (*Liriodendron tulipifera*), sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), red maple (*Acer rubrum*), American elm (*Ulmus americana*), winged elm (*Ulmus alata*), and American ash (*Fraxinus americana*).

Crescent Land and Timber, Corp., a subsidiary of Duke Power Company has the primary responsibility for management of the Lake Wylie watershed lands. Under their strict forest and wildlife management practices much of these lands have been reforested and now support larger and more diverse wildlife populations than prior to such management.

An on-site survey of the flora was conducted by Duke personnel, April 23,
1 1972. A list of flora is given in Table 3.4-1. The flora listed is typical of the vegetation in the Piedmont Carolinas, and as such, no rare or unusual species of flora are in danger of being disrupted due to the construction and subsequent operation of Catawba Nuclear Station.

1 Weather data recorded at Douglas Municipal Airport, 14 miles from proposed site.

The present status of the timber stands at the Catawba site are as follows:

	Species	Estimated Acreage	Stand Age	Stand Density (Stems Per Acre)
	Loblolly Pine	25	36	130
1	Loblolly Pine	9	24	150
	Loblolly Pine	80	17	180
	Loblolly Pine	30	13	800
	Loblolly Pine	8	10	800
	Shortleaf Pine - Hardwoods	-	20-50	-

3.4.2 FAUNA

Man has strongly influenced the vegetation of the Allison Creek area and as a result the fauna has also undergone environmental changes. The current practices of converting marginal farm land to forests and tree-farms will add to the diversity of habitats within this geographic area. It is because of these environmental changes that animals in this particular locale have the ability to tolerate and to adapt to a variety of habitat and environmental conditions and therefore, may be encountered in habitats other than those which are typical[1].

According to Mr. Walt Schrader[2], a District Biologist (District #3, Rock Hill, South Carolina) with the South Carolina Wildlife Resources Department, where suitable habitat is available in the lower Lake Wylie area there is abundant game, especially in western York County, South Carolina. He stated that the following wildlife are of huntable numbers in York County:[3]

Mammals:

Squirrel - Good population - moderate hunting pressure (168 days, limit 12).
Rabbit - Good to excellent population - moderate hunting pressure (no closed season, no limit.)
Raccoon - Over abundant population, low hunting pressure.
Opossum - Over abundant population, very low hunting pressure.
Deer - Good population, moderate to heavy hunting pressure (138 days, no limit).
Fox - Abundant population, little if any hunting pressure.

Gamebirds:

Turkey - Good to excellent population (especially in western York County), moderate hunting pressure (97 days, limit 5).
Quail - Good population, moderate hunting pressure (99 days, limit 15).
Dove - Excellent population, low to moderate hunting pressure.

Waterfowl: (Lake Wylie, Catawba River, Fishing Creek)

Mallard - Small to good populations, moderate hunting pressure.
Black Duck - Small populations, moderate hunting pressure.
Wood Duck - Good populations, moderate hunting pressure.
Canada Goose - low population (farm ponds mainly), moderate hunting pressure.

A more complete list of mammals and birds has been prepared for the Allison Creek environs. The list was obtained from a search of the literature on wildlife populations in South Carolina and North Carolina. (Table 3.4-2 and Table 3.4-3)

[1] Golley, F. B. South Carolina Mammals. 1966. The Charleston Museum. Charleston, South Carolina

[2] Telephone conversation between Mr. Walt Schrader and Mr. J. J. Sevic, April 4, 1972.

[3] Information concerning length of hunting season and limit were obtained from: South Carolina Wildlife, Jan.-Feb. 1972, Vol. 19, No. 1. South Carolina Wildlife Resources Department, Columbia, South Carolina.

3.5 WATER SUPPLY

The towns of Mount Holly and Belmont, North Carolina, take their raw water supplies from Lake Wylie. Rock Hill, South Carolina, takes its raw water supply from the Catawba River approximately three miles downstream from Wylie Dam. The large storage of Lake Wylie assures these towns and cities of adequate quantities of high quality raw water.

Duke has never made any charge for raw water withdrawn from its reservoirs for municipal use. A total of 21 cities and towns in North and South Carolina, having a total population of almost one-half million obtain their water supplies from Duke reservoirs.

Table 3.5-1 describes water supply intakes from Mountain Island through the Wateree sub-basin. Figure 3.5-1 shows locations of the intakes used for domestic water supply in this reach of Catawba River.

3.6 FLOOD CONTROL

There are six hydroelectric reservoirs upstream of Lake Wylie (Lake James, Rhodhiss, Hickory, Lookout, Norman and Mountain Island) which were built and placed in operation from 1915 to 1963. Allowances for flood capacity, freeboard and wave runup for these reservoirs were provided in accordance with sound and accepted engineering principles in use during these periods. These hydro developments were reviewed by the Federal Power Commission and Corps of Engineers as a prerequisite of the issuance of FPC License No. 2232 in 1958 covering these developments plus four other developments downstream (Figure 2.4-2).

Two notable floods have occurred within recent times in the Catawba River Basin. The July 1916 flood resulted in record flood flows upstream of Catawba, North Carolina, which is about 73 miles upstream of Wylie Dam. The August 1940[1] flood resulted in record flood flows downstream of Catawba, North Carolina. A detailed report on floods in the Catawba River is presented in Apprendix 2F, PSAR.

Pertinent elevations and flood levels near the Catawba Plant site are tabulated below:

Lake Wylie, full pond level - - - - - - - - - - - - - - - Elevation 569.4 msl

2 Lake Wylie maximum level due to AEC flood and seismic criteria, including wind wave - - - - - - - - - - - - - Elevation 595.2

Yard elevation of Catawba Nuclear Station - - - - - - - Elevation 593.5

The yard elevation is higher than the static maximum flood water elevation 591.8 msl, for a 25 year flood with a coincident failure of Cowans Ford Dam. However, suitable dike protection to the yard and plant structure will be provided against possible coincident wind wave effects.

[1] Geological Water Supply Paper 1066, "Floods of August 1940, in the Southeastern U. S."

3.7 FORESTRY AND SOIL CONSERVATION

The Duke Forestry Department has planted to trees 2,825 acres of open and cut over land at Cowans Ford and 8,400 acres around Lake Wylie.

The company land surrounding Duke reservoirs that is not devoted to recreation or other purposes is under a continuous forest management program. Any open or idle land has been, or will shortly be, planted to trees. The woodlands are operated under a sustained yield concept where the mature timber stands are harvested and the harvested areas prepared and replanted to trees suitable to the site. These forest management practices are having a favorable effect on the environment in several ways. The soil is being stablized and built up to a more productive state. The established forest cover eliminates erosion, keeping the streams and lakes clean. These young forests supply more oxygen to the atmosphere than the mature and over-mature trees that are being replaced. If a stand of trees is left to grow too long, they become decadent and stagnant, consuming more oxygen than they release.

In Duke's timber harvesting program the protection of the soil from erosion is of primary importance. Care is taken in locating the logging road system so as to keep the streams free of silt. Following the logging operations precautions are taken to correct any possible sources of erosion. Water turn outs are built into the logging roads and skid trails. These roads then are seeded to perennial grasses and/or lespedeza.

3.8 PUBLIC HEALTH AND SANITATION

Individual water supplies around Lake Wylie are predominantly deep wells. These wells are consistently good sources of adequate, potable water. Any water supply may have a bacteriological analysis run free of charge by contacting the local health department.

Individual waste disposal systems are predominantly septic tanks and tile fields or nitrification lines. These facilities must be inspected following construction and permitted by the local health department. Consequently, the waste disposal systems around Lake Wylie are doing a very good job.

Duke Power Company carries out an extensive larviciding program on Lake Wylie during the mosquito breeding season. This program has been carried out each year since the early twenties and has been most successful. This operation is accomplished through the use of power boats equipped with power sprayers operating on a 8-9 day cycle. No insecticides are used in larviciding operations. No. 2 diesel fuel with a spreader added will be used in the 1972 operations. This program is carried out with full knowledge of and following the recommendations of the Medical Entomologists associated with the South Carolina and North Carolina State Boards of Health.

Larval and adult surveys for mosquitoes are conducted on and around Lake Wylie. This provides a more accurate picture of what species are breeding in the lake and in what numbers. If a sudden influx of mosquitoes is found or a complaint is received an immediate investigation is begun to alleviate the problem.

Duke Power Company is in the early stages of raising Gambusia affinis, the mosquito fish, for restocking the shallow protected areas of the lakes as an added measure to assure more complete control in potential mosquito breeding areas. These little fish reproduce rapidly and a sufficient quantity is on hand to maintain a planned restocking program.

No ill effects to water fowl, fish, birds, small game or any other form of wildlife from the mosquito control program has ever been observed or reported to Duke Power Company.

1 Solid waste disposal is the sanitary problem causing the most concern in the greater Lake Wylie area. Through the coordinated effort of the local health departments of York County, South Carolina, Gaston and Mecklenburg Counties, North Carolina and the Environmental Health Department of Duke Power Company, the sanitary conditions around Lake Wylie are generally excellent.

1 York County, South Carolina opened an approved sanitary landfill and started a county wide pick-up service for solid waste in July 1972. The service utilizes compactor trucks with four cubic yard containers placed at convenient locations throughout the county. During the summer months when school is out and recreation is at a peak around Lake Wylie, the containers used in the fall and winter at county schools will be placed around the lake. York County also has a Solid Waste Control Officer who supervises four men in policing trash deposited in any unapproved manner.

Gaston County, North Carolina has recently started placing containers for solid waste in the county. The pick-up by the compactor trucks will be contracted through a garbage container service. All of the solid waste from the collections will be deposited in an approved county landfill.

1 Mecklenburg County, North Carolina has recently opened two approved landfills in the county. There are at least two private solid waste collectors picking up in every area of the county. Garbage pick-up is available to any household in Mecklenburg County.

The public health and mosquito control programs of Duke Power Company are under the consulting supervision of Dr. Harold W. Brown, Columbia University, New York, New York and Dr. F. M. Boldridge, Charlotte, North Carolina.

At the present time no public health problems of any significance are anticipated around Lake Wylie.

3.9 PHYSICAL AND CHEMICAL CHARACTERISTICS OF CATAWBA WATERS

Tables 3.9-1 through 3.9-4 show historical temperature and dissolved oxygen data for given stations upstream, downstream and in Lake Wylie. Table 3.9-5 gives nitrate and phosphate values as measured in the Allen intake. Tables 3.9-6 and 3.9-7 give water quality data for Mountain Island tailrace and Wylie tailrace.

Table 3.9-8 shows synoptic DO and BOD measurements taken at four stations
downstream of Wylie Dam from 1959 through 1972. Table 3.9-9 shows the
magnitude and frequency-of-occurrence of these DO and BOD readings. As
can be seen from Table 3.9-8, the DO of the water being discharged from
Wylie Dam ranges from 1.5 to 12.1 mg/l. The proposed weir described in Sub-
section 4.1.4 will have the effect of increasing the DO content of the water
2 discharged from Wylie Hydro during the summer. Also, Table 3.9-8 shows that
in the summer, the water discharged at Wylie Dam has reaerated 1-3 mg/l by
the time it reaches U S Highway 21 near Rock Hill about 5 miles below Wylie
Dam. Table 3.9-9 indicates that on the basis of BOD, the Catawba River
below Wylie Dam is relatively unpolluted. The number of BOD measurements
above 3 mg/l is infrequent, with the greatest number coming at the S C
Highway 5 station about 18 miles below the Dam. This Table shows that the
BOD at Wylie Dam is rarely greater than 2 mg/l with a gradual increase in
BOD to the S C 5 station and a gradual decrease to S C 9. From the stand-
point of DO, Table 3.9-9 indicates that the Catawba River below Wylie
is again relatively unpolluted, with few occurrences of DO less than 5 mg/l.

ER Table 3.1-1

Plant Allen Condenser Cooling Water Flow and Residence Times

	Units 1 and 2[1]					Units 3 and 4[1]					Unit 5	
	One Pump	Two Pumps (1 Each Unit)	Two Pumps (1 Unit)	Three Pumps	Four Pumps	One Pump	Two Pumps (1 Each Unit)	Two Pumps (1 Unit)	Three Pumps	Four Pumps	One Pump	Two Pumps
Flow in CFS	124	248	205	329	410	185	370	308	493	616	185	308
Residence time in seconds (condenser inlet to end of discharge pipe)	356	235	215	155	122	344	237	206	162	126	226	135

[1]These units share common intake and discharge pipes.

Amendment 1 (New)

ER Table 3.1-2

Plant Allen
Condenser Delta T Compilation

Month	Average Inlet Temperature °F	Plant Delta T °F	Average Outlet Temperature °F
January 1968	43.5	23.0	66.5
February	44.2	25.8	70.0
March	52.2	20.8	73.0
April	64.1	16.2	80.3
May	71.1	15.1	86.2
June	78.5	15.4	93.9
July	82.4	16.2	98.6
August	84.5	17.1	101.6
September	78.6	16.3	94.9
October	71.0	14.7	85.7
November	57.5	17.9	75.4
December	48.6	19.3	67.9
January 1969	44.7	22.5	67.2
February	46.2	23.1	69.3
March	49.2	20.3	69.5
April	61.6	17.3	78.9
May	70.4	15.7	86.1
June	77.9	13.7	91.6
July	84.6	14.8	99.4
August	82.4	16.0	98.4
September	78.1	13.7	91.8
October	70.1	14.2	84.3
November	57.7	22.0	79.7
December	47.9	19.3	67.2
January 1970	43.2	23.5	66.7
February	46.2	23.1	69.3
March	52.9	20.7	73.6
April	62.5	15.8	78.3
May	71.6	16.2	87.8
June	79.2	14.5	93.7
July	82.4	14.5	96.9
August	86.4	14.9	101.3
September	80.4	16.8	97.2
October	72.1	15.5	87.6
November	59.3	15.8	75.1
December	51.9	17.6	69.5

ER Table 3.1-2 - Continued

Plant Allen
Condenser Delta T Compilation

Month	Average Inlet Temperature °F	Plant Delta T °F	Average Outlet Temperature °F
January 1971	46.0	23.6	69.6
February	44.2	16.8	61.0
March	50.7	19.2	69.9
April	59.3	16.0	75.3
May	67.6	15.8	83.4
June	74.5	16.7	91.2
July	81.6	15.1	96.7
August	82.7	15.9	98.6
September	80.3	14.4	94.7
October	71.5	14.1	85.6
November	61.0	17.3	78.3
December	52.1	16.9	69.0
January 1972	50.4	18.3	68.7
February	46.6	23.7	70.3
March	53.2	20.5	73.7
April	61.6	17.4	79.0
May	69.9	14.7	84.6
June	75.4	11.8	87.2
July	81.2	14.0	95.2
August	82.8	15.8	98.6
September	79.4	15.2	94.6
October	69.0	15.4	84.4

ER Table 3.1-3 Amendment 1 (New)

A Tabulation of Intake Design Characteristics at Three Operating Steam Stations Within the Duke System

Allen Plant - Lake Wylie

	Units 1,2		Units 3,4		Unit 5	
Pumps Operating	1	2	1	2	1	2
Full Pond El	570	570	570	570	570	570
Flow (cfs)	248	410	370	616	185	308
Rack Vel (f/sec)	0.12	0.20	0.18	0.30	0.18	0.30
Screen Vel	0.15	0.25	0.22	0.36	0.22	0.36
Normal Drawdown	560	560	560	560	560	560
Rack Vel	0.20	0.33	0.30	0.50	0.30	0.50
Screen Vel	0.24	0.42	0.35	0.59	0.35	0.59
Maximum Drawdown	555	555	555	555	555	555
Rack Vel	0.31	0.51	0.46	0.74	0.46	0.77
Screen Vel	0.35	0.64	0.53	0.88	0.53	0.88
Screen Mesh Size	------ -3/8", #12----------					
Rack Dimensions	---------3/8"x4" @ 3"OC------					

Marshall Steam Station Lake Norman

	Units 1,2		Units 3,4	
Pumps Operating	1	2	2	3
Full Pond El	760	760	760	760
Flow (cfs)	562	804	1148	1486
Rack Vel (f/sec)	0.24	0.35	0.30	0.38
Screen Vel	0.24	0.35	0.30	0.38
Normal Drawdown	Previous Normal Drawdown 745 is the Maximum Drawdown -September, 1972			
Maximum Drawdown	745	745	745	745
Rack Vel	0.45	0.62	0.53	0.69
Screen Vel	0.45	0.62	0.53	0.69
Screen Mesh Size	----3/8", #12----------			
Rack Dimensions	----1/2" x 4" @3" OC---			

Riverbend Steam Station - Mountain Island Lake

	Unit 1		Unit 2		Units 1,2		Unit 3		Unit 4	
Pumps Operating	1	2	1	2	1	2	1	2	1	2
Full Pond El	648	648	648	648	648	648	648	648	648	648
Flow (cfs)	80	160	80	160	160	320	70	140	100	149
Rack Vel (f/sec)	0.52	0.52	0.52	0.52	1.05	1.05	0.46	0.46	0.66	0.49
Screen Vel	0.48	0.48	0.48	0.48	0.97	0.97	0.42	0.42	0.61	0.45

	Units 3,4		Unit 5		Unit 6		Unit 5,6		Unit 7	
Pumps Operating	1	2	1	2	1	2	1	2	1	2
Full Pond El	648	648	648	648	648	648	648	648	648	648
Flow (cfs)	170	289	100	149	111	171	211	320	111	171
Rack Vel (f/sec)	1.11	0.95	0.66	0.49	0.73	0.56	1.38	1.05	0.73	0.56
Screen Vel	1.03	0.87	0.61	0.45	0.67	0.52	1.28	0.97	0.67	0.52

-Lake level fluctuations do not affect intake velocities at Riverbend-

Screen Mesh Size: ----------------------3/8", #12--

Rack Dimensions: ----------------------5/16" x 3" OC--

ER Table 3.4-1

Flora - Allison Creek Environs

OPHIOGLOSSACEAE (Adder's-Tongue Family)
Botrychium virginianum (L.) Swartz, Rattlesnake Fern
PTERIDACEAE (Bracken Fern Family)
Pteridium aquilinum (L.) Kuhn, Bracken Fern
ASPIDIACEAE (Woodfern Family)
Polystichum acrostichoides (Michaux) Schott, Christmas Fern
ASPLENIACEAE (Spleenwort Family)
Asplenium platyneuron (L.) Oakes, Ebony Spleenwort
PINACEAE (Pine Family)
Pinus echinata Miller, Short-leaf Pine
Pinus taeda L., Loblolly Pine
Pinus Virginiana Miller, Scrub Pine
CUPRESSACEAE (Cypress Family)
Juniperus virginiana L., Red Cedar
POACEAE (Grass Family)
Sorghum halepense (L.) Persoon, Johnson Grass
COMMELINACEAE (Dayflower Family)
Commelina communis L. Dayflower
LILIACEAE (Lily Family)
Smilax bona-nox L., Greenbrier
Smilacina racemosa (L.) Desf., False Solomon's seal
Polygonatum biflorum (Walter) Ell., Solomon's Seal
Allium canadense L., Wild Onion
AMARYLLIDACEAE (Amaryllis Family)
Hypoxis hirsuta (L.) Colville, Yellow Star-grass
ORCHIDACEAE (Orchid Family)
Goodyera pubescens (Willd.) R. Brown, Downy Rattlesnake Plantain
SALICACEAE (Willow Family)
Salix nigra Marshall, Black Willow
Populus deltoides Marshall, Cottonwood
JUGLANDACEAE (Walnut Family)
Juglans nigra L., Black Walnut
Carya cordiformis (Wang.) K. Koch, Bitternut Hickory
Carya ovata (Miller) K. Koch, Shagbark Hickory
Carya tomentosa (Poiret) Nuttall, Mockernut
Carya glabra (Miller) Sweet, Pignut Hickory
BETULACEAE (Birch Family)
Alnus serrulata (Aiton) Pursh, Green Alder
Betula nigra L., River Birch
FAGACEAE (Beech Family)
Quercus alba L., White Oak
Quercus stellata Wang., Post Oak
Quercus rubra L., Red Oak
Quercus coccinea Muenchh., Scarlet Oak
Quercus marilandica Muenchh., Black Jack Oak
Quercus velutina Lam., Black Oak
Quercus nigra L., Water Oak
Quercus phellos L., Willow Oak

ER Table 3.4-1 (Continued)

ULMACEAE (Elm Family)
Ulmus americana L., American Elm
Ulmus alata Michx., Winged Elm
ARISTOLOCHIACEAE (Birthwort Family)
Asarum canadense L., Wild Ginger
PHYTOLACCAECAE (Pokeweed Family)
Phytolacca americana L., Pokeweed
BERBERIDACEAE (Barberry Family)
Podophyllum peltatum L., May-apple
MAGNOLIACEA (Magnolia Family)
Liriodendron tulipifera L., Tulip Tree
LAURACEAE (Laurel Family)
Sassafras albidum (Nuttall) Nees, Sassafras
HAMAMELIDACEAE (Witch-hazel Family)
Liquidambar styraciflua L., Sweet-gum
PLATANACEAE (Sycamore Family)
Platanus occidentalis L., Sycamore
ROSACEAE (Rose Family)
Fragaria virginiana Duchesne, Strawberry
Potentilla canadensis L., Five-fingers
Rubus cuneifolius Pursh, Blackberry
Crataegus crus-galli L., Hawthorn
Crataegus spathulata Michaux, Hawthorn
Amelanchier arborea (Michaux f.) Fernald, Serviceberry
Prunus americana Marshall, Wild Plum
Prunus serotina Ehrhart, Black Cherry
FABACEAE (Pea Family)
Cercis canadensis L., Redbud
Gleditsia triacanthos L., Honey Locust
Trifolium hybridum L., Alsike Clover
Desmodium nudiflorum (L.), D. C., Beggar's Lice
OXALIDACEAE (Wood Sorrel Family)
Oxalis violacea L., Violet Wood Sorrel
ANACARDIACEAE (Cashew Family)
Rhus radicans L., Poison Ivy
Rhus toxicodendron L., Poison Oak
Rhus glabra L., Smooth Sumac
AQUIFOLIACEAE (Holly Family)
Ilex opaca Aiton, Holly
Ilex decidua Walter var. longipes (Chapman) Ahles, Possum Haw
CELASTRACEAE (Staff-tree Family)
Euonymus americanus L., Strawberry Bush
ACERACEAE (Maple Family)
Acer rubrum L., Red Maple
VITACEAE (Vine Family)
Parthenocissus quinquefolia (L.) Planchon, Virginia Creeper
Vitis rotundifolia Michaux, Muscadine
Vitis labrusca L., Fox Grape
ELAEAGNACEAE (Oleaster Family)
Elaeagnus umbellata Thunberg, Silverberry

ER Table 3.4-1 (Continued)

APIACEAE (Parsley Family)
Chaerophyllum tainturieri Hooker, Wild Chervil
NYSSACEAE (Sour Gum Family)
Nyssa sylvatica Marshall, Black Gum
CORNACEAE (Dogwood Family)
Cornus florida L., Flowering Dogwood
ERICACEAE (Heath Family)
Chimaphila maculata (L.) Pursh, Pipsissewa
Oxydendrum arboreum (L.) DC., Sourwood
Vaccinium vacillans Torrey, Huckleberry
EBANACEAE (Ebony Family)
Diospyros virginiana L., Persimmon
OLEACEAE (Olive Family)
Fraxinus americana L. American Ash
APOCYNACEAE (Dogbane Family)
Vinca minor L., Periwinkle
POLEMONIACEA (Polemonium Family)
Pholx nivalis Lodd, Phlox
LAMIACEAE (Mint Family)
Lamium purpureum L., Henbit
SCROPHULARIACEAE (Figwort Family)
Verbascum thapsus L., Wooly Mullein
BIGNONIACEAE (Bignonia Family)
Campsis radicans (L.) Seemann, Trumpet Vine
RUBIACEAE (Madder Family)
Houstonia caerulea L., Bluets
Houstonia pusilla Schoepf, Bluets
Galium circaezans Michaux, Bedstraw
CAPRIFOLIACEAE (Honeysuckle Family)
Lonicera japonica Thunberg, Japanese Honeysuckle
Lonicera sempervirens L., Coral Honeysuckle
Viburnum prunifolium L., Black Haw
Sambucus canadensis L., Elderberry
ASTERACEAE (Aster Family)
Krigia dandelion (L.) Nuttall, Dwarf Dandelion
Taraxacum officinale Wiggers, Common Dandelion
Antennaria solitaria Rydberg, Pussy-toes
Gnaphalium obtusifolium L., Rabbit Tobacco

ER TABLE 3.4-2

Mammals of York County, South Carolina

Family, Species, Subspecies	Common Name	Rel. Abundance	Recorded	Habitat Preference
DIDELPHIIDAE - Opossums				
Didelphis marsupialis virginiana	Oppossum	numerous	yes	Low tangled woodlands near stream bottom
SORICIDAE - Shrews				
Sorex l. longirostris*	Southeastern Shrew	rare	no	Damp woods and swamps
Blarina brevicauda carolinensis	Short-tailed Shrew	uncommon to common	no	Damp woods, upland fields
Cryptotis p. parva	Least Shrew	uncommon	no	Weedy, old fields of a abandoned farms
TALPIDAE - Moles				
Scalopus aquaticus howelli	Eastern Mole	common	yes	Cultivated fields, gardens, pine woods and old fields
Condylura cristata parva*	Star-nosed Mole	rare	yes	Burrows in damp, muddy areas, aquatic feeder at times
VESPERTILIONIDAE - Bats				
Myotis l. lucifugus*	Little Brown Myotis	rare	no	Caves, tunnels, hollow trees
Lasionycteris noctivagans	Silver-haired Bat	uncommon	no	Forested areas along rivers and streams
Pipistrellus s. subflavus	Eastern Pipistrelle	uncommon	no	Caves, rock crevices, hollow trees
Eptesicus f. fuscus	Big Brown Bat	uncommon	no	Caves, abandoned houses and hollow trees
Lasiurus b. borealis*	Red Bat	uncommon	no	Trees and shrubs during June and July
Lasiurus c. cinereus*	Hoary Bat	uncommon	no	Wooded areas
Nycticeius h. humeralis	Evening Bat	uncommon	no	Trees, buildings and under bridges
Plecotus rafinesquii macrotis*	Big-eared Bat	rare	no	Trees, caves, buildings
LEPORIDAE - Rabbits				
Sylvilagus floridanus mallurus	Eastern Cottontail	abundant	yes	Upland habitats both wooded and open areas

Family, Species, Subspecies	Common Name	Rel. Abundance	Recorded	Habitat Preference
SCIURIDAE - Squirrels				
Sciurus c. carolinensis	Gray Squirrel	abundant	yes	Hardwood forests, urban areas
Sciurus n. niger*	Fox Squirrel	uncommon	no	Open woodlands, both hardwood and pine
Glaucomys volans saturatus	Southern Flying Squirrel	abundant	yes	Open hardwood forests
CRICETIDAE - Cricetids				
Oryzomys p. palustris	Rice Rat	uncommon	no	Semi-aquatic, marshy areas, grasses, sedges
Reithrodontomys h. humulis	Eastern Harvest Mouse	uncommon	no	Broomsedge fields, waste areas, roadside ditches and wet meadows
Peromyscus l. leucopus	White-footed Mouse	common	yes	Border of woody or brushy areas
Ochrotomys nuttalli aureolus	Golden Mouse	common	yes	Wooded and brushy areas, thickets of honeysuckle
Sigmodon hispidus komareki	Hispid Cotton Rat	common	yes	Overgrown grass-fields and thickets
Microtus p. pinetorum	Pine Vole	uncommon	yes	Semi-underground, old fields to hardwood forests
Ondatra z. zibethicus	Muskrat	common	yes	aquatic, encountered on lakes, ponds, streams and rivers
CANIDAE - Fox, Wolves, Dogs				
Vulpes vulpes fulva	Red Fox	uncommon	no	Uplands near heavily wooded bottom-lands
Urocyon c. cinereoargenteus	Gray Fox	common	no	Dense cover near water (slab piles, hollow logs rock cavities and dense brush)
PROCYONIDAE - Racoons				
Procyon lotor solutus	Raccoon	abundant	yes	Woodlands where den trees are plentiful, fresh-and-salt-water marshes
MUSTELIDAE - Mustelids				
Mustela frenata noveboracensis	Long-tailed Weasel	uncommon	yes	Burrows under woodland stumps, forest edges, sparse timbered areas
Mustela vison mink	Mink	uncommon to common	yes	Semi-aquatic, encountered along streams, lakes, rivers, etc.
Mephitis mephitis elongata	Striped Skunk	uncommon	no	Open farm land or wastelands
Lutra canadensis lataxina	River Otter	uncommon	no	Aquatic (frequents rivers, ponds, lakes, etc.)

Family, Species, Subspecies	Common Name	Rel. Abundance	Recorded	Habitat Preference
FELIDAE - Cats				
Lynx rufus floridanus	Bobcat	uncommon	no	Dense brush and bottom lands
CERVIDAE - Deer				
Odocoilues v. virginianus	White-tailed Deer	common	no	Open woods and brushy meadows to bottomland swamps

*Asterisks indicate subspecies which are probably or possibly found in th[illegible]unty.

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ER TABLE 3.4-3

Probable Birds of York County, South Carolina

Order, Species	Common Name	Comments
PODICIPEDIFORMES - Grebes		
Podilymbus podiceps	Pied-billed Grebe	Winter resident
CICONIIFORMES - Herons, Bitterns		
Ardea herodias	Great Blue Heron	Uncommon resident
Butorides virescens	Green Heron	Resident
Florida caerulea	Little Blue Heron	Frequent visitor
Casmerodius albus	Common Egret	Frequent visitor
Nyctanassa violacea	Yellow-crowned Night Heron	Summer resident
Ixobrychus exilis	Least Bittern	Summer resident
Botaurus lentiginosus	America Bittern	Uncommon winter visitor
ANSERIFORMES - Waterfowl		
Branta canadensis	Canada Goose	Winter resident
Anas platyrhyncnos	Mallard	Fairly common winter resident
Anas rubripes	Black Duck	Fairly common winter resident
Anas strepera	Gadwall	Uncommon winter visitor
Anas acuta	Pintail	Uncommon winter resident
Anas carolinensis	Green-winged Teal	Uncommon transient
Anas discors	Blue-winged Teal	Uncommon transient
Aix sponsa	Wood Duck	Uncommon resident
Aythya collaris	Ring-necked Duck	Winter resident
Aythya affinis	Lesser Scaup	Uncommon winter resident
Clangula hyemalis	Oldsquaw	Occasional winter visitor
Oxyura jamaicensis	Ruddy Duck	Occasional winter visitor
Lophodytes cucullatus	Hooded Merganser	Uncommon winter visitor
FALCONIFORMES - Vultures, Hawks		
Cathartes aura	Turkey Vulture	Fairly common resident
Coragyps atratus	Black Vulture	Fairly common resident
Accipter striatus	Sharp-shinned Hawk	Common resident
Accipter cooperii	Cooper's Hawk	Common resident
Buteo jamaicensis	Red-tailed Hawk	Resident
Buteo lineatus	Red-shouldered Hawk	Resident
Buteo platypterus	Broad-winged Hawk	Summer resident
Haliaeetus leucocephalus	Bald Eagle	Rare winter visitor
Circus cyaneus	Marsh Hawk	Winter resident
Falco sparverius	Sparrow Hawk	Resident

Order, Species	Common Name	Comments
GALLIFORMES - Quail, Grouse, Turkeys		
Colinus virginianus	Bobwhite	Common resident
GRUIFORMES - Cranes and Allies		
Rallus elegans	King Rail	Uncommon resident
Rallus limicola	Virginia Rail	Transient
Porzana carolina	Sora	Fairly common spring and fall transient
Gallinuia chloropus	Common Gallinule	Transient
Fulica americana	American Coot	Transient and occasional winter resident
CHARADRIIFORMES - Shore birds		
Charadrius vociferus	Killdeer	Common resident
Philohela minor	American Woodcock	Fairly common resident
Capella gallinago	Common Snipe	Transient and winter resident
Actitis macularia	Spotted Sandpiper	Transient
Tringa solitaria	Solitary Sandpiper	Common transient
Totanus flavipes	Lesser Yellowlegs	Transient
Erolia minutilla	Least Sandpiper	Transient
Larus argentatus	Herring Gull	Winter resident
Larus delawarensis	Ring-billed Gull	Winter resident
COLUMBIFORMES - Pigeons and Doves		
Columba livia	Rock Dove	Permanent resident
Zanaidura macroura	Mourning Dove	Common permanent resident
CUCULIFORMES - Cuckoos		
Coccyzus americanus	Yellow-billed Cuckoo	Summer resident
STRIGIFORMES - Owls		
Tyto alba	Barn Owl	Permanent resident, formerly commc
Otus asio	Screech Owl	Common permanent resident
Bubo virginianus	Great Horned Owl	Uncommon resident
Strix varia	Barred Owl	Fairly common permanent resident
CAPRIMULGIFORMES - Goatsuckers		
Caprimulgus carolinensis	Chuck-will's-widow	Common summer resident, April to October
Caprimulgus vociferus	Whip-poor-will	Common summer resident, April to October

Order, Species	Common Name	Comments
Chordeiles minor	Common Nighthawk	Common summer resident
APODIFORMES - Swifts and Hummingbirds		
Chaetura pelagica	Chimney Swift	Common summer resident, March to October
Archilochus colubris	Ruby-throated Hummingbird	Common summer resident, April to September
CORACIIFORMES - Kingfishers		
Megaceryle alcyon	Belted Kingfisher	Common permanent resident around rivers and ponds
PICIFORMES - Woodpeckers		
Colaptes auratus	Yellow-shafted Flicker	Common permanent resident
Dryocopus pileatus	Pileated Woodpecker	Rare resident
Centurus carolinus	Red-bellied Woodpecker	Common resident
Melanerpes erythrocephalus	Red-headed Woodpecker	Uncommon permanent resident
Sphyrapicus varius	Yellow-bellied Sapsucker	Winter resident
Dendrocopus villosus	Hairy Woodpecker	Permanent resident
Dendrocopus pubescens	Downy Woodpecker	Common permanent resident
PASSERIFORMES - Perching Birds		
Tyrannus tyrannus	Eastern Kingbird	Summer resident, April to September
Myiarchus crinitus	Great Crested Flycatcher	Summer resident, April to October
Sayornis phoebe	Eastern Phoebe	Permanent resident
Empidonax virescens	Acadian Flycatcher	Summer resident, April to September
Contopus virens	Eastern Wood Pewee	Summer resident, April to October
Eremophila alpestris	Horned Lark	Winter visitor and uncommon summer resident
Riparia riparia	Bank Swallow	Fall and spring transient
Stelgidopteryx ruficollis	Rough-winged Swallow	Summer resident
Hirundo rustica	Barn Swallow	Transient
Petrochelidon pyrrhonota	Cliff Swallow	Transient
Progne subis	Purple Martin	Summer resident
Cyanocitta cristata	Blue Jay	Common permanent resident
Corvus brachyrhynchos	Common Crow	Common permanent resident
Parus carolinensis	Carolina Chickadee	Common permanent resident
Parus bicolor	Tufted titmouse	Common permanent resident
Sitta carolinensis	White-breasted Nuthatch	Permanent resident
Sitta canadensis	Red-breasted Nuthatch	Irregular winter resident
Sitta pusilla	Brown-headed Nuthatch	Common permanent resident
Certhia familiaris	Brown Creeper	Regular winter visitor
Troglodytes aedon	House Wren	Regular summer resident

Order, Species	Common Name	Comments
Troglodytes troglodytes	Winter Wren	Uncommon winter resident
Thryothorus ludovicianus	Carolina Wren	Common permanent resident
Mimus polyglottos	Mockingbird	Permanent resident
Dumetella carolinensis	Catbird	Summer resident
Toxostoma rufum	Brown Thrasher	Permanent resident
Turdus migratorius	Robin	Permanent resident
Hylocichla mustelina	Wood Thrush	Summer resident
Hylocichla guttata	Hermit Thrush	Winter resident
Hylocichla ustulata	Swainson's Thrush	Spring and fall transient
Hylocichla fuscescens	Veery	Transient
Sialia sialis	Eastern Bluebird	Permanent resident
Pelioptila caerulea	Blue-gray Gnatcatcher	Regular summer resident
Regulus satrapa	Golden-crowned Kinglet	Fairly common winter resident
Regulus calendula	Ruby-crowned Kinglet	Common winter resident
Anthus spinoletta	Water Pipit	Winter resident
Bombycilla cedrorum	Cedar Waxwing	Common winter resident
Lanius ludovicianus	Loggerhead Shrike	Permanent resident
Sturnus vulgaris	Starling	Abundant resident
Vireo griseus	White-eyed Vireo	Summer resident
Vireo flavifrons	Yellow-throated Vireo	Summer resident
Vireo solitarius	Solitary Vireo	Transient
Vireo olivaceus	Red-eyed Vireo	Summer resident
Mniotilta varia	Black-and-White Warbler	Summer resident
Helmitheros vermivorus	Worm-eating Warbler	Uncommon transient
Vermivora peregrina	Tennessee Warbler	Uncommon transient
Parula americana	Parula Warbler	Transient and uncommon summer resident
Dendroica petechia	Yellow Warbler	Summer resident
Dendroica magnolia	Magnolia Warbler	Fairly common transient
Dendroica tigrina	Cape May Warbler	Common transient
Dendroica caerulescens	Black-throated Blue Warbler	Transient, April-May and Septembe October
Dendroica coronata	Myrtle Warbler	Winter resident
Dendroica virens	Black-throated Green Warbler	Transient
Dendroica dominica	Yellow-throated Warbler	Summer resident
Dendroica pennsylvanica	Chestnut-sided Warbler	Fairly common transient
Dendroica striata	Blackpoll Warbler	Common transient
Dendroica pinus	Pine Warbler	Common permanent resident
Seiurus aurocapillus	Ovenbird	Transient and summer resident
Seiurus noveboracensis	Northern Waterthrush	Transient
Seiurus motacilla	Louisiana Waterthrush	Transient and uncommon summer resident

Order, Species	Common Name	Comments
Oporornis formosus	Kentucky Warbler	Summer resident
Geothlypis trichas	Yellowthroat	Summer resident
Icteria virens	Yellow-breasted Chat	Summer resident
Wilsonia citrina	Hooded Warbler	Summer resident
Wilsonia canadensis	Canada Warbler	Transient
Passer domesticus	House Sparrow	Common resident
Dolichonyx oryzivorus	Bobolink	Transient
Sturnella magna	Eastern Meadowlark	Permanent resident
Agelaius phoeniceus	Red-winged Blackbird	Common resident
Icterus spurius	Orchard Oriole	Summer resident
Icterus galbula	Baltimore Oriole	Transient and fairly common winter resident
Quiscalus quiscula	Common Grackle	Common resident
Molothrus ater	Brown-headed Cowbird	Transient and summer resident
Piranga olivacea	Scarlet Tanager	Transient and summer resident
Richmondena cardinalis	Cardinal	Common resident
Pheucticus ludovicianus	Rose-breasted Grosbeak	Transient
Guiraca caerulea	Blue Grosbeak	Transient and summer resident
Passerina cyanea	Indigo Bunting	Summer resident
Hesperiphona vespertina	Evening Grosbeak	Irregular winter resident
Carpodacus purpureus	Purple Finch	Common winter resident
Spinus pinus	Pine Siskin	Winter resident
Spinus tristis	American Goldfinch	Permanent resident
Pipilo erythropthalmus	Rufous-sided Towhee	Permanent resident
Passerculus sandwichensis	Savannah Sparrow	Winter resident
Ammodramus savannarum	Grasshopper Sparrow	Summer resident
Passerherbulus henslowii	Henslow's Sparrow	Uncommon summer resident
Junco hyemalis	Slate-colored Junco	Common winter resident
Spizella pusilla	Field Sparrow	Permanent resident
Zonotrichia albicollis	White-throated Sparrow	Common winter resident
Passerella iliaca	Fox Sparrow	Winter resident
Melospiza georgiana	Swamp Sparrow	Winter resident
Melospiza melodia	Song Sparrow	Permanent resident

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1. Robbins, C.S., B. Bruun and H.S. Zim. Birds of North America (A Guide to Field Identification). Golden Press, New York. 1966.

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Water Supply I
From Mountain Isla

KEY NO.	NAME OF INTAKE	COUNTY AND STATE	STREAM, RIVER OR LAKE
1	Mount Holly	Gaston, N.C.	Lake Wylie
2	Southern Dyestuff Co.	Meck., N.C.	Lake Wylie
3	American & Efird Mills, Inc.	Gaston, N.C.	Lake Wylie
4	Superior Stone Co., Charlotte	Meck., N.C.	Tributary of Creek
5	Superior Yarn Mills, Inc.	Gaston, N.C.	Lake Wylie
6	Belmont	Gaston, N.C.	Lake Wylie
7	Lincolnton	Lincoln, N.C.	South Fork Ca
8	Stanley	Gaston, N.C.	Hoyle Creek
9	Gastonia (2 intakes)	Gaston, N.C.	South Fork Ca and Long Cr
10	Bessemer City	Gaston, N.C.	Long Greek
11	Beaunit Mills	Gaston, N.C.	South Fork Ca
12	Cramerton	Gaston, N.C.	South Fork Ca
13	Superior Stone Co.,Gastonia	Gaston, N.C.	Long Creek
14	Crown Converting Co.	Lincoln, N.C.	South Fork Ca
15	Carolina By-Products, Inc.	Gaston, N.C.	Crowders Cree
16	Westinghouse, Charlotte	Meck., N.C.	Lake Wylie
17	Charlotte	Meck., N.C.	Mountain Isla
18	Chester	Chester, S. C.	Catawba River
19	Camden	Kershaw, S.C.	Pinetree Cree
20	Hardwicks Chemical Co.	Kershaw, S.C.	Kelly Creek
21	Dupont	Kershaw, S.C.	Wateree
22	Kendall	Kershaw, S.C.	Kendall-Littl Creek
23	Whitehead Bros. Co.	Kershaw, S.C.	Gillies Creek
24	Grace Filter Plant, Springs Mill	Lancaster, S.C.	Catawba River
25	Lancaster	Lancaster, S.C.	Turkey Quarte
26	Lancaster Water & Sewer Dist.	Lancaster, S.C.	Bear Creek Re
27	Bowaters	York, S.C.	Catawba River
28	Rock Hill	York, S.C.	Catawba River
29	Rock Hill Printing & Finishing Co.	York, S.C.	Catawba River
30	J. P. Stevens	York, S.C.	Catawba River
31	Celanese	York, S.C.	Catawba River
32	Fort Mill Filter Plant - Springs Mill	York, S.C.	Catawba River
33	Manetta Mills	Chester, S.C.	Fishing Creek

ER Table 3.5-1

takes Along The Catawba River
d Through The Wateree Sub-Basin

	AVERAGE DAILY USE - MGD	WATER USE DETAILS
	1.35	Population of 6500 - domestic water for American & Efird Mills, Inc.
	1.50	Industrial use
	2.40	Industrial use
ong	Not Available	Gravel washing
	0.03	Industrial use
	3.00	Population of 8 000 - Several Industries
awba	2.42	Population of 14 200 - Several industries - sells to Highlands Water Company, serving Boger City
	0.76	Population of 3 300 - Several Industries
awba eek	15.00	Population of 42 000 - Many industries - sells to Dallas and Lowell, N. C. - Long Creek is a holding pond
	1.05	Population of 5 000
awba	Not Available	Industrial use and village
awba	4.18	Population (3 100 connecti
	Not Available	Gravel washing
awba	Not Available	Industrial use
k	Not Available	Condenser Water
	0.04	Industrial use
d	34.00	Population of 350 000
	2.65	Sells to J. P. Stevens #1, 2 and 3 - industrial and domestic use
k	1.57	Sells to Hermitage Cotton Mill - industrial and domestic use
	0.41	Industrial use
	1.65	Industrial use
Pinetree	0.14	Industrial use
Pond	2.50	Industrial use
	15.50	Sells to Lancaster, S.C. - industrial and domestic use
Reservoir	1.00	Domestic use
ervoir	0.50	Sells to Heath Springs, S. C. - domestic use
	39.50	Sells to U. S. Plywood - industrial use
	4.00	Industrial and domestic use
	12.00	Industrial use
	0.06	Industrial use
	56.00	Industrial use
	0.70	Industrial and domestic use
	0.31	Industrial use

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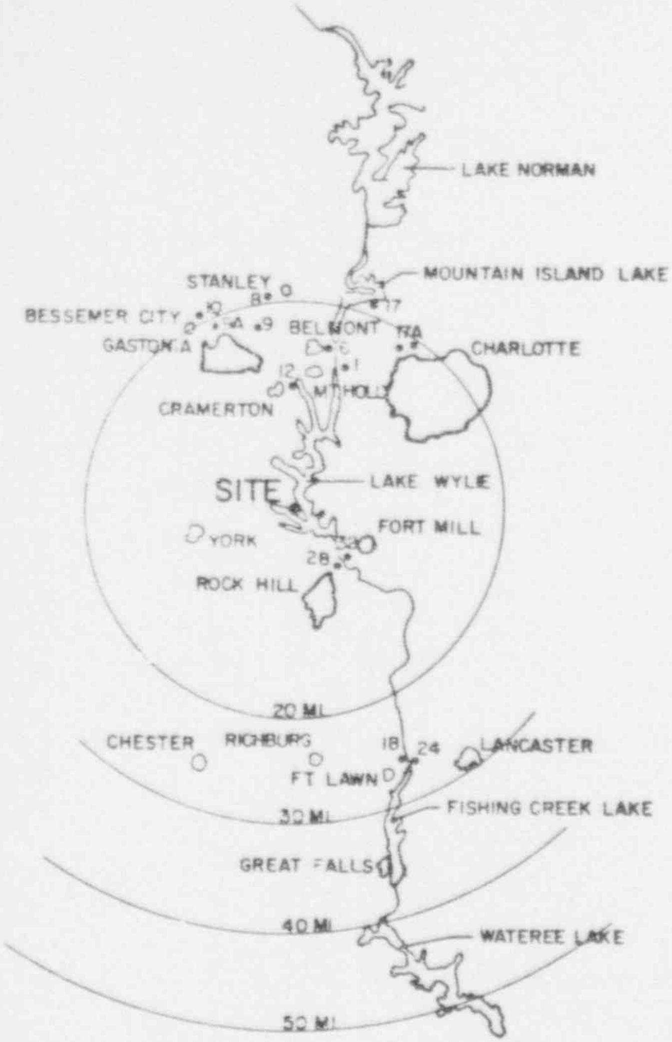


SOURCES OF DOMESTIC WATER

KEY NUMBER	OWNER
8	Town of Stanley
9	City of Gastonia
9a	City of Gastonia
17	City of Charlotte
17a	City of Charlotte
10	Town of Bessemer City
6	Town of Belmont
1	Town of Mount Holly
12	Town of Cramerton
28	City of Rock Hill
32	Springs Mill
18	Chester Metropolitan Water District
24	Springs Mill

Details On Table 2.4-2

SOURCES OF DOMESTIC WATER

CATAWBA NUCLEAR STATION

ER Figure 3.5-1

ER Table 3.9-1

Monthly Temperature and Dissolved Oxygen Data for Station 65.7 (Wylie Tailrace) for 1959-1972[1]

Month	Depth Ft	Average Temperature °F	Range °F	Average DO Mg/l	Range Mg/l
January	Mid-depth	47	53-44	9.8	11.0-7.9
February	Mid-depth	47	51-42	10.5	12.1-8.7
March	Mid-depth	51	57-48	10.7	11.9-9.9
April	Mid-depth	60	66-55	8.1	10.0-8.0
May	Mid-depth	68	72-66	7.4	8.9-5.0
June	Mid-depth	75	81-68	5.8	9.1-3.1
July	Mid-depth	80	87-75	3.9	6.2-1.6
August	Mid-depth	82	84-79	4.5	1.5-6.4
September	Mid-depth	82	85-80	5.3	7.2-3.2
October	Mid-depth	72	78-68	6.1	7.0-5.3
November	Mid-depth	62	70-55	7.7	8.6-6.3
December	Mid-depth	55	60-51	9.2	10.9-8.2

[1] Station noted in this table and subsequent tables ER 3.9-2 through 3.9-4 are in river miles above Wateree Dam - See ER Figure 2.4-2.

ER Table 3.9-2

Monthly Temperature and Dissolved Oxygen Data for Station 66.0 (Wylie Forebay) for 1959-1971

Month	Depth Ft	Average Temperature °F	Range °F	Average DO Mg/l	Range Mg/l
January	1	46	41-53	10.2	9.1-11.2
	10	46	41-53	10.1	9.1-11.2
	20	46	41-53	10.1	9.1-11.2
	30	45	41-53	10.1	9.1-11.2
	40	45	41-53	10.2	9.1-11.2
	50	46	41-53	10.0	9.1- 1.2
February	1	47	41-53	10.4	9.8-11.9
	10	46	41-51	10.2	9.1-11.9
	20	46	41-51	10.2	9.1-11.9
	30	46	41-51	10.2	9.1-11.9
	40	45	41-51	10.1	9.1-11.2
	50	45	41-51	10.1	9.1-11.2
March	1	49	46-53	10.4	9.8-11.2
	10	48	43-53	10.4	9.8-11.2
	20	48	41-53	10.5	9.1-11.9
	30	48	41-51	10.3	9.1-11.2
	40	48	41-51	10.2	9.1-11.2
	50	47	41-51	10.1	9.1-11.2
April	1	60	51-68	10.1	8.4-13.9
	10	58	51-63	9.6	7.0-12.6
	20	56	51-58	8.7	7.0-9.8
	30	55	51-58	8.4	7.0-9.8
	40	55	51-58	8.2	7.0-9.8
	50	54	51-58	8.0	6.3-9.8
	60	54	51-58	7.4	5.6-9.1
May	1	72	66-78	9.0	7.7-10.5
	10	70	63-76	8.2	7.0-9.8
	20	68	63-76	7.3	5.6-9.1
	30	66	61-73	6.5	4.2-9.1
	40	65	61-71	5.6	3.5-8.4
	50	62	58-66	5.7	2.8-7.7
	60	61	56-66	3.6	0.0-5.6
June	1	80	68-91	8.0	6.3-9.8
	10	78	68-91	7.1	2.8-9.8
	20	75	68-83	4.7	0.7-7.7
	30	73	66-81	3.1	0.0-7.0
	40	71	63-78	2.2	0.0-8.4
	50	67	61-71	0.8	0.0-3.5
	60	66	61-71	0.8	0.0-5.6

Monthly Temperature and Dissolved Oxygen Data for Station 66.0 (Wylie Forebay) for 1959-1971

Month	Depth Ft	Average Temperature °F	Range °F	Average DO Mg/l	Range Mg/l
July	1	83	73-88	7.6	5.6-9.1
	10	81	73-86	5.5	2.1-9.1
	20	79	71-86	3.6	0.7-7.7
	30	78	68-83	1.6	0.0-7.7
	40	76	68-81	0.5	0.0-2.8
	50	74	66-78	0.2	0.0-1.4
	60	71	66-76	0.1	0.0-0.7
August	1	84	78-88	7.5	5.6-9.8
	10	83	78-88	6.2	1.4-9.1
	20	81	76-88	4.2	0.0-7.7
	30	80	76-86	1.9	0.0-5.6
	40	78	73-83	1.1	0.0-4.9
	50	76	71-81	0.5	0.0-4.9
	60	74	68-81	0.5	0.0-4.9
September	1	79	73-86	6.4	4.2-8.4
	10	78	73-83	5.4	2.8-7.7
	20	78	73-83	4.7	2.1-7.0
	30	78	73-83	3.6	0.0-5.6
	40	77	71-81	2.9	0.0-5.6
	50	76	68-81	2.0	0.0-5.6
	60	74	68-78	1.9	0.0-5.6
October	1	71	61-78	6.7	4.9-8.4
	10	71	61-78	6.5	4.9-8.4
	20	71	61-78	6.2	4.9-7.7
	30	70	61-76	6.0	4.2-7.7
	40	70	61-76	5.8	3.5-7.7
	50	70	63-76	5.5	3.5-7.0
	60	69	63-71	5.5	3.5-7.0
November	1	61	56-68	7.7	6.3-8.4
	10	61	56-68	7.7	5.6-8.4
	20	61	56-68	7.6	4.9-8.4
	30	61	56-68	7.5	4.9-8.4
	40	61	56-68	7.5	4.2-8.4
	50	61	56-68	7.5	4.9-8.4
	60	61	56-68	7.4	4.9-8.4
December	1	53	48-58	9.0	7.7-9.8
	10	53	48-58	8.9	7.7-9.8
	20	53	48-58	8.7	7.7-9.8
	30	52	48-58	8.8	7.7-9.8
	40	52	48-58	8.7	7.7-9.8
	50	52	48-58	8.8	7.7-9.8
	60	52	48-58	8.6	7.7-9.8

ER Table 3.9-3

Monthly Temperature and Dissolved Oxygen Data for
Station 83.1 (Allen Intake) for 1959-1972

Month	Depth (Ft)	Avg. Temp. (°F)	Range (°F)	Avg. D.O. (Mg/d)	Range (Mg/d)
January	1	45	51-41	10.4	11.5-9.1
	10	45	52-41	10.4	11.4-9.1
	20	45	51-41	10.4	11.3-9.1
	30	45	51-42	9.7	10.8-9.0
February	1	46	52-43	10.7	11.7-9.0
	10	46	52-43	10.7	11.7-9.0
	20	46	52-43	10.7	11.7-9.0
	30	46	52-43	10.7	11.7-9.0
March	1	52	58-46	9.7	10.7-8.7
	10	51	55-46	9.6	10.6-8.7
	20	51	55-46	9.5	10.6-8.2
	30	51	55-46	9.4	10.6-7.4
April	1	60	67-53	9.8	10.7-8.9
	10	58	65-53	9.5	10.0-8.0
	20	58	62-53	8.9	10.0-5.8
	30	-	-		
May	1	71	74-68	8.2	9.0-6.0
	10	69	72-66	7.6	9.0-5.7
	20	68	72-65	7.4	8.5-5.4
	30	-	-	-	-
June	1	79	84-75	7.5	10.2-6.2
	10	77	80-73	6.5	9.2-3.0
	20	75	79-70	5.3	8.6-0.5
	30	-	-	-	-
July	1	82	87-79	7.1	9.2-4.8
	10	81	84-78	6.2	7.4-4.9
	20	80	83-78	4.9	6.4-3.1
	30	-	-		
August	1	84	87-77	6.8	9.9-5.0
	10	82	86-74	5.8	8.0-3.5
	20	81	84-73	4.4	5.6-3.0

ER Table 3.9-3 - continued

Monthly Temperature and Dissolved Oxygen Data for Station 83.1 (Allen Intake) for 1959-1972

Month	Depth (Ft)	Avg. Temp. (°F)	Range (°F)	Avg. D.O. (Mg/d)	Range (Mg/d)
September	1	80	85-72	6.4	8.0-4.6
	10	79	83-72	5.4	6.6-3.5
	20	78	82-72	5.0	6.6-2.6
October	1	69	73-63	7.3	8.7-4.9
	10	69	75-63	6.4	7.2-4.0
	20	69	75-63	6.4	7.1-3.7
November	1	61	69-57	7.7	8.7-6.7
	10	61	63-57	7.5	9.0-6.6
	20	61	63-57	7.4	8.9-6.6
	30	61	63-57	7.4	8.8-6.2
December	1	52	53-50	9.2	10.7-8.1
	10	52	53-50	9.2	10.3-8.3
	20	52	53-50	9.2	10.3-8.3
	30	52	53-50	9.2	10.3-8.3

ER Table 3.9-4

Monthly Temperature and Dissolved Oxygen Data for Station 94.0 (Mt Island Tailrace) for 1959-1972

Month	Depth Ft	Average Temperature °F	Range °F	Average DO Mg/l	Range Mg/l
January	Mid-depth	46	50-43	10.9	11.8-10.0
February	Mid-depth	48	52-45	11.2	12.4-10.4
March	Mid-depth	53	58-47	11.0	12.1-9.9
April	Mid-depth	59	67-53	10.0	11.0-9.0
May	Mid-depth	70	73-67	7.9	8.4-7.5
June	Mid-depth	75	80-66	7.2	9.1-5.9
July	Mid-depth	80	85-76	6.1	7.8-4.4
August	Mid-depth	82	87-78	5.3	6.5-3.0
September	Mid-depth	79	85-74	6.2	7.5-4.8
October	Mid-depth	71	81-64	6.9	8.2-5.8
November	Mid-depth	64	72-57	7.7	8.4-6.1
December	Mid-depth	55	57-52	9.2	10.4-8.0

ER Table 3.9-5

Synoptic Phosphate and Nitrate Data Taken at Allen Intake
July 1971 - August 1972

Date		Total Phosphate mg/l (PO_4)	Nitrate Nitrogen mg/l (NO_3-N)
July	6, 1971	0.150	0.140
	13	0.195	0.240
	20	0.150	0.180
	25	0.150	0.160
August	10	0.180	0.085
	16	0.180	0.190
	24	0.160	0.125
	31	0.200	0.120
September	7	0.200	0.110
	14	0.140	0.130
	21	0.160	0.155
	28	0.190	0.190
October	5	0.140	0.175
	19	0.420	0.295
	26	0.140	0.240
November	2	0.115	0.205
	9	0.175	--
	16	0.200	0.190
	23	0.140	0.230
December	7	0.120	0.230
	14	0.970	0.175
	22	0.528	0.210
	29	0.840	0.380
January	4, 1972	0.240	0.365
	11	0.110	0.320
	18	0.240	0.400
	25	0.100	0.315
February	2	0.160	0.415
	8	0.560	0.425
	15	0.135	0.320
	22	0.085	0.320
	29	0.462	0.061
March	7	0.700	0.270
	14	0.280	0.380
	21	0.200	0.080
	28	0.338	0.370

ER Table 3.9-5 Continued

Synoptic Phosphate and Nitrate Data Taken at Allen Intake

Date		Total Phosphate mg/l (PO_4)	Nitrate Nitrogen mg/l (NO_3-N)
April	4, 1972	0.200	0.330
	11	0.095	0.280
	18	0.136	0.305
	25	0.135	0.410
May	2	0.160	0.320
	9	0.180	0.350
	18	0.200	0.370
	23	0.080	0.330
	30	0.125	0.330
June	6	0.130	0.330
	13	0.175	0.140
	20	0.160	0.140
	27	0.195	0.210
July	6	0.070	0.170
	18	0.260	0.100
August	1	0.345	0.210
	7	0.285	0.120
	22	0.145	0.140
	29	0.150	0.270

ER Table 3.9-6
Water Quality Data - Mt. Island Tailrace

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
94.0		06/04/59	8	0	1		76.6	6.6	7.0					79.8
94.0		06/10/59	13	0	1		74.5	7.0		0.14	1.11	67		81.7
94.0		06/16/59	10	0	1		78.8	6.5	7.4	0.00	0.83	30		80.5
94.0		06/22/59	13	0	1	4.0	77.2	6.6	6.9	0.09	0.73	46		79.8
94.0		07/03/59	10	0	1		77.8	5.3	7.1	0.00	0.77	31		64.1
94.0		07/13/59	10	0	1		80.0	5.0	7.7	0.22	0.49	27		61.9
94.0		07/31/59	9	0	1		82.8	5.5	7.4	0.00	0.33	35		70.7
94.0		08/03/59	11	0	1		83.5	5.7	6.8	0.18	0.54	29		73.3
94.0		08/17/59	13	0	1		81.0	5.5	7.0	0.08	0.18			69.0
94.0		08/31/59	11	0	1		82.5	4.0	6.8	0.00	1.68	105		51.4
94.0		04/13/60	11	0	1		67.0	9.1	7.4			108		98.3
94.0		05/11/60	11	0	1		69.0	7.6	7.2			88		83.9
94.0		06/15/60	12	0	1		76.0	6.7	7.1			21		80.1
94.0		07/22/60	16	0	1		85.0	6.8	6.1			19		88.5
94.0		08/08/60	11	0	1		81.0	5.7	7.1	0.00	1.26	62		71.5
94.0		08/18/60	12	0	1		86.0	6.5	7.2	0.00	1.63	57		86.9
94.0		05/11/61	18	0	1		70.0	8.1				33		91.4
94.0		06/06/61	19	0	1		75.0	7.7		0.00	0.33	10	1.3	92.0
94.0		06/28/61	19	0	1		74.0	6.8	6.9	0.00	1.57	153		79.4
94.0		07/25/61	8	0	1		85.0	7.4	6.9			45		96.4
94.0		08/08/61	17	0	1		81.0	6.6	6.6			74		82.8
94.0		09/13/61	14	0	1		82.0	6.8	7.0	0.00	0.57	23		87.4
94.0		10/13/61	16	0	1						0.24	14		
94.0		11/10/61	15	0	1		66.0	7.4		0.00	0.61	12		80.0

ER Table 3.9-6 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
94.0		12/07/61	17	0	1		52.5	10.4	7.4	0.00	2.67	10		95.2
94.0		01/08/62	9	0	1		43.0	11.8	5.5	0.42	2.25	220		95.9
94.0		02/06/62	11	0	1		45.0	10.4		0.00	0.90	52		86.6
94.0		02/20/62	11	0	1		48.0	11.4						97.3
94.0		03/05/62	18	0	1		47.0	10.9	7.0	0.00	1.42	72		93.0
94.0		04/05/62	16	0	1		59.0	9.9	6.8	0.00	1.91	90		98.6
94.0		05/14/62	13	0	1		73.0	7.6	7.3		1.15	15		88.7
94.0		06/11/62	14	0	1						1.47	68		
94.0		07/09/62	14	0	1		85.0	7.5	7.3	0.00	0.49	50		97.7
94.0		08/01/62	17	0	1		82.0	4.3	7.1	0.00	0.60	24		55.3
94.0		08/21/62	13	0	1		87.0	3.0	6.0	0.23	0.49	12		40.1
94.0		08/29/62	15	0	1		86.0	3.3		0.34	0.63	13		44.1
94.0		09/12/62	16	0	1		82.2	4.8	7.0	0.25	0.25	17		61.7
94.0		09/23/62	8	0	1		42.0	12.6						100.0
94.0		09/26/62	17	0	1		75.0	5.6	7.1	0.10	0.41	14		66.9
94.0		10/25/62	19	0	1		66.0	5.9	7.1		0.11	10		63.7
94.0		11/13/62	9	0	1		59.8	8.9	7.1		2.05	8	3.1	88.6
94.0		12/04/62	16	0	1		56.5	9.8	6.7	0.00	0.41	12	1.4	93.9
94.0		01/09/63	7	0	1		44.0	10.0		0.11	0.93	16	1.3	81.3
94.0		01/15/63	16	0	1		48.0	10.9	7.3	0.00	0.74	16	2.0	93.0
94.0		02/07/63	15	0	1		49.5	10.7	7.2	0.00	2.43	37	1.4	93.7
94.0		03/07/63	14	0	1		51.5	11.1	6.8	0.00	4.50	36	1.7	99.8
94.0		04/02/63	14	0	1		56.8	10.9	7.1	0.00	1.53	30	1.5	104.5
94.0		05/07/63	15	0	1		63.5	8.4	7.2	0.00	1.12	19	0.7	92.7

ER Table 3.9-6 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
94.0		06/10/63	13	0	1		73.5	8.6	7.4	0.00	0.57	45	2.8	100.4
94.0		06/21/63	13	0	1		71.8	7.2	7.0	0.00	0.25	17	0.3	83.1
94.0		07/04/63	13	0	1		78.0	7.8	7.2	0.00	0.30	12	2.5	94.3
94.0		07/16/63	16	0	1		77.5	6.7	7.3	0.00	0.93	9	0.5	81.0
94.0		08/01/63	13	0	1		79.5	6.5	7.1	0.00	0.46	10	2.0	80.5
94.0		08/21/63	14	0	1		80.1	6.0	7.0	0.00	0.74	7	0.8	75.2
94.0		09/04/63	12	0	1		78.2	6.6	7.1	0.00	0.33	5	1.2	79.8
94.0		09/24/63	13	0	1		74.0	7.5	7.3	0.00	0.14	8	1.0	87.6
94.0		11/14/63	13	0	1		70.8	6.7	7.0	0.34	0.46	13		75.6
94.0		12/05/63	12	0	1		54.8	8.5	7.0	0.37	1.83	21	1.0	79.9
94.0		01/23/64	12	0	1		45.2	11.4	7.1	0.00	0.85	12	0.5	94.9
94.0		02/13/64	12	0	1		46.5	11.3	7.1	0.00	1.12	21	3.5	96.5
94.0		03/13/64	11	0	1		52.0	11.4	7.3	0.56	1.91	13	1.3	104.3
94.0		04/06/64	12	0	1		53.2	10.4	7.0	0.03	0.66	12	2.7	95.2
94.0		04/13/64	10	0	1		53.5	9.0				410		84.6
94.0		05/14/64	19	0	1		67.0	8.0	6.9	0.00	0.85	6	0.7	86.4
94.0		06/02/64	14	0	1		73.2	7.8		0.00	1.06	8	0.7	91.1
94.0		06/16/64	14	0	1		76.6	7.1	7.4	0.00	0.57	6	1.1	85.8
94.0		07/07/64	13	0	1		78.0	5.0	6.8	0.00	0.68	8	1.6	60.4
94.0		07/23/64	13	0	1		79.0	5.9	6.8	0.06	0.74	21	2.1	73.1
94.0		08/04/64	11	0	1		78.0	4.9	6.7	0.14	0.87	12	0.9	59.2
94.0		08/19/64	12	0	1		77.8	5.1	6.5	0.03	0.41	7	1.1	61.7
94.0		09/17/64	12	0	1		76.4	6.5	7.2	0.03	0.52	12	2.1	77.7
94.0		10/15/64	13	0	1		64.3	7.1	7.0	0.17	0.35	8	0.9	75.9

ER Table 3.9-6 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
94.0		11/12/64	14	0	1		61.3	6.1	7.9	0.45	1.20	31	2.5	61.9
94.0		12/01/64	18	0	1		54.5	8.0	7.2	0.37	1.09	12	0.8	75.2
94.0		01/13/65	15	0	1		50.1	10.2	6.3	0.03	1.12	9	1.7	91.7
94.0		02/11/65	13	0	1		52.2	11.6	7.0	0.03	0.96	16	1.2	106.2
94.0		03/10/65	13	0	1		51.1	11.1	7.1	0.00	1.17	23	1.2	99.8
94.0		04/08/65	13	0	1		57.2	11.0	7.0	0.01	0.57	10	1.1	107.4
94.0		06/03/65	13	0	1		71.8	7.2	6.8	0.00	0.38	6	1.0	83.1
94.0		07/30/65	11	0	1		79.0	5.4	6.7	0.00	0.41	13	0.8	66.9
94.0		08/16/65	15	0	1		82.2	5.3	6.9	0.00	0.19	8		68.1
94.0		09/02/65	14	0	1		80.8	6.0	6.9	0.00	0.27	8	1.3	75.2
94.0		09/20/65	13	0	1		80.9	5.3	6.7	0.00	0.03	8		66.4
94.0		11/16/65	14	0	1		64.0	7.8	6.8	0.08	0.14	10	1.2	81.7
94.0		12/08/65	19	0	1		52.0	9.7	6.8	0.48	0.76	9		88.8
94.0		01/06/66	16	0	1		53.5	10.4	6.7	0.11	1.20	6		97.8
94.0		02/07/66	16	0	1		47.0	12.4	7.3	0.06	0.85	4		105.8
94.0		03/07/66	14	0	1		48.5	12.1	7.1	0.03	1.31	39		106.0
94.0		04/08/66	16	0	1		57.0	10.9	7.0	0.06	0.71	6		106.5
94.0		05/11/66	16	0	1		69.0	8.4	7.0	0.00	0.30	6	2.6	92.7
94.0		06/07/66	11	0	1		75.8	7.3	6.8	0.01	0.74	4	1.0	87.2
94.0		06/20/66	10	0	1		67.0	8.0	6.8	0.00	0.71	6	1.6	86.4
94.0		06/21/66	11	0	1		80.0	6.0	6.9	0.00	1.50	7	2.1	74.3
94.0		07/05/66	8	0	1		75.6	6.1	6.9	0.00	0.35	7	0.9	72.9
94.0		08/04/66	9	0	1			3.7	6.8	0.00	0.46	9	1.1	
94.0		08/17/66	13	0	1		83.1	5.6	6.7	0.11	1.28	20	1.3	72.0

ER Table 3.9-6 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
94.0		09/06/66	15	0	1		84.5	5.6	7.1	0.04	0.27	10	1.7	72.9
94.0		09/29/66	13	0	1		76.0	7.4	7.0	0.01	0.38	6	1.1	88.4
94.0		10/21/66	13	0	1		69.0	8.2	6.9	0.03	0.38	7	0.4	90.5
94.0		11/15/66	16	0	1		62.0	8.4	7.0	0.06	0.41	8	0.5	85.3
94.0		12/07/66	17	0	1		54.0	9.6	7.0	0.06	0.35	12	0.8	90.3
94.0		01/12/67	8	0	1		47.0	11.0	6.9	0.08	0.68	12	1.0	93.9
94.0		02/13/67	17	0	1		47.5	11.3	6.8	0.00	0.41	6	0.5	96.5
94.0		03/08/67	15	0	1		55.1	11.1	6.9	0.00	0.33	7	1.0	104.4
94.0		04/04/67	16	0	1		65.2	9.4	6.9	0.00	0.25	4	1.2	100.5
94.0		05/10/67	16	0	1		70.5	7.5	6.9	0.00	0.41	5	1.1	84.6
94.0		06/06/67	11	0	1		65.5	7.3	6.9	0.00	0.11	7	0.3	78.0
94.0		06/21/67	15	0	1		79.0	5.9	6.9	0.00	0.25	6	1.0	73.1
94.0		07/11/67	17	0	1		80.5	4.4	6.8	0.17	0.98	12	1.3	55.2
94.0		07/26/67	8	0	1		79.8	6.8	6.9	0.03	0.41	6	1.1	84.2
94.0		08/07/67	15	0	1		80.9	5.6	6.8	0.00	2.73	5	1.0	70.2
94.0		09/08/67	09	0	1		78.5	7.1	7.0	0.03	1.37	8	1.5	87.9
94.0		10/04/67	09	0	1		71.8	7.3	6.8	0.14	0.98	6		84.3
94.0		11/16/67	16	0	1		57.2	8.4	7.1	0.31	0.41	9		82.0
94.0		12/04/67	16	0	1		56.5	9.0	7.2	0.11	0.38	15	0.8	86.2
94.0		01/18/68	18	0	1		45.9	11.3	7.2	0.00	0.44	10	2.2	94.1
94.0		02/14/68	15	0	1		46.8	11.2	6.9	0.06	1.34	21	0.8	95.6
94.0		03/18/68	15	0	1		57.0	10.3	6.7	0.00	1.75	22	1.8	100.6
94.0		06/19/68	16	0	1		77.5	6.6	6.8	0.00	0.60	7	1.2	79.8
94.0		08/27/68	16	0	1		81.7	5.8	6.9	0.06	1.00	6	2.2	72.7

ER Table 3.9-6 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
94.0		02/07/69	14	0	1		49.0	11.0	6.8	0.16	1.14	25	1.0	96.3
94.0		07/18/69	08	0	1		81.2	5.8	6.7	0.00	0.79	12	0.6	72.7
94.0		08/29/69	15	0	1		83.0	5.8	6.5	0.16	0.19	6	0.9	74.6
94.0		10/17/69	14	0	1		74.5	7.4	6.4	0.16	0.52	14	1.3	86.4
94.0		02/10/70	14	0	1		47.3	11.7	6.4	0.0	.49	9	1.0	99.9
94.0		02/27/70	14	0	1		48.5	11.3	6.4	.09	.68	22	1.4	98.9
94.0		04/14/70	13	0	1	3.8	62.5	9.5	6.3	0.0	.54	7		99.5
94.0		06/04/70	12	0	1		75.5	7.1	6.3	0.0	.38	7	.9	84.8
94.0		08/04/70	11	0	1		85.8	6.2	6.5	.16	.08	8	1.0	82.9
94.0		10/13/70	12	0	1		81.0	5.8	6.7	.19	.41	16	1.1	72.7
94.0		04/13/71	16	0	1		58.5	9.6	7.0	0.0	.19	7	2.2	93.8
94.0		06/09/71	14	0	1		72.2	7.8	6.9	0.0	.44	10	1.1	90.0
94.0		07/21/71	15	0	1		81.0	5.7	7.0	.06	.49	12	.6	71.5
94.0		09/01/71	15	0	1		84.0	5.4	6.8		.30	6	0.5	70.3
94.0		11/02/71	09	0	1		72.0	7.8	7.1	.03	.84	6	0.2	90.0
94.0		02/02/72	13	0	1		50.5	10.5	7.1	0.00	0.35	4	0.5	94.4
94.0		03/28/72	13	0	1		58.0	9.9	7.1	0.00	0.03	7	0.8	96.7
94.0		06/07/72	09	0	1	4.0	72.8	9.1	7.3	0.00	0.44	3	.9	105.0

ER Table 3.9-7
Water Quality Data - Wylie Tailrace

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
65.7		06/29/59	10	0	1		80.5	3.8	7.1	0.15	0.60	18		47.4
65.7		08/07/59	9	0	1	3.0	81.2	4.5	7.2	0.08	0.34	11		56.1
65.7		08/14/59	9	0	1		81.2	4.3	6.8	0.19	1.00	38		53.6
65.7		09/02/59	9	0	1		80.8	3.7	6.8	0.67	0.96	30		46.1
65.7		04/14/60	16	0	1		55.0	9.2	7.3	0.00	7.08	210		86.1
65.7		05/16/60	15	0	1		72.0	7.5	6.9			33		86.1
65.7		06/20/60	13	0	1		79.0	4.4	7.1			23		54.2
65.7		07/25/60	15	0	1		81.0	3.4	7.2			8		42.4
65.7		08/09/60	11	0	1		82.0	4.5	6.5	0.10	0.07	19		57.5
65.7		08/22/60	11	0	1		79.0	6.0	7.1			18		73.9
65.7		10/11/61	13	0	1		78.0	6.3		0.00	0.24	15	1.1	75.8
65.7		11/08/61	12	0	1		66.0	6.5		0.00	0.15	8	1.6	69.9
65.7		12/07/61	14	0	1		56.0	8.5		0.00	0.31	17	1.3	81.0
65.7		01/04/62	15	0	1		45.0	9.7	6.0	0.65	2.75	80	1.0	80.3
65.7		01/23/62	13	0	1		45.0	10.3						85.3
65.7		02/05/62	15	0	1		51.0	10.5	6.8	0.62	1.91	80	0.1	93.9
65.7		02/19/62	15	0	1		50.0	10.2						91.2
65.7		03/05/62	14	0	1		50.0	9.9	6.9	0.08	1.69	56	1.7	88.5
65.7		04/04/62	15	0	1		58.0	9.4	6.9	0.17	0.96	43	1.2	91.3
65.7		05/09/62	13	0	1		67.0	7.7		0.00	0.96	25	0.6	82.8
65.7		06/06/62	16	0	1		78.0	4.5	7.3	0.25	2.13	15	0.2	54.1
65.7		07/05/62	14	0	1		80.0	5.5		0.74	1.09	31	1.0	67.8
65.7		07/31/62	13	0	1		80.0	4.3	6.8	0.45	0.55	24		53.0
65.7		08/15/62	13	0	1		80.5	4.8	5.8	0.42	0.87	12	1.5	59.9

ER Table 3.9-7 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
65.7		08/28/62	14	0	1		82.5	7.1	7.2	0.00	0.11	10	1.2	90.8
65.7		09/11/62	15	0	1		83.5	6.0	7.1	0.57	0.55	17	1.1	76.7
65.7		09/24/62	16	0	1		76.0	6.8	6.3	2.35	1.64	12	2.7	80.8
65.7		10/23/62	13	0	1		73.7	6.1	7.2	0.00	0.87	10	0.7	70.8
65.7		11/12/62	14	0	1		59.0	8.6	6.9	0.00	0.14	13	0.1	85.2
65.7		12/03/62	17	0	1		53.0	9.8	6.9	1.33	1.15	12		89.2
65.7		01/07/63	18	0	1		45.0	10.9	7.2	0.25	1.56	11	1.1	90.3
65.7		01/14/63	17	0	1		43.7	11.0	7.3	0.23	0.93	15	3.2	88.9
65.7		02/06/63	15	0	1		44.5	10.9	7.0	0.54	5.38	22	1.9	90.3
65.7		03/06/63	13	0	1		49.5	11.4	7.1	0.00	2.92	43	1.7	99.3
65.7		04/01/63	16	0	1		57.8	8.0	7.2	0.20	3.33	159	4.5	77.7
65.7		05/06/63	17	0	1		65.8	8.1	7.2	0.00	1.26	81	0.9	86.2
65.7		06/06/63	13	0	1		75.5	5.1	7.2	0.37	0.85	19	1.5	60.6
65.7		06/18/63	18	0	1		72.6	3.4	7.7	0.28	0.71	39	0.4	39.0
65.7		07/01/63	18	0	1		74.5	6.2	7.2	0.51	0.74	24	1.8	72.0
65.7		07/15/63	18	0	1		78.5	2.6	7.4	0.00	0.76	16	1.1	32.0
65.7		07/31/63	18	0	1		82.0	3.4	7.4	0.37	0.35	12	1.5	43.5
65.7		08/19/63	18	0	1		82.0	2.4	7.0	0.00	0.35	10	1.2	30.7
65.7		09/02/63	15	0	1		81.0	7.2	7.0	0.00	0.35	8		89.8
65.7		09/18/63	8	0	1		77.0	5.1	7.4	0.37	0.49	8	1.3	61.3
65.7		10/10/63	17	0	1		71.0	6.0	7.1	0.06	0.46	9	1.4	67.4
65.7		11/12/63	15	0	1		60.5	8.2	7.2	0.90	0.66	12	1.2	82.9
65.7		12/03/63	15	0	1		53.8	9.0	6.8	0.48	0.90	20	1.6	84.2
65.7		01/22/64	16	0	1		45.0	10.8	7.3	0.08	0.76	17	1.2	89.5

ER Table 3.9-7 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
65.7		02/11/64	16	0	1		44.8	9.8	6.8	0.91	3.08	72	1.6	81.2
65.7		03/11/64	15	0	1		51.2	9.9	7.2	0.14	2.54	73	2.5	88.5
65.7		04/02/64	16	0	1		56.0	9.4	7.1	0.08	0.71	29	2.1	89.6
65.7		05/14/64	14	0	1		65.5	7.5	7.0	0.00	0.52	14	0.7	79.8
65.7		06/02/64	12	0	1		71.2	4.9	7.0	0.00	1.12	11	1.4	56.3
65.7		06/15/64	14	0	1		77.2	3.7	7.1	0.03	1.47	37	1.2	44.5
65.7		07/06/64	13	0	1		77.4	4.3	7.4	0.42	0.66	29	0.8	51.7
65.7		07/21/64	12	0	1		77.6	4.4	6.9	0.28	0.[illegible]9	11	0.9	52.9
65.7		08/03/64	9	0	1		81.0	3.9	7.1	0.00	1.01	23	0.6	48.6
65.7		08/18/64	13	0	1		80.8	4.7	7.1	0.06	0.96	14	1.2	58.6
65.7		09/15/64	12	0	1		79.0	6.0	7.2	0.09	0.16	8	1.1	73.9
65.7		10/13/64	13	0	1		68.8	7.0	6.6	0.00	1.56	51	1.3	76.9
65.7		11/10/64	12	0	1		62.3	7.6	7.0	0.17	0.68	14	1.1	79.2
65.7		11/30/64	11	0	1		56.0	8.0	6.8	0.11	1.88	5	1.0	76.3
65.7		01/12/65	15	0	1		51.1	9.3	6.9	0.06	1.69	35	0.8	83.2
65.7		02/09/65	12	0	1		48.2	10.7	7.1	0.08	0.55	13	1.7	93.2
65.7		03/08/65	17	0	1		48.0	10.6	7.1	0.06	1.01	34	2.9	90.0
65.7		04/06/65	14	0	1		56.8	8.9	6.9	0.03	4.23	87	1.3	84.8
65.7		06/02/65	14	0	1		72.6	5.0	6.8	0.55	0.41	14	3.4	57.4
65.7		07/28/65	17	0	1		80.1	4.0	6.9	0.14	0.66	20	2.2	49.9
65.7		08/13/65	18	0	1		81.3	4.1	7.0	0.00	0.87	4		51.1
65.7		09/01/65	14	0	1		84.0	3.9	6.9	0.03	0.14	6	1.1	50.5
65.7		09/16/65	14	0	1		83.0	3.7	7.3	0.34	0.60	8		47.3
65.7		11/09/65	15	0	1		62.8	8.4	7.1	0.00	0.87	12	1.1	87.5

ER Table 3.9-7 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
65.7		12/08/65	16	0	1		53.0	10.9	7.0	0.06	0.79	13		99.2
65.7		01/14/66	9	0	1		48.2	9.5	6.8	0.31	0.55	6		82.8
65.7		02/03/66	17	0	1		41.8	12.1	7.0	0.06	0.44	8		95.5
65.7		03/02/66	16	0	1		48.5	9.9	7.0	0.14	3.08	88		86.2
65.7		04/08/66	13	0	1		57.0	10.0	7.1	0.00	1.12	14		97.2
65.7		05/10/66	13	0	1		67.5	7.4	7.0	0.03	0.44	7	2.1	79.5
65.7		06/03/66	13	0	1		73.8	7.0	7.2	0.06	0.22	28	3.3	81.3
65.7		06/17/66	12	0	1		76.5	6.0	6.8	0.42	0.60	5	1.4	72.2
65.7		07/05/66	14	0	1		81.5	3.5	7.1	0.34	0.46	7	2.3	43.6
65.7		07/20/66	14	0	1		84.0	4.7	7.1	0.14	0.96	6	1.8	60.9
65.7		08/02/66	15	0	1		83.1	6.1	7.1	0.59	0.49	4	0.6	78.0
65.7		08/15/66	16	0	1		84.3	4.4	7.1	0.08	0.79	4	1.1	57.0
65.7		09/06/66	13	0	1		84.8	3.2	7.1	0.28	0.44	9	2.0	41.4
65.7		09/23/66	8	0	1		76.0	7.0	6.8	0.17	1.91	6	1.6	83.2
65.7		10/17/66	10	0	1		68.0	5.5	7.2	0.06	0.28	5	0.8	60.4
65.7		12/05/66	17	0	1		52.0	8.3	7.1	0.00	0.35	19	2.9	75.6
65.7		01/04/67	14	0	1		47.5	9.2	7.2	0.00	0.21	7	1.0	78.1
65.7		02/06/67	16	0	1		50.1	10.7	7.1	0.00	0.22	10	1.6	95.7
65.7		03/17/67	16	0	1		54.2	11.1	7.3	0.00	0.35	12	2.0	103.9
65.7		04/18/67	14	0	1		66.4	7.0	6.9	0.00	0.41	6	3.5	75.2
65.7		05/10/67	13	0	1		67.9	8.0	7.0	0.00	0.46	8	2.0	87.9
65.7		06/05/67	13	0	1		68.0	6.5	6.9	0.00	0.38	10	1.1	71.4
65.7		06/30/67	12	0	1		76.0	3.1	7.3	0.14	0.85	8	2.0	36.8
65.7		07/14/67	9	0	1		77.6	2.8	6.7	0.31	0.71	12	1.9	33.7

ER Table 3.9-7 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
65.7		07/24/67	9	0	1		78.5	1.6	6.9	0.45	0.63		1.5	19.7
65.7		08/04/67	09	0	1		82.0	1.5	6.6	0.23	2.32	10	2.7	19.1
65.7		09/05/67	15	0	1		79	4.3	6.9	0.08	2.57	17	1.7	53.0
65.7		10/17/67	14	0	1		76.	5.6	7.1	[illegible]	0.41	7	1.3	62.9
65.7		11/27/67	14	0	1		55.3	8.3	7.1	[illegible]	0.63	13		79.1
65.7		12/11/67	14	0	1		51.2	8.2	7.0	0.00	0.30	8	0.9	73.3
65.7		01/18/68	14	0	1		44.5	10.4	7.1	0.00	0.79	16	1.2	86.1
65.7		02/12/68	14	0	1		46.5	10.4	6.8	0.00	0.63	68	1.2	88.3
65.7		03/08/68	13	0	1		49.0	10.6	7.4	0.06	0.41	10	2.0	92.3
65.7		04/01/68	16	0	1		58.2	8.9	7.1	0.00	0.74	28	1.3	86.5
65.7		06/04/68	15	0	1		74.5	4.9	6.9	0.22	0.82	10	1.4	56.9
65.7		08/27/68	15	0	1		83.5	2.3	6.8	0.22	1.35	8	1.5	29.4
65.7		03/04/69	16	0	1		48.0	8.7	6.8	0.03	1.71	23	2.4	73.9
65.7		07/16/69	14	0	1		86.5	3.5	6.7	0.09	2.45	4	1.4	46.5
65.7		08/19/69	15	0	1		85.0	4.3	6.7	0.28	0.73	7	1.1	55.7
65.7		10/07/69	13	0	1		75.5	5.3	6.4	0.16	0.44	15	1.7	63.0
65.7		02/10/70	12	0	1		45.0	11.8	6.4	0.0	.44	9	1.2	97.7
65.7		04/23/70	15	0	1		64.5	8.3	6.6	0.0	.30	14	3.1	88.3
65.7		06/04/70	15	0	1		74.0	4.9	6.4	.22	.14	8	1.2	56.9
65.7		07/21/70	13	0	1		82.0	4.5	6.3	.16	.27	7	1.4	57.5
65.7		11/05/70	15	0	1		62.0	8.0	7.2	0.0	.38	11	1.2	80.8
65.7		05/20/71	14	0	1		70.9	5.0	6.3	1.65	1.33	72	2.0	56.1
65.7		06/09/71	10	0	1		74.1	6.6						76.7
65.7		07/09/71	11	0	1		78.5							

ER Table 3.9-7 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
65.7		07/21/71		0	1		78.0	3.2						38.5
65.7		08/02/71	10	0	1		79.5	4.9						60.4
65.7		08/16/71	10	0	1		79.5	6.4						78.9
65.7		09/01/71	10	0	1		85.0	5.9						76.4
65.7		09/23/71	11	0	1		78.5	5.8						71.5
65.7		10/08/71		0	1		75.9	6.6						78.5
65.7		10/15/71	13	0	1		71.0	6.1	7.0		.33	12	1.6	68.5
65.7		10/20/71	11	0	1		70.2	6.5						73.0
65.7		11/02/71	11	0	1		69.8	6.3						70.7
65.7		11/16/71	10	0	1		64.0	7.1						74.0
65.7		12/01/71	10	0	1		55.9	8.9						84.8
65.7		12/13/71	12	0	1		58.0	9.8						95.2
65.7		12/28/71	11	0	1		59.9	9.3						92.1
65.7		01/14/72	10	0	1		53.0	7.9						71.9
65.7		01/21/72	10	0	1		51.5	9.2	7.2	0.16	2.23	36	1.5	82.3
65.7		02/02/72	13	0	1		49.1	8.7						75.8
65.7		02/25/72	10	0	1		46.5	10.1						85.8
65.7		03/06/72	10	0	1		49.9	10.2						91.2
65.7		03/09/72	14	0	1		53.0	11.9	7.2	0.00	0.30	12	2.5	108.3
65.7		03/28/72	10	0	1		56.6	11.0						104.9
65.7		04/14/72	09	0	1		62.0	9.8						99.0
65.7		04/27/72	10	0	1		64.5	8.3						88.3
65.7		05/05/72	10	0	1		66.5	8.9						95.7
65.7		05/23/72	11	0	1		70.5	6.7						75.2

ER Table 3.9-7 (Continued)

STATION NO.	TRIB-UTARY	DATE MO DA YR	HR	DEPTH	REC. TYPE	SECCHI DISK	TEMP	D/O	PH	MN	FE	TURB	BOD	% D/O
65.7		06/06/72	10	0	1		74.0	7.2	7.1	0.00	0.22	12	1.6	83.6
65.7		06/C7/72	13	0	1		74.2	9.1						105.7
65.7		06/26/72	10	0	1		76.0	8.7						103.4

Measured DO and BOD for Four Stations* below Wylie Dam (1959-1972)

Date	Wylie Tailrace DO	Wylie Tailrace BOD	US 21 DO	US 21 BOD	SC 5 DO	SC 5 BOD	SC 9 DO	SC 9 BOD
6/ 6/72	7.2	1.6	7.0	1.7	7.7	2.3	5.3	2.3
1/21/72	9.2	1.5	11.2	1.1	8.3	1.7	9.6	2.3
10/15/71	7.0	1.6	5.9	1.4	7.0	1.2	7.8	1.8
8/12/71	-	-	4.7	1.9	5.8	2.0	5.4	1.9
6/10/71	6.6	-	7.9	1.2	7.4	1.6	5.4	2.2
5/20/71	5.0	2.0	6.2	2.5	6.4	2.2	6.3	4.3
11/ 5/70	8.0	1.2	8.0	0.9	7.0	7.5	6.7	2.2
7/21/70	4.5	1.4	5.5	1.6	5.1	1.7	4.8	2.1
6/ 4/70	4.9	1.2	5.2	1.4	5.6	2.1	6.5	2.5
4/23/70	8.3	3.1	8.3	3.2	8.6	4.4	7.0	4.8
2/10/70	11.8	1.2	11.7	1.5	10.4	1.9	9.9	2.3
10/ 7/69	5.3	1.7	7.1	1.8	4.9	3.4	6.2	2.7
8/19/69	4.3	1.1	5.6	1.8	6.2	1.5	5.5	1.4
7/16/69	3.5	1.4	5.6	2.6	7.0	2.7	5.2	2.6
3/ 4/69	8.7	2.4	10.2	2.3	10.1	3.7	10.5	3.1
8/27/68	2.3	1.5	5.7	1.1	7.4	1.3	5.0	2.3
6/ 4/68	4.7	1.4	6.3	1.9	7.2	5.4	4.9	2.1
4/ 1/68	8.9	1.3	10.0	2.2	6.2	3.6	6.5	4.2
3/ 8/68	10.6	2.0	12.7	2.4	9.5	4.6	10.1	3.5
2/12/68	10.4	1.2	10.5	1.0	9.7	5.3	8.6	5.3
1/18/68	10.4	1.2	10.9	1.3	10.8	2.2	10.9	2.8
12/11/67	8.2	0.9	8.7	1.5	7.3	8.0	8.0	2.7
11/27/67	8.3	-	8.3	-	6.3	8.5	6.2	6.0
10/17/67	5.6	1.3	6.3	1.9	6.3	1.8	4.9	2.5
9/ 5/67	4.3	1.7	5.2	1.6	3.6	5.8	6.1	2.6
8/ 4/67	1.5	2.7	4.5	2.3	3.6	2.2	4.0	2.8
7/24/67	1.6	1.5	4.8	3.1	3.5	2.7	6.1	1.7
7/14/67	2.8	1.9	5.5	2.4	4.3	2.6	3.1	3.6
6/30/67	3.1	2.0	6.9	2.3	3.6	3.4	3.8	3.9
6/ 5/67	6.5	1.1	7.3	1.9	4.1	4.9	4.1	3.5
5/10/67	8.0	2.0	10.0	3.0	2.4	6.4	7.0	4.6

Measured DO and BOD for Four Stations* below Wylie Dam (1959-1972)

Date	Wylie Tailrace		US 21		SC 5		SC 9	
	DO	BOD	DO	BOD	DO	BOD	DO	BOD
4/18/67	7.0	3.5	8.2	-	7.2	3.3	5.4	4.8
3/13/67	11.1	2.0	11.3	-	6.7		7.4	4.7
2/ 6/67	10.7	1.6	12.1	-	8.3	3.5	8.6	2.8
1/ 4/67	9.2	1.0	9.6	-	8.8	1.8	9.0	2.7
12/ 5/66	8.3	2.9	9.4	-	9.7	2.7	9.8	3.6
10/17/66	5.5	0.8	6.7	1.2	3.6	2.2	4.9	2.4
9/23/66	7.0	1.6	6.4	1.4	4.9	1.8	-	-
9/ 6/66	3.2	2.0	6.3	2.2	3.7	1.9	5.1	2.5
8/15/66	4.4	1.1	5.7	1.3	4.0	3.0	4.9	-
8/ 2/66	6.1	0.6	5.8	1.7	5.3	1.6	4.6	2.2
7/20/66	4.7	1.8	4.6	1.6	2.1	6.6	3.6	2.5
7/ 5/66	3.5	2.3	5.2	2.6	5.4	2.0	5.7	2.7
6/17/66	6.0	1.4	6.4	1.0	3.7	1.6	2.6	3.3
6/ 3/66	7.0	3.3	7.2	5.3	6.0	3.0	4.5	3.1
5/10/66	7.4	2.1	8.2	2.0	7.0	2.8	6.3	4.0
4/ 8/66	10.0	-	10.3	-	5.8	-	7.2	-
3/ 2/66	9.9	-	10.1	-	9.3	-	10.0	-
2/ 3/66	12.1	-	12.0	-	10.1	-	9.7	-
1/14/66	9.5	-	9.7	-	8.4	-	8.2	-
12/ 8/65	10.9	-	9.9	-	7.1	-	8.4	-
11/ 9/65	8.4	1.1	8.8	1.3	9.7	2.0	6.7	2.0
9/16/65	3.7	-	5.4	-	6.0	-	4.2	-
9/ 1/65	3.9	1.1	4.9	1.5	4.9	1.7	4.8	1.6
8/13/65	4.1	-	5.0	-	4.3	-	6.5	-
7/28/65	4.0	2.2	4.2	4.1	4.1	1.7	5.6	3.2
6/ 2/65	5.0	3.4	6.3	2.7	6.5	3.5	5.0	3.7
4/ 6/65	8.9	1.3	8.7	1.6	8.1	2.7	8.9	2.0
3/ 8/65	10.6	2.9	11.0	2.9	10.7	4.6	10.6	2.9
2/ 9/65	10.7	1.7	11.1	1.7	9.8	.3	9.4	3.6
1/12/65	9.3	.8	9.6	1.2	9.6	2.8	9.3	2.9

Measured DO and BOD for Four Stations* below Wylie Dam (1959-1972)

Date	Wylie Tailrace		US 21		SC 5		SC 9	
	DO	BOD	DO	BOD	DO	BOD	DO	BOD
11/30/64	8.0	1.0	8.1	1.3	8.3	2.0	8.3	1.1
11/10/64	7.6	1.1	7.6	1.2	7.7	1.8	8.1	.7
10/13/64	7.0	1.3	7.2	1.5	7.0	1.9	7.3	1.7
9/15/64	6.0	1.1	6.4	1.2	6.3	2.0	6.5	2.3
8/18/64	4.7	1.2	5.2	1.1	5.2	2.4	5.8	2.9
8/ 3/64	3.9	.6	6.1	1.2	4.2	1.9	5.5	2.0
7/21/64	4.4	.9	4.4	1.3	4.4	1.6	4.4	1.0
7/ 6/64	4.3	.8	6.6	1.1	6.6	2.1	8.6	2.8
6/15/64	3.7	1.2	4.5	1.5	4.2	2.1	6.4	1.8
6/ 2/64	4.9	1.4	7.3	2.0	3.0	7.6	7.3	5.2
5/14/64	7.5	0.7	8.5	2.0	6.2	2.0	4.5	2.4
4/ 2/64	9.4	2.1	9.6	-	7.0	5.1	8.7	3.1
3/11/64	9.9	2.5	9.9	-	8.7	6.3	9.0	3.6
2/11/64	9.8	1.6	10.2	-	8.6	3.3	9.2	3.0
1/22/64	10.8	1.2	11.0	-	9.1	4.3	10.5	2.0
12/ 3/63	9.0	1.6	9.2	-	7.3	5.3	8.5	2.8
11/12/63	8.2	1.2	8.9	-	9.8	1.8	5.6	3.5
10/10/63	6.0	1.4	8.0	1.9	8.1	1.6	6.0	1.8
9/18/63	5.1	1.3	5.2	1.5	4.3	2.5	4.1	1.9
9/ 2/63	7.2	-	5.6	-	7.3	2.4	5.0	-
8/19/63	2.4	1.2	5.0	1.9	8.4	1.3	6.7	2.1
7/31/63	3.4	1.5	6.0	2.4	3.8	1.6	6.8	2.8
7/15/63	2.6	1.1	4.7	1.4	5.4	4.4	7.0	1.3
7/ 1/63	6.2	1.8	6.4	1.7	7.4	2.4	5.2	3.3
6/18/63	3.4	.4	6.5	3.0	3.1	4.2	5.8	2.4
6/ 6/63	5.1	1.5	5.6	1.8	5.6	2.3	5.9	3.7
5/ 6/63	8.1	0.9	7.6	1.2	5.7	4.6	5.1	2.4
4/ 1/63	8.0	4.5	8.2	.8	6.0	4.5	5.9	3.0
3/ 6/63	11.4	1.7	9.9	3.4	8.0	7.0	9.4	4.2
2/ 6/63	10.9	1.9	10.8	1.2	9.4	2.5	9.0	1.6

Measured DO and BOD for Four Stations* below Wylie Dam (1959-1972)

Date	Wylie Tailrace		US 21		SC 5		SC 9	
	DO	BOD	DO	BOD	DO	BOD	DO	BOD
1/14/63	11.0	3.2	11.0	1.2				
1/ 7/63	10.9	1.1	11.2	5.1	8.7	5.1	7.7	5.3
12/ 3/62	9.8	-	10.3	1.5	7.5	2.3	7.5	2.5
11/12/62	8.6	.1	9.0	1.7	7.2	2.7	7.0	3.0
10/23/62	6.1	0.7	7.1	2.4				
9/24/62	6.8	2.7	6.0	1.3				
9/11/62	6.0	1.1	6.6	3.1				
8/28/62	7.1	1.2	7.5	2.1				
8/15/62	4.8	1.5	6.2	1.8				
7/31/62	4.3	-	5.4	2.2				
7/ 5/62	5.5	1.0	5.4	1.2				
6/ 6/62	4.5	.2	5.5	.1				
5/ 9/62	7.7	.6	7.5	-				
4/ 4/62	9.4	1.2	9.5	1.7				
3/ 5/62	9.9	1.7	10.0	0.6				
2/19/62	10.2	-	10.2	-				
2/ 5/62	10.5	.1	10.1	.3				
1/23/62	10.3	-	10.2	-				
1/ 4/62	9.7	1.0	10.1	1.0				
12/ 7/61	8.5	1.3	8.5	3.9				
11/ 8/61	6.5	1.6	7.9	.2				
10/11/61	6.3	1.1	-	-				
8/22/60	6.0	-	-	-				
8/ 9/60	4.5	-	4.3	-				
7/25/60	3.4	-						
6/20/60	4.4	-						
5/16/60	7.5	-						
4/14/60	9.2	-						
9/ 2/59	3.7	-						
8/14/59	4.3	-						

Measured DO and BOD for Four Stations* below Wylie Dam (1959-1972)

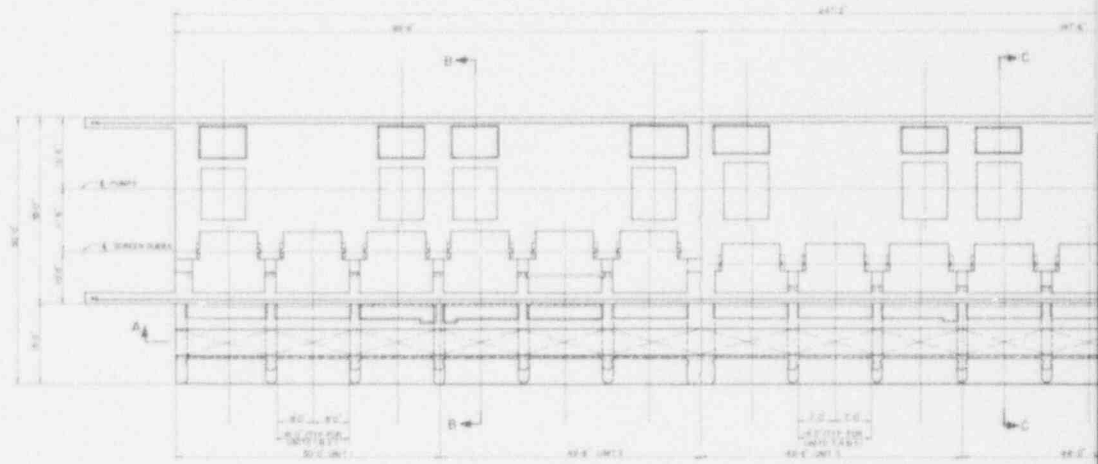
Date	Wylie Tailrace		US 21		SC 5		SC 9	
	DO	BOD	DO	BOD	DO	BOD	DO	BOD
8/ 7/59	4.5		-	-	-	-	-	-
6/29/59	3.8		-	-	-	-	-	-

*See ER Figure 4.1-19 for location of these points.

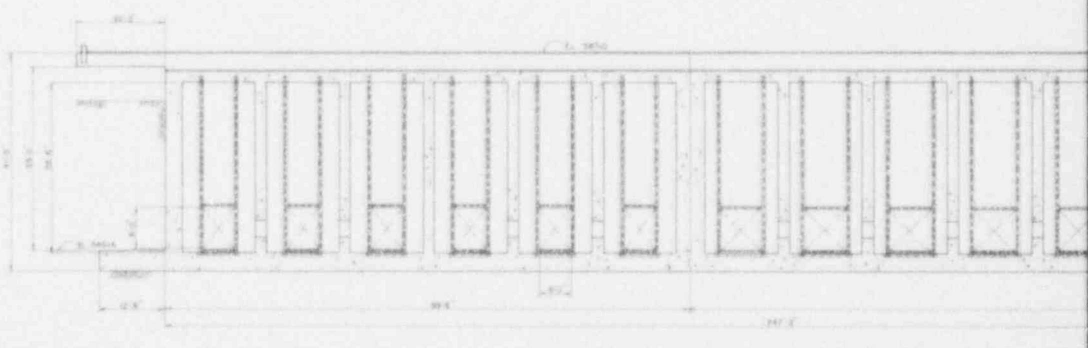
ER TABLE 3.9-9

Summary of DO and BOD Measurements below Wylie Dam

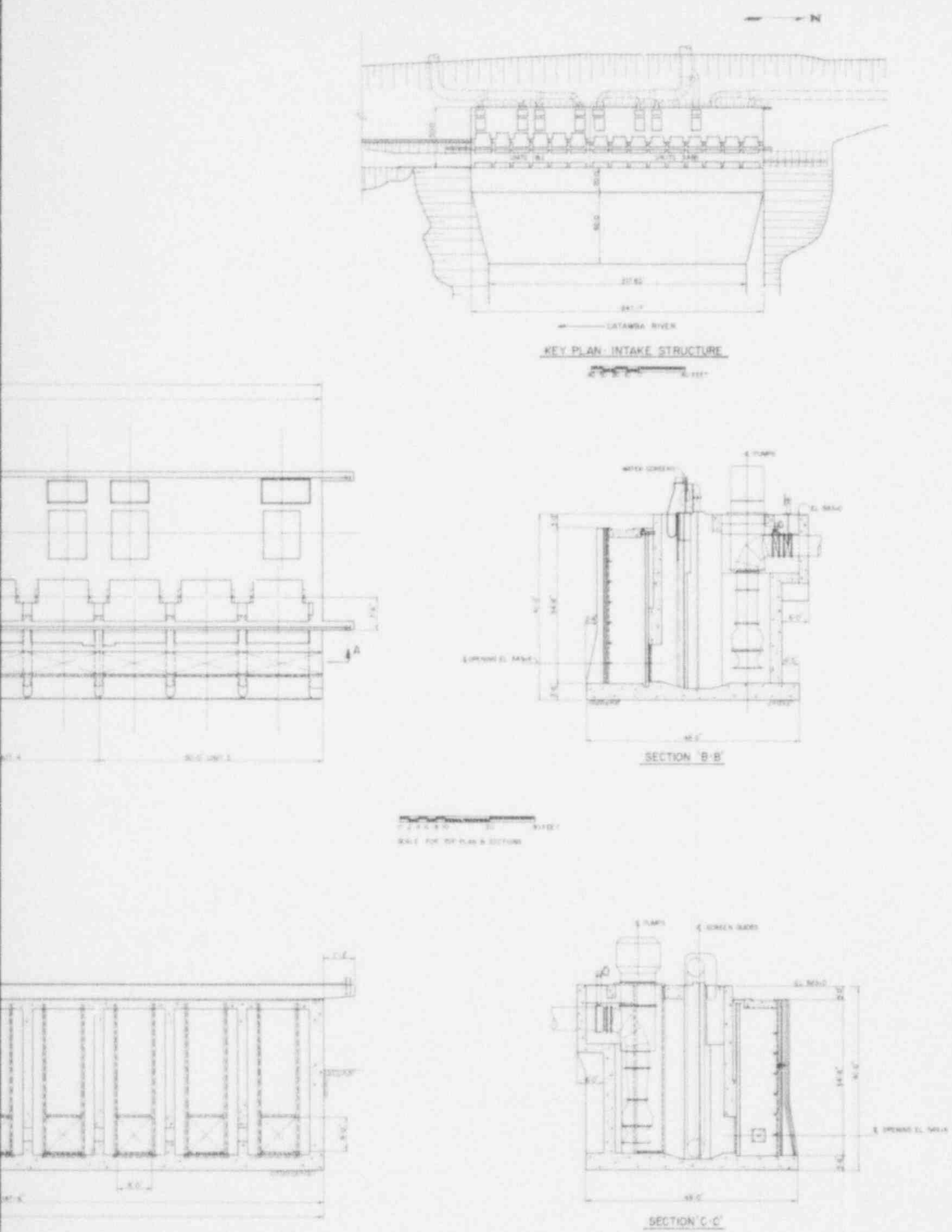
	Wylie Tailrace		US 21		SC 5		SC 9	
	#	%	#	%	#	%	#	%
# DO Readings < 13	122	100	113	100	94	100	93	100
12	120	98	110	97	94	100	93	100
11	115	94	102	90	94	100	93	100
10	103	84	87	77	89	95	87	93
9	88	72	76	67	79	84	76	82
8	72	59	62	55	67	71	65	70
7	58	48	49	43	48	51	54	58
6	47	39	31	27	35	37	38	41
5	39	32	10	9	25	26	18	19
4	19	16	0	0	13	14	4	4
3	6	5	0	0	3	3	1	1
2	2	2	0	0	1	1	0	0
1	0	0	0	0	1	1	0	0
# BOD Readings ≥ 0	98	100	89	100	88	100	83	100
1	82	84	83	93	86	98	82	99
2	22	22	29	33	63	72	69	83
3	6	6	10	11	34	39	31	37
4	1	1	3	3	24	27	12	14
5	0	0	2	2	15	17	4	5
6	0	0	0	0	8	9	1	1
7	0	0	0	0	5	6	0	0
8	0	0	0	0	3	3	0	0



TOP PLAN - INTAKE STRUCTURE



SECTION 'A-A'

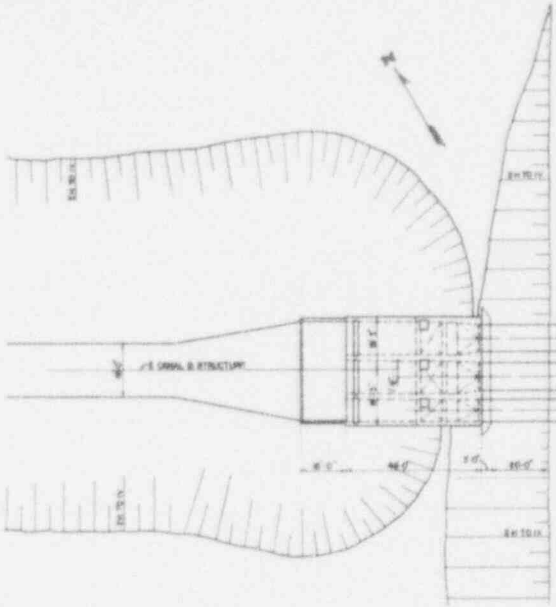


ALLEN INTAKE STRUCTURE

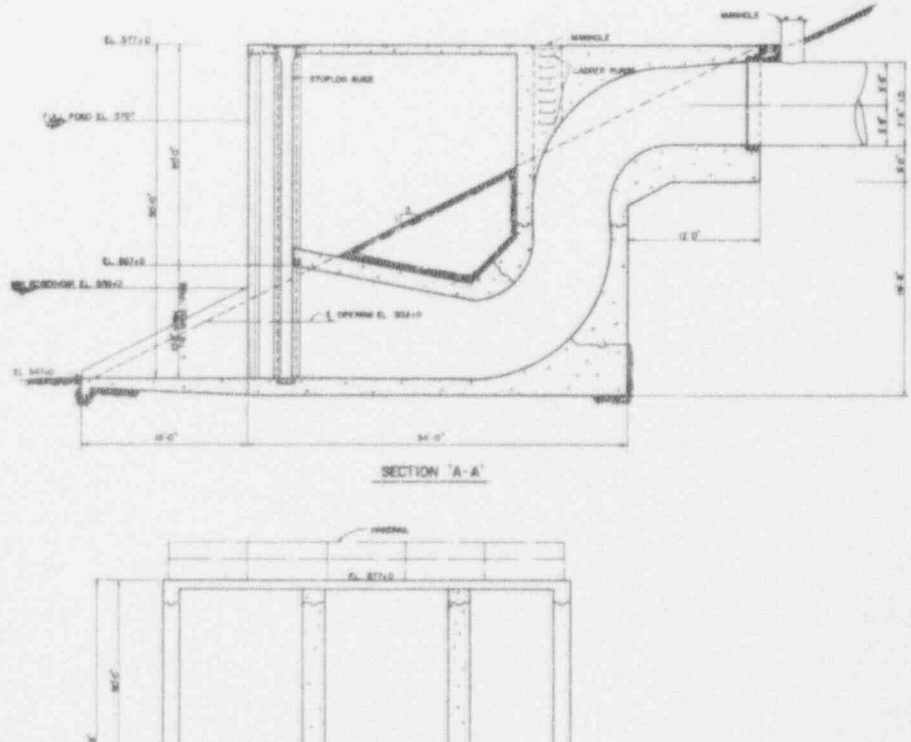
CATAWBA NUCLEAR STATION

ER Figure 3.1-1

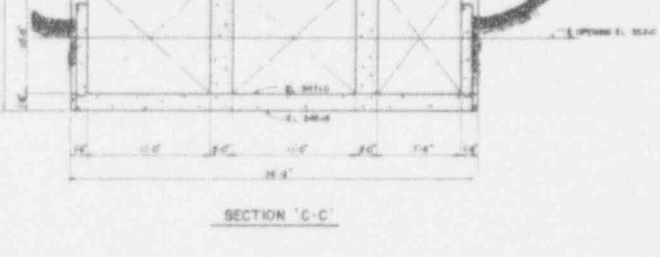
Amendment 1
(New)



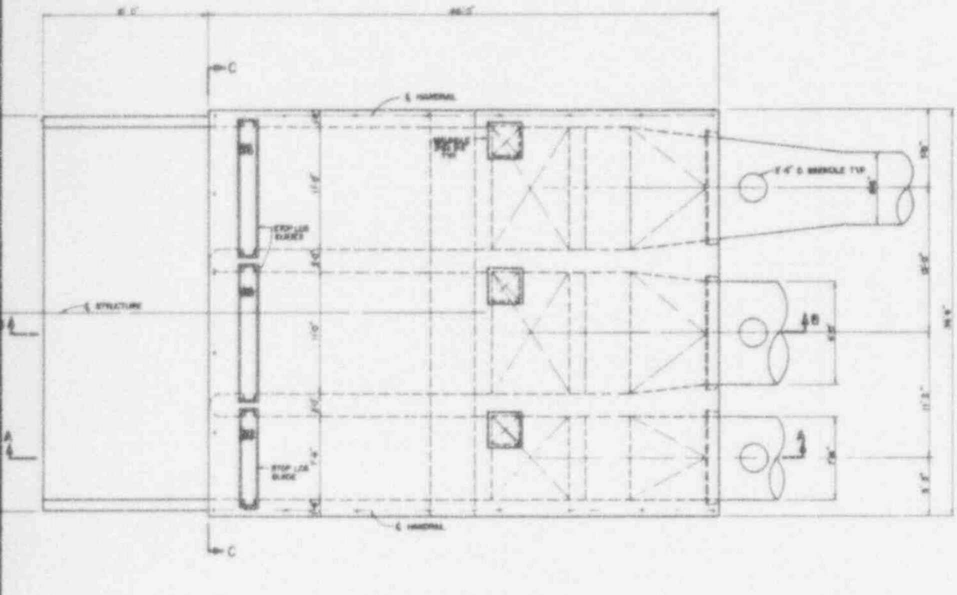
KEY PLAN - DISCHARGE STRUCTURE



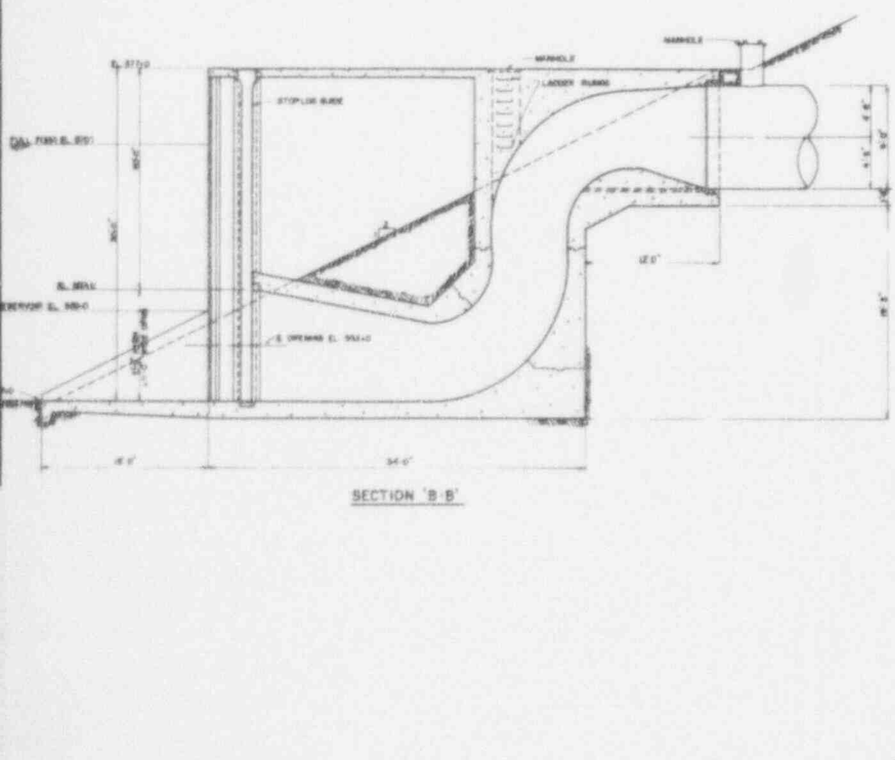
SECTION 'A-A'



SECTION 'C-C'



PLAN - DISCHARGE STRUCTURE



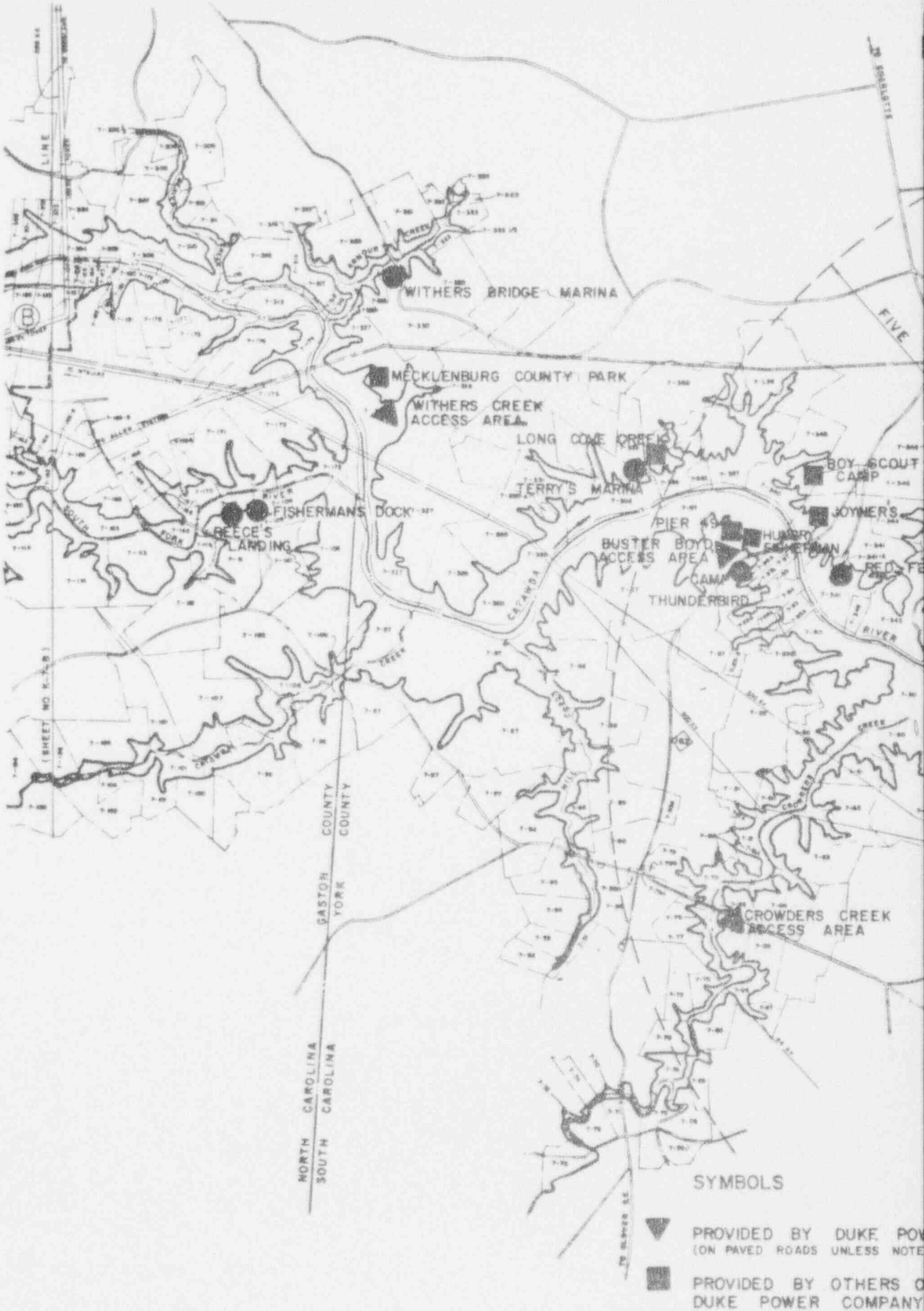
SECTION 'B-B'

ALLEN DISCHARGE STRUCTURE

CATAWBA NUCLEAR STATION

ER Figure 3.1-2

Amendment 1
(New)



WITHERS BRIDGE MARINA
MECKLENBURG COUNTY PARK
WITHERS CREEK ACCESS AREA
LONG COVE CREEK
TERRY'S MARINA
BOY SCOUT CAMP
JOYNERS
FISHERMANS DOCK
REECE'S LANDING
PIER 49
BUSTER BOYD ACCESS AREA
THUNDERBIRD
CROWDERS CREEK ACCESS AREA
NORTH CAROLINA
SOUTH CAROLINA
GASTON COUNTY
YORK COUNTY
SOUTH FORK
CATAWBA
FIVE
RIVER
LINE
SYMBOLS
PROVIDED BY DUKE POW
(ON PAVED ROADS UNLESS NOTE
PROVIDED BY OTHERS O
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RECREATION AREAS IN 5 MILE RADIUS

CATAWBA NUCLEAR STATION

ER Figure 3.3-2

Amendment 1
(New)

TABLE OF CONTENTS

Lake Norman

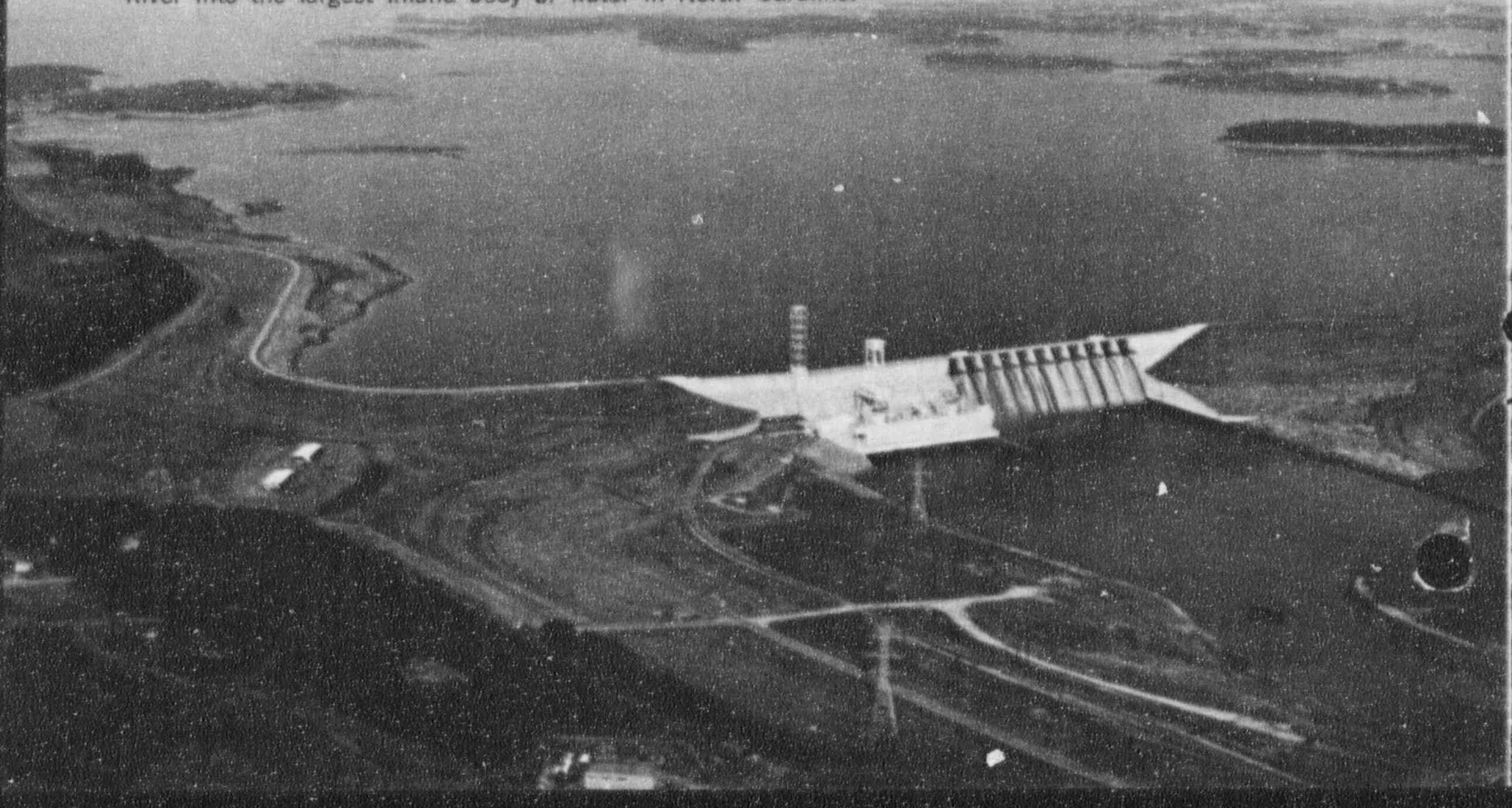
The Inland Sea

Horses reared and lunged in wild-eyed fright. The crack of musketry mingled with screams of the newly wounded and sobs of the dying. Frantic hands rammed home powder, patch, ball and a final patch. Angry eyes lined up the long rifle barrels, and fingers squeezed deadly triggers.

That was Cowans Ford, a narrow, shallow spot in the slow-flowing Catawba River—191 years ago.

Today, a high bank of white concrete holds out two arms of red Carolina clay, and together they push back a shimmery lake that fingers its way 34 miles in a northwesterly direction. Twenty miles away to the southwest a switch is flipped and the silence is interrupted by the boil of suddenly-freed water behind the bank of concrete.

This is Cowans Ford now—a mile-long hydroelectric dam transforming that same, slow-flowing Catawba River into the largest inland body of water in North Carolina.



It was February 1, 1781, when a band of North Carolina militia, commanded by General William Davidson, fought a heroic battle it had no hope of winning at Cowans Ford. Davidson's forces merely hoped to delay British Commander Lord Cornwallis in his pursuit of General Daniel Morgan and his American irregulars.

General Davidson died in the battle, and a monument nears Cowans Ford Dam and a General William Lee Davidson Memorial Area about one-half mile away commemorate the historical skirmish.

A few hundred yards away another metal marker contains "nameplate" facts about Cowans Ford Dam, the 11th and last hydroelectric installation built by Duke Power Company on the Catawba, and the resulting Lake Norman.

The length of the dam, including its earthen arms, is 7,906 feet—stretching between the counties of Mecklenburg and Lincoln, with the generating facilities on the Lincoln side.

Construction of the dam was begun in 1959 and completed in 1964, and the peaking power capacity of its four units is 372,000 kilowatts.

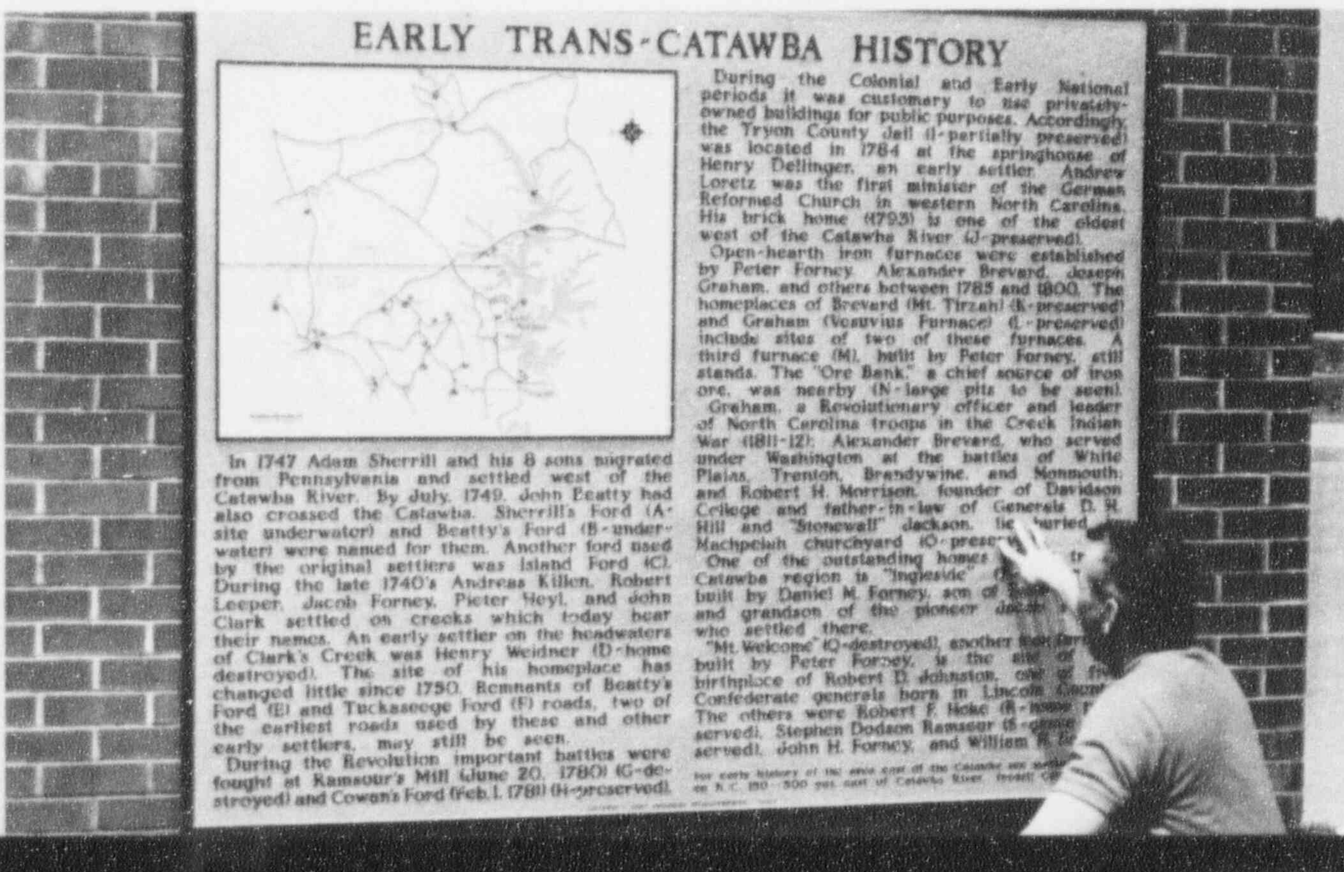
The height of the dam is 150 feet, 25 feet above the maximum water depth in front of the dam. Surface area of Lake Norman, when full, is 32,510 acres and this massive body of water is encircled by 520 miles of shoreline bordering four counties.

Marshall Steam Station, the first of a multi-billion generating complex planned for Lake Norman, was completed in 1970. Marshall's four units have a generating capability of over 2 million kilowatts, and during its first five years on the line the Marshall Station has been the nation's most efficient coal-burning facility.

Work is now underway on the McGuire Nuclear Generating Station near the east end of Cowans Ford Dam in Mecklenburg County. This two-unit station will have a generating capability of 2,300,000 kilowatts and will cost in excess of $500 million.

NORMAN ATWATER COCKE

The lake was named for Norman Atwater Cocke, retired Duke Power President, and was dedicated to the service and growth of the Piedmont Carolinas, along with Cowans Ford Station, by Governor Terry Sanford on September 29, 1964.



LAKE NORMAN - THE INLAND SEA

By Brooks Lindsay, AP

Charlotte Power Squadron

"Welcome to the Inland Sea!"

He looked like every old fisherman in the world —short grey hair, a day-old stubble of beard, a cigarette in the side of his mouth and a sizable string of fish in his hand.

I was anxious to get my boat off the trailer but I couldn't pass that up.

"Come again?"

"I've caught fish this morning," he said, as he moved off to his car, "on a lake that in some places would be called a sea."

"Read your Bible!"

Later, I did. Also, I did some quick research.

FACT: Sea of Galilee—fourteen miles long, eight miles across at widest point. Fresh water.

FACT: Dead Sea— forty-eight miles long, ten miles across. Salt water.

FACT: Lake Norman—eight miles wide at one point, thirty miles long. Fresh water. Largest inland lake in North Carolina.

FACT: Lake Norman—built by Duke Power Company, it helps carry the "peak electricity loads" of the Piedmont Carolinas.

Admittedly, it isn't the shape one normally thinks of as a sea, but there are similarities.

So what does this mean to you? Nothing, except that like the well-known storm on the Sea of Galilee, Norman can throw up some nasty weather occasionally. It's deceptive! On a calm day, it looks like the neighborhood pond. In ten minutes time it can whip up wind and waves to swamp a small fishing boat. This is because the wind has a chance to build up waves over a long distance. If it doesn't swamp you, it can turn your heart to ice as you fight your way to shore. It's worse if you have loved ones aboard.

Perhaps if one were to throw all the facts about boating, lake size and knowledge of boating by the average user of the lake into a computer it would be possible to come up with a good recommended boat size. If we had to guess, to pick a size, it would probably be around seventeen feet.

The reason for this is the larger boats are designed so well today they'll usually get a poor sailor home. But what about our old, salty, dyed-in-the-wool fisherman? He wants to fish off the points, in the reeds, bullrushes and up the coves. He likes the small, flat-bottomed skiff. Okay, here it is straight. He'd better be a **better boatman** than the large boat sailor . . . Not **claim** to be, but **be.** He'd better **know** what that little skiff can take and **know** when to try for home or when to try for a lee shore. Lake Norman isn't interested in his pride. When he plays with her, he plays her rules.

The "Ragpicker" or sailboat man, if he's experienced at all, will love this lake. He understands wind and waves because it's the first thing he learns. It propels his boat.

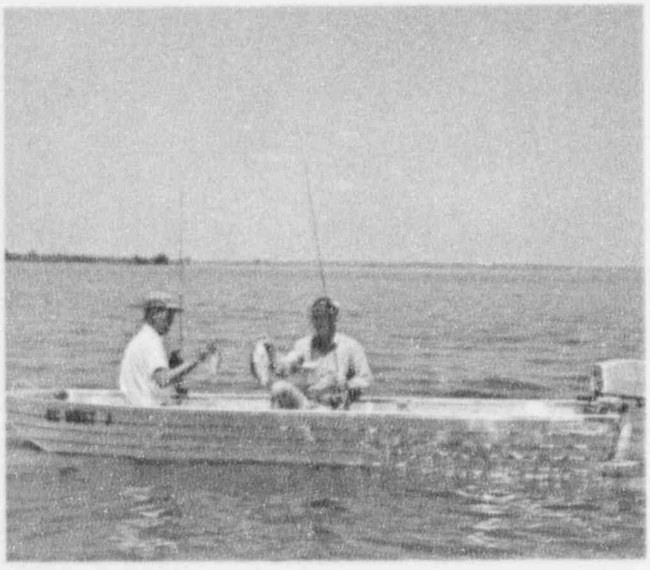
So, if one learns a bit about boats, a little about the weather and something about the Rules of the Road (driving regulations) this "Inland Sea," in addition to being a power producer, is also perhaps the most pleasant recreation area in the state.

As we said, it produces power (which Galilee doesn't), it gives more immediate recreational advantages than the ocean, there is no charge for its use, and it's close to home.

So, I'll see you around Lake Norman . . . either at the State Park or at one of the many access areas; at my own lot at the foot of Crazy Man Bay (leased to me by Duke Power), or in the middle of the lake. And if I blow my whistle (horn) I'm not telling you to get out of the way, I'm only telling you which way I'm steering my boat.

And if you'd like to know more about anything you've read here, including Lake Norman, come look us up in Charlotte in the Spring or Fall. A great bunch of guys who like people, boats and boating just like you, the Charlotte Power Squadron, will be happy to share their knowledge with you—and the nice thing about it is . . . It's FREE!

Happy boating!



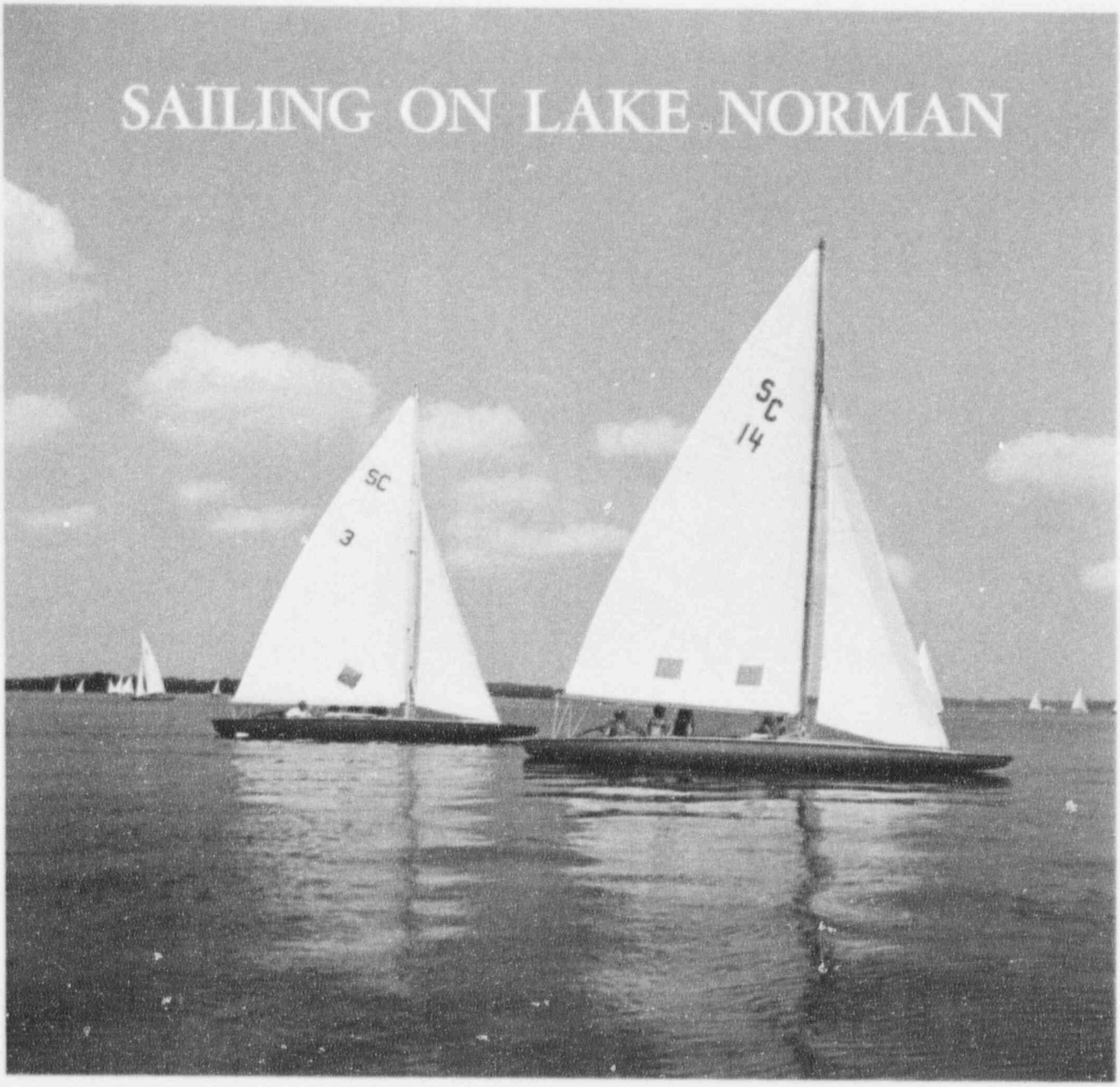
L. Brooks Lindsay, Jr. has long been associated with boating activities and boating safety in the Carolinas. He is a charter member of the Charlotte Power Squadron and was a driving force in formation of the Squadron.

Lindsay is a past commander of the Charlotte Power Squadron and holds permanent rank of commander in the U. S. Power Squadrons. He holds the educational grade of Advanced Pilot, having progressed through Piloting, Seamanship and Advanced Piloting courses.

He has attained 12 merit marks, awarded one per year by the Chief Commander of the U.S. Power Squadrons for service beyond normal duties, and this qualifies him as a senior member of the U.S. Power Squadrons.

Lindsay is an instructor for the Charlotte Power Squadron, as are all Squadron members, and is a key figure in the several 11-weeks piloting courses offered free to the public each year by the Charlotte Squadron. For information about the next class contact Lindsay or any Squadron member.

SAILING ON LAKE NORMAN



By Sandy McKeel

Lake Norman Yacht Club

With much wider expanses of open water and generally lower shoreline than other Piedmont power impoundments, Lake Norman offers excellent opportunities for pleasure sailing, competitive sailing and overnight cruising. However, the larger body of water will present conditions which should be anticipated by the novice and even by experienced sailors who have confined their sport to smaller lakes.

Whereas high winds usually produce only a chop on smaller lakes, a moderate breeze on Lake Norman can build substantial waves. Wave height depends upon not only wind velocity, but also the length of time the particular wind blows and the "fetch," or distance from the windward shore (the shore from which the wind is blowing).

While it requires 10 hours and a 75-mile fetch for a 20-knot wind to build waves to their maximum height, the violent winds in a sudden line squall have been observed to develop 2-3 foot waves (some swamped skippers have claimed 4 feet) on Lake Norman in 10-15 minutes over a 1½-2 mile fetch.

It should be remembered that there can be as much as an 8-mile fetch when a NE wind is blowing toward Cowans Ford Dam out of Reeds Creek.

Whitecaps first begin to appear in a moderate breeze of about 13-18 mph, generally safe for 10-12 foot boats. A fresh breeze of 19-23 mph produces long waves with whitecaps covering the water, and is safe for larger boats—although sailing may be rough and wet.

When you see a cumulo-nimbus cloud, you have about 30 minutes to make shore before the thunderstorm hits. If you can't reach safety, prepare to take the usual precautions. Don't be deceived by the first moderate winds blowing toward the storm. They will be followed by sudden gusts striking savagely from several directions.

When day sailing in a sustained, moderate or fresh breeze, remember that the waves which may be small when you start out will be bigger later in the day with no increase in wind velocity.

When beating into waves, try to meet them head-on and then bear off to pick up speed before heading up into the next one. Non-breaking waves release very little energy and don't push you back. Gravity makes the boat slide backward down the face of a wave, and the wind striking the increasingly exposed hull as it rises in the water pushes the boat back.

Breaking waves in shallow water (depth less than half a wave length) release considerable energy and should be avoided. In a heavy sea, try to plan your course near the windward shore where the waves will be smaller, and by all means keep your boat moving. It's easy to be stalled completely by a second wave while recovering from the previous one. The chances of swamping or capsizing are then very good.

Have fun sailing, but make sure that your boat and rigging are sound and that you are familiar with heavy weather sailing before venturing onto Lake Norman. It's a great lake for the "bed sheet brigade" but it's also different.

Charles B. (Sandy) McKeel is a former commodore of the Catawba Yacht Club, located on Duke Power's Lake Wylie, and the Lake Norman Yacht Club. He has been sailing for sport for over 25 years, and it's now a family fun affair with his wife, Mary Frances, and daughter, Debbie, joining in.

The Lake Norman Yacht Club is a member of the South Atlantic Yacht Racing Association and the North American Yacht Racing Union. Although the club's facilities do not accommodate casual visitors, persons interested in sailing or joining the club are invited to contact a member.

Complete sailing facilities are available and are gradually being expanded at the club site off County Road 1100. Regular class races are held on weekends, and as many as 150 boats from all over the Southeast participate in the club's annual invitational regatta each May.

STATE FISHING AND BOATING REGULATIONS

Fishing in Lake Norman will be among the best available anywhere in the state of North Carolina during the lake's first decade. This is the biological history of such power impoundments, and it follows the truth that Nature abhors a vacuum. New lakes usually have excellent food conditions, and this sets off a fish population explosion that continues for some five to eight years after the lake fills.

Lake Norman includes largemouth bass, crappie, bream, white bass and sauger (an import from Tennessee) among its game fish, plus catfish, carp and threadfin shad. The shad were introduced to provide food fish for the carnivorous game fishes.

North Carolina Wildlife Resources Commission fishing regulations apply to Lake Norman waters, just as they do to all public waters in the state.

A county resident may fish in Norman waters bordering his county without a license—provided he uses live bait. The use of artificial bait requires a county license costing $2.50. A state license, costing $5.50 for a North Carolina resident, will allow a person to fish anywhere in the state, including all the waters of Lake Norman, and use all types of lures and baits.

Special regulations cover the use of seines, fish traps, trotlines, and "bottle" or "can" fishing. Be sure to check these regulations before engaging in these types of fishing.

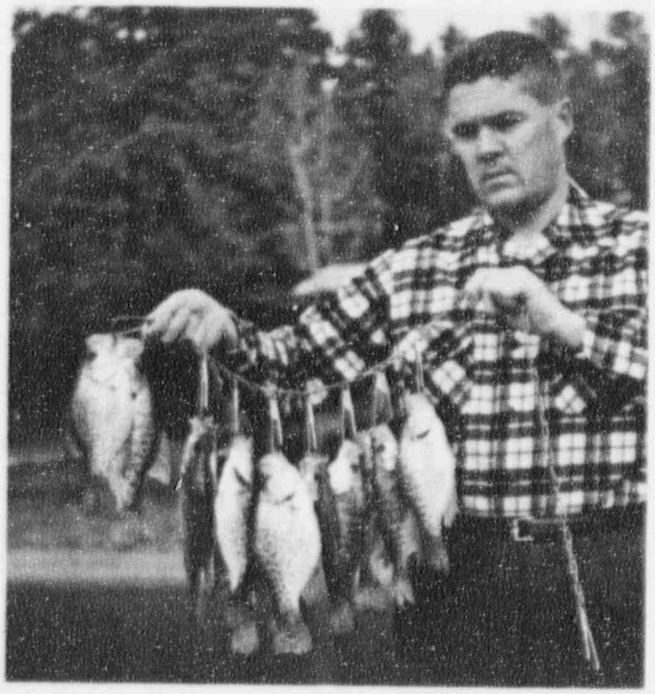
The wise fisherman, should he be fishing Lake Norman or any strange waters for the first time, will inquire of marina or fishing dock operators what recent conditions have been in regard to fishing. These people will gladly offer advice, instructions and directions as to how best to fill your stringer that particular day.

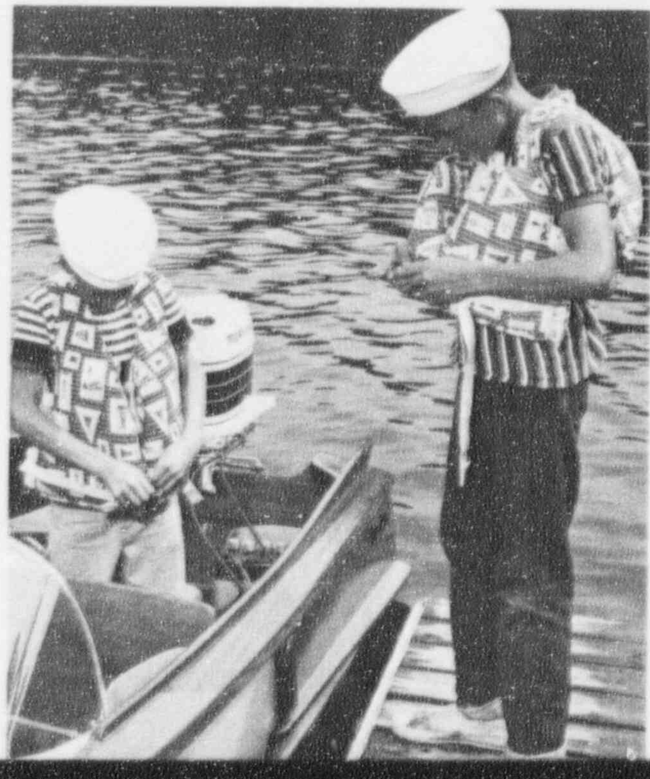
The North Carolina Wildlife Resources Commission is charged also with the enforcement of boating regulations and safety laws on inland state waters such as Lake Norman. In brief, these regulations require that all boats mounting motors of over 10 horsepower must be registered with the state and mount easily visible state registration numbers, and that a lifesaving flotation device be carried for every person aboard a boat.

All boat operators are expected to follow the usual "rules of the road" safety precautions, and reckless operation or operation of a boat while under the influence of alcohol can lead to citation and arrest by Wildlife Commission personnel or other peace officers.

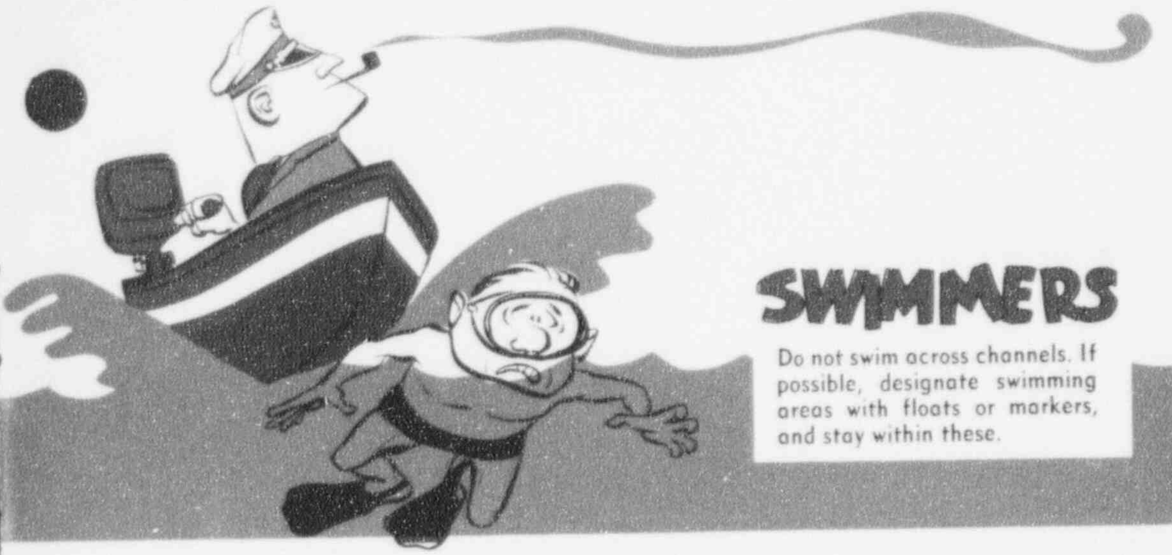
Regulations concerning water skiing require that the tow boat either carry an observer in addition to the driver, or be fitted with a rear view mirror of sufficient size and design to allow the driver to observe his skier, or the skier must wear a flotation device. The use of the "downed" skier flag is recommended.

The Wildlife Commission urges that all persons boating, skiing, or fishing in public waters such as Lake Norman observe all safety precautions and practice courtesy in their relations with other users. This will lead to safer, happier use of these recreational facilities with which the people of North Carolina have been so wonderfully endowed.



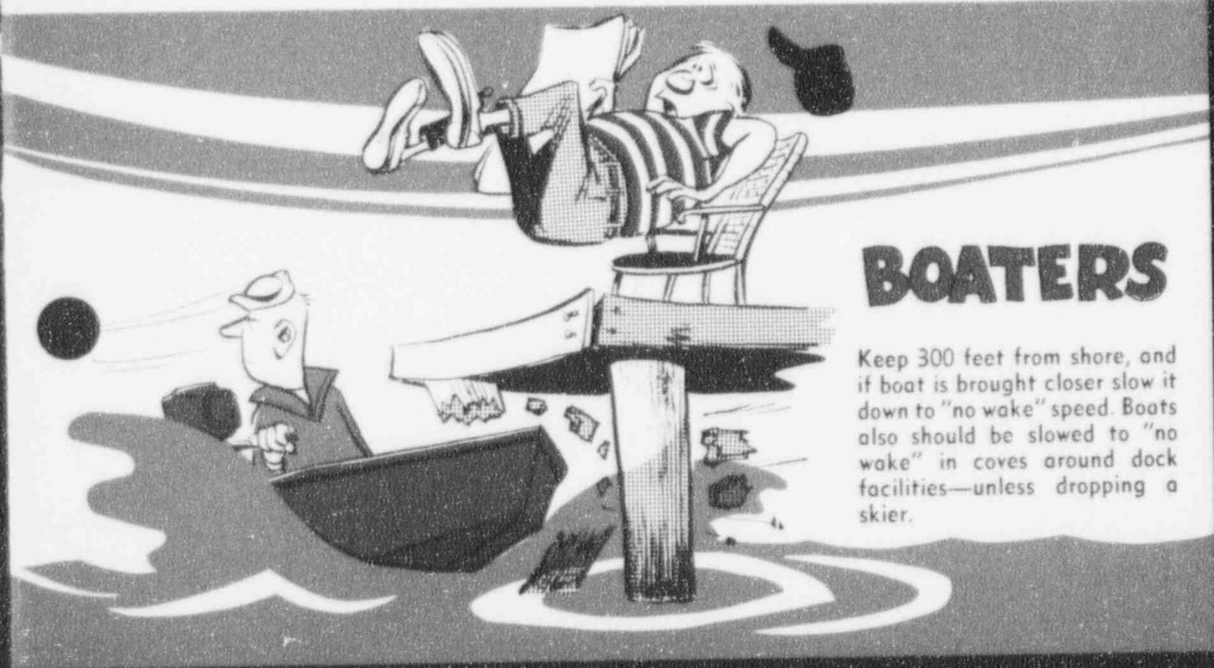


WATER SAFETY RULES



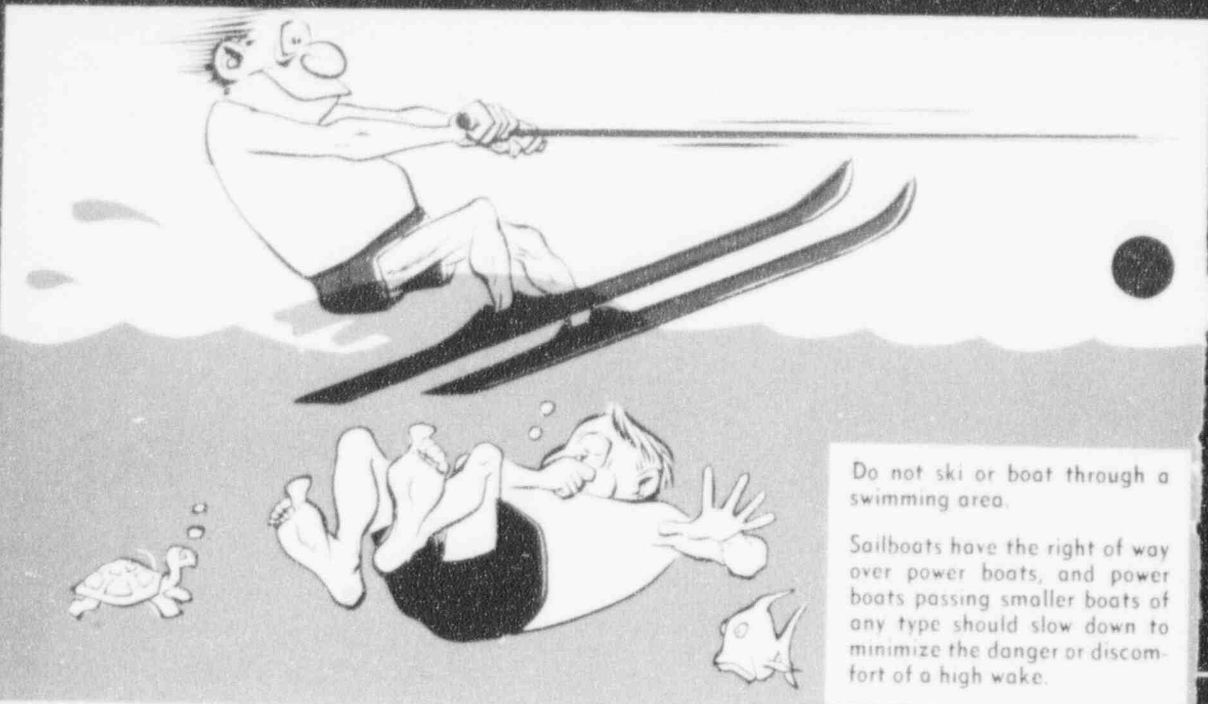
SWIMMERS

Do not swim across channels. If possible, designate swimming areas with floats or markers, and stay within these.



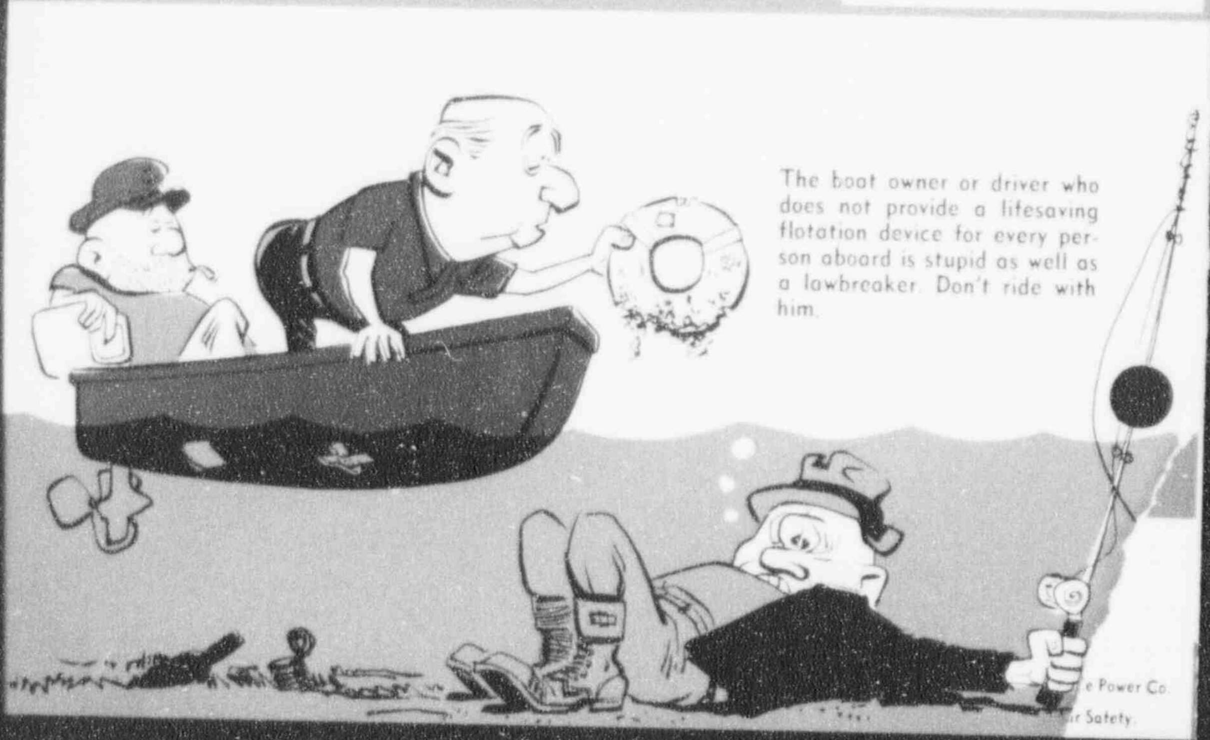
BOATERS

Keep 300 feet from shore, and if boat is brought closer slow it down to "no wake" speed. Boats also should be slowed to "no wake" in coves around dock facilities—unless dropping a skier.



Do not ski or boat through a swimming area.

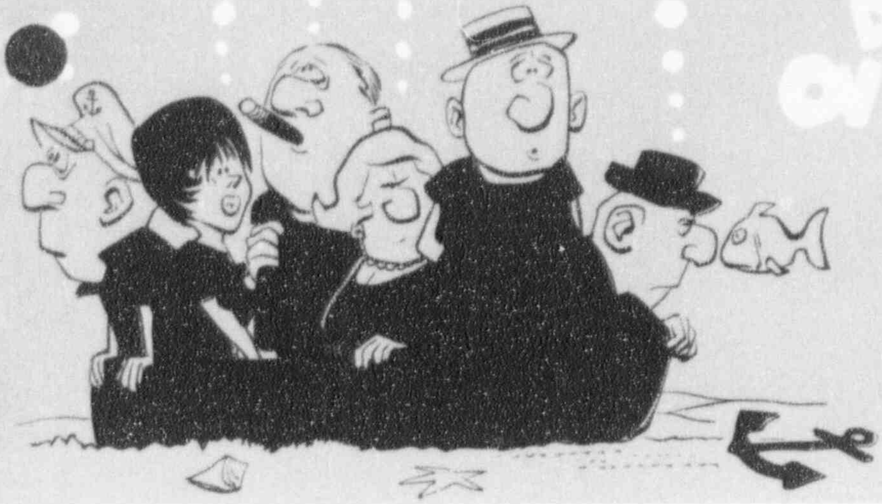
Sailboats have the right of way over power boats, and power boats passing smaller boats of any type should slow down to minimize the danger or discomfort of a high wake.



The boat owner or driver who does not provide a lifesaving flotation device for every person aboard is stupid as well as a lawbreaker. Don't ride with him.

DON'T OVERLOAD

Remember, seats do not indicate capacity.



DON'T STAND UP

If you must stand, or change seats, keep to the center with both hands on gunwales, keep low.

RULES OF THE ROAD

—IF two boats are approaching each other at an angle and there is a possibility of a collision, the boat to port (left) must give way to the boat to starboard (right).

—WHEN meeting another boat head-on, keep to starboard (right) unless you are too far to port (left) to make this practical.

—WHEN overtaking another boat, the boat being overtaken has the right-of-way. If you are being overtaken or being passed, you must maintain your course and speed.

—SAILBOATS or boats without motors always have the right-of-way over power boats unless the motor boat is being overtaken.

CITIZENSHIP
DUKE POWER
SERVICE

This booklet courtesy Duk

in the interests of you

LAKE NORMAN COMMISSION

The four counties surrounding Lake Norman—Lincoln, Catawba, Iredell and Mecklenburg—have joined in creating a Lake Norman Commission to assist in promoting safe use of the lake's waters. This commission, authorized by state law, consists of representatives from each of the four counties involved.

The Commission, after several study sessions, agreed to establish a uniform marking system on the lake and asked that, under the authority of the "Four County Act" Chapter 1025 of the 1965 Session Laws of the State of North Carolina, and also under General Statute 75A-10 through 75A-15 that the following ordinances be passed into law:

SECTION I:

It shall be unlawful for any person to move, remove, deface, damage or destroy or obliterate any navigational marker, safety marker, danger marker, or information sign or structure erected upon or in the waters of Lake Norman, or upon the immediate shores thereof, by the Lake Norman Commission acting as the joint regulating authority of Catawba, Iredell, Lincoln and Mecklenburg Counties.

SECTION II:

It shall be unlawful for any person to operate any water borne craft upon the waters of Lake Norman within one hundred fifty feet (150') of any launching area, dock, pier, marina, boat storage structure, marked swimming area, or private or public boat service areas, at greater than "No Wake" speed if said areas are marked by a "No Wake" sign. These regulations will be enforced by N. C. Wildlife Commission personnel and officers representing the Lake Norman Marine Commission.

These ordinances became effective after adoption by all four counties in June, 1966.

WHY A POWER LAKE RISES AND FALLS

Lake Norman, like all power impoundments used for hydroelectric generation, will fluctuate in level according to the generation needs for which it was built.

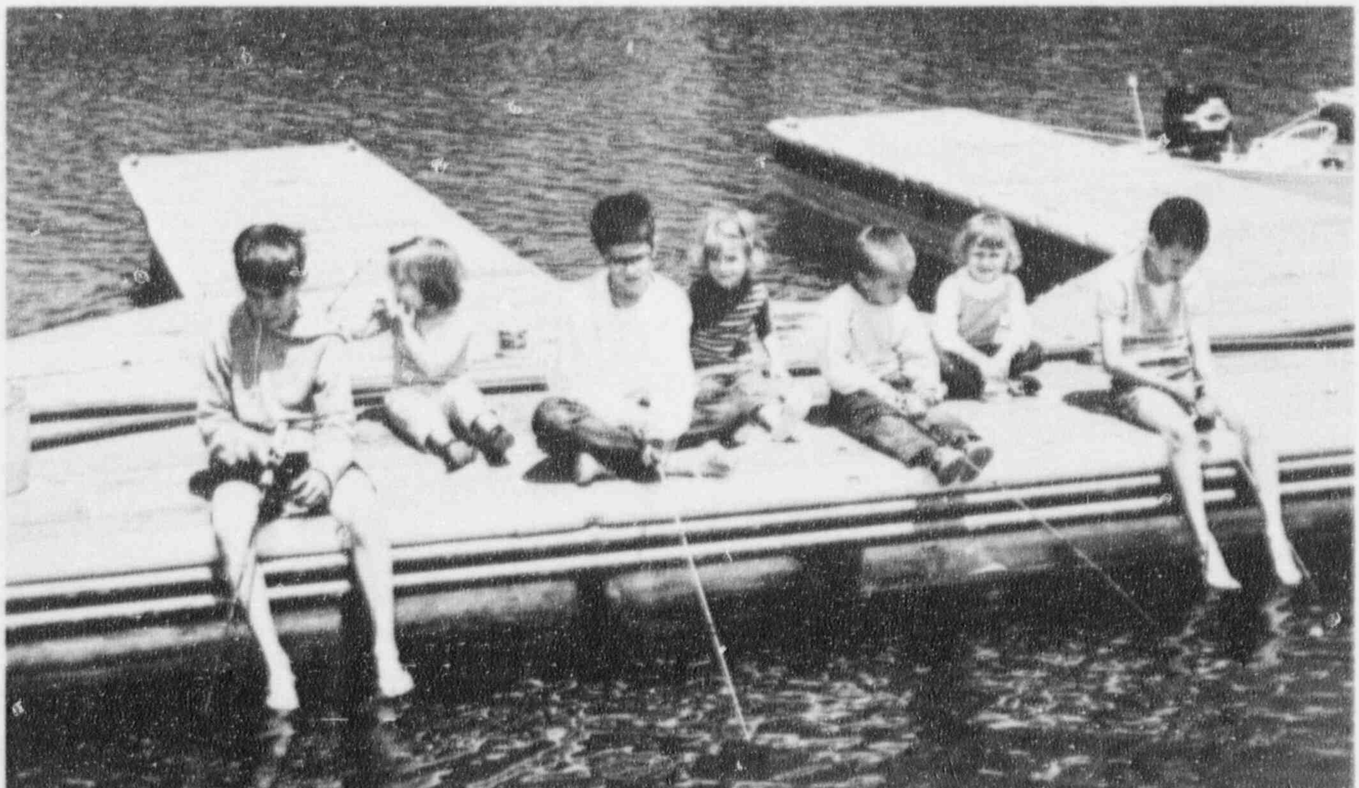
To meet the needs for electric service, the Cowans Ford Hydroelectric Station, which is part of the Cowans Ford Dam, was designed to operate at maximum efficiency from full pond to 15 feet drawdown, and to operate satisfactorily to 25 feet drawdown.

The operation of Cowans Ford has to be coordinated with the operation of other plants on Duke's Catawba River system to fit into the overall system operation in the most efficient manner.

The level of Lake Norman, as is customary with all power lakes, will vary from time to time. This is due to several factors such as: amount of rainfall, Duke's need for hydroelectric power at any given time, and emergency operation of Cowans Ford due to removal of other units on system for servicing, etc.

Generally, during an average rainfall year, the seasonal fluctuation of the pond level will be about eight feet over a period of three or four months. This may be exceeded, however, due to unusual conditions. Maximum drawdown for any one week is seldom more than two feet, but extreme situations, or emergencies may change this rapidly.

If boat docks or piers are constructed from lakeside lots, it is suggested that consideration be given to a hinged, floating portion at the tip which, of course, rises and lowers with the water.



PARKS
CAMPGROUNDS
ACCESS AREAS

In 1962 Duke Power Company made available to the state of North Carolina a 1,328-acre tract on the Iredell County shores of Lake Norman for a state park. Some portions of the park are now in use, and additional facilities will be added in later years.

The park, known as Duke Power State Park, features a 33-acre, constant-level swimming lake, an initial camping area of 33 sites with a central wash house-toilet facilities, two picnic areas totaling 110 tables and a boat-launching ramp.

A dam holds the swimming area at a constant level, and heavy sand covers the 400 yards of beach. Bathhouses and all other swimming facilities are provided.

Oren Hawkins has served as superintendent of the park since it was opened. Hawkins may be contacted by calling AC 704/528-6350. Camping reservations are not taken for less than one week nor more than two weeks, and picnic facilities are on a first come-first served basis. Minimum camping fees are $2.00 per day.

In addition to the boat-launching facility at the park, and numerous launching ramps at privately-owned marinas around the lake, Duke Power also has provided 10 access areas open to the boating or fishing enthusiast. Parking space that could accommodate 30,000 cars has been made available at these 10 areas.

Lake Norman's "big" waters have caused changes in the boating habits of the Piedmont water enthusiast. With some 33 miles of open channel from the dam to the lake's headwaters, and with numerous deep coves to explore, the cabin cruiser has become a common sight on the lake.

The large boats still are outnumbered by outboard and stern-drive runabout units, however, and advocates of these smaller craft have discovered that weather must now be included in their boating plans. Squalls over the wide sections of the lake (eight miles at its widest point) can cause uncomfortable moments for small boats, particularly if heavily loaded.

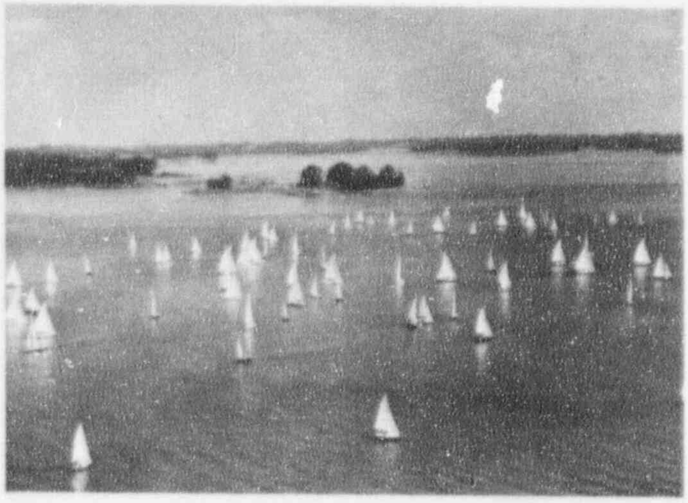
The sailboater can find plenty of uncrowded water to pursue his sport, and the sight of jaunty sails billowing in the breeze has become a common sight on brisk summer afternoons.

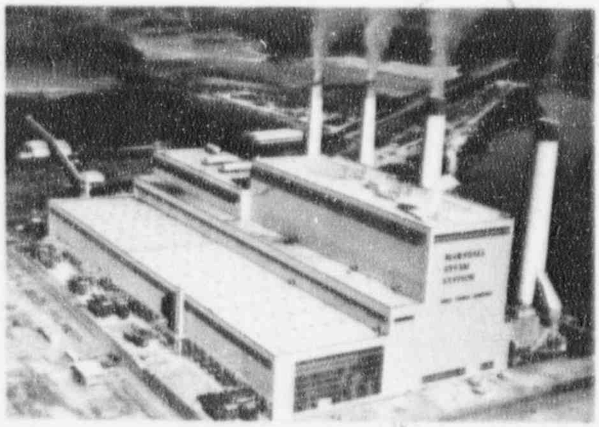
Duke Power made as much of the Lake Norman shoreline as possible available for recreational lots on a lease basis. Certain areas, of course, were set aside for future steam generation plants, and other areas for transmission lines and related facilities. Forestry projects for rehabilitation or preservation of the watershed are necessary in some areas.

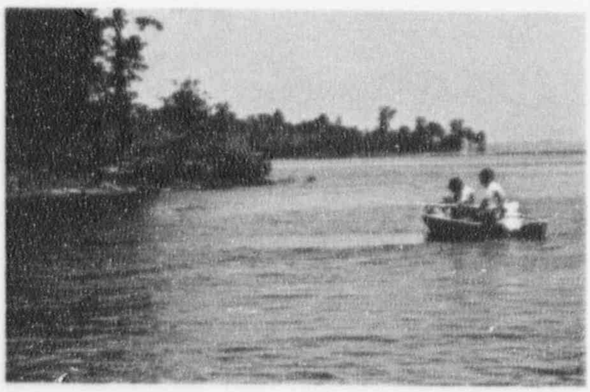
The choice lakeside lands available after fulfilling necessary company functions were then surveyed into sites for recreation cottages, and leased to the public on a first-come basis for a reasonable annual fee. Duke Power builds and helps maintain the necessary roads to reach these lakeside sites, and pays taxes on all the land involved.

Some 2,600 lots, averaging three-fourths acre each, were made available on the shores of Lake Norman. All of these have been leased to individuals, and hundreds of attractive cottages now dot the coves and points of the big lake.

In addition, much land under private ownership has been sold for home sites on the shores of all four counties bordering Lake Norman. Paved streets have been provided in some instances, and thriving colonies of summer-fun seekers have sprung up.

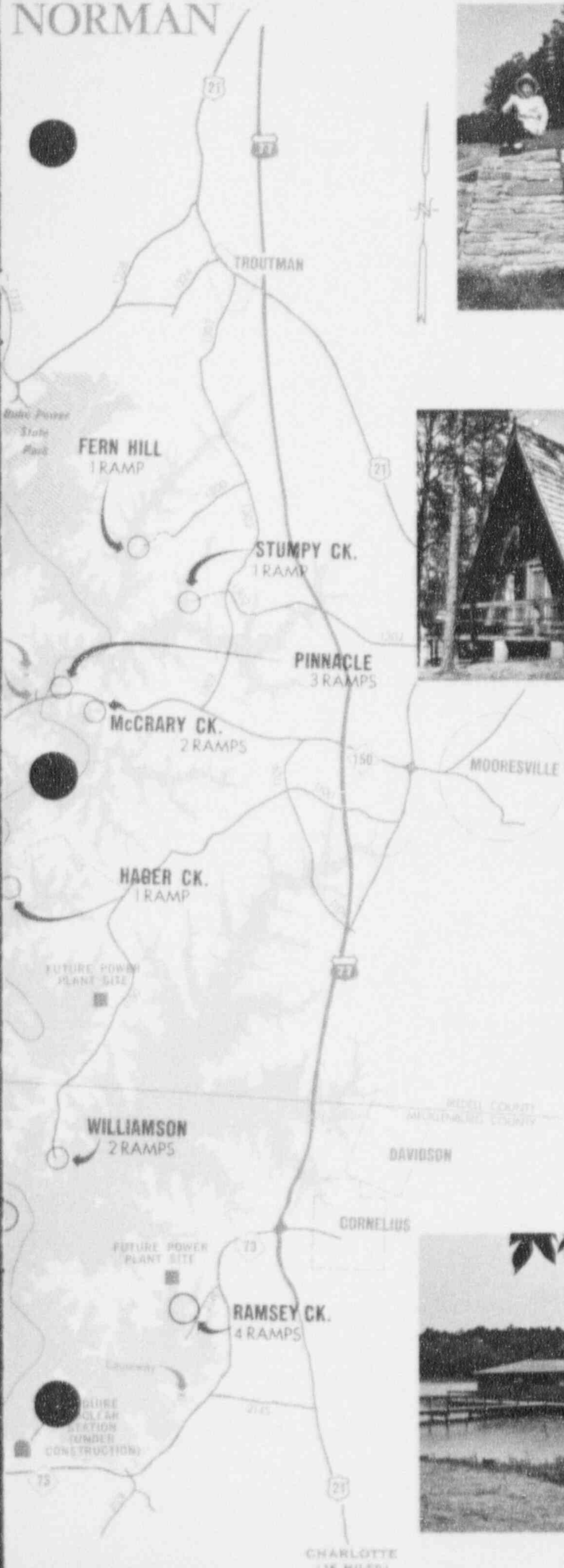


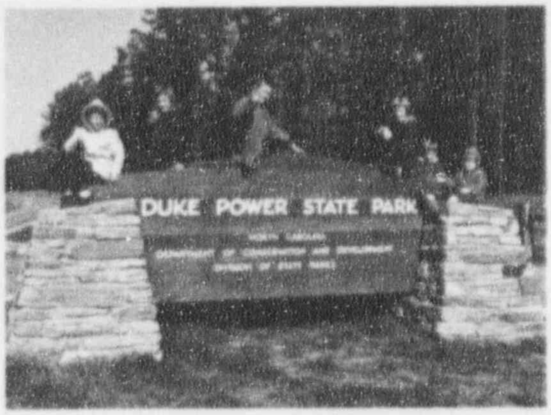


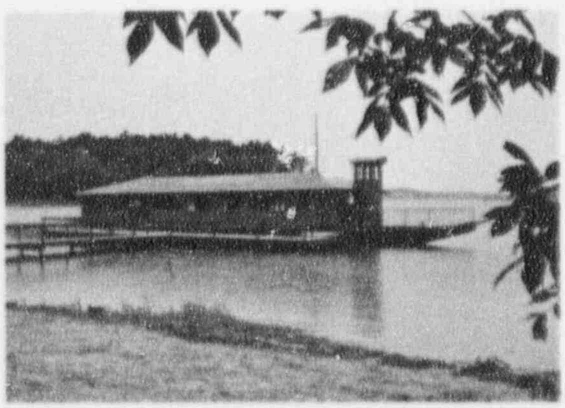


A more detailed map of Lake Norman and all of its facilities, including the secondary road systems and privately operated marinas, is available from Duke Power Company. You may receive a copy of this map free by writing Public Relations Department, Duke Power Co., 422 South Church Street, Charlotte, N. C.

NORMAN

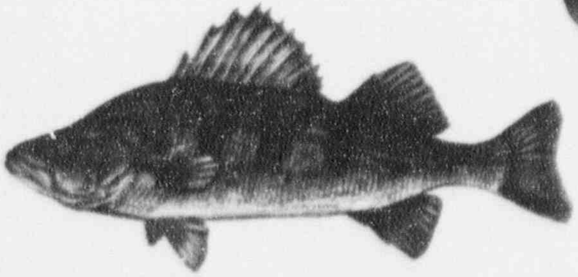

TROUTMAN
Duke Power State Park
FERN HILL
1 RAMP
STUMPY CK.
1 RAMP
PINNACLE
3 RAMPS
McCRARY CK.
2 RAMPS
MOORESVILLE
HAGER CK.
1 RAMP
FUTURE POWER PLANT SITE
WILLIAMSON
2 RAMPS
DAVIDSON
CORNELIUS
FUTURE POWER PLANT SITE
RAMSEY CK.
4 RAMPS
CONSTRUCTION)
CHARLOTTE
(16 MILES)

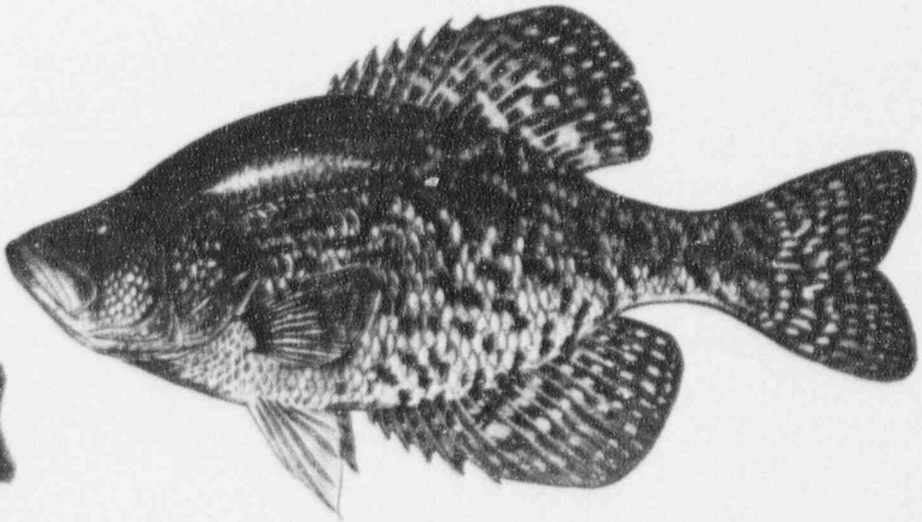

DUKE POWER STATE PARK



Favorite Fishes of Lake Norman

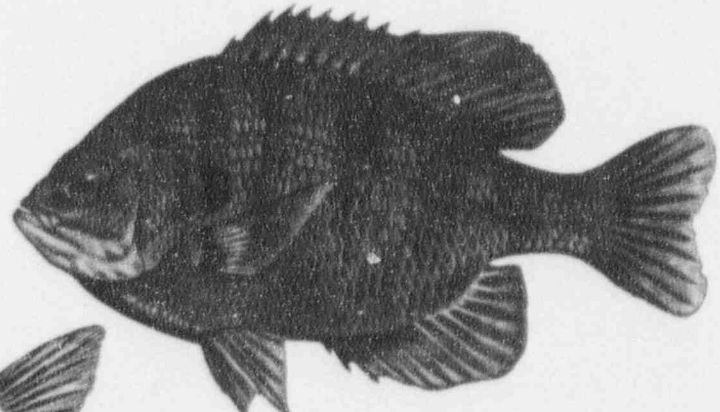
And tips on how to catch them

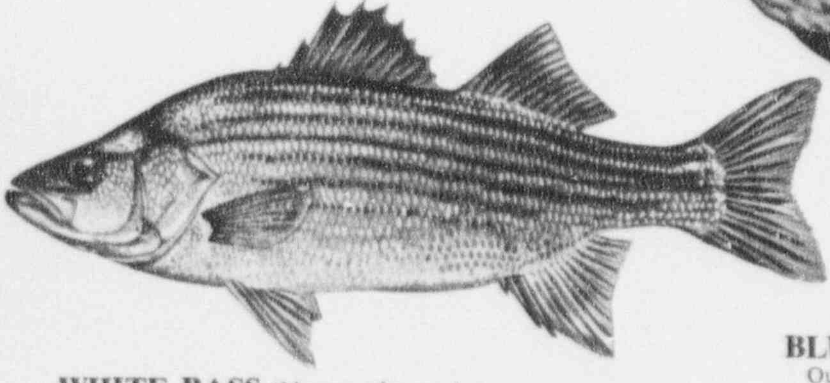




YELLOW PERCH *(Perca flavescens)*
Often referred to as the "Raccoon" Perch, this species is one of Lake Norman's most underrated game fish. Can be taken with small spinners with pork rind trail, minnows and jogs. Excellent food fish.

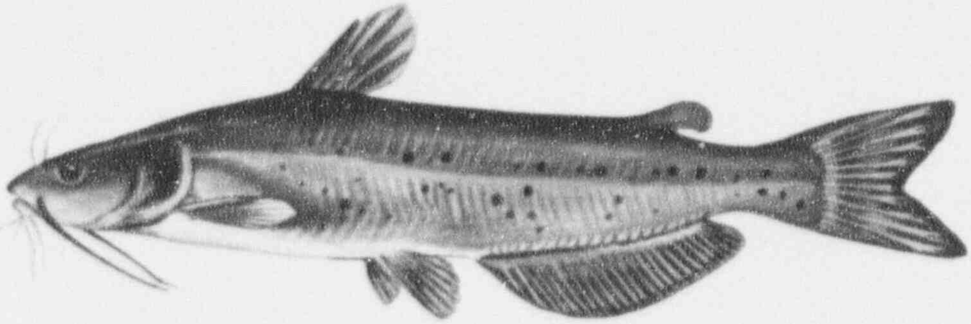
BLACK CRAPPIE *(Pomoxis nigromaculatus)*
Along with the White Crappie, this is the most sought-after panfish in Lake Norman. Caught best around submerged brush and stumps. Most productive baits are live minnows and jigs.





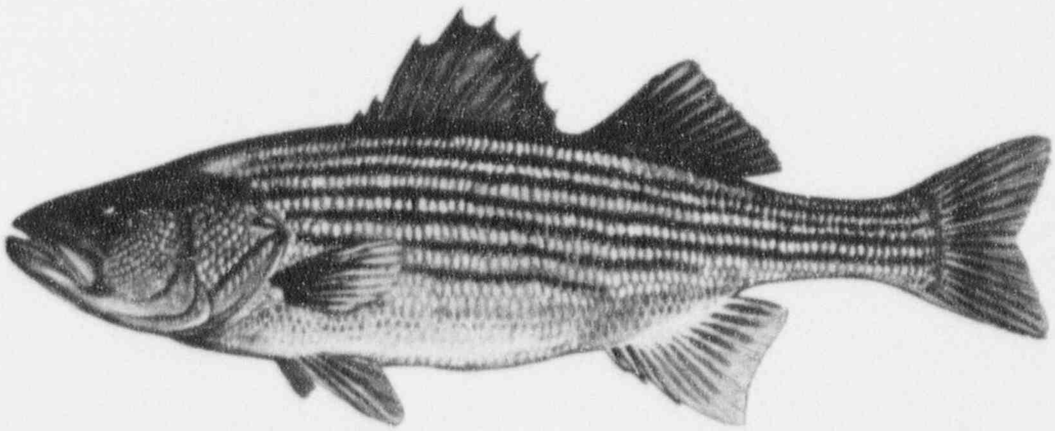
WHITE BASS *(Morone chrysops)*
A schooling fish, this scrappy fighter can be taken best in late afternoon while surface feeding on shad. A variety of jigs, spinners and small plugs are productive. Minnows are best natural bait. Usually found in open water.

BLUEGILL *(Lepomis macrochirus)*
Ounce for ounce, the best fighter in the lake, and considered among the best food fish. Bait fishermen prefer worms, beetle grubs, "catalpa worms," crickets and small grasshoppers. Can also be taken with flyrod with small spinners, streamer flies and popping bugs. Usually found in abundance around fallen trees, submerged brush and piers.



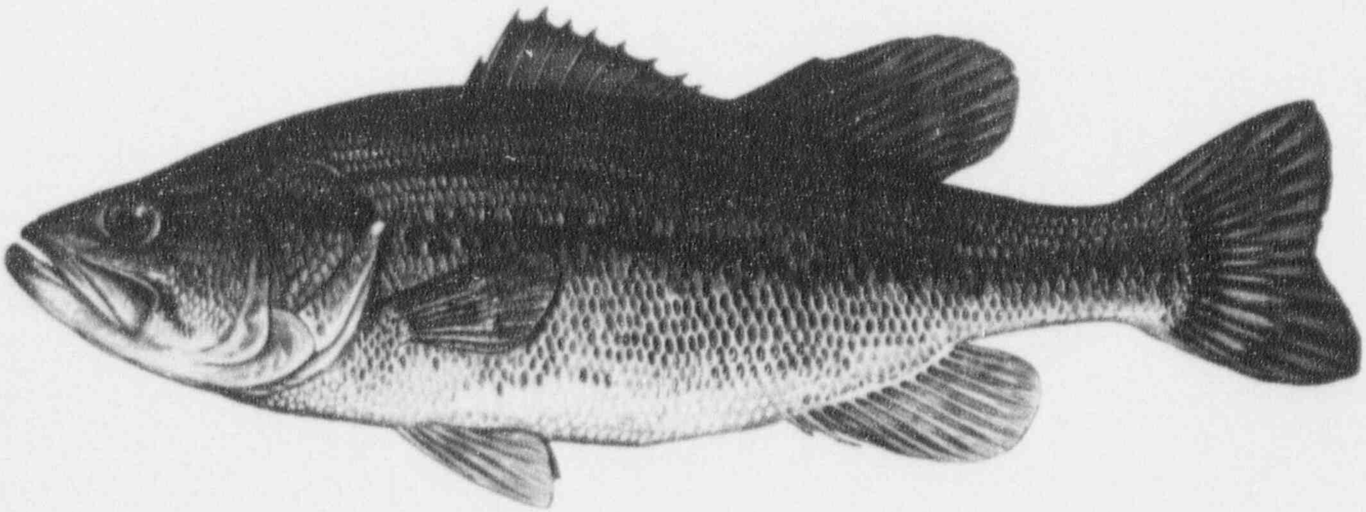
CHANNEL CATFISH *(Ictalurus punctatus)*

The Channel Catfish and his smaller cousin, the White Catfish, are tenacious fighters and considered excellent food fish. They are readily taken on worms, dead minnows and shad, dough baits and corn. At night best results are with set hooks and trot lines.
(NOTE: strict state laws govern use of set hooks and trot lines).



STRIPED BASS *(Morone saxatilus)*

A growing population of Striped Bass is providing excellent sport fishing in Lake Norman. Spinners, spoons and jigs are best lures. Although growing to much larger sizes in reservoirs where this species is better established, the average size of Striped Bass in Lake Norman is currently two pounds.



LARGEMOUTH BASS *(Micropterus salmoides)*

A spectacular fighter, this fellow is a top-quality game fish which may be taken by virtually every known method of angling. Best methods are trolling with deep-running lures off points (winter and summer) and casting with surface lures (spring and fall). Green and purple artificial worms productive in summer, along with night-crawlers and minnows. When feeding on shad, this species can be taken best with shad-like spinners and jigs. Best summer success usually in morning and late afternoon.

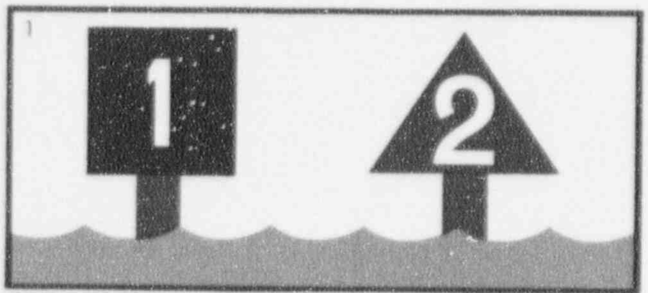
Drawings by Duane Raver, Jr., N. C. Wildlife Resources Commission

LAKE NORMAN WATERWAY MARKERS

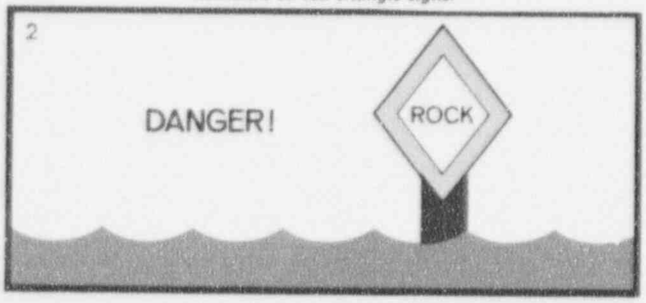
The Federal-Uniform Marking System adopted by national boating organizations for use in both ocean and inland waters is the system now in effect on Lake Norman.

Large information signs are on land tips at major water junctions to give further directions. Signs listing safety rules and boating regulations are posted at most marinas and public boat launching areas.

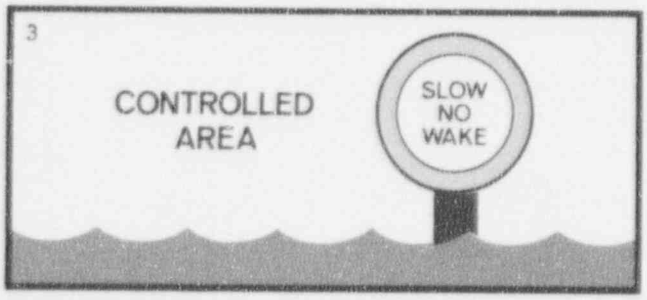
NOTE: Individuals shall not erect any sign such as those in figures 1 through 5. All such signs are erected by the Four-County Lake Norman Commission, and it is unlawful to deface, damage or destroy any of the signs.



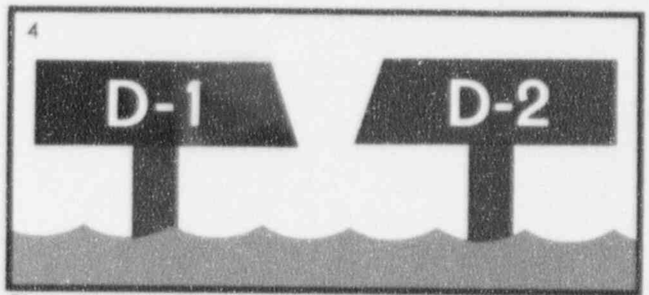
The left side of the channel going upstream from Cowans Ford Dam will be marked with odd numerals on square, black signs. The right side of the channel going upstream from Cowans Ford Dam will be marked with even numerals on red triangle signs.



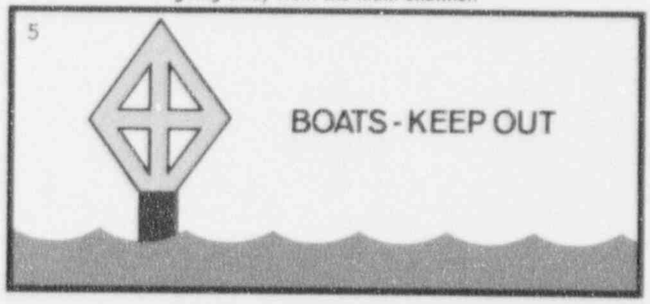
A yellow diamond indicates danger with the hazard painted on the sign in black.



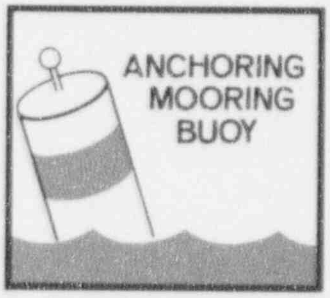
A yellow circle indicates a controlled area (such as a dock) and boats should heed explanation within circle.



The creek systems which branch outward from the main channel are marked with pointer signs. Black signs with odd numbers are on the left going away from the main channel, and red signs with even numbers are on the right going away from the main channel.



A yellow diamond with cross is another danger indicator, and boats should not progress beyond that point.



Individuals may use a blue-banded white buoy with an anchoring ring for anchoring boats near shore or docking areas.

A red flag with a white diagonal band on a float indicates a skin diver. Give at least 25 yards clearance.

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4 ENVIRONMENTAL EFFECTS OF CATAWBA NUCLEAR STATION

4.1 THERMAL EFFECTS

4.1.1 ECOLOGICAL EFFECTS

Catawba Nuclear Station site straddles the narrows of a peninsula which extends southeasterly in to the main body of Lake Wylie, a hydro electric reservoir of 12,455 acres impounded in 1925. This peninsula is bounded on the south by a Lake Wylie cove receiving Big Allison Creek. The station site is located approximately midway between the headwaters of Big Allison Creek Cove and the juncture of this cove with the main lake some 4 1/2 miles upstream of Wylie Dam. The flow of the Catawba River averages 4400 cfs at Wylie Dam. The lake undergoes seasonal stratification with fairly rapid loss of oxygen from the hypolimnion, dropping to levels of 1.0 mg/l and lower at the 50 foot level by mid-June and lasting until late August. Early overturn typically has occurred in this lake due to hydroelectric discharges withdrawing hypolimnetic water from a depth of 20 to 50 feet. Very low oxygen concentration is seldom found at depths shallower than 25 feet and thus extension of this condition into the shallower side arms of the reservoir would be limited by this depth contour.

The lake surface area that is expected to be most directly affected by the heated discharge is the zone comprising approximately 250 acres upstream of the condenser cooling water discharge point and 425 acres downstream from the discharge to a point in the center of the main body of the lake. The area of immediate ecological concern is therefore an arm of Lake Wylie which can be described as a comparatively shallow body of water of just under 1000 surface acres. Other areas, in the main body of the impoundment, of approximately 1270 acres upstream of the reservoir center point and 700 acres downstream to the dam are also considered biologically a somewhat different body of water because of the greater water depth as well as summer oxygen limitations at the deeper levels. The Big Allison Creek Cove shallows from about 40 feet at the juncture with the main reservoir to 30 feet at the point of condenser cooling water discharge. This ecological differentiation is being made since the annual natural depletion of oxygen from the deep water establishes limitations on those organisms that might be found in this environment.

4.1.1.1 Depth of Euphotic Zone

Another significant factor in establishing trophic levels as well as energy flow components in a small lake or reservoir is the depth of the euphotic zone. This defines the surface volume of water in which energy utilization by chlorophyll fixes carbon for new cell material, the action of the primary producers at the base of the trophic pyramid. Early water quality studies on Lake Wylie by Duke, e g "The Catawba River, Limnological and Water Quality Studies, June - October, 1959, Special Study A, Production of Oxygen in the Surface Water of the Catawba Reservoir by Photosynthetic Activity," established that the depth of the compensation point for the bottom of the euphotic zone, at station 66.4 (immediately upstream of the dam) and station 68.1 (mouth of Allison Creek) by both diurnal sampling studies and light - dark bottle experiments, was consistently at a depth of 15 - 20 feet. At these stations the depth of the euphotic zone extended to the top of the thermocline and the upper boundary of the low oxygen water of the hypolimnion.

4.1.1.2 Fishes of Lake Wylie

At the other end of the trophic pyramid as compared to the primary producers
of the euphotic zone are the carnivorous fish. The fishery characteristic of
Lake Wylie is the usual assortment of warm water species found throughout the
lakes and streams of central and eastern North and South Carolina (Table 4.1-4a).
1 Fish population studies by the North Carolina Wildlife Resource Commission (1965)
and South Carolina Wildlife Resources Department are described in Appendix 4A.
It is important to note that fishes in Lake Wylie are also found in Norman and
vice versa; therefore, the extensive studies of thermal effects of Marshall
Steam Station on Lake Norman are relevant to Lake Wylie as well as to other
lakes in this area.

1

Due to blocking of the Catawba River by the series of dams forming the hydroelectric impoundments, there is no significant migratory movement of fishes in this system. Therefore, the indigenous species found in the reservoirs spend their life cycle in their confines. Thus the energy flow as converted by the primary producers is restricted and maintained in the body of water as it moves through various trophic levels with little or none being transported out of the aquatic system by the movement of fish up or downstream.

4.1.1.3 Nutrient Enhancement and Pollutants

Major sources of municipal pollutants and other sources of plant nutrients are limited to discharges from several small municipalities at the head of Lake Wylie on the main arm of the reservoir and along the South Fork of the Catawba River upstream of the Allen Steam Plant discharge canal. These points of discharge are under the jurisdiction of the Department of Water and Air Resources, State of North Carolina and are required in terms of quality of discharge to meet the quality criteria for the receiving waters that have been established by this agency. A recent survey of plant nutrients in Lake Wylie and in comparison to other bodies of water on the system is shown in Table 4.1-1. The sampling point for this series on Lake Wylie was just upstream of the dam. It is evident that in the sequence of Lakes Norman, Mountain Island and Wylie a pattern of increment of total algal cells in the euphotic zone seems to be one related to the quantity of total phosphorus. However, the quantity of phosphorus is generally well within that amount recommended for lakes and impoundments in current federal criteria. It should be noted that Lakes Norman and Mountain Island receive no direct wastewater discharges from any municipal sources. However, home development on the shores of Lake Wylie and in the immediate vicinity of the proposed plant site unless carefully controlled, in terms of septic tank performance, could very well lead to higher levels of nutrient enhancement and higher sustained levels of primary producers.

Since the nutrient cycling of nitrogen and phosphorus in a lake is so intimately related to the physical and chemical characteristics of the stratification, overturn and mixing sequences of a lake, it is essential that the annual cycling of these materials be established with reference to the sustained population of primary producers. A sampling series in the arms of the lake adjacent to the plant site and along the main axis of the impoundment at the critical seasonal periods will be carried out. It may be found that certain species of algae are characteristically dominant in the seasonal variation and in turn may be more or less sensitive to passage through the plant cooling system.

4.1.1.4 Intermediate Trophic Levels

Between the primary producers and the top of the trophic pyramid may be several steps including zooplankton (herbivores and detritus feeders), benthic organisms (herbivores and detritus feeders), small carnivores and finally at the top of the pyramid the large carnivores. As will be noted in the tabulation of the fishery of Lake Wylie, the top of the trophic pyramid is dominated by fishes that are plankton feeders with only a limited number of carnivorous species representing but a small portion of the total fish population.

The macro-invertebrates comprising the benthic herbivores as well as benthic organisms of temporary residence (aquatic insect larvae) follow marked seasonal patterns. There are generally maximum populations in winter and spring dropping to low numbers in summer as the various species leave their larval states and the aquatic habitat. Thus the characteristics of this population as well as emergent sequences which are sensitive to water temperatures could undergo a shift in time with respect to their normal period of emerging. A program is now underway to establish these sequences as well as the characteristics of the benthic invertebrates including the aquatic insects so that the normal pattern of the life cycle be established both in areas that might be affected by plant effluent as well as in suitable control locations.

A diagram of the probable trophic levels in Lake Wylie and the associated arms of the lake drawn with reference to known limnological considerations and showing energy flow components is presented in the attached Figure 4.1-1.

Biocides will not be introduced to the condenser cooling waters since proven mechanical means (Subsection 4.1.4) will be used to maintain clean steam condensers resulting in minimum heat rejected to lake waters.

4.1.2 BACKGROUND STUDIES

In 1959 Duke began limnological investigation of all its existing reservoirs on the Catawba River in order to have adequate information to predict and influence water quality in the proposed Cowans Ford Reservoir, now Lake Norman. Lake Wylie was an important part of these investigations and surveillance of the lake has been continued since the initial studies. In his unpublished report to Duke Power Company, Dr. Charles M. Weiss, limnological consultant to Duke, outlined the physical characteristics of the Catawba River reservoirs as follows:

"A comparison of certain physical characteristics of impounded bodies of water as compared to natural lakes can serve to explain some of the changes found in these reservoirs. Lakes usually have a shape analogous to a basin with shallow water on the perimeter and the deepest in the center. Inflow and outflow is usually through relatively shallow breaks in the edge. In contrast an impoundment, although having shallow water along its edges, has its deepest water at one end and particularly in hydroelectric impoundments usually the end through which there is a regulated movement of water. There is also a general shallowing of the impoundment in the upstream direction until it reaches the depth of the uncontrolled stream of river feeding into the reservoir.

"The characteristic asymmetry of an impoundment basin results in water quality characteristics which at the shallow end are comparable to those found in rivers and at the deep end resembling in part those of natural lakes. This division of an impoundment into a 'river' and 'lake' section was clearly seen in the behavior of all parameters that were analyzed . . ."

In describing the stratification of Lake Wylie in the summer of 1959, Dr. Weiss observed that, because of the depth of the hydroelectric intakes, stratification does not remain as strong throughout the summer as in a natural lake. Lake Wylie "developed the temperature profiles characteristic of stratified lakes early in the summer but which changed to a gradual temperature gradient from top to bottom as the season progressed. Although the zone of rapid temperature change per unit of depth did not persist throughout the summer, the thermal gradient that continued was sufficient to maintain density differences with resulting formation of marked differences in the vertical distribution of dissolved oxygen, turbidity, iron and manganese."

4.1.3 SAMPLING PROGRAM FOR THE ENVIRONS OF CATAWBA NUCLEAR STATION

4.1.3.1 Biological Sampling for Lake Wylie

The Lake Wylie biological monitoring program will consist of a minimum of one full year of data which will be collected prior to plant operation. This survey will provide background information on numbers and kinds of organisms present in the lake as well as data on important chemical and physical characteristics. Once the power plant is installed and condenser cooling waters are being discharged, the receiving body of water will be monitored to detect any detrimental effects. Adequate plans will be made to assure that operational data can be compared with pre-operational data to detect significant changes, including any interaction between Allen Steam Station and Catawba Nuclear Station. Supplemental sampling will be undertaken to determine the impact of plant construction on the biota in the immediate site area.

The Lake Wylie monitoring program is to be coordinated with the work of other investigators and sampling programs at other relevant locations (e g "RP-49 Lake Norman, "Thermal Effects - Allen Plant" and "The Biological Sampling Program for the Aquatic Environs of McGuire Nuclear Station") to achieve maximum multi-use of data. Duke will continue to monitor Lake Wylie overall as well as the immediate aquatic environs of Allen Steam Station and the proposed Catawba Nuclear Station.

Proposed Biological Sampling Program

1. Benthos

Benthic sampling at the Catawba site is being carried out at the present time in conjunction with benthic studies at Allen Steam Station 15 miles upstream from the proposed Catawba Nuclear Station. Sampling stations have been located in the proposed intake and discharge coves as well as in control areas up and downstream from the site. In order to define existing benthic conditions, sampling will be seasonal (four per year).

2. Zooplankton and Phytoplankton

Plankton will be sampled by standard plankton techniques and will provide the following information: (1) identification of the major groups (diatoms, green algae, blue-green algae, flagellates, etc); (2) number of organisims per major group; and (3) chlorophyll estimation. Sampling stations will be located at the intake and in the discharge area as well as up and downstream from the site. Sampling will be conducted bimonthly (six per year).

3. Periphyton

Periphyton will be sampled using periphyton substrates (e g, plexiglass plates or glass slides). Representative samples will be analyzed for species composition, chlorophyll or ash-free dry weight. Four to five stations will be established and maintained in the intake, discharge and control areas. The substances will be exposed for one month intervals; samples will be taken monthly.

4. Fish *

The fisheries study should provide the following data: (1) species composition; (2) size class; (3) age composition: and (4) spawning areas on Lake Wylie with emphasis on Allison Creek Cove. The determination of spawning areas will be during the spawning season. Sampling procedures and the frequency of sampling will be determined at a later date.

5. Synoptic Water Quality

Necessary parameters (temperature, dissolved oxygen, nutrients, etc) will be sampled to establish baseline water quality data and to provide supporting data for the benthos, plankton, periphyton and fish sampling programs. The quality of water being discharged downstream from Lake Wylie will also be included in this program.

6. Continuous Water Temperature Monitoring

In order to supplement the synoptic water quality program, several continuous temperature monitoring stations will be located in the vicinity of Catawba Nuclear Station within the expected plume trajectory and the intake structure. Particular attention will also be directed toward monitoring interaction, if any, between Allen Steam Station and Catawba Nuclear Station.

*The fisheries study will be requested from the South Carolina Wildlife Resources Department. If this state agency cannot undertake such a project, other possibilities will be explored.

4.1.3.2 Terrestrial Study - Immediate Site Area and Transmission Corridors

A survey of vegetation will be initiated during the spring or early summer of 1973 prior to the start of construction of Catawba. This survey will include three sampling stations (Figure 4.1-16) two of which will be located within areas receiving maximum impact from construction and future operation of Catawba. The third station will be located outside the exclusion area and will serve as a control.

The objective of this study is to determine or measure the effects of construction and the subsequent operation of Catawba upon the immediate terrestrial environs. A late vernal and early autumnal sampling schedule has been selected to provide an admixture of seasonal vegetation types. An overlay will be prepared from an aerial photograph to delineate the distinct vegetative types within the site area. Permanent condition - trend transects will be located and recorded for each of the three sampling stations (Figure 4.1-16). One station will be located in or near the exclusion area in the vicinity of the discharge cove; the second station will be located in the site area along the transmission corridor to be cleared to Shelby, North Carolina; and the control station will be located in an undisturbed area outside of the immediate area of influence of Catawba. The measurement of present conditions of vegetation with later measurements along the same transects will be useful in determining long-range trends which may be due to construction and/or future operation and/or normal vegetative succession. An additional aspect of this vegetative survey includes a determination of dominant tree species (≥ 4" dbh) at each of the three stations. The survey will not be reverified until prior to operation of Catawba.

Approximately 334 acres (Subsection 7.6.5) of possible wildlife habitat within the exclusion area will be cleared for the construction and subsequent operation of Catawba, the exclusion area (450 acres) presently consists of 382 acres of wooded land (mostly loblolly pine), 23 acres of cleared land, and 45 acres of water. The partial loss of this possible habitat will result in a corresponding loss and/or change in the wildlife inhabitants. According to Walt Schrader, District Wildlife Biologist, Rock Hill, South Carolina, no wildlife population studies have been conducted in this particular locale. A list of mammalian and avian species for York County, South Carolina has been prepared from the available literature (Table 3.4-2 and Table 3.4-3). To determine the actual numbers of mammalian and avian species now occupying the immediate site area is not possible without a major commitment of manpower and a detriment to the wildlife itself. Potential benefits, if any, do not justify an intensive faunal sampling program and the quality of data obtainable is questionable. Duke does not plan to undertake such a sampling program but will continue to review the literature to update the list of mammalian and avian species known to occur in the site area.

Amendment 1
(Entire page revised)

4.1.4 DESCRIPTION OF CONDENSER COOLING WATER SYSTEM

The condenser cooling water system for Catawba consists of an underwater weir upstream of Wylie Hydroelectric Station, a skimmer wall at the mouth of the intake cove, an intake structure, condensers and a discharge structure.

As stated in Subsection 4.1.2, the temperature profiles which develop in the lake during early summer are characteristic of stratified lakes. Since the water discharged through Wylie Hydro Station comes from the lower layers of the lake, the cool water is lost, reducing the stratification in late summer. To retain this cool water and make it available to Catawba, a sub-
1 merged weir, with its crest 20 feet below full pond level, will be built just upstream of the dam (Figure 4.1-2). The volume of cool water available will be small compared to Catawba's requirements. However, with judicious use, the volume will be sufficient to keep Catawba's discharge temperatures below 103 F, a temperature which some of Duke's steam plants have produced for years with no serious detrimental results. As an additional benefit, water passed downstream will have a higher dissolved oxygen content than that presently being discharged and will improve the water quality of the Catawba River downstream of Wylie Dam. This concept of retaining the cool water from the winter months for use during the summer has been tested and proven on Lake Norman and will also be used at Lake Keowee.

The submerged weir will be constructed of rock from a quarry approximately
1 1-1/2 miles below Wylie Dam on property currently owned by Duke or a suitable alternate source.

The placement of a submerged weir in front of Wylie Dam will result in the
1 receiving waters below the impoundment being of generally higher quality. These waters will be both warmer and higher in dissolved oxygen.

Based upon 20 years of historical temperature records, the operation of the nuclear plant on Lake Wylie and the function of the submerged weir, average monthly discharge temperatures below Wylie Dam have been predicted. Occurrences of individual average monthly discharge temperatures exceeding 93 F
1 for the months of June, July and August would be 5 in 60 months, and the number of predicted occurrences of individual average monthly discharge temperatures exceeding 90 F for the same three months would be 29 in 60 months. The highest predicted discharge temperature from Wylie Dam is 94.4 F.

The reaction of fish and their associated biota to an increase in temperature is discussed in Subsection 4.1.6.

Water will be drawn into the plant from the Catawba River arm of Lake Wylie. This water will move under a skimmer wall equipped with movable gates which will allow condenser cooling water to be drawn from the surface layers during normal operation. During unusual or extreme weather conditions, when the upper water is warm enough to produce discharge temperatures higher than acceptable, the skimmer wall can be adjusted so that cool low-level water will be drawn into the condenser. After the water passes under the skimmer wall, it will be drawn through an intake cove to the intake structure. The

circulating pumps will supply water to the steam turbine condensers and will also supply service water to miscellaneous uses such as heat exchangers. Duties performed by the service water include air conditioning, turbine oil cooling, recirculating cooling water cooling and component cooling for the primary side of the plant. Service water is pumped from the condenser cooling water intake pipes before reaching the condenser, passes through heat exchangers and then enters the condenser cooling water discharge piping
1 downstream of the condenser. No treatment is planned for control of organic growth in the station service water system.

Service water requirements vary with the maximum being 3-4 percent of the circulating flow. All circulating water except service water will pass through the condenser.

Due to the possibility of Asiatic Clams being in the condenser circulating water piping, cleanable strainers will be installed in the pipes upstream of the automatic condenser tube cleaning system. The debris removed will be sent to a landfill. One condenser waterbox may be cleaned with the unit in operation.

Figure 4.1-3 shows an elevation and typical sections of the skimmer wall. Cool water will pass through the skimmer wall with low velocities to avoid harm to fish and destruction of lake stratification.

The intake structure (Figure 4.1-4) will provide support for the circulating
1 pumps and racks and screens. The racks will prevent large objects from entering the intake structure, and the screens will collect smaller objects. Debris collected on the racks will be periodically removed and taken to a landfill. The material collected by the screens will be directed through the trash trough to a trash collection pit, and it will also be periodically removed to a landfill.

System design is not complete yet, but approximate circulating pump flows and temperature rises across the condenser for full load operation are tabulated below:

	Circulating Flow-Two Units (cfs)	Temperature Rise Across Condenser (F)
2 Pumps Per Unit	2800	26
3 Pumps	3800	19
4 Pumps	4500	16

The service water also experiences a temperature rise. However, this temperature rise is lower than the condenser rise, and the effect of the service water is to slightly lower the discharge temperature of the condenser water. Thus, it is seen that the preceding temperature rises represent the upper limit and that the actual rises experienced will be slightly lower than these shown. The service water systems of the two units at Catawba Nuclear Station will be interconnected. Therefore, when a unit is off-line, its pump may be cut off and its service water may be drawn from an operating unit.

1 The condenser tubes are 1-1/8 inch outside diameter 22 gage 304 stainless steel and are 52.71 feet long.

The lengths of condenser cooling water conduit are as follows:

	Unit 1	Unit 2
1 Condenser Intake Conduit	940 Ft	1470 Ft
Condenser Discharge Conduit	1340 Ft	770 Ft

Steel plate for the pipe shell and flanges will conform to ASTM Specification A-283, Grade C. Steel plate for pipe stiffeners and for reinforcement of specials will conform to ASTM Specification A-36.

Condenser cleaning is accomplished by injecting sponge rubber balls into the condenser inlet. These balls are slightly larger than the condenser tube diameter and they clean the tubes as they are forced down them by the water flow. The balls are recaptured at the condenser outlet for reuse. This eliminates the need for injecting chlorine, or other biocide, into the circulation water.

The discharge facilities at the Catawba Nuclear Station will be designed to allow the warm water to float on the surface of the lake with a minimum amount of mixing. This type of discharge will facilitate cooling and minimize the affected area. The discharge structure is shown on Figure 4.1-5 and the lay-
1 out of the condenser piping is shown on Figure 4.1-6. The intake and discharge channels are shown on Figure 4.1-17.

Preliminary estimates of the velocities at the skimmer wall and the intake screens are tabulated below:

Lake Elevation - 569.4 Ft	2800 cfs 2 Pumps	3800 cfs 3 Pumps	4500 cfs 4 Pumps
Skimmer Wall	0.46 f/s	0.62 f/s	0.73 f/s
Intake Screens	1.02 f/s	0.92 f/s	0.82 f/s
Lake Elevation 559.4 Ft	2 Pumps	3 Pumps	4 Pumps
Skimmer Wall	0.46 f/s	0.62 f/s	0.73 f/s
Intake Screens	1.50 f/s	1.36 f/s	1/21 f/s

Figure 4.1-8, Sheets 1 through 3 show the physical bed contours of Lake Wylie from Allen Steam Station to Wylie Hydroelectric Station. Figure 4.1-8a shows the physical bed contours in the immediate area of the plant intake, discharge,
1 Allison Creek embayment, the Standby Nuclear Service Water Pond and the Waste Water Collection Basin. The area-volume curve and table for Lake Wylie are given on Figure 4.1-8b.

4.1.5 PHYSICAL EFFECTS OF THERMAL DISCHARGE INTO LAKE WYLIE

There is insufficient flow in the Catawba River through Lake Wylie to make dilution of the thermal discharge a large factor in temperature reduction. Therefore, the heat must be spread over a large surface area so that three processes - conduction, evaporation, and radiation - can remove the heat to the atmosphere. Transport of heat through water is accomplished primarily by moving the warm water from one place to another (convection), since the processes of conduction and radiation in the water are relatively small.

One of the major convective mechanisms is advection or movement of water due to ambient and pumping currents. To describe heat transfer from a water surface where advection is the principal convective mechanism within the water body, the following equation has been developed from the work of Velz and Gannon:[1]

$$A = 62.4 \text{ Btu} - \text{deg } F^{-1} ft^{-3} \; Q \sum_{T_1}^{T_2} T_w/H$$

where A = area required to cool from T_1 to T_2,

T_w = temperature increment,

H = net heat loss (see Edinger and Geyer[2], p. 45), and

Q = flow.

Two other convective mechanisms affecting water are: 1) mixing, which is the transport of water due to ambient turbulence in the lake (primarily wind induced) and 2) density current advection, which is the flow of water due to density difference. Edinger[3] has lumped these processes together and describes them with a term called diffusivity. According to Edinger's work the temperature loss due to the above processes can be described with the following equations:

1) $B_1 = \left[K/(\text{Depth} \times \text{Width}^2 \times \text{Diff})\right]^{\frac{1}{2}}$

1 where K = surface heat exchange coefficient (see Edinger and Geyer[2], p48),

Depth = average depth of channel,

Width = average width of channel,

Diff = diffusivity, and

[1] "Forecasting Heat Loss in Ponds and Streams", C. J. Velz and J. J. Gannon, Vol. 32, No. 4, Journal WPCF, April 1960.

[2] "Heat Exchange in the Environment," J. E. Edinger and J. C. Geyer, Report No. 2, RP-49, Cooling Water Studies for Edison Electric Institute, Johns Hopkins University, June 1965.

[3] "Shape Factors for Cooling Lakes," John Eric Edinger, Journal of the Power Division, Proceedings of the American Society of Civil Engineers, December 1971.

2) $T = T_1 - K \times (T_1 - E) \times \left[1\text{-Exp}\ (-1 \times B_1 \times AREA)\right] / B_1/Q/62.4\ \text{Btu-deg}\ F^{-1}ft^{-3}$

where T = new temperature,

T_1 = initial temperature across opening o sidearm,

E = equilibrium temperature,

AREA = area of arm, and

Q = flow across the opening of the sidearm

Note: Exp is the exponential function. For derivation of Equation 2, see end of section.

A value of $10^6 f^2/d$ was used for "Diff" since it yields a reasonable but con-
1 servative (predicts higher inlet temperature) fit to data measured near Allen.

To estimate the intake and discharge temperatures at Catawba Nuclear Station, a computer model has been developed using these equations. The program is listed in Table 4.1-11 and described below.

The lake is divided into six sections, labeled A through G in Figure 4.1-7. Heat loss in Sections B, F and G is described by the advection equation, and that in Sections A, C and E by the diffusion equation. The description of the heat loss in Section D is dependent on the amount of flow through the lake. When the flow through the lake equals or exceeds the flow required by the plant's condensers, the model draws the water needed by the plant from the ambient flow at ambient temperature. A temperature increment is added to the condenser cooling water and the water is discharged at point 2. The size of the temperature increment is determined by the quantity of cooling water being used and the load factor of the plant. From point 2, the model simulates cooling of the water in
1 Sections A, B, C, D, F and G in that order. The heat loss in Section D is described by the diffusion equation. Surface areas and shorelines of Sections A through F are found in Tables 4.1-8 and 4.1-9 respectively.

If the plant's cooling water requirements exceed the river flow, the water is cooled in Sections A, B and C. The recirculated portion is then cooled in Sections D and E, and mixed with ambient temperature water at point 1 to be recirculated throughout the plant, and to repeat the cycle. The heat loss in Section D is described by the advection equation. This recirculation is repeated until the plant intake temperature is nearly the same as it was on the previous cycle, signifying that a state of equilibrium has been reached. Then the program simulates the cooling of the unrecirculated water in Sections F and G. Since there is a small quantity of cool water in the bottom of the lake, provisions will be made to utilize this cool water to provide cooler discharge temperatures in the summer than would be possible otherwise.

A maximum temperature can be specified, and the model will calculate the flow of cool water required in the intake to achieve that temperature.

The ambient temperatures of the inflows to Lake Wylie are necessary input for this simulation. To obtain these ambient temperatures, average monthly inlet temperatures from Allen Steam Station, which is approximately 11 miles upstream of the Catawba Nuclear Station, were compared to average equilibrium temperatures which had been computed from Douglas Airport meteorology. This was done for a ten year period. Based on this data, the following relationships are used in the simulation to establish an ambient temperature:

	Month	Lake Wylie Ambient Temperatures
	January and December	-Equilibrium +8 F
	February and August	-Equilibrium +3 F
	March through June	-Equilibrium +0 F
	July	-Equilibrium +2 F
2	September through November	-Equilibrium +6 F

Monthly average meteorological and hydrological data for the 20 year period 1951-1970 have been used as inputs to the model, and monthly average plant intake and discharge temperatures have been computed. These results are shown in Table 4.1-2.

A load factor of 91 percent is assumed for the plant year round. This factor is based on the assumption that the plant will operate at 100 percent capacity five days and at 70 percent capacity the other two days of each week. No credit is taken for yearly refueling outages.

For these computations, it was stipulated that the discharge temperature was not to exceed 103 F. Whenever the program calculates a discharge temperature greater than this limit, it makes a back calculation to determine what quantity of "low-level" water is required to keep the discharge temperature from exceeding 103 F. The temperature of the low-level water is assumed to be 70 F. This temperature is a conservative estimate based on measurements in Lake James - a lake formed by the impoundment of the Catawba and Linville Rivers. These two sections of the lake are connected by a 30 foot-deep canal. Since there is no low-level outlet from the Catawba River portion of the lake, the canal bottom acts as a weir similar to the one proposed for Lake Wylie. Temperature measure-
1 ments in Lake James show that while the streams flowing into the lake average 70 F in the summer, the bottom water remains at approximately 50 F (Source: Catawba River Basin Pollution Survey, 1961, N. C. State Stream Sanitation Committee). The results of the simulation show that Catawba will only need low-level water three months in 20 years to avoid exceeding 103 F and that these months are not in the same year. Further, the quantity needed in the warmest month is only 1/4 of the water which is available. Monthly discharge temperatures exceed 100 F only 18 months out of the 20 year period, or less than one month per year.

Table 4.1-3 shows the simulated years ranked from "worst" to "best" for various parameters and the values of the parameters. From this table, it can be seen that a year considered "bad" in one respect might be "good" in another. For instance, the year 1969 requires more area below Wylie Dam cooling the condenser discharge within 5 F of ambient than any other year. Yet it is the year with the lowest average discharge temperature. By looking at the "Yearly Average Discharge" and "Yearly Average Area Below Dam" columns, one might pick 1964 as
1 a nearly average year. But then 1964 is the year with one of the lowest maximum excess temperature at the dam. Since no particular year is bad or average in all respects and since there is disagreement as to which parameters are the most important, no one year has been singled out as the average year and no year is labeled the extreme year. Figures 4.1-9 and 4.1-10 show the predicted isotherms for January 1954 and July 1956, respectively. These two months are

shown because their predicted discharge temperatures are exceeded in 10 percent (1 in 10 recurrent interval) of the winter (January, February and December) and summer (June, July and August) months over the 20 years of record. Figures 4.1-11 and 4.1-12 illustrate the predicted 3 degree excess isotherms for January 1955 and July 1954, respectively. These lake areas are exceeded in 10 percent (1 in 10 recurrence interval) of the winter and and summer months. The surface elevation of Lake Wylie is nearly always within a few feet of its maximum (569.4 feet above msl). During the years 1951-1970, the average of the maximum drawdowns for each year is 5.4 feet. For most of the year, drawdowns are substantially less than this average. Therefore, the effects of drawdown and accompanying loss of surface area on the predicted temperatures are expected to be minimal. Results of computations simulating drawdowns of 5 feet and 10 feet show that the volume of cool water is sufficient to keep discharge temperatures below 103 F in both cases. However, temperatures at points in the lake are computed to be higher than temperatures at full pond. For instance, the surface temperatures at the dam are $\frac{1}{2}$-2 degrees higher at 5 foot drawdown
2 than at full pond, and 1-3 degrees higher at 10 foot drawdown. (Table 4.1-2a,b,c).

Over the 20 simulated years (assuming full pond), the average discharge temperatures by month are:

January	70.5 F	July	100.1 F
February	70.6 F	August	99.7 F
March	74.0 F	September	95.4 F
April	79.1 F	October	84.0 F
May	88.9 F	November	75.9 F
June	95.9 F	December	71.5 F

These are the expected discharge temperatures from Catawba. Alternate cooling systems are discussed in Section 5.3.

Subsection 4.1.4 describes the use of a movable skimmer to divert the Catawba River flow through the Catawba Nuclear Station. The rate of the river flow, plant discharge temperature and the cool water level during the summer months will be the main factors considered in the operation of the skimmer. The operation of the skimmer is an important consideration in the analysis of the dissolved oxygen concentration which will be found in Catawba's condenser cooling water.

1 The general conditions which will exist during the summer months are (1) the river flow exceeds the plant flow; (2) the river flow is less than the plant flow and recirculation is taking place, but the plant discharge temperature is less than 103 F; and (3) the plant discharge temperature is approaching 103 F. For the condition where the river flow exceeds the plant flow, the water will consist of the ambient flow which will be drawn from a layer that extends from the surface down to elevation 550 (crest of the downstream weir). When recirculation is taking place but the discharge is less than 103 F, the condenser cooling water will be a mixture of the ambient flow and the recirculated water. The ambient flow will pass under the condenser cooling water plume, but the maximum duration time for this has been estimated to be 0.5 day. This estimate is based on the maximum area affected to the 3 F (above ambient) isotherm. Since the area affected upstream of the intake is small and the occurrence of this effect is infrequent (see Table 4.1-2), it can be assumed for the dissolved oxygen analysis that the condenser cooling water

will be taken from the same level as in the case with no recirculation. This will be a conservative approach since the condenser cooling water will be discharged on the surface where reaeration will be taking place, if the dissolved oxygen concentration is not in equilibrium, before recirculation occurs. The following estimates of the dissolved oxygen concentrations from Catawba are based on the data found in Table 3.9-2 and averaged over a 20 foot depth:

June	July	August
6.8 mg/l	5.6 mg/l	5.5 mg/l

If the discharge temperature is approaching 103 F, the skimmer will be adjusted so that the cool water can be drawn from the lower layers. In the estimate of the dissolved oxygen concentration which will be discharged from Catawba, the cool water pool is assumed to have a zero dissolved oxygen concentration. The maximum flow from this pool has been estimated at 400 cfs (see Table 4.1-2). The following estimates of the monthly average dissolved oxygen use the above assumption and a total plant flow of 4500 cfs:

June	July	August
6.2 mg/l	5.1 mg/l	5.0 mg/l

Although Catawba will add a substantial heat load to Lake Wylie, its effect on early stratification will be confined to the southern portion of the lake. The opposing flow of the river will prevent warmed water (3 F or more above ambient) from extending farther upstream than the vicinity of the intake. Experience at Marshall and Allen has shown that, in a normally isothermal lake, as warmed water approaches ambient (3-5 F above ambient) it mixes to the bottom of the lake. Thus, any heat from Catawba which extends farther upstream than the intake will likely be mixed to the lake bottom and will not cause early stratification. There will be areas near the discharge where stratification will be present throughout the winter. During this period, there will be horizontal transport of water along the bottom and vertical transport in the unheated isothermal areas of the lake which will displace the subsurface water in these heated areas; therefore, there will be continued exchanges of the water in the lake bottom which will eliminate any permanently stagnant zones.

There are currently two private waste treatment facilities discharging into Lake Wylie in the area between the proposed Catawba intake and Wylie Dam. These facilities, which are part of a planned 4-unit system for a housing development on the eastern shore of the lake, have the following design flow and estimated effluent BOD load(1):

	Unit #4	Design Flow (gpd)	Design Flow (cfs)	Estimated Effluent BOD (mg/l)
	1	45,000	.070	30
	2	32,000	.050	30
	3	29,000	.045	30
2	4	39,000	.060	30

Both of the completed units discharge into the upper end of two relatively long (2000 ft) and shallow (20 ft at full pond) coves.

(1) Letter of March 20, 1973 from Ronald W Kinney, Field Representative, South Carolina Pollution Control Authority.

Figures 4.1-9 through 12 show that the expected 1:10 occurrence of temperature rise in the area of these coves is 12 F over a summertime ambient of 86.8 F and 14 F over a wintertime ambient of 50.7 F. Therefore, a potential exists for interaction of the thermal plume from Catawba and the waste discharge from these treatment facilities. The worst case for waste assimilation would be in the summer when the lake is stratified and lower DO levels and
2 higher temperatures exist. One potential interaction is that the rate of BOD exertion and DO depletion may be increased due to increased temperatures.

This would, in fact, occur but since the DO in the surface layer is not appreciably affected by the plant operation as described above and since the amount of BOD discharged into the coves is low (11.3 #/day for unit 1), the increased temperatures are not expected to be a problem. The other potential interaction is that the elevated temperatures due to Catawba would strengthen the already present summertime stratification and force the wastewater discharge to flow under the warmer upper layer into the deoxygenated lower layers. However, because the present discharges are into long, shallow coves, they would be forced to remain in the oxygen rich upper layers for the entire length of the coves and would have warmed to the temperature of the surface layer upon entering the main body of the lake, thus preventing underflow into the oxygen depleted layers. Therefore, although the treatment facilities discharge into the somewhat undesirable long, narrow coves where waste transport and dilution are reduced, the effects of temperature increases on these discharges are not expected to be a problem.

Derivation of Equation 2

The heat loss in a cove will cause a drop in the temperature of the water flowing by the mouth of the cove. The temperature drop is found by a heat budget analysis where the quantity of heat approaching the cove equals the quantity leaving and the quantity dissipated from the surface of the cove.

$$p \times Cp \times Q \times (T_1 - T) = \Delta H$$

$$\Delta H = K \times \int_0^{AREA} (T-E)\, dA$$

$$= K \times \int_0^{AREA} (T_1 - E) \times EXP\,(-B_1 \times A)\, dA$$

$$= K\,(T_1 - E) \times \left[1 - EXP\,(-B_1 \times AREA)\right] / B_1$$

$$pcpQ\,(T_1 - T) = K \times (T_1 - E) \times \left[1 - EXP\,(-B_1 \times AREA)\right] / B_1$$

$$T = T_1 - K \times (T_1 - E) \times \left[1 - EXP\,(-B_1 \times AREA)\right] B_1/p/Cp/Q$$

4.1.5.1 Effects of Thermal Discharge on Water Quality below Wylie Dam

As shown in Table 4.1-2 and discussed in Subsection 4.1.5, Catawba Nuclear Station will affect temperatures downstream of Wylie Dam. As shown in Table 4.1-2, the maximum monthly average temperature elevation above ambient at Wylie Dam is predicted to be 13.3 F (March 1955). It will also be noted that maximum temperature elevations at the dam occur in the winter and spring months when river flows are high and temperatures are low. Table 4.1-2d shows that in only 11% of the 240 months predicted will the temperature elevations above ambient at Wylie Dam be greater than 10 F. Table 4.1-2d also gives the magnitude and frequency of elevated temperatures at several points below Wylie Dam (See Figure 4.1-19 for location of these additional points). Also, Table 4.1-2d gives magnitude and frequency of temperature elevations above ambient expected in the summer months when dissolved oxygen (DO) may be a critical factor. As can be seen from Table 4.1-2, a temperature elevation above ambient of 10 F is never attained at Wylie Dam in the summer months, and the occurrence of 5 F temperature elevation is reduced to zero at S C Highway 9, some 30 miles below Wylie Dam.

DISSOLVED OXYGEN CONCENTRATIONS

A computer program has been developed to study the sensitivity of the downstream DO concentration to predicted elevation in temperature due to Catawba Nuclear Station. The program uses a segmented DO model, superimposed on the temperature prediction program described in Subsection 4.1.5. The simulation uses the Streeter-Phelps equation as described by Velz[1] and the program requires the following inputs:

1. Waste load being discharged downstream
2. Initial DO
3. Temperatures
4. Initial BOD
5. Reaeration coefficient (K_2)
6. Deoxygenation coefficient (K_1)

The waste loads being discharged downstream were obtained from the Environmental Protection Agency discharge permit applications filed for all discharges between Wylie Dam and Highway S C 9. It was decided to carry the analysis only as far as S C 9 since the temperature predictions show that out of 240 months only 5 percent would have temperatures elevated over 5 F above ambient due to Catawba Nuclear Station and in the summer months, no instances of temperatures over 5 F above ambient would occur (Table 4.1-2d). Analysis of the discharges in this stretch showed that of the known industrial discharges, only two contributed substantial BOD loading to the river. These were Celanese near U S 21 (avg = 5,304#/day) and Bowater's near S C 5 (avg = 15,988#/day). The sum of the other industrial discharges in this reach was less than 100#/day of BOD, therefore they were omitted from the analysis. Two municipal discharges,

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[1] Velz, Clarence J, Applied Stream Sanitation, Wiley-Interscience, New York NY, 1970.

Rock Hill and Fort Mill, located in this reach were included, but due to the proximity of the Fort Mill discharge to the Celanese discharge, these two were combined. Sugar Creek, which receives the discharge from the Charlotte, N C sewage treatment plant, flows into the Catawba River between the Rock Hill municipal discharge and the Bowater discharge. Because of the lack of reliable flow and BOD loading data on Sugar Creek, it was taken as a constant discharge of 330 cfs based on USGS records at Station 2-1465 and a BOD load equal to the average of 118 measurements taken by the state of South Carolina over the last 14 years.(1) Therefore, the segmented DO model consists of five reaches: (1) Wylie Dam to Celanese - 4.9 miles, (2) Celanese to Rock Hill discharge - 0.9 miles, (3) Rock Hill discharge to Sugar Creek - 5.2 miles, (4) Sugar Creek to Bowater - 7.5 miles, and (5) Bowater to Highway S C 9 - 11.3 miles.

The initial DO was taken as the average of the Wylie tailrace measurements (Table 3.9-1). Temperatures were taken as the average temperature within each segment as predicted by the program described in Subsection 4.1.5. Initial BOD was taken as 2 mg/l at Wylie tailrace (see Table 3.9-9 which shows this figure is exceeded only 22 percent of the time). The reaeration coefficient (K_2) is calculated from Churchill's (2) reaeration model which takes into account velocity and depth of river flow. The deoxygenation coefficient (K_1) is taken from Fair, Geyer & Okun(3) and is a typical value for treated industrial and municipal wastes. In addition, since the purpose of this simulation was only to test the sensitivity of stream DO to changes in temperature it was assumed that the proposed submerged weir in front of Wylie Dam has no effect on initial DO when in reality it will increase summertime DO in the tailrace. Temperatures used in the simulation reflect the presence of the submerged weir.

Using the above model, simulations of the downstream DO were conducted using:

(1) predicted ambient temperatures

(2) predicted elevated temperatures due to Catawba Nuclear Station

Table 4.1-2e shows the maximum differences between runs (1) and (2) for each month. The summer differences are negligible (0-.3 mg/l). The largest difference occurs during the spring due to the change in saturation levels. An analysis of Table 3.9-8 shows that the critical DO period generally occurs in July. Therefore, all July measurements presented in this table were averaged and plotted in Figure 4.1-20 along with an average July DO profile simulated using a July river flow and ambient temperature averaged over the period 1951-1970. Although deviations between the measured and simulated profiles exist, the general shape of the simulated curve is correct. A simulated curve which duplicates the measured data can be obtained by adjusting BOD loads, river flows, reaeration and deoxygenation coefficients, however, the sensitivity of the simulated summer DO concentration to changes in temperature remains in the 0-.3 mg/l range.

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(1) Letter of September 14, 1972, from Noel M Hurley, Monitoring Branch, S C Pollution Control Authority.

(2) Churchill, M A, Elmore, H L, and Buckingham, R A, J ASCE, SA4, 1962.

(3) Fair, G M, Geyer, J C, and Okun, D A, Water and Wastewater Engineering, Volume 2, Wiley & Sons, Inc, New York, 1968.

Runs (1) and (2) above were made using average DO and BOD concentrations; therefore, additional runs were made using minimum tailrace DO and maximum reported BOD loadings for two years, 1968 and 1965. The year 1968 exhibited the greater sensitivity of the twenty-years simulated to changes in temperature during the summer months and 1965 had the lowest DO downstream of the twenty years. The inputs to the simulation were as follows: (1) initial BOD of 4 mg/l rather than 2 mg/l, (2) minimum recorded tailrace DO values from Table 3.9-1 rather than average values, (3) maximum BOD loadings from downstream discharges rather than average (number obtained from EPA permit applications), and (4) the maximum Sugar Creek BOD loading recorded rather than the average. These runs indicated that the sensitivity to temperature did not change from the average case.

The simulation was tested for sensitivity to the reaeration coefficient (K_2), the deoxygenation coefficient (K_1), and Sugar Creek BOD loadings. Changes in these inputs caused the following decreases in critical DO downstream using 1951 as a base:

MONTH (DO in mg/l)

	J	F	M	A	M	J	J	A	S	O	N	D
half reaeration (K_2)	.1	.2	.2	.3	.4	.7	1.2	1.2	1.2	1.0	.9	.4
double deoxygenation (K_1)	.3	.3	.3	.4	.4	.4	.5	.5	.4	.4	.3	.4
triple Sugar Creek BOD												
Ambient Temperature	.1	.1	.2	.1	.2	.3	.7	.5	.5	.5	.4	.2
Elevated Temperature	.1	.1	.2	.1	.2	.3	.7	.5	.6	.6	.4	.2

From the above information it can be concluded that during the summer months the model is more sensitive to changes in reaeration coefficient and the deoxygenation coefficient than from the expected temperature rise due to Catawba Nuclear Station (see Table 4.1-2e).

Since the information available on Sugar Creek loadings was limited, the program was run using triple average Sugar Creek BOD. The differences due to elevation in temperatures did not change from the average case.

Historically, when DO concentrations in a stream are analyzed, periods of low flow (7-day 10-year) have been considered critical. The predicted temperatures listed in Table 4.1-2 are monthly average, therefore, the critical flow which was considered here is a 30-day 20-year low flow of 718 cfs (October 1954). (From USGS records at the Rock Hill gage, the historical 30Q20 is 700 cfs and the 7Q10 is 648 cfs.) It can be seen from Table 4.1-2 that the predicted excess temperature at the dam for this October 1954 flow was zero. Under low flow situations essentially all the cooling takes place within the lake resulting in a negligible elevation of temperature downstream, and consequently no effect on downstream DO.

This analysis shows that the temperature rises due to Catawba Nuclear Station will have a negligible effect on the more critical summertime DO values downstream of Wylie Dam. Therefore, downstream water users and downstream dischargers would experience the same summertime DO concentrations when Catawba Station is in operation. The effect during the winter and spring would be somewhat greater. This is due to inherently higher DO values during the winter and spring seasons, and although the effects are greater because DO values are approaching saturation, quantitatively the DO values are quite high.

TOXICITY

Much of the above information can be used in analyzing effects of temperature rise on potentially toxic wastes discharged into the Catawba River. It should be pointed out from the beginning that the critical time for potentially toxic discharge will be during low flow situations when there is not enough river flow to dilute toxic discharges. However, during these low flow situations, primarily all cooling of the Catawba cooling water will take place in the lake thereby having little effect on downsteam toxicity.

Very few measurements of potentially toxic materials in the Catawba River have been made, therefore it is difficult to obtain background levels of toxic materials. However, chemical analysis of the first major discharge (Celanese) into the river flow below Wylie Dam is available from the EPA discharge permit application. Also, one grab sample from the second major discharge, Rock Hill sewage treatment plant, is available from S C Pollution Control Authority files. These discharges are in the area below Wylie Dam where temperature rise above ambient could have an effect on toxicity. Therefore, to evaluate the level of toxicity which may be expected below the dam, the above discharges were diluted with the river flow to arrive at expected concentration levels. Although it is highly unlikely that excess temperatures due to Catawba will be associated with a low flow situation, the 7-day 10-year low flow for the Rock Hill gaging station was used to dilute discharges so that an upper bound on toxicity could be obtained. The results of this dilution are shown in Table 4.1-2f along with potentially toxic levels (toxicity to fish or humans, whichever is lower) and USPH drinking water standards for each substance.[1]

From Table 4.1-2f it can be seen that expected concentration levels under a low flow situation are always well below published toxic limits, and in most cases the expected concentrations meet drinking water standards. Since concentrations of potentially toxic substances are so low even under minimum dilution conditions and low flows and high temperatures are not expected to occur simultaneously, the operation of Catawba Station is not likely to cause any significant increase in toxicity downstream of Wylie Dam.

(1) McKee, J E and H W Wolf, Water Quality Criteria, Second Edition, The Resources Agency of California, Sacramento, California, 1963.

ALTERATION OF SPECIES COMPOSITION

Thc ranked predicted temperatures, for the months of June, July and August (Table 4.1-2g) at the Highway U S 21 station indicate a maximum temperature of near 93°F, a one in twenty occurrence level, with an average July temperature for twenty years of record being 89.6°F or 5.2°F above the presently experienced ambient. This shift toward a new ambient will have an impact of dubious significance. The new regime will not reach TLm's reported for indigenous fish species and the anticipated average conditions at U S 21 are several degrees cooler. (1, 2 & 3)

The anticipated temperature regime will be in the range suitable for both green and bluegreen algal growth (4). Operation of a fossil fuel generating station on Lake Wylie with a combination of heat and nutrients conducive to algal growth has not resulted in any reported blooms. Therefore, it is unlikely that a significant difference in algal quality will occur in the river downstream of Wylie Dam. Some shift may occur in the number and kind of benthic organisms inhabiting the affected river section, but it is not likely that functional or structural integrity of the system will be significantly altered.

[1]Anon, 1956. "Proc Fifth Annual Water Symposium, Feb, 1956". Louisiana State University; Engr Exp Sta Bull 55.

[2]Brett, J R 1958. "Some Principles in the Thermal Requirements of Fishes." Quarterly Review of Biology 31(2);75; Ontario Fisheries Research Lab List No 5 (1958).

[3]Hart, J S 1952. Geographic Variations of Some Physiological and Morphological Characters in Certain Freshwater Fish. Ontario Fish Res Lab (Canada) No 72.

[4]Cairns, J 1956. "The Effects of Increased Temperatures Upon Aquatic Organisms". Proc 10th Indust Waste Conf, Purdue University Engr Bull 40(1):346.

4.1.6 FISH

Biological surveys of the fish population in Lake Wylie (Catawba Reservoir) have been carried out by the North Carolina Wildlife Resources Commission
1 and the South Carolina Wildlife Resources Department; copies of these reports including lists of fish species, results of population surveys, growth studies, stocking programs and management recommendations are included in Appendix 4A. Also included in Appendix 4A is an "Estimation of Fish Standing Crop, Sport Fish Harvest and Angler Use" comparing Lake Wylie to two other Duke lakes - Mountain Island and Norman.

Lake Wylie provides a warm water fish habitat. The principal game species are largemouth bass, Micropterus salmoides (Lacepede), white bass, Morone chrysops (Rafinesque), and crappies, Pomoxis spp. No salmonids are known to occur in the lake, nor do cool water species such as smallmouth bass, Micropterus dolomieui Lacepede, or walleye, Stizostedion vitreum (Mitchill), inhabit Lake Wylie. The "Catalog of the inland Fishing Waters in North Carolina" describes the reservoir as providing "good fishing for crappie, catfish and largemouth bass."[1]

The primary game fish species in Lake Wylie as described by the South Carolina Wildlife Resources Department in its publication "Fishing in South Carolina," are largemouth bass, white bass and a "few striped bass," Morone saxatilis (Walbaum); also, it notes that "catfish generally offer good fishing in Lake Wylie."[2]

The North Carolina State creel census notes that 1.3 fish were caught per hour in the lake with the species composition as follows: "47 percent crappie, 21 percent sunfish, 14 percent catfish, 9 percent white bass, 3 percent largemouth bass, 3 percent carp, tr. others."[1] Based upon a creel census conducted on Wylie Reservoir by the South Carolina Wildlife Resources Department for the period July - December 1970 and assuming that this period represents 40 percent of annual activity, Jenkins has reported annual totals compared to predicted totals for Lake Wylie as follows: 25 angler hours/acre (compared to a predicted 28 angler hours/acre), 1.4 lb/hour (predicted 0.54) and 35.5 lb/acre (predicted 15.3).[3]

While fish population surveys have not been carried out in the section of river below Wylie Hydro Station, the resident fish population can be expected to be
1 almost identical to that collected from the nearby lakes both upstream and downstream. The close similarity between the dominant species of the upstream and downstream lakes is apparent from the data presented in Table 4.1-4a.

[1] Fish, Frederic F. 1968. A Catalog of the Inland Fishing Waters in North Carolina. North Carolina Wildlife Resources Commission. p.81.

[2] South Carolina Wildlife Resources Department. Fishing in South Carolina.

[3] Jenkins, Robert M. 1972. Estimation of Fish Standing Crop, Sport Fish Harvest and Angler Use for Lakes Mountain Island, Wylie and Norman, Duke Power Company Projects, North and South Carolina. National Reservoir Research Program, Bureau of Sport Fisheries and Wildlife. 13 pp.

It has been reported that the dominant predator fish found in the turbid,
Piedmont streams is the largemouth bass.[1] While largemouth bass have been
collected from all types of stream and lake habitat in the Catawba River Water-
shed except the better trout streams, its relative - the smallmouth bass - has
1 been collected only from streams in the foothills of the Blue Ridge Mountains.[2]

A list of the fish species which probably occur in the stretch of the Catawba
River below Wylie Hydro Station has been prepared from the "Annotated Check-
list of the Fish Species Found in the Catawba River Watershed" (Table 4.1-4b).[2]

1 There are no rare or endangered fish species in Lake Wylie.[3] The only species
of fish whose existence in the lake might be directly related to the steam
plant's operation would be the threadfin shad, Dorosoma petenense (Gunther);
this highly important forage species maintains a continuing population only in
1 area lakes that have steam electric stations.[4] Thus, the addition of the steam
station on Lake Wylie will facilitate a substantial increase in the over-wintering
population of threadfin shad (numbers of threadfin shad already over-winter in
the discharge area of Allen Steam Station which is also located on Lake Wylie).

The predicted potential commercial fish harvest in Lake Wylie using a 100-year
1 mean is 13.6 lbs/acre.[5] This prediction is based upon the taking of such fish
as carp, Cyprinus carpio Linnaeus, carpsuckers, Carpiodes ssp., and redhorses,
Moxostoma spp., which are not presently commercially harvested in the Carolinas.
There has apparently been a small commercial catfish fishing industry on Lake
1 Wylie at infrequent times.[6]

[1] Louder, Darrell E. 1964. Survey and Classification of the Catawba River and Tributaries, North Carolina. North Carolina Wildlife Resources Commission.

[2] Louder, Darrell E. 1964. Appendicies to the Survey and Classification of the Catawba River and Tributaries, North Carolina. North Carolina Wildlife Resources Commission.

[3] Miller, Robert Rush. 1972. Threatened Freshwater Fishes of the United States. Transactions of American Fisheries Society. Vol. 101, No. 2. p. 239-252.

1 [4] McNaughton, W. D. 1967. The Threadfin Shad in North Carolina Waters, North Carolina Wildlife Resources Commission. D-J Proj. F-16-R, Job X-A, 6 p.

[5] Jenkins, Robert M. 1972. Estimation of Fish Standing Crop. Sport Fish Harvest and Angler Use for Lakes Mountain Island, Wylie and Norman. Duke Power Company Projects, North and South Carolina. National Reservoir Research Program. Bureau of Sport Fisheries and Wildlife. 13 pp.

[6] North Carolina Wildlife Resources Commission. 1961. Inventory of Fish Populations in Lentic Waters. Federal Aid in Fish Restoration, Project F5R and F6R, Job No. 1. p. 150.

From the time of the fall overturn until the lake is thermally stratified in the spring, the effects of the plant upon Lake Wylie fishes should be similar to those noted for the effects of Marshall Steam Station upon Lake Norman fishes (an extensive investigation of Marshall's effects upon Lake Norman and its aquatic organisms has been carried out with a final report of the findings due in the Summer, 1973). As already noted, threadfin shad will overwinter in the discharge waters. In response to this abundant forage supply of threadfin shad and possibly because of temperatures nearer their optimum, numerous game fishes are expected to migrate into the discharge area during the winter; as a result of this migration, a substantial sport fishery will develop in the discharge area.[1]

A different reaction will be noted from the onset of thermal stratification until the fall overturn. The provisional maximum temperatures recommended as compatible with the well-being of various species of fish and their associated biota are 93°F for the growth of catfish, gar, white bass, buffalo, threadfin shad and gizzard shad; and 90°F for the growth of largemouth bass, bluegill and crappie.[2] While some revision of these numbers may occur in the future, their use for general purposes appears to be valid. It can be noted that the median temperature tolerance limits (the temperature at which 50 percent of the test fish die) is generally above 93°F for many of the characteristic Lake Wylie fishes and the final preferendum temperature (the preferred temperature which is selected under conditions of the highest acclimation temperature) for species such as largemouth bass, bluegill and carp is near 90°F (Table 4.1-4). However, the temperature at which these species have been observed in the field are lower (Table 4.1-4).

Based upon twenty years of historical temperature records, operation of the nuclear plant on Lake Wylie employing lake cooling is predicted to result in composite average monthly discharge temperatures exceeding both 90°F and 93°F during the months of May through September (Table 4.1-5). The number of predicted occurrences of individual average monthly discharge temperatures exceeding 93°F for the months of May through September would be 78 in 100 months, and the number of predicted occurrences of individual average monthly discharge temperatures exceeding 90°F for the months of May through September would be 87 in 100 months. In July the area required to cool the discharge temperature to 93°F will average 1540 acres with a maximum of 2350 acres, while the area required to cool the discharge temperature to 90°F will average 2530 acres with a maximum of 4020 acres.

[1] Adair, William D. and David J. DeMont. 1971. "Fish" in "Environmental Responses to Thermal Discharges from Marshall Steam Station, Lake Norman, North Carolina." p. 57, Interim Report.

[2] National Technical Advisory Committee. 1968. Water Quality Criteria. p. 43.

The normal occurrence is for fishes to avoid warmed waters which are above their upper temperature tolerance limits. Studies at the Connecticut Yankee Plant showed that fish moved out of the discharge canal when temperatures reached 94 - 100°F and returned when the water temperature returned to the 92 - 94°F range.[1] Alabaster has observed that non-lethal changes in temperature cause fish to become more active and is considered to have survival value in heated effluents. Thus, the changes in temperature which caused fish to move away were smaller than the change which could kill the fish even if they were suddenly exposed to them.[2]

Using the method of conditioned responses, a wide variety of fish species have demonstrated the ability to discriminate between small temperature differences.[3] In experiments by Bull, responses were obtained for temperature differences of 0.18°F and less, and he concluded that "in the discriminatory perception of temperature a fish is provided with a sensory field which is so acutely sensitive as to be of obvious value in directive movements."[4] In view of the fact that fishes can discriminate between various temperatures, their ability to avoid the discharge plume, if desired, seems obvious.

Using the data presented in Table 4.1-5, it can be expected that many of the fishes of Lake Wylie will emigrate from the discharge waters above 90°F and most of the fishes will emigrate from the discharge waters above 93°F.

[1]Massengill, R. R. 1969. In "The Connecticut River Investigation, ed. D. E. Merriman, 9th Semiannual Progress Report to Connecticut Water Resources Commission.

[2]Alabaster, J. S. and K. G. Robertson. 1961. The Effect of Diurnal Changes in Temperature, Dissolved Oxygen and Illumination on the Behavior of Roach (Rutilus rutilus L.), Bream (Abramis brama L.) and Perch (Perca fluviatilis L.).

[3]Brett, J. R. 1956. Some Principles in the Thermal Requirements of Fishes. Quart. Rev. Biol. 31(2) pp. 75-78.

[4]Bull, Herbert O. 1936. Studies on Conditional Responses in Fishes. Part VII. Temperature, Perception in Teleosts. pp. 1-27.

4.1.6.1 Cooling Tower Alternative (1b)

The number of occurrences of discharge temperatures in excess of 93 F and 90 F and the areas needed to cool to 93 F and 90 F when these temperatures are exceeded is reduced if mechanical draft cooling towers are used. Based upon twenty years of historical temperature records, operation of the nuclear plant on Lake Wylie employing mechanical draft cooling towers is predicted to result in composite average monthly discharge temperatures which do not exceed 93 F and exceed 90 F only in July and August (Table 4.1-6). The number of predicted occurrences of individual average monthly discharge temperatures exceeding 93 F for the months of May through September would be 13 in 100 months, and the number of predicted occurrences of individual average monthly discharge temperature exceeding 90 F for the months of May through September would be 39 in 100 months (Table 4.1-6).

The areas needed to cool the discharge water to 93 F and 90 F when these temperatures are exceeded is reduced when the cooling tower alternative is compared to the lake cooling alternative (Table 4.1-5). In July the area required to cool the discharge temperature to 93 F during the six times out of 20 that this temperature is exceeded will average 280 acres with a maximum of 560 acres, while the area required to cool the temperature to 90 F during the 18 times out of 20 that this temperature is exceeded will average 620 acres with a maximum of 1310 acres.

4.1.6.2 Fish Spawning

1 The effects of Catawba Nuclear Station upon fish spawning should be similar to those observed for the Marshall Steam Station.

The spawning times of some fish species may be modified by variations in water
1 temperatures between the discharge and ambient lake areas, but significant
effects are not expected. In fact, successful spawning by two characteristic
Lake Wylie fish species, shad and largemouth bass has been reported for the
discharge area of Marshall Steam Station on Lake Norman. Shad "eggs were
observed" to be most numerous near the point of discharge adhering to the
discharge structure and to rocks and vegetation lining the discharge canal;
"the discharge waters facilitated the overwintering of threadfin shad in the
discharge cove and appear to be responsible for maintaining the population in
the lake."[1] Largemouth bass spawned earlier in the region of the discharge cove
than in the control coves with "numerous young-of-year largemouth bass (being
observed) in the discharge canal and cove"; later examination showed discharge
fish to be significantly larger both in length and weight than those caught
from control coves.[1] A more detailed analysis concerning the thermal effects
of Marshall Steam Station upon fish spawning is reported on pages 14-17 and 27
1 of the "Completion Report" prepared by the North Carolina Wildlife Resources
Commission (Appendix 4A).

The spawning characteristics of the principal species of fish in Lake Wylie are presented in Table 4.1-7. From the information describing the spawning requirements, egg characteristics, and depths of egg deposition, it is apparent that the spawning habits of the fishes of Lake Wylie offer little opportunity for eggs to be either pumped through the plant or impinged upon plant structures.

[1]Adair, William D. and David J. Demont, 1971. "Fish" in "Environmental Responses to Thermal Discharges from Marshall Steam Station, Lake Norman, North Carolina."

4.1.6.3 Impingement and Entrainment of Fish

During the winter months at Catawba the intake water velocity at both the racks (5/8" x 2-1/2" at 4" on center) and traveling water screens (3/8"; No 14) will be 1.5 fps or less (assuming two pump operation, full load condition and gross sectional area of the opening).

Studies by the Massachusetts Department of Natural Resources[1] and Pacific Gas and Electric Company[2] recommend that intake velocities be maintained at or below 1.5 fps. During the spring, summer, and fall, four-pump operation will normally be utilized resulting in intake water velocities of 0.82 to 1.21 fps at the racks and screens (Subsection 4.1.4). It should be noted that the lower velocities prevail during the season when eggs, larvae, or juveniles of fishes are most susceptible to entrainment or impingement.

Operation of a steam generating facility necessitates frequent visits by
Operating personnel to the station's intake area. Normal operating procedure
at the Riverbend Steam Station, where intake velocities reach a maximum velo-
city of 1.38 ft/sec (ER Table 3.1-3) is for screens to be rotated daily and
1 racks to be cleaned one-two times per week. [Interviewing three employees
who had a total of 81 years' experience at this station, it was their consensus
that very few fish were collected on the intake racks and screens and those
that were, were possibly diseased fish or had died elsewhere and were drawn
to the intake the same as other floating debris. On numerous occasions,
threadfin shad (1" or less) had been observed schooling immediately in front
of the intake structure and appeared to be unaffected by the current.]

It should be noted that threadfin shad, an introduced species in area lakes, are susceptible to winter kills when the ambient water temperature drops below 45°F. In January, 1970, lake water temperatures of 38.8°F were recorded at Marshall Steam Station on Lake Norman which resulted in a massive winter kill of threadfin shad. This natural die-off caused the intake screens at Marshall to become clogged with dead or dying threadfin shad.

[1]Fairbanks, R. B., W. S. Collings and W. T. Sides. 1971. An assessment of the effects of electrical power generation on marine resources in the Cape Cod Canal.
1 Massachusetts Department of Natural Resources, Division of Marine Fisheries, 48 pp.

[2]Adams, J. R. 1968. Thermal effects and other considerations at steam-electric plants, a survey of studies in the Marine environment. Pacific Gas & Electric Company, Department of Engineering Research. Report No 6934. 4-68, 87 pp.

With the exception of threadfin shad which maintains a continuing population only in area lakes that have heated effluent from steam electric generating stations;[3] Duke's experience at other stations with similar intake structures and velocities (Figure 4.1-13, 4.1-14, 4.1-15 and Table 3.1-3), indicates that fish do not become impinged on the intake screens. Intake velocity criteria should be based upon swim speeds and behaviour of indigenous fishes, the
1 presence of migratory fishes, the location and design of the intake structure, the design of intake screens, and experience from stations operating with similar intake velocities.

The spawning characteristics of the fishes of Lake Wylie are such that no massive migration of fishes at any life stage past the intake structure should occur. The location of the intake structure, the ability of fish to swim out of the intake area, and the lowintake velocities all decrease the likelihood of fish becoming impinged upon the intake screens.

1 [3] McNaughton, W. D. 1967. The threadfin shad in North Carolina waters. N. C. Wildlife Resources Commission, D-J Project F-16-R, Job X-A 6p.

4.1.6.4 Gas-Bubble Disease

A detailed study has been initiated at Marshall Steam Station to document the occurrence of gas-bubble disease and the associated percent saturation of the dissolved gases of oxygen and nitrogen. A partial description of the occurrence of gas-bubble disease at Marshall Steam Station is presented on pages 19-21 of the "Completion Report" prepared by the North Carolina Wildlife Resources Commission (Appendix 4A).

Preliminary results of the temperature and dissolved gas data obtained during the studies around Marshall Steam Station are provided in Tables 4.1-10 to 4.1-10b and Figure 4.1-18, Sheets 1-14. Table 4.1-10 provides a comparison of the intake temperature, discharge temperatures, Δt's, and flow of Marshall Steam Station from November - May for the periods 1969-1970, 1970-1971, 1971-1972. Table 4.1-10a provides the average dissolved gas saturation and temperatures at the intake and discharge of Marshall Steam Station during the monthly sampling program; the data obtained at Allen Steam Station and Riverbend Steam Station is also included. The monthly average operating data for Allen, Marshall, and Riverbend Steam Stations are included in Table 4.1-10b. Figure 4.1-18, Sheets 1-14 present the profiles of percent saturation of dissolved nitrogen and oxygen in the area around Marshall Steam Station during the period November 1971 - May 1972.

A thorough analysis of the data obtained concerning the occurrence of gas-bubble disease is almost complete and should be available by Spring of 1973.

The average monthly percent saturation of dissolved nitrogen gas at the point of discharge of Catawba Nuclear Station has been calculated (Table 4.1-10c) for the period November-April using: (1) the average intake temperature calculated from Table 4.1-2, (2) the average discharge temperature presented in Table 4.1-5, and (3) assuming a 100 percent saturation at the intake.

The winter-time occurrence of gas-bubble disease in some fish as a consequence of the operation of Catawba Nuclear Station is possible but does not appear probable.

4.1.7 Plankton

Biological surveys describing the character of plankton populations in Lake Wylie are not available; however, research under way at the Allen Plant on Lake Wylie will define the species composition and diversity of phytoplankton passing through the condenser systems.

The School of Public Health, University of North Carolina at Chapel Hill has been awarded a grant from the Duke Power Company to establish the existing plankton (zooplankton and phytoplankton) populations in Lakes Norman, Mountain Island, Wylie and Wateree. This study is to be initiated during the winter or early spring of 1973 and will supplement the biological baseline sampling program planned for Catawba (Subdivision 4.1.3.1). Plankton populations have been characterized at two Catawba River impoundments upstream from Lake Wylie. RP-49 (Interim Report)[1] has presented the phytoplankton composition of Lake Norman and the zooplankton of Lake James has been characterized by R. E. Coker (1926).[2]

Phytoplankton entrainment studies at the Allen Plant, Lake Wylie, have recently been completed. The objective of this study was to measure the effects of various operating Delta T's (10, 20, 30 F) upon the Lake Wylie phytoplankton productivity as determined by rate of carbon-14 uptake and on subsequent algal growth. The results of this study are being formalized and the final report is being prepared for publication.

The effects of thermal discharges upon primary productivity, zooplankton entrainment, and periphyton accumulation on glass slides has been studied extensively at Marshall Steam Station, Lake Norman.[1] The final results of these studies should be available by the summer of 1973.

The results of studies at both Allen and Marshall Steam Stations which are indicative of the effects at Catawba Nuclear Station (Tables 4.1-1a, 4.1-4a and 4.1-4b) coupled with the comprehensive plankton study planned for the Catawba site prior to plant operation (Subsection 4.1.3) should provide not only a basis from which one can measure the effects of thermal discharges, but also a basis for predicting what the effects will be upon the aquatic biota.

Information regarding the design of the intake structures (i.e., size, location, flow and velocity for Allen Steam Station on Lake Wylie, Riverbend Steam Station on Mountain Island Lake and Marshall Steam Station on Lake Norman are shown on Figures 4.1-13, 4.1-14, and 4.1-15, respectively. (See Table 3.1-3)

[1] Environmental responses to thermal discharges from Marshall Steam Station, Lake Norman, North Carolina (Interim Report) 1971, Staff of the Cooling Water Discharge Project (RP-49) Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland.

[2] Coker, R. E., 1926. "Plankton Collections in Lake James, N. C. - Copepods and Cladocera," J. Elisha Mitchell Society, pp. 228-269.

4.1.8 Benthos

A study of the benthic macroinvertebrate population of Lake Wylie is currently being conducted under the direction of Dr. Charles M. Weiss, Department of Environmental Sciences and Engineering, University of North Carolina at Chapel Hill.

The objectives of the study are to evaluate the effects on benthos of the operation of Allen Steam Station, to establish baseline data on the benthic population around the site of the Catawba Station, and to describe the extent of infestation of Lake Wylie by the Asiatic Clam (Corbicula manilensis).

Samples have been collected in May, June, and November of 1972, and another sampling was conducted in mid-December, 1972. Sampling methods include the use of a Modified Petersen Dredge, aquatic sweep net, Hester-Dendy artificial sustrate samplers and hand-searching shallow areas for Corbicula. The bottom type at each sampling station will be qualitatively described. Depth, temperature, dissolved oxygen, Secchi depth, and other available water quality parameters will be used in the analysis of the findings at each station. Fourteen sampling stations have been established, including six in the area around Allen Steam Station and five in the area around the Catawba site (Figure 4.1-16).

Appended to this text are two tables which present lists of the taxa of benthic organisms collected during the May and June sampling periods. The sets of data from the November benthic sampling and two subsequent Corbicula surveys are not included in these tables.

1 Table 4.1-13 shows the taxa collected by dredge sampling in deeper areas of Lake Wylie, while Table 4.1-12 shows the taxa collected by Hester-Dendy artificial substrates and sweep netting in the littoral areas of the lake. Each of these tables gives an indication of which taxa were most abundant in the lake and which taxa were collected in the vicinity of the Catawba site (Stations 7, 8, 9, 10, 14; see map, Figure 4.1-16).

A total of 61 different taxa were collected in Lake Wylie. Of these, 41 taxa have been found near the Catawba site. A greater diversity of benthos was evident in the littoral areas (52 taxa) as compared to the deep water areas (29 taxa) for the lake as a whole. The Catawba area showed the same general trend, with 26 littoral taxa and 19 deep water taxa.

The Asiatic clam (Corbicula) population is the largest component of benthic biomass in Lake Wylie and the Catawba site. No measures are presently being considered for controlling asiatic clams in Lake Wylie.

More detailed and quantitative analyses of the data presented here and the later data not included in this discussion will be contained in the final report of this study, which should be available in the Spring of 1973.

Benthic studies at Marshall Steam Station on Lake Norman, conducted by the RP-49 staff of Johns Hopkins University, will also provide valuable information on thermal effects which can be used to predict the environmental impact upon the benthic invertebrates on Lake Wylie. The results of this study should be available in the Summer of 1973.

4.1.9 SUMMARY

Based on environmental studies completed so far, it is concluded that Catawba Nuclear Station, served by lake cooling as detailed in Subsection 4.1.5 will be environmentally compatible in all significant respects; however, supplemental cooling by cooling towers is an alternate.

In summary, should the thermal effects produced by Catawba Nuclear Station prove to be unfavorable to the fishes or water quality of Lake Wylie, such trends would be detectable during early operation of the station. Detection of trends is the object of the continuing biological monitoring program and should unfavorable conditions develop, such conditions are not irreversible and appropriate corrective actions would be taken by Duke Power Company. No such trends are expected.

4.2 RADIOLOGICAL EFFECTS

4.2.1 SUMMARY

Conservative analyses demonstrate conclusively that there will be no adverse effects on the environment from discharges of radioactive material resulting from either normal or unusual operating of Catawba. The evaluation of the expected performance of the waste disposal systems shows that these systems will process potentially radioactive wastes and reduce discharges to levels far below the limits of 10 CFR 20. When viewed in perspective, the radiological effect of Catawba Nuclear Station upon a person living continuously adjacent to the station property is negligible.

An Environmental Radioactivity Monitoring Program will be established to verify that discharges from the station are as predicted or lower. This program will monitor all critical exposure pathways which could lead to radiation exposure to man, at activity levels far below those that may be considered harmful; thereby allowing ample opportunity for corrective action.

4.2.2 RADIOACTIVE LIQUID RELEASES

Operation of the station results in some waste liquids which must be treated before they can be reused or discharged. The Liquid Waste System provides this treatment capability for liquids which may contain radioactivity.

The Liquid Waste System is designed to (1) collect reactor grade water and process it for reuse and (2) to collect potentially radioactive liquid wastes and process them to forms suitable for release or shipment offsite. This design objective is attained by segregation of equipment drains and waste streams to prevent mixing of water which is normally reused with that which is normally discharged. Process equipment includes holdup tanks, filters, demineralizers and an evaporator.

In addition to the waste liquids described above, discharge of some reactor coolant may be necessary for control of tritium concentrations in the station. Routine discharge of this reactor coolant will not be necessary. However, the contribution to the liquid waste discharge from the station of the largest amount of reactor coolant which may be discharged in one year has been included in the analyses incorporated in this section. This quantity of reactor coolant can be treated for release by either the Liquid Waste System or the Boron Recycle System.

The estimated volumes of potentially radioactive liquid wastes resulting from operation of the station are presented in Table 4.2-1. Liquid radioactive discharges are far below the limits of 10 CFR 20, as shown in Table 4.2-3.
2 Discharges are shown for normal operation. Design (upper limit) fission product releases are a factor of 10 higher. Routine station discharges are expected to be no more than those shown for normal operation. The radioactive discharges shown in Table 4.2-3 are based on the following assumptions:

2 a. Fission product and corrosion product concentrations in the reactor coolant as shown in Table 4.2-2, and secondary coolant as shown in Table 4.2-2a.

b. Liquid releases shown in Table 4.2-1.

c. An eight-hour process period.

2 d. A process decontamination factor of 10^3 for all waste.

e. Decontamination factors as shown in PSAR Table 11.1-1 for the letdown demineralizer applied to letdown for tritium control.

Liquid waste is diluted by the annual average CCW flow of 3960 cfs. Although there will be recirculation of condenser cooling water during parts of the year, recirculation of radioactive effluents is not considered because the annual average concentration in the lake and in the annual average discharge from Wylie Dam will be the same if there were no recirculation.

1

The concentrations at the discharge of the lakes down stream of Catawba can be expressed as a fraction of the plant discharge concentration as indicated in Table 4.2-4a.

These analyses demonstrate that concentrations of radioactivity in Lake Wylie resulting from normal operation of the station are quite small when compared to the limits of 10 CFR 20 and natural background radioactivity. There will be no adverse environmental effects from liquid releases from the station.

4.2.3 RADIOACTIVE GASEOUS RELEASES

The Gaseous Waste System functions to remove potentially radioactive gaseous contaminants from the reactor coolant and to collect gases generated by operation of the boron recycle evaporator. These gases are contained during normal station operation, and there is no requirement for discharge of radioactive gases via the Gaseous Waste System.

A portion of the non-recycleable reactor coolant leakage denoted in Subsection 4.2.2 was assumed to occur inside the Containment and the remainder inside the Auxiliary Building. Gases resulting from leakage inside the Containment will be contained until the Containment is purged. Prior to purge, the lower Containment auxiliary carbon filter system will be operated to remove 99.9% of the particulates and iodine. The activity level in the Containment atmosphere was based on the assumed Reactor Coolant System leak. Activity buildup in the containment was calculated for a one year period. This activity is then discharged to the atmosphere by the Containment Purge System. Gases resulting from leakage inside the Auxiliary Building were assumed to be released without further decay to the atmosphere via the Auxiliary Building Ventilation System. All of the noble gas leaked to the secondary coolant is released from the condenser air ejector. The quantities of gaseous activity
2 expected to be released are presented in Table 4.2-4 and are based on the following assumptions:

a. Fission product concentrations in the reactor coolant as shown in Table 4.2-2., and secondary coolant as shown in Table 4.2-2a.

b. Liquid releases as shown in Table 4.2-1

c. A partition factor of 5×10^{-3} for I from coolant leaks

2 d. An iodine partition factor of 5×10^{-5} for the air ejector and 3.6×10^{-2} for the gland seal system.

e. Atmospheric diffusion based on average meteorology as described in subsection 2.4.1.

These analyses demonstrate that the concentrations of gaseous radioactivity at the Exclusion Area boundary resulting from the operation of the station are quite small when compared to the limits of 10 CFR 20. There will be no adverse environmental effects resulting from gaseous releases from the station.

4.2.4 RADIOACTIVE SOLID WASTE DISPOSAL

The Solid Waste System provides the capability to package solid wastes for shipment in a variety of AEC and Department of Transportation approved containers to an offsite licensed disposal facility. Evaporator concentrate and spent resin will be handled in the waste drumming room or directed to a truck-mounted shipping container. Other solid wastes of low activity or no activity, such as soiled clothing, rags, paper and gloves, will be compressed in drums by a hydraulic compactor. Adequate monitoring of this material will be provided to assure safe storage prior to shipment.

An estimated volume of 480 ft^3 of demineralizer resins and 820 ft^3 of
1 evaporator "bottoms" will be generated each year for two units. These wastes will range in activity from zero to a maximum of 5×10^4 curies in the resins and 1×10^3 curies in the "bottoms" assuming one percent fuel defects in each unit.

Shipping container design and permissible radiation levels external to the containers are governed by regulations of the AEC and the Department of Transportation. Duke will meet the requirements imposed by these regulations to assure safe transportation of solid wastes.

Ultimate disposal of solid wastes will be by burial in an AEC or Agreement State licensed facility meeting the requirements for such facilities imposed by the AEC. These requirements govern the form of the solid wastes and the integrity of the burial container, assuring safe disposition of solid wastes.

4.2.5 COMPARISON OF RADIOACTIVE, GASEOUS AND LIQUID WASTE RELEASES WITH ESTABLISHED STANDARDS AND LIMITS

4.2.5.1 Dose from Gaseous and Liquid Releases

The radioactive waste handling and processing systems at Catawba
2 were chosen over the alternatives considered in Section 5.4 in order that
releases of radioactive materials be as low as practicable in accordance
with AEC regulations and accepted radiation protection standards. Tables
4.2-3 and 4.2-4 show that expected radioactive liquid and gaseous releases
result in concentrations of radionuclides that are small fractions of the
applicable maximum permissible concentrations (MPC) found in AEC regulations,
10CFR20. Correspondingly, the resulting doses to individuals are expected to
be a small fraction of the applicable standards and regulatory limits.

Although th. amount of radioactivity added to the environment from station operation is minimal, possible critical exposure pathways to man have been evaluated in order to estimate the maximum dose to an individual and to the surrounding population, as well as to establish the sampling requirements for the Offsite Radiological Monitoring Program. These pathways include:

1. Whole body dose from gaseous waste releases.

2. Drinking water from that portion of Lake Wylie affected by the radioactive liquid waste releases or from wells directly associated with this portion of the lake.

3. Swimming, boating, fishing or walking along the shore of lake within this same area.

4. Eating fish from within this portion of the lake.

5. Consuming milk or other dairy products from locations affected by gaseous waste releases.

6. Eating foods (crops, animals) grown in areas or raised on feeds affected by gaseous waste releases.

Of the above, it is expected that Items 1, 2, 3, and 4 will be critical
exposure pathways, in the sense that they will account for most of the very
low exposure; Items 5 and 6 are not considered to be critical pathways for
this plant. The extremely small amounts and concentrations of iodine and
radioactive particulates that are expected to be released during normal opera-
1 tion, and the location of nearby farms and dairies in relation to the prevailing
wind directions, should make milk and food crops of no significance as a pos-
2 sible critical pathway to man for this plant (2.3 millirem per year to an
infant's thyroid at the nearest farm). However all of these pathways (including
the terrestrial pathway Items 5 and 6 above) have been included in the Offsite
Radiological Monitoring Program (Table 4.2-5) and will be monitored frequently
and completely.

Evaluation of Items 1 and 2 above show the resulting maximum hypothetical annual dose estimates from these gaseous and liquid waste releases to be:

		Dose Estimates (millirem per year, whole body)	
		Normal Operation	Design Condition
	Gaseous Waste Releases	2.5	25
	Liquid Waste Releases (drinking)	0.055	0.26
2	Liquid Waste Releases (eating fish)	0.008	0.077
	Liquid Waste Releases (swimming, etc.)	0.00022	0.0022
	Total	2.6	25.3

It should be emphasized that these dose estimates represent the maximum dose of a hypothetical individual and that the total dose for people living in the immediate vicinity of the station or beyond (critical population group) will be very much lower (less than 1 percent of the dose due to natural background radiation). For example, the dose estimates from gaseous waste releases have been conservatively calculated as occurring at the point of maximum ground level concentration within the poorest sector for meteorological diffusion and assume that a person remains at this location 24 hours per day, 365 days per year. Also, the annual dose estimates resulting from liquid waste releases conservatively assume that a person's only source of drinking water for an entire year is directly from the discharge area in Lake Wylie which contains the average annual concentration of radionuclides from the two nuclear units.

In regard to Items 3 and 4, calculations have shown that a person would only
2 receive a dose of 0.00022 millirem if he devoted 24 hours per day, everyday
for an entire year, to swimming, boating, fishing, or walking along the shore
of the discharge area which contains the average annual concentration of
radionuclides from the two nuclear units.

2 This person would also receive a dose of only 0.008 mrem per year if he ate as much as 20 grams of fish a day, everyday, directly from the discharge area, again assuming these same conditions of annual average radioactivity levels and assuming the maximum reconcentration factors in the environment.

2 All doses except the swimming dose and ingestion doses have been conservatively
calculated assuming that exposure to the 10 CFR 20 maximum permissible
concentrations produces a dose rate of 500 mrem/yr. The swimming dose was
1 calculated at a point on the surface of an infinite slab of water forty feet
thick. The ingestion dose was calculated assuming that the milk pathway is
operative for 6 months a year and that the vegetable pathway is operative for
4 months.

1 All of the above assumptions which result in a maximum annual whole body
2 dose from normal operation of 2.6 mrems to a hypothetical individual who lives
essentially full time in the immediate vicinity of the plant, who drinks the
water and eats the fish directly from the discharge area are, in a sense,
impossibilities. They are intended merely to illustrate what little effect
the plant will have on anyone. A much more realistic dose estimate can be made
for the surrounding population. The average person in the surrounding

population (within an assumed 50 mile radius) will receive a dose of about
2 .02 millirem per year from liquid and gaseous effluents under normal operating
conditions.

The total liquid and gaseous dose estimates for the maximum hypothetical individual and the average person in the surrounding population may be compared directly with the radiation protection standards of the International Commission on Radiological Protection (ICRP) and the National Council on Radiation (NCRP). These standards which form the basis for the Federal Radiation Council/AEC limits (Radiation Protection Guide) permit 500 millirems per year maximum dose to an individual and 170 millirem per year to a suitable sample of an exposed population group.

4.2.5.2 Existing Background Radioactivity

The resulting concentrations of activity in the environment and population dose from Catawba may also be compared with the background radioactivity from natural and man-made sources that already exists in the area. Natural background radiation consists of cosmic rays from outer space as well as from some 40 naturally occurring radioactive elements on earth, (80 naturally occurring radionuclides). The major portion of the human exposure results from naturally occurring potassium-40 and from the uranium and thorium series of radionuclides which are distributed variously in the earth, air and water everywhere. Variations in the sum of terrestrial and cosmic ray background radiation in the United States, on the average, ranges from a low of about 75 millirems per year in Louisiana and Texas to a high of about 225 millirems per year in Colorado. The average value for the United States is approximately 105 millirems per year and for South Carolina it is 110 millirems per year from these sources.

In addition, man receives additional dose; from the materials he uses for construction (30-50 millirems per year more from brick than from a wood frame house, for example), from the air he breathes, from the water he drinks and from the chemicals that make up his own body (about 21 millirems per year just from the naturally occurring radioactive materials in his own body, from food, water and air intake).

Also, as far as the total dose to the surrounding population (within 50 miles)
2 is concerned, Catawba will contribute about .02 percent additional dose to
that which the population now receives from natural background radiation or,
in terms of total population dose, as follows:

Man-rem Within 50 Mile Radius

	From Plant Effluents	From Natural Background Radiation
2	31	158,000

The average of preliminary terrestrial gamma background measurements made at the Catawba site indicate the following:

Location	Calculated whole body gamma dose, mrem/year
a. Within Plant Site Area	80
b. 1/4 mile West	109
c. 1-1/2 miles WNW	70
d. 6 miles NW	42

The concentrations of radioactivity in the Catawba River above and below the Catawba Nuclear Station, from natural and manmade sources have been reported as follows:

Location		Dates	Gross Activity pCi/l	Tritium pCi/l
Charlotte, N. C.	N. C. State Board of Health	1967	2.65	
	(Radiological Health Section)	1970	2.40	
Rock Hill, S. C.	S. C. State Board of Health (Div. of Radiological Health)			
1. Water Treatment Plant		1970	3.2	
		1971	7.0	
		1972	4.6	367.1
2. US #21 Hwy Bridge		1970	4.0	
		1971	9.8	

Gross activity average, 4.8 pCi/l or

4.8×10^{-9} μC/ml

Radioactivity in water is due to several sources. "All waters contain traces of radioactivity originating from naturally radioactive minerals dissolved from rock strata or from radioactive particulate matter or gases in the atmosphere. Common among these materials are trace elements of potassium-40, radium, thorium and uranium. Such trace elements are dissolved by water, both on its way to and flowing in the water courses. Precipitation is the major mechanism by which particulate matter or radioactive gases such as thoron and radon are removed from the atmosphere. The combined radioactivity of these materials consitutes what is known as background radioactivity of the water. The total radioactivity would include both background radioactivity and contributions from fallout and other man-made sources.

A knowledge of the concentration of the background radioactivity, as well as the total activity, is an important factor in the appraisal of water quality since standards pertaining to radiation exposure or concentration within drinking water are expressed in terms of additions to the natural background."(1)

In order to evaluate the significance of liquid waste releases from Catawba as they relate to existing pre-operational background conditions, comparison is made below of the average activity in the Catawba River (Lake Wylie) with the annual average concentrations that may exist in the discharge area from the operation of the nuclear station.

2 Gross Beta Radioactivity (Other than Tritium)

	Average Background Radioactivity in Lake Wylie	Annual Average Concentration in Discharge Area	
		Expected Operation	Design Conditions
pCi/l	5.3	0.14	1.4
μCi/ml	5.3×10^{-9}	1.4×10^{-10}	1.4×10^{-9}

2

Comparison of these gross concentrations may be made with the U. S. Public Health Service drinking water standards. These standards, based on considerations of Federal Radiation Council recommendations, set the limits for approval of a drinking water supply at 1000 pCi/l (1.0×10^{-6} μCi/ml) gross beta radioactivity (when strontium^{90} is at a negligibly small fraction of its limit of 10 pCi/l or 1.0×10^{-8} μCi/ml). It can thus be seen that the annual average concentration in the discharge area resulting from radioactive liquid waste releases, are very small in comparison to the U. S. Public Health Service drinking water limits.

(1) Radiological Health Data and Reports, Vol. 10, No. 5, May 1969, "Radioactivity in North Carolina Surface, Ground and Cistern Waters, January - December, 1967," Sanitary Engineering Division, Radiological Health Section, North Carolina State Board of Health.

Using the average background radioactivity noted above, (5.3 pCi/l) the total amount of radioactive material in Lake Wylie at full volume was calculated to be 1850 mCi at any moment during the average year. Also,
2 based on average streamflow, more than 21,000 mCi of activity flowed by Wylie Dam during the year. These amounts may be compared directly with the 480 mCi per year of gross beta activity, other than tritium, expected to be released from the station in liquid effluents during normal operation and with the 4800 mCi per year during design conditions. In other words, the concentration and the gross beta radioactivity other than tritium in Lake Wylie resulting from liquid waste disposal operations will only be a small fraction of the amounts that have existed there and that exist there now without the nuclear station.

As far as the tritium dose is concerned, even if a person were to consume all of his water from the discharge area immediately adjacent to the station containing the average annual concentration of tritium from releases at Catawba, it would only lead to a dose of 0.03 mrem per year. This 0.03 mrem dose is 1/16,000th of the Radiation Protection Guide for an individual and 1/5000th of the Radiation Protection Guide for a suitable sample of the exposed population.

4.2.5.3 Radiological Impact On Biota Other Than Man

The Catawba Nuclear Station is a "minimum release" plant that will release gaseous and liquid radioactive wastes at levels "as low as practicable" within the dose and concentration limits required by radiation protection standards and AEC radiation protection regulations. (Subdivision 4.2.5.1, Tables 4.2-3, 4.2-4.)

A general observation based on twenty-five years of radiobiological environmental studies indicates that radiation dose standards adequate to protect man will also effectively serve to protect other life in man's environment. There may be exceptions to this observation, but it is nevertheless, generally true. The radiation dose standards referred to above are the recommendations of the International Commission on Radiological Protection and the National Council on Radiation Protection. Over this period of time the basic occupational exposure recommendations of these standards organizations has been a whole body dose in the range of 5000-15,000 millirems per year due to external and/or internal radiation. The corresponding annual whole body population dose standard has been 500 millirems to the highest individual and 170 millirems average dose to a suitable sample of the exposed population. Over this twenty-five year period the standards have been lowered, not because of any evidence of harm at the higher levels but to lower the possible risk as more people became exposed to radiation.

The radioactivity released to the environment from radioactive gaseous and liquid releases at Catawba will also be a very small fraction of the background radioactivity existing there now, before the plant is even built. (Subdivision 4.2.5.2)

The Catawba Nuclear Station is essentially identical to the McGuire Nuclear Station. In the Environmental Statement for McGuire (Docket Nos.50-369 and 50-370),the AEC evaluated the dose to biota other than man, and concluded that, "...no detectable radiological impact is expected on the aquatic biota or terrestrial mammals as a result of the quantity of radionuclides to be released..."(ES, page 5-20). In performing this evaluation, the AEC used much greater quantities and concentrations of radioactivity than Duke calculates will actually be released from McGuire during normal operation.

1 Since Catawba will be quite similar to McGuire in design, in location and hence ecological habitats for aquatic and terrestrial organisms, and in the quantities and concentrations of radioactivity estimated to be released to the environment, it is therefore concluded that Catawba too will have no detectable radiological impact. A confirming calculation to support this conclusion has been made. For example, the dose to a muskrat has been estimated using data from Table 5.4 and methods described in Appendix J of the AEC Environmental Statement for the McGuire Nuclear Station and the highest concentrations of radionuclides expected in Lake Wylie as a result of the expected normal operation of Catawba. The muskrat was chosen because it may be the aquatic organism exhibiting the highest or limiting dose; that is, the doses to all other organisms would be very much lower. The resulting dose to a muskrat, which is assumed to live in the discharge canal is only 25 mrad per year due to expected normal operation of the station. Muskrats (and other aquatic organisms) that live elsewhere in the lake (rather than in the discharge canal) would of course receive much lower doses due to dilution of these materials with the lake water.

Therefore, as a result of all of the above considerations, the radiological impact on all life other than man (or even including man), from the routine operation of the Catawba Nuclear Station will be negligible and without significance.

4.2.6 OFFSITE RADIOLOGICAL MONITORING PROGRAM

The purpose of the Offsite Radiological Monitoring Program is to provide surveillance and backup support to detailed effluent monitoring, (as required by AEC Safety Guide 21), which is needed in order to evaluate individual and population exposure and the ecological significance, if any, of the contributions to the existing environmental radioactivity levels that result from station operation at design levels.

During operation of Catawba Nuclear Station, the only contribution of radioactive materials to the environment will be from controlled releases of low-level gaseous and liquid wastes that are made in accordance with AEC regulations. The design and operation of the radioactive waste disposal system will maintain quantities of radioactive materials released as low as practicable in compliance with regulatory limits. The objective of the Offsite Radiological Monitoring Program is to provide assurance that the contribution of radioactivity to the environment, and hence population dose, is indeed negligible.

This monitoring program will include guidance of the Environmental Protection Agency (EPA) in its design. The sampling methods, analytical procedures and sensitivities will essentially be those described in the EPA "Environmental Radioactivity Surveillance Guide,"ORP/SID72-2. This EPA "Guide" will be supplemented, as necessary, with procedures from other sources including those of the American Public Health Association as described in the publication, "Standard Methods for the Examination of Water and Wastewater" and those of the U. S. Public Health Service, "Radioassay Procedures for Environmental
1 Samples," 999-RH-27. The program will also be conducted in cooperation with the following state and federal agencies having appropriate jurisdiction or concern in the area of environmental radioactivity: (1)South Carolina State Board of Health, Division of Radiological Health; (2)South Carolina Pollution Control Authority; (3)South Carolina Wildlife Resources Department; (4)North Carolina State Board of Health, Radiation Protection Program; (5)North Carolina Wildlife Resources Commission; (6)U. S. Public Health Service; (7)U. S. Fish and Wildlife Service; and (8)Water Quality and Air Pollution Control offices of the Environmental Protection Agency. The appropriate agencies will be asked to review the program and provide additional recommendations on type samples, frequency of collection, and locations for sampling. Duke Power will also participate in split sampling programs and in data exchange with these agencies as requested. Summary reports of monitoring results will be distributed to the above agencies and to other state and federal agencies upon request and as required.

Monitoring of aquatic vegetation, plankton, bottom organisms; terrestrial vegetation and crops; and fish (items 5, 6 & 8 in Table 4.2-5) will begin at least two years prior to the operation of Unit 1 and the remainder of the program will be put into effect at least one year before operation. The entire program will continue during the operating period, but will be modified as necessary to reflect any changes required as a result of pre-operational experience, local population growth, operational data from Catawba and similar plants, and appropriate regulations.

Radioactive materials from waste releases, if they can be detected at all beyond the Exclusion Area, are most likely to be found in samples of air and water from locations where these materials are dispersed by stream flow and wind. Air and water samples also serve as one of the earliest indicators of change in environmental radioactivity. Therefore, air and water samples will receive primary emphasis, both in the number of samples collected and in the frequency of collection. These samples will ordinarily be counted for gross alpha and beta activity. If the gross activity exceeds a predetermined small fraction of any effective concentration limit allowed in such a sample, analysis to determine the component radionuclides will be made by use of a multichannel gamma analyzer. Gamma analyses will also be made on representative composite samples on a quarterly basis. Additional radiochemical analyses will be made for strontium 89 and 90, which are beta emitters and cannot ordinarily be detected by gamma analysis.

Measurements of gamma dose and dose rate will also be made. Thermoluminescent dosimeters located both in the prevailing wind directions and elsewhere and immersed in water downstream of the liquid effluent release point will measure the direct dose effects of gaseous and liquid activity releases during the operating period. Water will also be analyzed for tritium.

Samples of secondary importance in regard to numbers of samples and frequency of collection include lake bottom sediment, terrestrial and aquatic vegetation (including fruit and vegetable crops), plankton, fish and milk. Fish samples will include both game fish and rough species (bottom feeders). Bottom sediment, vegetation and plankton will be counted for gross beta activity. Again, if the gross activity exceeds a predetermined small fraction of any effective concentration limit, additional analyses will be made by use of a multichannel gamma analyzer and by radiochemical means. Gamma analyses will also be made on representative composite samples on a quarterly basis. Fish and milk will not be counted for gross beta activity but will be subjected to gamma analysis, determination of gross beta minus K^{40}, as well as radiochemical analyses for strontium 89 and 90. Milk will also be analyzed for tritium.

The sensitivity of these analyses and the size of samples taken will permit
absolute measurement of existing preoperational and operational levels to be
made even though they may be considerably below permissible levels in many
cases. It is expected that gross beta and gross alpha radioactivity will be
counted with a low background gas flow proportional counter having nominal
backgrounds of 1.0 cpm for beta and 0.05 cpm for alpha. By way of illustra-
1 tion, if environmental samples are counted for a period of 20 minutes and
results are expressed at the 90 percent confidence level then the minimum
detectable activity will be approximately 3.6 pCi for beta and 2.4 pCi for
alpha radiation in samples of air, water and other materials.

The sensitivity of the radiation exposure measurements (gross gamma) in excess of background levels is approximately 10 mR for an annual integrated dose, and 0.001 mR/hr for a dose rate measurement.

The sensitivity of the analyses for various radionuclides in representative samples is typically as follows:

	Gross Beta	Gross Alpha	Cs^{137}	Sr^{90}	Sr^{89}	I^{131}	Co^{60}
Air particulates and iodine, pCi/m^3	3×10^{-3}	1×10^{-3}	1×10^{-2}	1×10^{-3}	5×10^{-3}	1×10^{-2}	-
All water samples and milk, pCi/l	0.3	0.3	10	1	5	10	10
Fish, pCi/Kg	-	-	80	5	25	-	-
Vegetation and Crops, pCi/Kg	-	-	80	5	25	-	-

Additional sensitivities are as follows:

K^{40} in fish and animals, 1.2×10^{-6} µCi/g.

H^3 in water and milk, 2×10^{-6} µCi/ml by liquid scintillation counting and as low as 2×10^{-9} µCi/ml by electrolytic enrichment and gas counting.

1 The environmental radioactivity sampling methods, analytical procedures and sensitivities will essentially be those proposed by the Environmental Protection Agency in the "Environmental Radioactivity Surveillance Guide," ORP/SID72-2. This "Guide" will be supplemented as necessary with procedures from other sources including those of the American Public Health Association as described in their publication, "Standard Methods for the Examination of Water and Wastewater" and those of the U. S. Public Health Service in their "Radioassay Procedures for Environmental Samples" 999-RH-27.

The sensitivity of these procedures are more than adequate to detect and measure the small amounts of various radionuclides from waste releases at Catawba that may be found in environmental samples. This will insure the capability to determine that any resulting doses to the public from these materials will be well within the dose limits permitted by applicable AEC regulations. However, in most cases, since the actual releases will be so low, it is not likely that radioactive materials released as expected during normal operations can actually be detected in the off-site environment and that portion attributable to Catawba actually distinguished. This is due to the fact that concentrations in environmental samples will be a very small fraction of existing background levels. Primary reliance in determining population doses will depend, therefore, on effluent data. It is expected that the Off-site Radiological Monitoring Program will provide surveillance adequate to provide reasonable confirmation of calculations based on effluent release data.

Additional examples of the analytical sensitivity of the program versus concentrations in the environment and concentrations associated with applicable regulations are as follows, for various radionuclides of concern.

A. Releases into Water

Radionuclides	Discharge Concentration (normal operation) µCi/ml	Concentration Permitted by AEC Regulations µCi/ml	Sensitivity of Analysis µCi/ml
Tritium	1.8×10^{-7}	3×10^{-3}	2×10^{-9}
Sr^{90}	5.0×10^{-16}	3×10^{-7}	1×10^{-9}
Cs^{137}	2.2×10^{-11}	2×10^{-5}	1×10^{-9}
Co^{60}	2.8×10^{-14}	5×10^{-5}	1×10^{-8}
I^{131}	9.3×10^{-12}	3×10^{-7}	1×10^{-8}

B. Releases into Air

Radionuclide			
I^{131}	4.7×10^{-14}	1×10^{-10}	1×10^{-14}

Since reconcentration of radioactivity can occur in the environment, particular attention will be devoted to evaluating the significance of any buildup of activity in these samples. Dose estimates to man will be made if the above analyses show that significant amounts of radioactivity from plant releases are accumulating in the environmental samples (i.e., such as amounts that could possibly result in doses in excess of one percent of 10CFR20 limits), although primary emphasis for the calculation of dose will be placed on effluent data. Analysis for, and concentrations of, specific radionuclides in environmental samples will be correlated with known plant releases of the same nuclide. Although the preoperational monitoring results may serve as a base line for comparison during the operational period, such comparisons have been complicated in the past by fallout from nuclear testing, releases from other facilities, and spatial and time variations in naturally occurring radioactive materials and radiation. Therefore, to aid in evaluating the effect of the plant releases on the environment during the operating period, the plant's contribution of activity will be differentiated from existing environmental levels by comparing levels found in similar samples collected at the same time in different locations. This is done by collecting samples both within and beyond the Exclusion Area, upstream and downstream, upwind and downwind from the station, in locations of highest expected levels offsite, and in control locations.

Table 4.2-5 describes the Offsite Radiological Monitoring Program that is proposed for the Catawba Nuclear Station. The samples and measurements include all critical exposure pathways relating to dose to man that have been determined to be of possible significance for this station plus additional samples of interest. For location of sampling stations, see Figure 4.2-1.

4.2.7 POSSIBILITIES AND CONSEQUENCES OF ACCIDENTAL RELEASES

The Catawba Preliminary Safety Analysis Report and the Westinghouse Reference Safety Analysis Report contain an extensive examination of possible routine radioactive releases in Chaper 11 and a similar examination of design basis accidents in Chapter 15. Since the PSAR and RESAR are safety evaluation documents, all parameters that affect the results are of a very conservative nature. This conservative approach to safety evaluation is used so that the design features of the plant will always be more than adequate to protect the health and safety of the general public. In order to perform a realistic appraisal of accident consequences, it is necessary to make realistic assumptions throughout the calculations.

This section will examine accidents in six of the nine classes that have been specified in the proposed Annex to Appendix D of 10 CFR 50. Class 1 accidents are by definition trivial and are not considered while Class 9 accidents are those of such extremely low probability of occurrence that they need not be addressed since they are considered "incredible." Class 4 accidents are not considered because they apply only to boiling water reactors.

The accident classes as defined in the above document are as follows:

Class No.	Description
2	Small Releases Outside Containment
3	Radwaste System Failures
5	Fission Product to the Primary and Secondary Systems
6	Refueling Accidents
7	Spent Fuel Handling Accidents
8	Accident Initiation Events Considered in Design Basis Evaluation in the Safety Analysis Report

A reasonable accident analysis must address two concerns; a determination of the radiological consequence of the event and a determination of the frequency of occurrence of the event. The usual procedure for establishing the radiological consequences of an event classed as an accident is to compare the calculated dose with the limits of 10 CFR 100. Since the intent of this section is to show a realistic approach to accident analysis, the results are compared to 10 CFR 20 limits for routine releases. This approach dramatically demonstrates that, under the conditions specified, no significant environmental effects result from these accidents. See summary in Table 4.2-6.

There are two general classes of events that can be identified; those that cause little, if any, damage to equipment and those that either damage equipment or cause severe operating problems. In the case of the former, it

need only be shown that the environmental consequences are trivial for several occurrences. The latter class of events cannot be evaluated properly on a mathematical probability basis due to the lack of statistically significant industrial experience with these accidents. Commercial power generating reactors have been in operation since 1957 (Shippingport) and today there are
2 | over 14,000 MW of nuclear generating capacity in service. Throughout this experience there have been no significant radioactive releases due to accidents and there have been no injuries or deaths due to radioactive releases. It is logical that an event which damages equipment or causes severe operating inconvenience is unlikely to recur during the life of the plant due to revised procedures or redesign or replacement of the fault causing component. With respect to estimated releases of radioactivity due to accidents discussed below, the exclusion area boundary Fraction of Maximum Permissible Concentration (FMPC) and the average dose to the population over a 50 mile radius area are presented for each event in Table 4.2.6.

The radiological consequences of most accidents are dependent on the primary coolant system activity. The design basis for reactor coolant activity levels is 1.0 percent fuel defects and corrosion products as fully described in RESAR Chapter 15. Based on experience with currently operating reactors, a more releastic assumption would be continuous operation with 0.1 percent fuel defects. These values are shown in Table 4.2-2.

There is significant but limited experience to support the assumption of 0.1 percent fuel defects but it is evident that the results, which vary linearly with coolant activity, are so low that the conclusions reached (i.e., no adverse environmental effects) are valid.

Other classes of accidents analyzed here are all based on 0.1 percent fuel defects and corrosion products. It should be noted that activity in the primary coolant system does not result in an offsite exposure unless equipment failure or operating errors occur.

Class 2 - Miscellaneous Small Releases Outside the Containment

This type of event has been discussed in Subsection 4.2.3 and the results are presented in Table 4.2-4.

For the purposes of this section, the results shown in Table 4.2-4 represents a reasonable evaluation and demonstrate the very low environmental effects of spills and leaks both inside the Containment and inside the Auxiliary Building.

Class 3 - Radwaste System Failures

The only radwaste system components whose failure could result in an offsite exposure are the waste gas decay tanks. The results of this type of postulated failure are presented in Class 8.

The consequences of inadvertent operator action during purging the Containment
2 | or discharging the contents of waste monitor tank are minimized by process monitors which terminate these operations automatically on high radiation alarm.

The gases from spills and leaks in the Auxiliary Building and radioactive air ejector off-gases resulting from operation with steam generator tube leaks are two other events which could contribute to offsite exposure but
2 whose consequences are limited by the action of the monitor in the unit vent.

All gases are discharged through a monitored single vent for each unit. All previously processed liquids are discharged from the waste monitor
2 tank through a single monitored discharge pipe and diluted in the CCW discharge. These provisions insure that adequate protection is provided for both unplanned actions and system failures by the alarm and process termination function of the process monitoring system.

2

Class 5 - Events That Release Radioactivity into the Secondary System

The primary and secondary systems are separated in the steam generator by the tubes and tube sheet. Should a leak develop in a steam generator tube, primary system coolant would pass directly into the secondary system; and, if that primary coolant contained dissolved fission product gases as described for normal operation, these gases would be available for release from the condenser air ejector to the unit vent.

The magnitude of the assumed tube leak directly affects both the environmental consequences and the continued operation of the unit. The resulting loss of coolant from a single steam generator tube rupture is greater than the normal makeup capacity. Under these circumstances, the reactor would be shut down and the affected steam generator could be isolated within thirty minutes. The ruptured tube would have to be plugged before the unit could be made operable again. This case is an example of an accident whose frequency of occurrence is limited by the problem it causes and the extensive repair effort required to remedy the situation. Should this event occur even once during the life of the plant, it would initiate an exhaustive effort to determine not only the cause but also development of means to prevent another occurrence. However, for the purposes of this analysis, one steam generator tube rupture is assumed to occur in one year (the averaging period for 10 CFR 20 limits).

The assumptions used to evaluate one steam generator tube rupture are:

1. Gaseous fission product coolant inventory from 0.1 percent fuel defects.

2. The complete failure of one tube resulting in a 125,000 pound primary to secondary leak in thirty minutes before the affected steam generator is isolated.

3. No previous tube leakage.

4. All noble gases stripped in the condenser and discharged by the air ejector.

2 5. An iodine partition factor of 5×10^{-5} in the condenser and 10^{-2} in the steam

generator.

6. Two hour average meteorology giving a ground release X/Q (relative concentration) of 1.3×10^{-4} sec/m^3.

7. One tube failure averaged over one year.

The assumptions result in a FMPC of 1.6×10^{-2} at the exclusion area boundary and a 50 mile radius annual average dose to the population of 5.2×10^{-2} mrem. The effect on plant operation of a small steam generator tube leak is much less pronounced than that of a tube rupture. The loss from the primary side would have to be compensated for by makeup and the addition to the secondary side would have to be removed to preserve a constant volume in each system. The magnitude of the leak that represents an intolerable or inconvenient quantity to make up is dependent upon many parameters, including coolant activity level, availability of usable makeup water, and availability of processing equipment. This type of event is included in subsection 4.2.3.

2

Class 6 - Refueling Accidents Inside Containment

See Class 7.

Class 7 - Accidents to Spent Fuel Outside Containment

Class 6 and Class 7 are discussed together because the only difference between an activity release inside the Containment and a similar release in the spent fuel pool area is the ability to completely isolate the Containment. The Spent Fuel Pool Ventilation System's operation can be terminated and this action would reduce the offsite dose significantly. But for the purposes of this section, the Spent Fuel Pool Ventilation System operation is assumed to continue through the accident.

An accident which results in mechanical damage to a fuel assembly is considered to be the maximum potential source of activity released during refueling operations. In this accident, it is assumed that a fuel assembly which has been irradiated for three full core cycles is removed from the core and damaged after one week of decay. It is assumed that while the assembly is being handled underwater, an incident occurs resulting in the severance of the cladding for a full row of fuel pins (15 pins).

Severence of the fuel pin cladding will release fission product activity. Since the fuel pellets are cold, only the activity contained in the pellet-cladding gap will be released. Fuel assemblies are handled under a minimum of 10.5 feet of water so that activity released from the assembly must pass upwards through the water before reaching the Auxiliary Building atmosphere.

No retention of noble gases in the pool water is assumed while a decontamination factor of 760 for iodine is used.

Although this analysis identifies the consequences of an incident which damages a spent fuel assembly, the fully tested equipment and the administrative procedures for handling this fuel make it difficult to identify a mechanism for the incident. However, in spite of the preventive measures, were an incident to occur, a redesign of the handling equipment or a change in procedures would be initiated to prevent recurrence.

These assumptions are summarized as follows:

1. One row of fuel pins (15 out of 204 pins) is ruptured.

2. Noble gas and iodine gas activity released from the ruptured pins are 15/204 of the gap activities shown in RESAR Table 15.4-11 for the highest rated assembly discharged.

3. 168 hour shutdown decay preceding the accident.

4. Iodine reduced by a factor of 760 in the pool water.

5. Two hour average meteorology giving a ground release X/Q of 1.3×10^{-4} sec/m^3.

6. One incident averaged over one year.

These assumptions result in an FMPC of 3.6×10^{-2} at the exclusion area boundary and a 50 mile radius annual average dose to the population of .12

Class 8 - Accident Initiation Events Considered in Design Basis Evaluation In The Safety Analysis Report

There are several accidents and events described in the RESAR Chapter 15 analysis which do not result in a release of activity to the environment and therefore are not considered in this report.

There are three accidents that under certain circumstances could result in an activity release: Waste Gas Decay Tank failure, steam line failure, and the Design Basis Loss-of-Coolant Accident (LOCA).

As noted in Class 3, the only radwaste system component whose failures would lead to an offsite exposure is the Waste Gas Decay Tank. A rupture of one of these tanks is highly unlikely due to the fabrication and quality assurance procedures used by the manufacturer and Duke. As noted in previous examples, were a tank rupture to occur in spite of all precautions, the damage to the tank would require the purchase of another tank which would be redesigned to preclude a recurrence of the event during the life of the plant.

Normal operation of the Waste Gas System does not result in a discharge to the atmosphere. For the purposes of this analysis, a rupture of one tank is assumed to release one tenth of the activity shown in PSAR Table 11.3-4 which is based on one percent fuel defects.

The results of these assumptions is an FMPC of .17 at the exclusion area boundary and a 50 mile radius annual average dose to the population of .58 mrem.

A main steam line failure does not result in a release of radioactivity to the environment unless there has been both fuel defects, contributing to the primary coolant system activity, and steam generator tube leaks prior to the event. This event is discussed in PSAR and RESAR Chapter 15. The probability of these three events occurring simultaneously or in rapid sequence cannot be determined. This type event is not likely to recur.

The following assumptions are used to evaluate a steam line failure:

2 1. Steam generator activity shown in Table 4.2-2a.
2. One steam generator volume of water is released (95,000 Lbs).
1 3. 1/10 of the available I escapes.
4. Average two hour meteorology giving a ground release X/Q 1.3×10^{-4} sec/m^3.
5. One steam line failure averaged over one year.

2 These assumptions result in an FMPC of 1.7×10^{-5} at the exclusion area boundary and a 50 mile radius annual average dose to the population of 5.6×10^{-5} mrem.

The design basis Loss-of-Coolant Accident (LOCA) is postulated as resulting from the double ended rupture of the largest primary coolant pipe. The core protection systems, the energy suppression systems and the full range of responses to this event are fully discussed in RESAR and PSAR Chapters 6 and 15. No mechanism has been postulated to cause a failure of this magnitude, and no such actual event has been experienced in the industry. For this analysis, the releases from one LOCA have been averaged over a one year period.

A realistic evaluation of this event concludes that no damage to the fuel would be sustained. In order to perform an analysis which reports the results of a series of unrealistic occurrences, it is assumed that some unpostulated mechanism results in the release of the gap activity in every fuel pin. Most of the activity released would be contained in the Containment and only a small amount would leak to the environment.

The assumptions used to evaluate a LOCA are:

1. Gap activity from all assemblies released to the Containment.

2. One-half of the iodine plates out on the walls of the Containment.

3. Seventy-five percent removal of iodine by sprays.

4. Sixty percent removal of iodine in the ice beds.

5. Containment leak rate of .05 volume percent per day occurs during approximately ten days that building pressure is greater than atmospheric.

6. Annulus Ventilation System charcoal filter efficiency of 99 percent.

7. Four day average meteorology giving a ground release X/Q of 2.1×10^{-4} sec/m^3.

These assumptions result in an FMPC of 4.7×10^{-4} at the exclusion area boundary and a 50 mile radius annual average dose to the population of 1.8×10^{-3} mrem.

Conclusions:

The results of the preceding analyses are summarized in Table 4.2-6. Two classes of probability are identified as "P" (may occur but consequences shown require coolant activity prior to event) and "I" (not likely to occur, consequences are presented from one event in one year during the life of the plant).

In order to put the consequences of these accidents in perspective, the resulting doses shown in Table 4.2-6 would be in addition to the naturally occurring background radioactivity. Preliminary measurements at the Catawba site have confirmed a range of natural gamma background of 110 mrem discussed in Subsection 4.2.5 of this report. Even the largest average dose shown in
2 Table 4.2-6, .58 mrem, would only increase this estimated exposure to 110.58
mrem. This increase is insignificant and leads to the conclusion that none of the accidents examined endanger the health and safety of the general public.

4.2.8 EMERGENCY PLANS

There is no credible reactor accident that can endanger the public because of the redundant structures and systems provided in the plant to prevent reactor accidents from occurring and to mitigate the consequences of an accident should one occur. Nevertheless, to be on the safe side, the results of an incredible accident are evaluated so that there will be a positive program to protect the health and safety of the public in the event of this incredible accident situation.

Accordingly, an Emergency Plan for the Catawba Nuclear Station will be established for the protection of life and property in all emergency and accident situations in accordance with AEC regulations. As such, it will particularly apply to those situations involving radiation and contamination where the health and safety of station personnel and the general public may be involved, but in addition it will also include other general industrial emergency and accident conditions. The Emergency Plan will be a coordinated effort involving station personnel, facilities and equipment; the emergency resources and capabilities of Duke Power Company; outside emergency services; and various local, state and federal agencies having appropriate jurisdiction or concern for the public health and safety.

The Emergency Plan will be compatible with facility design features, site layout, and site locations with respect to such considerations as access routes, surrounding population distributions, and lake and land use.

Agreements will be made with local, state and federal authorities for coordination of activities in the event of an emergency. These services or agencies will include: the South Carolina State Board of Health, Division of Radiological Health; the York County Civil Defense agency; the Sheriff's Department for York County; the York County Police; the South Carolina Highway Patrol; the AEC Region II Compliance Office and the York County Health Department. Arrangements will also be made with local agencies for fire protection, medical support, and for ambulance and rescue service. Arrangements will be made with appropriate agencies to provide logistical support in the event that evacuation of off-site areas becomes necessary. Means for coordination and cooperation will be established with persons and groups in the immediate area off-site, who might be affected by an accident, such as residences and recreational facilities on Lake Wylie as well as water authorities of nearby cities.

Additional emergency assistance from within the company, as well as the full resources of Duke Power Company and backup from corporate management, are available to the Catawba Nuclear Station.

A detailed Emergency Plan will be prepared for the Final Safety Analysis Report. Procedures for implementing the Emergency Plan and for achieving its objectives will be prepared by the staff of the Catawba Nuclear Station prior to initial operation of the first unit.

The emergency and accident situations covered in the Emergency Plan will include the following situations among others: fire, vehicular accidents, natural disasters, medica' injury or illness, radiation and contamination, civil disturbance, industrial sabotage and reactor accidents.

Radiological emergency situations, if they occur at all, are expected to be highly localized and only station property and station personnel would be subjected to any major hazard. In some cases, other persons and members of the public could also be involved to a lesser extent. Cognizance has been taken of the fact that construction forces will be on-site during the operation of Unit 1 for the construction of Unit 2; and that later Unit 2 will be operating. Members of the public will also be within the Exclusion Area at various times (highway and rail traffic, visitors, boating and recreation on Lake Wylie, etc.). In case of a major accidental release of activity, the general public and property in locations beyond the Exclusion Area may also be affected. The plan will include the protection of all these groups.

1 4.2.9 TRANSPORTATION OF FUEL AND BYPRODUCTS

Transportation of new fuel from a fabrication plant to the reactor, irradiated fuel from the reactor to a reprocessing plant and low level radioactive waste to a commercial AEC-licensed burial ground should produce no environmental effects except those due to the increased rail and/or truck traffic itself. That is, the environmental effects will be confined to the use of petroleum fuel and additional exhaust emissions from diesel engines, the total effect of increased rail or vehicular traffic and the environmental effect of increased rail or vehicular accidents that may occur. Because of Federal regulatory requirements for protective packaging of shipments of radioactive materials, radiation should not be a significant factor affecting man or his environment.
1 See Table 4.2-8.

New fuel for Catawba 1 and 2 will be delivered from one of the Westinghouse fuel fabrication plants in either a type RCC or RCC-1 shipping container, which has been issued Department of Transportation Special Permit No. 5450 and will be shipped under the general license provided in Title 10 of the Code of Federal Regulations, Part 71, Section 71.7 (B). This container holds two fuel assemblies. Transport controls limit each shipment to no more than seven containers. A pproximately 28 shipments (over a two-year period) will be made to supply the two Catawba units initially, with approximately 11 shipments per year thereafter (based on seven containers per shipment).

Irradiated fuel will be shipped to a reprocessing plant under license, in AEC/DOT authorized casks and in accordance with applicable regulations. It is expected that rail and/or truck casks will be used for these shipments. Assuming annual refueling in each unit, and 72 assemblies per refueling, there would be 144 spent fuel assemblies shipped per year. The number of assemblies per shipment, and the the number of shipments, will vary depending on whether rail or truck casks are used and on licensing restrictions.

Low level radioactive wastes consisting of spent ion-exchange resins, evaporator bottoms and contaminated trash will be shipped to an AEC licensed commercial radioactive waste burial ground for disposal. These wastes will be shipped under license, in approved containers and in accordance with applicable regulations. The resins and evaporator bottoms will be shipped in specification DOT Type B containers or AEC approved containers for large quantities of radwaste (shielded casks). Contaminated trash will be shipped in specification DOT Type A containers (55-gallon steel drums). It is expected that disposal of these materials will require about 33 truck shipments per year for the two Catawba units.

Federal regulations governing the packaging and transportation of radioactive materials can be found in the Code of Federal Regulations, Title 49, Parts 170 to 199; Title 14, Part 103; Title 10, Part 71; Title 39, Parts 124.2(d) and 125.2(d); Title 46, Parts 146 and 149. These Federal regulations are administered by the U. S. Atomic Energy C ommission and the Department of Transportation. The limitations imposed by these regulations on both quantity and method of packaging insure that any significant effects resulting from a severe transportation accident would be confined to the immediate area.

Because of the care and concern taken by shippers to comply with these Federal regulations, the record of safety in the transportation of radioactive materials has been excellent. It is estimated that more than 300,000 packages of radioactive materials are now being shipped annually throughout the United States. Transportation accidents have occurred; but to date there have been no known deaths or injuries due to radiation from fissile or radioactive materials in the transportation environment. "This record of safety has been truly phenomenal and is without question far superior to that for any other hazardous commodity."[(1)]

4.2.10 DIRECT RADIATION

Direct radiation exposure due to the Catawba Station is expected to be well within applicable regulations for the operating staff and maintenance personnel, and virtually negligible for the population living in the vicinity of the plant.

Recent data on operating nuclear power stations show an average total onsite exposure of approximately 240 man-rem per year; this exposure is divided between shutdown and operation in a ratio of about three to one. It is expected that normal exposures at Catawba will be at or below the levels reported for currently operating plants, due to Catawba's incorporation of evolutionary nuclear station design. The direct dose at the exclusion area boundary is estimated to be about 2×10^{-5} mrem per hour. Exposures due to direct doses
1 offsite are expected to be less than .02 man-rems per year, based on the following assumptions:

a. Average dose rate at the exterior surface of the Reactor Building of 1.0 mrem per hour.

b. Dose rate decreased by distance and air shielding; no credit for shielding by other structures or terrain.

c. Projected populations for year 2000 (PSAR Figure 2.1-20); all persons within the one-mile radius circle are assumed to live continuously at the 2500-foot boundary.

Direct doses to the public from Catawba Station are thus seen to be insignificant.

(1) Grella, A. W.; "A Review of Department of Transportation (DOT) Regulations for Transportation of Radioactive Materials"; Office of Hazardous Materials, Department of Transportation.

4.3 OTHER WATER QUALITY EFFECTS

4.3.1 MECHANICAL CLEANING OF CONDENSER TUBES

Catawba Nuclear Station is equipped with a mechanical system for cleaning of condenser tubes to prevent the fouling of condenser heat transfer surfaces. Cleaning of these tubes is necessary to avoid a reduction of thermal efficiency and a corresponding increase in waste heat rejection to the cooling water. The mechanical cleaning system injects sponge rubber balls into the condenser inlet water boxes where they disperse and flow with the water through the condenser tubes to achieve a scrubbing of the tube surfaces. The sponge balls are collected by a strainer in the condenser discharge water pipe and pumped back for reinjection into the inlet water boxes.

Operating experience with this type system at Duke's Marshall Steam Station, which uses Lake Norman water for cooling, has shown it to be a satisfactory method for maintaining clean condenser tubes without the use of chemical treatments.

The condenser cooling water tubes are stainless steel. Considering the high purity and non-corrosive nature of the cooling water, there should be no significant corrosion products released from the tubes to Lake Wylie.

1 4.3.2 MECHANICAL FILTRATION OF POTABLE WATER SUPPLY

At Catawba Nuclear Station, the supply system for filtered water will utilize diatomaceous earth filters to accomplish the filtration process without the use of coagulants. Chlorine will be applied at the rate of 3 to 8 ppm to produce a free residual of 1 ppm measured daily by the orthotolodine test method.

The 1500 gallon per minute purification system will include two diatomaceous earth type pressure filters having a capacity of 750 gpm each for 24 hours.
1 Normal expected usage will require operation of one filter at 750 gpm for approximately 7 hours per day. One filter precoat will treat an average of 1,080,000 gallons. Each filter will use an average of 450 pounds of inert diatomaceous earth, in a thin layer on cylindrical filter tubes, as the filtering media. The spent material at the end of a typical run will be flushed with approximately 1,550 gallons of filter backwash-and-precoat water to a waste collection basin (described in Subdivision 4.3.3.6) where the filter media and collected solids will settle out and be retained permanently.

The environmental effect of using this filter system will be a reduction of more than 100,000 pounds per year in the dissolved chemicals being passed downstream as compared to the amount which would result from the use of conventional municipal type water purification.

4 3.3 NON-RADIOACTIVE WASTE WATER DISCHARGES

4.3.3.1 Summary

In addition to the potentially radioactive liquid waste described in Subsection 4.2.3, there are other miscellaneous liquid wastes which are not radioactive but which may require treatment from a chemical or public health standpoint. These liquid waste include the station's domestic sewage, drains which may contain small quantities of industrial chemicals and ordinary floor drains. Each of these sources of waste water is treated as required to make it suitable for transfer to a single waste water collection basin which services the entire station. In this collection basin, settleable materials are removed and further treatment such as chemical neutralization can be carried out if needed prior to discharge of the waste water to the river. Steam Generator blowdown, discussed in Subdivision 4.3.3.7 is discharged when not radioactive to the CCW discharge. Table 4.3-1 gives a summary of water usage at Catawba.

1 During operation, normal disposition of garbage and other nonradioactive trash
will be to landfill.

4.3.3.2 Temporary Sewage Treatment Systems

During the period of plant construction all domestic sewage from the field
toilets, field office toilets, and mess hall will amount to a maximum total
flow of 29,000 gallons per day. The average flow of effluent from the tem-
porary system will develop during 1975 to the maximum in 1976 and remain
constant until 1979. It will then decrease until a time several months after
1 the startup of Unit 2 when it will cease. These wastes will be treated in two
prefabricated extended aeration type sewage treatment plants having a combined
capacity of 32,000 gallons per day, and using up to 5 pounds of chlorine per
day in chlorine contact chambers with 30 minutes retention. Sewage solids
will be digested completely by extended aeration treatment, leaving only a
chlorinated liquid effluent with 0.5 ppm combined chlorine residual to be
pumped to the station's waste water collection basin (described in Subdivision
4.3.3.6) where the water ultimately will be discharged back to Lake Wylie.

Residual combined chlorine in the effluent of both temporary and permanent sewage treatment systems will be determined by daily tests using a procedure outlined in Standard Methods.

The sewage treatment facilities meet all applicable standards of the State of South Carolina; approval of their construction and operation will be obtained from the South Carolina Pollution Control Authority, the South Carolina State Board of Health, the York County Health Department; and they will be operated under the supervision of a trained waste treatment plant operator who is certified by the State of South Carolina.

4.3.3.3 Permanent Sewage Treatment System

All domestic sewage from the station is estimated to total 5500 gallons per day.
It will be collected and treated in one septic tank with sand filters, followed
by a chlorine contact chamber that will apply up to 1 pound of gaseous chlo-
1 rine per day. The effluent will have a 0.5 ppm combined chlorine residual and
will be pumped to the station's waste water collection basin (described in Sub-
division 4.3.3.6) where the water will be ultimately discharged back to Lake
Wylie.

1 Residual combined chlorine in the effluent of both temporary and permanent sewage treatment systems will be determined by daily tests using a procedure outlined in Standard Methods.

This sewage treatment facility meets all applicable standards of the State of South Carolina; approval of its construction and operation will be obtained from the South Carolina Pollution Control Authority, the South Carolina State Board of Health and the York County Health Department; and it will be operated under the supervision of a trained waste water treatment plant operator who is certified by the State of South Carolina.

4.3.3.4 Waste Water Containing Chemicals

A representative listing of chemicals which are expected to be used in various plant processes and the waste disposal considerations for each of these chemicals is as follows:

Chemical Process	Chemicals Typically Used	Disposal Considerations
Secondary Coolant Feedwater Conditioning	Very dilute water solution containing Ammonia, Hydrazine, Sodium Phosphate	Small quantities and no special hazards involved. Drains containing these chemicals normally will be pumped to the plant waste water collection basin (described in Subdivision 4.3.3.6) with no special treatment required. Approximately 2,000 pounds of hydrazine will be used per unit per year. The hydrazine reacts chemically with oxygen in the system to form nitrogen and water, with a small portion of the hydrazine decomposing to form ammonia. Approximately 2,600 gallons of 26° Baume aqua ammonia will be used per unit per year. This is used for pH control of steam generator feedwater and small amounts will be disposed of through the steam generator blowdown.

	Chemical Process	Chemicals Typically Used	Disposal Considerations
1 1	Equipment Cleaning Solutions	Dilute water solutions of Sodium Phosphate, Powdered Detergents, Liquid Detergents	These are all mild chemicals and normal disposal is to the plant waste water collection basin with no special treatment required. Prior to start up approximately 500 gallons of liquid detergent will be used over about a three-year construction period for degreasing and spray cleaning piping assemblies for both units during shop fabrication, with wastes being processed through the temporary sewage treatment system. Also prior to start up of each unit, hot 0.5% trisodium phosphate solutions will be used for cleaning condensers and the condensate-feedwater system. Estimated amounts for each unit would include 30,000 pounds trisodium phosphate and 140 gallons liquid detergent. Disposal will be to the waste water collection basin. Approximately 800 gallons of commercial liquid detergents will be used annually by the station for normal plant maintenance and cleanup. Any waste from this operation will be processed through the plant sewage treatment system. Powdered detergents used for the decontamination of clothing, equipment, laundries and laboratory articles may be used in quantities up to 3,200 pounds per year for two units. The laundry waste will be processed through activated carbon filters for removal of organics and detergents. Approximately 1000 pounds of activated carbon will be used per year. After usage,

Chemical Process	Chemicals Typically Used	Disposal Considerations
		the carbon filter will be drummed and disposed of as low level radioactive solid waste.
Demineralizer Regeneration	Water solutions of Sulfuric Acid and Sodium Hydroxide	These are strong chemicals but involve no harmful residues after neutralization. The spent acid is mixed with the spent caustic to assure neutralization, then the waste water is pumped to the plant waste water collection basin. (Note: See Subsection 4.3.4 for further discussion)
Corrosion Control in Closed Cooling Systems	Dilute water solution of Sodium Nitrite and Borax; Potassium Chromate	In the auxiliary coolant system component cooling loop, approximately 100 pounds of potassium chromate will be used per unit per year for corrosion control. During maintenance of the system, any necessary draindown will be collected and returned to the system. Any spillage will be collected and processed through the radioactive waste disposal system. In other closed cooling systems, sodium nitrite and borax will be used. No blowdown is required. These treatment chemicals are not normally discharged but no special hazards would be involved and any leakage or spillage from these cooling systems would be pumped to the plant waste water collection basin. Approximately 1,200 pounds of sodium nitrite and Borax will be used per unit per year.

Chemical Process	Chemicals Typically Used	Disposal Considerations
Primary Coolant Water Conditioning	Dilute water solutions of Boric Acid, Lithium Hydroxide, Hydrazine	No special chemical hazards are involved with dilute solutions of these chemicals. Any spillage or leakage of these chemicals during storage or handling would be recovered or appropriately neutralized for discharge to the waste water collection basin. Approximately 11 pounds of lithium hydroxide will be used per year. (Note: Approximately 18,000 pounds of boric acid will be used per unit per year. Since the primary coolant itself will contain some radioactivity, any primary coolant drains will be processed through the radioactive liquid waste disposal systems described in Subsection 4.2.2)
Chemical Laboratories	Misc. chemical reagents	Very small quantities of chemicals are involved in the laboratory procedures and no special chemical waste treatment is required. (Note: Drains from the "Hot Lab" may contain small quantities of radioactivity so all drains from this lab will be processed through the radioactive liquid waste disposal system described in Subsection 4.2.2)
Drinking Water Disinfection, Sanitary Waste Water Post-Treatment	Chlorine	No disposal considerations involved.

The blowdown system on each unit is designed for a maximum capacity of 600,000 pounds per day. There is the normal makeup capability of 475 gpm or 5,700,000 pounds per day for two units.

In addition, the station's overall waste disposal capabilities take into account the possible need for the handling of other chemicals. For example: if some new chemical or combination of chemicals should be needed for the cleaning of plant equipment items, the resulting waste water could be appropriately purified for release or concentrated and collected for disposal as chemical or radioactive waste material.

4.3.3.5 Other Drains

All miscellaneous floor drains from the Turbine Building and similar plant areas where radioactive systems are not involved will be collected in sumps and pumped to the station waste water collection basin (described in Subdivision 4.3.3.6) where the water ultimately is discharged back to Lake Wylie.

A system of yard drains collects the ordinary surface water runoff in the vicinity of the station and conducts this runoff to Lake Wylie.

4.3.3.6 Waste Water Collection Basin

All non-radioactive waste water from the station, except the cooling water and the surface runoff from the yard, will be conducted to a single outdoor collection basin. A block diagram of the chemical discharges to this basin is shown in Figure 4.3-1.

The basin will be located near the cooling water discharge channel(Figure 2.2-3)
and will have a total storage capacity of approximately 25 million gallons with
a drawdown capacity of approximately 5 million gallons. The dike will require
approximately 100,000 cubic yards of Group 1 fill material which will be obtained
1 from the area immediately northeast of the basin. Cross sections of the dike
and outlet works are shown on Figure 4.3-2. The effluent from the basin will
flow into the cooling water discharge channel approximately 1000 ft downstream
from the cooling water discharge structure. The rate of effluent flow from the
basin will be variable from 0 to 5000 gpm and will be controlled to allow for
planned holdup as desired.

Provisions will be made for daily sampling of the effluent, and daily analysis for pH and conductivity of the effluent will be conducted. The expected effluent pH will be between pH 6.0 - 8.5, and the retention capability of the basin will allow for additional treatment prior to discharge as required. Periodic testing will include checks for heavy metal concentrations in the effluent. The effluent structure will also be equipped with an oil trap to prevent the discharge of possible oil spillage originating in the turbine building or other facilities.

The final effluent from the basin will be suitable for unrestricted discharge to Lake Wylie. The construction and operation of this waste water facility will be carried out in compliance with permits to be obtained from the South Carolina Pollution Control Authority; the South Carolina State Board of Health, and the York County Health Department.

4.3.3.7 Steam Generator Blowdown

The Steam Generator Blowdown Recycle System allows cleanup of the secondary side concurrent with Steam Generator Tube leaks without excessive radioactive discharge to the environment. This is accomplished by the use of bead type mixed bed demineralizers which remove impurities from the blowdown allowing the water to be recycled or discharged depending on effluent activity level. Although the system is designed for continuous blowdown recycle, it is expected that normally no tube leaks would exist and the blowdown could then be discharged to the condenser circulating water. Monitoring and interlocks are provided to assure that discharges will be consistant with Technical Specifications.

4.3.4 DEMINERALIZED WATER SUPPLY

The two regenerable mixed bed make-up demineralizers will have a capacity of 475 gpm each for 24 hours. Normally one demineralizer unit will be in service with the other one on standby or being regenerated. A typical run of one regenerated demineralizer unit will average 76 hours at 150 gpm, treating 684,000 gallons, or 216,000 gallons per day. Approximately 137,000 pounds of 100 percent sodium hydroxide and 89,000 pounds of 66° Baume sulfuric acid will be used per year to regenerate the mixed bed demineralizers. After regeneration the spent acid and caustic will be mixed to assure neutralization to pH 9-10 with the reaction products being sodium sulfate and alkalinity. Before the further neutralization and dilution which will be achieved in the wastewater collection basin, the regenerant effluent will contain approximately 55 ppm sodium sulfate and 40 ppm of alkalinity expressed as $CaCO_3$ (to pH 7 endpoint). If this effluent were diluted by the minimum average daily flow of 411 cfs through Lake Wylie Dam, it would only contribute approximately 0.11 ppm alkalinity as $CaCO_3$ and 0.14 ppm sodium sulfate to Lake Wylie. With the additional beneficial effects of the wastewater collection basin, the discharge to the lake will be even less significant.

4.3.5 STANDBY NUCLEAR SERVICE WATER POND

A dike will be constructed across Beaver Dam Creek (Figure 2.2-3) to create the Standby Nuclear Service Water (SNSW) Pond for Catawba. The surface area at elevation 571.0 is 48 acres. Details of the SNSW Pond and Dam are given in Appendix 2G of the PSAR.

The SNSW Pond will be quiescent. A review of recent aerial photographs of the Catawba site indicates that the 410 acre watershed serving Beaver Dam Creek (SNSW Pond) is forested and undeveloped. The nutrient and sediment load is anticipated to be considerably less than the Lake Wylie average and, therefore, not conducive to nuisance algal blooms.

4.4 LAND USE

4.4.1 CATAWBA NUCLEAR STATION

Catawba Nuclear Station is located on properties acquired for siting a steam plant on the shores of Lake Wylie, which provides a source of condenser cooling water. All property within the 2500 foot radius Exclusion Area, 450 acres, is owned by Duke, with the exception of six acres owned by the Concord Church. There is no church on the property, only picnic shelters and a small cemetery containing 156 graves which occupy a small portion of the six acre property. The first burial in the cemetery was in 1822 and the last in 1967. The cemetery and lot are maintained by the Concord Cemetery Association.

Lake Wylie surface constitutes approximately 17 percent of the Exclusion Area. The portion of the site occupied by the plant proper, its yard, waterways and transmission rights-of-way was, prior to the development, covered with pines, brush and a small amount of timber. The plant buildings and most of the yard will be located on both sides of the existing right-of-way of county road 1132, which will be relocated to the south of the plant. Coordination of land use with appropriate planning agencies is described in Section 3.2 and Chapter 6.

This site is ideally suited for a nuclear generating facility for the following reasons:

a. Requires only 1-1/2 miles of public road relocation.

b. Does not require relocation of permanent residences.

c. Utilizes to a major extent properties already owned by Duke.

d. Utilizes many existing transmission rights-of-way.

e. Site topography provides a natural site for Standby Nuclear Service Water Pond and very favorable surface drainage features.

f. Has remoteness advantages without access disadvantages.

g. Is close to public highway and railroad access.

Duke estimates the cost of relocating county road 1132 to be $1,390,000. This road terminates at the southeastern end of the peninsula approximately two miles from the site. It provides access to 13 permanent homes, five permanent mobile homes and 70 recreational homes lying to the east of the plant site. The relocated road will provide access to a proposed picnic area and fishing deck to be constructed in cooperation with York County, S. C. The only significant environmental cost of this relocation will be the deforestation of about ten acres of Duke land for the right-of-way.

Except for a few lake homes and cottages, the area is typically rural for Piedmont Carolina. These properties are not likely to be affected by the nuclear plant aesthetically, functionally or value wise except for some increased traffic and activity in the general site area during plant construction. Of the area within a two mile radius of the site, 91 percent is

Duke property and the remaining 9 percent is privately owned (Figure 4.4-1). Forty-two percent of the Duke property is under the lake.

1 The switching station (Subdivision 4.4.1.1) has been located to the west of and close to the plant; however, for aesthetic consideration the incoming and outgoing transmission lines are routed along rights-of-way, away from the plant.

Within five miles of the site the land is predominantly rural nonfarm and recreational with a small amount of land being used to support beef cattle and farming. There are a few industrial and business sites in the area
1 (Figure 4.4-16).

Zoning in Mecklenburg County, North Carolina (Figure 4.4-27) is predominantly residential. There is no zoning in York County, South Carolina outside of city limits.

Although the site is located geographically in the heart of the highly industrialized and populated region of the Carolinas, the immediate vicinity of the site is relatively unpopulated and without industry or commerce of any importance except for recreational opportunity. Figures 4.4-2 through 4.4-7 show the population distribution within ten miles of the site for 1970 and the estimated distribution in ten year intervals to 2019. Figures 4.4-8 through 4.4-13 show the distribution for the same years for areas ten to 50 miles from the site. Population distribution totals are given in Table 4.4-1. Figures 4.4-14 and 4.4-15 and Table 4.4-2 show agricultural land usage within a 50 mile radius of the site. Figure 4.4-1 shows the location of cleared farm land, not owned by Duke within two miles of the site.

Farm products within ten miles of the plant are listed and located as follows:

To the North	beef cattle, dairy, swine, poultry, apple and peach orchards, vineyards, cotton, grain and soybeans.
To the East	beef cattle, dairy, swine, poultry, vineyards, vegetables and soybeans.
1 To the South	beef cattle, dairy, poultry, peaches, cotton and soybeans.
To the West	beef cattle, dairy, swine, poultry, peaches, vineyards, cotton and soybeans.

Figure 4.4-30 shows concentrations of major farm products within ten miles of the site.

The values of major crops harvested in Mecklenburg County, North Carolina and York County, South Carolina for 1970 are as follows:

Crop	Mecklenburg County[1]	York County[2]
Corn	$ 96,600	$ 57,000
Wheat	$ 37,800	$ 10,000
Oats	$ 54,000	$ 19,000
Barley	$ 39,200	$ 14,000
Soybeans	$116,000	$ 71,000
Peaches	-	$457,000
Grapes	$ 10,400	$142,900
Cotton	$ 12,000	$587,000
Hay	$517,000	$323,000

The nearest commercial product industries are located between seven and eight miles from the plant near Rock Hill and Fort Mill, South Carolina. The nearest airport with scheduled commercial service is 14 miles north-northeast of the site. The nearest airport is five miles south of the site serving only light aircrafts. The nearest commercial airway is approximately six miles northwest of the site. No active military installations are located within 50 miles except for the the North Carolina Air National Guard at Douglas Airport. A natural gas pipeline is routed southwest of the plant approximately 6.2 miles at the nearest point (Figure 4.4-16). The industries within ten miles of the plant are detailed in Table 4.4-3. Distances from the center lines of the reactors to nearby facilities are as follows:

Quadrant	Facility	Distance	Remarks
Northeast	Residence	3500 ft	
	School	9.2 miles	586 students
	Dairy	9.0 miles	51 cows
	Hospital	16.7 miles	864 beds
	Industry	7.4 miles	216 employees
Southeast	Residence	4000 ft	
	School	5.8 miles	319 students
	Dairy	8.2 miles	43 cows
	Hospital	7.0 miles	762 beds
	Industry	6.8 miles	100 employees
Southwest	Residence	4300 ft	
	School	9.7 miles	1 046 students
	Dairy	5.6 miles	65 cows
	Hospital	10.7 miles	228 beds
	Industry	3.5 miles	25 employees
Northwest	Residence	5200 ft	
	School	4.0 miles	290 students
	Dairy	5.5 miles	60 cows
	Hospital	14.2 miles	254 beds
	Industry	5.6 miles	40 employees

[1] Data from Mecklenburg County Agricultural Extension Agent, Telephone conversation on February 1, 1973.

[2] Data from "South Carolina Crop Statistics," 1970 Preliminary and York County Agricultural Extension Agent, Telephone Conversation on February 2, 1973.

Details of main industries located in the Arrowood Industrial Park complex, located about ten miles from the site (Figure 4.4-16) are given in Table 4.4-3. There is no master plan for the development of this complex according to the developers, Arrowood-Southern.[1] About 1300 acres of the remaining 1400 acres available for development are zoned heavy industrial.

1 Figure 4.4-17 shows distances to the nearest residence, school, church, hospital, farm and dairy from the center line of the reactors for each of the 16 sectors. Public facilities and institutions within ten miles of the plant are detailed in Table 4.4-4 and are shown in Figure 4.4-18.

Figure 4.4-29 is an aerial photograph taken October 1972, showing the area within two miles of the plant site.

[1] Telephone communication with Mr. F. M. Funderburke, Manager of Properties, Arrowood-Southern.

Amendment 1

4.4.1.1 230 kV Switching Station

The Catawba 230 kV switching station is located about 700 feet west of the powerhouse and encompasses an area of 16.3 acres. Its design will utilize low profile modern rigid frame structures to enhance the overall appearance and to harmonize with the contemporary architectural concept of the complete Catawba Nuclear Station. A pleasing symmetrical arrangement of buses and equipment as seen in Figure 4.4-24 is achieved in the layout by utilizing the modern concept of breaker placement known as the breaker and a half arrangement. This design allows the reduction in the number of circuit breakers required in the switching station as compared to other comparable methods and is shown in Figure 4.4-25.

Power is transmitted from each Catawba nuclear generating unit on two separate overhead transmission lines connecting to the 230 kV switching station. This thereby complies with regulations requiring each unit to have two connections to the offsite power system. Initially the 230 kV switching station will interconnect with the Duke Power 230 kV network by five double circuit 230 kV overhead transmission lines as shown in Figure 4.4-19. The utilization of double circuit lines permits the reduction in the number of rights-of-way required by allowing the use of one tower line for two 3 phase circuits. Provisions for future installation of four additional double circuit lines are included in the design. All of these tranmission lines interconnecting with the switching station are composed of stranded aluminum wire, insulators that are sky gray in color and attaching hardware that has a galvanized coating of a silver gray color. These colors blend in well with other equipment in the switching station and most importantly the sky, thereby reducing to a minimum any contrast with the surrounding environment.

Inside the switching station all supporting structures for the buses and equipment are of a tapered rigid frame design and are constructed as low as standards will permit without sacrificing adequate electrical clearances. Power circuit breakers are also of a low profile design as well as the switching station relay house, the only building in the switching station, which is also designed for low profile appearance. The power circuit breakers use an inert, nontoxic gas for insulation and power interruption. Since there is no oil in these breakers, no source of pollution from oil fires, explosions or leaking oil exists, thereby aiding in preserving the natural environment. The gray color of the power circuit breakers blends in with the galvanized station steel, the aluminum buses, the overhead lines, the aluminized siding of the relay house and the powerhouse and the surface of the switching station, including the road, which is covered with crushed stone of the similar grayish color. Prefabricated concrete trenches carry all the necessary power and control cables throughout the station underground eliminating this from view. The concrete covers of these trenches provide walkways inside the station.

All of these features provide the station with its low profile, its subtle blend of colors and establishes its aesthetically pleasing appearance. These features also subdue the outline of the station against natural surrounding terrain as demonstrated by Figure 4.4-26.

4.4.2 TRANSMISSION LINES

Transmission line rights of way to connect the Catawba Nuclear Station to the existing transmission system have been chosen to preserve as intact as possible the surrounding environment and to minimize conflict with the present and planned uses of land within the rights of way.

1. Description of the Lines

The transmission lines to be built in conjunction with the Catawba Nuclear Station to connect with Duke's existing grid or system (see Figure 4.4-19) are described as follows:

1. Catawba to Allen 230 Kv Line (11.21 miles) is an existing Duke Power double circuit steel tower line. At present a 230 Kv line extends from Duke's Allen Station to Newport Tie Station via Allison Creek Tap Station which is located approximately one mile west of the project area. The portion of this line from Allen Station to Allison Creek Tap Station (9.95 miles) will be rebuilt with a new line and extended into the Catawba Station (1.26 miles from existing Allison Creek Tap Station). The conductors on the rebuild are bundled two per phase. Each conductor is 2156 MCM ACSR (Bluebird). The tower will be a standard 230 Kv type designed for the specified conductor. The two overhead ground wires are 1/2 inch high strength steel. Since this line is a rebuild on existing right of way, the only right of way requirement is a 150-foot wide cleared strip (1.26 miles) from the existing Allison Creek Tap Station to Catawba Nuclear Station. This represents an area of 23 acres. The right of way requirements include danger tree rights on adjoining properties. The towers in the line are 110 to 175 feet high. Minimum wire clearance to ground at any point is 35 feet. This line is being rebuilt to eliminate the impact of an additional line and right of way on this route.

2. Catawba to Shelby Tap 230 Kv Line (25 miles) is a Duke standard double circuit steel tower line. The towers are Duke's 2N series (subdivision 4.4.2.1) and the six conductors are 2156 MCM ACSR (Bluebird). The two overhead ground wires are 1/2 inch high strength steel. Right of way requirements for this line consist of a 120-foot wide cleared strip for one mile where the line parallels the Catawba to Pacolet 230 Kv Line, a 150-foot wide cleared strip for 22.69 miles, and a 270-foot wide cleared strip for 1.31 miles where this line parallels and are to be used jointly with the Catawba to Pacolet 230 Kv Line into Catawba Nuclear Station. The rights of way include danger tree rights on adjoining properties. The additional area needed for new rights of way is 470 acres. The towers in the line are 110 to 175 feet high. Minimum wire clearance to ground at any point is 35 feet. (See Figure 4.4-20).

3. Catawba to Pacolet 230 Kv Line (41.38 miles) is a Duke standard double circuit steel tower line. The line consists of 40.07 miles of existing 230 Kv construction and 1.31 miles of new 230 Kv construction into Catawba Station. The towers are 2F series (subdivision 4.4.2.1) and the six conductors on each tower are 954 MCM ACSR (Cardinal). The overhead ground wires are 1/2 inch high strength steel. Existing right of way requirement for this line is a 150-foot wide cleared strip (40.07 miles) with danger tree rights on adjoining property. This line parallels the Catawba to Shelby Tap 230 Kv Line for 1.31 miles into Catawba Station. The new right of way requirements are included above for the Catawba to Shelby Tap 230 Kv Line. The towers in the line are 110 to 150 feet high. Minimum wire clearance to the ground at any point is 35 feet. (See Figure 4.4-20).

4. Catawba to Newport Line (5.24 miles) is an existing double circuit steel tower line that runs to Newport Tie Station. The line consists of Duke Power's 2LL series towers (see Figure 4.4-20) with six 1272 MCM ACSR (Pheasant) conductors on each tower. The existing overhead ground wires are 1/2 inch high strength steel.

5. Catawba to Newport Line (5.24 miles) is a new double circuit steel tower line being built for Catawba Nuclear Station. The towers are Duke Power's 2LL series (subdivision 4.4.2.1) and the six conductors on each tower are 1272 MCM ACSR (Pheasant). The overhead ground wires are 1/2 inch high strength steel. This line will require an additional 120-foot strip along the existing right of way to Newport. A 270-foot strip right of way .75 mile long will be required for extending the existing and the new Newport Lines into Catawba Nuclear Station. Both right of way requirements include danger tree rights on adjoining properties. 1
The area required for the additional right of way is about 90 acres. The new line is designed to parallel an existing right of way strip in order to reduce the environmental impact of the line. Right of way for the new line has been clear cut and seeded with grass, except in active agricultural areas.

The impact of these lines as they relate to historic sites have been studied. Investigations and studies indicate that there will be no effect from the lines on any known historic site in York or Cherokee County.

No historic sites listed in the Department of the Interior's - National Park Service - National Register of Historic Places are located in the route of the proposed line. No historic sites nominated for inclusion in the National Register of Historic Places are located in the route of the proposed line.

On November 6, 1972, R. A. Cloninger of Duke Power Company met with James D. Compton, who is the manager of the Greater Gaffney Chamber of Commerce, in Gaffney, South Carolina. At this meeting, the proposed route of the line was discussed and no evidence was found which would indicate that the proposed Catawba to Shelby Tap Line would interfere or have any effect on any historical site in Cherokee County listed or nominated to be listed in the National Register of Historic Places. Mr. Compton said that he knew of no historic site, other than Kings Mountain National Park, that was located in or near the route of the line.

On November 13, R. A. Cloninger of Duke Power Company met with Sam B. Mendenhall, a state senator and noted historian of Rock Hill, South Carolina, to discuss any historic sites that might be located near the route of the Catawba to Shelby Tap Line or the Catawba to Newport Line in York County. It was decided that the proposed line route would not pass over any existing historic sites in York County or any sites being nominated as historic sites in the National Register of Historic Places.

A book, entitled Survey of Historic Sites in York County, which was prepared by the Catawba Regional Planning Council, revealed that the proposed line would not interfere with any historic sites.

The environmental impact of the proposed Catawba to Shelby Tap and Catawba to Newport Lines on future uses of the land in or near the proposed rights of way has been studied and investigated. It has been found that the line rights of way will not interfere with any projects such as picnic grounds, parks, or other public facilities that are planned or are being planned by York or Cherokee County.

1 On November 6, 1972, R. A. Cloninger of Duke Power Company met with J. Ed Allen, County Supervisor of York County, at the courthouse in York, South Carolina. Mr. Allen said that no park or other public facility was being planned in the area of the proposed line routes.

Also on November 6, 1972, R. A. Cloninger of Duke Power Company met with Herbert P. Blanton, County Supervisor of Cherokee County. The effect of the proposed line on any future land uses along the right of way was discussed. It was concluded that no plans were made for any facilities or industrial sites along the Catawba Shelby Tap Line route in Cherokee County.

11. Treatment of the Right of Way

Our studies of the environmental effects of the proposed lines out of Catawba Nuclear Station indicate that the transmission lines and rights of way have been located to minimize the environmental impact of the surrounding area. The use of common right of way strips has been planned where feasible. Right of way corridors will be blended with the surrounding areas so that the contrast between cleared areas and natural areas will be minimized. Selective cutting will be utilized where practical and low growing vegetation will be left at road crossings to screen the view of the transmission line. Road crossings that are bare of vegetation will be planted with low-growth species where practical to provide a screen. Where the line crosses or parallels streams, low growing vegetation will not be disturbed at the water's edge so that soil stability will be maintained and aquatic life will not be affected.

Also where possible, towers will be constructed in locations to minimize their view and lower their silhouette against the sky. These procedures proposed in the U. S. Departments of the Interior and Agriculture publication "Environmental Criteria for Electric Transmission Systems" will be followed where practical.

The transmission line rights of way out of Catawba Nuclear Station except for Catawba - Newport Transmission Line and the line to Allen have not been cleared. The rights of way, once cleared, will be planted with 50 pounds of Fescue #31 per acre and Sericea Lespedeza will be used in rough areas such as steep slopes. Where necessary, other vegetation such as rye and German millet are planted along with the fescue to provide cover and protection until the grass becomes established. Planting the rights of way will impede erosion and provide food and cover for small game. Maintenance of all rights of way is performed as required. Bush-hogging operations and hand clearing will be done on a 3 to 4 year cycle. No herbicides will be used. Grasses, cover crops, low growing and ornamental shrubs are left intact upon the right of way.

III. Consideration of Alternative Routes

There is no alternative to the construction of transmission lines and the acquisition of rights of way in order to assimilate the output of Catawba Nuclear Station into the existing transmission system. The only alternatives are other locations of the rights of way which have been considered (See Figure 1-1). 1

The selected line routes and alternatives for the lines out of Catawba Nuclear Station run over land of similar geologic formation. These formations range from Mica Gneiss, Schist, Amphibolite in the eastern parts of York County to Quartz Monsonite and Tonolite in the western parts of the county around Kings Mountain National Park.

The topography of York and Cherokee Counties is generally uniform. The undulating terrain is characteristic throughout the counties with slightly more and steeper hills in the area around the Kings Mountain Park (See Figure 4.4-28).

Since the geologic and topographic criteria were similar on all the alternative line routes studied, the proposed routes were selected because their paths would be the least detrimental to the aesthetic, economic, and historic values of York and Cherokee Counties.

1. The Catawba to Allen 230 Kv Line is to be rebuilt using the existing right of way already acquired by Duke Power Company. No alternative route was considered for this line.

2. There were two other alternatives to the construction of the Catawba to Shelby Tap 230 Kv Line, and the acquisition of its right of way. One alternative was a right of way extending in a straight line from Catawba Nuclear Station to Shelby Tap. This alternative was rejected because the line and right of way

would have to pass through the south side of Clover, which is a high residential area and industrial center, and would also pass through the Kings Mountain National Park. Another alternative would route the proposed line around the north side of Kings Mountain National Park. This alternative was also rejected because all major public access roads to Kings Mountain National Park are located on the north side of the park. It has been determined that the proposed route (see Map) selection will cause the least environmental impact to the surrounding historic, scenic, and natural areas.

3. The Catawba to Pacolet 230 Kv Line is an existing line built prior to the construction of Catawba Nuclear Station. Alternative routes were considered for bringing the Pacolet Line into Catawba Nuclear Station from its present location one mile west of the plant site. The selected route (See Figure 4.4-19), paralleling the Shelby Tap Line was chosen in order to reduce the number of rights of way into Catawba Nuclear Station.

4. The Catawba to Newport Line is an existing line that will be folded in to Catawba Nuclear Station upon its completion. Again the best alternative for extending the existing Newport Line into Catawba Nuclear Station would be to parallel the new Catawba to Newport Line in order to reduce the number of rights of way into the plant site.

1 5. The route of the Catawba to Newport Line was selected to parallel the existing Newport line already in the area. No other alternatives were considered because use of the existing right of way would be less damaging to the environment. The existing lines and right of way is not adjacent to any parks, recreation areas (except Lake Wylie), historic sites or scenic views.

The rights of way selections and their clearing, and the design and construction of the lines have been done to avoid or minimize conflict with the natural, historic, scenic values, and resources of the project area. As far as practical the Federal Power Commission's "Guidelines for the Protection of Natural, Historic, Scenic, and Recreational Values in the Design and Location of Rights of Way and Transmission Facilities" has been followed.

IV. Construction Practices

In constructing the line, bulldozers and hand labor will be used to clear the right of way corridor. A 65-ton truck-mounted crane will be used to set the steel towers in place. The conductor will be strung and tensioned by equipment mounted on 5-ton trucks with high flotation tires. Also a track mounted backhoe will be used for digging the foundation of the towers. The environmental impact of this construction equipment will be temporary. After the construction of the towers and stringing of the conductors, any damage done to the area in the right of way will be repaired and proper drainage restored. Also a cover crop of grass will be planted so that erosion will be minimized.

Access for construction equipment must be provided for the Catawba to Shelby Tap Line in order to minimize damage to adjoining property. Since 1966, Duke Power has built temporary access roads along the line corridors maintaining proper drainage and seeding the roads after all construction is completed. Experience has indicated that this method is far less damaging to the environment than traveling across country to reach the construction sites.

Approximately 25 miles of temporary road will be required along the Catawba to Shelby Tap right of way. Alternate Route 1 would require 21 miles of temporary road and 22 miles of road would be necessary for Alternate Route 2.

For construction of the Catawba to Newport and Catawba to Allen Lines, the seeded road along the existing right of way will be used. After construction this road will be reseeded and returned to its present state.

Design of this transmission line will be completed in accordance with the National Electric Safety Code to provide for public health and safety. Duke Power's experience in the design and construction of this type tower line indicates that the towers are durable and structurally sound and pose no threat to public health and safety.

V. Land Use Along the Lines

The proposed right of way for the Catawba to Shelby Tap Line will traverse York and Cherokee Counties, a distance of approximately 25 miles. Total acreage occupied by the line and its right of way will be 470 acres. Of the land making up these 470 acres, forest land comprises 320 acres or 68% of the land. Pasture land covers 33 acres or 7% of the land. Active and inactive agricultural fields make up 117 acres or 25% of the land. Although some mining operations are within a few miles of the line route, no active or abandoned mines are crossed.

The Catawba to Newport Tie Line will extend from Catawba Nuclear Station to Newport Tie Station covering a distance of approximately 5.24 miles. The acreage included by the line and its right of way will occupy 91 acres. Forest land makes up most of the land use along the line totaling 72 acres or 80% of the land use. Pasture land covers 12 acres or 12%. Agricultural fields make up 8% of the land use covering 7 acres.

The existing Catawba to Allen Line extends 9.95 miles from Allen Steam Plant near Belmont, North Carolina, to Allison Creek Tap which is about 1 mile west of Catawba Nuclear Station. The present right of way occupies 306 acres of which 277 or 90.4% is forest land. The remaining 9.6% or 29 acres is in open fields.

The fold-ins of the Pacolet, Allen, Shelby Tap and Newport Lines will be contained on Duke Power property all of which is used for timber production.

Land affected by the line rights of way is divided between Crescent Land and Timber Corporation and a number of private landowners. All of the Crescent Land and Timber property is devoted to timber production. The private properties are presently being used for crops, pasture, and timber growth. Table 4.4-5 reflects the gross dollar value and productivity of land traversed by the proposed lines. Crescent Land and Timber Corporation property and private forest land are listed separately because timber production on Crescent's property is much greater due to an intensive management program. Crop land and pasture land production and value were based on the most widely produced commodities in York and Cherokee Counties, cotton and milk yields from dairy operation.

After these lines are constructed, the pasture land and agricultural land can continue their present uses. On the forest land, all tall growing trees will have to be removed from the right of way corridors. A terrestrial survey of the immediate site area and the transmission corridors is included in subdivision 4.1.3.2 of this report.

4.4.2.1 Double Circuit - 230,000 Volt Galvanized Steel Towers

The steel used in all parts of the towers shall be in strict accordance with the specifications for medium open hearth, structural, plate steel and tower bolts as adopted by the American Society for Testing Materials. Minimum member thickness is to be 3/16". All members to have a minimum of two holes on one end. Two overhead ground wire connections will be supplied with each tower. A 13/16" diameter grounding hole is required in each stub member about 3" below ground line.

Insulator connections are provided on each crossarm and will be either strain or suspension or both (depending on the final design).

All four corner legs shall be punched for ladder bolts to the ground line, but ladder bolts shall be furnished for only one corner to within 8 feet of the ground. Ladder bolts to be spaced 16 inches center to center and to alternate on the two faces of the corner post.

A sufficient number of bolts and washers with an excess of 5 percent shall be furnished for assembling towers in the field. Bolts are to be tower bolts with square heads and must be furnished with a special hex nut. (U.S.C. 2.3.4 or equivalent.) Minimum bolt size is to be 3/4".

All material entering into the construction of the tower shall be thoroughly galvanized. Structural and plate steel shall be galvanized as per latest ASTM-123 except average coating shall not be less than 2.75 ounces and minimum 2.5 ounces per square foot. Bolt and nut galvanizing shall be as specified in latest ASTM-394 except average not less than 1.65 and minimum 1.50 ounces per square foot.

The zinc used for galvanizing will be "Virgin" prime western, ASTM B-6. No zinc reclaimed from dross will be used.

The allowable unit stresses as presented in the "Electrical Transmission Line and Tower Design" guide of the Task Committee on Tower Design of the
1 American Society of Civil Engineers will be used in the structure design of the towers. Typical dimensions are presented in Figure 4.4-31.

4.4.3 HISTORICAL LANDMARKS

4.4.3.1 Indian History

The area within a five mile radius of the Catawba site was investigated for Indian history.

In 1763 the area surrounding the site of the Station was part of the Catawba Indian Reservation. Indian grounds have been discovered at several locations near the site.

Three miles up river from the Highway No. 21 bridge is the location of Indian Walk Dam. An old ford was situated at this point and on the flat land below the dam on the east side, many relics have been uncovered.

Many large boulders are situated on a high hill approximately one mile east of the Indian dam site and one mile back from the river. A section of an ancient Indian trail is still visible on this lookout hill which may have been a camp site. Shell beads and other artifacts have been found here.

At the mouth of Allison Creek, about two miles upstream from the dam, an Indian ground has been located on the south bank of the creek. Another site is situated on an island hill just north of the creek.[1] No other intensive archaeological study has been done to date, and none is proposed.

1 It has been concluded that the construction and operation of Catawba Nuclear station will have no impact on these historical sites.

4.4.3.2 Lake Wylie - The Beginning

Duke Power was founded sixty-eight years ago on a new idea--that of developing a whole river valley into a hydroelectric system.

Had it not been for the foresight of James Buchanan Duke, who invested large amounts of his own money in what was then considered a "might risky venture," the Southeast's largest electric utility, Duke Power, might never have been born.

In its early years the utility, then named Southern Power, made many contributions to methods of generation, transmission and distribution. It has continued to be a leader in the utility industry.

In June, 1900, Dr. W. Gill Wylie, a native of Chester, South Carolina, organized the Catawba Power Company. He was granted a charter by the South Carolina legislature in 1901 to build and operate a hydroelectric station at Indian Hook Shoals near Fort Mill, South Carolina. Wylie employed William S. Lee, who

[1] James A. Stenhouse, EXPLORING OLD MECKLENBURG (Charlotte, N. C. 1952), pp 45, 17, 18.

became Vice President and Chief Engineer in 1903, to design and build it.

At 6 a.m. on March 30, 1904, power flowed from the recently completed Catawba Station to the Victoria Cotton Mills at Rock Hill. Power for turning the generators was brought from the waterwheels by rope drive--a primitive arrangement by today's standards, but one which impressed visitors of that time. This site is still in use but the original dam was replaced in 1925 with a higher one and the primitive power plant replaced with a modern design. The 12,455 acre lake is now called Lake Wylie.

Later in 1904 the transmission lines were extended to Rock Hill, York, Clover, Fort Mill, Pineville and Charlotte using 11,000 volts--high voltage transmission for those days (Figures 4.4-21 and 4.4-22).

About this time a series of interesting events took place which had a most important effect on power development in the Carolinas. These involved a sore foot, a doctor's conversation and the dream of a young engineer. Quoting from Dr. Wylie: "About this time I met Mr. B. N. Duke (J. B. Duke's brother) and had the good fortune to successfully perform on him an operation for appendicitis. Later, Mr. J. B. Duke was laid up with an infected foot I was treating, and he inquired about my water power and told me to send that man Lee up to talk to him.

"As a result, the Southern Power Company was organized and $2 million dollars raised, Mr. Duke raising most of it." The company came into being June 1905, with Dr. Wylie as president.

William S. Lee, the young engineer, dreaming of harnessing the Catawba River for hydroelectric generation, became the company's chief engineer. His dream has now been fulfilled.

On October 3, 1960 at ceremonies at the dam near Rock Hill, S. C., Catawba Lake and Catawba Station were renamed Wylie Station and Lake Wylie in honor of the distinguished South Carolinian who served as Duke Power's first president. (Figure 4.4-23)

By early 1972, Duke Power was serving over one million customers throughout the Piedmont section of the two Carolinas.

4.5 CONSTRUCTION EFFECTS

During construction, efforts will be made to reduce the environmental impact. Erosion, sedimentation, dust, smoke, noise, unsightly landscape and waste disposal will be controlled to practicable levels and within permissible limits, where such limits are specified by regulatory authorities. In the absence of such regulations, Duke will abide by dictates of good citizenship.

Erosion in the construction area and the resulting sedimentation will be controlled by providing piped drainage systems, intercept and berm ditches and ground covers where necessary to control the flow of surface water. Spoiled earth materials will be deposited in a controlled manner such that high water or surface runoff will not transport materials to the water body.

Good drainage, dry weather wetting and the paving of the most traveled construction roads will reduce dust generated by vehicular traffic. Bare areas will be provided with a ground cover of vegetation wherever and whenever practicable.

Excessive and objectionable construction noises will be reduced to acceptable levels. Contractor's and company's motor powered equipment will be equipped with the available noise reducing equipment and maintained in good order.
Tree lined fringes left around most construction areas for appearance reasons
1 will contribute to noise reduction (See Subsection 4.5.3).

Care will be taken to control smoke or other undesirable emissions to the atmosphere during construction. Duke Power will adhere to air pollution control regulations applicable to York County and the State of South Carolina, as they relate to open burning and the operation of certain fuel-burning equipment. Permits and operating certificates will be secured where required. Efforts will be made to keep fuel-burning construction equipment in good mechanical order to avoid excessive emissions. All reasonable precautions will be taken to prevent accidental fires on the construction site and brush or forest fires on adjacent lands.

Wastes such as chemicals, fuels, lubricants, bitumens and raw sewage will not be deposited or discharged onto the natural watershed where surface runoff can transport these materials to Lake Wylie. Solid construction waste such as foliage, packing materials, rags, scrap iron, etc. will not be disposed of in the lake. Such waste will either be buried or transported to a nearby landfill.

Traffic problems will be reduced by providing parking and unload points for commercial carriers off public roads with convenient points of access. Onsite parking will be provided for construction workers. Since an access railroad will be provided, many of the large commercial hauls for transporting large equipment to the site will not require use of the public roads.

Construction buildings, storage and maintenance areas and parking areas will be maintained in a neat manner to improve the construction plant appearance.
Construction yards, construction substations, employee and office parking areas,
1 mess hall and the construction office (Figure 2.2-3) are temporary and will be
removed upon completion of construction. These areas will be restored by suitable landscaping to blend with the natural and developed landscape.

In addition to one and one-half miles of relocated county roads, a three-fourths of a mile portion of existing county road, which links the site with the existing highway, will be improved to the standards of a primary road. This three-
1 fourths of a mile road improvement is the only work to be done for the purpose of improving existing roadways. No significant adverse effect is expected in the area due to the improvement of the road. On the contrary, local residents and tourist will derive benefit from a better road.

4.5.1 CONSTRUCTION WORK FORCE

Duke's construction experience indicates that about 75 percent of the work force at Catawba will be drawn from the neighboring counties; about 13 percent will move into this area from other Duke jobs and the remaining 12 percent will live within commuting distance. Completion of the project is unlikely to affect the area economically since a relatively small percentage of the work force will move from outside into the project area.

A major proporation of the skilled labor force at Catawba will be drawn from the unskilled laborers hired locally and trained under the Duke in-house training program. Previous experience at Duke's Oconee Nuclear Station indicates about 44 percent of the skilled labor force was hired locally as laborers and was subsequently trained and promoted to the skilled ranks.

More than half of the peak skilled work force of 1300 at Catawba is expected to be drawn from the local area and trained at the project site. Moreover, fewer construction workers are now willing to commute or move to new project sites.

4.5.2 ECOLOGICAL EFFECTS OF CONSTRUCTION

When the site area is prepared for construction, complete razing is not the assumed method. Only the minimum amount of necessary clearing will be done. Those areas in the vicinity of the site which will be cleared of all vegetation are shown on Figure 4.5-2. Excavation, filling and spoiling will be done only
1 within the cleared areas. Those cleared areas not needed for the plant proper will be restored by suitable landscaping to blend with the natural terrain. Two methods of seeding, mechanical seeding and hydro seeding, are most likely to be used. Seeding and restoration planting will be done as soon after construction as possible.

The grading of the site and construction of dikes, intake and discharge canal involves the following approximate quantities of earthwork:

SNSW Dam embankment	200,000 yd^3
Waste Water Collection Basin embankment	110,000 yd^3
Intake Canal	200,000 yd^3
Discharge Canal	100,000 yd^3
Site Grading	500,000 yd^3
Underwater Weir (fill)	100,000 yd^3

Figure 2.2-3 shows the area of excavation and likely borrow areas, if excavation in the plant area does not provide suitable embankment materials.

The construction of the plant and switchyard involves the clearing of 334 acres of land by methods described in Section 4.5. The impact of construction on recreation, wildlife and forestry is detailed in Chapter 7.

Access to the site will be provided by existing County Road 1132 east of Highway 274. The construction will cause some increase of traffic on these roads. Power for construction is already provided at the site.

The transmission facilities construction will be planned to produce the minimum impact upon the environment. Farm and pasturelands will not be disturbed except for access and for tower construction. Access will be gained by using existing farm and woods roads where possible. Where no access roads exist, access will be constructed to each tower site. New access roads built for construction access will not be installed as permanent facilities and will be restored after construction is complete. At tower sites, grading and terracing will be done to prevent erosion at the construction site and to stabilize the ground surface in the area while foundation construction is in progress.

In woodlands, all marketable timber will be removed and sold. Other growth will be cleared and disposed of on the right-of-way by burning where possible, and by burying where appropriate. After right-of-way strips are cleared, they will be prepared, fertilized and seeded for pasture-type growth and native regrowth. No damage to wildlife is anticipated.

The ecological effects of construction in the skimmer wall area will be minimal and short-termed. Recreation will be temporarily discontinued in the locale adjacent to the skimmer wall. Some turbidity may exist in the lake during construction of the skimmer wall.

The construction of the underwater weir will have little adverse effects upon the environment. The material will be transported by dump trucks and barges and dumped by clamshell buckets. A temporary suspension of recreational activity in the area will be unavoidable. Limited turbidity may also result from the dumping of material into the lake.

4.5.3 NOISE EFFECTS

Environmental effects of excessive noise levels considered include induced hearing loss and annoyance to inhabitants of the area. It is highly unlikely that either of these will occur during construction or subsequent operation of the plant. Reasons for this are as follows:

Based on measurements at other construction sites, it is expected that the overall noise levels during construction at the exclusion boundary be in the
1 45-73 dB(A) range. This will occur during the period of site excavation when large earthmoving equipment is in operation.

Transmission of noise is affected by wind direction and velocity, topography, buildings and natural screening such as trees. While no absolute value can be predicted for each location and physical and meteorological conditions, about 63 dB(A) could be expected at a point on the lake at a distance of 2500 feet from the source of the noise. This value would be reduced if a clear line of sight did not exist. At a distance of 5000 feet, across water, the noise level would probably be reduced to 45 dB(A).

An observer at the two points could detect total levels of 45 to 63 dB(A), but these noise levels will not cause physical damage. It is an established fact (based on observations and measurements) that no hearing loss is induced by a lifetime of exposure to sound levels of 80 dB(A) or less. Data developed by the American Academy of Opthamology and Otolaryngology for numerically estimating the percentage risk of developing a hearing loss for lifetime exposures consider only levels of 80 dB(A) and above.

The above noise levels will momentarily be exceeded when explosive charges are discharged during rock excavation. The noise generated by each of these blasts will be of extremely short duration and will not be as loud as naturally occuring thunder generated by lightening during local summer storms. An observer at the site boundary would hear these explosions and some echo as the sound reflects from natural obstructions. Duke has no record of significant adverse environmental effects from blasting.

The annoyance factor varies widely with individuals and the degree of acceptability by inhabitants near the boundary is quite difficult to establish.

Criteria that considers average public reaction to varying noise levels have been developed. When used as a basis for determining the reaction to anticipated levels, these criteria indicate no widespread complaints at anticipated daytime levels during the construction period. Noise levels during operation are expected to be much lower at the boundary. When subjected to the same criteria (NC-45) no adverse public reaction would be anticipated.

4.5.4 ACCESS RAILROAD

The access railroad will extend 6.25 miles from Newport, S. C. to the plant site as shown on Figure 4.5-1. A minimum 50 foot right-of-way for a total of 38 acres will be necessarily used for the railroad. Of the 38 acres needed, 14 percent is now harvested cropland, 9 percent is open pastureland and the remaining 77 percent is scrub woodland. This acreage would be permanently lost for its current use due to railroad construction. Little economic impact of the access railroad on the general area is expected except for the loss of about nine acres of land for its agricultural usages.

There is no significant economic advantage of the railroad, estimated to cost $1.3 million, during the plant construction. However, an estimated annual savings of about $21,000 will accrue during the plant operation.

	Truck	Rail
Number of shipments annually	144	15
Freight cost per shipment	$ 1,050	$ 13,000
Freight cost per year	$151,200	$195,000
Labor cost per shipment*	5 men x 24 hrs x $5 per hr = $600	6 men x 48 hrs x $5 per hr = $1440
Labor cost per year	$ 86,400	$ 21,600
Total cost per year	$237,600	$216,600

*$5 per hour assumed labor rate.

As shown above, the transport of fuel by railroad involves about one-fourth the manhours required for truck shipment. This minimizes the radiation exposure to personnel during fuel handling.

4.6 AESTHETIC IMPACT

The Catawba Nuclear Station architectural concept will be contemporary in spirit and fact, and imaginative in functional design.

The rectangular forms of the enclosed Turbine Buildings and Auxiliary Building related to the cylindrical forms of the Reactor Buildings will provide surface planes to break up the massive areas into aesthetically pleasing patterns.

The Administration Building will be in the same contemporary spirit as other structures. An aesthetic blend of contemporary building materials, in pleasing colors, will be used to relate structures to one another.

Yard areas around all structures, as well as parking areas, will be landscaped with native growth to blend with the site. The existing forested areas on the site will be disturbed as little as possible and selected areas will be reforested at the completion of construction.

The switchyard will be of low-profile, rigid framed structures. Overhead lines will connect the station with the switchyard.

County Road 1132 will be relocated south of the site and screened from the site by topography and vegetation.

4.7 THE CATAWBA NUCLEAR STATION AND THE ECONOMY

Construction and operation of the Catawba Nuclear Station will have significant economic impact, both direct and indirect upon the entire Duke Power service area, particularly that section in the vicinity of the station.

The major direct effects are: construction and operating payrolls and local purchases; direct taxes (property taxes); and indirect taxes (income taxes) from business represented by the sale of the electrical output of the station.

The principal indirect effect is the economical benefit rising from the assurance of an adequate, reliable supply of additional electrical power at a reasonable cost.

Construction of the project will be a major engineering effort. Construction employment is expected to reach a peak of 2100 and will average 1500 during the construction stage. Since Duke Power constructs its own generating stations, a substantial number of the workers are regular company employees who will move to the Catawba site as other projects now underway are completed. A number of construction skills, however, are not needed continually; these skills will come from the local work force or brought in from other areas for the time their work is needed. Since commuting is a characteristic of labor in this part of the country, many communities will contribute to the work force, minimizing any strain on local employment and avoiding a serious dislocation of existing work forces.

Construction experience has shown that, with each new generating plant, Duke Power has purchased a greater and greater percentage of its materials and services from local sources, expenditures totaling millions of dollars. In addition, the total construction payroll will be over $129 million, and most of this money will be spent in local communities.

Upon completion of the plant, the annual operating payroll is expected to be approximately $1.2 million. About 84 full-time employees will operate the station, a small number compared to plant investment. These employees and their families will add to the economy of the area but as a group will not produce any serious effect on schools and other public services. The plant itself will require no addition to tax-paid police or fire staffs.

Although the permanent payroll is not especially large, it is a steady payroll. Employment will not vary appreciably with fluctuations in the general business cycle, and therefore will exert a stabilizing influence on the local economy. With an approximate investment of $646 million, the Catawba Nuclear Station will be the largest plant in the two Carolinas and will create very substantial revenues for York County and the state of South Carolina -- with revenues amounting to nearly $17 million.

In addition, according to the formula used by the Federal Power Commission, the investment in generating facilities of $646 million will create over $19 million in federal taxes each year.

The plant will be an unusual asset to the county since it will be practically free of demands on tax supported services of the county, including publicly supported water, sewer services and trash disposal.

Almost the entire annual county tax payment, therefore, is a net gain to the county government unlike tax income from most industrial investments which are offset by related expenses to tax supported services.

The indirect importance of this station to the economy of the Duke Power service area is significant although more difficult to measure in dollars and cents. The Piedmont section of North and South Carolina is a growth area, predicted to be the fifth largest urban area of the nation by 1980. Predicated upon the continuing adequate supply of electrical power, there are no indications that this growth will ease off in the foreseeable future.

In the past Duke Power has kept pace with the economic development of the Piedmont, an area which continues to grow at a very rapid rate. With this in mind, the massive construction program under way is geared to meet the area's expanding electrical requirements and Catawba Station is a vital part of this program.

The economy of the Piedmont Carolinas has experienced a dramatic revolution since the end of World War II. At that time, textiles was predominant, with the furniture and tobacco industries running a distant second. These industries all have grown substantially in the post-war period; however, they represent a much smaller portion of the total industry of the area today than ever before, a condition brought on by a large influx of widely diversified industries. These firms range from light industry like Western Electric's several manufacturing facilities to heavy industry like the Westinghouse and General Electric turbine plants.

This trend toward diversification has created a labor market which has offered a wide spectrum of opportunity to workers of this area. With the aid of the outstanding technical education programs of both Carolinas, native workers from this section have had little difficulty mastering the skills and trades required by this wide scope of industrial opportunities.

Some environmentalists have claimed that industrial development is harmful to an area and should not be encouraged. Even for congested areas, this concept is debatable; however, the Piedmont Carolinas are far from reaching a crowded condition, and regional planning is aimed at avoiding such concentrations. Most of our new industrial plants are locating in the expanse of open space, in rural areas, utilizing land that has been lying idle since the end of cotton as the South's money crop.

An excellent network of existing paved roads gives employees easy access to the plant and to the cultural advantages of neighboring small cities.

The program of encouraging diversification of industry is making headway toward solving one of the most pressing economic problems of the region -- that of raising per capita income. In 1960 North Carolina ranked 45th and South Carolina 48th among the states in income per capita. In 1970 North Carolina had improved to 39th and South Carolina to 47th. We feel this record must be improved further to help provide the people of this area with a standard of living equal to the national average. To accomplish this goal we must maintain selective industrial recruiting programs for the two Carolinas -- programs, however, which are essentially dependent upon and sustained by the availability of adequate power generating facilities.

The two generating units of the Catawba Nuclear Station must be in operation by the dates scheduled if the overall development of the Duke Power service area is not to be threatened by a possible shortage of electricity.

4.8 UNAVOIDABLE ENVIRONMENTAL EFFECTS

The projected need for electrical energy to meet the public's requirements for industrial, commercial, residential growth and increasing pollution control activities must be met if the physical and economic health of this area is to be maintained. Meeting this need requires more electrical generating capacity which, regardless of type will have some unavoidable environmental effects. The following sections identify and discuss unavoidable adverse environmental effects which may occur as a result of construction and operation of the Catawba Nuclear Station or an alternate fossil fired equivalent station.

4.8.1 LAND RESOURCE

Construction activities of the Catawba Nuclear Station, as well as of an equivalent fossil fired alternate, will cause limited unavoidable environmental changes in the land resource. The changes are limited to the local site except for transmission lines, railroad and vehicular access roads. The adverse environmental effects of construction activities at Catawba Nuclear Station, or its fossil equivalent, can be minimized by the usual continued attention to desirable construction practices. Since with a nuclear station, land alteration and dedication to fuel and ash storage and handling are insignificant in quantities compared to an equivalent fossil station, Catawba Nuclear Station is clearly a wise choice from the point of view of minimum land resource alteration and dedication. The impact of the station and its environs will be minimized by aesthetic design and landscaping resulting in an improvement in the site area.

4.8.2 AIR

The unavoidable environmental effects on the air resource produced by Catawba Nuclear Station will be insignificant compared to those produced by an equivalent fossil fired station. An auxiliary boiler will be used for plant heating prior to operation of Unit 1 and for 8 to 10 hours during the startup of Unit 1. The auxiliary boiler will have approximately 30,000 pounds per
2 hour of steam flow at 200 to 250 psia and would burn approximately 293 gallons per hour of No. 2 fuel oil with a maximum of 0.8% sulfur. The environmental effects on the air resources by this boiler will be insignificant compared to those produced by combustion of coal in an equivalent fossil fired station. One of the principal advantages of nuclear stations is the virtual elimination of air pollution problems which may arise if alternate fossil fuels were to be used.

The use of full or partial capacity cooling towers by Catawba Nuclear Station is predicted to increase the water consumption and adversely affect the meteorology of the site and its environs. This is discussed in Subsection 2.4.1 in this report.

4.8.3 WATER

As described in other sections of this report, discharges of wastes are constantly under extensive control and regulations. Catawba Nuclear Station will require more condenser cooling water than its fossil equivalent because of lower thermal efficiency. No irreversible adverse aquatic environmental effects will be produced by either Catawba Nuclear Station or its fossil alternate.

Although full capacity cooling towers would essentially eliminate thermal effects in Lake Wylie, the additional cost and meteorological effects of these towers, where their use is not warranted, is an avoidable adverse environmental effect. This alternate is discussed in Section 7.4.

4.9 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The construction and operation of the Catawba Nuclear Station will bring about certain changes in the environment of the area in which it is located. The changes have been described and evaluated in other sections of this report and the conclusions have indicated that the environmental effects of Catawba Nuclear Station will be a minimum. The impact on the natural environment produced by Catawba Nuclear Station is insignificant compared to that caused in the past by conversion of this land from wilderness to agricultural uses and from agriculture to idle lands to be reclaimed by nature. In the short term, the site lands will be used to produce electrical energy needed to sustain and enhance the physical and economic health of this area including increasing requirements of electrical energy for pollution abatement and control. The use of background material presented in this report and to be developed during the construction and operation of Catawba Nuclear Station will provide scientists and others with additional specific knowledge which should benefit the long term productivity, not only in this area but in this region as well.

Considering the shrinking reserve of fossil fuels and the possibility that emergency action will be taken sometime in the future to save fossil fuels from complete extinction, it is obvious that Catawba Nuclear Station has the virtue of being forward looking and conservative. Catawba Nuclear Station represents a positive step forward toward conservation of irreplaceable fossil fuels.

There is nothing about the Catawba Nuclear Station site to preclude the area's return for other uses in future years, if needed; nor is the station expected to cause significant adverse effects to the aquatic environment of Lake Wylie. Likewise, sub-surface conditions, including ground water, will not be affected. Transmission lines will cause little short term change in productivity and no long term change in productivity.

Upon completion of Catawba Nuclear Station's useful life, all highly radioactive materials, such as the spent fuel, will be removed, reprocessed and radioactive residuals sent to federal repository facilities. Decommissioning will be carried out in compliance with all applicable federal regulations. Public access to areas of remaining low level radioactivity will be carefully controlled until, through cleaning and/or decay, such access restriction is no longer required. This control, or restriction, will be of little, if any, importance to long term use of productivity of station environs.

In summary, since the Catawba Nuclear Station and its off-site facilities can be almost entirely removed at the end of station life, or sooner if justified, the short term use to produce needed electrical energy does not preclude long term uses, or productivity, of the environment.

4.10 IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OR RESOURCES

The construction of Catawba Nuclear Station is essential to meet the expected increase in the power needs of Duke's service area in the post 1978 years. Natural resources which will be committed on this account are land, water lost due to evaporation, nuclear fuel and construction materials which will go into the construction of the plant, the access railroad, and transmission lines. Except for the construction materials and nuclear fuel, none of the other resources will be irreversibly committed since the dismantling of the plant will make them available for other uses. In view of the present rate of load growth, this can be labeled only as a most remote possibility. Efforts will, however, be made to make the most economical use of the natural resources.

No attempt has been made to inventory all material in the plant by weight; however, Table 4.10-1 lists the major materials used in the fuel cycle, control rods and burnable poisons since these require replacement at regular intervals.

4.11 PLANS FOR DECOMMISSIONING AND COST ESTIMATES

The ultimate plans for decommissioning the Catawba Nuclear Station, forty or more years after initial operation will depend on regulations and requirements in effect at that time and the available technology. Whatever is required at that time is what will be done. Up to the present date, reactor plants have been successfully decommissioned by methods ranging from deactivating the reactor and leaving the buildings intact to the complete removal of all buildings and contents.

As of now the estimated cost of permanently decommissioning both units of the Catawba Nuclear Station at the end of their useful life is estimated at $6,000,000, based on 1972 dollars. This is based on:

1. Deactivating the reactors;
2. Decontaminating of process systems and areas of the plant;
3. Removing all nuclear fuel from the site for recovery of fuel materials and ultimate disposal of radioactive wastes;
4. Sealing of buildings or portions of buildings containing activated process piping and components by means of welding, locking or bolting welding plates over openings, etc;
5. Dismantling and sealing of all gaseous and liquid waste systems and effluent lines;
6. Maintaining some security and fire systems.

The decommissioned plant would then be isolated within the security fence and subject to periodic security surveillance, fire inspections and radiological monitoring of the plant exterior and environs. Maintenance would be performed as required over the years to maintain the integrity of the decommissioned plant, to preclude any possible release or radioactive materials to the environment and otherwise to insure the protection of the health and safety of the public

It is expected that after a number of years in this decommissioned state, all areas of the plant could be very readily entered, and the intact systems completely dismantled and removed. The buildings could also be removed if necessary so that other uses of this location could be made as desired. If it is necessary at the time of final shutdown to completely dismantle and remove buildings and contents then this too can and will be done.

ER Table 4.1-1

Comparative Nutrient Levels for Primary Producers

Mid-Euphotic Zone Samples

July 1971

Lake	Total Algae cells/ml	mg/l Total N	NO_3-N	NH_3-N	Total P	PO_4-P
Norman	10,248	.72	.20	.05	.013	.003
Mt Island	13,432	.64	.04	.03	.017	.002
Wylie	67,588	.67	.03	.03	.030	.003

Table 4.1-1a

A comparison of Temperature, Dissolved Oxygen and Manganese Data for Station 113.4 in Lake Norman and Station 68.1 in Lake Wylie.

Depth (Ft.)	Temp. °F		D.O. (mg/l)		Mn (mg/l)	
	N	W	N	W	N	W
1	82.8	83.6	7.3	7.1	0.01	0.0
5	80.8	83.2	6.7	7.2	0.03	0.0
10	80.1	82.7	6.5	6.7	0.04	0.0
15	79.5	82.4	5.8	6.0	0.08	0.0
20	79.0	82.1	5.0	4.8	0.14	0.0
25	77.5	81.4	3.1	3.2	0.14	0.0
30	74.7	80.8	1.9	2.7	0.48	0.10
35	70.4	80.0	1.6	0.5	0.59	0.10
40	67.3	79.1	1.2	1.0	0.50	0.57
50	62.4	76.6	0.9	0.1	0.43	
60	57.5		0.5		0.60	
70	55.0		0.4		0.63	
80	54.5		0.4		0.94	
90	54.5		0.5		1.40	
100	55.0		0.6		1.61	

These data are averages for August Samplings from 1965-1970 excluding 1967 which was reported as approximately 4 F cooler at the water surface.

ER TABLE 4.1-2

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
LAKE COOLING ONLY

1951

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	49.9	73.6	65.5	56.3	6.4	49.9	.0	4567.	219.4	424.7	163.7	421.4	.0	702.5	495.	1932.	2427.
2	50.0	73.7	66.7	57.7	7.7	50.0	.0	4347.	218.2	424.7	165.3	433.6	.0	702.5	1245.	1944.	3189.
3	53.6	77.3	70.5	64.1	10.5	53.6	.0	3384.	207.4	424.7	157.5	415.9	.0	702.5	2336.	1908.	4244.
4	62.6	77.4	74.9	72.4	9.8	62.6	.0	3978.	154.6	424.7	116.4	572.7	.0	702.5	2754.	1971.	4725.
5	70.6	85.4	82.9	80.4	9.8	70.6	.0	4123.	152.7	424.7	115.0	352.3	.0	702.5	2721.	1747.	4468.
6	82.4	97.2	94.0	89.5	8.4	81.1	.0	2633.	144.7	424.7	108.0	1274.1	58.4	702.5	1161.	2712.	3873.
7	88.2	103.0	99.2	89.7	4.3	85.4	266.1	1234.	150.4	424.7	111.8	1274.1	155.7	702.5	0.	2819.	2819.
8	87.8	102.6	98.8	91.3	5.6	85.7	.0	1709.	145.7	424.7	107.1	1274.1	88.5	702.5	224.	2743.	2967.
9	82.8	97.6	93.7	85.2	4.4	80.8	.0	1587.	154.6	424.7	113.2	1274.1	84.2	702.5	0.	2753.	2753.
10	74.7	89.5	85.7	77.7	5.7	72.0	.0	1564.	168.6	424.7	124.9	1274.1	128.4	702.5	193.	2823.	3016.
11	58.3	75.5	72.0	65.5	10.0	55.5	.0	1814.	209.3	424.7	161.4	1274.1	213.1	702.5	1025.	2985.	4010.
12	51.9	75.6	68.1	62.5	10.6	51.9	.0	3052.	230.2	424.7	173.9	450.5	.0	702.5	1562.	1982.	3543.

1952

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	55.6	72.9	69.4	65.4	9.8	55.6	.0	3417.	193.4	424.7	145.2	310.2	.0	702.5	1516.	1776.	3292.
2	49.7	73.4	66.9	56.4	6.7	49.7	.0	5233.	224.9	424.7	172.4	453.8	.0	702.5	1016.	1978.	2994.
3	55.1	72.4	68.9	58.3	3.2	55.1	.0	13295.	188.7	424.7	145.4	388.9	.0	702.5	0.	1850.	1850.
4	63.4	78.2	75.1	71.6	8.2	63.4	.0	5161.	162.4	424.7	122.3	326.7	.0	702.5	2685.	1739.	4424.
5	75.4	90.2	87.6	84.6	9.5	75.1	.0	3501.	152.3	424.7	115.1	1245.2	.0	702.5	2347.	2640.	4987.
6	86.0	100.8	97.7	94.2	8.7	85.5	.0	3226.	142.9	424.7	105.5	1351.8	.0	702.5	1610.	2727.	4337.
7	87.3	102.1	98.9	94.4	7.5	86.9	.0	2914.	141.3	424.7	103.8	1143.5	.0	702.5	761.	2516.	3277.
8	85.4	100.3	97.0	92.0	6.9	85.1	.0	2764.	139.9	424.7	102.6	1145.8	.0	702.5	564.	2515.	3079.
9	81.2	96.0	92.2	88.2	7.0	81.2	.0	3998.	145.7	424.7	103.0	227.3	.0	702.5	818.	1603.	2421.
10	66.4	81.2	78.4	73.9	8.4	65.5	.0	2611.	175.2	424.7	132.7	1274.1	.0	702.5	893.	2709.	3602.
11	59.7	77.0	73.0	65.5	9.5	56.0	.0	1585.	215.5	424.7	165.0	1274.1	268.6	702.5	769.	3050.	3820.
12	49.9	73.6	68.0	60.5	10.9	49.6	.0	1683.	239.6	424.7	181.4	1274.1	.0	702.5	983.	2822.	3805.

1953

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	54.3	71.6	68.1	64.1	9.8	54.3	.0	3141.	189.1	424.7	141.9	544.2	.0	702.5	1360.	2002.	3362.
2	51.6	75.3	68.8	57.5	5.9	51.6	.0	5914.	222.9	424.7	170.9	449.5	.0	702.5	610.	1970.	2580.
3	55.7	73.0	69.5	61.5	5.8	55.7	.0	7339.	186.1	424.7	143.4	383.2	.0	702.5	1185.	1840.	3025.
4	64.0	78.8	76.3	73.3	9.6	63.7	.0	3505.	158.9	424.7	120.0	1358.5	.0	702.5	2580.	2765.	5345.
5	79.3	94.2	91.0	87.0	8.8	78.2	.0	2828.	148.1	424.7	110.4	1274.1	52.8	702.5	1430.	2713.	4143.
6	84.7	99.5	96.3	91.3	8.5	82.8	.0	2424.	149.2	424.7	112.2	1274.1	110.2	702.5	1068.	2773.	3841.
7	87.8	102.6	98.9	93.4	6.8	86.6	.0	2288.	143.7	424.7	104.4	1274.1	.0	702.5	512.	2649.	3161.
8	86.7	101.6	97.8	91.3	6.5	84.8	.0	1946.	152.0	424.7	111.6	1274.1	88.1	702.5	339.	2753.	3092.
9	81.9	96.7	92.8	85.3	4.5	80.8	.0	1752.	148.9	424.7	107.4	1274.1	.0	702.5	0.	2658.	2658.
10	74.5	89.3	85.4	76.9	5.8	71.1	.0	1491.	176.8	424.7	132.1	1274.1	180.6	702.5	192.	2891.	3083.
11	61.5	78.8	74.7	64.7	8.7	56.0	.0	1229.	223.1	424.7	172.9	1274.1	320.3	702.5	552.	3118.	3670.
12	49.1	72.8	65.3	59.9	10.8	49.1	.0	2984.	231.3	424.7	174.6	452.5	.0	702.5	1546.	1986.	3532.

NOTES: COLUMNS 'O1-O4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'HCFS' IS AMOUNT OF COOL WATER IN CFS REQ'D TO AVOID DISCHARGE TEMP. IN EXCESS OF 103 DEG. F.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
LAKE COOLING ONLY

1954

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	50.7	74.4	66.9	55.6	4.9	50.7	.0	6261.	227.0	424.7	171.4	443.5	.0	702.5	0.	1969.	1969.
2	52.6	76.3	69.3	59.9	7.3	52.6	.0	4583.	218.0	424.7	165.2	433.2	.0	702.5	1081.	1944.	3024.
3	55.2	72.5	69.0	62.0	6.8	55.2	.0	6288.	185.4	424.7	142.9	381.7	.0	702.5	1834.	1837.	3671.
4	70.0	84.8	82.3	79.8	9.8	70.0	.0	4349.	153.7	424.7	115.8	52.2	.0	702.5	2987.	1449.	4435.
5	71.7	86.5	84.0	81.5	9.8	71.7	.0	3820.	156.9	424.7	118.2	792.7	.0	702.5	2640.	2195.	4835.
6	83.5	98.4	95.2	91.2	8.5	82.6	.0	2900.	147.5	424.7	109.8	1274.1	.0	702.5	1464.	2659.	4122.
7	88.2	103.0	99.2	91.2	4.4	86.8	397.0	1370.	144.4	424.7	105.2	1274.1	126.2	702.5	0.	2777.	2777.
8	88.2	103.0	98.6	89.6	3.9	85.7	12.9	1445.	142.1	424.7	102.8	1274.1	78.3	702.5	0.	2724.	2724.
9	86.4	101.3	96.8	84.3	.0	84.3	.0	988.	144.8	424.7	103.8	1274.1	59.3	509.0	0.	2516.	2516.
10	75.5	90.3	85.8	70.3	.3	70.0	.0	713.	176.6	424.7	132.7	1274.1	220.2	575.8	0.	2804.	2804.
11	57.7	81.3	74.4	59.4	6.2	53.2	.0	849.	225.1	424.7	172.1	1274.1	259.3	702.5	174.	3058.	3232.
12	46.8	70.5	64.3	57.3	10.5	46.8	.0	1887.	220.5	424.7	164.1	922.1	.0	702.5	902.	2434.	3336.

1955

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	47.6	71.3	65.6	58.1	10.5	47.6	.0	1833.	222.9	424.7	168.1	1008.5	.0	702.5	884.	2527.	3411.
2	48.9	72.6	65.5	59.2	10.3	48.9	.0	3218.	214.0	424.7	162.0	424.3	.0	702.5	1810.	1928.	3737.
3	53.1	76.8	71.4	66.4	13.3	53.1	.0	2600.	198.8	424.7	150.9	287.3	.0	702.5	2734.	1764.	4498.
4	67.0	81.8	79.3	76.3	9.3	67.0	.0	3934.	148.4	424.7	111.7	580.4	.0	702.5	2333.	1968.	4301.
5	75.6	90.5	87.3	82.3	8.6	73.7	.0	2352.	151.5	424.7	114.1	1274.1	115.3	702.5	1233.	2782.	4015.
6	80.9	95.7	91.9	83.9	7.6	76.3	.0	1557.	161.9	424.7	123.0	1274.1	201.5	702.5	662.	2888.	3550.
7	87.1	102.0	98.1	91.6	6.1	85.5	.0	2009.	138.8	424.7	101.4	1274.1	65.8	702.5	356.	2707.	3064.
8	84.4	99.3	95.4	89.4	5.4	84.0	.0	2412.	130.2	424.7	92.9	1167.9	.0	702.5	186.	2518.	2704.
9	80.4	95.2	90.7	81.7	2.8	78.9	.0	1466.	141.8	424.7	100.3	1274.1	.0	702.5	0.	2643.	2643.
10	67.0	81.9	78.5	71.5	6.7	64.8	.0	1877.	168.6	424.7	126.7	1274.1	131.4	702.5	386.	2828.	3214.
11	56.0	79.7	72.9	62.4	8.4	54.0	.0	1241.	219.0	424.7	163.7	1274.1	129.4	702.5	443.	2912.	3356.
12	49.4	73.1	66.8	54.3	8.7	45.6	.0	1031.	243.4	424.7	186.7	1274.1	261.4	702.5	425.	3093.	3518.

1956

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	45.6	69.2	63.0	53.5	8.9	44.6	.0	1400.	223.3	424.7	167.5	1274.1	.0	702.5	521.	2792.	3313.
2	47.9	71.6	64.5	55.8	7.9	47.9	.0	4234.	213.6	424.7	161.6	423.2	.0	702.5	1220.	1926.	3146.
3	50.9	74.6	67.7	60.6	9.7	50.9	.0	3487.	203.2	424.7	154.1	406.5	.0	702.5	2220.	1891.	4111.
4	60.3	75.1	71.9	68.7	8.4	60.3	.0	4793.	153.4	424.7	115.5	307.5	.0	702.5	2360.	1704.	4063.
5	74.3	89.1	86.0	82.5	8.8	73.7	.0	3159.	143.7	424.7	105.3	1415.4	.0	702.5	1570.	2794.	4364.
6	85.0	99.9	96.0	86.0	6.7	79.3	.0	1203.	164.5	424.7	126.2	1274.1	226.3	702.5	391.	2918.	3310.
7	87.6	102.5	98.1	88.1	3.9	84.2	.0	1226.	144.4	424.7	106.0	1274.1	134.0	702.5	0.	2786.	2786.
8	87.3	102.1	97.7	87.7	3.8	83.9	.0	1278.	148.0	424.7	108.5	1274.1	115.9	702.5	0.	2774.	2774.
9	78.0	92.8	88.9	80.4	3.8	76.6	.0	1612.	147.3	424.7	106.8	1274.1	.0	702.5	0.	2655.	2655.
10	69.2	84.0	80.1	74.6	5.7	68.9	.0	2411.	144.2	424.7	102.3	1147.6	.0	702.5	262.	2521.	2783.
11	53.7	77.4	71.2	65.7	12.0	53.7	.0	2636.	209.3	424.7	156.1	131.7	.0	702.5	1673.	1624.	3297.
12	57.6	74.9	70.8	64.3	6.9	57.4	.0	2131.	177.5	424.7	130.7	1207.6	.0	702.5	407.	2643.	3050.

NOTES: COLUMNS 'D1-D4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'HCFS' IS AMOUNT OF COOL WATER IN CFS REQ'D TO AVOID DISCHARGE TEMP. IN EXCESS OF 103 DEG. F.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
LAKE COOLING ONLY

1957

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	49.9	73.6	65.4	60.2	10.3	49.9	.0	2804.	214.2	424.7	159.5	409.[illegible]	.0	702.5	1259.	1910.	3170.
2	52.4	76.1	69.0	57.3	4.9	52.4	.0	6735.	210.8	424.7	159.7	417.7	.0	702.5	0.	1915.	1915.
3	51.9	75.6	69.3	58.7	6.8	51.9	.0	5407.	210.4	424.7	161.6	427.5	.0	702.5	1307.	1927.	3234.
4	66.8	81.6	78.4	71.9	5.1	66.8	.0	7877.	150.0	424.7	112.9	300.2	.0	702.5	760.	1690.	2451.
5	76.1	90.9	88.3	84.3	8.9	75.4	.0	3105.	146.7	424.7	111.2	1274.1	.0	702.5	1590.	2659.	4250.
6	81.1	95.9	92.1	86.5	5.4	81.1	.0	6870.	135.3	424.7	99.0	261.3	.0	702.5	587.	1623.	2210.
7	85.0	99.8	96.1	90.6	6.8	83.8	.0	2312.	142.1	424.7	103.2	1274.1	.0	702.5	510.	2647.	3156.
8	82.8	97.6	93.8	86.3	5.6	80.7	.0	1714.	146.3	424.7	107.6	1274.1	89.0	702.5	224.	2744.	2968.
9	80.0	94.8	90.9	85.9	5.9	80.0	.0	3135.	135.8	424.7	95.7	612.4	.0	702.5	298.	1971.	2269.
10	63.7	78.5	75.3	71.8	8.1	63.7	.0	3711.	155.7	424.7	113.3	483.9	.0	702.5	1146.	1880.	3026.
11	56.8	74.1	69.0	61.8	5.0	56.8	.0	6589.	177.5	424.7	130.6	338.6	.0	702.5	0.	1774.	1774.
12	49.8	73.5	65.3	54.7	4.9	49.8	.0	5874.	215.5	424.7	160.4	412.2	.0	702.5	0.	1915.	1915.

1958

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	42.8	66.5	59.0	47.8	5.0	42.8	.0	6207.	231.2	424.7	174.3	451.5	.0	702.5	0.	1984.	1984.
2	39.7	63.4	56.9	46.2	6.5	39.7	.0	5386.	226.8	424.7	173.5	456.8	.0	702.5	798.	1984.	2782.
3	47.5	71.2	64.9	54.2	6.7	47.5	.0	5475.	213.5	424.7	163.9	434.0	.0	702.5	1385.	1939.	3324.
4	61.3	76.1	72.9	65.2	3.9	61.3	.0	10305.	153.2	424.7	115.3	307.0	.0	702.5	0.	1703.	1703.
5	73.8	88.6	85.4	78.6	4.8	73.8	.0	8299.	149.2	424.7	112.3	298.7	.0	702.5	0.	1687.	1687.
6	79.4	94.2	91.1	88.1	8.7	79.4	.0	3646.	138.2	424.7	101.2	820.6	.0	702.5	1776.	2187.	3963.
7	85.4	100.2	97.0	93.0	7.6	85.4	.0	3511.	134.9	424.7	98.5	686.7	.0	702.5	1046.	2047.	3094.
8	83.6	98.4	94.7	89.7	6.1	83.6	.0	2714.	134.1	424.7	95.0	1123.3	.0	702.5	448.	2480.	2928.
9	80.7	95.5	91.6	84.1	4.1	80.0	.0	1938.	140.9	424.7	100.8	1319.1	.0	702.5	0.	2687.	2687.
10	67.5	82.3	79.0	73.0	6.6	66.4	.0	2189.	163.4	424.7	121.1	1274.1	.0	702.5	447.	2686.	3133.
11	60.5	77.8	73.7	65.7	7.5	58.2	.0	1618.	187.7	424.7	141.8	1274.1	152.0	702.5	493.	2883.	3376.
12	45.7	69.4	61.3	55.5	9.8	45.7	.0	2960.	217.7	424.7	162.0	416.5	.0	702.5	1191.	1923.	3115.

1959

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	47.5	71.2	63.0	53.5	6.0	47.5	.0	4816.	214.1	424.7	159.3	409.0	.0	702.5	483.	1910.	2393.
2	49.5	73.2	66.0	58.9	9.4	49.5	.0	3502.	209.3	424.7	158.4	414.2	.0	702.5	1489.	1909.	3398.
3	51.4	75.1	68.2	59.8	8.4	51.4	.0	4021.	201.5	424.7	152.8	402.8	.0	702.5	1655.	1884.	3539.
4	63.3	78.1	74.9	69.8	6.5	63.3	.0	6115.	147.4	424.7	110.9	294.5	.0	702.5	1645.	1680.	3324.
5	75.6	90.5	87.3	83.3	8.6	74.7	.0	2879.	142.9	424.7	106.2	1274.1	.0	702.5	1449.	2650.	4099.
6	79.2	94.0	90.9	87.4	8.2	79.2	.0	3675.	135.4	424.7	99.2	749.9	.0	702.5	1565.	2112.	3676.
7	84.6	99.5	95.7	90.2	6.2	84.0	.0	2497.	129.3	424.7	92.8	1301.3	.0	702.5	410.	2650.	3061.
8	85.5	100.3	96.5	92.0	6.5	85.5	.0	3297.	128.5	424.7	90.9	677.2	.0	702.5	612.	2024.	2635.
9	80.1	94.9	90.0	85.7	5.6	80.1	.0	5016.	132.9	424.7	93.6	237.0	.0	702.5	408.	1591.	1998.
10	69.9	84.7	80.4	73.1	3.2	69.9	.0	9617.	143.1	424.7	104.0	266.5	.0	702.5	0.	1641.	1641.
11	54.5	71.8	66.7	61.2	6.7	54.5	.0	4862.	176.0	424.7	129.4	335.2	.0	702.5	834.	1768.	2602.
12	46.9	70.6	62.4	52.5	5.6	46.9	.0	5208.	214.6	424.7	159.7	410.0	.0	702.5	385.	1912.	2296.

NOTES: COLUMNS 'O1-O4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'HCFS' IS AMOUNT OF COOL WATER IN CFS REQ'D TO AVOID DISCHARGE TEMP. IN EXCESS OF 103 DEG. F.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS-- LAKE COOLING ONLY

1960

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	48.2	71.9	63.7	53.7	5.5	48.2	.0	5268.	210.9	424.7	156.9	402.1	.0	702.5	241.	1897.	2138.
2	46.5	70.2	63.1	49.0	2.5	46.5	.0	13097.	213.8	424.7	161.7	423.5	.0	702.5	0.	1926.	1926.
3	44.5	68.2	62.0	48.6	4.1	44.5	.0	9053.	219.6	424.7	168.5	446.9	.0	702.5	0.	1962.	1962.
4	65.7	80.5	77.3	69.5	3.8	65.7	.0	10573.	150.5	424.7	113.3	301.3	.0	702.5	0.	1692.	1692.
5	71.4	86.2	83.0	78.9	7.5	71.4	.0	5282.	144.3	424.7	108.6	288.2	.0	702.5	1975.	1668.	3644.
6	80.1	94.9	91.8	88.3	8.2	80.1	.0	3571.	134.3	424.7	98.3	853.2	.0	702.5	1509.	2213.	3722.
7	84.1	98.9	95.2	90.2	6.5	83.7	.0	2717.	132.8	424.7	94.9	1137.8	.0	702.5	456.	2493.	2948.
8	85.1	99.9	95.3	91.2	6.1	85.1	.0	4813.	129.3	424.7	91.5	235.7	.0	702.5	672.	1584.	2255.
9	80.3	95.1	91.2	86.7	6.4	80.3	.0	3610.	134.7	424.7	94.9	367.5	.0	702.5	433.	1724.	2157.
10	69.6	84.4	81.1	77.6	8.0	69.6	.0	3816.	150.0	424.7	109.1	380.0	.0	702.5	1096.	1766.	2862.
11	57.0	74.3	70.9	66.9	9.9	57.0	.0	3201.	185.6	424.7	139.5	530.5	.0	702.5	1492.	1983.	3475.
12	44.8	68.5	63.5	58.0	13.2	44.8	.0	2405.	248.2	424.7	189.7	479.9	.0	702.5	1934.	2045.	3979.

1961

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	45.8	69.5	62.1	55.5	9.7	45.8	.0	3344.	237.7	424.7	179.4	466.0	.0	702.5	1396.	2010.	3406.
2	49.5	73.2	66.6	56.1	6.6	49.5	.0	5252.	220.7	424.7	169.2	444.6	.0	702.5	989.	1962.	2951.
3	55.3	72.6	69.1	61.7	6.4	55.3	.0	6583.	182.5	424.7	140.6	375.3	.0	702.5	1422.	1825.	3247.
4	57.2	74.5	70.5	62.3	5.1	57.2	.0	7558.	175.4	424.7	132.5	352.5	.0	702.5	757.	1788.	2544.
5	71.0	85.8	82.6	79.7	8.7	71.0	.0	4612.	150.6	424.7	113.4	301.5	.0	702.5	2548.	1693.	4241.
6	80.1	94.9	91.6	88.7	8.6	80.1	.0	4575.	139.2	424.7	104.7	277.1	.0	702.5	2235.	1648.	3883.
7	85.2	100.0	96.8	93.3	8.1	85.2	.0	3692.	137.1	424.7	100.2	566.8	.0	702.5	1272.	1931.	3203.
8	83.1	97.9	94.7	91.2	8.1	83.1	.0	4374.	138.9	424.7	101.4	9.4	.0	702.5	1408.	1377.	2785.
9	84.0	98.8	95.0	90.0	6.0	84.0	.0	3113.	139.3	424.7	98.3	629.3	.0	702.5	299.	1994.	2293.
10	73.0	87.8	84.4	76.9	6.9	70.0	.0	1722.	179.8	424.7	136.3	1274.1	170.7	702.5	360.	2888.	3248.
11	61.6	76.4	73.7	69.7	8.5	61.2	.0	2840.	173.9	424.7	130.9	1318.3	.0	702.5	1009.	2750.	3759.
12	49.0	72.7	65.3	54.0	5.0	49.0	.0	6461.	233.2	424.7	176.1	456.7	.0	702.5	302.	1993.	2295.

1962

MO	O1	O2	O3	O4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	45.9	69.6	62.1	50.7	4.8	45.9	.0	6690.	231.1	424.7	174.4	451.8	.0	702.5	0.	1984.	1984.
2	50.6	74.3	67.8	57.2	6.6	50.6	.0	5533.	228.4	424.7	175.2	461.6	.0	702.5	1057.	1992.	3050.
3	51.4	75.1	68.9	56.2	4.3	51.4	.0	7688.	217.1	424.7	166.8	442.0	.0	702.5	0.	1953.	1953.
4	63.4	78.2	75.1	68.0	4.6	63.4	.0	9166.	160.2	424.7	120.7	322.1	.0	702.5	0.	1730.	1730.
5	79.0	93.8	91.2	87.7	8.9	78.8	.0	3532.	144.5	424.7	109.0	993.8	.0	702.5	1775.	2374.	4149.
6	80.2	95.0	91.7	88.3	8.1	80.2	.0	4897.	138.7	424.7	104.3	276.2	.0	702.5	2068.	1646.	3714.
7	87.5	102.3	98.5	90.5	5.8	84.7	.0	1682.	147.8	424.7	109.8	1274.1	118.1	702.5	238.	2777.	3015.
8	88.0	102.9	98.4	87.9	3.6	84.3	.0	1211.	152.6	424.7	112.5	1274.1	149.8	702.5	0.	2816.	2816.
9	82.5	97.3	92.9	82.4	2.8	79.6	.0	1250.	156.0	424.7	113.4	1274.1	101.6	702.5	0.	2772.	2772.
10	73.2	88.0	84.1	74.6	5.3	69.3	.0	1333.	177.7	424.7	133.5	1274.1	196.5	702.5	116.	2909.	3025.
11	52.7	76.4	70.2	63.2	10.5	52.7	.0	2033.	207.7	424.7	154.9	818.2	.0	702.5	1091.	2308.	3399.
12	44.8	68.4	62.8	54.8	10.4	44.4	.0	1609.	232.8	424.7	176.1	1274.1	.0	702.5	841	2810.	3651.

NOTES: COLUMNS 'O1-O4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'HCFS' IS AMOUNT OF COOL WATER IN CFS REQ'D TO AVOID DISCHARGE TEMP. IN EXCESS OF 103 DEG. F.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
LAKE COOLING ONLY

1963

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	46.2	69.9	64.3	59.3	13.1	46.2	.0	2654.	235.7	424.7	177.9	122.5	.0	702.5	1996.	1663.	3659.
2	44.0	67.6	62.7	56.7	12.9	43.8	.0	2009.	228.3	424.7	175.1	1245.1	.0	702.5	1857.	2776.	4633.
3	56.7	74.0	70.5	63.2	6.5	56.7	.0	6566.	181.3	424.7	139.6	372.6	.0	702.5	1385.	1821.	3206.
4	66.4	81.2	78.6	75.1	9.7	65.4	.0	3046.	160.9	424.7	122.6	1274.1	51.0	702.5	2107.	2736.	4843.
5	74.6	89.4	86.8	83.3	9.5	73.8	.0	3060.	152.6	424.7	116.0	1274.1	.0	702.5	2006.	2670.	4675.
6	81.1	96.0	92.5	88.3	8.3	80.0	.0	2792.	145.1	424.7	108.1	1274.1	52.1	702.5	1264.	2707.	3971.
7	85.7	100.5	96.8	90.8	6.6	84.2	.0	2180.	143.6	424.7	104.8	1274.1	64.3	702.5	506.	2714.	3220.
8	86.2	101.1	97.2	90.2	5.9	84.3	.0	1933.	146.0	424.7	107.1	1274.1	56.6	702.5	243.	2711.	2953.
9	80.3	95.2	91.3	84.3	4.9	79.4	.0	1937.	148.5	424.7	106.9	1274.1	.0	702.5	0.	2657.	2657.
10	71.4	86.2	82.9	77.4	6.8	70.6	.0	2309.	160.5	424.7	118.4	1274.1	.0	702.5	449.	2680.	3129.
11	57.2	74.5	71.1	66.6	9.4	57.2	.0	2606.	188.2	424.7	141.5	1118.0	.0	702.5	1152.	2575.	3777.
12	41.7	65.4	58.6	51.5	9.8	41.7	.0	3465.	242.9	424.7	185.5	483.4	.0	702.5	1458.	2039.	3497.

1964

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	48.2	71.9	64.3	54.5	6.3	48.2	.0	4836.	225.6	424.7	170.2	440.1	.0	702.5	522.	1953.	2485.
2	44.3	68.0	61.5	51.9	7.6	44.3	.0	4799.	227.4	424.7	174.2	458.7	.0	702.5	1366.	1288.	3353.
3	54.5	71.8	68.3	64.3	9.8	54.5	.0	4327.	181.5	424.7	139.8	373.1	.0	702.5	3087.	1822.	4909.
4	63.0	77.9	74.6	68.6	5.6	63.0	.0	7206.	154.4	424.7	116.2	309.5	.0	702.5	1187.	1707.	2894.
5	74.9	89.7	86.6	82.6	8.6	74.0	.0	2946.	149.0	424.7	110.7	1274.1	40.7	702.5	1582.	2702.	4284.
6	82.2	97.0	93.9	89.4	8.2	81.2	.0	2771.	142.9	424.7	106.3	1274.1	43.7	702.5	1237.	2694.	3931.
7	84.2	99.0	95.6	92.3	8.1	84.2	.0	3982.	132.1	424.7	96.4	309.3	.0	702.5	1285.	1665.	2950.
8	86.3	101.1	96.5	92.1	5.8	86.3	.0	5074.	132.6	424.7	93.9	242.3	.0	702.5	523.	1596.	2119.
9	80.4	95.2	91.4	87.4	7.0	80.4	.0	3974.	140.6	424.7	99.2	210.7	.0	702.5	629.	1578.	2207.
10	63.6	78.4	74.8	67.0	3.4	63.6	.0	10454.	164.3	424.7	123.0	320.5	.0	702.5	0.	1735.	1735.
11	60.2	75.0	71.4	66.2	6.0	60.2	.0	6396.	167.0	424.7	125.0	326.2	.0	702.5	624.	1745.	2370.
12	51.1	74.8	67.2	56.2	5.1	51.1	.0	5985.	222.8	424.7	168.2	434.4	.0	702.5	277.	1953.	2230.

1965

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	48.4	72.1	64.5	52.1	3.7	48.4	.0	8262.	225.2	424.7	169.9	439.3	.0	702.5	0.	1962.	1962.
2	48.3	72.0	65.5	54.1	5.8	48.3	.0	5982.	226.2	424.7	173.4	456.5	.0	702.5	626.	1983.	2609.
3	50.4	74.1	67.9	56.8	6.4	50.4	.0	5821.	218.7	424.7	168.0	445.5	.0	702.5	1162.	1959.	3121.
4	65.0	79.8	76.6	71.5	6.5	65.0	.0	6167.	154.7	424.7	116.5	310.3	.0	702.5	1782.	1709.	3491.
5	77.2	92.0	89.4	86.4	9.4	77.0	.0	3594.	146.9	424.7	110.8	945.4	.0	702.5	1994.	2330.	4324.
6	77.2	92.0	89.4	85.9	8.9	77.0	.0	3494.	143.4	424.7	108.2	1047.3	.0	702.5	1772.	2426.	4198.
7	83.8	98.6	94.6	90.1	6.3	83.8	.0	5460.	135.5	424.7	99.0	258.3	.0	702.5	814.	1620.	2434.
8	84.6	99.4	95.4	91.8	7.2	84.6	.0	4753.	138.6	424.7	101.1	262.9	.0	702.5	1071.	1630.	2701.
9	80.8	95.6	91.8	87.3	6.5	80.8	.0	3461.	140.7	424.7	99.3	471.5	.0	702.5	447.	1839.	2285.
10	65.9	80.7	77.5	74.0	8.1	65.9	.0	3799.	158.9	424.7	115.8	422.6	.0	702.5	1178.	1825.	3003.
11	55.8	73.1	69.7	65.7	9.9	55.8	.0	3139.	189.7	424.7	142.6	613.9	.0	702.5	1525.	2073.	3599.
12	49.8	73.5	67.9	62.4	12.6	49.8	.0	2426.	230.8	424.7	174.3	396.3	.0	702.5	1676.	1929.	3604.

NOTES: COLUMNS 'D1-D4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'HCFS' IS AMOUNT OF COOL WATER IN CFS REQ'D TO AVOID DISCHARGE TEMP. IN EXCESS OF 103 DEG. F.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
LAKE COOLING ONLY

1966

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	43.5	67.2	59.8	53.0	9.5	43.5	.0	3415.	235.1	424.7	177.3	460.1	.0	702.5	1250.	2000.	3250.
2	44.9	68.6	62.2	52.2	7.3	44.9	.0	5045.	233.4	424.7	178.9	472.0	.0	702.5	1246.	2012.	3258.
3	52.3	76.0	69.8	57.8	5.5	52.3	.0	6711.	222.7	424.7	171.1	454.3	.0	702.5	955.	1975.	2930.
4	65.1	79.9	76.7	70.7	10.3	60.4	.0	1831.	185.0	424.7	142.9	1274.1	274.4	702.5	1472.	3004.	4475.
5	75.3	90.2	87.0	81.5	9.3	72.2	.0	2139.	166.5	424.7	126.9	1274.1	187.4	702.5	1328.	2882.	4210.
6	79.0	93.9	90.7	86.2	8.7	77.5	.0	2608.	155.3	424.7	116.4	1274.1	101.9	702.5	1413.	2775.	4188.
7	83.3	98.1	94.9	90.4	7.5	82.9	.0	2880.	144.0	424.7	106.0	1317.9	.0	702.5	930.	2695.	3625.
8	84.0	98.8	95.0	88.5	6.1	82.4	.0	2001.	148.4	424.7	108.4	1274.1	69.7	702.5	357.	2728.	3085.
9	77.3	92.1	88.8	83.8	6.5	77.3	.0	2796.	149.9	424.7	109.1	1027.2	.0	702.5	519.	2413.	2932.
10	66.3	81.1	77.8	72.3	7.3	65.0	.0	2294.	172.9	424.7	128.5	1274.1	.0	702.5	600.	2703.	3302.
11	54.8	72.1	67.6	62.8	8.0	54.8	.0	4626.	191.0	424.7	143.6	375.7	.0	702.5	1271.	1838.	3109.
12	46.8	70.5	63.1	53.3	6.5	46.8	.0	4958.	235.4	424.7	177.7	461.1	.0	702.5	719.	2001.	2720.

1967

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	50.0	73.7	66.2	60.1	10.1	50.0	.0	3038.	229.7	424.7	173.4	449.2	.0	702.5	1442.	1980.	3421.
2	41.9	65.6	59.2	51.3	9.4	41.9	.0	3881.	230.2	424.7	176.3	464.6	.0	702.5	1795.	1998.	3793.
3	58.9	76.2	72.9	67.9	11.5	56.4	.0	2178.	197.0	424.7	152.1	1274.1	218.4	702.5	2066.	2969.	5035.
4	71.3	86.1	82.3	73.3	9.0	64.3	.0	1271.	189.8	424.7	146.9	1274.1	295.0	702.5	760.	3034.	3794.
5	73.1	87.9	84.1	75.6	8.5	67.1	.0	1414.	176.1	424.7	135.3	1274.1	258.7	702.5	727.	2971.	3698.
6	83.2	98.1	94.3	86.3	7.8	78.5	.0	1498.	165.1	424.7	125.6	1274.1	221.5	702.5	655.	2913.	3568.
7	82.6	97.4	94.2	89.7	7.7	82.0	.0	2703.	142.2	424.7	104.9	1274.1	.0	702.5	851.	2648.	3499.
8	80.9	95.7	92.5	89.5	8.6	80.9	.0	4342.	144.5	424.7	105.5	35.3	.0	702.5	1612.	1413.	3025.
9	75.0	89.8	85.6	82.3	7.3	75.0	.0	4601.	151.7	424.7	110.4	284.8	.0	702.5	946.	1674.	2621.
10	66.0	80.8	78.1	74.6	8.5	66.0	.0	3888.	166.5	424.7	124.7	409.2	.0	702.5	1466.	1828.	3294.
11	51.5	75.2	67.9	59.0	7.5	51.5	.0	4358.	229.4	424.7	173.5	452.4	.0	702.5	1045.	1983.	3028.
12	51.0	74.7	67.1	57.8	6.8	51.0	.0	4491.	224.6	424.7	169.6	438.3	.0	702.5	651.	1960.	2611.

1968

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	43.9	67.6	60.2	48.3	4.4	43.9	.0	7382.	235.9	424.7	178.0	462.0	.0	702.5	0.	2003.	2003.
2	41.9	65.6	59.3	48.9	7.0	41.9	.0	5265.	240.4	424.7	184.2	486.9	.0	702.5	1041.	2039.	3079.
3	53.3	77.0	70.7	63.7	10.4	53.3	.0	3429.	215.0	424.7	165.2	437.7	.0	702.5	2448.	1945.	4393.
4	63.8	78.6	76.0	72.5	10.7	61.8	.0	2746.	175.0	424.7	134.6	1274.1	159.9	702.5	2409.	2871.	5280.
5	70.2	85.0	82.4	78.4	9.8	68.6	.0	2692.	160.2	424.7	122.7	1274.1	132.2	702.5	1794.	2816.	4610.
6	78.7	93.6	90.4	86.9	8.6	78.3	.0	3313.	143.4	424.7	105.8	1305.2	.0	702.5	1723.	2682.	4404.
7	83.3	98.1	94.9	91.4	8.1	83.3	.0	3873.	138.6	424.7	101.3	427.5	.0	702.5	1361.	1795.	3155.
8	84.2	99.0	95.8	92.3	8.1	84.2	.0	3988.	139.5	424.7	101.8	293.0	.0	702.5	1249.	1662.	2911.
9	79.6	94.4	91.1	85.6	6.3	79.3	.0	2496.	151.9	424.7	111.1	1177.1	.0	702.5	365.	2567.	2933.
10	66.6	81.4	78.2	74.2	7.6	66.6	.0	2876.	162.5	424.7	118.4	1157.2	.0	702.5	849.	2565.	3414.
11	53.7	77.4	70.0	62.8	9.1	53.7	.0	3392.	217.8	424.7	164.6	427.4	.0	702.5	1302.	1937.	3239.
12	43.0	66.7	59.8	54.6	11.6	43.0	.0	2937.	242.5	424.7	185.2	482.8	.0	702.5	1900.	2038.	3938.

NOTES: COLUMNS 'D1-D4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'HCFS' IS AMOUNT OF COOL WATER IN CFS REQ'D TO AVOID DISCHARGE TEMP. IN EXCESS OF 103 DEG. F.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
LAKE COOLING ONLY

1969

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	43.5	67.2	60.4	52.6	9.1	43.5	.0	3732.	247.0	424.7	188.7	492.7	.0	702.5	1400.	2056.	3455.
2	42.4	66.1	59.7	50.5	8.1	42.4	.0	4514.	232.3	424.7	177.9	469.2	.0	702.5	1581.	2007.	3588.
3	48.2	71.9	65.8	56.3	8.1	48.2	.0	4620.	225.8	424.7	173.4	460.7	.0	702.5	2124.	1987.	4111.
4	62.4	77.2	74.1	70.5	8.1	62.4	.0	5242.	158.5	424.7	119.3	318.3	.0	702.5	2657.	1723.	4380.
5	71.8	86.6	84.1	81.6	9.8	71.8	.0	4219.	151.1	424.7	113.8	222.4	.0	702.5	2764.	1614.	4379.
6	79.7	94.5	91.2	87.5	7.8	79.7	.0	5106.	141.5	424.7	106.4	282.1	.0	702.5	1858.	1657.	3515.
7	84.5	99.3	96.1	92.6	8.1	84.5	.0	3980.	137.3	424.7	100.3	329.1	.0	702.5	1360.	1694.	3054.
8	80.5	95.3	92.1	87.6	7.1	80.5	.0	3057.	139.3	424.7	101.6	992.5	.0	702.5	769.	2361.	3130.
9	77.3	92.1	88.8	84.8	7.5	77.3	.0	3569.	149.1	424.7	108.5	531.0	.0	702.5	893.	1916.	2809.
10	67.0	81.8	77.7	74.6	7.6	67.0	.0	4420.	157.0	424.7	114.3	295.7	.0	702.5	1215.	1694.	2909.
11	51.0	74.7	67.4	59.0	8.0	51.0	.0	4100.	225.0	424.7	170.1	442.8	.0	702.5	985.	1965.	2950.
12	44.0	67.7	60.3	52.0	8.0	44.0	.0	4040.	234.3	424.7	176.7	458.4	.0	702.5	1075.	1997.	3072.

1970

MO	D1	D2	D3	D4	EX-4	AMB	HCFS	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	41.0	64.7	57.8	47.2	6.2	41.0	.0	5440.	242.5	424.7	135.2	482.6	.0	702.5	601.	2037.	2639.
2	43.0	66.7	60.3	52.2	9.2	43.0	.0	3960.	233.3	424.7	178.7	471.4	.0	702.5	1860.	2011.	3871.
3	50.0	73.7	67.5	60.8	10.8	50.0	.0	3440.	218.6	424.7	167.9	445.3	.0	702.5	2839.	1959.	4798.
4	62.4	77.2	74.7	71.7	9.7	62.0	.0	3480.	162.9	424.7	123.3	1434.7	.0	702.5	2644.	2848.	5492.
5	71.0	85.8	83.3	80.8	9.8	71.0	.0	4190.	153.3	424.7	115.5	269.7	.0	702.5	2839.	1666.	4504.
6	78.4	93.3	90.1	86.1	9.1	77.0	.0	2690.	154.5	424.7	115.6	1274.1	97.8	702.5	1613.	2769.	4382.
7	81.0	95.3	92.5	89.1	8.1	81.0	.0	3900.	139.5	424.7	101.9	408.1	.0	702.5	1381.	1777.	3158.
8	82.0	96.8	92.8	87.9	5.9	82.0	.0	5820.	139.8	424.7	102.0	265.4	.0	702.5	593.	1634.	2227.
9	82.0	95.3	92.0	86.9	4.9	82.0	.0	5910.	141.8	424.7	100.1	255.4	.0	702.5	0.	1625.	1625.
10	73.4	88.2	84.2	70.2	3.2	67.0	.0	867.	187.6	424.7	144.2	1274.1	266.8	702.5	0.	3000.	3000.
11	51.0	74.7	69.1	61.6	10.6	51.0	.0	1770.	220.2	424.7	166.4	1228.4	.0	702.5	1024.	2742.	3766.
12	50.0	73.7	67.5	60.0	10.0	50.0	.0	1801.	221.2	424.7	164.8	998.3	.0	702.5	790.	2511.	3301.

NOTES: COLUMNS 'D1-D4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
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COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

ER Table 4.1-2a

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at Full Pond

A. Monthly average isotherm areas for the <u>median</u> year using <u>lake area</u> as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1962	69.6 Discharge										
		65	24	425	0	0	0	0	0	449	4	449
		60	58	425	27	38	0	457	0	1004	8	1004
		55	107	425	69	155	0	703	0	1458	12	1458
		50	196	425	145	368	0	703	0*	1836	15	1836*
		48.9	231	425	174	452	0	703	0*	1984	16	1984*
		45.9 Ambient										
Feb	1965	72.1 Discharge										
		70.0	10	240	0	0	0	0	0	250	2	250
		65.0	38	425	14	8	0	240	0	725	6	725
		60.0	77	425	47	101	0	703	0	1352	11	1352
		55.0	138	425	99	247	0	703	0	1611	13	1611
		51.3	226	425	173	457	0	703	626*	1983*	16	2609*
		48.3 Ambient										
Jun	1964	97.0 Discharge										
		95	12	425	0	0	0	0	0	437	4	437
		90	51	425	28	459	0	703	0	1666	14	1666
		85	123	425	89	1274	0	703	1237*	2613	22	3850*
		84.2	143	425	106	1274	44	703	1237*	2694	22	3931*
		81.2 Ambient										
Jul	1967	97.4 Discharge										
		95	15	425	0	0	0	0	0	440	4	440
		90	57	425	33	500	0	703	0	1717	14	1717
		85	142	425	105	1274	0	703	851*	2649	22	3500*
		82.0 Ambient										
Aug	1952	100.3 Discharge										
		100	2	0	0	0	0	0	0	2	0	2
		95	37	425	15	246	0	419	0	1142	9	1142
		90	98	425	67	863	0	703	564*	2155	18	2719*
		88.1	140	425	103	1146	0	703	564*	2515	21	3079*
		85.1 Ambient										
Dec	1966	70.5 Discharge										
		70	2	0	0	0	0	0	0	2	0	2
		65	30	425	0	0	0	0	0	455	4	455
		60	67	425	34	57	0	642	0	1225	10	1225
		55	121	425	80	187	0	703	0	1515	12	1515
		50	228	425	171	444	0	703	719*	1970	16	2689*
		49.8	235	425	178	461	0	703	719*	2001	16	2702*
		46.8 Ambient										

*Downstream area to within 5°F of ambient

ER Table 4.1-2a

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at Full Pond

B. Monthly average isotherm areas for the <u>median</u> year using <u>discharge temperature</u> as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1955	71.3 Discharge										
		70	17	354	0	0	0	0	0	371	3	371
		65	48	425	17	9	0	202	0	700	6	700
		60	91	425	53	111	0	703	0	1382	11	1382
		55	163	425	115	286	0	703	495	1692	14	2187
		50.6	223	425	168	1009	0	703	884*	2527	21	3411*
		47.6 Ambient										
Feb	1965	72.1 Discharge										
		70	10	240	0	0	0	0	0	249	2	249
		65	38	425	14	8	0	240	0	725	6	725
		60	77	425	47	101	0	703	0	1352	11	1352
		55	138	425	99	247	0	703	0	1611	13	1611
		51.3	226	425	173	457	0	703	625*	1983	16	2609*
		48.3 Ambient										
Jun	1955	95.7 Discharge										
		95	3	149	0	0	0	0	0	153	1	153
		90	30	425	11	322	0	177	0	965	8	965
		85	70	425	45	1237	0	681	0	2457	20	2457
		80	144	425	108	1274	156	703	662*	2809	23	3471*
		79.3	162	425	123	1274	202	703	662*	2888	24	3550*
		76.3 Ambient										
Jul	1961	100.0 Discharge										
		95	37	425	14	93	0	496	0	1064	9	1064
		90	97	425	66	377	0	703	1272*	1667	14	2938*
		88.2	137	425	100	567	0	703	1272*	1931	16	3203*
		85.2 Ambient										
Aug	1960	99.9 Discharge										
		95	33	425	9	5	0	206	0	678	6	678
		90	90	425	58	141	0	703	672*	1416	12	2087*
		88.1	129	425	92	236	0	703	672*	1584	13	2255*
		85.1 Ambient										
Dec	1953	72.8 Discharge										
		70	14	277	0	0	0	0	0	456	4	456
		65	45	425	15	6	0	144	0	634	5	634
		60	87	425	52	107	0	703	0	1372	11	1372
		55	156	425	110	271	0	703	1257	1664	14	2921
		52.1	231	425	175	453	0	703	1546*	1986	16	3532*
		49.1 Ambient										

*Downstream area to within 5°F of ambient

ER Table 4.1-2a

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at Full Pond

C. Monthly average areas for the median year using downstream area as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1970	64.7 Discharge										
		60	26	425	0	0	0	0	0	451	4	451
		55	62	425	32	52	0	564	0	1134	9	1134
		50	114	425	76	175	0	703	0	1492	12	1492
		45	209	425	157	402	0	703	601*	1895	16	2496*
		44.0	243	425	185	483	0	703	601*	2037	17	2639*
		41.0 Ambient										
Feb	1956	71.6 Discharge										
		70	7	166	0	0	0	0	0	173	1	173
		65	34	425	8	0	0	0	0	467	4	467
		60	69	425	39	78	0	703	0	1313	11	1313
		55	125	425	86	210	0	703	464	1676	14	2935
		50.9	214	425	162	423	0	703	1220*	1926	16	3146*
		47.9 Ambient										
Jun	1960	94.9 Discharge										
		90	34	425	13	121	0	528	0	1121	9	1121
		85	93	425	63	524	0	703	1509*	1807	15	3316*
		83.1	134	425	98	853	0	703	1509*	2213	18	3722*
		80.1 Ambient										
Jul	1952	102.1 Discharge										
		100	13	425	0	0	0	0	0	438	4	438
		95	55	425	31	382	0	703	0	1595	13	1595
		90	138	425	101	1144	0	703	761*	2511	21	3272*
		89.9	141	425	104	1144	0	703	761*	2516	21	3277*
		86.9 Ambient										
Aug	1964	101.1 Discharge										
		100	7	235	0	0	0	0	0	242	2	242
		95	44	425	19	32	0	570	0	1089	9	1089
		90	115	425	79	201	0	703	523*	1522	13	2045*
		89.3	133	425	94	242	0	703	523*	1596	13	2119*
		86.3 Ambient										
Dec	1954	70.5 Discharge										
		70	2	0	0	0	0	0	0	2	0	2
		65	28	425	0	0	0	0	0	453	4	453
		60	62	425	29	217	0	474	0	1206	10	1206
		55	113	425	72	505	0	703	402	1818	15	2221
		50	214	425	158	922	0	703	902*	2421	20	3323*
		49.8	221	425	164	922	0	703	902*	2434	20	3336*
		46.8 Ambient										

*Downstream area to within 5°F of ambient

ER Table 4.1-2a

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at Full Pond

D. Monthly average isotherm areas for the median year using total area as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1957	73.6 Discharge										
		70	17	344	0	0	0	0	0	361	3	361
		65	47	425	16	7	0	130	0	625	5	625
		60	88	425	52	107	0	703	175	1374	11	1549
		55	159	425	112	277	0	703	1259	1676	14	2935
		52.9	214	425	160	409	0	703	1259*	1910	16	3170*
		49.9 Ambient										
Feb	1956	71.6 Discharge										
		70	7	166	0	0	0	0	0	173	1	173
		65	37	425	8	0	0	0	0	1928	16	1928
		60	69	425	39	78	0	703	0	1313	11	1313
		55	125	425	86	210	0	703	464	1676	14	2935
		50.9	214	425	162	423	0	703	1220*	1926	16	3146*
		47.9 Ambient										
Jun	1961	94.9 Discharge										
		90	35	425	17	31	0	703	0	1211	10	1211
		85	96	425	69	176	0	703	2235	1468	12	3703
		83.1	139	425	105	277	0	703	2235*	1648	14	3883*
		80.1 Ambient										
Jul	1958	100.2 Discharge										
		100	1	0	0	0	0	0	0	1	0	1
		95	37	425	15	139	0	557	0	1173	10	1173
		90	99	425	68	506	0	703	1046*	1800	15	2846*
		88.4	135	425	99	687	0	703	1046*	2047	17	3094*
		85.4 Ambient										
Aug	1968	99.0 Discharge										
		95	28	425	7	29	0	291	0	780	6	780
		90	82	425	53	162	0	703	877	1424	12	2302
		87.2	140	425	102	293	0	703	1249*	1662	14	2911*
		84.2 Ambient										
Dec	1954	70.5 Discharge										
		70	2	0	0	0	0	0	0	2	0	2
		65	28	425	0	0	0	0	0	453	4	453
		60	62	425	29	217	0	474	0	1206	10	1206
		55	113	425	72	505	0	703	402	1818	15	2221
		50	214	425	158	922	0	703	902*	2421	20	3323*
		49.8	221	425	164	922	0	703	902*	2434	20	3336*
		46.8 Ambient										

*Downstream area to within 5°F of ambient

ER Table 4.1-2a

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at Full Pond

E. Monthly average isotherm areas for the <u>1:10</u> year using <u>lake</u> <u>area</u> as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1969	67.2 Discharge										
		65	11	243	0	0	0	0	0	254	2	254
		60	43	425	16	7	0	155	0	645	5	645
		55	86	425	52	110	0	703	0	1376	11	1376
		50	155	425	110	272	0	703	922	1664	14	2586
		46.5	247	425	189	493	0	703	1400*	2056	17	3455*
		43.5 Ambient										
Feb	1966	68.6 Discharge										
		65	18	425	0	0	0	0	0	443	4	443
		60	51	425	24	37	0	539	0	1075	9	1075
		55	96	425	62	145	0	703	0	1431	12	1431
		50	174	425	128	329	0	703	1246	1758	14	3004
		47.9	233	425	179	472	0	703	1246*	2012	17	3258*
		44.9 Ambient										
Jun	1955	95.7 Discharge										
		95	3	149	0	0	0	0	0	152	1	152
		90	30	425	11	322	0	177	0	965	8	965
		85	70	425	45	1237	0	681	0	2457	20	2457
		80	144	425	108	1274	156	703	662*	2809	23	3471*
		79.3	162	425	123	1214	202	703	662*	2888	24	3550*
		76.3 Ambient										
Jul	1962	102.3 Discharge										
		100	12	370	0	0	0	0	0	382	3	382
		95	45	425	22	495	0	308	0	1295	11	1295
		90	100	425	70	1274	0	703	152	2571	21	2723
		87.7	148	425	110	1274	0	703	238*	2777	23	3015*
		84.7 Ambient										
Aug	1953	101.6 Discharge										
		100	9	324	0	0	0	0	0	333	3	333
		95	44	425	20	423	0	338	0	1249	10	1249
		90	103	425	70	1274	0	703	339	2605	21	2944
		87.8	152	425	117	1274	88	703	339*	2753	23	3092*
		84.8 Ambient										
Dec	1962	68.4 Discharge										
		65	17	331	0	0	0	0	0	348	3	348
		60	48	425	19	200	0	283	0	975	8	975
		55	92	425	56	559	0	703	0	1834	15	1835
		50	163	425	117	1054	0	703	755	2461	20	3216
		47.4	234	425	176	1274	0	703	841*	2810	23	3651*
		44.4 Ambient										

*Downstream area to within 5°f of ambient

ER Table 4.1-2a

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at Full Pond

F. Monthly average isotherm areas for the 1:10 year using discharge temperature as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1951	73.6 Discharge										
		70	17	354	0	0	0	0	0	371	3	371
		65	48	425	17	9	0	202	0	700	6	700
		60	91	425	53	111	0	703	0	1382	11	1382
		55	163	425	115	286	0	703	495*	1692	14	2187*
		53.9	220	425	164	421	0	703	495*	1932	16	2427*
		49.9 Ambient										
Feb	1953	75.3 Discharge										
		75	1	0	0	0	0	0	0	1	0	1
		70	27	425	4	0	0	0	0	456	4	456
		65	61	425	34	64	0	703	0	1296	11	1296
		60	112	425	76	184	0	703	0	1500	12	1500
		55	141	425	99	248	0	703	610*	1615	13	2225*
		54.6	223	425	171	450	0	703	610*	1970	16	2580*
		51.6 Ambient										
Jun	1953	99.5 Discharge										
		95	27	425	9	209	0	258	0	928	8	928
		90	73	425	48	975	0	703	449	2222	18	2671
		85.8	149	425	112	1274	110	703	1068*	2773	23	3841*
		82.8 Ambient										
Jul	1953	102.6 Discharge										
		100	15	511	0	0	0	0	0	526	4	526
		95	56	425	29	513	0	560	0	1583	13	1583
		90	133	425	95	1274	0	703	512*	2629	22	3141*
		89.6	144	425	104	1274	0	703	512*	2649	22	3161*
		86.6 Ambient										
Aug	1951	102.6 Discharge										
		100	14	425	0	0	0	0	0	439	4	439
		95	50	425	26	572	0	365	0	1589	13	1589
		90	115	425	81	1274	0	703	224*	2598	21	2822*
		88.7	146	425	107	1274	89	703	224*	2743	23	2967*
		85.7 Ambient										
Dec	1964	74.8 Discharge										
		70	24	425	0	0	0	0	0	499	4	499
		65	57	425	27	38	0	430	0	977	8	977
		60	106	425	68	153	0	703	0	1454	12	1454
		55	195	425	144	367	0	703	277*	1832	15	2109*
		54.1	223	425	168	434	0	703	277*	1953	16	2230*
		51.1 Ambient										

*Downstream area to within 5°f fo ambient

FR Table 4.1-2a

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at Full Pond

G. Monthly average isotherm areas for the 1:10 year using downstream area as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1967	73.6 Discharge										
		70	19	388	0	0	0	0	0	407	3	407
		65	51	425	21	21	0	291	0	807	7	807
		60	96	425	59	129	0	703	200	1411	12	1611
		55	173	425	125	313	0	703	1442	1738	14	3180
		53.0	230	425	173	449	0	703	1442*	1980	16	3421*
		50.0 Ambient										
Feb	1955	72.6 Discharge										
		70	12	276	0	0	0	0	0	288	2	288
		65	40	425	14	8	0	226	0	712	6	712
		60	78	425	46	100	0	703	0	1352	11	1352
		55	141	425	99	248	0	703	1418	1615	13	3033
		51.9	214	425	102	424	0	703	1810*	1428	16	3737*
		48.9 Ambient										
Jun	1969	94.5 Discharge										
		90	32	425	14	24	0	574	0	1069	9	1069
		85	91	425	64	163	0	703	1513	1445	12	2953
		82.7	142	425	106	282	0	703	1588*	1657	14	3245*
		79.7 Ambient										
Jul	1969	99.3 Discharge										
		95	30	425	9	42	0	415	0	920	8	920
		90	39	425	17	211	0	484	0	1175	10	1175
		87.5	140	425	102	408	0	703	1381*	1777	15	3158*
		84.5 Ambient										
Aug	1968	99.0 Discharge										
		95	28	425	7	29	0	291	0	780	6	780
		90	82	425	53	162	0	703	877	1424	12	2302
		87.2	140	425	102	293	0	703	1249*	1662	14	2911*
		84.2 Ambient										
Dec	1965	73.5 Discharge										
		70	18	329	0	0	0	0	0	347	3	347
		65	50	425	20	57	0	424	0	975	8	975
		60	94	425	58	159	0	703	484	1438	12	1922
		55	169	425	122	300	0	703	1545	1719	14	3263
		52.8	231	425	174	396	0	703	1676*	1929	16	3605*
		49.8 Ambient										

*Downstream area to within 5°F of ambient

ER Table 4.1-2a

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at Full Pond

H. Monthly average isotherm areas for the <u>1:10</u> year using <u>total</u> area as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1967	73.7 Discharge										
		70	19	388	0	0	0	0	0	407	3	407
		65	51	425	21	21	0	291	0	807	7	807
		60	96	425	59	129	0	703	200	1411	12	1611
		55	173	425	125	313	0	703	1442	1738	14	3180
		53.0	230	425	173	449	0	703	1442*	1980	16	3421*
		50.0 Ambient										
Feb	1966	68.6 Discharge										
		65	18	425	0	0	0	0	0	443	4	443
		60	51	425	24	37	0	539	0	1075	9	1075
		55	96	425	62	145	0	703	0	1431	12	1431
		50	174	425	128	329	0	703	1246	1758	14	3004
		47.9	233	425	179	472	0	703	1250*	2000	16	3250*
		44.9 Ambient										
Jun	1952	100.8 Discharge										
		100	5	196	0	0	0	0	0	201	2	201
		95	42	425	20	262	0	703	0	1452	12	1452
		90	107	425	75	942	0	703	1891	2252	19	4143
		88.5	143	425	106	1351.8	0	702.5	1610*	2727	22	4337*
		85.5 Ambient										
Jul	1952	102.1 Discharge										
		100	13	425	0	0	0	0	0	438	4	438
		95	55	425	31	382	0	703	0	1595	13	1595
		90	138	425	101	1144	0	703	761*	2511	21	3272*
		89.9	141	425	104	1144	0	703	761*	2516	21	3277*
		86.9 Ambient										
Aug	1966	98.8 Discharge										
		95	23	425	2	108	0	90	0	648	5	648
		90	67	425	40	809	0	677	0	2015	17	2015
		85.4	148	425	108	1274	70	703	357*	2728	22	3085*
		82.4 Ambient										
Dec	1952	73.6 Discharge										
		70	19	409	0	0	0	0	0	428	3	428
		65	51	425	21	227	0	358	0	1081	9	1081
		60	96	425	59	589	0	703	189	1872	15	2061
		55	209	425	159	1092	0	703	983	2515	21	3498
		52.1	240	425	181	1274	0	703	983*	2822	23	3805*
		49.1 Ambient										

*Downstream area to within 5°F of ambient

ER Table 4.1-2b

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at a 5 Foot Drawdown

A. Monthly average isotherm areas for the median year using lake area as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1962	69.6	Discharge									
		65	24	374	0	0	0	0	0	398	4	398
		60	58	374	29	46	0	527	0	1034	10	1034
		55	107	374	71	163	0	632	0	1346	13	1346
		50	196	374	147	374	0	632	297*	1724	16	2021*
		48.9	231	374	177	459	0	632	297*	1872	17	2170*
		45.9	Ambient									
Feb	1965	72.0	Discharge									
		70	10	240	0	0	0	0	0	250	2	250
		65	38	374	14	9	0	240	0	674	6	674
		60	77	374	47	102	0	632	0	2131	11	2131
		55	138	374	99	247	0	632	0	1490	14	1490
		51.3	226	374	174	457	0	632	837*	1863	17	2699*
		48.3	Ambient									
Jun	1964	97.4	Discharge									
		95	14	374	0	0	0	0	0	388	4	388
		90	52	374	30	510	0	632	215	1597	15	1812
		85	124	374	91	1070	35	632	1278*	2326	22	3604*
		84.2	144	374	109	1070	86	632	1278*	2414	22	3692*
		81.2	Ambient									
Jul	1967	97.9	Discharge									
		95	18	374	0	0	0	0	0	392	4	392
		90	60	374	36	540	0	632	194	1641	15	1835
		85.0	145	374	107	1070	0	632	948*	2328	22	3276*
		82.0	Ambient									
Aug	1952	100.6	Discharge									
		100	3	163	0	0	0	0	0	166	2	166
		95	39	374	17	240	0	409	0	1078	10	1078
		90	99	374	69	835	0	632	765*	2008	19	2773*
		88.1	141	374	104	1070	0	632	765*	2322	22	3087*
		85.1	Ambient									
Dec	1966	70.5	Discharge									
		70	2	0	0	0	0	0	0	2	0	2
		65	30	374	5	0	0	0	0	409	4	409
		60	67	374	36	66	0	632	0	1159	11	1159
		55	121	374	83	195	0	632	0	1404	13	1404
		50	228	374	174	451	0	632	703*	1858	17	2561*
		49.8	235	374	180	468	0	632	703*	1890	18	2593*
		46.8	Ambient									

*Downstream area to within 5°F of ambient

ER Table 4.1-2b

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at a 5 Foot Drawdown

B. Monthly average isothern areas for the median year using discharge temperatures as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1955	71.3	Discharge									
		70	6	99	0	0	0	0	0	105	1	105
		65	33	374	7	62	0	124	0	599	6	599
		60	70	374	38	302	0	612	0	1399	13	1399
		55	126	374	85	636	0	632	602	1852	17	2454
		50.6	163	374	127	1070	236	632	808*	2602	24	3410*
		47.6	Ambient									
Feb	1965	72.0	Discharge									
		70	10	240	0	0	0	0	0	250	2	250
		65	38	374	14	9	0	240	0	674	6	674
		60	77	374	47	102	0	632	0	1231	11	1231
		55	138	374	99	247	0	632	0	1490	14	1490
		51.3	226	374	174	457	0	632	837*	1863	17	2699*
		48.3	Ambient									
Jun	1955	96.2	Discharge									
		95	5	222	0	0	0	0	0	227	2	227
		90	32	374	15	438	0	241	0	1100	10	1100
		85	71	374	49	1070	0	632	0	2196	20	2196
		80	145	374	111	1070	111	632	808*	2524	24	3332*
		79.3	163	374	127	1070	236	632	808*	2602	24	3410*
		76.3	Ambient									
Jul	1961	100	Discharge									
		95	36	374	14	93	0	496	0	1012	9	1012
		90	97	374	66	376	0	632	1270*	1545	14	2815*
		88.2	137	374	100	566	0	632	1270*	1809	17	3079*
		85.2	Ambient									
Aug	1960	99.9	Discharge									
		95	33	374	12	14	0	303	0	736	7	736
		90	90	374	61	149	0	632	777*	1305	12	2082*
		88.1	129	374	94	244	0	632	777*	1473	14	2250*
		85.1	Ambient									
Dec	1953	72.8	Discharge									
		70	14	276	0	0	0	0	0	290	3	290
		65	45	374	18	14	0	214	0	663	6	663
		60	87	374	54	115	0	632	190	1261	12	1451
		55	156	374	112	279	0	632	1354	1553	14	2907
		52.1	231	374	177	460	0	632	1645*	1874	17	3518*
		49.1	Ambient									

*Downstream area to within 5°F of ambient

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at a 5 Foot Drawdown

C. Monthly average isotherm areas for the median year using downstream area as basis.

Month	Year	Isotherm Temp(°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1970	64.7	Discharge									
		60	26	374	0	0	0	0	0	400	4	400
		55	62	374	32	53	0	563	0	1082	10	1082
		50	114	374	76	176	0	632	0	1371	13	1371
		45	209	374	157	403	0	632	750*	1774	17	2524*
		44.0	243	374	185	483	0	632	750*	1970	18	2668*
		41.0	Ambient									
Feb	1956	71.6	Discharge									
		70	7	166	0	0	0	0	0	173	2	173
		65	34	374	11	0	0	0	0	418	4	418
		60	69	374	41	85	0	632	0	1201	11	1201
		55	125	374	88	217	0	632	595	1435	13	2030
		50.9	214	374	164	429	0	632	1339*	1812	17	3151*
		47.9	Ambient									
Jun	1960	95.1	Discharge									
		95	1	0	0	0	0	0	0	1	0	1
		90	35	374	17	139	0	610	0	1175	11	1175
		85	94	374	67	533	0	632	1601*	1700	16	3301*
		83.1	135	374	102	848	0	632	1601*	2091	19	3692*
		80.1	Ambient									
Jul	1952	102.4	Discharge									
		100	15	374	0	0	0	0	0	389	4	389
		95	56	374	32	424	0	632	203	1519	14	1721
		90	140	374	103	1070	0	632	987*	2319	22	3306*
		89.9	143	374	105	1070	0	632	987*	2324	22	3311*
		86.9	Ambient									
Aug	1964	101.1	Discharge									
		100	7	235	0	0	0	0	0	242	2	242
		95	44	374	22	41	0	596	0	1026	10	1026
		90	115	374	82	209	0	632	838*	1412	13	2250*
		89.3	133	374	97	250	0	632	838*	1486	14	2324*
		86.3	Ambient									
Dec	1954	70.5	Discharge									
		70	2	0	0	0	0	0	0	2	0	2
		65	28	374	0	0	0	0	0	402	4	402
		60	62	374	32	235	0	514	0	1217	11	1217
		55	113	374	75	524	0	632	461	1717	16	2179
		50	214	374	160	939	0	632	1056*	2319	22	3375*
		49.8	221	374	166	992	0	632	1056*	2385	22	3441*
		46.8	Ambient									

*Downstream area to within 5°F of ambient

ER Table 4.1-2b

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at a 5 Foot Drawdown

D. Monthly average isotherm areas for the median year using total area as basis.

Month	Year	Isotherm Temp(°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1957	73.6	Discharge									
		70	17	374	0	0	0	0	0	360	3	360
		65	47	374	19	14	0	192	0	645	6	645
		60	88	374	54	114	0	632	258	1263	12	1521
		55	159	374	115	284	0	632	1345	1564	15	2909
		52.9	214	374	162	416	0	632	1347*	1798	17	3143*
		49.9	Ambient									
Feb	1956	71.6	Discharge									
		70	7	166	0	0	0	0	0	173	2	173
		65	54	374	11	0	0	0	0	418	4	418
		60	69	374	41	85	0	632	0	1201	11	1201
		55	125	374	88	217	0	632	595	1435	13	2030
		50.9	214	374	164	429	0	632	1339*	1812	17	3151*
		47.9	Ambient									
Jun	1961	94.9	Discharge									
		90	35	374	17	31	0	632	0	1089	10	1089
		85	96	374	69	176	0	632	2231	1347	13	3579
		83.1	139	374	105	277	0	632	2231*	1527	14	3759
		80.1	Ambient									
Jul	1958	100.2	Discharge									
		100	1	0	0	0	0	0	0	1	0	1
		95	37	374	15	139	0	557	0	1121	10	1121
		90	99	374	68	505	0	632	1161*	1678	16	2839*
		88.4	135	374	99	686	0	632	1161*	1925	18	3086*
		85.4	Ambient									
Aug	1968	99.0	Discharge									
		95	28	374	7	29	0	291	0	729	7	729
		90	82	374	53	162	0	632	876	1303	12	2179
		87.2	140	374	102	293	0	632	1248*	1540	14	2788*
		84.2	Ambient									
Dec	1954	70.5	Discharge									
		70	2	0	0	0	0	0	0	2	0	2
		65	28	374	0	0	0	0	0	402	4	402
		60	62	374	32	235	0	514	0	1217	11	1217
		55	113	374	75	524	0	632	461	1717	16	2179
		50	214	374	160	939	0	632	1056*	2319	22	3385*
		49.8	221	374	166	992	0	632	1056*	2385	22	3441*
		46.8	Ambient									

*Downstream area to within 5°F of ambient

ER Table 4.1-2c

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at a <u>10</u> Foot Drawdown

A. Monthly average isotherm areas for the 1:10 year using lake area as basis.

Month	Year	Isotherm Temp(°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1969	67.2	Discharge									
		65	11	243	0	0	0	0	0	254	3	254
		60	43	331	19	17	0	309	0	718	8	718
		55	86	331	55	119	0	569	0	1161	13	1161
		50	155	331	113	282	0	569	1014	1449	16	2464
		46.5	247	331	165	501	0	569	1480*	1814	20	3294*
		43.5	Ambient									
Feb	1966	68.6	Discharge									
		65	18	331	0	0	0	0	0	350	4	350
		60	51	331	26	45	0	617	0	1071	12	1071
		55	96	331	65	153	0	569	0	1215	13	1215
		50	174	331	130	337	0	569	1403	1541	17	2944
		47.9	233	331	165	479	0	569	1403*	1778	19	3181*
		44.9	Ambient									
Jun	1955	97.6	Discharge									
		95	11	331	0	0	0	0	0	342	4	342
		90	39	331	21	600	0	330	0	1319	14	1319
		85	77	331	54	841	48	569	240	1920	21	2160
		80	150	331	116	841	229	569	870*	2236	24	3106*
		79.3	168	331	131	841	274	569	870*	2314	25	3184*
		76.3	Ambient									
Jul	1962	103	Discharge									
		100	15	331	0	0	0	0	0	346	4	346
		95	48	331	28	664	0	413	0	1483	16	1483
		90	103	331	75	841	83	569	422	2002	22	2424
		87.7	150	331	115	841	200	569	422*	2206	24	2628*
		84.7	Ambient									
Aug	1953	103	Discharge									
		100	16	331	0	0	0	0	0	347	4	347
		95	51	331	30	626	0	499	0	1536	17	1536
		90	110	331	80	841	89	569	617	2020	22	2637
		87.8	158	331	120	841	208	569	617*	2227	24	2845*
		84.8	Ambient									
Dec	1962	70.0	Discharge									
		65	24	331	0	0	0	0	0	355	4	355
		60	55	331	29	299	0	422	0	1136	12	1136
		55	98	331	65	656	0	569	319	1720	19	2038
		50	169	331	125	841	0	569	1011	2036	22	3047
		47.4	238	331	165	841	256	569	1185*	2401	26	3585*
		44.4	Ambient									

*Downstream area to within 5°F of ambient

ER Table 4.1-2c

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at a <u>10</u> Foot Drawdown

B. Monthly average isotherm areas for the <u>1:10</u> year using <u>discharge area</u> as basis.

Month	Year	Isotherm Temp (°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1951	73.6	Discharge									
		70	17	331	0	0	0	0	0	348	4	348
		65	48	331	22	24	0	328	0	753	8	753
		60	91	331	58	127	0	569	0	1176	13	1176
		55	163	331	120	301	0	569	720	1484	16	2204
		52.9	220	331	165	435	0	569	720*	1721	19	2441*
		49.9	Ambient									
Feb	1953	75.3	Discharge									
		75	1	0	0	0	0	0	0	1	0	1
		70	27	331	7	0	0	0	0	365	4	365
		65	61	331	36	72	0	569	0	1069	12	1069
		60	112	331	79	192	0	569	0	1283	14	1283
		55	209	331	162	424	0	569	791*	1695	18	2486*
		54.6	223	331	165	457	0	560	791*	1745	19	2536*
		51.6	Ambient									
Jun	1953	100.6	Discharge									
		100	3	166	0	0	0	0	0	169	2	169
		95	33	331	17	342	0	422	0	1144	12	1144
		90	78	331	55	841	0	569	789	1875	20	2663
		85.8	154	331	119	841	198	569	1593*	2212	24	3805*
		82.8	Ambient									
Jul	1953	103	Discharge									
		100	17	331	0	0	0	0	0	349	4	349
		95	57	331	34	611	0	569	0	1602	17	1602
		90	135	331	100	841	125	569	764*	2100	23	2864*
		89.6	145	331	109	841	152	569	764*	2147	23	2911*
		86.6	Ambient									
Aug	1951	103	Discharge									
		100	16	331	0	0	0	0	0	347	4	347
		95	52	331	31	681	0	435	0	1530	17	1530
		90	117	331	86	841	114	569	335*	2058	22	2523*
		88.7	147	331	111	841	188	569	335*	2188	23	2523*
		85.7	Ambient									
Dec	1964	74.8	Discharge									
		70	24	331	0	0	0	0	0	356	4	356
		65	57	331	30	47	0	493	0	959	10	959
		60	106	331	71	162	0	569	0	1238	13	1238
		55	195	331	146	375	0	569	400*	1616	18	2016*
		54.1	223	331	165	442	0	569	400*	1730	19	2130*
		51.1	Ambient									

*Downstream area to within 5°F of ambient

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at a <u>10</u> Foot Drawdown

C. Monthly average isotherm areas for the <u>1:10</u> year using <u>downstream area</u> as basis.

Month	Year	Isotherm Temp(°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1967	73.7	Discharge									
		70	19	331	0	0	0	0	0	350	4	350
		65	51	331	24	30	0	357	0	793	9	793
		60	96	331	62	138	0	569	479	1196	13	1674
		55	173	331	127	322	0	569	1728	1522	17	3250
		53.0	230	331	165	457	0	569	1728*	1752	19	3480*
		50.0	Ambient									
Feb	1955	72.6	Discharge									
		70	12	276	0	0	0	0	0	288	3	288
		65	40	331	18	22	0	289	0	700	8	700
		60	78	331	51	114	0	569	320	1143	12	1463
		55	141	331	104	261	0	569	1772	1406	15	3177
		51.9	214	331	165	435	0	569	2175*	1716	19	2845*
		48.9	Ambient									
Jun	1969	94.5	Discharge									
		90	32	331	14	24	0	569	0	970	11	970
		85	91	331	64	163	0	569	1718	1219	13	2937
		82.7	142	331	107	283	0	569	2066*	1431	16	3491*
		79.7	Ambient									
Jul	1969	99.3	Discharge									
		95	30	331	12	52	0	507	0	932	10	932
		90	85	331	59	206	0	569	1392	1250	14	2643
		87.5	137	331	103	338	0	569	1606*	1478	16	3084*
		84.2	Ambient									
Aug	1968	99.0	Discharge									
		95	28	331	10	38	0	380	0	787	9	787
		90	82	331	56	171	0	569	1111	1209	13	2320
		87.2	140	331	105	301	0	569	1482*	1446	16	2927*
		84.2	Ambient									
Dec	1965	73.5	Discharge									
		70	18	331	0	0	0	0	0	349	4	349
		65	50	331	22	64	0	477	0	943	10	943
		60	94	331	60	165	0	569	624	1220	13	1844
		55	169	331	124	306	0	569	1676	1500	16	3176
		52.8	231	331	165	401	0	569	1806*	1697	18	3503*
		49.8	Ambient									

*Downstream area to within 5°F of ambient

ER Table 4.1-2c

Isotherm Areas to Within 3°F of Ambient for Lake Wylie at a 10 Foot Drawdown

D. Monthly average isotherm areas for the 1:10 year using total area as basis.

Month	Year	Isotherm Temp(°F)	A	B	C	D	E	F	G	Wylie	% Wylie	Total
Jan	1967	73.7	Discharge									
		70	19	331	0	0	0	0	0	350	4	350
		65	51	331	24	30	0	357	0	793	9	793
		60	96	331	62	168	0	569	479	1196	13	1674
		55	173	331	127	322	0	569	1728	1522	17	3250
		53.0	230	331	165	457	0	569	1728*	1752	19	3480*
		50.0	Ambient									
Feb	1967	65.6	Discharge									
		65	3	0	0	0	0	0	0	3	0	3
		60	30	331	90	0	0	0	0	370	4	370
		55	66	331	39	82	0	569	0	1087	12	1087
		50	120	331	85	209	0	569	892	1313	14	2205
		45	227	331	165	463	0	569	2117*	1755	19	3872*
		44.6	230	331	165	472	0	569	2117*	1767	19	3884*
		41.6	Ambient									
Jun	1952	101.1	Discharge									
		100	7	292	0	0	0	0	0	299	3	299
		95	44	331	25	283	0	569	0	1251	14	1251
		90	109	331	80	841	0	569	1642*	1930	21	3572*
		88.5	145	331	110	841	63	569	1642*	2058	22	3700*
		85.5	Ambient									
Jul	1952	102.7	Discharge									
		100	16	331	0	0	0	0	0	347	4	347
		95	58	331	37	446	0	569	287	1440	16	1727
		90	141	331	107	841	0	569	1203*	1989	22	3192*
		89.9	144	331	109	841	64	569	1203*	2058	22	3261*
		86.9	Ambient									
Aug	1966	100.6	Discharge									
		100	3	141	0	0	0	0	0	144	2	144
		95	32	331	14	295	0	248	0	920	10	920
		90	76	331	51	841	0	569	200	1868	20	2068
		85.4	156	331	119	841	193	569	620*	2209	24	2829*
		82.4	Ambient									
Dec	1952	74.9	Discharge									
		70	24	331	0	0	0	0	0	356	4	356
		65	57	331	30	296	0	468	0	1182	13	1182
		60	102	331	68	651	0	569	408	1721	19	2128
		55	177	331	132	841	0	569	1181	2050	22	3231
		52.6	244	331	165	841	256	569	1276*	2406	26	3682
		49.6	Ambient									

*Downstream area to within 5°F of ambient

ER TABLE 4.1-2d

Analysis of 240 Months Predicted Temperature (1951-1970)

	Wylie Dam		US 21***		Sugar Crk		SC 5		SC 9	
TOTAL MONTHS (240 TOTAL)										
F Above Ambient	# Months	%	# Months	%	# Months	%	# Months	%	# Months	%
0-.9	238	99	238	99	228	95	219	91	174	73
1.0-4.9	238	99	235	98	222	93	205	85	150	63
5.0-9.9	208	87	165	69	119	50	61	25	12	5
10.0-14.9	26	11	8	3	0	0	0	0	0	0
>15.0	0	0	0	0	0	0	0	0	0	0
SUMMER* MONTHS (100 TOTAL)										
F Above Ambient	# Months	%	# Months	%	# Months	%	# Months	%	# Months	%
0-.9	98	98	98	98	90	90	82	82	58	58
1.0-4.9	98	98	95	95	83	83	71	71	45	45
5.0-9.9	81	81	54	54	31**	31	10	10	0	0
10.0-14.9	0	0	0	0	0	0	0	0	0	0
>15.0	0	0	0	0	0	0	0	0	0	0

* Summer Months = June - October (or time when DO is critical)

** (1) Max = 6.1°F (2) Of these 31, 18 occur in June when low DO's are less frequent.

***See Figure 4.1-19 for location of these points.

ER TABLE 4.1-2e

Maximum Monthly Difference in DO* between Ambient and Elevated Temperature (mg/l)

	J	F	M	A	M	J	J	A	S	O	N	D
1951	.3	.5	1.2	.5	.5	.3	.2	.2	.1	.1	.5	.6
1952	.7	.3	.4	.4	.4	.4	.2	.2	.2	.3	.5	.7
1953	.6	.4	.7	.6	.4	.4	.2	.2	.1	.2	.4	.6
1954	.2	.7	.9	.5	.5	.4	.2	.1	0	0	.3	.6
1955	.6	.8	1.5	.4	.4	.3	.2	.2	0	.2	.4	.6
1956	.6	.5	1.0	.5	.4	.3	.1	.1	.1	.2	.6	.3
1957	.1	.3	.7	.2	.4	.1	.2	.2	.1	.3	.2	.1
1958	.1	.3	.4	.2	.2	.4	.2	.2	.1	.2	.3	.5
1959	.2	.7	.9	.3	.4	.3	.2	.2	.1	.1	.2	.2
1960	.2	.1	.2	.2	.3	.3	.2	.2	.1	.2	.5	.9
1961	.6	.3	.8	.2	.4	.3	.3	.2	.2	.2	.4	.1
1962	.2	.3	.4	.2	.4	.3	.2	.1	.1	.2	.5	.7
1963	.8	1.2	.8	.5	.4	.3	.2	.2	.1	.2	.5	.6
1964	.3	.4	1.2	.2	.4	.4	.2	.2	.2	.1	.2	.1
1965	.1	.2	.5	.3	.5	.3	.1	.2	.1	.3	.5	.7
1966	.5	.4	.6	.6	.4	.4	.2	.2	.2	.3	.3	.2
1967	.6	.6	1.3	.5	.4	.4	.2	.3	.2	.3	.3	.3
1968	.1	.4	1.2	.7	.5	.4	.3	.3	.2	.3	.4	.8
1969	.5	.5	.6	.4	.4	.3	.3	.3	.2	.2	.3	.3
1970	.3	.6	1.1	.5	.5	.4	.2	.2	.1	.1	.6	.5

*The figure shown is the maximum difference anywhere in the stretch between Wylie Dam and S.C. 9.

ER TABLE 4.1-2f

Potentially Toxic Substances Concentration below Wylie Dam

Substance	Discharge(mg/l)	Plant Flow Rates (CFS)	Concentration in River(mg/l)*	Toxic** Level (mg/l)	Drinking Water Std (mg/l)
Celanese Plant					
Chloride	1.6	95.5	.24	400	250
Fluoride	0.8	↓	.01	2.3	1.2
Boron	127.0	↓	18.7	3600	1.0
Manganese	2.0	↓	.29	40	.05
Molybdenum	2.9	↓	.43	70	No Limit
Magnesium	51.3	↓	7.6	100	No Limit
Potassium	.15	↓	.02	50	No Limit
Titanium	2.5	↓	.34	No Limit	No Limit
Rock Hill Plant					
Copper	.05	23	.002	.02	1.0
Chromium	.25	23	.009	5	.05

* 7 day - 10 year low flow used = 648 cfs

** Toxic levels refer to fish or humans whichever is lower. Ref. McKee, J E and H W Wolf, Water Quality Criteria, Second Edition, The Resources Agency of California, Sacramento, California, 1963.

ER Table 4.1-2g

Predicted Temperatures at US 21 and Associated Ambients (Ranked by Temperature F)

	JUNE			JULY			AUGUST		
Rank	Year	Temp	Excess	Year	Temp	Excess	Year	Temp	Excess
1	1952	92.7	7.2	1952	92.9	6.0	1964	91.1	4.8
2	1953	89.8	7.0	1953	91.9	5.3	1968	90.8	6.6
3	1954	89.7	7.1	1961	91.8	6.6	1965	90.8	6.2
4	1951	88.0	6.9	1958	91.5	6.1	1952	90.5	5.4
5	1964	87.9	6.7	1969	91.1	6.6	1959	90.5	5.0
6	1961	87.7	7.6	1965	90.8	6.6	1961	90.2	7.1
7	1962	87.3	7.1	1968	89.9	6.6	1960	90.2	5.1
8	1960	87.3	7.2	1955	89.6	4.1	1953	89.3	4.5
9	1958	87.1	7.7	1963	89.3	5.1	1951	89.3	3.6
10	1963	86.8	6.8	1954	89.2	2.4	1967	88.5	7.6
11	1969	86.5	6.8	1965	89.1	5.3	1968	88.2	4.6
12	1959	86.4	7.2	1957	89.1	5.3	1963	88.2	3.9
13	1968	85.9	7.6	1966	88.9	6.0	1955	87.9	3.9
14	1957	85.5	4.4	1960	88.7	5.0	1954	87.6	1.9
15	1964	84.9	7.9	1959	88.7	4.7	1970	86.9	4.9
16	1966	84.7	7.2	1962	88.5	3.8	1966	86.5	4.1
17	1970	84.6	7.6	1967	88.2	6.2	1969	86.1	5.6
18	1967	84.3	5.8	1970	88.1	7.1	1962	85.9	1.6
19	1956	84.0	4.7	1951	87.7	2.3	1956	85.7	1.8
20	1955	81.9	5.6	1956	86.1	1.9	1957	84.3	3.6
Average		86.6	6.5		89.6	5.2		88.4	4.3

ER Table 4.1-3

Years 1951-1970 Ranked By Magnitudes of Various Parameters

No. Years	Yearly Average Equilibrium Temperature		Yearly Average River Flow		Yearly Average Discharge Temperature		Maximum Discharge Temperature		Yearly Average Excess at Wylie Dam		Maximum Excess at Wylie Dam		Yearly Average Area Below Wylie Dam to Reach 5 F Excess	
	Year	Temp (F)	Year	Flow (cfs)	Year	Temp (F)	Year	Temp (F)	Year	Excess (F)	Year	Excess (F)	Year	Area (Acres)
1	1953	64.4	1955	2120	1954	86.9	1951	103.0	1967	8.6	1955	13.3	1969	1560
2	1954	64.0	1956	2454	1953	86.2	1954	103.0	1963	8.6	1960	13.2	1968	1370
3	1952	63.9	1951	2824	1951	85.7	1962	102.9	1968	8.5	1963	13.1	1970	1350
4	1951	63.1	1963	2845	1962	85.1	1953	102.6	1955	8.2	1965	12.6	1963	1201
5	1957	62.5	1954	2949	1955	85.0	1956	102 5	1970	8.1	[illegible]	12.0	1967	1170
6	1961	62.4	1953	3056	1952	84.8	1952	102.1	1969	8.1	1968	11.6	1961	1170
7	1964	62.4	1967	3175	1956	84.4	1955	102.0	1952	8.0	1967	11.5	1965	1170
8	1965	62.1	1966	3434	1957	84.3	1964	101.1	1966	7.7	1952	10.9	1952	1160
9	1955	62.0	1970	3606	1959	83.7	1963	101.1	1953	7.6	1970	10.8	1951	1140
10	1959	62.0	1968	3699	1961	83.7	1959	100.3	1965	7.6	1951	10.6	1964	1030
11	1962	61.9	1962	3867	1965	83.6	1958	100.2	1961	7.3	1962	10.5	1966	1000
12	1963	61.8	1952	4116	1963	83.4	1961	100.0	1956	7.2	1954	10.5	1953	950
13	1956	61.6	1969	4216	1967	83.4	1960	99.9	1960	6.8	1953	10.3	1959	910
14	1960	61.2	1961	4305	1964	83.3	1957	99.8	1959	6.8	1957	10.3	1954	920
15	1958	60.2	1958	4515	1960	82.8	1965	99.4	1964	6.8	1966	10.3	1955	950
16	1967	60.2	1959	4632	1966	82.4	1969	99.3	1951	6.7	1958	9.8	1956	890
17	1966	59.8	1957	4646	1970	82.3	1968	99.0	1957	6.5	1969	9.8	1960	820
18	1968	59.7	1965	4693	1958	82.0	1966	98.8	1958	6.4	1964	9.8	1957	640
19	1970	59.6	1964	5234	1968	82.0	1967	98.1	1962	6.4	1961	9.7	1958	630
20	1969	59.2	1960	5582	1969	81.2	1970	96.8	1954	6.0	1969	9.4	1962	600

ER Table 4.1-4
Median Temperature Tolerance Limits, Final Preferendum, and Field Observed Temperatures for Some of the Principal Fishes of Lake Wylie.

SPECIES	Median Temperature Tolerance Limits[5] Acclimated to F	Upper Limit F	Time (Hrs)	Final Preferendum Temperature	Field Observed Temperatures
Gizzard shad Dorosoma cepedianum (LeSueur)	77 95	93.2 98.6	48 48	-	72.5 - 73.4[1]
Carp *Cyprinus carpio* Linnaeus	-	-	-	89.6[6]	-
Golden shiner *Notomigonus crysoleucas* (Mitchill)	68 86	89.6 95.0	66 66	-	-
Channel catfish *Ictalurus punctatus* (Rafinesque)	59 77	86 93.2	24 24	-	-
Mosquitofish *Gambusia affinis* (Baird and Girard)	59 95	95 98.6	66 66	-	-
Largemouth bass *Micropterus salmoides* (Lacepede)	68 86	89.6 93.2	72 72	86 - 89.6[5]	80 - 81.9[1]
Bluegill *Lepomis macrochirus* (Rafinesque)	50 86	82.4 96.9	24 24	90.1[2]	-
Yellow perch *Perca flavescens* (Mitchill)	41 77 (winter) 77 (summer)	69.8 86 89.6	96 96 96	69.8[4]	54 (small fish)[3] 68.4 (larger fish)[3] 70.2[5]

Numbers indicate the reference cited.

ER Table 4.1-4 (Continued)

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ER Table 4.1-4a

Comparison of Fish Species Upstream and Downstream From Catawba Nuclear Station Based Upon Cove Sampling With Rotenone[1]

Reservoir	No. Fish/Acre	Wt. Fish/Acre	Young-of-Year Bass/Acre	Numerically Important Species % Total Number		% Total Weight	
Lake Norman NCWRC Study June, 1965	3,337	225.6	23	Bluegill	33.6	Gizzard Shad	46.1
				Gizzard Shad	31.9	Threadfin Shad	14.7
				Redbreast	13.4	Bluegill	13.6
				Crappie	10.1	Crappie	12.1
				Threadfin Shad	3.3	Redbreast Sunfish	8.7
				Largemouth Bass	1.2	Largemouth Bass	1.6
Mountain Island NCWRC Study July, 1965	8,530.9	109.7	46	Threadfin Shad	65.6	Gizzard Shad	56.1
				Bluegill	16.7	Threadfin Shad	14.7
				Gizzard Shad	6.9	Redbreast Sunfish	4.9
				Redbreast Sunfish	6.5	Bluegill	3.9
				Largemouth Bass	0.7	Largemouth Bass	3.5
Lake Wylie (upper) NCWRC Study July, 1965	4,935.5	105.9	107	Bluegill	36.9	Gizzard Shad	40.6
				Threadfin Shad	32.6	Bluegill	22.8
				Yellow Perch	9.1	Redbreast Sunfish	6.6
				Gizzard Shad	6.0	Threadfin Shad	6.0
				Redbreast Sunfish	5.4	Yellow Perch	4.2
				Largemouth Bass	2.4	Largemouth Bass	4.1
Lake Wylie (lower) SCWRD Study June, 1970	12,605	393.1	91	Threadfin Shad	56.9	Gizzard Shad	40.6
				Bluegill	21.9	Threadfin Shad	19.8
				Gizzard Shad	6.9	Bluegill	16.5
				Yellow Perch	5.5	Redbreast Sunfish	7.8
				Largemouth Bass	0.7	Yellow Perch	6.0

Amendment 1 (New)

ER Table 4.1-4a (Continued)

Comparison of Fish Species Upstream and Downstream From Catawba Nuclear Station Based Upon Cove Sampling With Rotenone[1]

Reservoir	No. Fish/Acre	Wt. Fish/Acre	Young-of-Year Bass/Acre	Numerically Important Species % Total Number		% Total Weight	
Lake Wateree SCWRD Study June, 1970	3,999	248.4	104	Threadfin Shad	28.7	Bluegill	13.5
				Gizzard Shad	24.0	Pumpkinseed	9.6
				Pumpkinseed	15.2	Threadfin Shad	9.1
				Bluegill	12.8	Channel Catfish	9.0
				Yellow Perch	5.9	White Catfish	6.0
				Largemouth Bass	2.4	Largemouth Bass	3.1

[1] Data abstracted from fishery studies by N C Wildlife Resources Commission (June, 1965) and S C Wildlife Resources Department (Appendix 4A).

ER Table 4.1-4b

List of Probable Fish Species Occurring in the Stretch of the Catawba River or its Tributaries Below Wylie Hydro Station.[1]

Gizzard Shad	Dorosoma cepedianum (Lesueur)
Redfin pickerel	Esox americanus americanus Gmelin
Carp	Cyprinus carpio Linnaeus
Golden shiner	Notemigonus crysoleucas (Mitchill)
Highfin shiner	Notropis altipinnis (Cope)
Dusky shiner	Notropis cummingsae Myers
Creek chub	Semotilus atromaculatus (Mitchill)
Lake chubsucker	Erimyzon sucetta (Lacépède)
Brown bullhead	Ictalurus nebulosus (Lesueur)
Warmouth	Lepomis gulosus (Cuvier)
Redbreast sunfish	Lepomis auritus (Linnaeus)
Pumpkinseed	Lepomis gibbosus (Linnaeus)
Bluegill	Lepomis macrochirus Rafinesque
Largemouth bass	Micropterus salmoides (Lacépède)
Johnny darter	Etheostoma nigrum Rafinesque
Yellow perch	Perca flavescens (Mitchill)

[1] Louder, Darrell E. 1964. Appendicies to the Survey and Classification of the Catawba River and Tributaries, North Carolina. North Carolina Wildlife Resources Commission.

ER Table 4.1-5

Predicted Temperature (F) and Areas (Acres) Needed to Cool to 93 F and 90 F Employing Lake Cooling

(From 20 Years of Historical Records)

Month	Average Discharge Temp	Maximum Discharge Temp	Number Occurrences Above** 93 F	Number Occurrences Above** 90 F	Area to Cool to* 93 F	Area to Cool to* 90 F
Jan	70.5	74.4	0	0	0	0
Feb	70.6	76.3	0	0	0	0
Mar	74.0	77.3	0	0	0	0
Apr	79.1	86.1	0	0	0	0
May	88.9	94.2	2	8	260 (300)	390 (1000)
Jun	95.9	100.8	20	20	690 (2270)	1460(4140)
Jul	100.1	103.0	20	20	1540(2350)	2530(4020)
Aug	99.7	103.0	20	20	1280(2030)	2050(2910)
Sep	95.4	101.3	16	19	510 (1290)	980 (2060)
Oct	84.0	90.3	0	1	0	0
Nov	75.9	81.3	0	0	0	0
Dec	71.5	75.6	0	0	0	0

*The areas given are average areas for only those occurrences when either 93 F or 90 F was exceeded.

**In twenty years.

ER Table 4.1-6

1 Predicted Discharge Temperature (F) and Areas (Acres) Needed to Cool to 93 F and 90 F Employing Supplemental Mechanical Draft Cooling Towers

(From 20 Years of Historical Records)

Month	Average Discharge Temp	Maximum Discharge Temp	Number Occurrences Above**		Area to Cool to*	
			93 F	90 F	93 F	90 F
Jan	61.7	69.9	0	0	0	0
Feb	61.8	66.9	0	0	0	0
Mar	66.7	71.0	0	0	0	0
Apr	77.8	84.3	0	0	0	0
May	82.2	86.8	0	0	0	0
Jun	87.9	93.5	1	3	250 (250)	600 (1150)
Jul	92.4	94.9	6	18	280 (560)	620 (1310)
Aug	91.9	94.3	6	16	130 (270)	490 (870)
Sep	87.9	92.3	0	2	0	360 (390)
Oct	77.9	80.0	0	0	0	0
Nov	69.5	75.0	0	0	0	0
Dec	62.3	71.7	0	0	0	0

*The areas given are average areas for only those occurrences when either 93 F or 90 F was exceeded.

**In twenty years.

ER Table 4.1-7
Spawning Characteristics Of The Major Fishes Of Lake Wylie

Species	SPAWNING TEMPERATURE (F) Usual	Range	Max. Temp. Recommended[29]	Egg Characteristics	Depth of Egg Deposition	Comments
Threadfin Shad *Dorosoma petenense* (Gunther)	70 F[1,2,3,4]	58-82[4,5]	80 F	Adhesive[4,6]	No greater than two (2) feet deep[4]	Eggs adhere to vegetation and rocks in shallow water.[4] Spawning by clupeid fish has occurred in the discharge cove of Marshall Steam Station where the "eggs were observed most numerous near the point of discharge adhering to the discharge structure and to rocks and vegetation lining the discharge canal....the eggs were viable."[7]
Golden Shiner *Notemigonus crysoleucas* (Mitchill)	-	60-80 F[8,9]	-	Extremely Adhesive[8,9]	Shallow Water	-
Carp *Cyprinus Carpio* Linnaeus	65-68 F[8,10,11]	60-68 F[12]	-	Adhesive[8,12]	Eggs are deposited on plants, debris, or sink to the bottom[8,12]	-
White Catfish *Ictalurus catus* (Linnaeus)	70 F[13]	-	80 F	Adhesive[13]	Twelve to eighteen inches deep[13]	"White catfish usually nest on sand or gravel bars"[13]
Striped Bass *Morone saxatilis* (Welbaum)	-	-	-	-	-	It appears that striped bass are not reproducing naturally in Lake Wylie and that the fishery will be maintained through stockings of fingerling fish.[14,30]

Numbers indicate the reference cited

ER Table 4.1-7
Spawning Characteristics Of The Major Fishes Of Lake Wylie
(Continued)

Species	Usual	Range	Max. Temp. Recommended[29]	Egg Characteristics	Depth of Egg Deposition	Comments
White Bass *Morone chrysops* (Rafinesque)	-	58-75 F[15]	75 F	Demersal and Adhesive[8,16]	Two to four feet in streams, and usually three to six feet in lakes[15]	White bass generally spawn in tributaries[8,16,17,18]
Largemouth Bass *Micropterus salmoides* (Lacepede)	62-68 F[8]	60-75 F[8,19,20,21,22]	75 F	-	Two to five feet[8]	"The largemouth prefers to nest in quiet water"[8]
White Crappie *Pomoxis annularis* Rafinesque	Mid 60's F[8]	64-68 F[26]	-	-	Three to twelve feet[8,20]	White crappies often spawn in roots of vegetation or brush piles[8,27]
Bluegill *Lepomis macrochirus* Refinesque	-	68-80 F[8,23,24,25]	-	-	Six to twelve inches deep[8]	Bluegill nests are "usually located in hard sand or fine gravel"[8]
Yellow perch *Perca flavescens* (Mitchill)	Mid 40's[8]	45-55 F[24]	-	Eggs are laid in a gelatinous mass in long strings; they are semibouyant and nonadhesive[8,28]	Near shore[28]	The egg strings are woven in and around aquatic plants or brush[28]

Numbers indicate the reference cited

ER Table 4.1-7 (Continued)
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ER Table 4.1-8

Lake Wylie Surface Areas - Sections A Through F

Elevation	530	535*	540	545*	550	555*	560	565*	570
Section A	4	72	132	198	246	298	352	440	552
Section B	139	181	225	268	316	360	410	467	529
Section C	55	90	131	181	236	310	404	513	609
Section D	670	714	772	855	971	1072	1157	1280	1423
Section E	473	810	1085	1284	1436	1618	1832	2080	2328
Section F	400	445	498	584	663	735	802	895	995
Total Area	1741	2312	2843	3370	3868	4393	4957	5675	6436

Note: Areas shown are in Acres

*5' Areas are interpolated from an area curve

2 ER Table 4.1-9

Lake Wylie Shoreline Sections A Through F

Section	Miles of Shoreline Elevation 569.4	Percent Total Shoreline	Miles of Shoreline Elevation 559.4[1]	Percent Total Shoreline[2]
A	15	4.4	9	4.2
B	10	3.0	8	3.8
C	13	4.1	10	4.7
D	27	8.3	21	9.9
E	41	12.6	36	16.9
F	17	5.2	13	6.1
Total	123	37.6	97	45.6

[1]Total Lake Wylie shoreline at Elevation 569.4 = 327 miles.

[2]Total Lake Wylie shoreline at Elevation 559.4 = 213 miles.

2 Note: Duke Power owns 258 miles or about 79 percent of the 327 mile Lake Wylie shoreline at Elevation 569.4. At lake Elevation 559.4, Duke owns 159 miles or about 75 percent of the shoreline.

ER Table 4.1-10 Amendment 1 (New)

MARSHALL STEAM STATION OPERATING DATA
NOVEMBER - MAY, 1969-1970, 1970-1971, 1971-1972

	1969-70				1970-71				1971-72			
	Inlet Temp. °C (°F)	Discharge Temp. °C (°F)	ΔT °C (°F)	Plant Flow (cfs)	Inlet Temp. °C (°F)	Discharge Temp. °C (°F)	ΔT °C (°F)	Plant Flow (cfs)	Inlet Temp. °C (°F)	Discharge Temp. °C (°F)	ΔT °C (°F)	Plant Flow (cfs)
NOVEMBER	13.9 (56.9)	25.0 (77.1)	11.2 (20.2)	1261	15.3 (59.6)	25.9 (78.7)	10.6 (19.1)	1715	15.7 (60.3)	25.6 (78.1)	9.8 (17.8)	1535
DECEMBER	8.5 (47.3)	21.5 (70.7)	13.0 (23.4)	1083	10.8 (51.5)	22.7 (73.0)	11.9 (21.5)	1544	10.3 (50.6)	20.5 (68.9)	10.1 (18.3)	1617
JANUARY	4.7 (40.5)	20.0 (68.0)	15.3 (27.5)	931	7.0 (44.6)	20.6 (69.2)	13.6 (24.6)	1248	9.3 (48.8)	20.3 (68.7)	11.0 (19.9)	1669
FEBRUARY	6.1 (43.1)	21.9 (71.4)	15.7 (28.3)	927	5.4 (41.8)	21.3 (70.4)	15.8 (28.6)	1143	7.5 (45.5)	19.0 (66.2)	11.5 (20.7)	1530
MARCH	8.3 (46.9)	19.9 (67.8)	11.6 (20.9)	982	8.3 (47.1)	23.3 (74.1)	15.0 (27.0)	1221	9.5 (49.2)	20.3 (68.7)	10.8 (19.5)	1383
APRIL	11.2 (52.2)	23.3 (73.9)	12.1 (21.7)	1067	10.6 (51.1)	24.7 (76.6)	14.1 (25.5)	1225	12.4 (54.4)	23.4 (74.2)	11.0 (19.8)	1577
MAY	12.9 (55.3)	24.4 (76.0)	11.5 (20.7)	1241	12.5 (54.6)	24.6 (76.4)	12.1 (21.8)	1187	14.2 (57.6)	24.3 (75.9)	10.1 (18.3)	1827

STEAM STATION OPERATING AND GAS SATURATION DATA AT TIME OF DISSOLVED GAS STUDIES NOVEMBER 1971 - MAY 1972*

	ALLEN STEAM STATION							MARSHALL STEAM STATION							RIVERBEND STEAM STATION						
	Intake			Discharge				Intake			Discharge				Intake			Discharge			
MONTH	Temp. °C (°F)	O_2 % Sat.	N_2 % Sat.	Temp. °C (°F)	O_2 % Sat.	N_2 % Sat.	ΔT C° (F°)	Temp. °C (°F)	O_2 % Sat.	N_2 % Sat.	Temp. °C (°F)	O_2 % Sat.	N_2 % Sat.	ΔT C° (F°)	Temp. °C (°F)	O_2 % Sat.	N_2 % Sat.	Temp. °C (°F)	O_2 % Sat.	N_2 % Sat.	ΔT C° (F°)
NOV.**	-	-	-	-	-	-	-	15.6 (60.1)	74.0	98.5	26.0 (78.8)	90.0	109.0	10.4 (18.7)	-	-	-	-	-	-	-
DEC.	13.7 (56.7)	96.4	112.0	26.0 (78.8)	97.3	106.6	12.3 (22.1)	11.5 (52.7)	83.4	97.9	20.5 (68.9)	97.1	112.2	9.0 (17.2)	12.0 (53.6)	101.5	111.8	19.2 (66.6)	114.3	112.9	7.2 (13.0)
JAN.	9.8 (49.6)	113.4	123.2	19.3 (66.7)	155.4	159.0	9.5 (17.1)	10.3 (50.5)	92.0	101.8	21.0 (69.8)	112.2	117.4	10.7 (19.3)	8.8 (47.8)	102.9	109.7	15.7 (60.3)	136.6	133.6	6.9 (12.5)
FEB.	7.9 (46.2)	95.3	104.2	19.5 (67.1)	110.0	106.0	11.6 (20.9)	7.3 (45.1)	93.8	99.9	20.2 (68.4)	120.5	115.9	12.9 (23.3)	6.7 (44.1)	95.4	100.0	13.0 (55.4)	104.4	110.3	6.3 (11.3)
MAR.	13.2 (55.8)	102.2	86.6	25.2 (77.4)	124.2	88.5	12.0 (21.6)	10.1 (50.2)	91.1	99.4	21.8 (71.2)	124.9	130.6	11.7 (21.0)	13.0 (55.4)	109.0	88.4	20.6 (69.1)	129.2	91.9	7.6 (13.7)
APR.	19.0 (66.2)	92.7	104.3	28.6 (83.5)	101.6	102.9	9.6 (17.3)	13.9 (57.0)	75.7	104.0	26.5 (79.7)	82.8	110.2	12.6 (22.7)	15.7 (60.3)	99.5	105.3	23.0 (73.4)	119.0	117.9	7.3 (13.1)
MAY	22.0 (71.6)	89.6	109.2	33.4 (92.1)	95.1	97.8	11.4 (20.5)	15.1 (59.2	60.5	105.6	25.0 (77.0)	72.8	124.1	9.9 (18.8)	20.6 (69.1)	105.4	112.1	25.6 (78.1)	110.6	112.8	5.0 (9.0)

NOTES: * Numbers are the average of all depths sampled and multiple sampling dates when available.
** Samples were not taken at Allen and Riverbend Steam Station during the month of November, 1971.

MONTHLY AVERAGE OPERATING DATA
ALLEN, MARSHALL, AND RIVERBEND STEAM STATIONS
NOVEMBER 1971 - MAY 1972

	ALLEN STEAM STATION				MARSHALL STEAM STATION				RIVERBEND STEAM STATION			
Month	Inlet Temperature °C (°F)	Outlet Temperature °C (°F)	ΔT C° (F°)	Plant Flow (cfs)	Inlet Temperature °C (°F)	Outlet Temperature °C (°F)	ΔT C° (F°)	Plant Flow (cfs)	Inlet Temperature °C (°F)	Outlet Temperature °C (F°)	ΔT C° (F°)	Plant Flow (cfs)
NOVEMBER '71	16.2 (61.1)	26.4 (79.5)	10.0 (18.1)	1091	15.7 (60.3)	25.6 (78.1)	9.8 (17.8)	1535	16.1 (61.0)	23.7 (74.7)	7.6 (13.7)	839
DECEMBER '71	11.2 (52.1)	22.3 (72.1)	11.3 (20.3)	1153	10.3 (50.6)	20.5 (68.9)	10.1 (18.3	1617	11.0 (51.7)	19.0 (66.1)	8.0 (14.4)	779
JANUARY '72	10.2 (50.3)	20.4 (68.7)	9.8 (17.7)	1197	9.3 (48.8)	20.3 (68.7)	11.0 (19.9)	1669	10.2 (51.4)	16.8 (63.3)	6.6 (11.8)	874
FEBRUARY '72	8.2 (46.7)	20.4 (68.8)	12.0 (21.7)	1052	7.5 (45.5)	19.0 (66.2)	11.5 (20.7)	1530	7.7 (45.8)	15.3 (59.6)	7.6 (13.8)	919
MARCH '72	11.8 (53.2)	22.7 (72.9)	10.4 (18.8)	1259	9.5 (49.2)	20.3 (68.7)	10.8 (19.5)	1383	9.6 (49.3)	17.2 (63.0)	7.6 (13.7)	919
APRIL '72	16.3 (61.3)	26.4 (79.5)	10.0 (17.9)	1224	12.4 (54.4)	23.4 (74.2)	11.0 (19.8)	1577	14.9 (58.8)	21.8 (71.3)	6.9 (12.5)	804
MAY '72	21.0 (69.9)	31.1 (88.0)	9.8 (17.6)	1201	14.2 (57.6)	24.3 (75.9)	10.1 (18.3)	1827	19.5 (67.2)	24.4 (75.9)	4.9 (8.7)	676

ER Table 4.1-10c

Calculated Average Monthly Percent Saturation of Dissolved Nitrogen Gas at the Point of Discharge of Catawba Nuclear Station

Month	Average Intake Temperature(°F)	Average Discharge Temperature(°F)	Average Percent Saturation Nitrogen
Jan	47.4	70.5	123
Feb	46.9	70.6	126
Mar	52.4	74.0	122
Apr	64.2	79.1	113
Nov	56.2	75.9	119
Dec	48.1	71.5	126

```
80 REM CO CONTROLS THE PROGRAMMED COOLING TOWER
90 CO=0
100 READ A$
110DATAMO    O1    O2    O3    O4   EX-4 AMB HCFS  FLOW    A     B    C     D     E     F    G    WYLIE TOTAL
114 READ D$
115DATAMO    O1    O2    O3    O4   EX-4 AMB COOL  FLOW    A     B    C     D     E     F    G    WYLIE TOTAL
120 READ S$
130 DATA ER TABLE 4.1-2 (CONTINUED)                                   PAGE
134 READ E$
135 DATA ER TABLE 5.3-1 (CONTINUED)                                   PAGE
140 READ T$
150 DATA PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
153 READ C$
154 DATA LAKE COOLING ONLY
156 READ H$
157 DATA SUPPLEMENTAL COOLING TOWERS
160 READ U$
170 DATA NOTES:  COLUMNS 'O1-O4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
180 READ V$
200 DATA COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
210 READ W$
220 DATA COLUMN 'HCFS' IS AMOUNT OF COOL WATER IN CFS REQ'D TO AVOID DISCHARGE TEMP. IN EXCESS OF 103 DEG. F.
224READ F$
225 DATA COLUMN 'COOL' IS AMOUNT OF COOLING IN DEG. F. PROVIDED BY THE 17 DEG. RANGE TOWER.
230 READ X$
235 REM C2 IS A CONTROL:  C2=1, SUP COOLING: C2=0, NO COOLING
240 C2=0
250 DATA COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
255 READ B$
257 DATA COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
260 READ Y$
270 DATA OF 7
275 REM G8: PAGE COUNTER OR NUMBER
280 G8=1
285 REM F:  MIXING FACTOR: 1 IS NO MIXING
290 F=1.0
295 REM G6:  YEAR OF DATA
300 G6=1950
310 READ Z$
320 DATA ER TABLE 4.1-2                                               PAGE
324READ G$
325 DATA ER TABLE 5.3-1                                               PAGE
327 REM L:  LOAD FACTOR
330 L=.91
340 GO TO 2639
345 REM D:  DIFFUSIVITY
350 D=1E6
355 REM LO:  DRAWDOWN FACTOR
360 LO=1.0
365 REM M1: MONTH: E: EQUILIBRIUM TEMP: 30: DRY BULB TEMP: S1: DEW POINT TEMP: W: WINDSPEED(MPH): C3: FLOW
```

ER TABLE 4.1-11
COMPUTER PROGRAM FOR TEMPERATURE
PREDICTION IN THE VICINITY OF
CATAWBA NUCLEAR STATION


```
370 READ M1,E,B0,S1,W,Q3
390 IF C2=0,THEN 440
395 REM SUB CALCULATES AMBIENT TEMP
400 GOSUB 6260
405 REM D1:  DELTA T FOR SOME COOLING TOWER
410 D1=24
420 GO TO 460
440 GOSUB 6260
445 REM SUB PICKS DELTA T FOR AMBIENT CONDITIONS
450 GO SUB 6170
455 REM A0 IS USED TO CHECK FOR STABILIZATION
460 A0=T1
465 REM N IS USED TO STOP CALCULATIONS IF UNSTABLE SITUATION EXISTS
470 N=0
475 REM C0 CONTROLS PROGRAMMED COOLING TOWER
490 IF C0=1,THEN 6630
495 REM F1:  WINDSPEED FUNCTION
500 F1=73+7.3*W
520 IF C0=1,THEN 540
525 REM C: AMT OF COOLING BY TOWER
530 C=0
535 REM A:  AMBIENT TEMPERATURE
540 A=T1
550 REM C3 IS A CONTROL: C3=1, DISTANCE BELOW DAM TO MEET 3 OR 5 DEGREES IS PRINTED
560 C3=1
565 REM R:  LIMIT OF COOLING ABOVE AMBIENT FOR AREA CALCULATIONS
570 R=3
580 IF R<=0,THEN 2450
610 REM C5 IS A CONTROL: C5=1 HYPOLIMNETIC WATER IS ADDED TO INTAKE
620 C5=1
630 REM C6 IS A CONTROL FOR HYPO-COOLING CONTROLLED BY SUBROUTINE
640 C6=1
660 GO TO 760
670 REM RECORDS AMOUNT OF COOLING FOR SPECIFIED CONDITIONS
680 C=1+C
690 T1=A
700 A0=T1
710 GO TO 760
715 REM T1:  CONDENSER INLET TEMP
720 T1=((Q1-(Q2-C3))*A+(Q2-C3)*T8)/Q1
730 A0=T8
755 REM T2:  CONDENSER DISCHARGE TEMP
760 T2=T1+D1*L
775 REM Q1:  PLANT FLOW
780 Q1=71500/D1
785 REM T3:  DISCHARGE TEMP INTO LAKE
790 T3=(T2-C)*F
795 REM Q2:  FLOW AFTER MIXING OCCURS
800 Q2=Q1/F
805 REM T0:  TEMP USED IN VAPOR PRESSURE CALCULATION:V0:  V.P. FOR THAT TEMP
```

ER TABLE 4.1-11
COMPUTER PROGRAM FOR TEMPERATURE
PREDICTION IN THE VICINITY OF
CATAWBA NUCLEAR STATION

```
810 TO=E
820 GOSUB 2790
830 V1=VO
840 TO=S1
850 GOSUB 2790
860 G=VO
870 TO=T3
875 REM U1-U3:  CONTROLS IN AREA CALCULATIONS
880 U6=0
890 U8=0
900 GOSUB 2790
910 U6=0
920 U4=0
930 V3=VO
935 REM S2,S4,S6-S9,A7:  AREAS IN SECTIONS OF LAKE AND BELOW
940 S4=0
950 S6=0
960 S8=0
970 S2=0
980 S9=0
990 U1=0
1000 U2=0
1010 A7=0
1020S7=0
1024 REM SECTION A
1025 REM DIFFUSION ABOVE DISCHARGE
1027 REM K:  HEAT EXCHANGE COEFFICIENT
1030 K=15.7+F1*(.26+25.4*(V3-G)/(T3-S1))
1035 REM B1:  DIFFUSIVITY TERM
1040 B1=(K/62.4/25/1200^2/D)^.5
1050 T4=T3-K*(T3-E)*(1-EXP(-1*B1*2.18E7*LO))/B1/Q2/86400/62.4
1060 IF(T3-A)<=R,THEN 1120
1070 S4=(LOG((T3-A)/R))/B1
1080 IF S4>2.18E7*LO,THEN 1100
1090 GO TO 1120
1100 S4=2.18E7*LO
1110 REM S4= AREA IN ALLISON CREEK
1120 IF(T4-A)<0.0,THEN 3030
1129 REM SECTION B
1130 REM ADVECTION BELOW DISCHARGE: ALLISON CREEK
1140 A1=1.85E7*LO
1150 A2 = 0
1160 TO=T4
1170 GOSUB 2790
1180 V4=VO
1190 A2=A2+Q2*224640*24*.5/(4.03E-8*((T4+460)^4-(E+460)^4)+F1*(V4-V1)*25.4+F1*.26*(T4-E))
1200 IF U6=1,THEN 1260
1210 IF (T4-R)>A,THEN 1250
1220 S2=A2/43560
1230 U6=1
```

```
1240 IF U8=1,THEN 1260
1250 S2=0
1260 T4=T4-.5
1270 U8=1
1280 IF(T4-A)<0.0,THEN 3030
1290 IF A1>A2,THEN1160
1300 IF(T4+.5-R)<A,THEN 1330
1310 S2=A1/43560
1320 REM
1330 T5=T4
1340 T0=T5
1350 GOSUB 2790
1360 V5=V0
1365 REM SECTION C
1370 REM DIFFUSION:  LITTLE ALLISON CREEK SIDEARM
1380 K=15.7+F1*(.26+25.4*(V5-G)/(T5-S1))
1390 B2=(K/62.4/25/1000^2/D)^.5
1400 T6=T5-K*(T5-E)*(1-EXP(-1*B2*1.09E7*L0))/B2/Q2/86400/62.4
1410 IF (T6-A)<=R,THEN 1470
1420 S6=(LOG((T5-A)/R))/B2
1430 IF S6>1.09E7*L0,THEN 1450
1440 GO TO 1470
1450 S6=1.09E7*L0
1460 REM S6=AREA L. ALLISON CREEK
1470 IF(T6-A)<0.0,THEN 3040
1480 J6=T6
1490 P9 =T6
1500 IF Q2>Q3,THEN 1540
1510 T8=T1
1520 GO TO 1930
1525 REM SECTION D
1530 REM ADVECTION FROM JUNCTION TO INTAKE:  CATAWBA RIVER
1540 A3=5.55E7*L0
1550 U3=0
1560 A4 = 0
1570 T0=T6
1580 GOSUB 2790
1590 V6=V0
1600 A4=A4+(Q2-Q3)*24*224640*.5/(4.03E-8*((T6+460)^4-(E+460)^4)+F1*25.4*(V6-V1)+F1*.26*(T6-E))
1610 IF U1=1,THEN 1670
1620 IF(T6-R)>A,THEN 1670
1630 S7=A4
1640 U1=1
1650 IF U3=1,THEN 1670
1660 S7=0
1670 T6=T6-.5
1680 U3=1
1690 IF(T6-A)<0.0,THEN 3070
1700 IF A3>A4,THEN 1570
1710 IF(T6+.5-R)<A,THEN 1740
```

```
1720 S7=A3
1730 REM
1740 T7=T6
1750 T0=T7
1760 GOSUB 2790
1770 V7=V0
1775 REM SECTION E
1780 REM DIFFUSION ABOVE INTAKE TO A POINT NEAR BUSTER BOYD BRIDGE
1790 K=15.7+F1*(.26+25.4*(V7-G)/(T7-S1))
1800 B3=(K/62.4/25/2800^2/D)^.5
1810 T8=T7-K*(T7-E)*(1-EXP(-1*B3*7.1E7*L0))/B3/(Q2-Q3)/86400/62.4
1820 IF(T8-A)<=R,THEN 1870
1830 S8=(LOG((T7-A)/R))/B3
1840 IF S8>7.1E7*L0,THEN 1860
1850 GO TO 1890
1860 S8=7.1E7*L0
1870 IF(T8-A)>0.0,THEN 1890
1880 T8=A
1890 IF C6=0,THEN 3350
1895 REM CHECK FOR STABLIZATION OF CALCULATIONS
1910 IF ABS(T8-A0)>.5,THEN 720
1920 REM
1930 A6=0
1940 A5=3.06E7*L0
1950 IF Q2>Q3,THEN 1980
1951 Q4=Q2
1952 T0=T6
1953 GOSUB 2790
1954 V(1)=V0
1955 K=15.7+F1*(.26+25.4*(V(1)-G)/(T6-S1))
1956 B(4)=(K/62.4/25/2800^2/D)^.5
1957 T6=T6-K*(T6-E)*(1-EXP(-1*B(4)*5.55E7*L0))/B(4)/Q2/86400/62.4
1958 IF (T6-A)<=R,THEN 1963
1959 S7=LOG((T6-A)/R)/B(4)
1960 IF S7>5.55E7*L0,THEN 1962
1961 GO TO 1963
1962 S7=5.55E7*L0
1963 IF (T6-A)>0.0,THEN 1965
1964 T6=A
1965 P9=T6
1966 J6=T6
1970 GO TO 1990
1980 Q4=Q3
1990 T0=P9
2000 GOSUB 2790
2010 V9=V0
2015 REM SECTION F
2020 REM ADVECTION BELOW JUNCTION TO DAM:  CATAWBA RIVER
2030 A6=A6+Q4*24*224640*.5/(4.03E-8*((P9+460)^4-(E+460)^4)+F1*(V9-V1)*25.4+F1*.26*(P9-E))
2040 IF U2=1,THEN 2100
```

```
2050 IF(P9-R)>A,THEN 2100
2060 S9=A6
2070 U2=1
2080 IF U4=1,THEN 2100
2090 S9=0
2100 P9=P9-.5
2110 U4=1
2120 IF(P9-A)<0.0,THEN 2240
2130 IF A5>A6,THEN 1990
2140 IF(P9+.5-R)<A,THEN 2170
2150 S9=A5
2160 REM
2170 IF Q2>Q3,THEN 2200
2180 P9=(P9*Q2+A*(Q3-Q2))/Q3
2190 IF(P9-A)<0.0,THEN 2240
2200 T9=P9
2210 IF C2=0,THEN 2260
2220 IF(T9-A)>R,THEN 670
2230 GO TO 2290
2240 T9=A
2250 IF C6=0,THEN 2270
2260IF C5=1,THEN 3300
2270 IF C3=1,THEN 3140
2290 IF C0=1,THEN 6690
2295 REM E0:  EXCESS AT DAM
2300 E0=T9-A
2305 REM CONVERTS AREAS TO ACRES
2310 S6=S6/43560
2320 S8=S8/43560
2330 S9=S9/43560
2340 S7=S7/43560
2350 S4=S4/43560
2360 A7=A7/43560
2365 REM S0:  SUM OF AREAS ABOVE DAM
2370 S0=S4+S2+S6+S7+S8+S9
2375 REM G5:  SUM OF ALL AREAS
2380 G5=S0+A7
2383 REM PRINT STATEMENTS FOR PREDICTIONS
2385 IF C0=0,THEN 2390
2386 PRINT USING 2440,M1,T1,T3,J6,T9,E0,A,C,C3,S4,S2,S6,S7,S8,S9,A7,S0,G5
2387 GO TO 2400
2390 PRINT USING 2440,M1,T1,T3,J6,T9,E0,A,C5,Q3,S4,S2,S6,S7,S8,S9,A7,S0,G5
2400:                              'E                                                        # 'E
2410:     'EE
2420:'E
2430:          'EE
2440:## ###.# ###.# ###.# ##.# ##.# ##.# ###.# #####. ###.# ###.# ###.# ####.# ###.# ###.# ####. ####. ####.
2450 U9=U9+1
2460 IF R<=0,THEN 370
2470 IF U9<=12,THEN 2780
```

```
2480 IF G7=3,THEN 2720
2490 PRINT
2500 G6=G6+1
2510 PRINT USING 2520,G6
2520:                                   ####
2530 G7=G7+1
2540 PRINT
2545 IF CO=0,THEN 2550
2546 PRINT USING 2420,D$
2547 GO TO 2560
2550 PRINT USING 2420,A$
2560 U9=1
2580 IF G6=1951,THEN 350
2585 REM G7:  YEAR COUNTER
2590 IF G7<=3,THEN 2780
2600 IFG6=1969,THEN 2770
2610 G7=1
2620 GO TO 2780
2630 IF G6>1950,THEN 2670
2639 IF CO=1,THEN 2645
2640 PRINT USING 2400,Z$,G8,Y$
2641 GO TO 2650
2645 PRINT USING 2400,G$,G8,Y$
2650 PRINT
2660 GO TO 2690
2669 IF CO=1,THEN 2675
2670 PRINT USING 2400,S$,G8,Y$
2671 GO TO 2680
2675 PRINT USING 2400,E$,G8,Y$
2680 PRINT
2690 PRINT USING 2410,T$
2694 IF CO=1,THEN 2698
2695 PRINT USING2697,C$
2696 GO TO 2700
2697:                                 'E
2698 PRINT USING 2697,H$
2700 PRINT
2710 GO TO 2500
2720 PRINT
2730 PRINT USING 2420,U$
2740 PRINT USING 2430,V$
2750 PRINT"         COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F."
2760 GO TO 2805
2770 G7=2
2780 GO TO 370
2785 REM SUB CALCULATES VAPOR PRESSURE
2790 A(1)=3.788935E-02
2800 GO TO 2880
2805 IF CO=1,THEN 2815
2810 PRINT USING 2430, W$
```

```
2812 GO TO 2820
2815 PRINT USING 2430,F$
2820 PRINT"          COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS."
2830 PRINT USING 2430,X$
2835 PRINT USING 2430,B$
2840 PRINT"          COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'."
2850 PRINT"          COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'."
2860 G8=G8+1
2870 GO TO 2900
2880 A(2)=1.847192E-03
2890 GO TO 2940
2900 FOR J=1 TO 4
2910 PRINT
2920 NEXT J
2930 GO TO 2669
2940 A(3) =6.704453E-05
2950 A(4) = 1.437457E-07
2960 A(5) = 6.158138E-09
2970 A(6) = 2.7969434E-11
2980 V0=0
2990 FOR J=1 TO 6
3000 V0=V0+(A(J)*(T0)^(J-1))
3010 NEXT J
3020 RETURN
3025 REM TEMP CANNOT GO BELOW AMBIENT
3030 T4=A
3040 T6=A
3050 J6=A
3060 P9=A
3070 T8=A
3080 IF(T4-A)=0.0,THEN 2200
3090 GO TO 1890
3130 REM SECTION G
3140 IF (T9-A)>R+2,THEN 3160
3150 GO TO 2290
3160D5=P9
3170A7=0
3180 T0=D5
3190 GOSUB2790
3200 V8=V0
3210 REM ADVECTION BELOW DAM:  CATAWBA RIVER
3220 A7=A7+G4*24*224640*.5/(4.03E-8*((D5+460)^4-(E+460)^4)+F1*(V8-V1)*25.4+F1*.26*(D5-E))
3230 D5=D5-.5
3240 IF (D5+.5-A)>R+2,THEN 3180
3250 REM
3260 D5=D5+.5
3290 GO TO 2290
3295 REM CALCULATES HYPOLIMNETIC REQ'D
3300 IF T2<=103,THEN 3470
3310 T2=103
```

ER TABLE 4.1-11
COMPUTER PROGRAM FOR TEMPERATURE
PREDICTION IN THE VICINITY OF
CATAWBA NUCLEAR STATION


```
3330 C6=0
3340 GO TO 790
3350 T1=T2-D1*L
3360 REM HO=TEM OF HYPOLIMNETIC WATER
3370 HO=70
3380 IF Q2>Q3,THEN 3410
3385 REM Q5:  HYPOLIMNETIC REQ'D IN CFS
3390 Q5=(Q1*T1-A*Q1)/(HO-A)
3400 GO TO 3450
3410 Q5=(Q1*(T1-T8)+(T8-A)*Q3)/(HO-T8)
3450 IF C5=0,THEN 1930
3470 IF C6=0,THEN 3510
3480 Q5=0
3510 GO TO 2270
3700DATA  1, 41.9, 42.3, 32.0, 8.4, 4567
6090DATA 12, 42.0, 44.7, 32.0, 8.1, 1801
6165 REM SUB SELECTS DELTA T
6170 IF T1>54,THEN 6200
6180 D1=25
6190 GO TO 6240
6200 IF T1>60,THEN 6230
6210 D1=19
6220 GOTO 6240
6230 D1=16.3
6240 RETURN
6250 REM SUB ADJUST INTAKE TEM RELATIVE TO EQUILIBRIUM TEM-- BASIS ALLEN INTAKE TEM 1961-70
6260 IF M1=1,THEN 6360
6270 IF M1=2,THEN 6380
6280 IF M1=7,THEN 6400
6290 IF M1=8,THEN 6380
6300 IF M1>=9,THEN 6420
6310 T1=E
6320 GO TO 6440
6330 IF M1=12,THEN 6360
6340 T1=E+6
6350 GO TO 6440
6360 T1=E+8
6370 GO TO 6440
6380 T1=E+3
6390 GO TO 6440
6400 T1=E+2
6410 GO TO 6440
6420 IF M1=12,THEN 6360
6430 T1=E+6
6440 RETURN
6450 REM CALCULATION OF WET BULB TEMP    B0=DRY BULB TEMP: S1=DEW POINT TEMP
6460 NO=B0
6470 TO=B0
6480 GOSUB 2790
6490 N1=V0*33.8
```

ER TABLE 4.1-11
COMPUTER PROGRAM FOR TEMPERATURE
PREDICTION IN THE VICINITY OF
CATAWBA NUCLEAR STATION


```
6500 T0=51
6510 GO SUB 2790
6520 G=V0
6530 N2=G*33.8
6540 N3=N1-0.000367*(30*33.8)*(B0-N0)*(1+(N0-32)/1571)
6550 IF N3>=N2,THEN 6570
6560 GO TO 6760
6565 REM N4:  WET BULB TEMP
6570 N4=N0
6580 N0=N0-1
6590 T0=N0
6600 GOSUB 2790
6610 N1=V0*33.8
6620 GO TO 6540
6625 REM PROGRAMMED COOLING TOWER
6630 IF M1<5,THEN 6710
6640 IF M1>10,THEN 6710
6650 D1=24
6660 C=12
6670 Y3=0
6680 GO TO 500
6690 IF Y3=1,THEN 6870
6700 GO TO 6450
6710 D1=24
6720 C=12
6730 GO TO 6660
6740 Y3=0
6750 GO TO 500
6760 IF M1<5,THEN 6800
6770 IF M1>10,THEN 6800
6780 Y0=42.4+.63*N4
6790 GO TO 6810
6800 Y0=35.4+.64*N4
6810 Y1=T3
6820 Y2=Y0
6830 IF Y2<=Y1,THEN 2300
6840 C=C-1
6850 Y3=1
6860 GO TO 500
6870 IF T3>=Y0,THEN 2300
6880 IF C>0,THEN 6910
6890 C0=0
6900 GO TO 500
6910 C=C-1
6920 GO TO 500
6930 END
```

ER Table 4.1-12
Lake Wylie Benthic Study

List of Taxa Collected in May and June Sampling Periods
Using Sweep Net and Hester - Dendy Sampling (Littoral Sampling)

	Present at Catawba Site (#7,8,9,10,14)
Phylum Arthropoda	
Class Insecta	
Order Diptera	
Family Chironomidae	
Subfamily Chironominae	
1. Chironomus	
2. Cryptochironomus	X
*3. Dicrotendipes	X
*4. Glyptotendipes	X
5. Microtendipes	X
6. Parachironomus	X
*7. Polypedilum	X
*8. Pseudochironomus	X
9. Stenochironomus	
10. Stictochironomus	X
11. Tribelos	
12. Xenochironomus	
13. Chironomini sp.A(Robach)	X
14. Cladotanytarsus	X
*15. Rheotanytarsus	X
16. Tanytarsus	
Subfamily Tanypodinae	
17. Ablabesmia	X
18. Coelotanypus	
*19. Procladius	
20. Zavrelimnia	X
Subfamily Orthocladiinae	
21. Cardiocladius	
*22. Cricotopus	X
*23. Nannocladius	X
24. Orthocladius	
*25. Psectrocladius	
Family Culicidae	
26. Chaoborus	
Family Ceratopogonidae	
27. Palpomyia	
Order Megaloptera	
28. Sialis	
Order Trichoptera	
29. Hydroptila	X
30. Oecetis	X
*31 Polycentropus	X
Order Ephemeroptera	
32. Caenis	X
33. Hexagenia	X
Order Odonata	
34. Gomphis	

ER Table 4.1-12 (Continued)

35. Family Coenagrionidae	
Class Arachnida	
36. Order Hydracarina	
Class Crustacea	
37. Suborder Cladocera	
38. Suborder Copepoda	
Class Amphipoda	
39. <u>Gammarus</u>	
Phylum Annelida	
Class Oligochaeta	
Family Tubificidae	
*40. <u>Limnodrilus sp.</u>	
41. <u>Limnodrilus hofl[illegible]isteri</u>	
42. <u>Ilyodrilus templetoni</u>	
43. <u>Aulodrilus pigueti</u>	
*44. Family Naididae	X
45. Class Hirudinea	X
Phylum Mollusca	
Class Pelecypoda	
Family Corbiculidae	
*46. <u>Corbicula</u>	X
*47. Family Spheridae	
Class Gastropoda	
48. <u>Gyraulus</u>	X
49. <u>Physa</u>	X
*50. Phylum Br[illegible]oa (statoblasts)	X
51. Phylum Ne[illegible]a	X
Phylum Cho[illegible]	
Class Osteichthyes (Fish)	
*52 [larvae]	
[eggs]	X
TOTALS = 52 taxa overall	26 taxa Catawba

*Indicates an abundant taxon (at least 25 individuals/sq.ft. at any station, or 50 individuals/11 sq.ft. [11 stations])

ER Table 4.1-13
Lake Wylie Benthic Study

List of Taxa Collected in May and June Sampling Periods
Using Modified Petersen Dredge (Deep Water Sampling)

	Present at Catawba Site (#7,8,9,10,14)
Phylum Arthropoda	
Class Insecta	
Order Diptera	
Family Chironomidae (larvae)	
Subfamily Chironominae	
*1. _Chironomus_	X
2. _Tanytarsus_	X
Subfamily Tanypodinae	
3. _Apsectrotanypus_	
*4. _Coelotanypus_	X
5. _Conchapelopia_	X
*6. _Procladius_	X
7. _Tanypus_	X
Subfamily Orthocladiinae	
8. _Cricotopus_	X
9. _Nannocladius_	
Family Culicidae	
*10. _Chaoborus_	X
Family Ceratopogonidae	
11. _Palpomyia_	X
Family Psychodidae	
12. _Pericora_	
Order Ephemeroptera	
13. _Caenis_	
*14. _Hexagenia_	X
Class Crustacea	
15. Suborder Cladocera	X
16. Suborder Eucopepoda	X
Class Oligochaeta	
Family Tubificidae	
*17. _Limnodrilus_	X
18. _Limnodrilus cervix_	
*19. _Limnodrilus hoffmeisteri_	
*20. _Aulodrilus limrobius_	
*21. _Aulodrilus pigueti_	X
*22. _Ilyodrilus templetoni_	X
23. Family Naididae	
24. Class Turbellaria	
25. Phylum Nematoda	
*26. Phylum Bryozoa (statoblasts)	X
Phylum Mollusca	
Class Gastropoda	
27. _Gryaulus_	X
Class Pelecypoda	

ER Table 4.1-13 (Continued)
Lake Wylie Benthic Study

	Present at Catawba Site (#7,8,9,10,14)
Family Corbiculidae	
*28. Corbicula manilensis	X
29. Family Sphaeridae	X
TOTALS = 29 taxa overall	19 taxa Catawba

* Indicates an abundant taxon (at least 25 individuals/sq. ft. at any station or 50 individuals/11 sq. ft. [11 stations])

ER Table 4.2-1

Design Estimates of Annual Waste Quantities from Two Units

	Volume (gal/yr)
Reactor Coolant Treated and Discharged for Tritium Control (1)	150,000
Treated Non-Recycleable Reactor Coolant System Leakage	14,000
Laundry and Hot Shower	240,000
Decontaminations, Lab Rinses, Other Leakage (all treated)	88,000
2 Turbine Building Drains	360,000
TOTALS	852,000

(1) If discharge for tritium control is required, maximum quantity discharged in one year is shown. This effluent can be processed in Boron Recycle System

ER Table 4.2-2 (Page 1 of 2)

Equilibrium Fission Product and Corrosion Product Concentrations in Reactor Coolant

	Isotope	Concentration ($\mu Ci/gm$)[1]
	Fission Products	Normal Operation[2]
	Br-84	4.1×10^{-3}
2	Rb-88	3.6×10^{-1}
	Rb-89	9.8×10^{-3}
	Sr-89	3.7×10^{-4}
	Sr-90	1.3×10^{-5}
	Sr-91	1.9×10^{-4}
2	Sr-92	7.6×10^{-5}
	Y-90	1.5×10^{-5}
	Y-91	5.9×10^{-4}
	Y-92	7.0×10^{-5}
	Zr-95	6.9×10^{-5}
	Nb-95	6.7×10^{-5}
	Mo-99	5.2×10^{-1}
	I-131	2.5×10^{-1}
	I-132	8.8×10^{-2}
	I-133	3.8×10^{-1}
	I-134	5.4×10^{-2}
	I-135	2.1×10^{-1}
	Te-132	2.6×10^{-2}
	Te-134	2.9×10^{-3}
	Cs-134	2.5×10^{-2}
	Cs-136	1.4×10^{-2}
	Cs-137	1.3×10^{-1}
	Cs-138	9.1×10^{-2}
	Ba-140	4.1×10^{-4}

(1) Concentration is given in scientific notation where, for example, 5.0×10^{-4} means .0005 or 5 parts in 10,000 parts.

(2) Concentration resulting from 0.1 percent fuel defects.

Equilibrium Fission Product and Corrosion Product Concentrations in Reactor Coolant

Isotope	Concentration (μCi/gm)[1]
Fission Products	Normal Operation[2]
La-140	1.4×10^{-4}
Ce-144	3.2×10^{-5}
Pr-144	3.2×10^{-5}
Kr-85	1.4×10^{-2}
Kr-85m	2.1×10^{-1}
Kr-87	1.2×10^{-1}
Kr-88	3.7×10^{-1}
Xe-131m	3.1×10^{-1}
Xe-133	8.4
Xe-133m	1.7×10^{-1}
Xe-135	5.9×10^{-1}
Xe-135m	1.8×10^{-2}
Xe-138	6.6×10^{-2}
Corrosion Products	
Mn-54	7.7×10^{-4}
Mn-56	2.9×10^{-2}
Co-58	2.5×10^{-2}
Co-60	7.4×10^{-4}
Fe-59	1.0×10^{-3}
Cr-51	9.3×10^{-4}

(1) Concentration is given in scientific notation where, for example, 5.0×10^{-4} means .0005 or 5 parts in 10,000 parts.

(2) Concentration resulting from 0.1 percent fuel defects.

ER Table 4.2-2a

Normal Operation Estimates of Steam Generator Secondary Side Activity* With Steam Generator Tube Leaks

Isotope	Liquid Concentration $\mu c/gm$	Vapor Concentration $\mu c/gm$
I 131	7.3×10^{-5}	7.3×10^{-7}
I 132	4.5×10^{-6}	4.3×10^{-8}
I 133	7.6×10^{-5}	7.5×10^{-7}
I 134	1.2×10^{-6}	1.0×10^{-8}
I 135	2.4×10^{-5}	2.3×10^{-7}

* Primary coolant activity resulting from 0.1% defective fuel.
Primary to secondary leak rate of 20 gallons per day.
Steam generator water mass of 95,000 lbs/generator.
50 gallon per minute steam generator blowdown.
No iodine lost from air ejector.
Mass partition factor of 10^{-2} in steam generator.

ER Table 4.2-3

Normal Operation Estimates of Annual Radioactivity Releases in Liquid Waste From Two Units

Isotope	Tritium Control	Non-Recyclable Leakage	Laundry	Misc.	Turbine Building	Total	Average Add. Disch. Conc. (μc/ml)	Fraction of Limit[1]
	Annual Release (μc)							
FISSION PRODUCTS								
BR 84	6.5×10^{-3}	6.1×10^{-3}	2.1×10^{-3}	7.7×10^{-4}	---	1.6×10^{-2}	4.4×10^{-18}	1.5×10^{-12}
RB 88	1.5×10^{-4}	1.4×10^{-4}	4.9×10^{-5}	1.8×10^{-5}	---	3.6×10^{-4}	1.0×10^{-19}	3.4×10^{-14}
RB 89	2.3×10^{-7}	2.2×10^{-7}	7.4×10^{-8}	2.7×10^{-8}	---	5.5×10^{-7}	1.6×10^{-22}	5.2×10^{-17}
SR 89	2.1×10^{1}	2.0×10^{1}	6.7	2.5	---	5.0×10^{1}	1.4×10^{-14}	4.7×10^{-9}
SR 90	7.4×10^{-1}	6.9×10^{-1}	2.4×10^{-1}	8.7×10^{-2}	---	1.8	5.0×10^{-16}	1.7×10^{-9}
SR 91	6.1	5.7	1.9	7.1×10^{-1}	---	1.4×10^{1}	4.1×10^{-15}	5.8×10^{-11}
SR 92	5.6×10^{-1}	5.2×10^{-1}	1.8×10^{-1}	6.5×10^{-2}	---	1.3	3.7×10^{-16}	5.3×10^{-12}
Y 90	7.2	7.3×10^{-1}	2.5×10^{-1}	9.2×10^{-2}	---	8.3	2.4×10^{-15}	1.2×10^{-10}
Y 91	3.1×10^{2}	3.1×10^{1}	1.1×10^{1}	3.9	---	3.5×10^{2}	1.0×10^{-13}	3.3×10^{-9}
Y 92	7.7	7.7×10^{-1}	2.7×10^{-1}	9.7×10^{-2}	---	8.8	2.5×10^{-15}	4.2×10^{-11}
ZR 95	3.9	3.6	1.3	4.6×10^{-1}	---	9.3	2.6×10^{-15}	4.4×10^{-11}
NB 95	3.8	3.5	1.2	4.4×10^{-1}	---	9.0	2.5×10^{-15}	2.5×10^{-11}
MO 99	2.5×10^{5}	2.5×10^{4}	8.7×10^{3}	3.2×10^{3}	---	2.9×10^{5}	8.2×10^{-11}	4.1×10^{-7}
I 131	1.4×10^{4}	1.3×10^{4}	4.4×10^{3}	1.6×10^{3}	9.8×10^{-1}	3.3×10^{4}	9.3×10^{-12}	3.1×10^{-5}
I 132	4.5×10^{2}	4.2×10^{2}	1.4×10^{2}	5.3×10^{1}	5.3×10^{-3}	1.1×10^{3}	3.0×10^{-13}	3.8×10^{-8}
I 133	1.7×10^{4}	1.5×10^{4}	5.3×10^{3}	1.9×10^{3}	8.0×10^{-1}	3.9×10^{4}	1.1×10^{-11}	1.1×10^{-5}
I 134	5.1	4.8	1.6	6.0×10^{-1}	2.3×10^{-5}	1.2×10^{1}	3.4×10^{-15}	1.7×10^{-10}
I 135	5.2×10^{3}	4.9×10^{3}	1.7×10^{3}	6.1×10^{2}	1.4×10^{-1}	1.2×10^{4}	3.5×10^{-12}	8.8×10^{-7}
TE132	1.4×10^{3}	1.3×10^{3}	4.4×10^{2}	1.6×10^{2}	---	3.3×10^{3}	9.2×10^{-13}	3.1×10^{-8}
TE134	6.0×10^{-2}	5.6×10^{-2}	1.9×10^{-2}	7.0×10^{-3}	---	1.4×10^{-1}	4.0×10^{-17}	1.3×10^{-11}
CS134	1.3×10^{4}	1.3×10^{3}	4.5×10^{2}	1.7×10^{2}	---	1.5×10^{4}	4.3×10^{-12}	4.7×10^{-7}
CS136	7.2×10^{3}	7.3×10^{2}	2.5×10^{2}	9.2×10^{1}	---	8.3×10^{3}	2.3×10^{-12}	2.6×10^{-8}
CS137	6.8×10^{4}	6.9×10^{3}	2.4×10^{3}	8.7×10^{2}	---	7.9×10^{4}	2.2×10^{-11}	1.1×10^{-6}
CS138	1.6	1.6×10^{-1}	5.5×10^{-2}	2.0×10^{-2}	---	1.8	5.1×10^{-16}	1.7×10^{-10}
BA140	2.3×10^{1}	2.1×10^{1}	7.3	2.7	---	5.4×10^{1}	1.5×10^{-14}	5.1×10^{-10}
LA140	6.9	6.5	2.2	8.1×10^{-1}	---	1.6×10^{1}	4.6×10^{-15}	2.3×10^{-10}

(1) Fraction of 10CFR20, Appendix B Limit

ER Table 4.2-3

Normal Operation Estimates of Annual Radioactivity Releases in Liquid Waste From Two Units

Isotope	Annual Release (μc) Tritium Control	Non-Recyclable Leakage	Laundry	Misc.	Turbine Building	Total	Average Add. Disch. Conc. (μc/ml)	Fraction of Limit[1]
FISSION PRODUCTS								
CE144	1.8	1.7	5.8×10^{-1}	2.1×10^{-1}	---	4.3	1.2×10^{-15}	1.2×10^{-10}
PR144	8.3×10^{-9}	7.8×10^{-9}	2.7×10^{-9}	9.8×10^{-10}	---	2.0×10^{-8}	5.6×10^{-24}	1.9×10^{-18}
TOTAL	3.8×10^{5}	6.9×10^{4}	2.4×10^{4}	8.7×10^{3}	1.9	4.8×10^{5}	1.4×10^{-10}	4.5×10^{-5}
CORROSION PRODUCTS								
MN 54	4.4×10^{1}	4.1×10^{1}	1.4×10^{1}	5.1	---	1.0×10^{2}	2.9×10^{-14}	2.9×10^{-10}
MN 56	1.9×10^{2}	1.8×10^{2}	6.1×10^{1}	2.2×10^{1}	---	4.5×10^{2}	1.3×10^{-13}	1.3×10^{-9}
CO 58	1.4×10^{3}	1.3×10^{3}	4.5×10^{2}	1.7×10^{2}	---	3.4×10^{3}	9.5×10^{-13}	9.5×10^{-9}
CO 60	4.2×10^{1}	3.9×10^{1}	1.3×10^{1}	4.9	---	1.0×10^{2}	2.8×10^{-14}	5.6×10^{-10}
FE 59	5.7×10^{1}	5.3×10^{1}	1.8×10^{1}	6.6	---	1.3×10^{2}	3.8×10^{-14}	6.3×10^{-10}
CR 51	5.2×10^{1}	4.9×10^{1}	1.7×10^{1}	6.1	---	1.2×10^{2}	3.5×10^{-14}	1.8×10^{-11}
TOTAL	1.8×10^{3}	1.7×10^{3}	5.8×10^{2}	2.1×10^{2}	---	4.3×10^{3}	1.2×10^{-12}	1.2×10^{-8}
TRITIUM								
H 3	5.9×10^{8}	5.5×10^{7}				6.5×10^{8}	1.8×10^{-7}	6.1×10^{-5}
TOTAL	5.9×10^{8}	5.5×10^{7}	2.4×10^{4}	8.9×10^{3}	1.9	6.5×10^{8}	1.8×10^{-7}	1.1×10^{-4}

(1) Fraction of 10CFR20, Appendix B Limit

ER Table 4.2-4

Normal Operation Estimates of Annual Airborne Radioactivity Releases from Two Units

Isotope	From Leakage in Auxiliary Building Annual Release (microcuries)	From Leakage in Containment Building Annual Release (microcuries)	From Air Ejectors Annual Release (microcuries)
Kr-85m	7.8×10^{6}	2.5×10^{3}	1.1×10^{7}
Kr-85	5.2×10^{5}	2.2×10^{5}	7.4×10^{5}
Kr-87	4.5×10^{6}	4.2×10^{2}	6.4×10^{6}
Kr-88	1.4×10^{7}	2.8×10^{3}	2.0×10^{7}
Xe-131m	1.2×10^{7}	2.4×10^{5}	1.6×10^{7}
Xe-133m	6.3×10^{6}	2.5×10^{4}	9.0×10^{6}
Xe-133	3.1×10^{8}	2.9×10^{6}	4.5×10^{8}
Xe-135m	6.7×10^{5}	1.3×10^{1}	9.5×10^{5}
Xe-135	2.2×10^{7}	1.5×10^{4}	3.1×10^{7}
Xe-138	2.4×10^{6}	5.1×10^{1}	3.5×10^{6}
I-131	4.6×10^{4}	6.6×10^{-1}	2.4×10^{3}
I-132	1.6×10^{4}	2.8×10^{-3}	1.4×10^{2}
I-133	7.0×10^{4}	1.1×10^{-1}	2.5×10^{3}
I-134	1.0×10^{4}	6.4×10^{-4}	3.4×10^{1}
I-135	3.9×10^{4}	1.9×10^{-2}	7.9×10^{2}
TOTAL	3.8×10^{8}	3.4×10^{6}	5.4×10^{8}

Isotope	From Gland Seal System Annual Release (microcuries)	From Turbine Building Ventilation Annual Release (microcuries)
I-131	2.2×10^{3}	1.4×10^{4}
I-132	1.3×10^{2}	8.5×10^{2}
I-133	2.3×10^{3}	1.5×10^{4}
I-134	3.1×10^{1}	2.0×10^{2}
I-135	7.2×10^{2}	4.6×10^{3}
TOTAL	5.4×10^{3}	3.5×10^{4}

	Total Concentration (microcuries/ml)	Total Fraction of Limit [(1)]
Exclusion Area Boundary	6.7×10^{-10}	4.9×10^{-3}

[(1)] Fraction of 10CFR20, Appendix B Limit

ER Table 4.2-4a

Estimates of Radioactivity Concentration in Hydro Station Discharges Downstream of Catawba:

Hydro Station	Average Stream Flow (CFS)
Wylie	4400
Fishing Creek	4860
Great Falls	5150
Rocky Cr. Cedar Cr.	5425
Wateree	5825

Wylie $= \frac{(3960)}{(4400)} \times$ Catawba discharge

Fishing Creek $= \frac{(3960)}{(4860)} \times$ Catawba discharge

Great Falls $= \frac{(3960)}{(5150)} \times$ Catawba discharge

Rocky Cr. Cedar Cr. $= \frac{(3960)}{(5425)} \times$ Catawba discharge

Wateree $= \frac{(3960)}{(5825)} \times$ Catawba discharge

ER Table 4.2-5

The Offsite Radiological Monitoring Program for the Catawba Nuclear Station

TYPE SAMPLE OR MEASUREMENT	CRITERIA FOR SELECTION OF SAMPLING LOCATIONS	COLLECTION FREQUENCY
1. Water (surface water, drinking water, ground water)	For comparison purposes water samples are collected: a. Upstream, well beyond Site and Exclusion Area, (Lake Wylie control location) b. Within 500 ft of point where liquid effluent enters Lake Wylie c. Downstream, well beyond Site and Exclusion Area (Wylie Dam) d. Rock Hill Water Supply (8 miles downstream) Belmont and Mt. Holly water supplies (Lake Wylie) e. Well water samples near liquid waste discharge and elsewhere within Low Population Zone.	Monthly; Sample b will be collected continuously during operation; water supplies will consist of representative monthly samples, Sample e will be collected quarterly
	Measurements of Tritium, Strontium 89, 90 in above samples.	Quarterly
2. Airborne Particulates including iodine, rain and settled dust	Comparison of on-site vs off-site locations at distances up to 10 miles near towns and populated areas; and in prevailing wind directions at points of highest expected concentrations and control location.	Monthly, sample collected continuously
3. Radiation Dose and Dose Rate	Comparison of on-site vs off-site locations near towns and populated areas; at distances up to 10 miles and in prevailing wind directions at points of highest expected concentrations; also within 500 ft of point where liquid effluent enters Lake Wylie; and control locations.	Dose: Quarterly, Integrated total, duplicate samples at each location Dose Rate: Quarterly, Single Measurement

ER Table 4.2-5 (Continued)

The Offsite Radiological Monitoring Program for the Catawba Nuclear Station

TYPE SAMPLE OR MEASUREMENT	CRITERIA FOR SELECTION OF SAMPLING LOCATIONS	COLLECTION FREQUENCY
4. Lake Bottom and Shoreline Sediment including Benthos	For comparison purposes, sediment samples are collected:	
	a. Upstream, well beyond Site and Exclusion Area (Lake Wylie control location)	Quarterly
	b. Within 500 ft of point where liquid effluent enters Lake Wylie	Quarterly
	c. Downstream, well beyond Site and Exclusion Area (Wylie Dam)	Quarterly
5. Aquatic Vegetation and/or Plankton	For comparison purposes, samples are collected:	
	a. Upstream, well beyond Site and Exclusion Area (Lake Wylie control location)	Quarterly (as available)
	b. Within 500 ft of point where liquid effluent enters Lake Wylie	Quarterly (as available)
	c. Downstream, well beyond Site and Exclusion Area (Wylie Dam)	Quarterly (as available)
6. Terrestrial Vegetation and Crops	Comparison of nearby upwind and downwind directions in Low Population Zone and in control location	Quarterly of pasture grass (3 times in season), corn, beans, green leafy vegetables
7. Milk	From nearby farms in prevailing wind directions and from control location	Quarterly
8. Fish	Fish samples will include both game fish and rough species (bottom feeders) collected:	
	a. Within Exclusion Area where liquid effluent enters Lake Wylie	Quarterly (as available)
	b. Within 500 ft of point where liquid effluent enters Lake Wylie	Quarterly (as available)
	c. Downstream, well beyond Site and Exclusion Area (Wylie Dam)	Quarterly (as available)

ER Table 4.2-5 (Continued)

The Offsite Radiological Monitoring Program for the Catawba Nuclear Station

TYPE SAMPLE OR MEASUREMENT	CRITERIA FOR SELECTION OF SAMPLING LOCATIONS	COLLECTION FREQUENCY
9. Miscellaneous	Investigation of special situations found as a result of the monitoring program and/or station operations, to provide extended coverage; also as may be required due to nuclear testing or unusual fallout conditions not associated with the Nuclear Station	As Necessary

ER TABLE 4.2-6

SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS

	Class	Incident	Probability Class	Exclusion Area Boundary Fraction of MPC (10CFR20)	50 Mile Average Dose (mrem)
	2	Miscellaneous Small Leaks	P	2.2×10^{-3}	6.3×10^{-2}
2					
	5	Steam Generator Tube Rupture	I	1.6×10^{-2}	5.2×10^{-2}
	6,7	Spent Fuel Accidents	I	3.6×10^{-2}	1.2×10^{-1}
2	8	Main Steam Line Failure	I	1.7×10^{-5}	5.6×10^{-5}
	8	Design Basis Loss of Coolant	I	4.7×10^{-4}	1.8×10^{-3}
	8	Waste Gas Decay Tank Rupture	I	1.7×10^{-1}	5.8×10^{-1}

P - May occur but consequences depend upon coolant activity prior to event.

I - Not likely to occur but consequences presented as one event in one year.

ER Table 4.2-7
Samples, Locations and Collection Frequencies

CODE:

M - Monthly
Q - Quarterly
3 - 3 Times in Growing Season

LOCATION	Well Water Residence, Other	Finished Water Water Supply	Raw Water Water Supply	Surface Water	Rain, Settled Dust	Air Particulates	Vegetation Pasture Grass, Forage	Vegetation - Crops Corn, Beans, Leafy Gr.	Vegetation Aquatic Plankton	Lake Bottom & Shoreline Sediment Incl. Benthos	Radiation Dose and Dose Rate	Fish	Milk
Site													
Within Exclusion Area													
Restricted Area Boundary											Q		
Point of Maximum Concentration in Prevailing Wind Directions					M	M					Q		
Lake Wylie													
Below Mountain Island Station (Control)				M	M				Q	Q	Q	Q	
Point 500 ft from Liquid Effluent Discharge				M					Q	Q	Q	Q	
Within Lower Lake Near Effluent Discharge Area									Q	Q		Q	
Wylie Dam				M					Q	Q		Q	
Camp Steere BSA	Q									Q	Q		
Tega Cay	Q						Q			Q	Q		
York County Park Area	Q								Q	Q	Q		
Allison Creek Access Area									Q	Q	Q		
Belmont Water Supply Intake		M	M										
Mt. Holly Water Supply Intake		M	M										
Rock Hill					M	M					Q		
Water Supply Intake (Catawba R)		M	M										
York					M						Q		
Clover					M						Q		
Fort Mill					M						Q		
Catawba Girl Scout Camp	Q										Q		
Farms Within 3 miles of Site (NE Quadrant)							Q	3					Q
Farms Within 3 miles of Site (SW Quadrant)							Q	3					Q
Nearest Dairy 5.3 miles from Site (NW Quadrant)													Q
Point of Highest Ground Concentration in most Prevalent Wind Directions (SW and NE Quadrants)					M	M					Q		

ER Table 4.2-8

RADIOLOGICAL IMPACT OF TRANSPORTED MATERIALS

	New Fuel	Spent Fuel (a) Truck	or	Rail	Radwaste
Origin	Columbia, S. C.		Catawba		Catawba
Destination	Catawba		Barnwell, S. C.		(undetermined)
Distance (miles)	70		120		400 (b)
Trips/year	11	144		15	33
Dose rate @6 ft. (c) (mrem/hr)	0.10		10.0		10.0
Crew dose (d) (man-rem/yr)	.0018	4.1		.43	3.2
Population dose (e) (man-rem/yr)	.000053	.12		.012	.092

(a) Figures for truck and rail are mutually exclusive.

(b) Approximate distance to Morehead, Kentucky site.

(c) Estimated levels; depends on source activity and cask design.

(d) Assumptions: travel of 200 mi/day, crew of 2 drivers or brakemen, no credit for truck cab shielding.

(e) Assumptions: travel of 200 mi/day, average population density of 300/sq. mi., dose rate reduced by distance and by attenuation in air.

ER Table 4.3-1

Summary of Water Usage in Catawba Nuclear Station

	Source	Disposition	Chemical Treatment
Nuclear Service Water	Lake	Lake	No chemical treatment
Condenser Cooling Water	Lake	Lake	No chemical treatment
High Pressure Service Water	Lake	Lake	No chemical treatment
Condenser Cooling Water Intake Screen Backwash	HPSW	Lake	No chemical treatment; trash filtered out will be collected and water will drain back to the lake
Low Pressure Service Water	Lake	Lake	No chemical treatment on portion used for cooling
Filtered Water	LPSW	Waste Water Collection Basin	Chlorinated and filtered through diatomaceous earth before use. 315,000 gals per day average
Drinking Water (includes sanitary water supply)	Filtered Water	Waste Water Collection Basin	All sanitary waste water will be processed through an extended aeration tank and sand filter and will be chlorinated before going to the waste water collection basin. 5,500 gallons per day average
Laundry and Hot Shower	Drinking Water	To Condenser Cooling Water Discharge	Waste will go through carbon filters before discharge. 660 gallons per day average
Demineralized Water	Filtered Water	Make-up to Plant Systems	Through mixed-bed demineralizer before use. 216,000 gallons per day average

ER Table 4.4-5

Amendment 1 (New)

Value and Productivity of Land

Land Use	Productivity Per Acre Per Year	Unit Value $	Gross Value Per Acre $	Shelby Tap Est. R/W Cost/Acre	Shelby Tap Est. Value Per Acre	Newport Est. R/W Cost/Acre	Newport Est. Value Per Acre	Allen Est. R/W Cost/Acre	Allen Est. Value Per Acre
1. Duke Power Lands: All Forest	570 Bd. Ft.[1]	32.67/MBF[2]	18.62						
2. Private Lands:									
Forest	130 Bd. Ft.[3]	32.67/MBF	4.25	1000	500	617	500	434	434
Crops	290 lbs. Cotton[4]	.31/lb.[4]	89.90	1000	500	617	500	434	434
Pasture	2212 lbs. Milk[5]	.69/lb.[5]	1,526.00	1000	500	617	500	434	434

1 Soil-Site Relationships, Stand Structure, and Yields of Slash and Loblolly Pine Plantations in the Southern U. S. by Coile & Shumacker

2 Crescent Land & Timber Corp. Annual Forestry Report No. 32, 1971

3 Forest Statistics for the Piedmont of South Carolina 1967, U. S. Forest Service

4 South Carolina Crop Statistics, U.S.D.A. and Clemson University 1967

5 South Carolina Livestock and Poultry Statistics, U.S.D.A. and Clemson University, July 1965

ER Table 4.10-1

Commitment of Materials

A. Control Rods [1]

Material	KG/Unit	Amt. Recovered (KG)
Silver	2791	0
Indium	365	0
Cadmium	143	0

B. Burnable Poison Rods

Boron	70	0

C. Boron in Reactor Coolant [2]

Boron	12,960	

D. Fuel

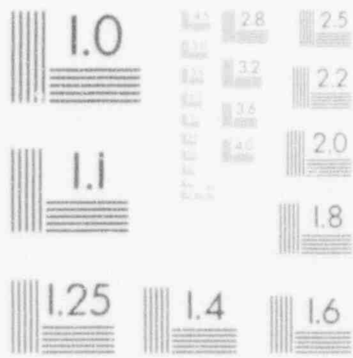
Uranium	1,328,080 at 3.27 average enrichment	1,270,960
Zirconium	302,680	

1. Control Rods have an expected lifetime of 10 years so these numbers represent approximately 25% of commitment for life of plant.

2. This number represents Boron lost due to Helium production and waste from evaporator bottoms.

1

IMAGE EVALUATION TEST TARGET (MT-3)



150mm

6″

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

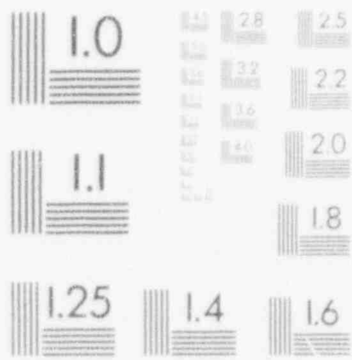
IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION TEST TARGET (MT-3)



150mm

6″

1

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

1

IMAGE EVALUATION
TEST TARGET (MT-3)

150mm

6"

CATAWBA NUCLEAR STATION
BIG ALLISON CREEK
LITTLE ALLISON CREEK

LAKE WYLIE BED TOPOGRAPHY

CATAWBA NUCLEAR STATION

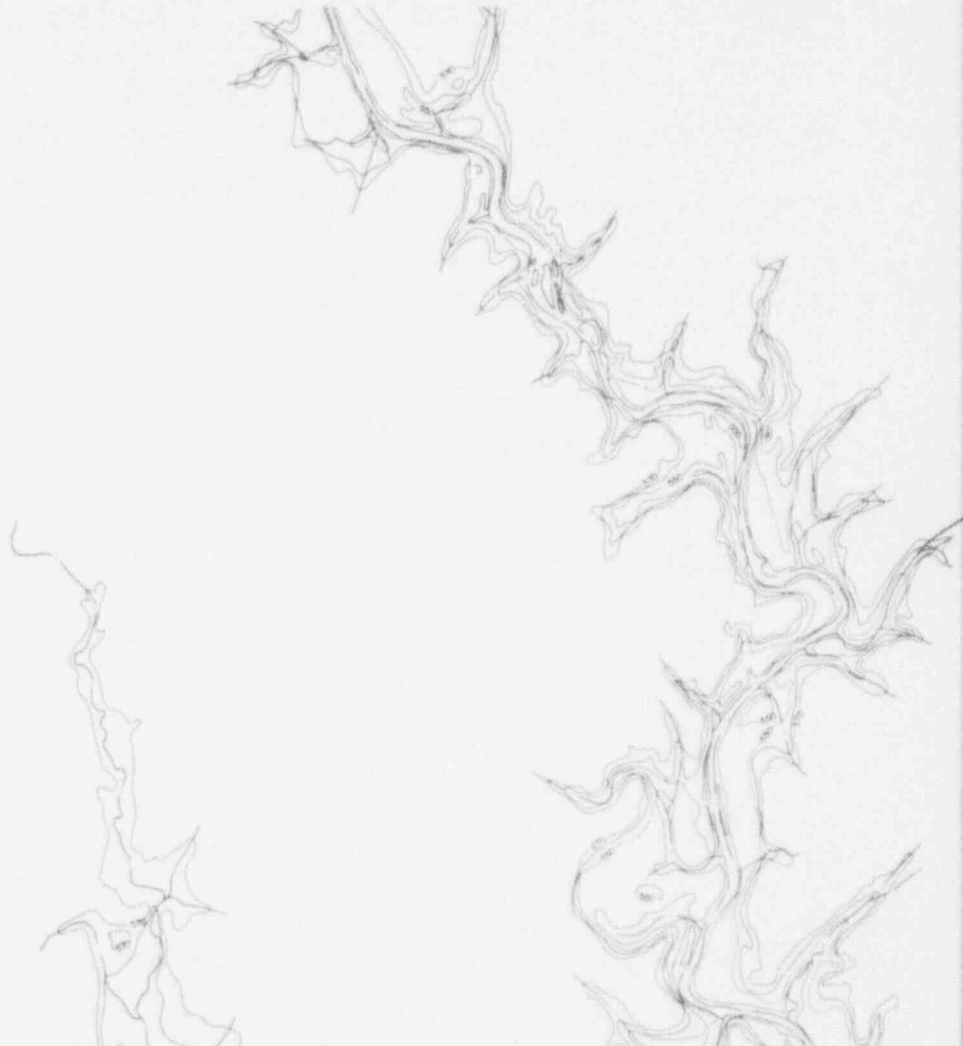
ER Figure 4.1-8 (1 of 3)

Amendment 1

LAKE WYLIE BED TOPOGRAPHY

CATAWBA NUCLEAR STATION
ER Figure 4.1-8 (2 of 3)

Amendment 1


MATCH LINE SH. 2

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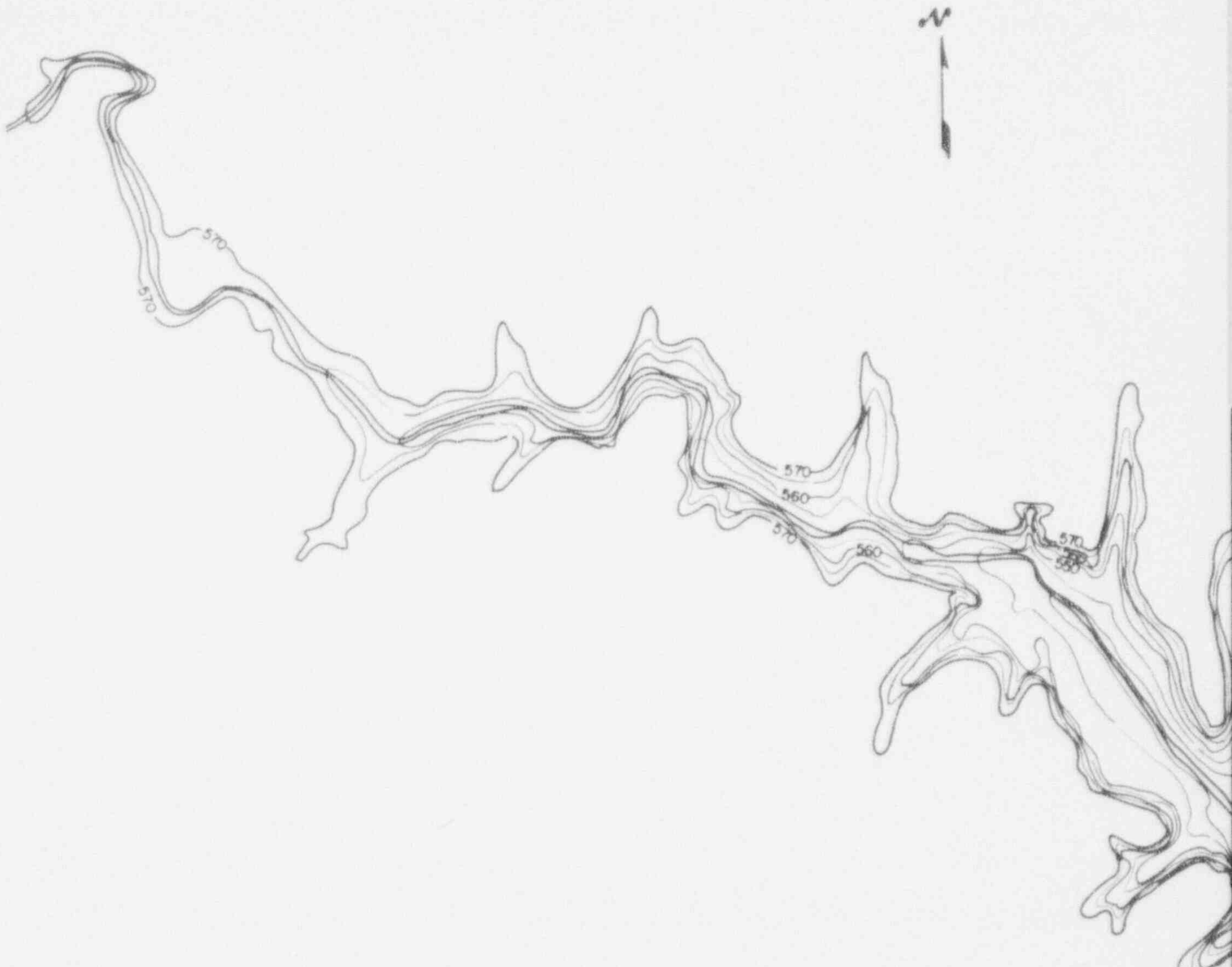
LAKE WYLIE BED TOPOGRAPHY

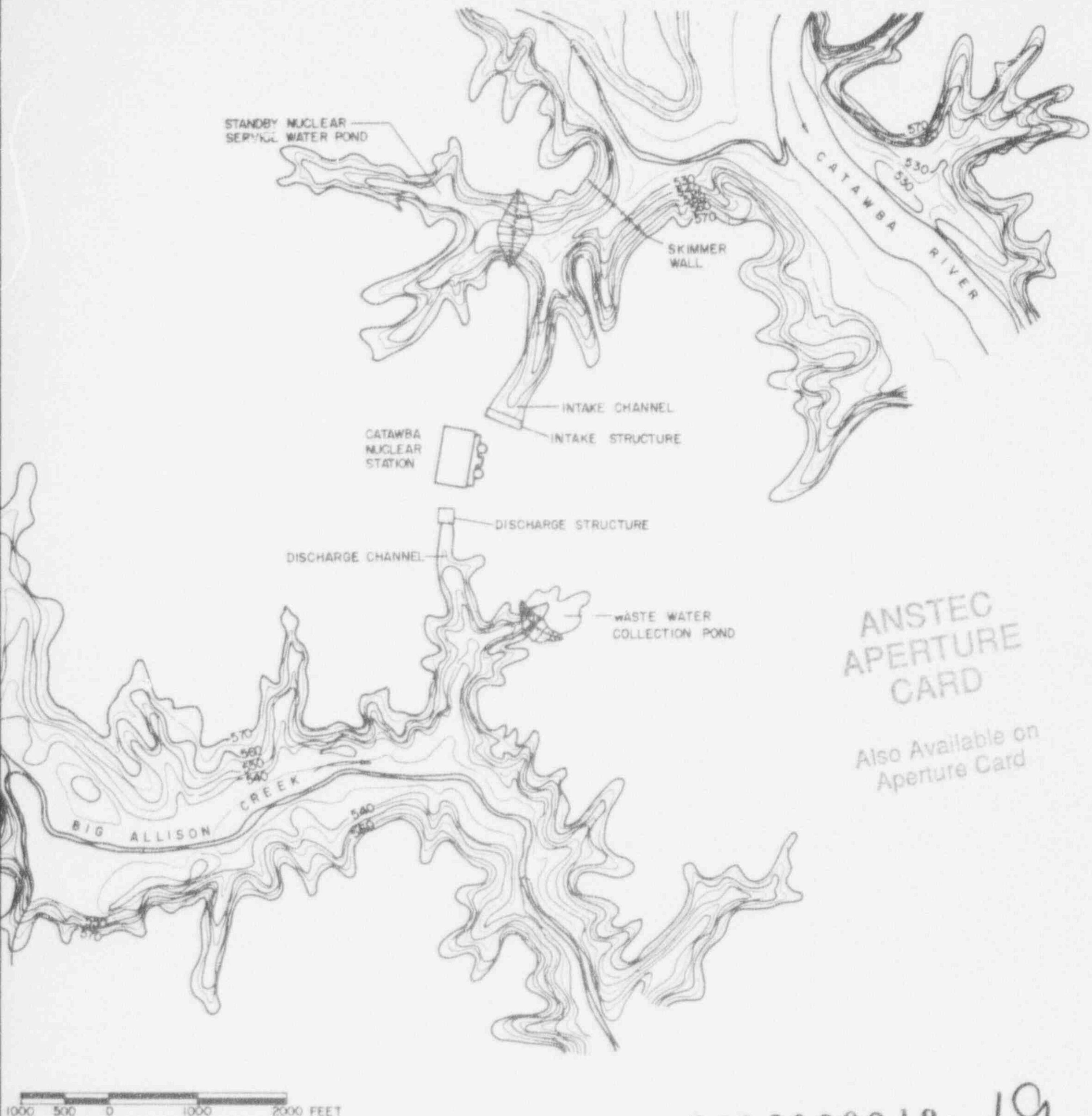
CATAWBA NUCLEAR STATION

ER Figure 4.1-8 (3 of 3)

Amendment 1



N
570
570
570
560
570
560
570
560



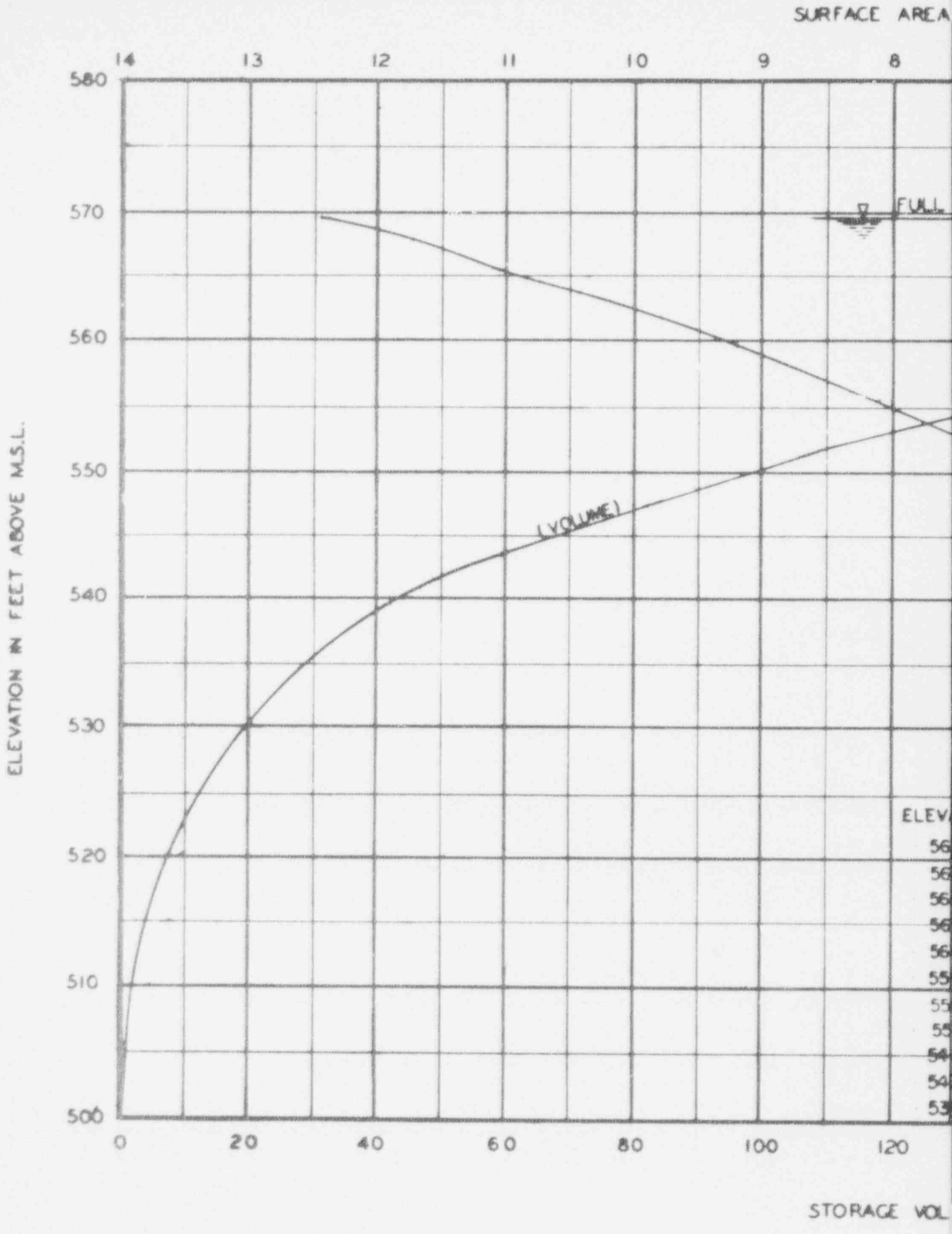
10 FT CONTOUR ELEVATIONS TAKEN FROM SURVEY DATED 1-1-25
5 FT CONTOURS INTERPOLATED

LAKE WYLIE BED TOPOGRAPHY
INTAKE & DISCHARGE AREA

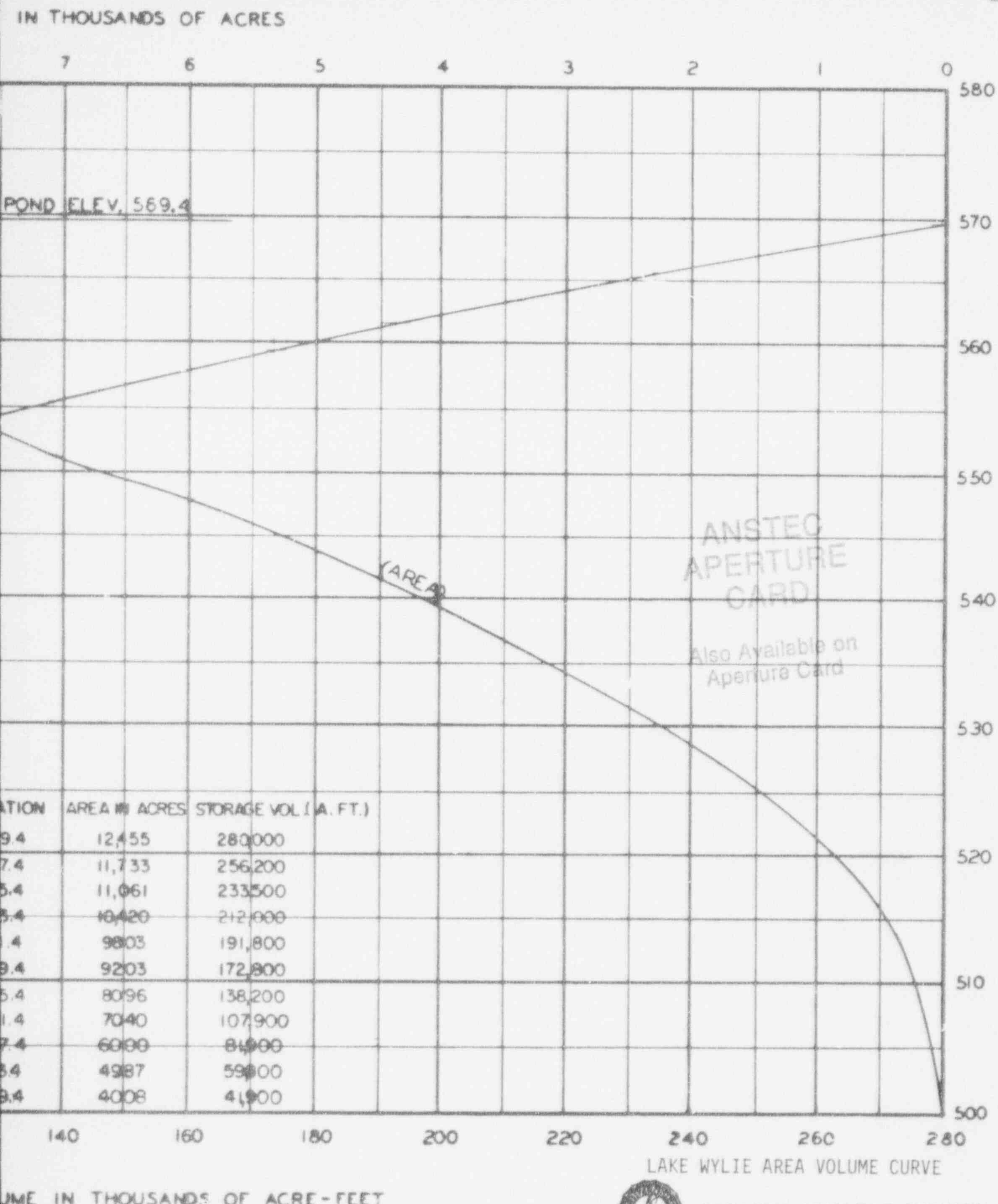
CATAWBA NUCLEAR STATION

ER Figure 4.1-8a

Amendment 1
(New)



SURFACE AREA
14
13
12
11
10
9
8
580
570
560
550
540
530
520
510
500
FULL
(VOLUME)
ELEVATION IN FEET ABOVE M.S.L.
0
20
40
60
80
100
120
STORAGE VOL



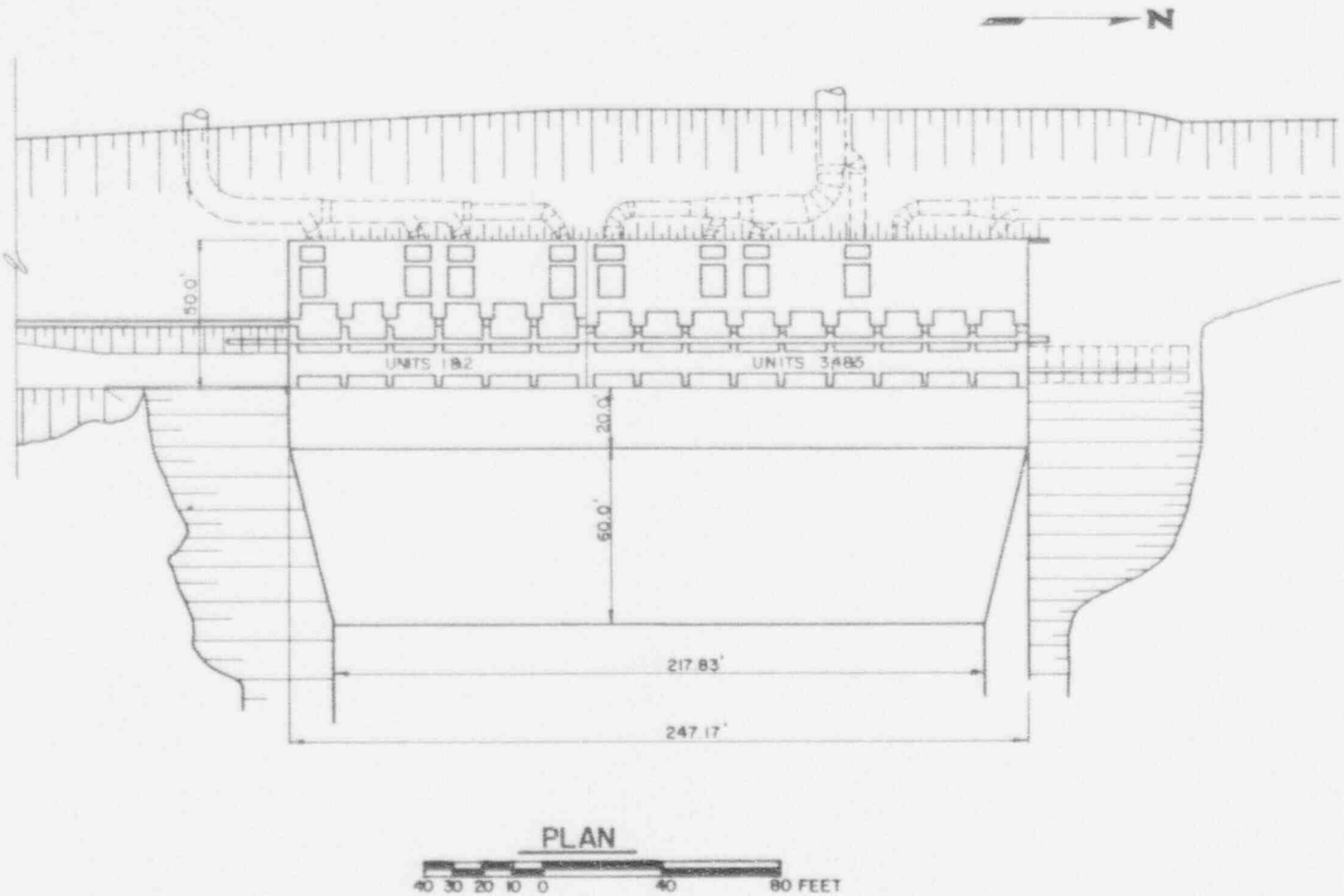
ATION	AREA IN ACRES	STORAGE VOL (A. FT.)
9.4	12,455	280,000
7.4	11,733	256,200
5.4	11,061	233,500
3.4	10,420	212,000
.4	9803	191,800
9.4	9203	172,800
5.4	8096	138,200
1.4	7040	107,900
7.4	6090	81,900
3.4	4987	59,800
9.4	4008	41,900

LAKE WYLIE AREA VOLUME CURVE

CATAWBA NUCLEAR STATION
ER Figure 4.1-8b

Amendment 1
(New)

9406090213 - 20

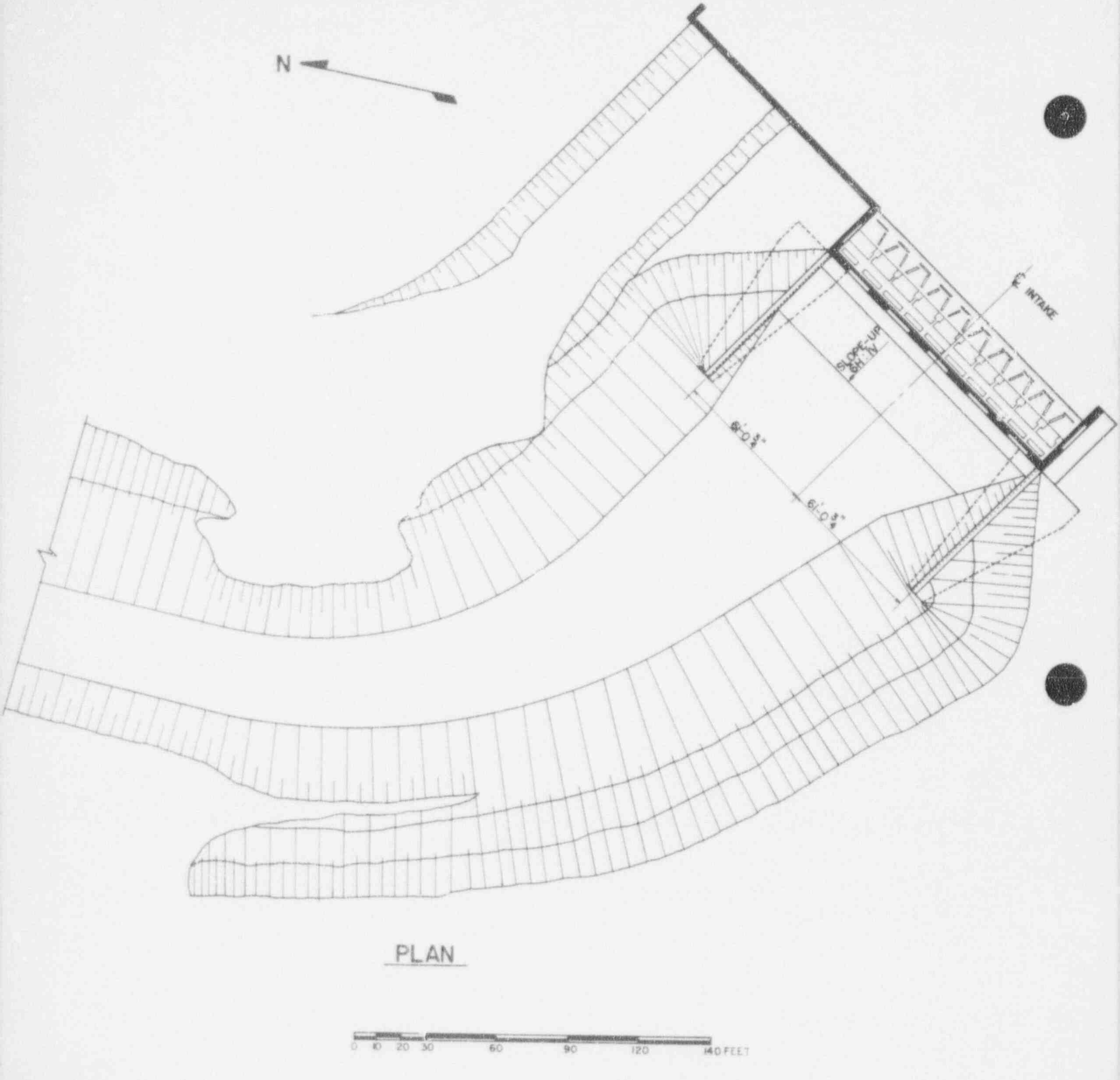


ALLEN INTAKE STRUCTURE

CATAWBA NUCLEAR STATION

ER Figure 4.1-13

Amendment 1
(New)

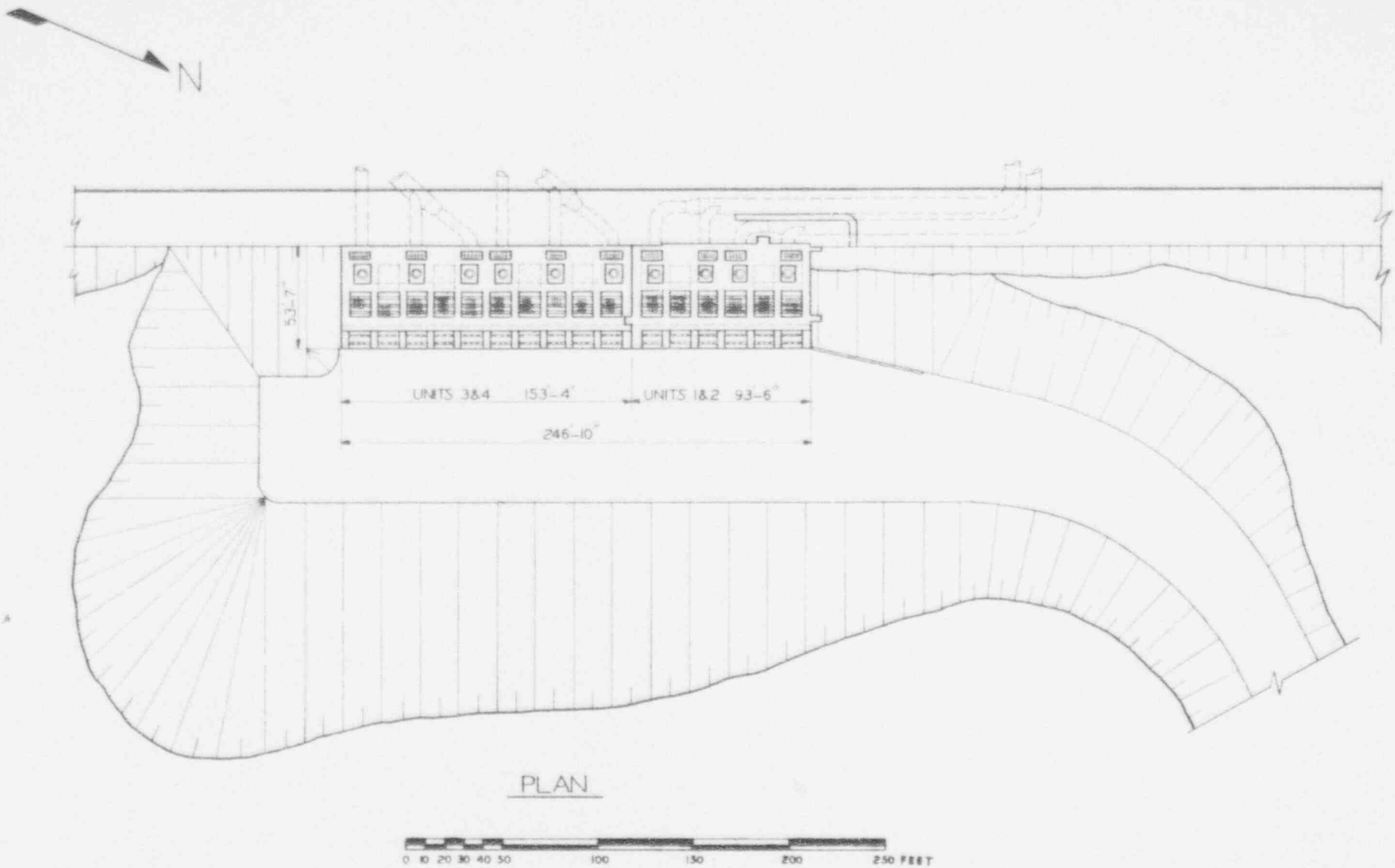


RIVERBEND INTAKE STRUCTURE

CATAWBA NUCLEAR STATION

ER Figure 4.1-14

Amendment 1
(New)

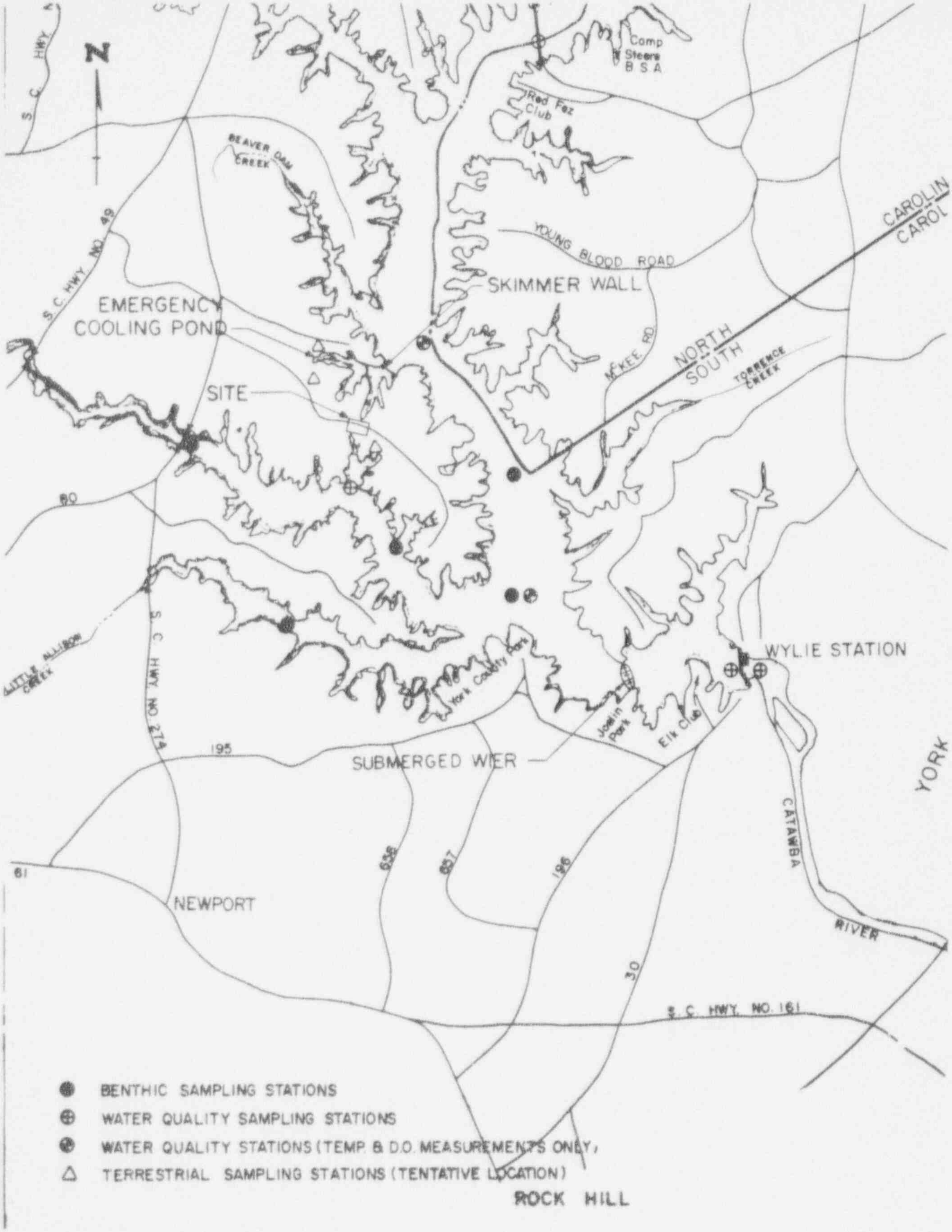


MARSHALL INTAKE STRUCTURE

CATAWBA NUCLEAR STATION

ER Figure 4.1-15

Amendment 1
(New)



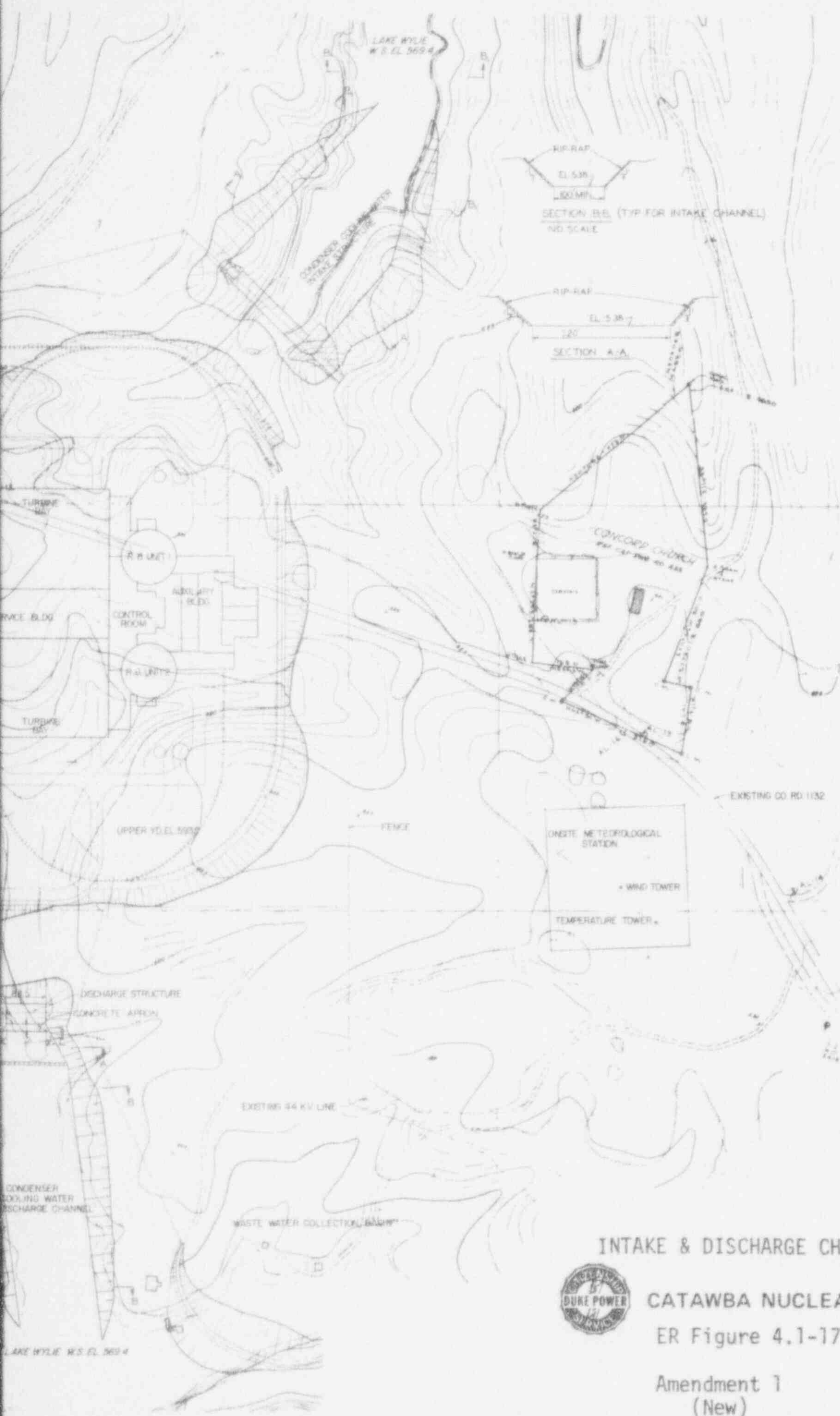
BIOLOGICAL SAMPLING STATIONS

CATAWBA NUCLEAR STATION

ER Figure 4.1-16

Amendment 1
(New)


CONSTRUCTION ACCESS ROAD
GATE
ACCESS RAILROAD
EMPLOYEE PARKING
ADMINISTRATION BUILDING
SWITCHING STATION YARD EL. 632.0
LOWER YD EL 606.5
ACCESS ROAD
GATE
RIP RAP
EL 547
CONCRETE RETAINING WALL
CONCRETE APRON
SECTION C-C
NO SCALE
EL 547
RIPRAP
EL 544
SECTION A-A
NO SCALE
EL 544
180
SECTION B-B (TYP)
NO SCALE



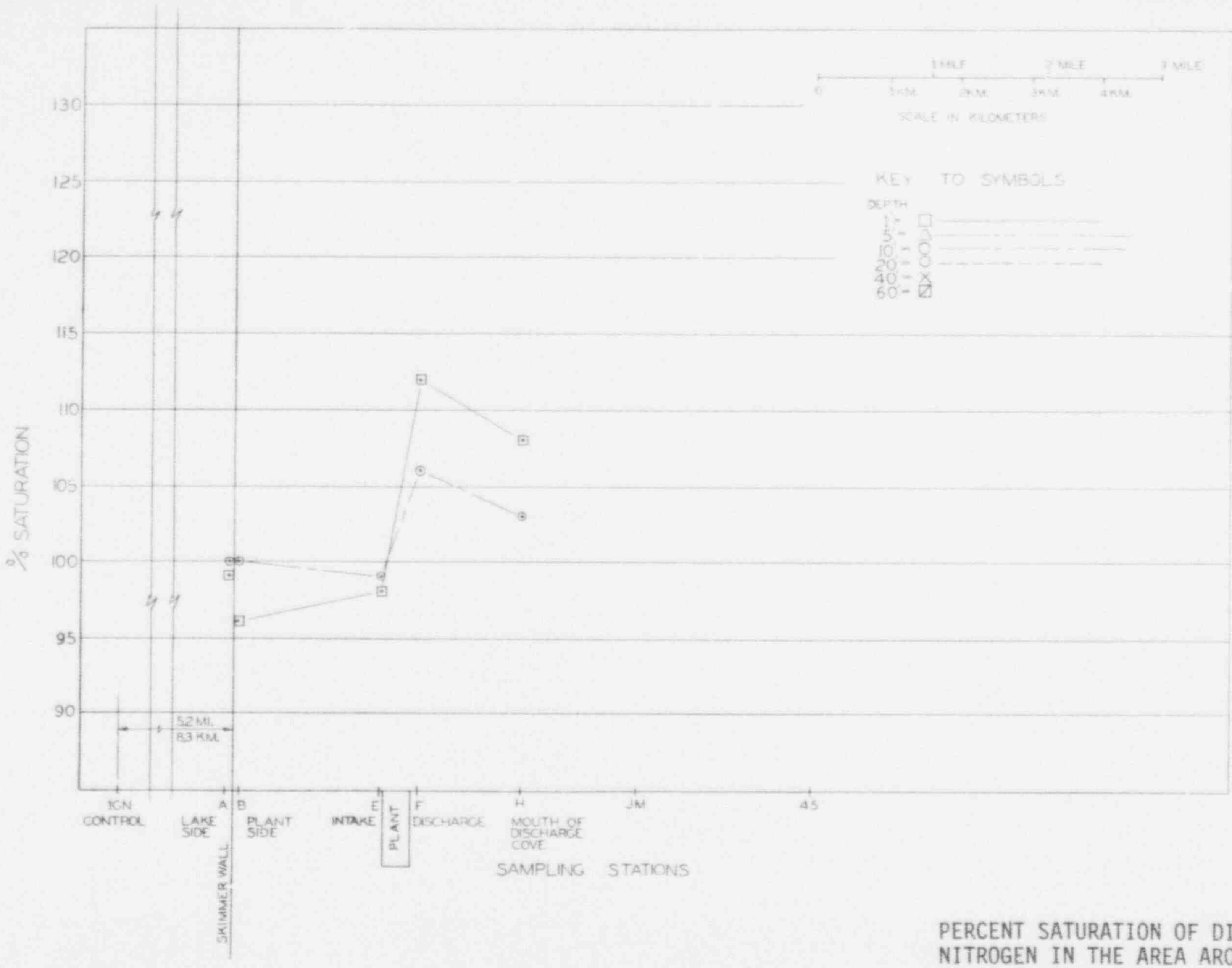
INTAKE & DISCHARGE CHANNELS (PRELIMINARY)

CATAWBA NUCLEAR STATION

ER Figure 4.1-17

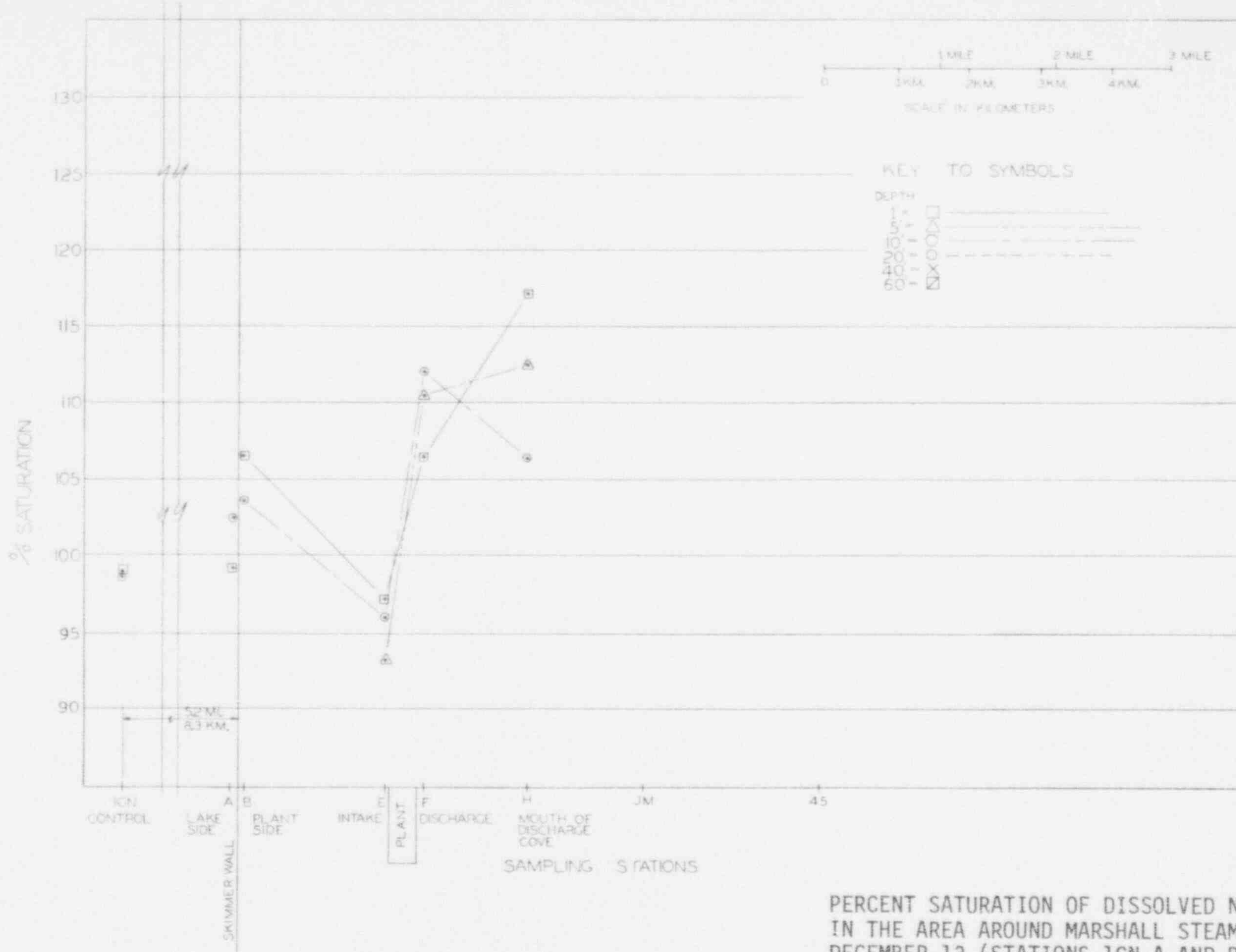
Amendment 1
(New)

9406090213 - 21



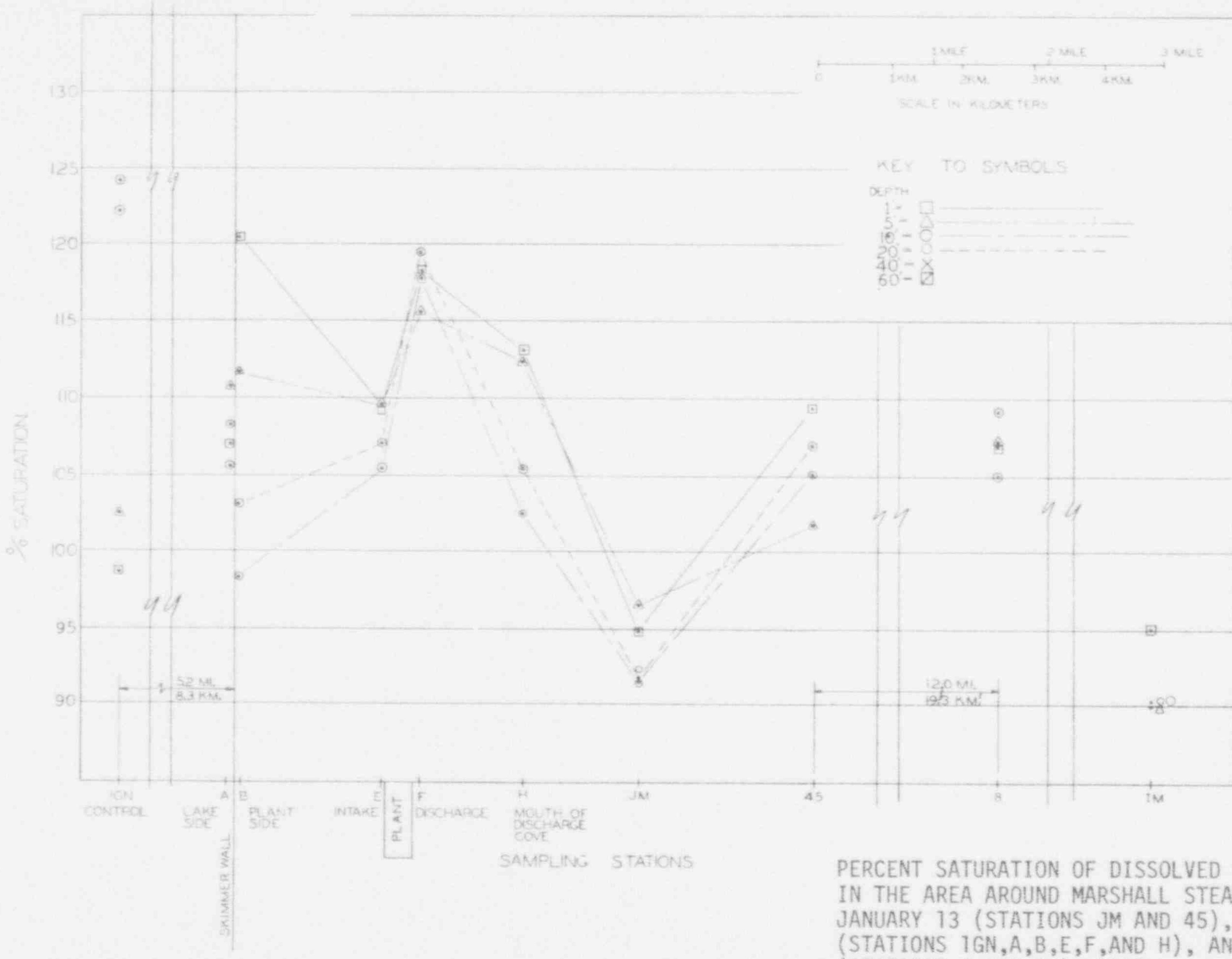
PERCENT SATURATION OF DISSOLVED NITROGEN IN THE AREA AROUND MARSHALL STEAM STATION, NOVEMBER 19, 1971.

CATAWBA NUCLEAR STATION
ER Figure 4.1-18 (1 of 14)
Amendment 1 (New)



PERCENT SATURATION OF DISSOLVED NITROGEN IN THE AREA AROUND MARSHALL STEAM STATION, DECEMBER 13 (STATIONS 1GN,A,AND B), AND DECEMBER 15 (STATIONS E,F,AND H), 1971.

CATAWBA NUCLEAR STATION
ER Figure 4.1-18 (2 of 14)
Amendment 1 (New)

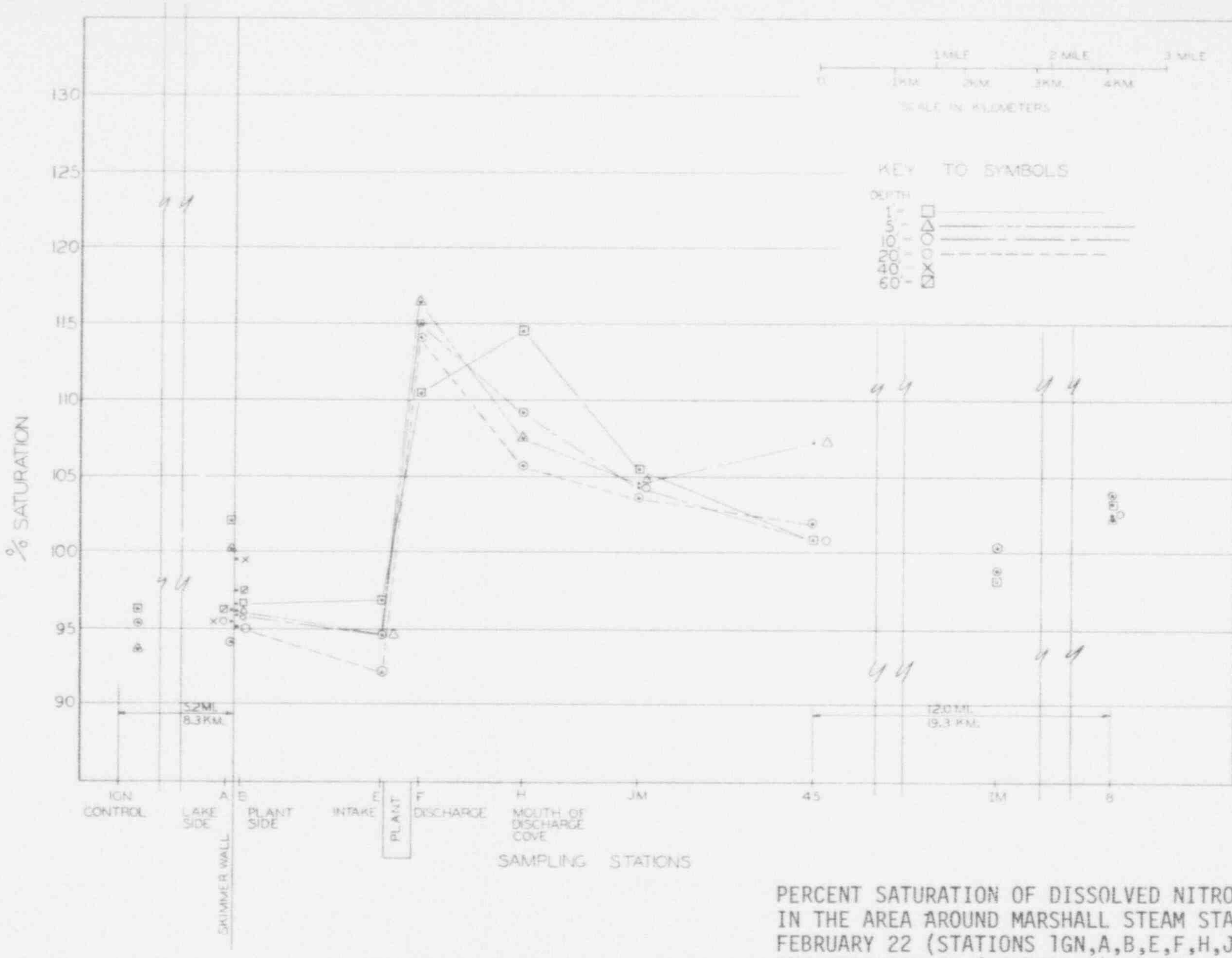


PERCENT SATURATION OF DISSOLVED NITROGEN IN THE AREA AROUND MARSHALL STEAM STATION, JANUARY 13 (STATIONS JM AND 45), JANUARY 18 (STATIONS 1GN,A,B,E,F,AND H), AND JANUARY 19 (STATIONS 8 AND IM), 1972.

CATAWBA NUCLEAR STATION

ER Figure 4.1-18 (3 of 14)

Amendment 1 (New)

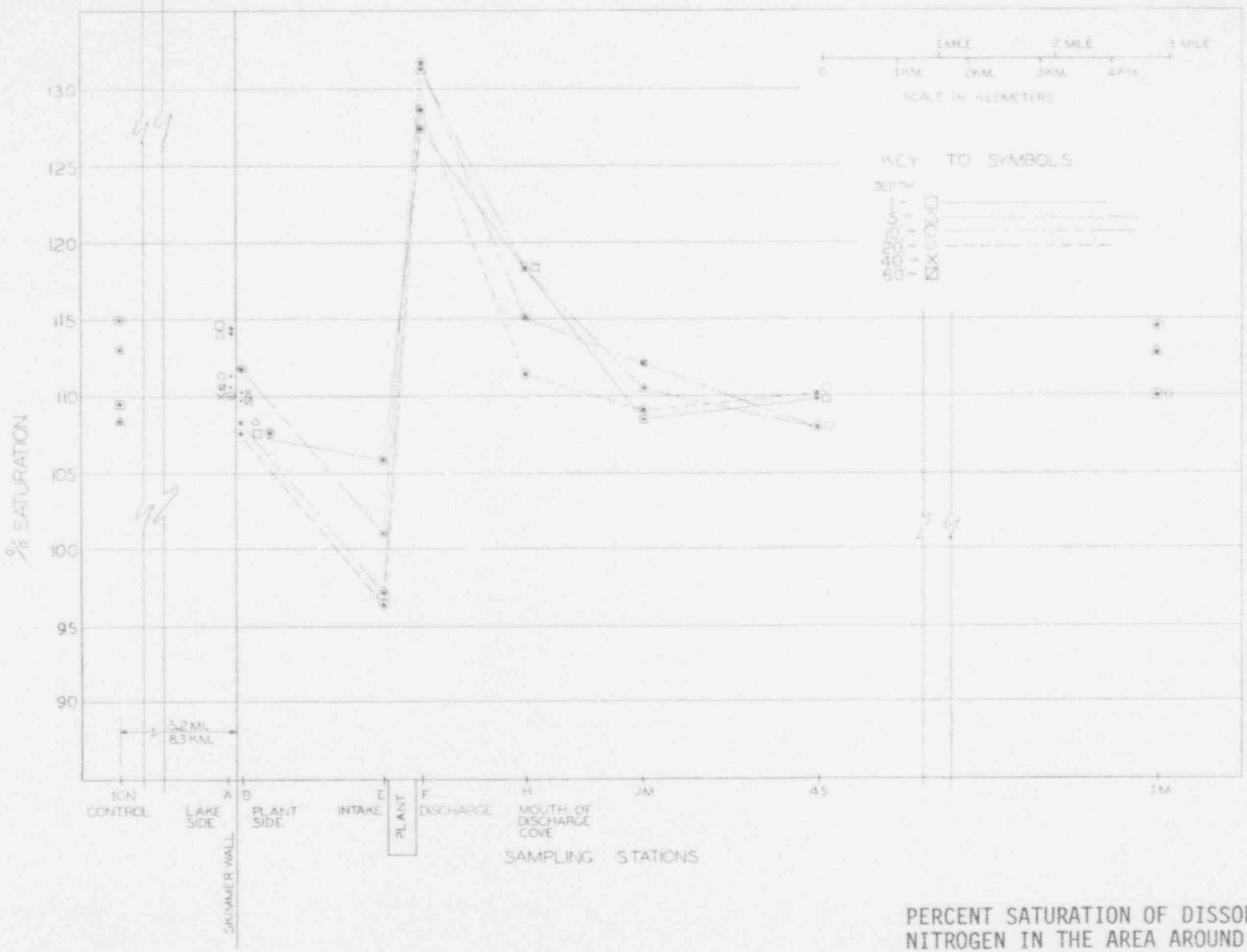


PERCENT SATURATION OF DISSOLVED NITROGEN
IN THE AREA AROUND MARSHALL STEAM STATION,
FEBRUARY 22 (STATIONS IGN,A,B,E,F,H,JM,45,IM),
AND FEBRUARY 23 (STATION 8), 1972

CATAWBA NUCLEAR STATION

ER Figure 4.1-18 (4 of 14)

Amendment 1 (New)

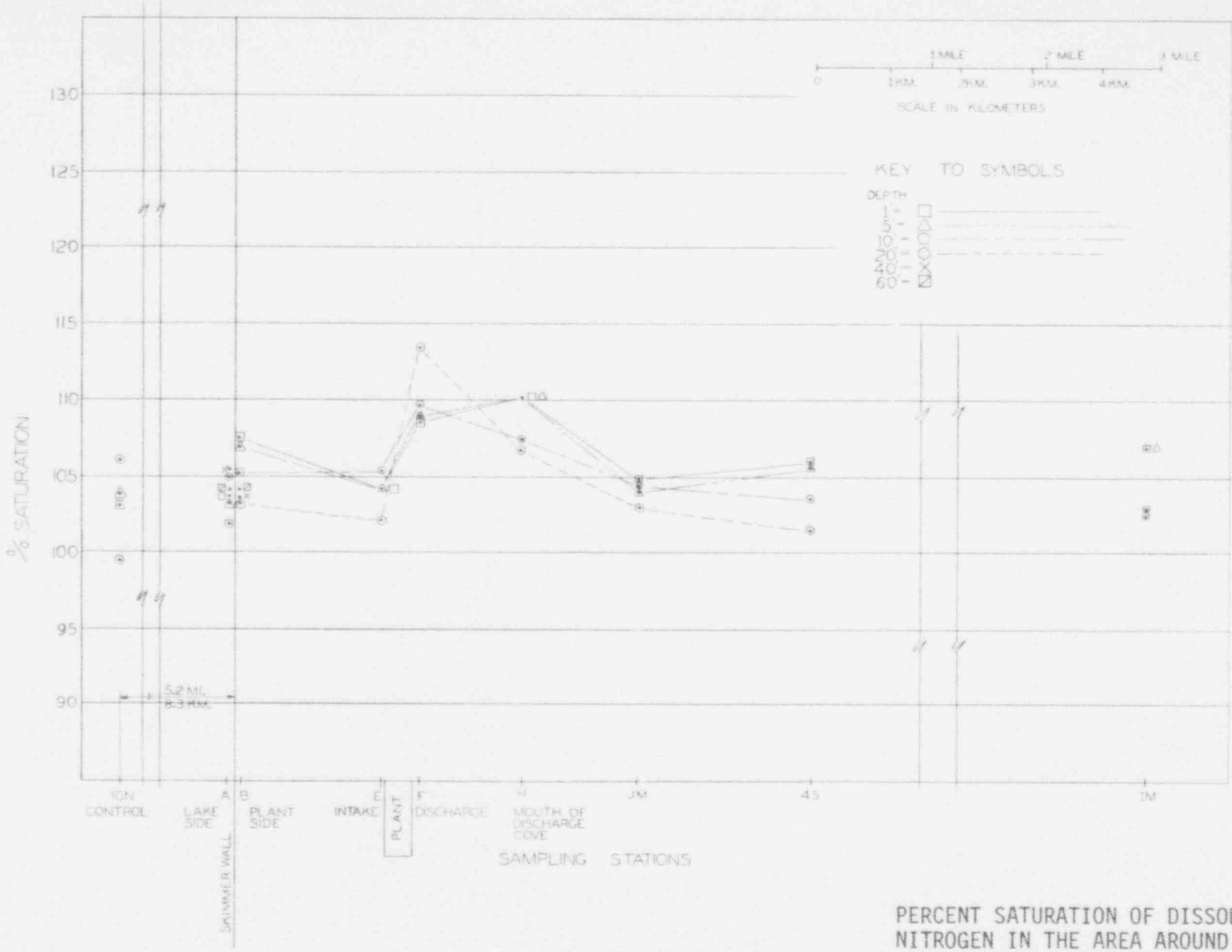


PERCENT SATURATION OF DISSOLVED NITROGEN IN THE AREA AROUND MARSHALL STEAM STATION, MARCH 17, 1972.

CATAWBA NUCLEAR STATION

ER Figure 4.1-18 (5 of 14)

Amendment 1 (New)

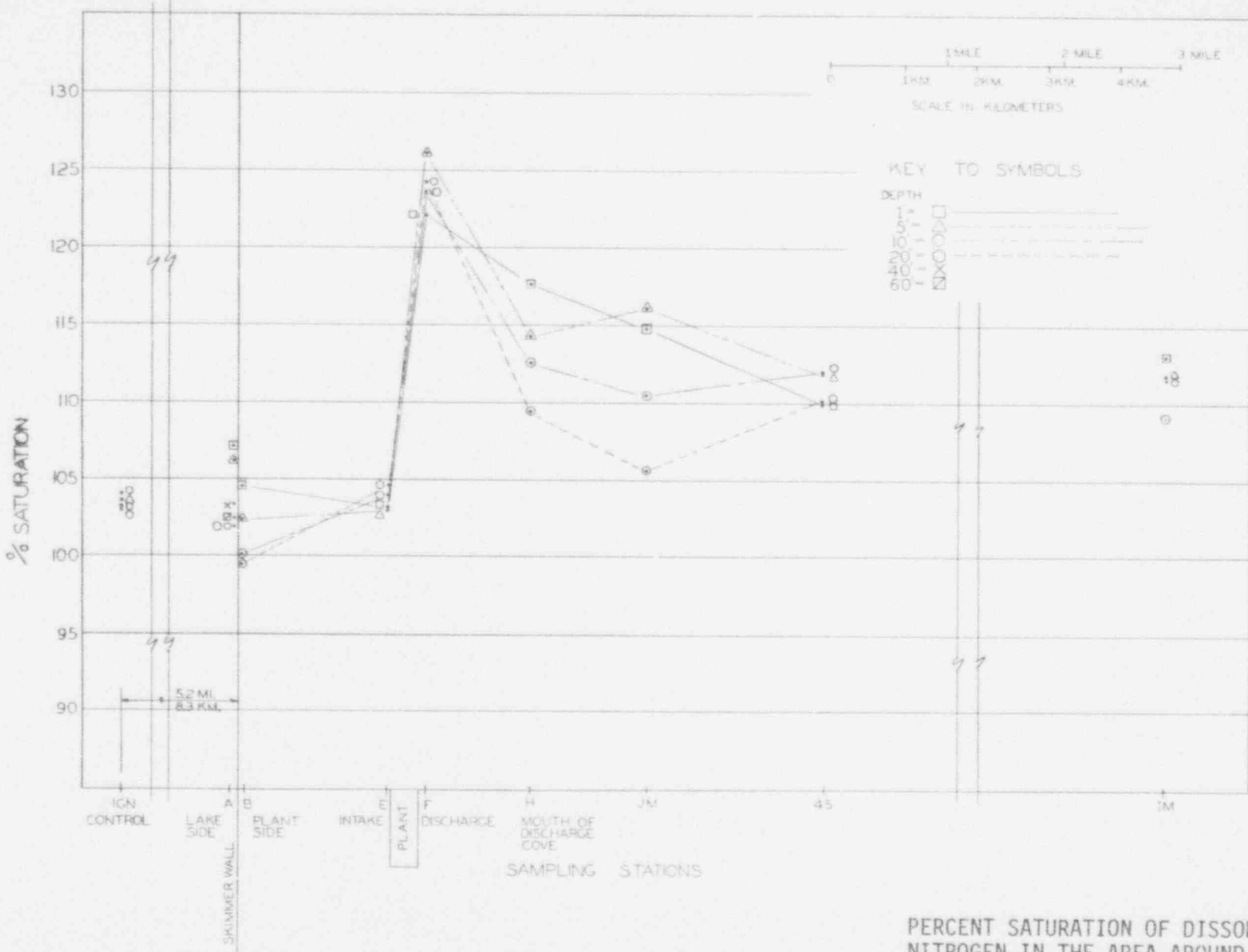


PERCENT SATURATION OF DISSOLVED NITROGEN IN THE AREA AROUND MARSHALL STEAM STATION, APRIL 28, 1972.

CATAWBA NUCLEAR STATION

ER Figure 4.1-18 (6 of 14)

Amendment 1 (New)

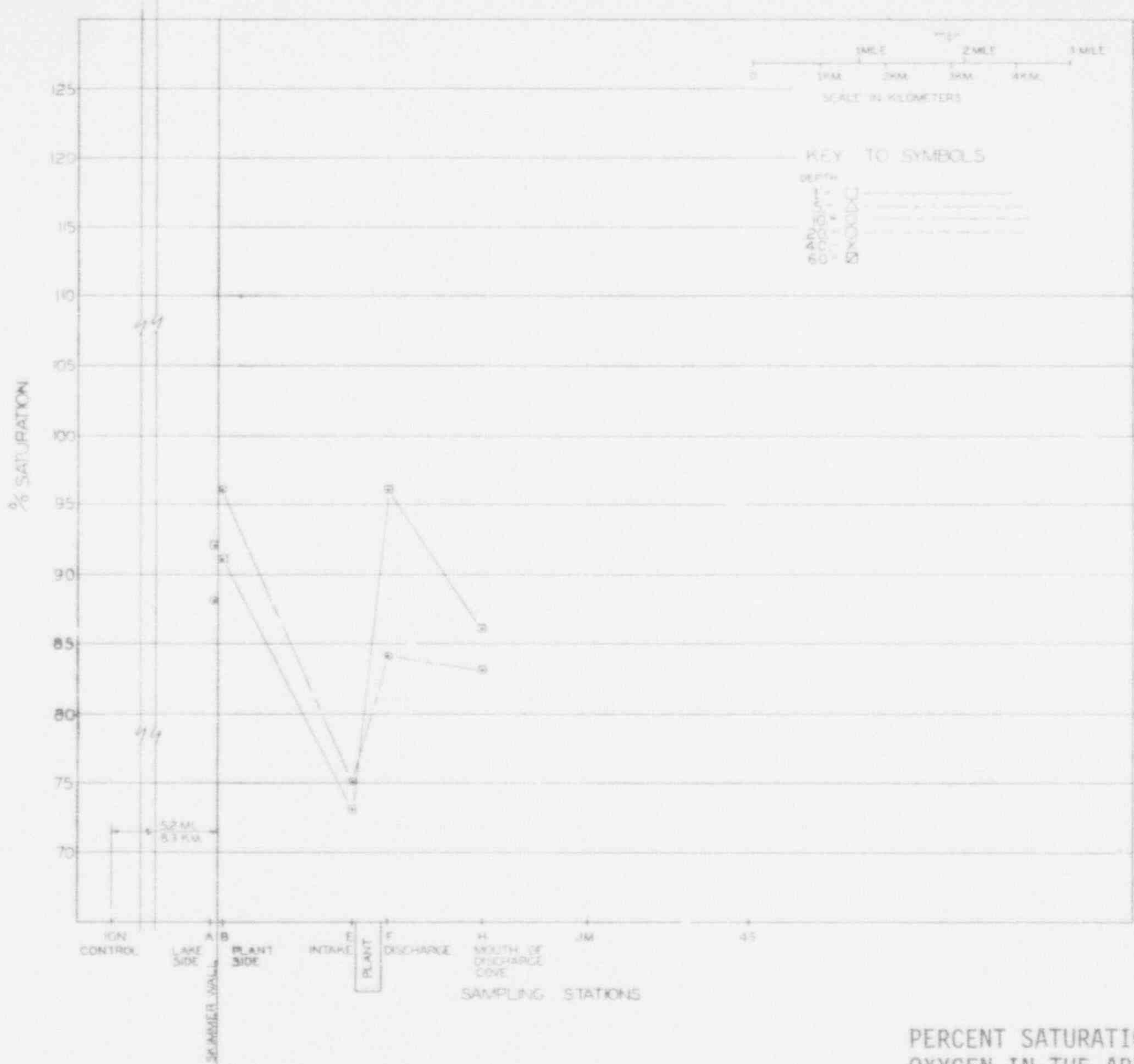


PERCENT SATURATION OF DISSOLVED NITROGEN IN THE AREA AROUND MARSHALL STEAM STATION, MAY 24, 1972.

CATAWBA NUCLEAR STATION

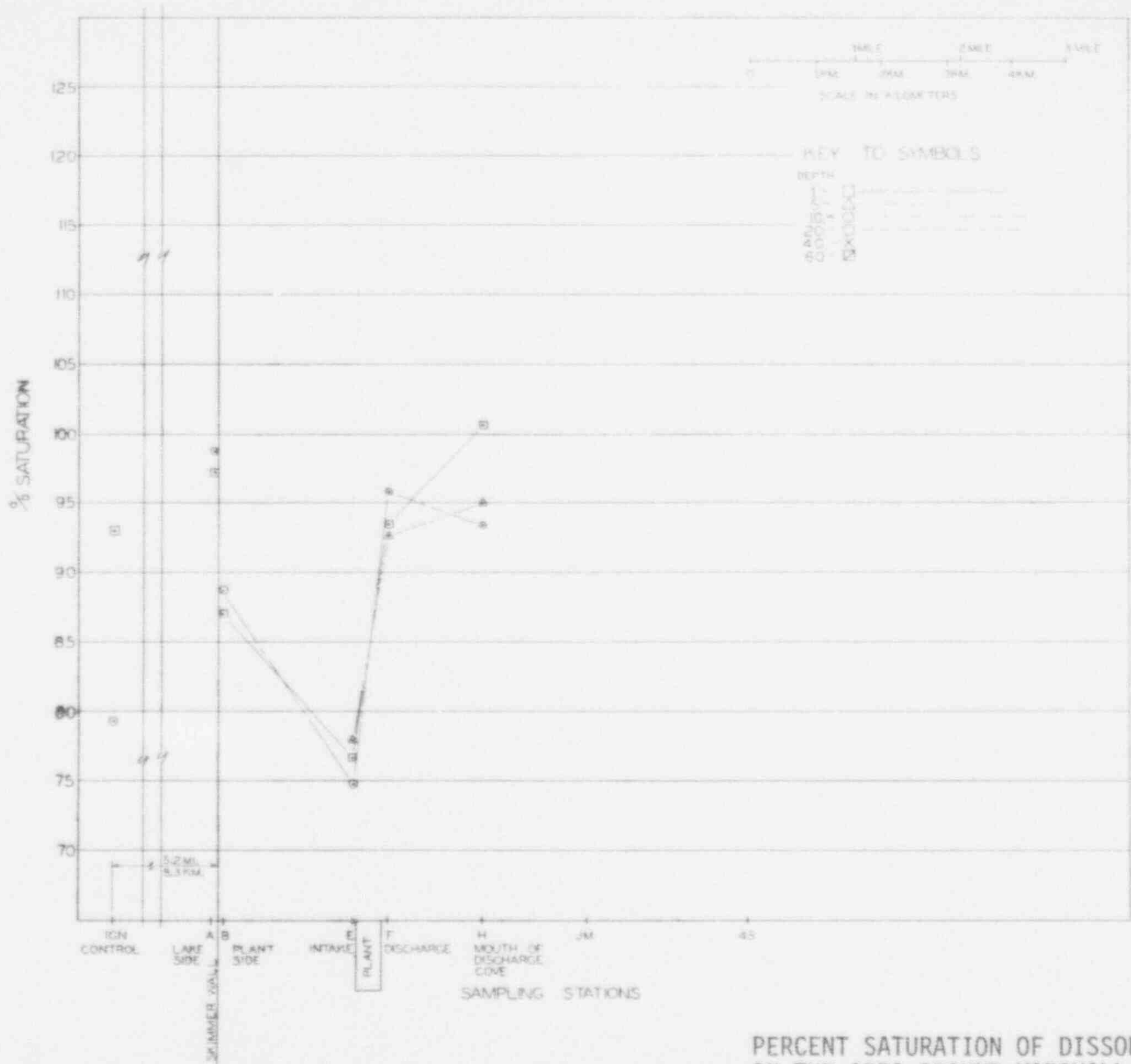
ER Figure 4.1-18 (7 of 14)

Amendment 1 (New)



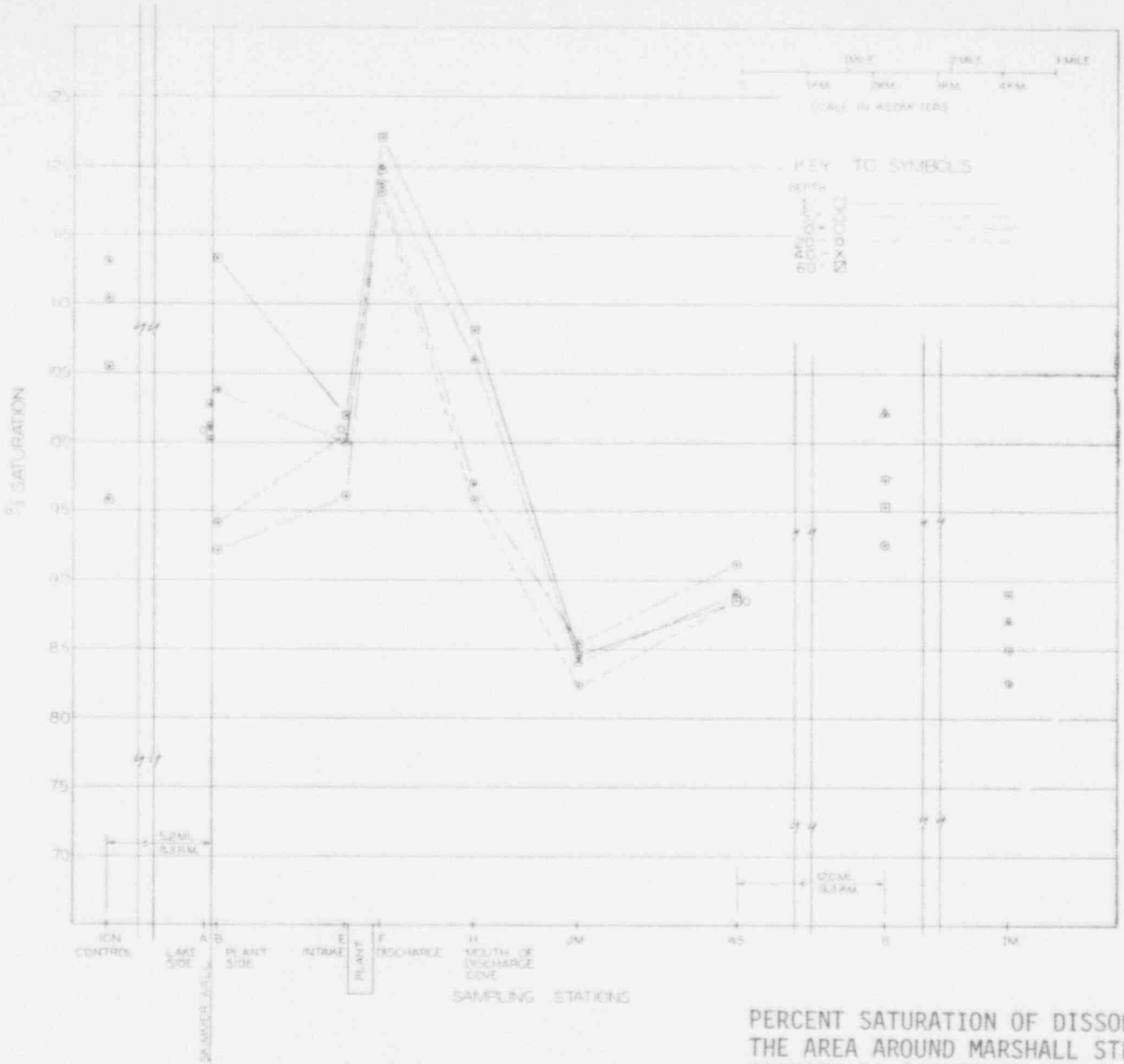
PERCENT SATURATION OF DISSOLVED OXYGEN IN THE AREA AROUND MARSHALL STEAM STATION, NOVEMBER 19, 1971.

CATAWBA NUCLEAR STATION
ER Figure 4.1-18 (8 of 14)
Amendment 1 (New)



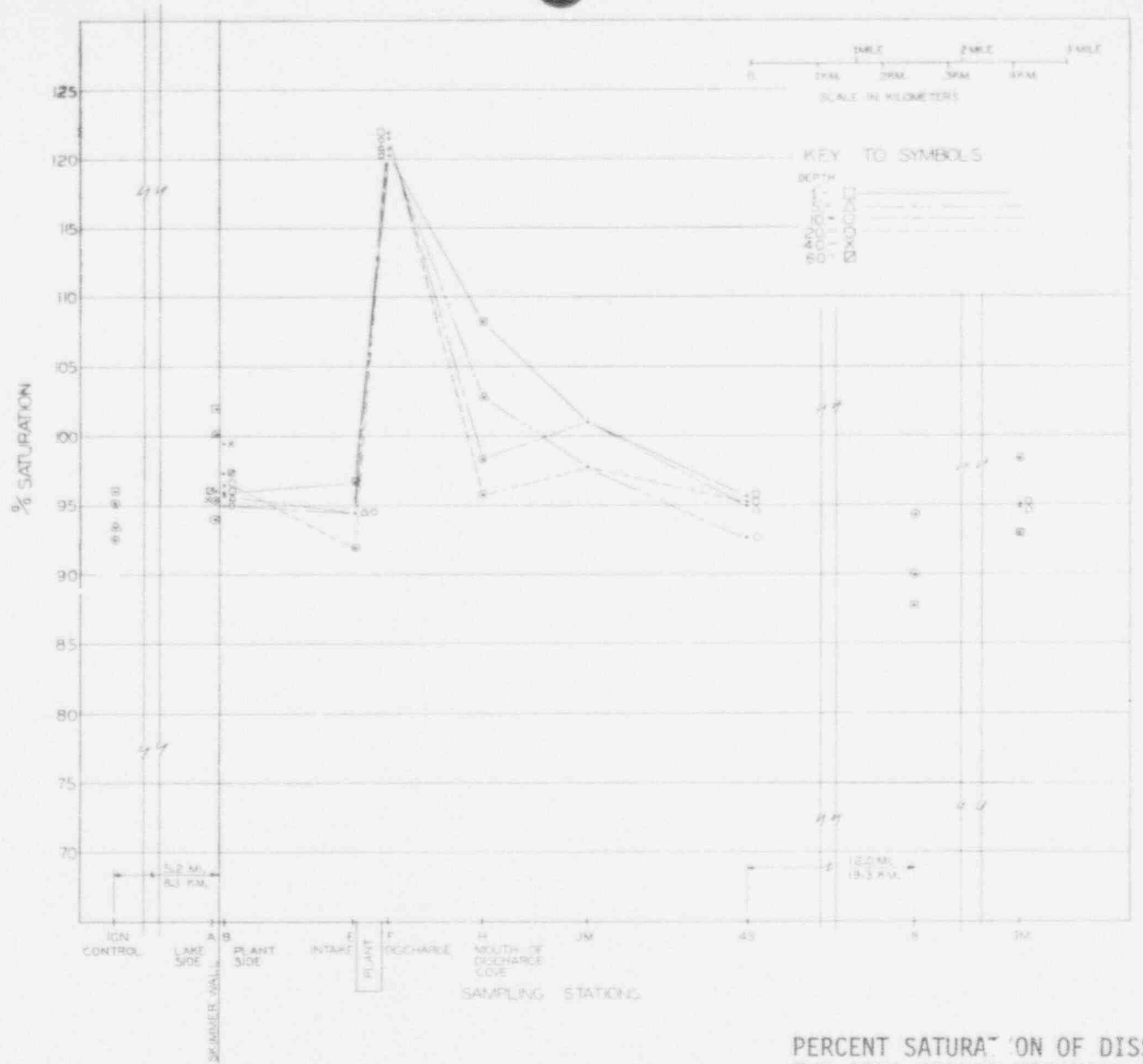
PERCENT SATURATION OF DISSOLVED OXYGEN IN THE AREA AROUND MARSHALL STEAM STATION, DECEMBER 13 (STATIONS 1GN,A AND B) AND DECEMBER 15 (STATIONS E,F, AND H), 1971.

CATAWBA NUCLEAR STATION
ER Figure 4.1-18 (9 of 14)
Amendment 1 (New)



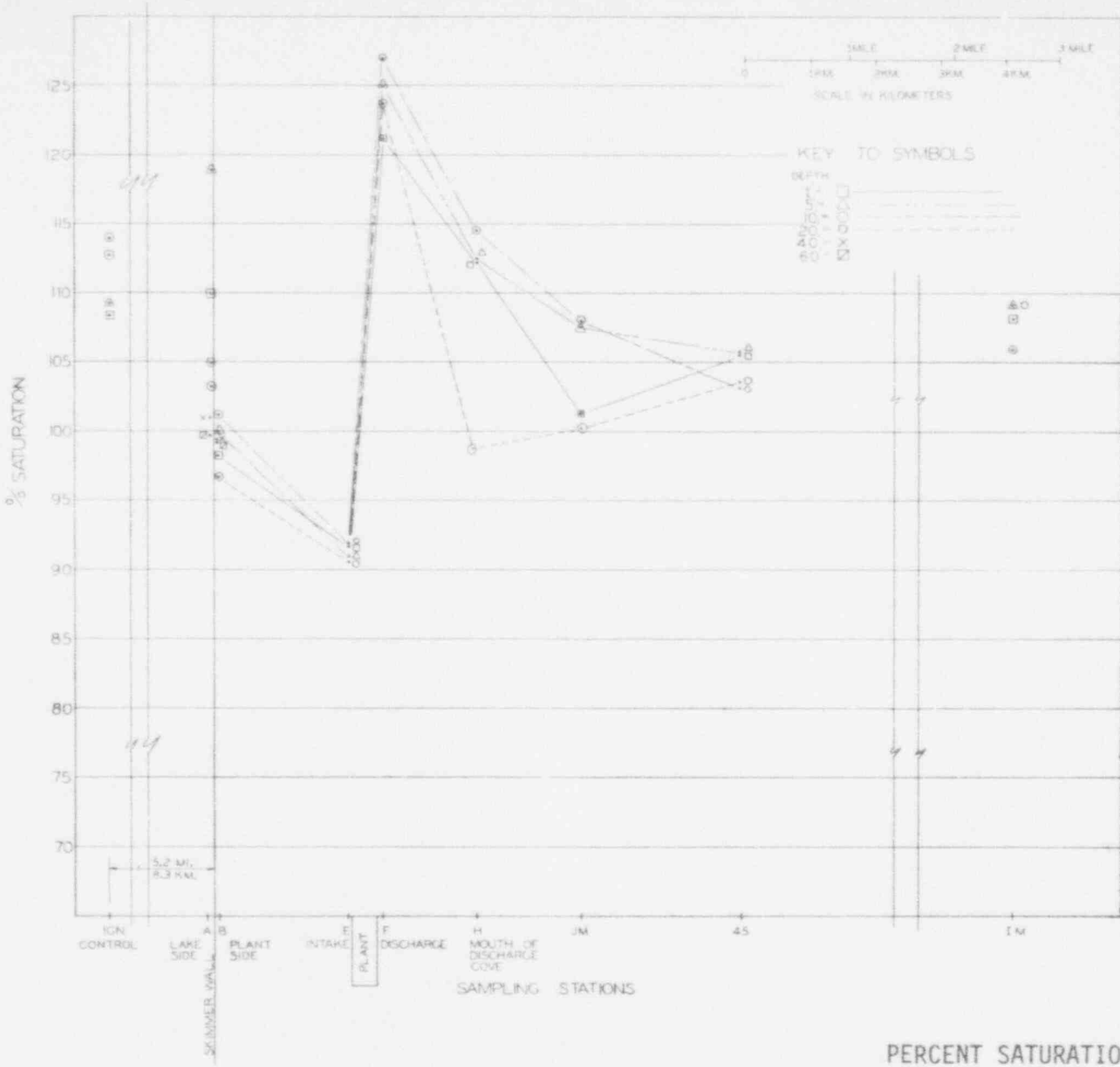
PERCENT SATURATION OF DISSOLVED OXYGEN IN THE AREA AROUND MARSHALL STEAM STATION, JANUARY 13 (STATIONS JM AND 45), JANUARY 18 (STATIONS 1CN,A,B,E,F,AND H), AND JANUARY 19 (STATIONS 8 AND IM), 1972.

CATAWBA NUCLEAR STATION
ER Figure 4.1-18 (10 of 14)
Amendment 1 (New)



PERCENT SATURAT ON OF DISSOLVED OXYGEN IN THE AREA AROUND MARSHALL STEAM STATION, FEBRUARY 22 (STATIONS 1GN,A,B,E,F,H,JM, 45,IM), AND FEBRUARY 23 (STATION 8), 1972.

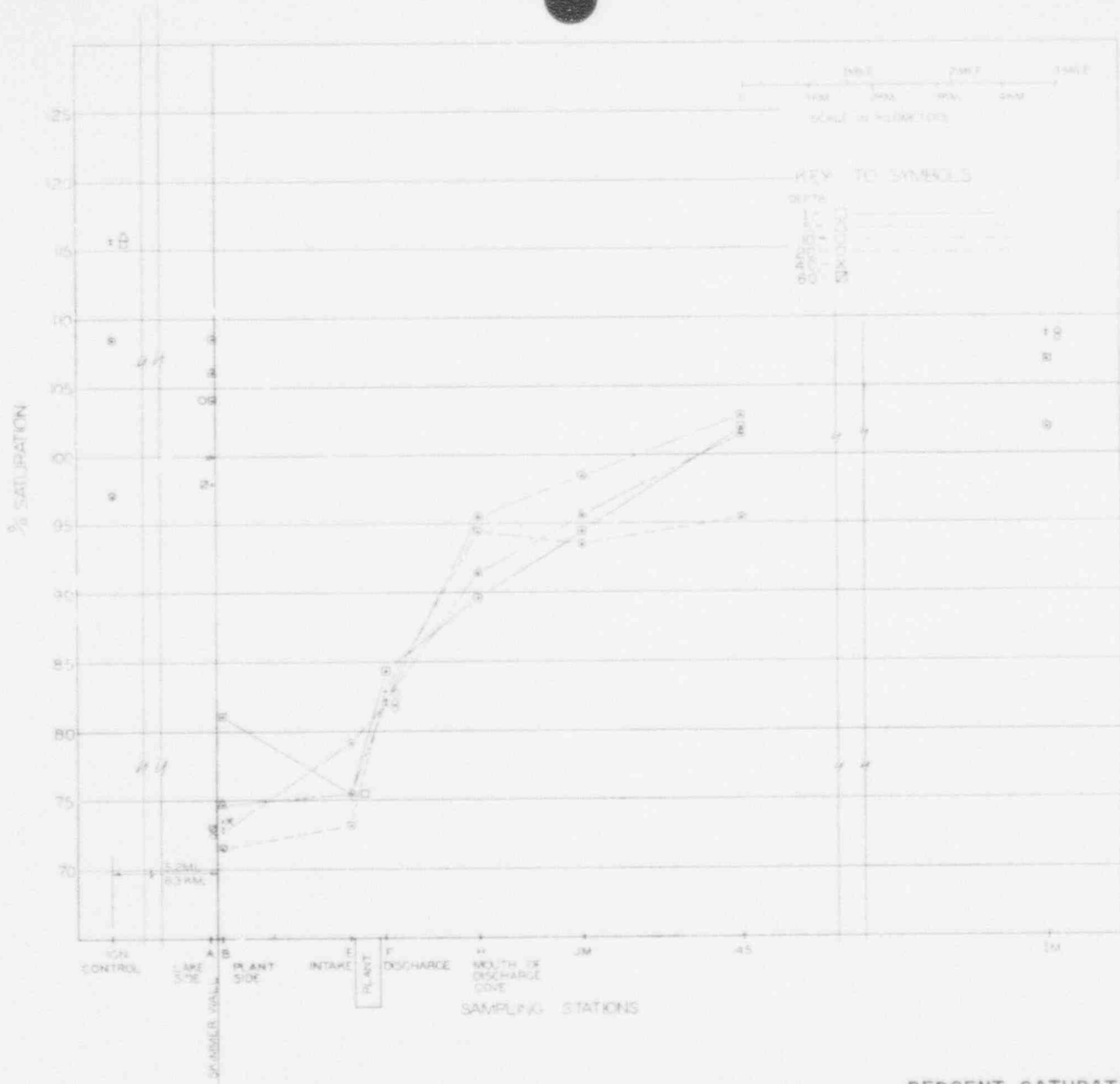
CATAWBA NUCLEAR STATION
ER Figure 4.1-18 (11 of 14)
Amendment 1 (New)



PERCENT SATURATION OF DISSOLVED OXYGEN IN THE AREA AROUND MARSHALL STEAM STATION, MARCH 17, 1972.

CATAWBA NUCLEAR STATION
ER Figure 4.1-18 (12 of 14)

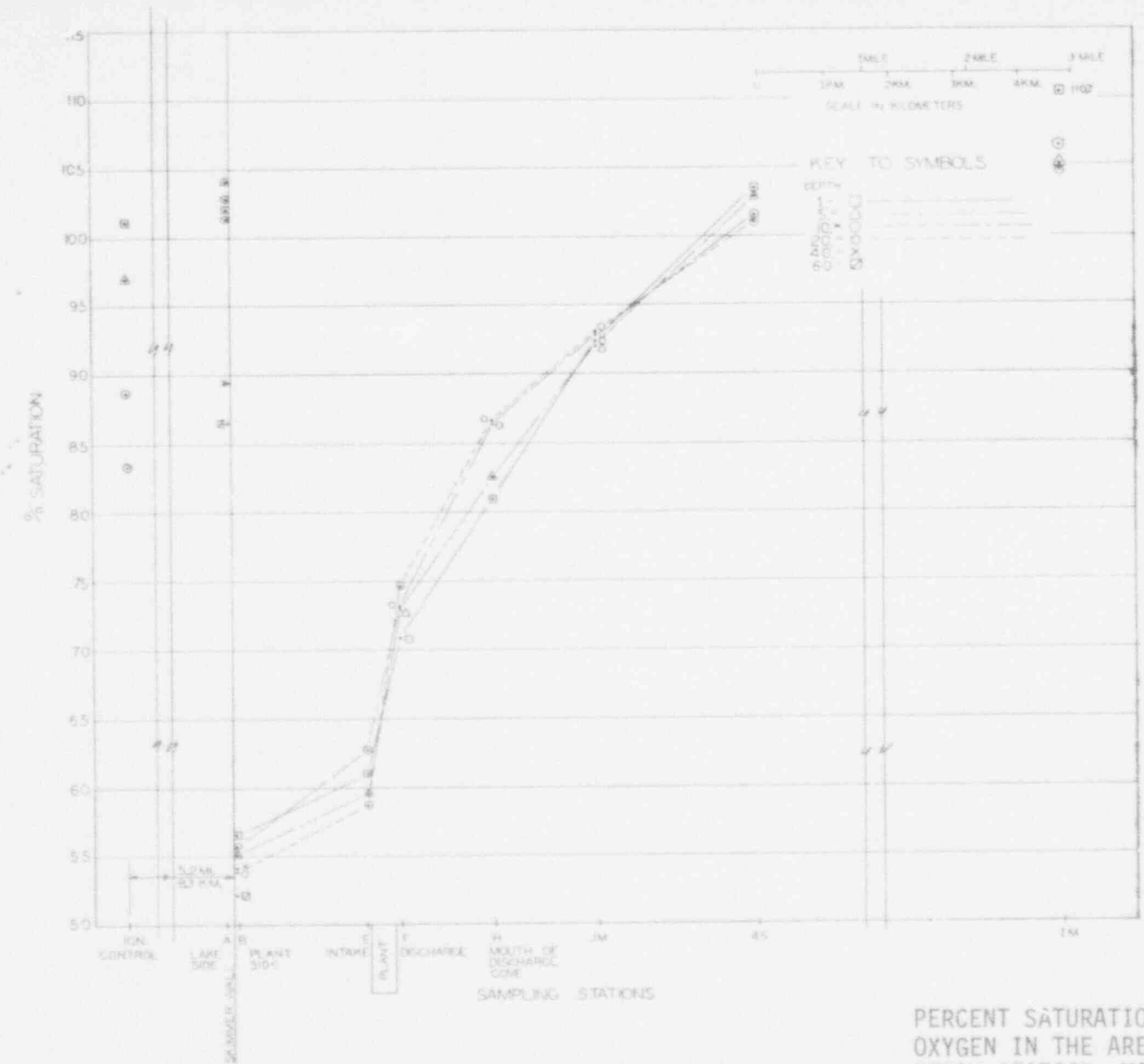
Amendment 1 (New)



PERCENT SATURATION OF DISSOLVED OXYGEN IN THE AREA AROUND MARSHALL STEAM STATION, APRIL 28, 1972.

CATAWBA NUCLEAR STATION
ER Figure 4.1-18 (13 of 14)

Amendment 1 (New)



PERCENT SATURATION OF DISSOLVED OXYGEN IN THE AREA AROUND MARSHALL STEAM STATION, MAY 24, 1972.

CATAWBA NUCLEAR STATION

ER Figure 4.1-18 (14 of 14)

Amendment 1 (New)


N
JACOB FORK
CLARK CREEK
INDIAN CREEK
SO. FORK CATAWBA RIVER
S.A.L.
Gaston Co.
US 321
LONG CREEK
GASTONIA
US 74
US 29
CATAWBA CREEK
N.C.
S.C.
CROWDERS CREEK
ALLISON
CATAWBA
CREEK
NC 49
STEELE CR.
SOUTHERN
LITTLE SUGAR CR.
York Co.
WYLIE
SOUTHERN R.R.
YORK
Celanese Fibers
SUGAR CREEK
ROCK HILL
US 21
SC 49
CATAWBA
12 MILE
FISHING CREEK
WAXHAW
Chester Co.
Rock Hill
L.B.C.
CHESTER
S.A.L.
SOUTHERN R.R.
CAMP
US 321
US 21
0 5 10
SCALE IN MILES

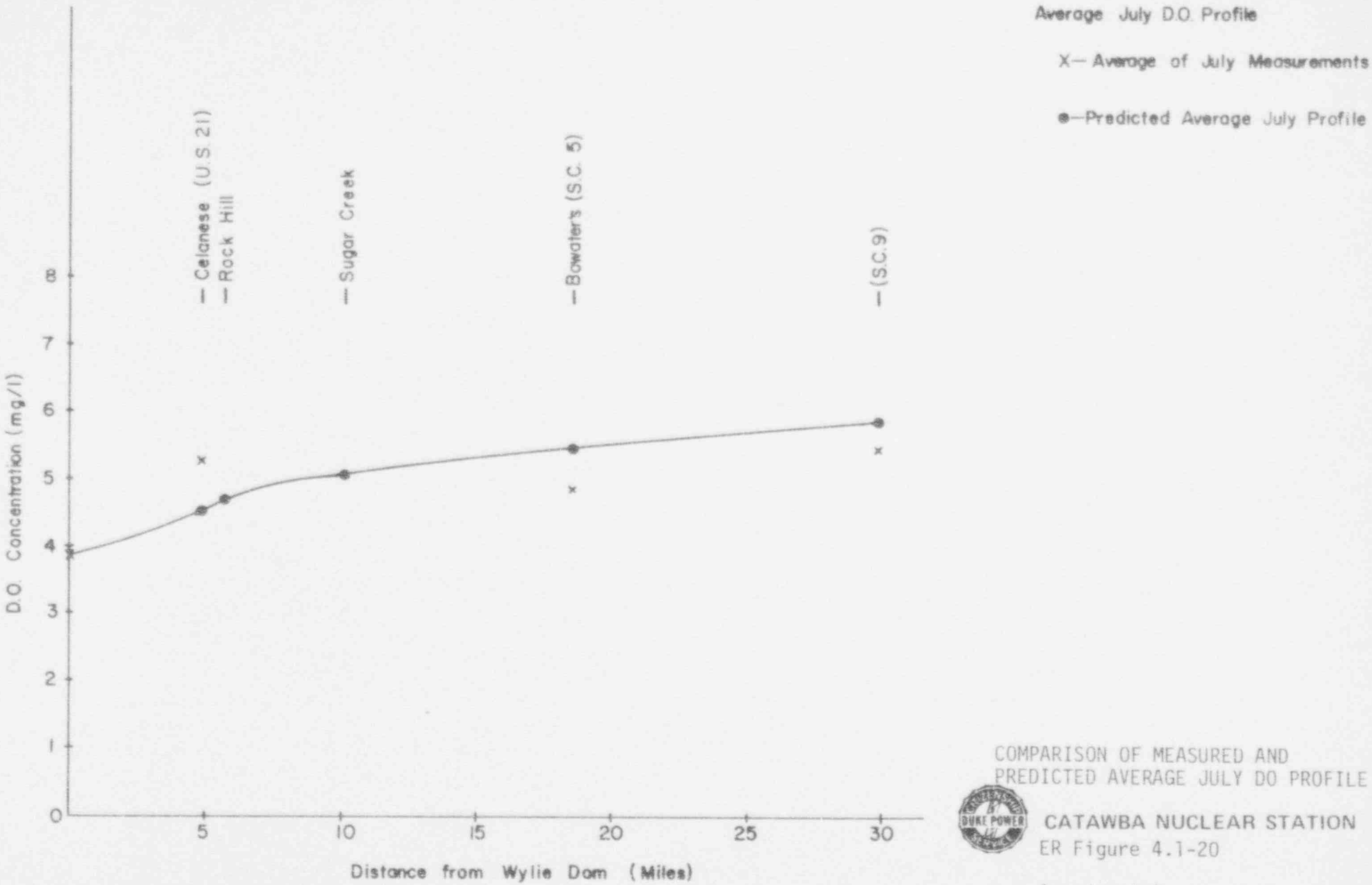
9406090213 -22

MAJOR DISCHARGES INTO CATAWBA
RIVER BELOW WYLIE DAM

CATAWBA NUCLEAR STATION

ER Figure 4.1-19

Amendment 2
(New)



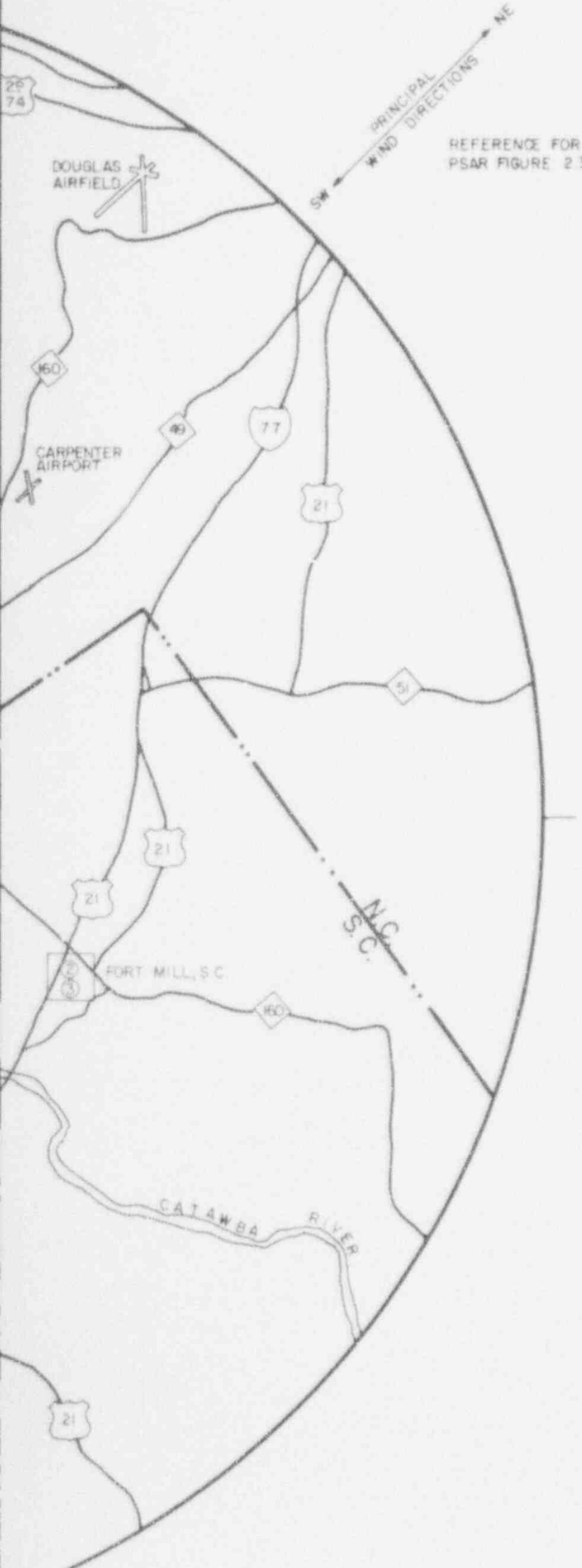
COMPARISON OF MEASURED AND PREDICTED AVERAGE JULY DO PROFILE

CATAWBA NUCLEAR STATION

ER Figure 4.1-20

Amendment 2
(New)

N
BELMONT WATER SUPPLY INTAKE
GASTONIA AIRPORT
N.C.
S.C.
CLOVER, S.C.
SITE
RESIDENTIAL COMMUNITY
LAKE WYLIE
YORK AIRPORT
RECREATION AREA
YORK, S.C.
ROCK HILL AIRPORT
ROCK HILL, S.C.
15 MILE R
0
1
2 MILES



REFERENCE FOR METEOROLOGICAL DISTRIBUTION
PSAR FIGURE 2.3-8 (1,2,3)

LEGEND

1. WATER, SURFACE OR WELL
2. RAIN AND SETTLED DUST
3. DOSIMETER, TLD
4. FISH
5. AIR PARTICULATES
6. VEGETATION AQUATIC OR TERRESTRIAL & CROPS
7. SEDIMENT
8. MILK

- △ NEAREST RESIDENCE, 3500 FT
- △2 NEAREST FARM, 1.0 MI
- △3 NEAREST USED SHORELINE AREA 1.6 MI
- △4 NEAREST MUNICIPAL WATER INTAKE, 6.0 MI
- △5 NEAREST COMMUNITY, 7.0 MI
- △6 NEAREST DAIRY, 5.5 MI

REFERENCE FOR MOVEMENT OF GROUNDWATER
PSAR APPENDIX 2B GROUNDWATER HYDROLOGY SECTION 2.3

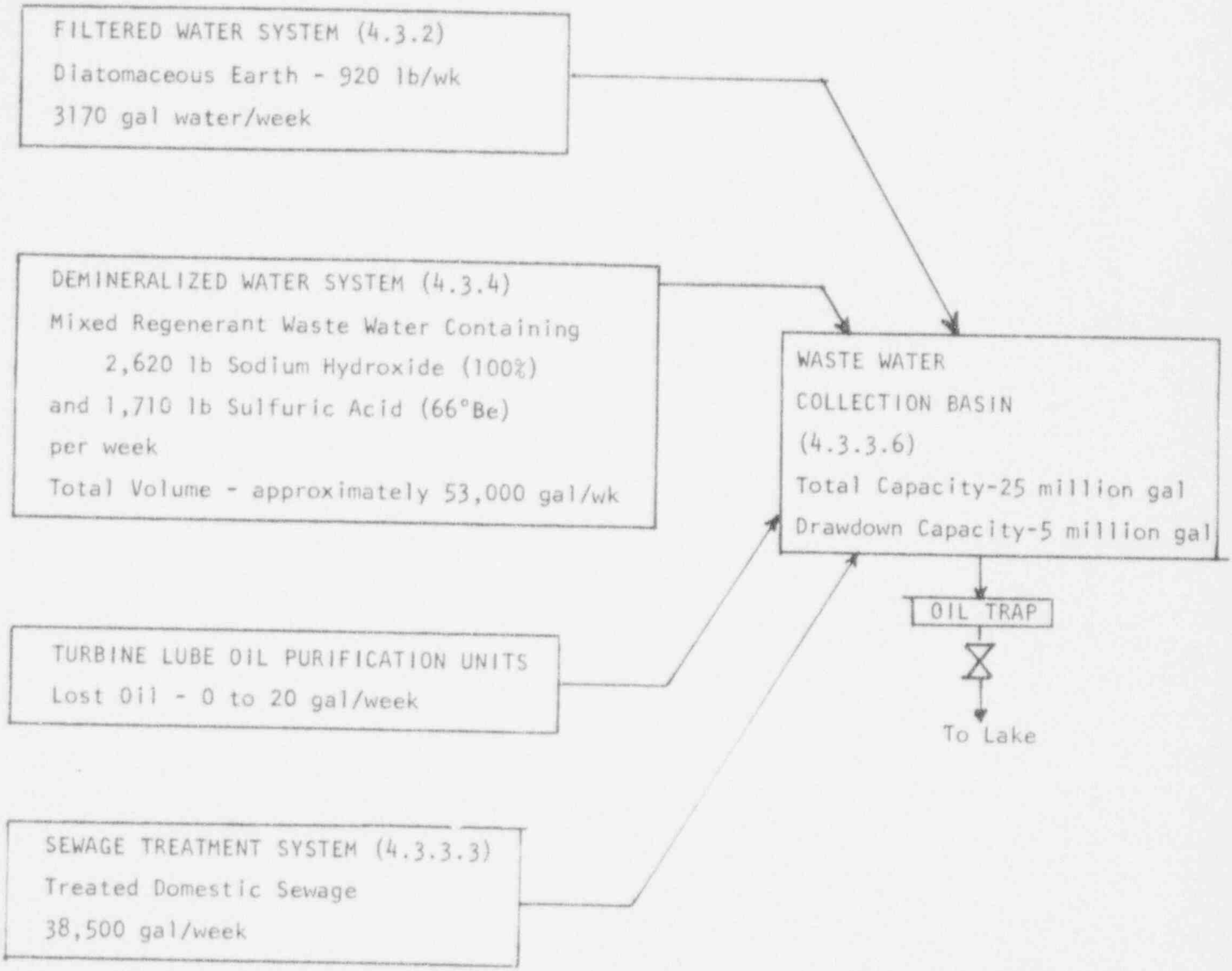
RADIOLOGICAL SAMPLING STATIONS

DUKE POWER

CATAWBA NUCLEAR STATION

ER Figure 4.2-1

Amendment 1 (New)



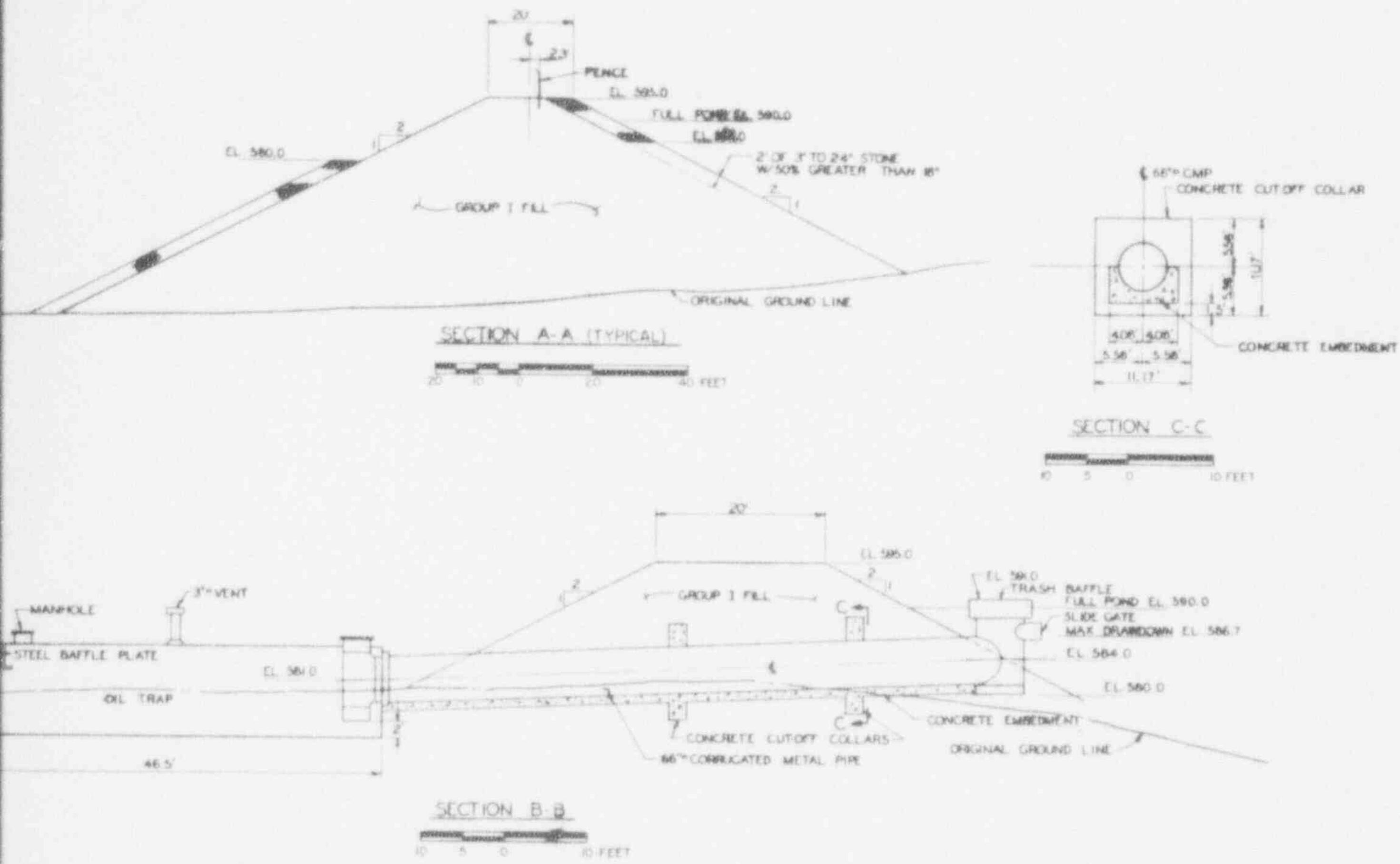
Block Diagram of Chemical Discharge to Waste Water Collection Basin

CATAWBA NUCLEAR STATION

ER Figure 4.3-1

Amendment 1
(New)

PLAN



WASTE WATER COLLECTION BASIN

DUKE POWER

CATAWBA NUCLEAR STATION

ER Figure 4.3-2

Amendment 1
(New)


N
NNE
NNW
NW
WNW
W
WSW
SW
SSW
S
SSE
LAKE WYLIE
DUKE POWER CO
CATAWBA NUCLEAR STATION
DUKE POWER CO
LAKE WYLIE
DUKE POWER CO
RECREATIONAL HOMES
PERMANENT HOMES
PERMANENT MOBILE HOMES
LOCAL BUSINESS
BARNS
ACCESS AREA
CLEARED FARM LAND
DUKE PROPERTY
PRIVATELY OWNED PROPERTY

SECTOR	APPROX. AREA OF CLEARED FARM LAND (ACRES)
N	20.3
NNE	0
NE	0
ENE	0
E	0
ESE	0
SE	0
SSE	0
S	0
SSW	0
SW	0
WSW	0
W	0
WNW	95.9
NW	91.0
NNW	10.7
TOTAL	217.9

SCALE IN MILES

1/2 1/4 0 1

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EXISTING LAND USE WITHIN 2 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-1

Amendment 1

Principal
Acreage

County	Harvested Cropland-Acres	Corn Acreage	Corn Yield	Wheat Acreage	Wheat Yie
NORTH CAROLINA[2]					
Anson	31 659	4 000	65	3 400	35
Burke	10 841	3 220	65	497	26
Cabarrus	29 661	1 944	55	3 882	40
Catawba	32 249	5 500	50	4 500	45
Cleveland	41 789	3 000	60	3 500	50
Gaston	14 647	2 000	60	3 000	45
Iredell	49 643	10 275	54	6 750	38
Lincoln	29 956	4 500	65	5 000	45
Mecklenburg	18 891	2 130	50	1 094	45
Rowan	56 598	8 065	55	6 813	50
Rutherford	15 603	4 000	33	1 000	50
Stanley	44 878	7 144	55	8 823	40
Union	87 540	12 500	72	16 500	41
SOUTH CAROLINA[3]					
Cherokee	20 458	400	28	950	36
Chester	24 030	1 250	21	320	30
Chesterfield	58 279	2 900	15	1 000	32
Fairfield	8 844	750	20	200	28
Kershaw	30 257	4 750	22	750	35
Lancaster	12 067	1 200	20	310	35
Laurens	37 066	500	22	2 370	35
Newberry	34 458	2 100	21	1 550	38
Spartanburg	61 842	1 400	23	2 400	35
Union	8 813	450	20		
York	31 231	1 550	23	220	36

1. Yields in Bushels per Acre

2. Data from County Extension Chairman
North Carolina Department of Agriculture

3. Data from South Carolina Crop Statistics
1970 Preliminary
South Caroline Crop and Livestock Reporting Service

e 4.4-2

Food Crops
nd Yield[1]

	Oats		Barley		Soybeans	
ld	Acreage	Yield	Acreage	Yield	Acreage	Yield
	2 600	70	1 400	50	12 000	29
	440	36	195	33	1 200	29
	2 608	56	1 504	35	3 403	25
	3 200	85	3 000	60	7 000	30
	3 000	60	1 800	55	8 000	20
	2 500	55	3 000	60	3 000	25
	10 440	58	5 800	52	10 300	25
	4 000	50	4 000	60	10 000	25
	1 182	47	930	27	1 780	22
	5 951	56	6 608	35	5 026	25
	800	43	300	50	3 000	30
	3 195	56	4 098	35	8 109	25
	3 300	55	1 600	47	39 000	26
	270	39	340	38	1 200	20
	480	35	350	36	1 400	21
	720	39	250	34	25 400	19
	220	33	50	36		
	240	33	300	44	9 900	20
	460	38	50	34	1 200	20
	1 550	46	1 600	53	6 000	20
	4 100	42	1 750	47	11 500	19
	1 850	43	950	37	12 600	18
	160	39	40	38		
	600	40	350	50	1 200	21

Industries Within 10 Miles

Key Symbol	Name	Number of Employees	Type of Business
M- 1	Shuford Mill, Clover Plant	45	Textiles (commission flocking)
M- 2	American Thread Co.	450	Textiles (thread, rug and knitting yarns)
M- 3	Chadburn Hosiery Co.	40	Distribution center for womens hosiery
M- 4	Kent Moore Corp. E.I.P.	25	Metal finishing
M- 5	Cannon Mills Co., Plant No. 3	300	Textiles (sheeting)
M- 6	Crown Southern, Neely Plant	80	Textiles (spinning)
M- 7	Springs Mills, Ft. Mill Plant	1 138	Textiles (sheeting)
M- 8	Springs Mills, White Plant	595	Textiles (sheeting)
M- 9	Randolph Yarn, Inc.	128	Orlon
M-10	Hosiery Corp. of America	150	Finished nylons
M-11	Smith Enterprises	350	Christmas gifts, Easter baskets, etc.
M-12	York Corrugated Containers	160	Corrugated boxes
M-13	M. Lowenstein & Sons	401	
M-14	Celanese Fibers Co.	1 995	Acetate triacetate filament yarn
M-15	Star Paper Tube	126	Paper tubes
M-16	J. P. Stevens Co., Aragon Plant	500	Rayon & Synthetic fabrics
M-17	J. P. Stevens Co., Industrial Plant	850	Blue denims
M-18	M. Lowenstein & Sons	3 225	Print, dye & finish cotten & synthetic yarns
M-19	Ostrow Textile Co.	107	Finish, sort & package bed linens, towels and blankets
M-20	Mt. Vernon Mills, Inc.	215	Combed cotten and blended synthetics
M-21	Associated Mechanical Erectors	100	Machinery installation
M-22	Westinghouse Nuclear Turbine Plant	900	Nuclear turbine manufacturing
M-23	B. F. Goodrich, Footwear Co.	216	Warehousing footwear
M-24	Fruehauf Div. Fruehauf Corp.	350	Trailer manufacturers
M-25	Southern Acom Sales	24	Vending machine distributors
M-26	Cone Mills Corp.	425	Unfinished cloth
C- 1	Ivanya, Inc.	-	-
C- 2	Diamond Shamrock Chemical Co.	100	Special chemicals

Industries Within 10 Miles

Key Symbol	Name	Number of Employees	Type of Business
-	ARROWOOD INDUSTRIAL PARK		
	Superior Stone Co.	79	Rock quarry, crushed stone
	Whitin Machine Works, Inc.	100	Textile sales and warehouse
	Cisne & Associates, Inc.	200	General contractors
	Industrial Piping, Inc.	125	Piping contractors
	Hayes-Albion Corp., Textile Division	67	Aluminum beams
	Henley Paper Co.	27	Paper warehouse
	Buxton, Inc.	7	Manufacturer of Buxton billfolds
	Armstrong Cork Co.	55	Manufacturer of carpet backing
	Crompton & Knowles Corp.	80	Manufacturer of textile machinery
	Eastex Packaging, Inc.	100	Manufacturer of folding cartons
	American Barmag Corp.	100	Manufacturer of textile machinery
	Wrenn Bros. Carolina, Inc.	75	Hyster forklift sales
	St. Joe Paper Co.	90	Manufacturer of corrugated containers
	Display Fixture Co.	100	Manufacturer of store displays
	Gill Mfg. Co.	35	Manufacturer of farm & industrial machinery
	Microtron Corp.	35	Manufacturer of air filters
	Inmont Corp.	82	Manufacturer of printing ink and dye
	Style Craft Packaging	250	Packaging of plastics
	Duff-Norton Co.	360	Manufacturer of hydraulic jacks
	General Tire and Rubber Co.	800	Manufacturer of tires
	General Foods Corp.	29	Food distribution
	W. T. Grants Warehouse	40	Freight warehouse
	Allied Chemical Corp.		Not in operation

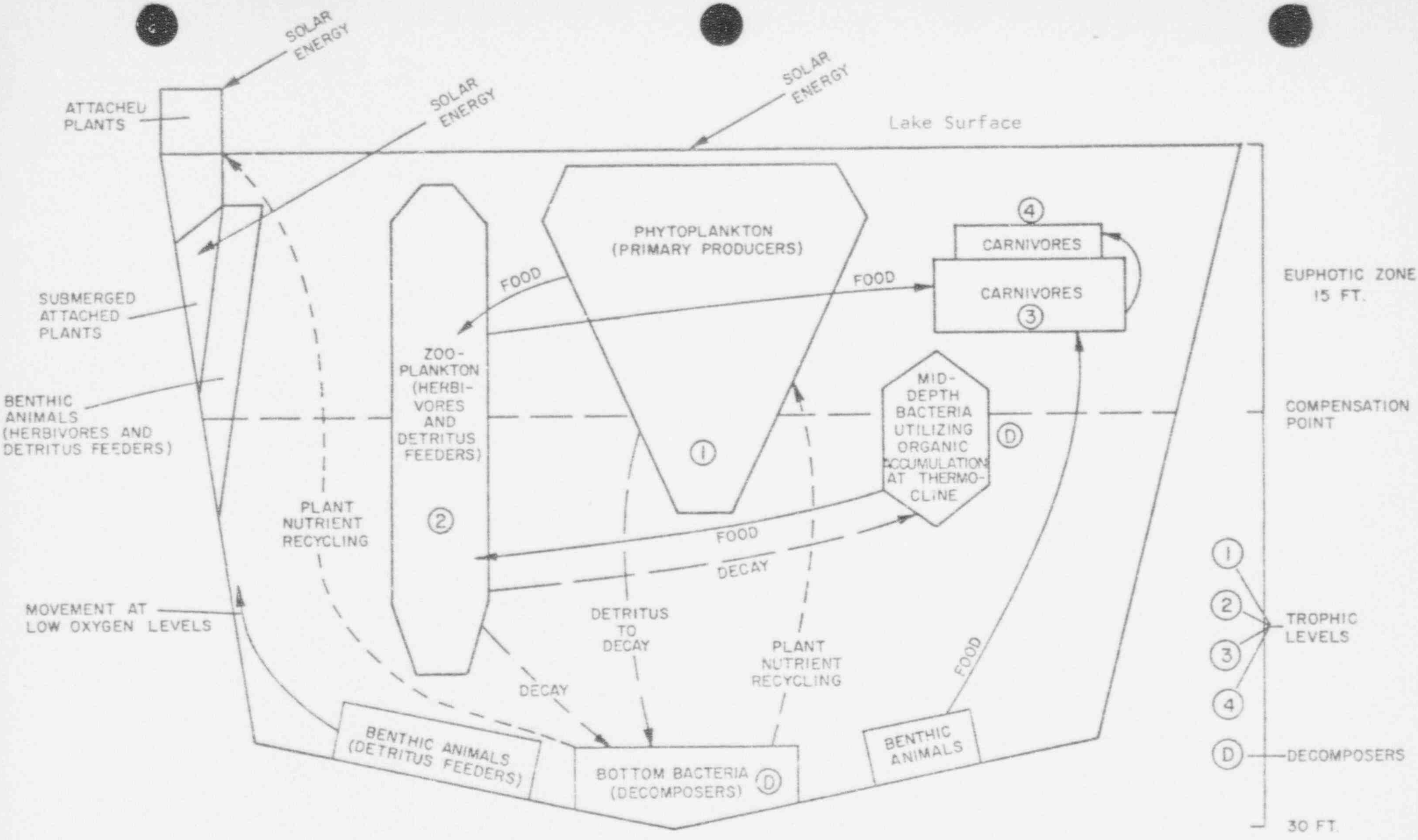
ER Table 4.4-4 (Page 1 of 2)

Public Facilities and Institutions

Libraries	Name	Population	Distance	Direction
L-1	Fort Mill Public Library	36	8.2	ESE
L-2	Rock Hill Public Library	120	9.2	SSE
L-3	Winthrop College Library	750	7.9	SSE
L-4	York Pulbic Library	33	10.2	WSW
L-5	Clover Public Library	44	9.5	WNW
Parks				
P-1	Little Mountain Family Campground	300	4.5	NW
P-2	Catawba Girl Scout Camp	135	2.4	WSW
P-3	Bethelwood Camp	100	6.2	SSW
P-4	Childrens Nature Museum	500	3.1	SSE
P-5	Harris Road Park and Playground	150	7.4	ESE
P-6	York County Park	100	2.5	SE
P-7	Camp Thunderbird	532	4.3	NNE
P-8	Camp Steere	200	3.9	NNE
P-9	Mecklenburg County Park	1 000	7.4	NNE
Prison Camps				
PC-1	York County Prison Camp	90	8.7	SW
Schools				
S-1	Middle Elementary School	805	9.4	WNW
S-2	Clover High School	775	9.2	WNW
S-3	Episcopal Church Home for Children	668	9.9	WSW
S-4	York Centralized High School	1 046	9.7	WSW
S-5	Bethel Elementary School	290	4.0	NW
S-6	Riverview School	178	6.1	ESE
S-7	A. O. Jones School	588	8.3	ESE
S-8	Fort Mill Junior High	431	9.0	ESE
S-9	Carother's Elementary School	553	8.4	ESE
S-10	Fort Mill High School	695	9.3	ESE
S-11	York Road Elementary	560	7.1	S
S-12	Northwestern High School	1 639	7.3	S
S-13	Rawlinson Road Junior High School	1 250	7.2	S
S-14	Ebinport School	557	6.3	SSE
S-15	Catawba Academy	319	5.8	SSE
S-16	Rosewood School	648	6.1	SE
S-17	Rock Hill High School	1 858	7.5	SSE
S-18	Richmond Drive School	603	7.4	SSE
S-19	Winthrop College	4 500	8.2	SSE
S-20	Ebenezer Avenue School	512	8.7	SSE

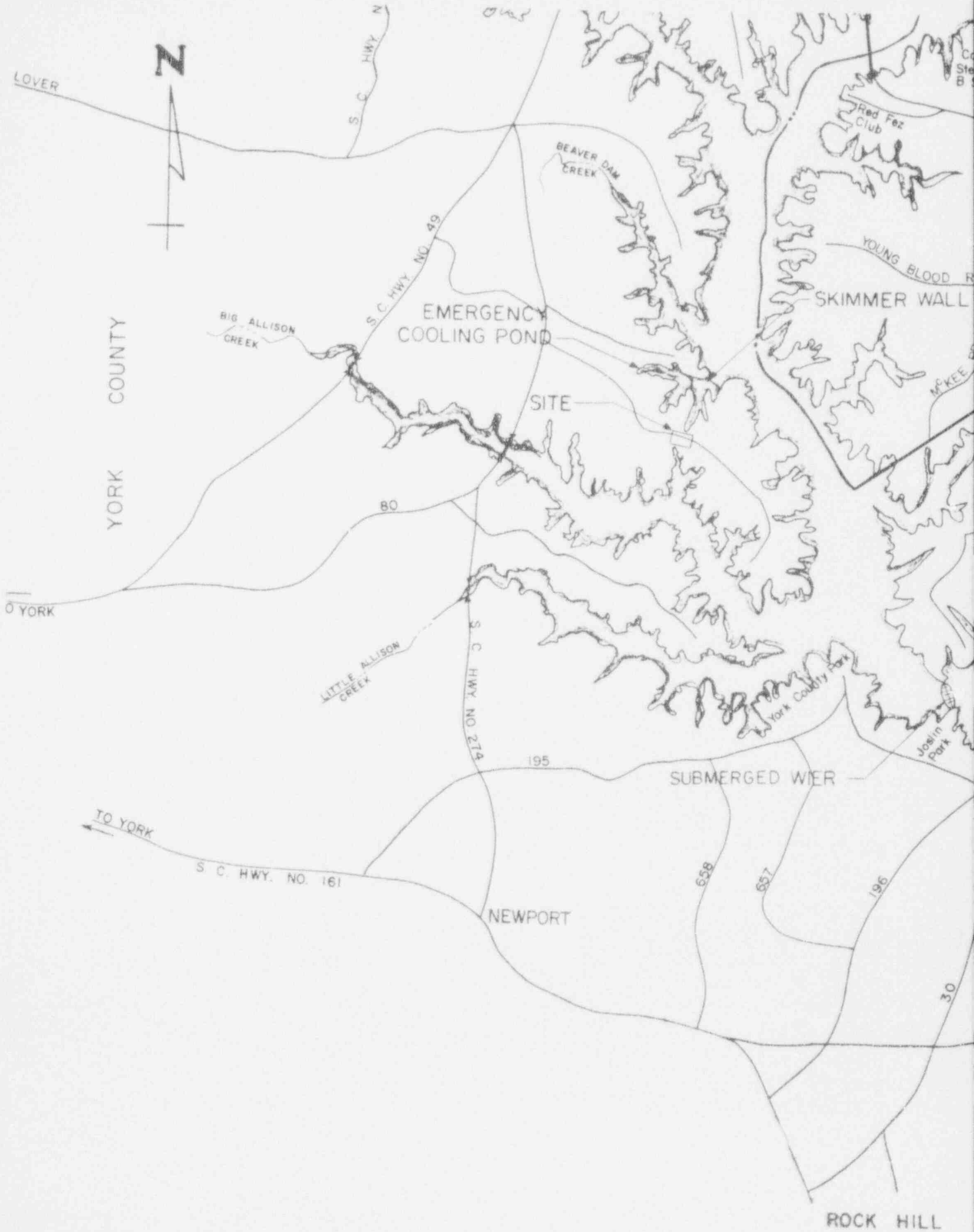
Public Facilities and Institutions

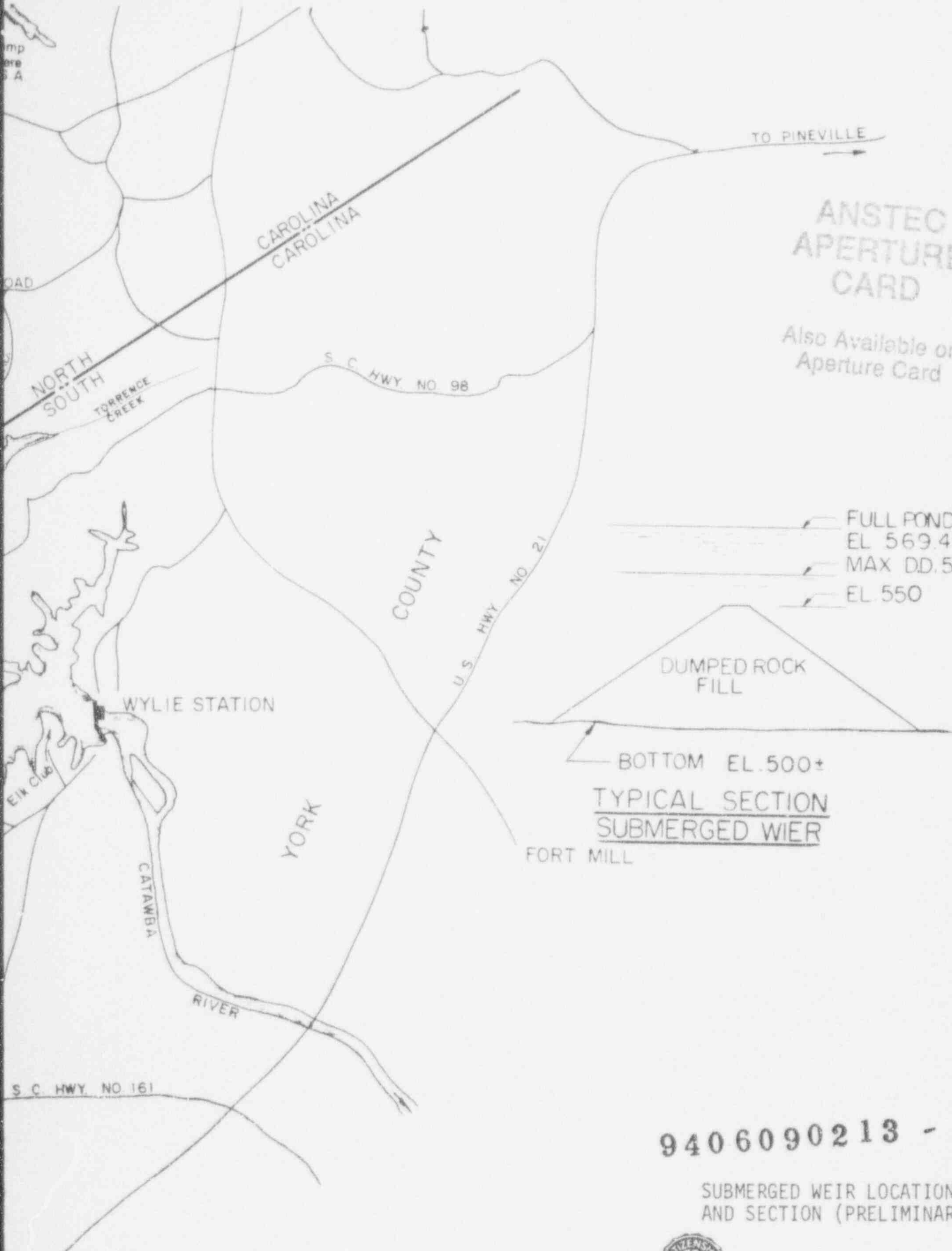
Schools	Name	Population	Distance	Direction
S-21	Friendship College	236	8.9	SSE
S-22	Finley Road School	414	8.7	S
S-23	Sunset Park School	484	9.4	S
S-24	Arcade Victoria Special Education School	220	9.2	SSE
S-25	Sylvia Circle Elementary	419	10.0	SSE
S-26	Central Elementary	426	9.7	SSE
S-27	Sullivan Junior High	1 750	9.4	SSE
S-28	Northside Elementary	471	9.2	SSE
S-29	Belleview Elementary	412	9.9	SSE
S-30	York Technical Education Center	1 263	9.3	SE
S-31	Clinton Junior College	217	9.8	S
S-32	Olympic High School	1 570	9.3	NE
S-33	Steele Creek Elementary	586	9.2	NE
S-34	Pineville Elementary	500	10.0	E
Hospitals				
H-1	York General Hospital	762	7.0	SSE
H-2	Devine Saviour Hospital	228	10.7	WSW



Diagrammatic Presentation of Trophic Levels In Lake Wylie

CATAWBA NUCLEAR STATION
ER Figure 4.1-1


N
LOVER
S. C. HWY. N
BEAVER DAM CREEK
Red Fez Club
YOUNG BLOOD R
SKIMMER WALL
S. C. HWY. NO. 49
EMERGENCY COOLING POND
BIG ALLISON CREEK
YORK COUNTY
SITE
McKEE
80
O YORK
LITTLE ALLISON CREEK
S. C. HWY. NO. 274
York County Park
Joslin Park
195
SUBMERGED WIER
TO YORK
S. C. HWY. NO. 161
658
657
196
NEWPORT
30
ROCK HILL

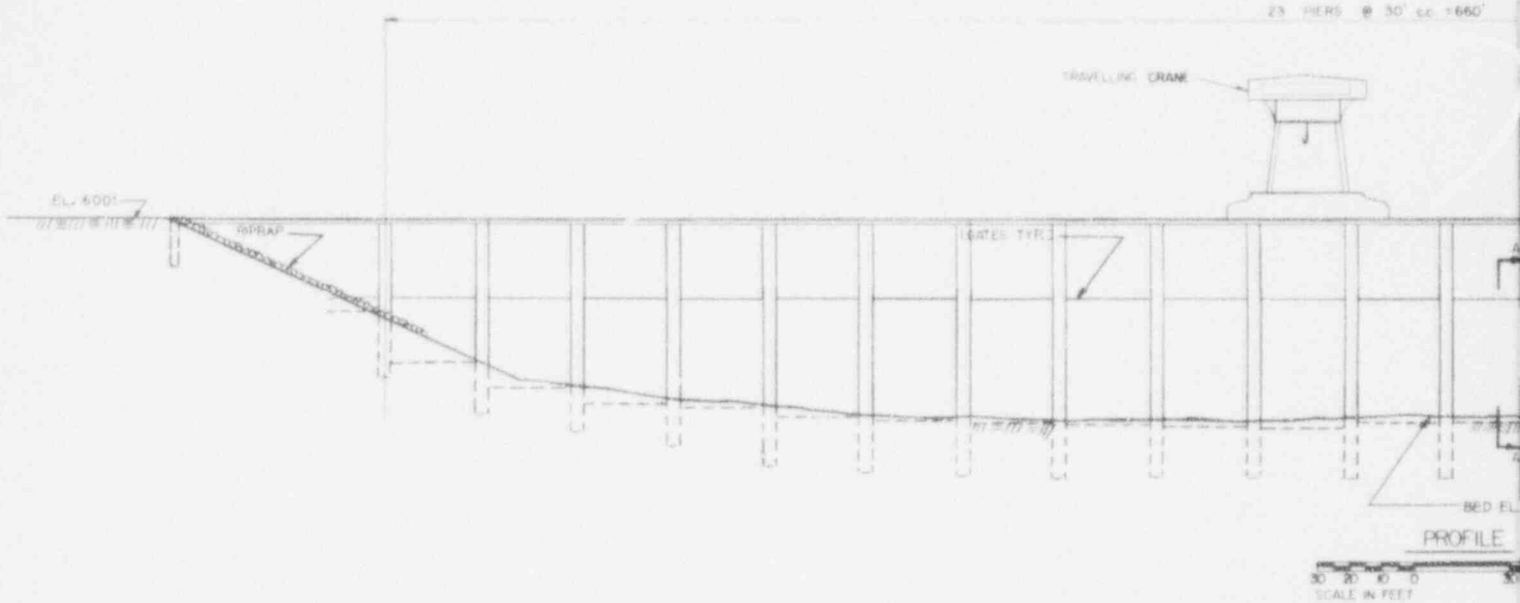


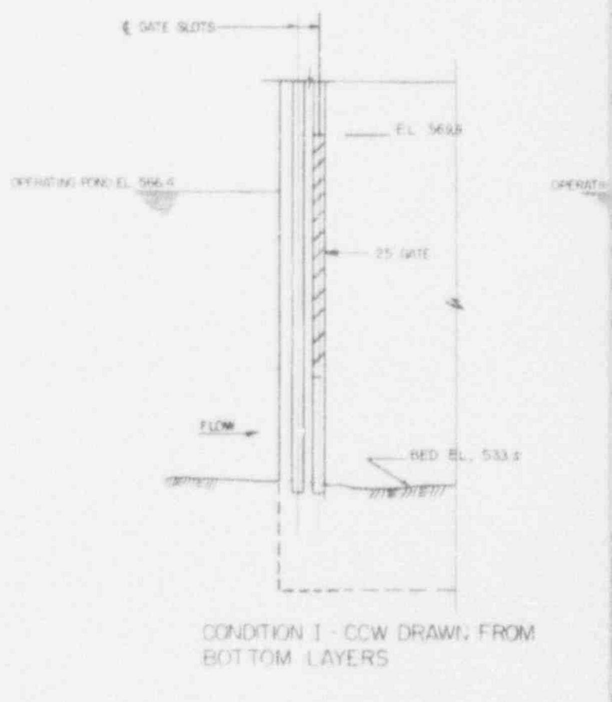
9406090213 - 27

SUBMERGED WEIR LOCATION
AND SECTION (PRELIMINARY)

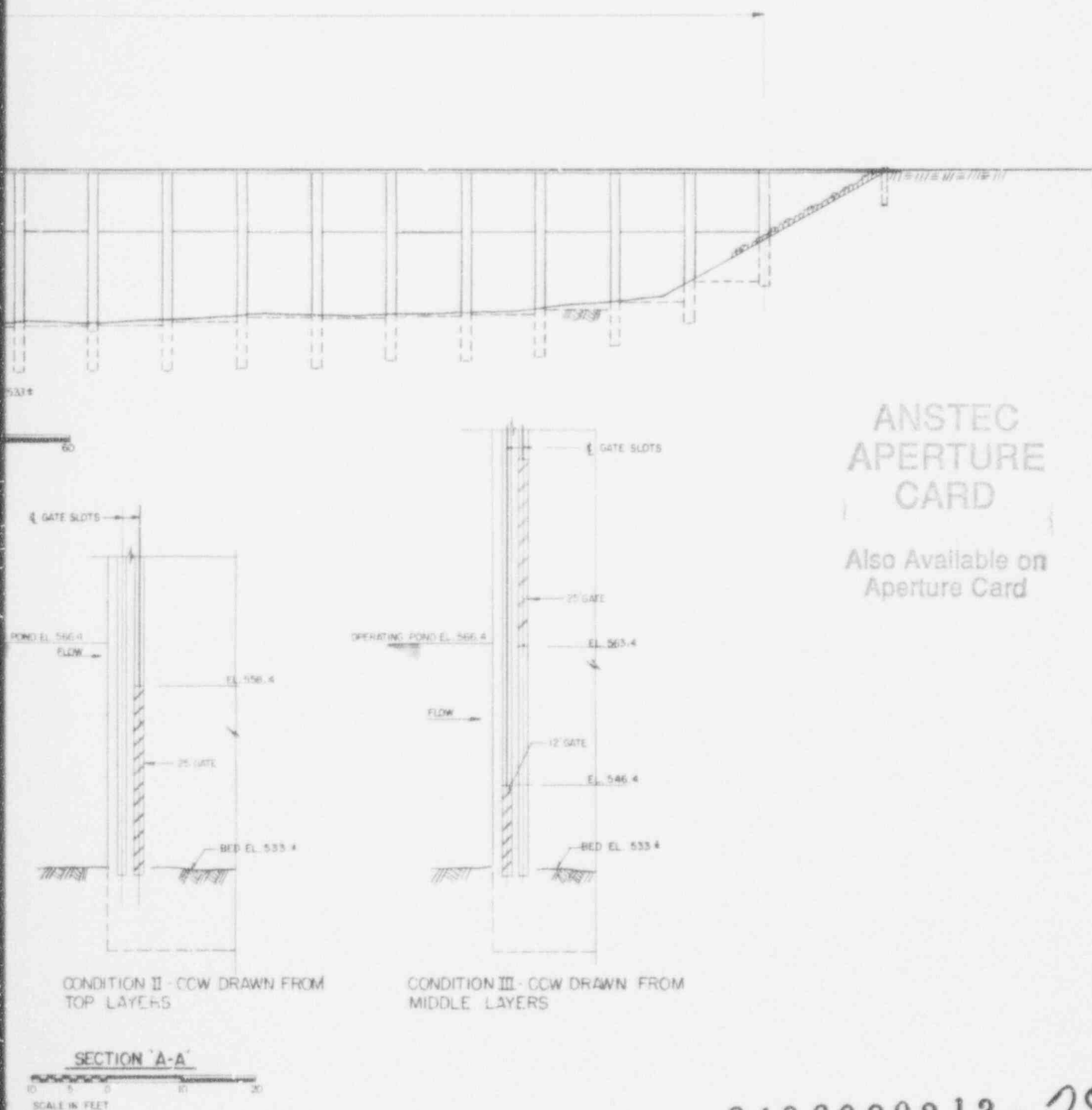
CATAWBA NUCLEAR STATION

ER Figure 4.1-2





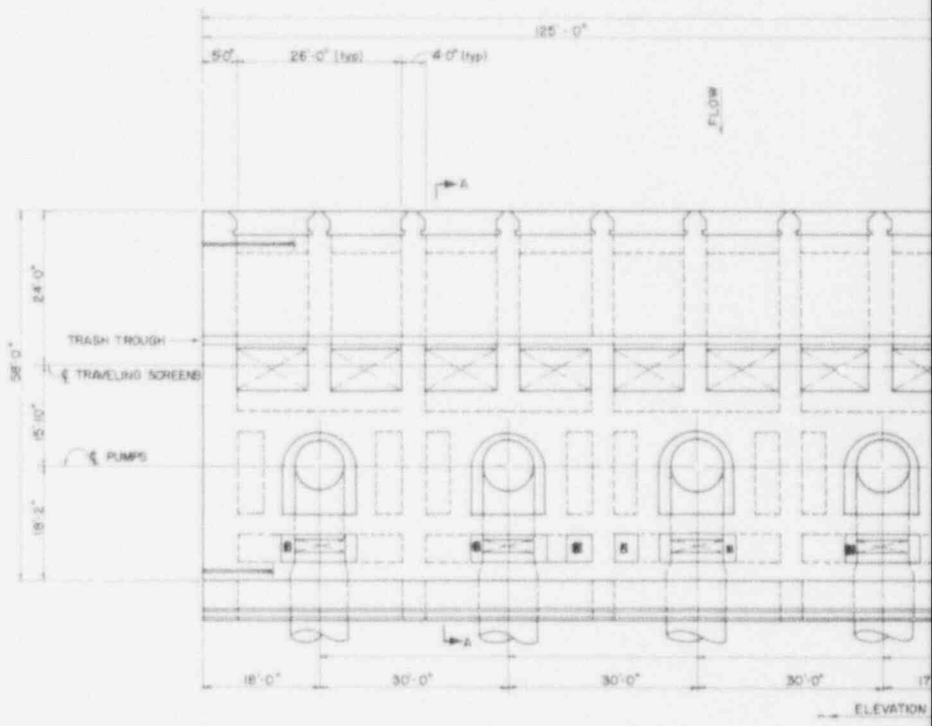
CONDITION I - CCW DRAWN FROM BOTTOM LAYERS

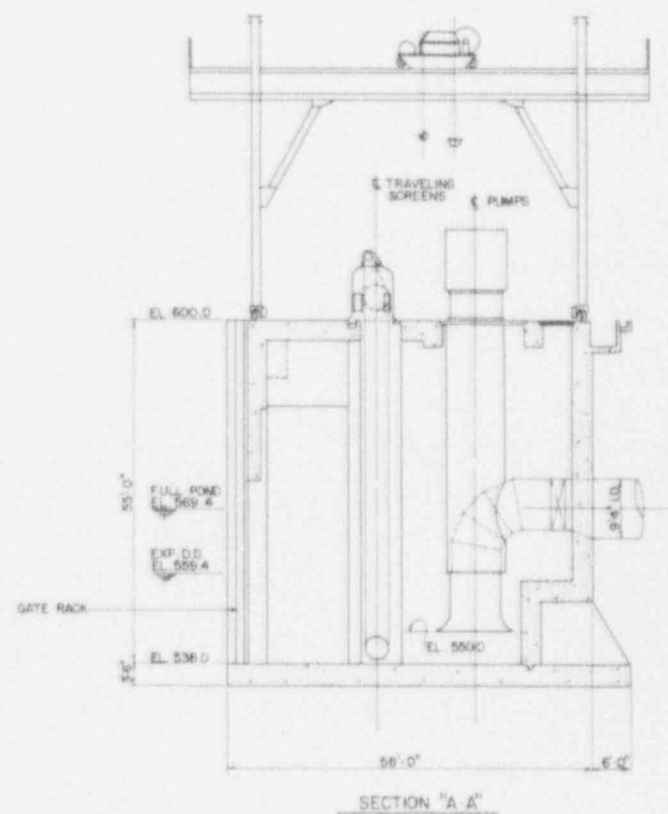


SKIMMER WALL (PRELIMINARY)

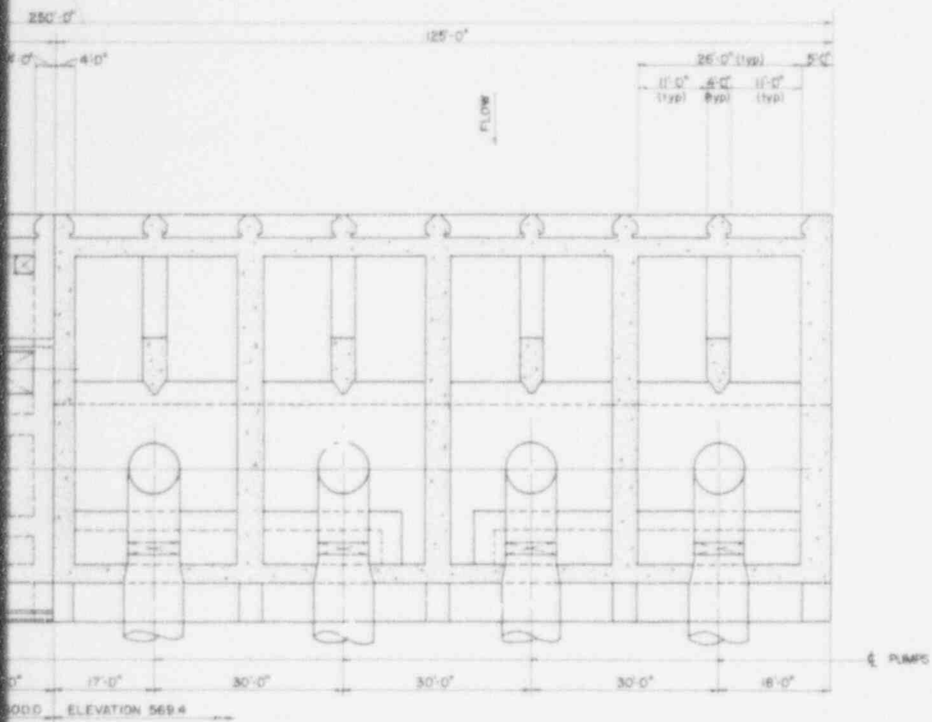
CATAWBA NUCLEAR STATION

ER Figure 4.1-3


125'-0"
5'-0"
26'-0" (typ)
4'-0" (typ)
FLOW
A
24'-0"
58'-0"
15'-10"
18'-2"
TRASH TROUGH
℄ TRAVELING SCREENS
℄ PUMPS
18'-0"
30'-0"
30'-0"
30'-0"
ELEVATION


℄ TRAVELING SCREENS
℄ PUMPS
EL. 600.0
55'-0"
FULL POND EL. 569.4
EXP. D.D. EL. 559.4
GATE RACK
EL. 536.0
EL. 550.0
9'-6" I.D.
58'-0"
6'-0"

SECTION "A-A"



PLAN

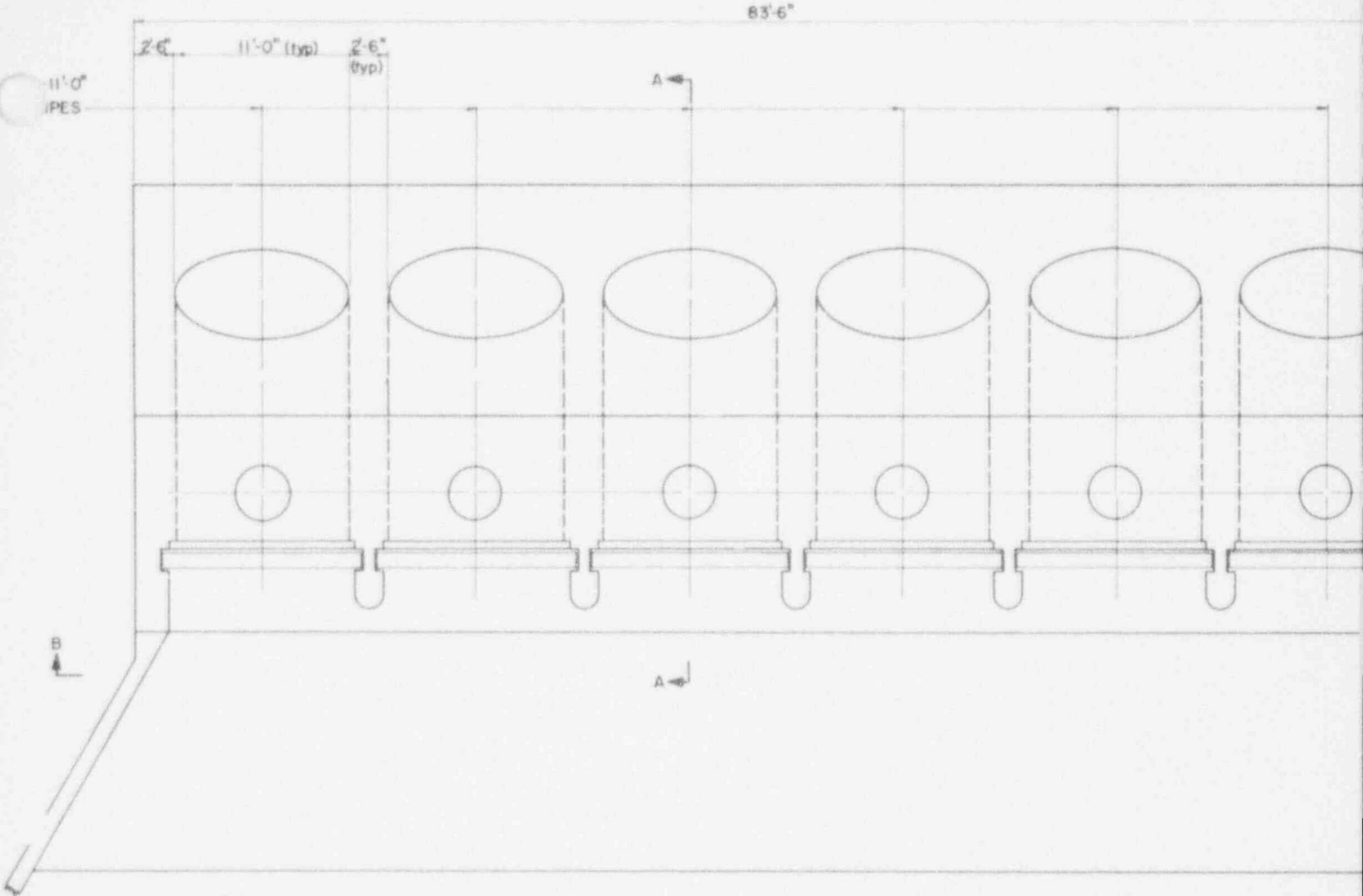
SCALE IN FEET

9406090213 - 29

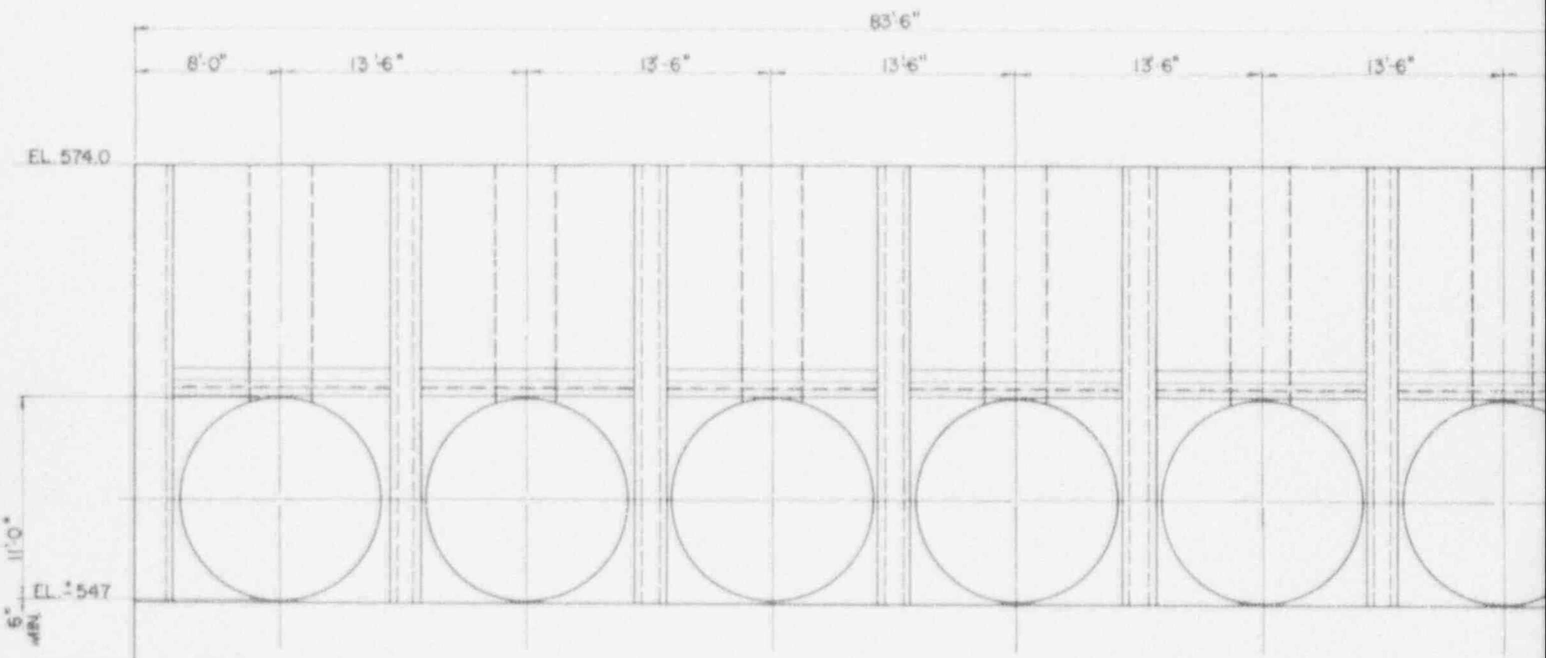
INTAKE STRUCTURE
PLAN AND SECTION (PRELIMINARY)

CATAWBA NUCLEAR STATION

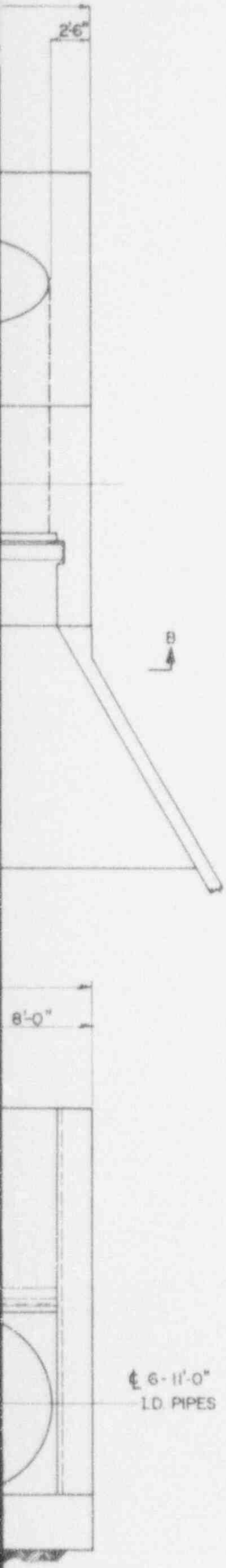
ER Figure 4.1-4

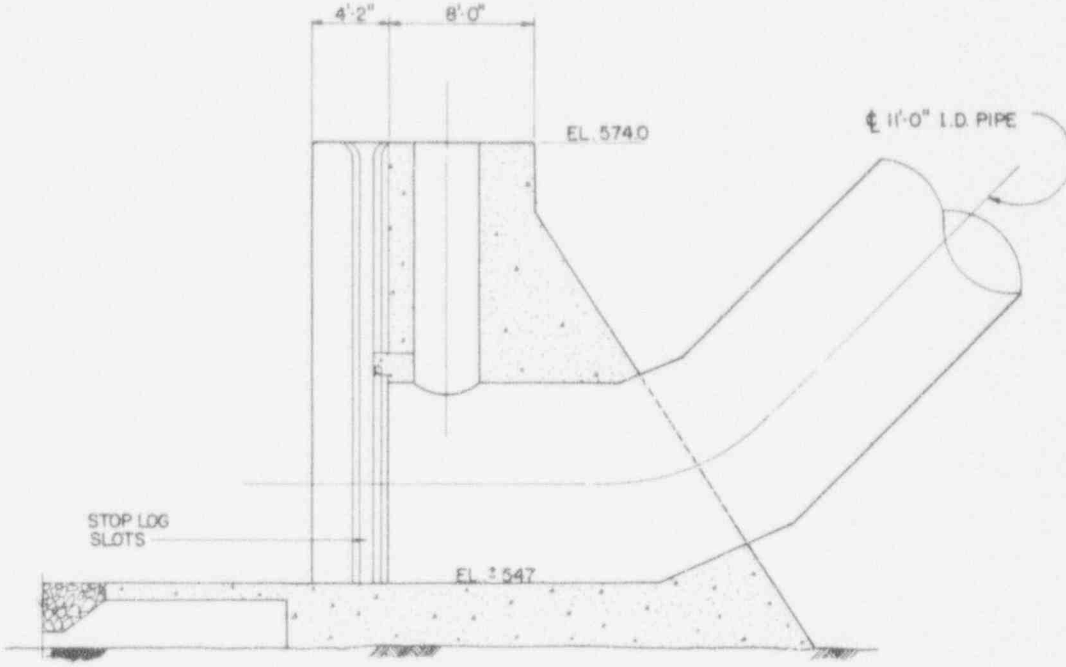


PLAN



ELEVATION "B-B"



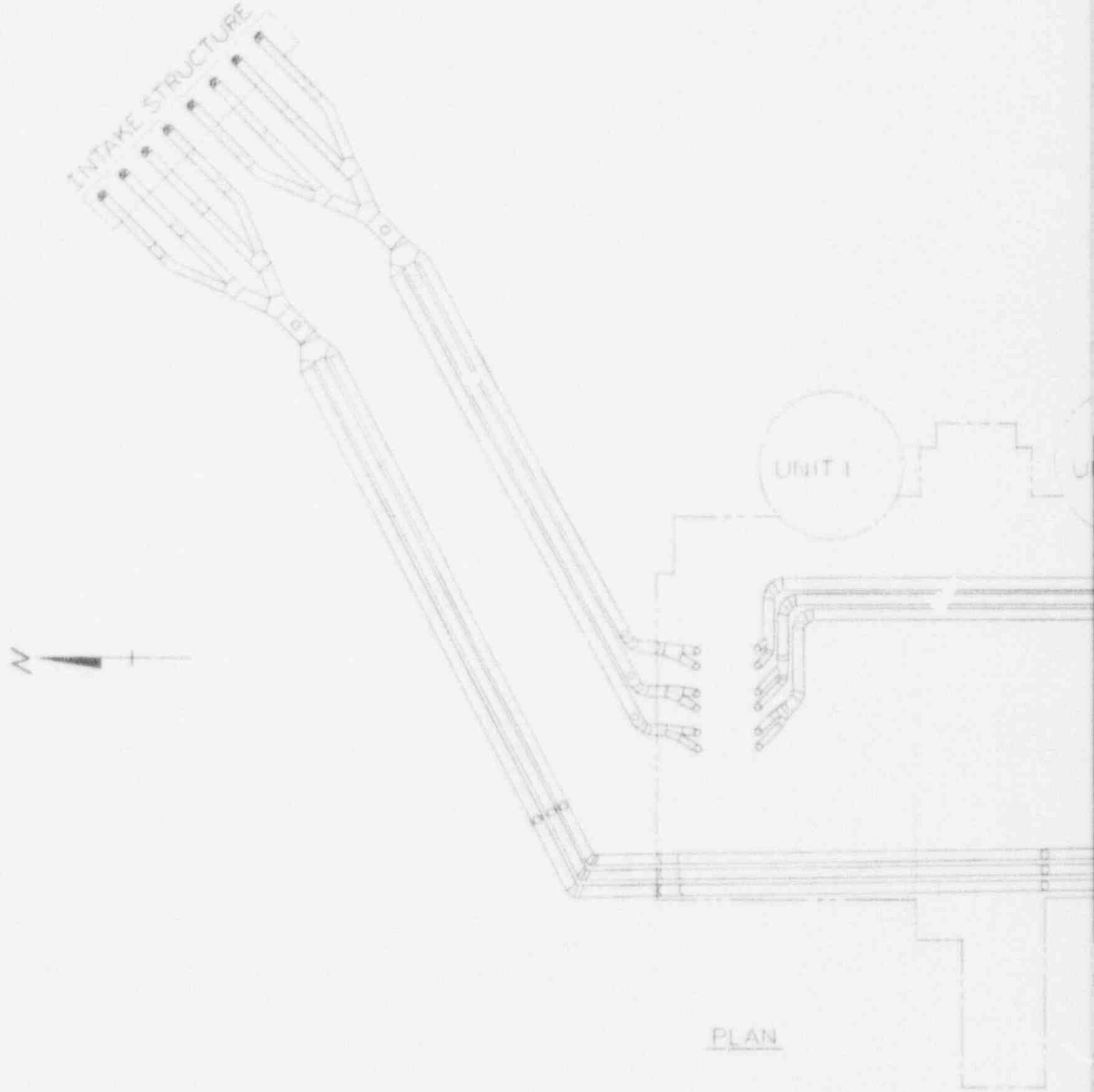


SECTION "A-A"

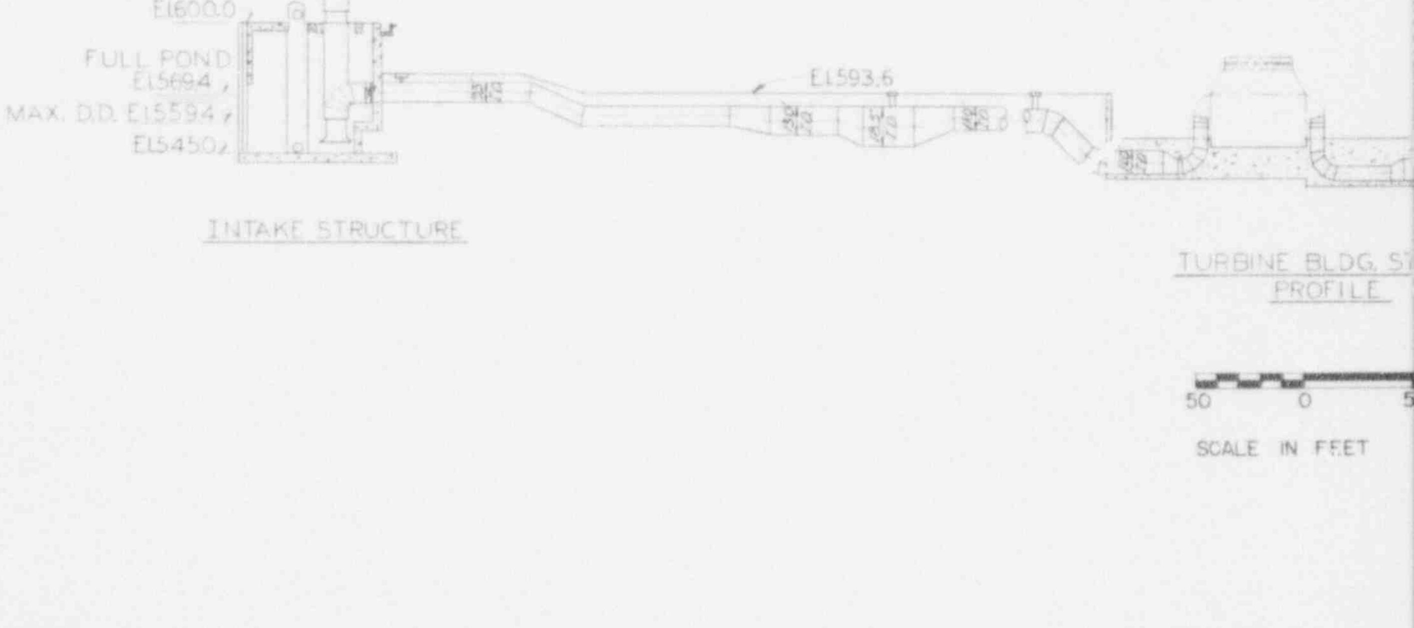
DISCHARGE STRUCTURE
PLAN AND SECTION (PRELIMINARY)

CATAWBA NUCLEAR STATION

ER Figure 4.1-5

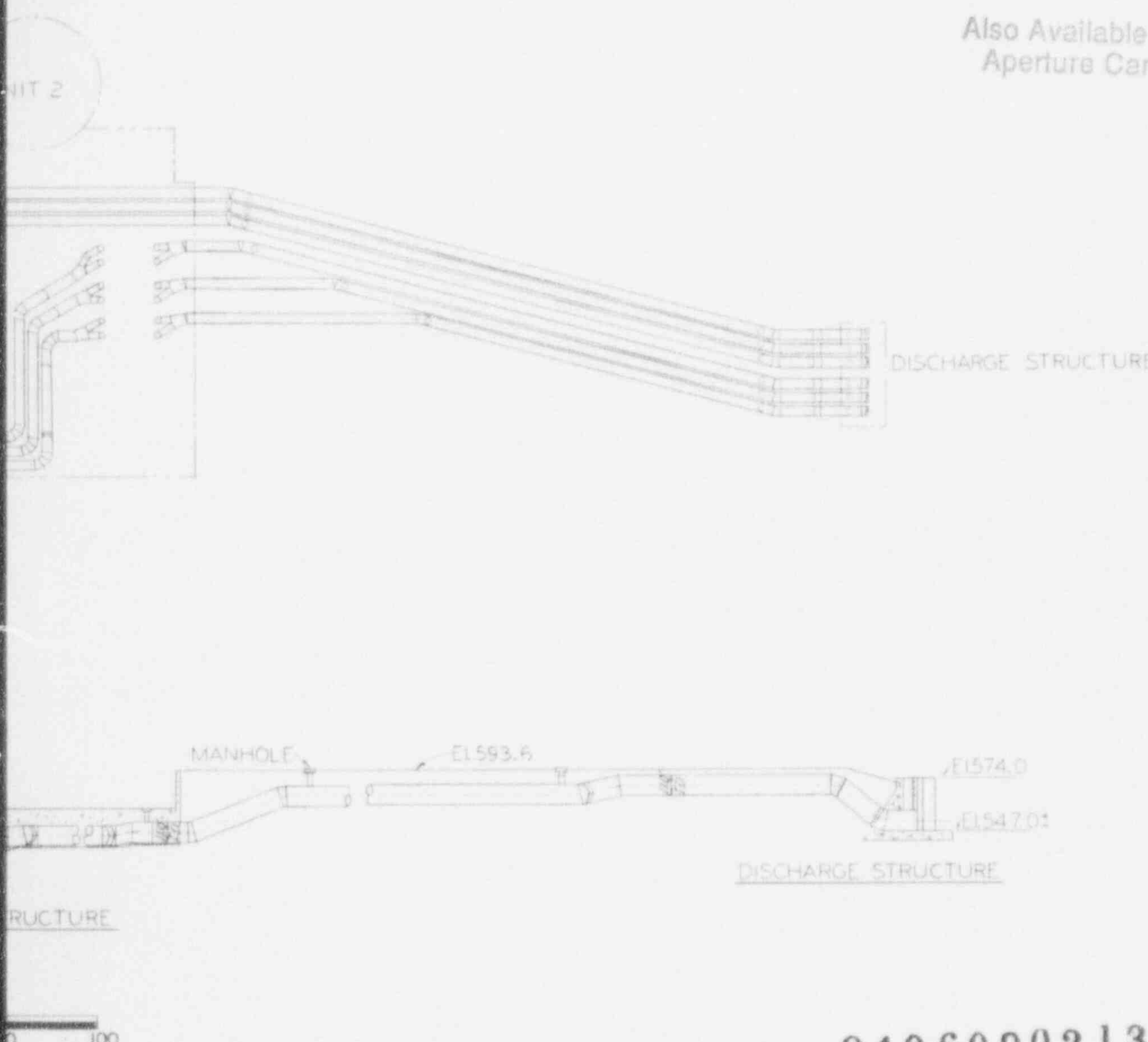


PLAN



INTAKE STRUCTURE

TURBINE BLDG. ST
PROFILE

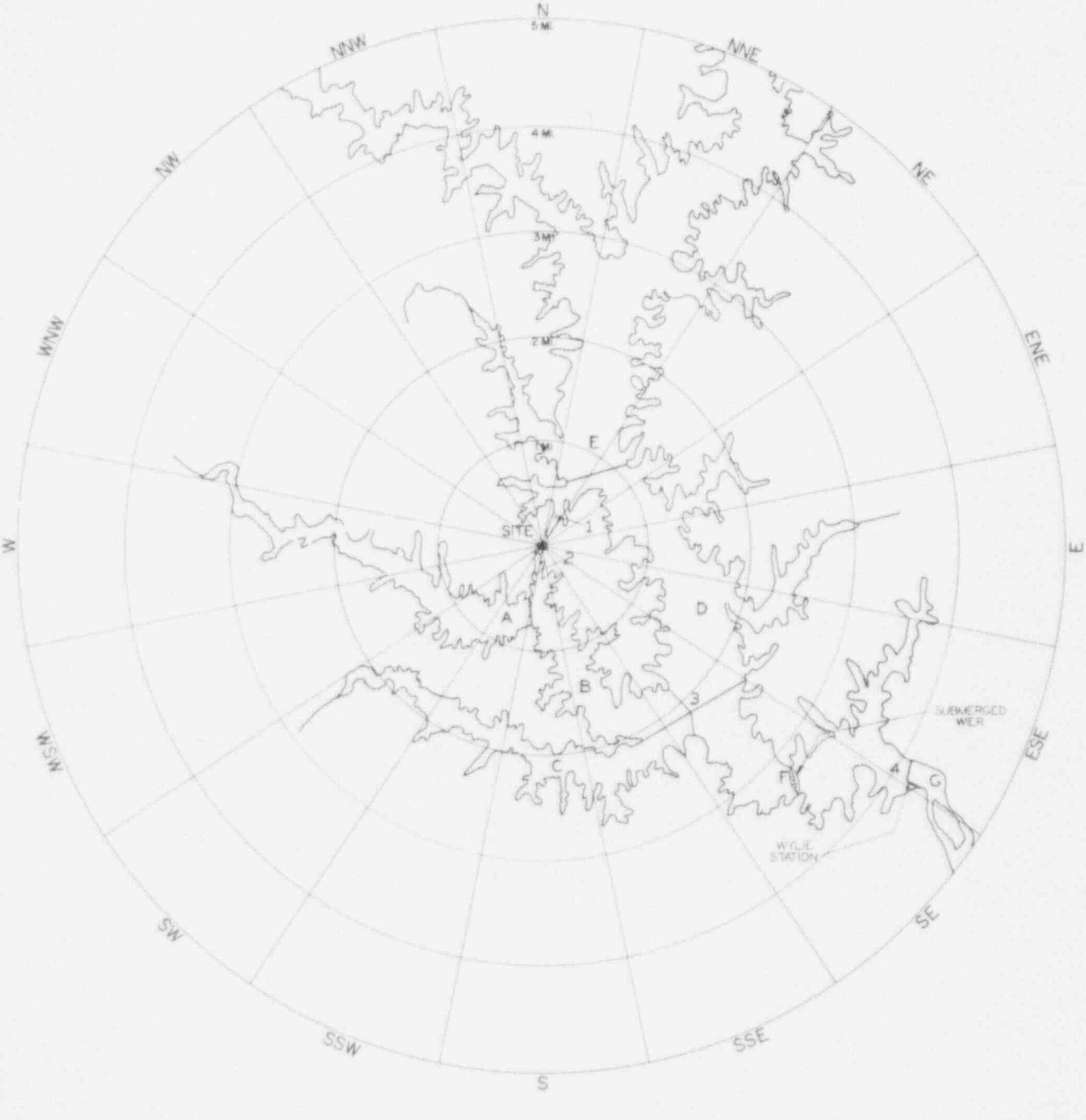


9406090213- 31

LAYOUT CONDENSER COOLING WATER SYSTEM

CATAWBA NUCLEAR STATION

ER Figure 4.1-6



LAKE SECTIONS FOR THERMAL EFFECTS COMPUTATIONS

CATAWBA NUCLEAR STATION

ER Figure 4.1-7

CATAWBA NUCLEAR STATION
BIG ALLISON CREEK
LITTLE ALLISON CREEK

9406090213-32

LAKE WYLIE BED TOPOGRAPHY

CATAWBA NUCLEAR STATION

ER Figure 4.1-8 (1 of 3)


MILL CREEK
CROWDERS CREEK
CATAWBA
BEAVER DAM CR.

1000 500 0 1000 2000 FEET

ELEVATIONS SHOWN TAKEN FROM
SURVEY DATED 11-25
CONTOUR INTERVAL 20 FT.

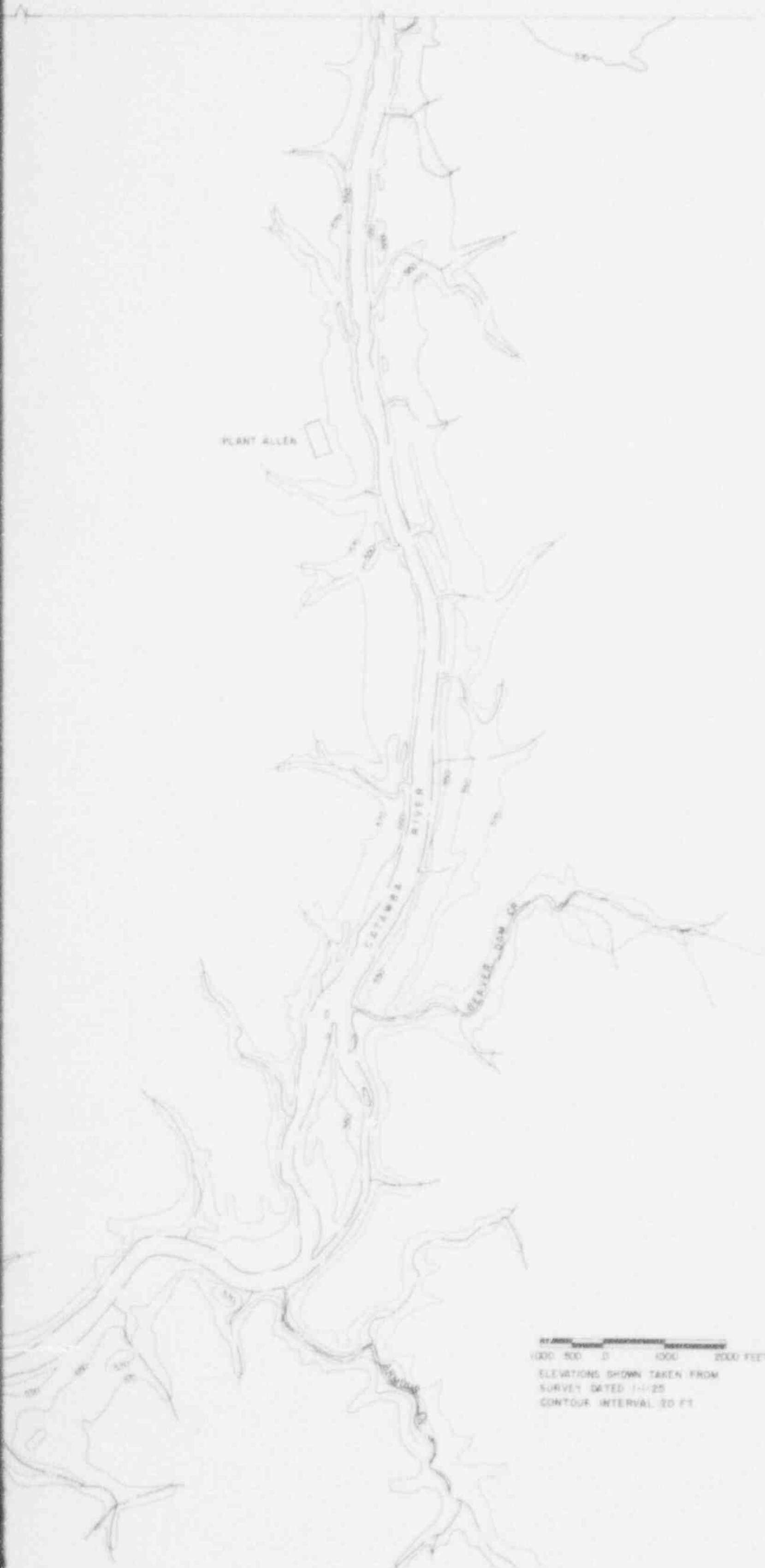
LAKE WYLIE BED TOPOGRAPHY

DUKE POWER

CATAWBA NUCLEAR STATION

ER Figure 4.1-8 (2 of 3)

CATAWBA CR.
SOUTH FORK CATAWBA RIVER
MATCH LINE SH 2

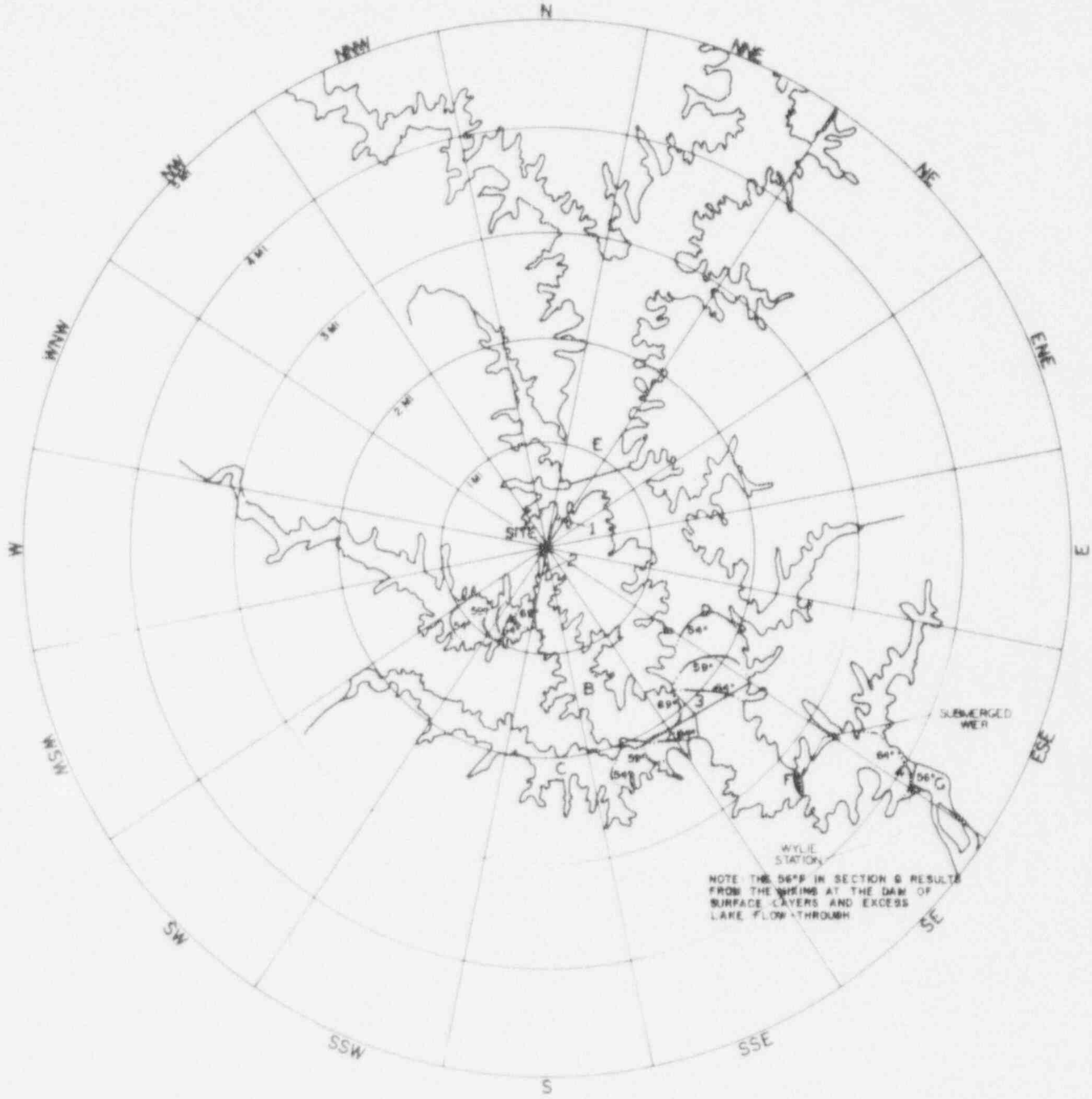


LAKE WYLIE BED TOPOGRAPHY

DUKE POWER

CATAWBA NUCLEAR STATION

ER Figure 4.1-8 (3 of 3)

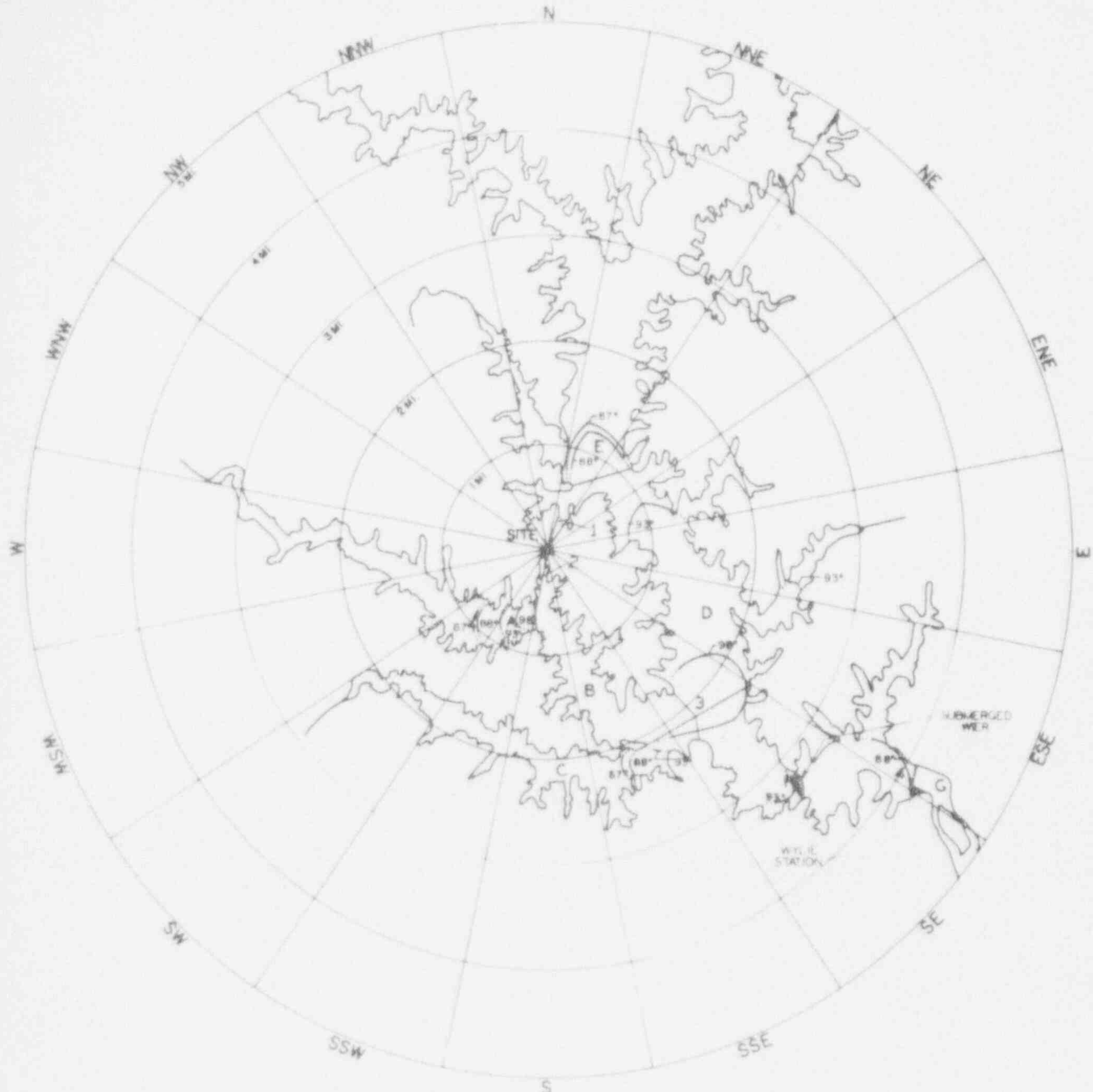


PREDICTED ISOTHERMS FOR JANUARY 1954 CONDITIONS
AMBIENT TEMPERATURE = 50.7°F
DISCHARGE TEMPERATURE = 74.4°F
90% OF THE WINTER DISCHARGE TEMPERATURES ARE LOWER THAN OR EQUAL TO THIS DISCHARGE TEMPERATURE

PREDICTED ISOTHERMS FOR
JANUARY 1954 CONDITIONS

CATAWBA NUCLEAR STATION

ER Figure 4.1-9

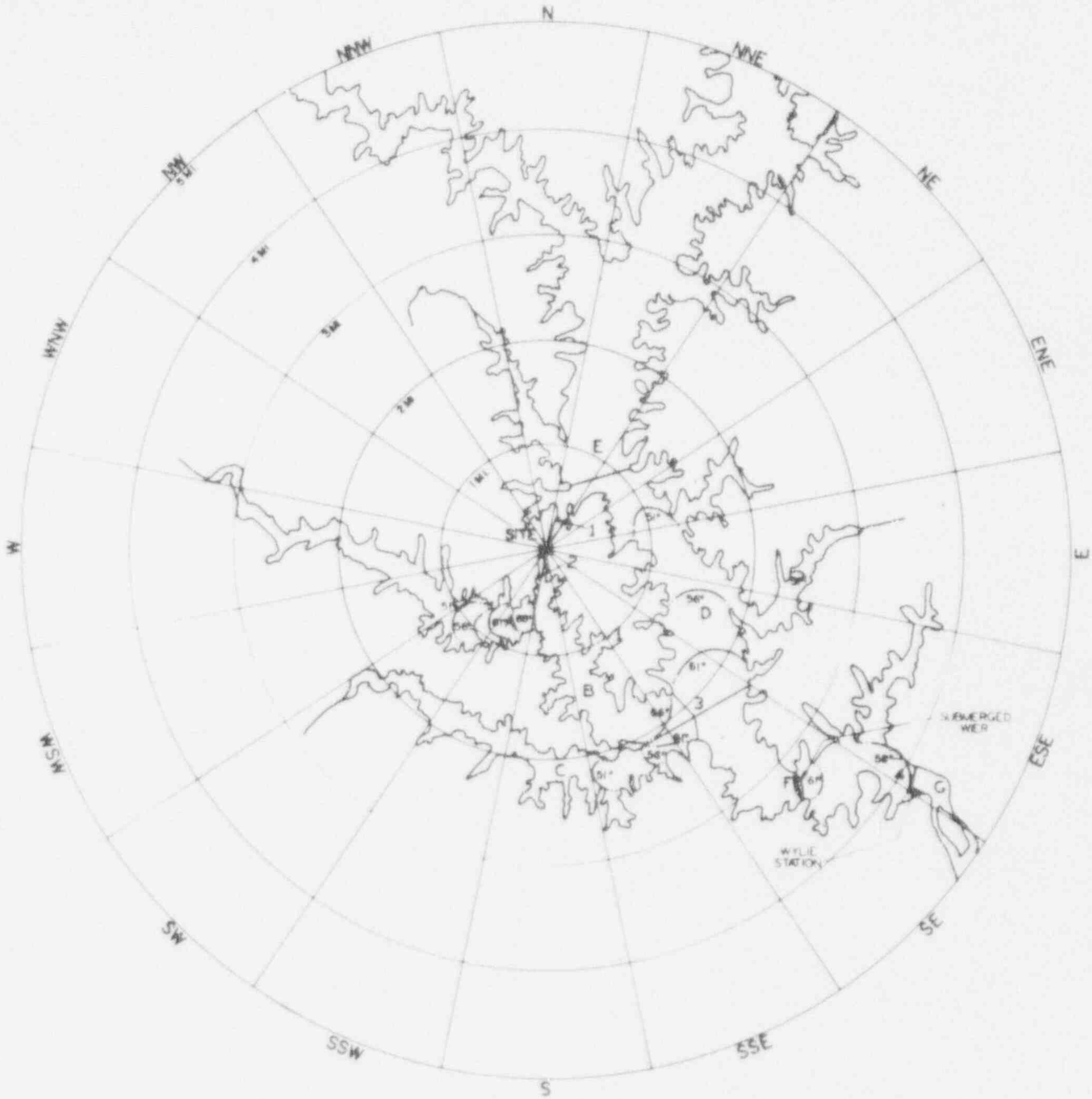


PREDICTED ISOTHERMS FOR JULY 1956 CONDITIONS
AMBIENT TEMPERATURE = 84.2°F
DISCHARGE TEMPERATURE = 102.5°F
90% OF THE SUMMER DISCHARGE TEMPERATURES ARE LOWER THAN OR EQUAL TO THIS TEMPERATURE.

PREDICTED ISOTHERMS FOR
JULY 1956 CONDITIONS

CATAWBA NUCLEAR STATION

ER Figure 4.1-10

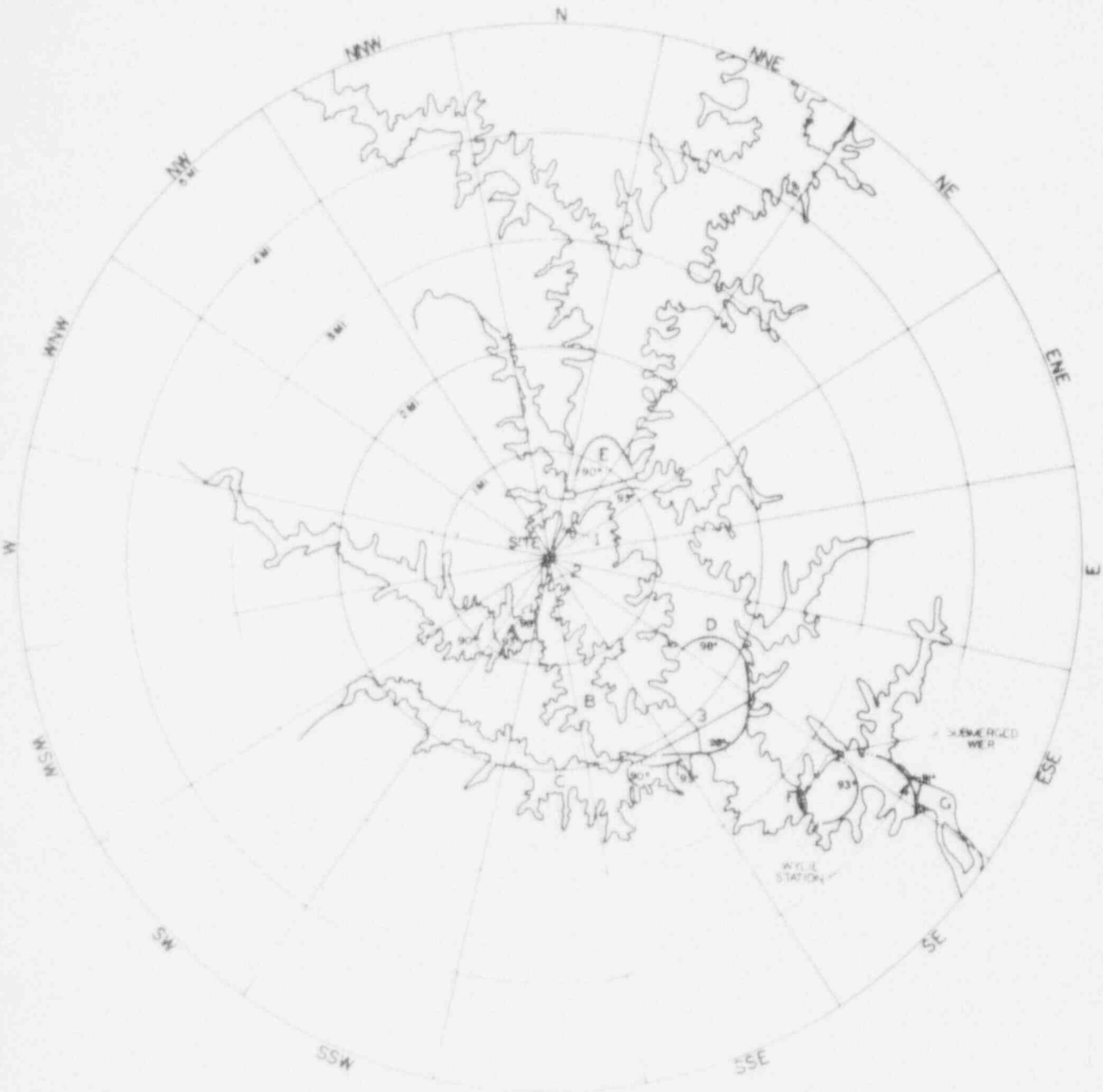


PREDICTED ISOTHERMS FOR JANUARY 1955 CONDITIONS
AMBIENT TEMPERATURE = 47.6°F
DISCHARGE TEMPERATURE = 71.3°F
90% OF THE WINTER LAKE AREAS AFFECTED TO THE 3°F EXCESS ISOTHERM ARE EQUAL TO OR LESS THAN THIS MONTH.

PREDICTED ISOTHERMS FOR JANUARY 1955 CONDITIONS

CATAWBA NUCLEAR STATION

ER Figure 4.1-11

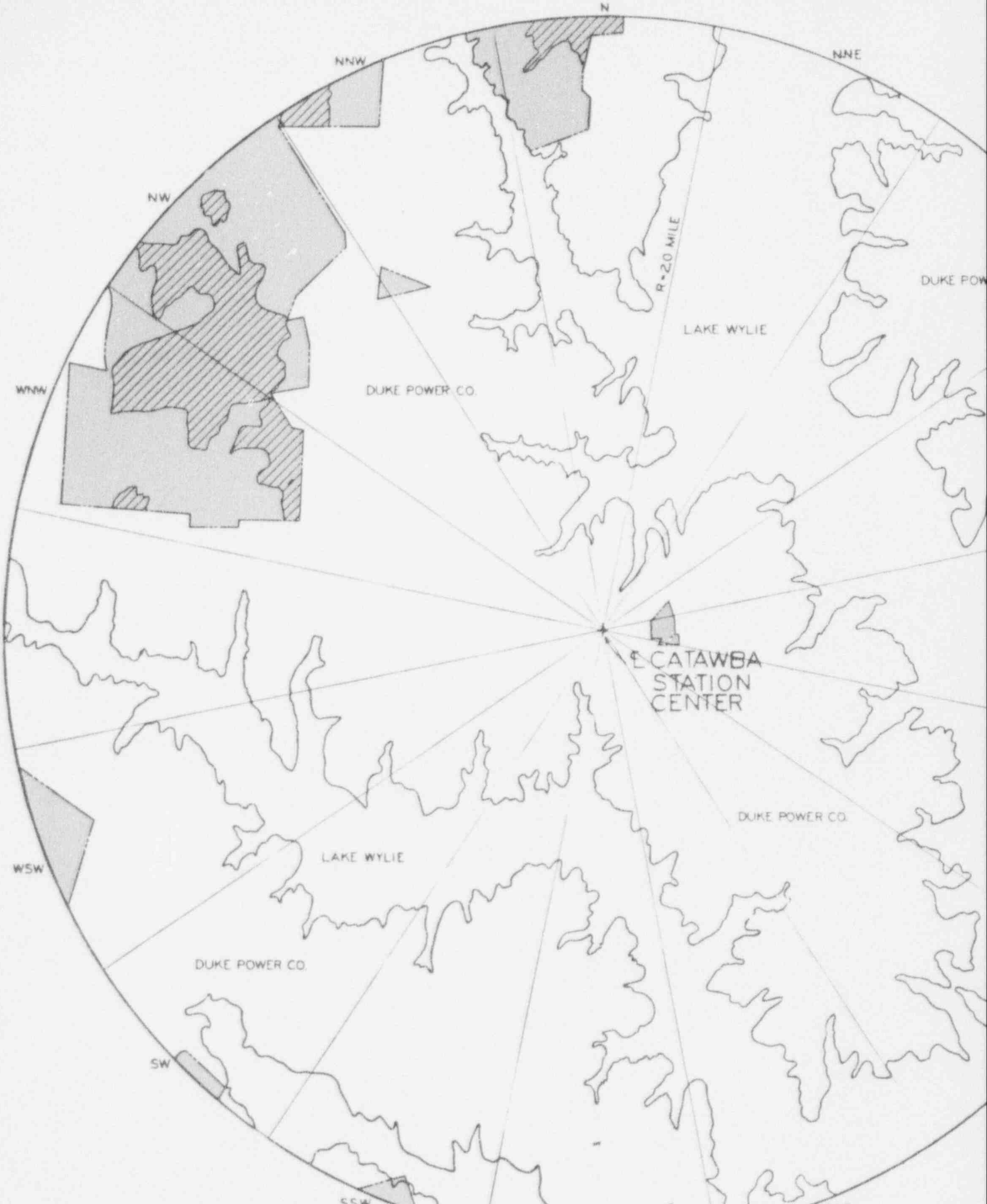


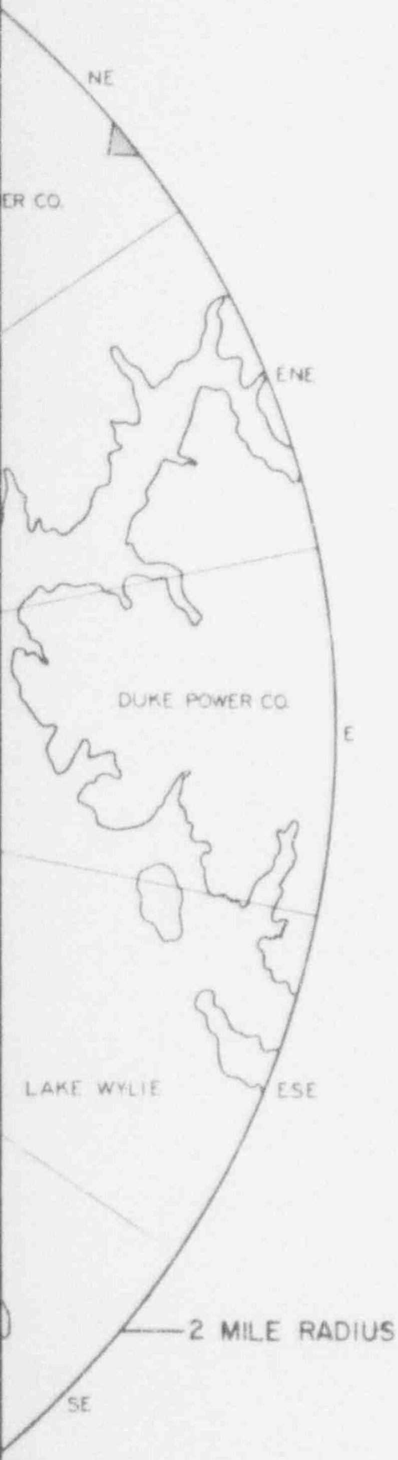
PREDICTED ISOTHERMS FOR JULY 1954 CONDITIONS
AMBIENT TEMPERATURE = 86.8°F
DISCHARGE TEMPERATURE = 103.0°F
90% OF THE SUMMER LAKE AREAS AFFECTED TO THE 3°F EXCESS ISOTHERM ARE EQUAL TO OR LESS THAN THIS MONTH

PREDICTED ISOTHERMS FOR
JULY 1954 CONDITIONS

CATAWBA NUCLEAR STATION

ER Figure 4.1-12


N
NNE
NNW
NW
WNW
W
WSW
SW
SSW
S
SSE
R-20 MILE
LAKE WYLIE
DUKE POWER CO.
CATAWBA
STATION
CENTER
DUKE POWER CO.
LAKE WYLIE
DUKE POWER CO.



SECTOR	APPROX. AREA OF CLEARED FARM LAND (ACRES)
N	20.3
NNE	0
NE	0
ENE	0
E	0
ESE	0
SE	0
SSE	0
S	0
SSW	0
SW	0
WSW	0
W	0
WNW	95.9
NW	91.0
NNW	10.7
TOTAL	217.9

SCALE IN MILES

1/2 1/4 0 1

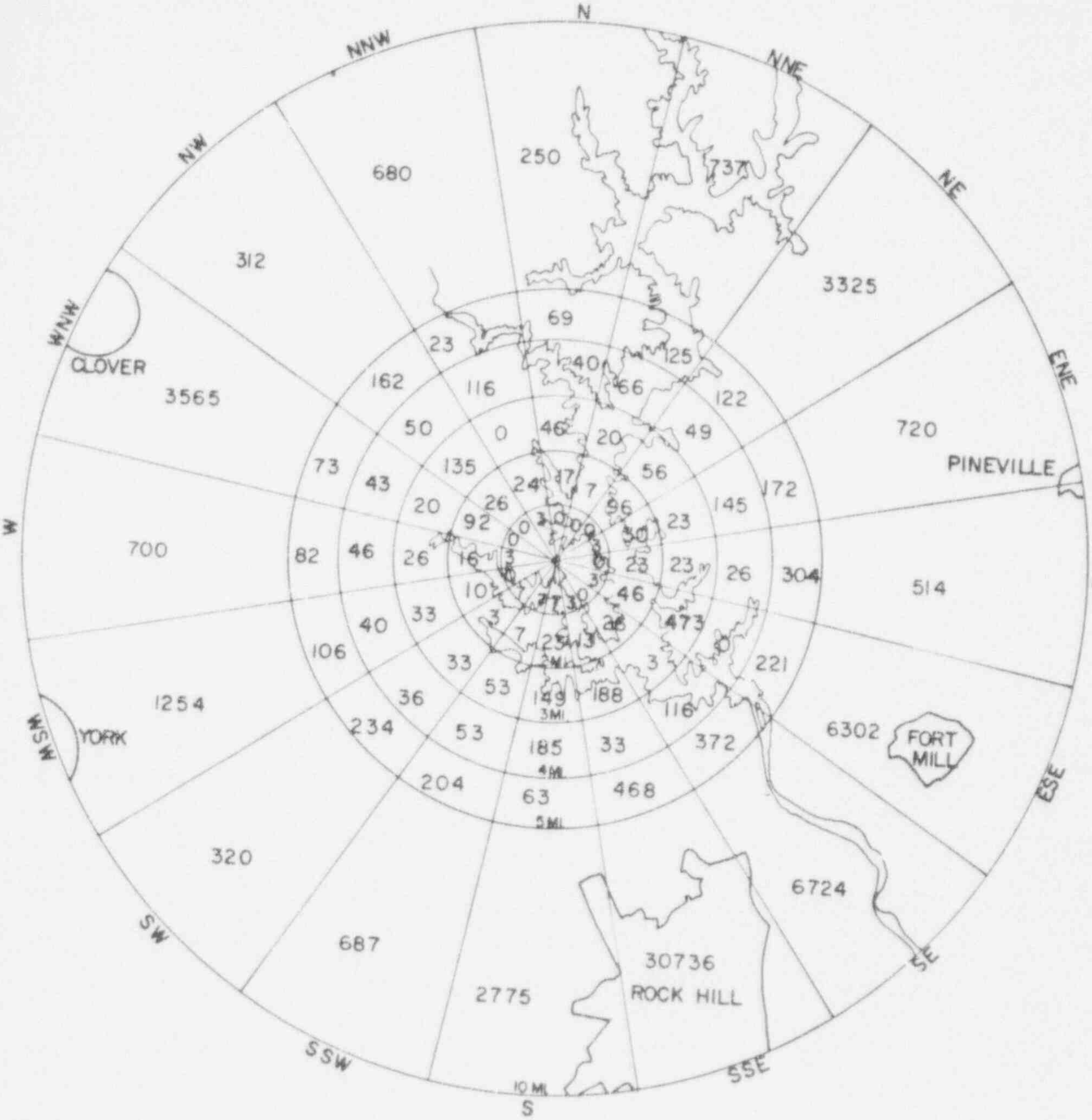
CLEARED FARM LAND
DUKE PROPERTY
PRIVATELY OWNED PROPERTY

PROPERTY MAP 0-2 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-1

1970

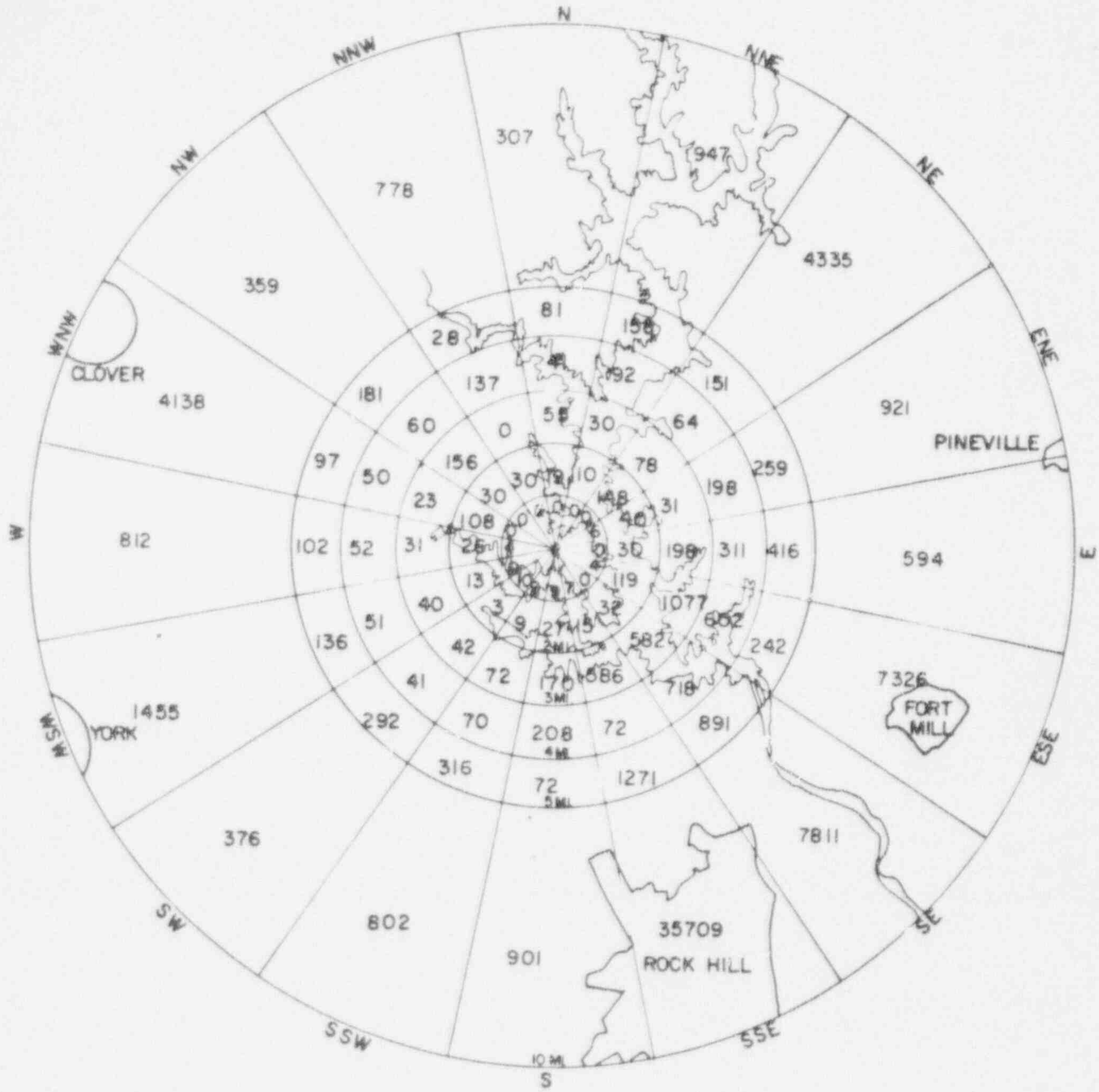


ESTIMATED POPULATION DISTRIBUTION, 1970, 0 - 10 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-2

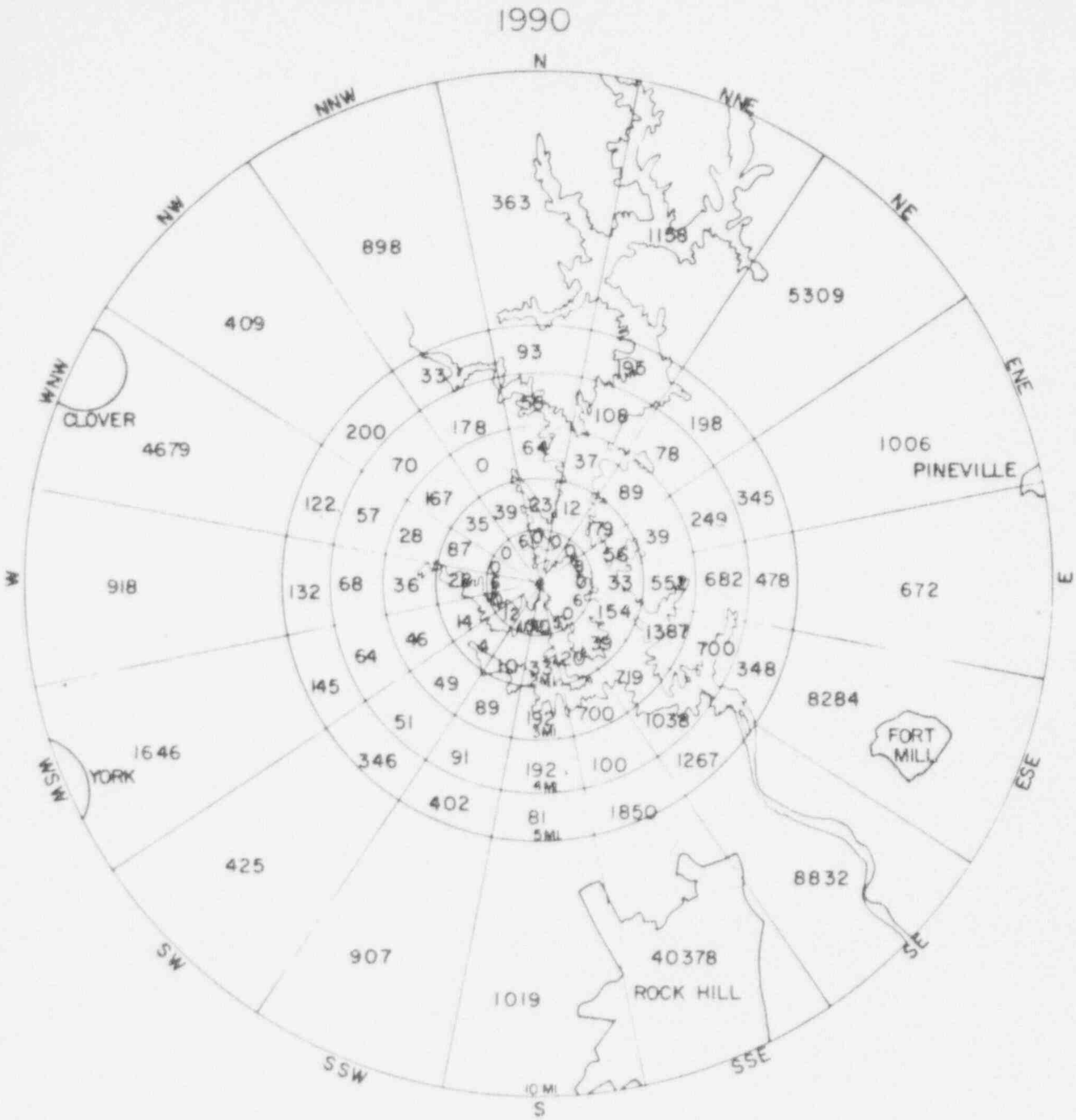
1980



ESTIMATED POPULATION DISTRIBUTION,
1980, 0 - 10 MILES

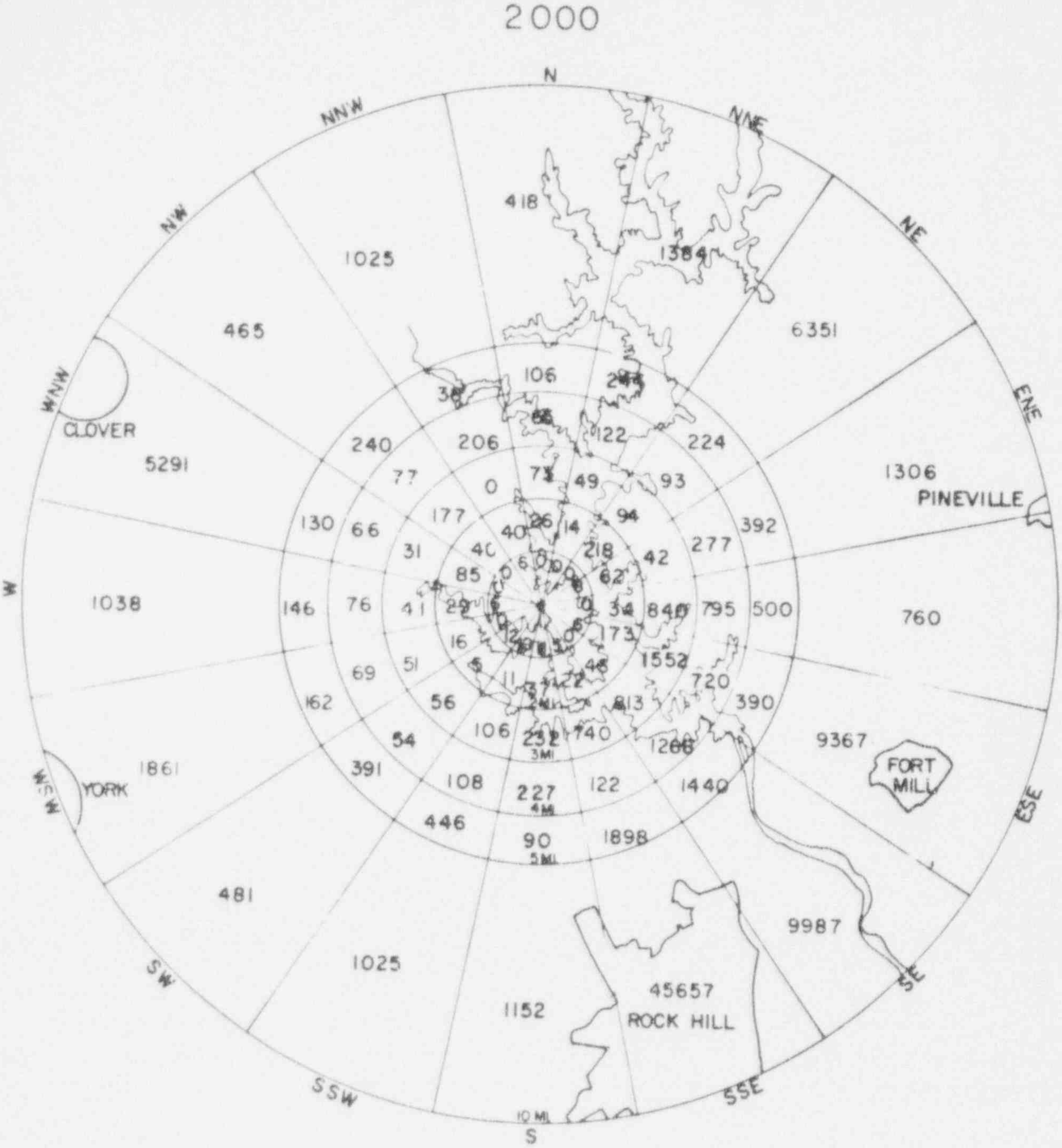
CATAWBA NUCLEAR STATION

ER Figure 4.4-3



ESTIMATED POPULATION DISTRIBUTION,
1990, 0 - 10 MILES

CATAWBA NUCLEAR STATION
ER Figure 4.4-4

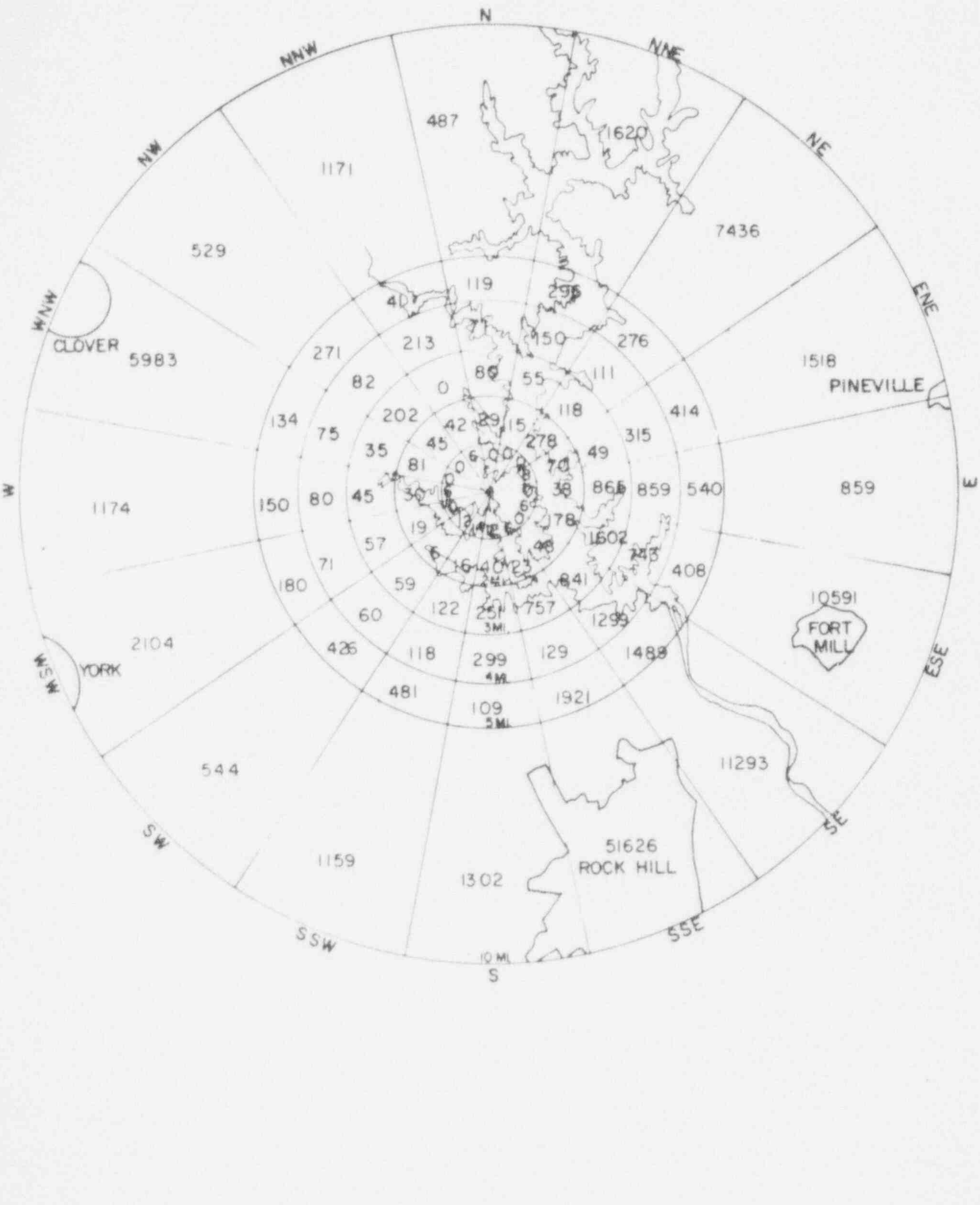


ESTIMATED POPULATION DISTRIBUTION,
2000, 0 - 10 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-5

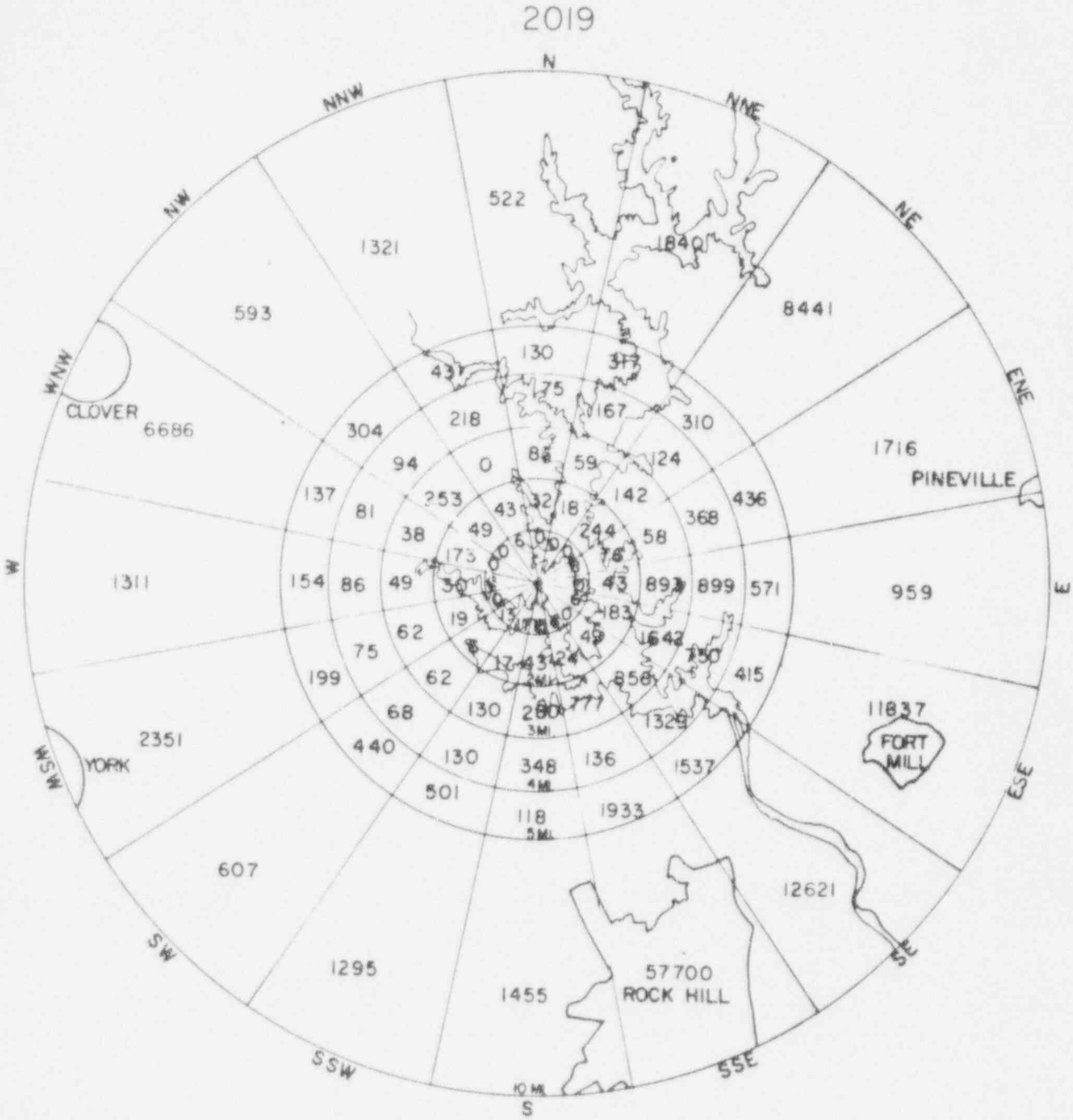
2010



ESTIMATED POPULATION DISTRIBUTION, 2010, 0 - 10 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-6

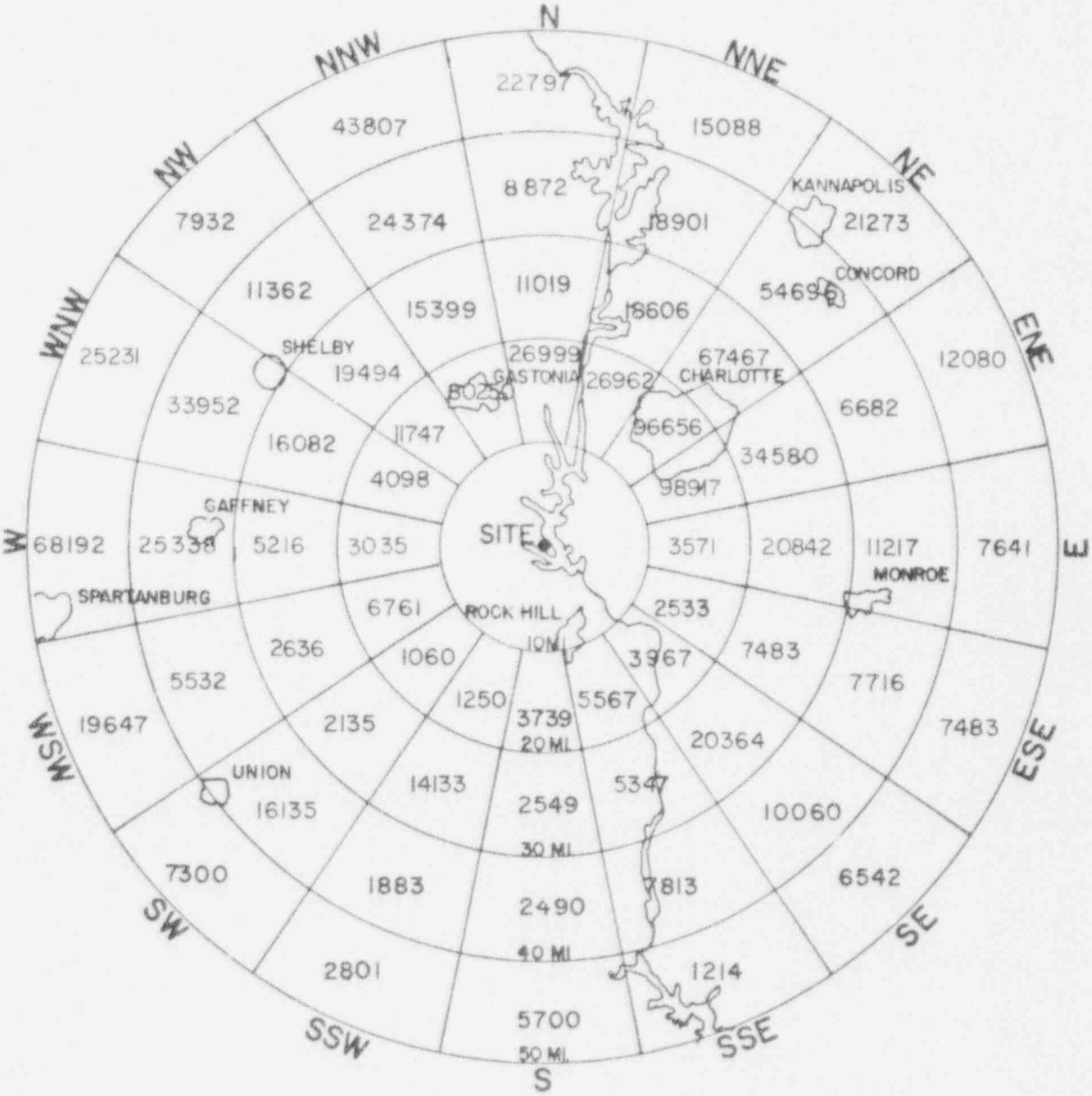


ESTIMATED POPULATION DISTRIBUTION,
2019, 0 - 10 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-7

1970

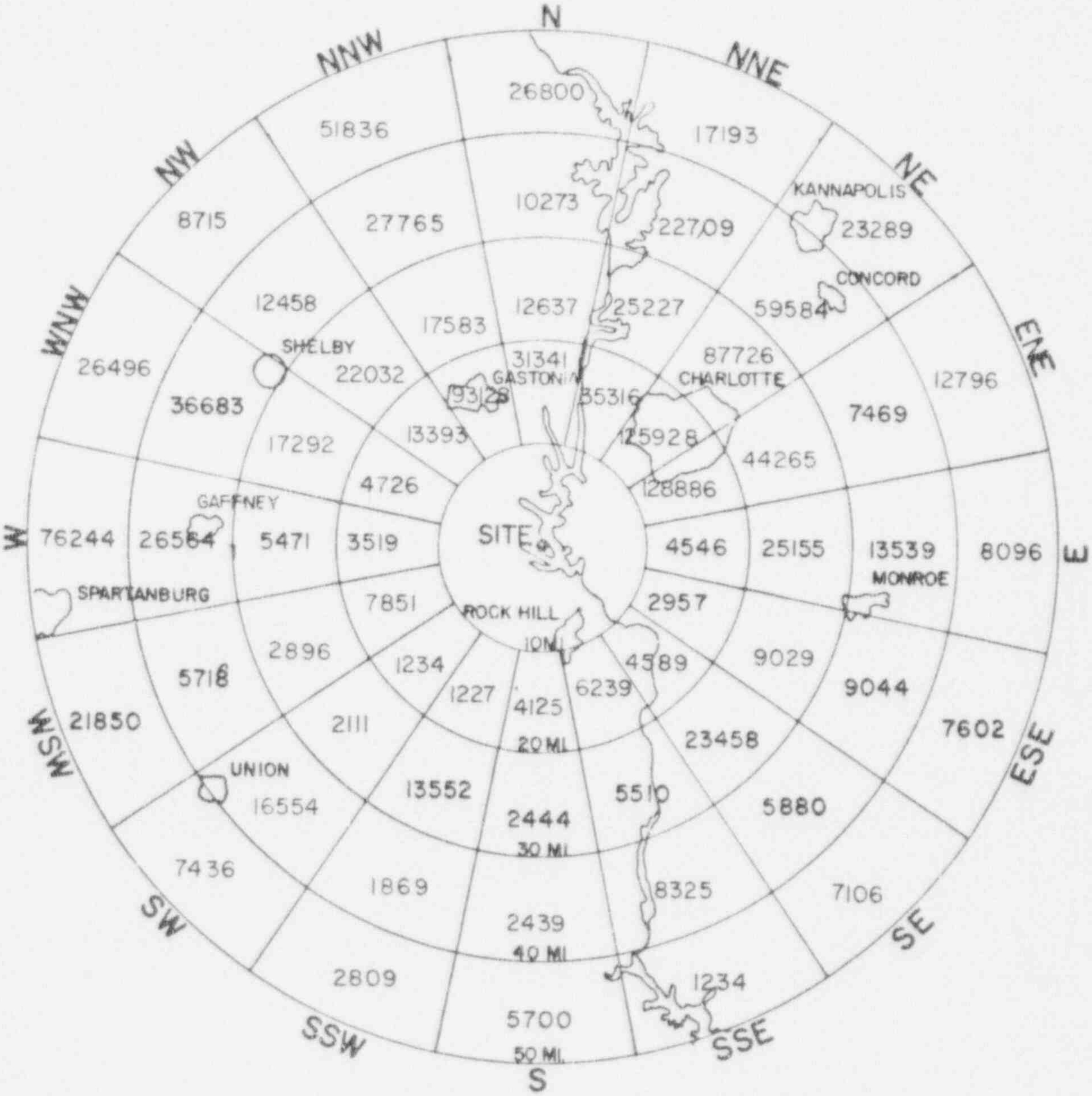


ESTIMATED POPULATION DISTRIBUTION, 1970, 10 - 50 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-8

1980

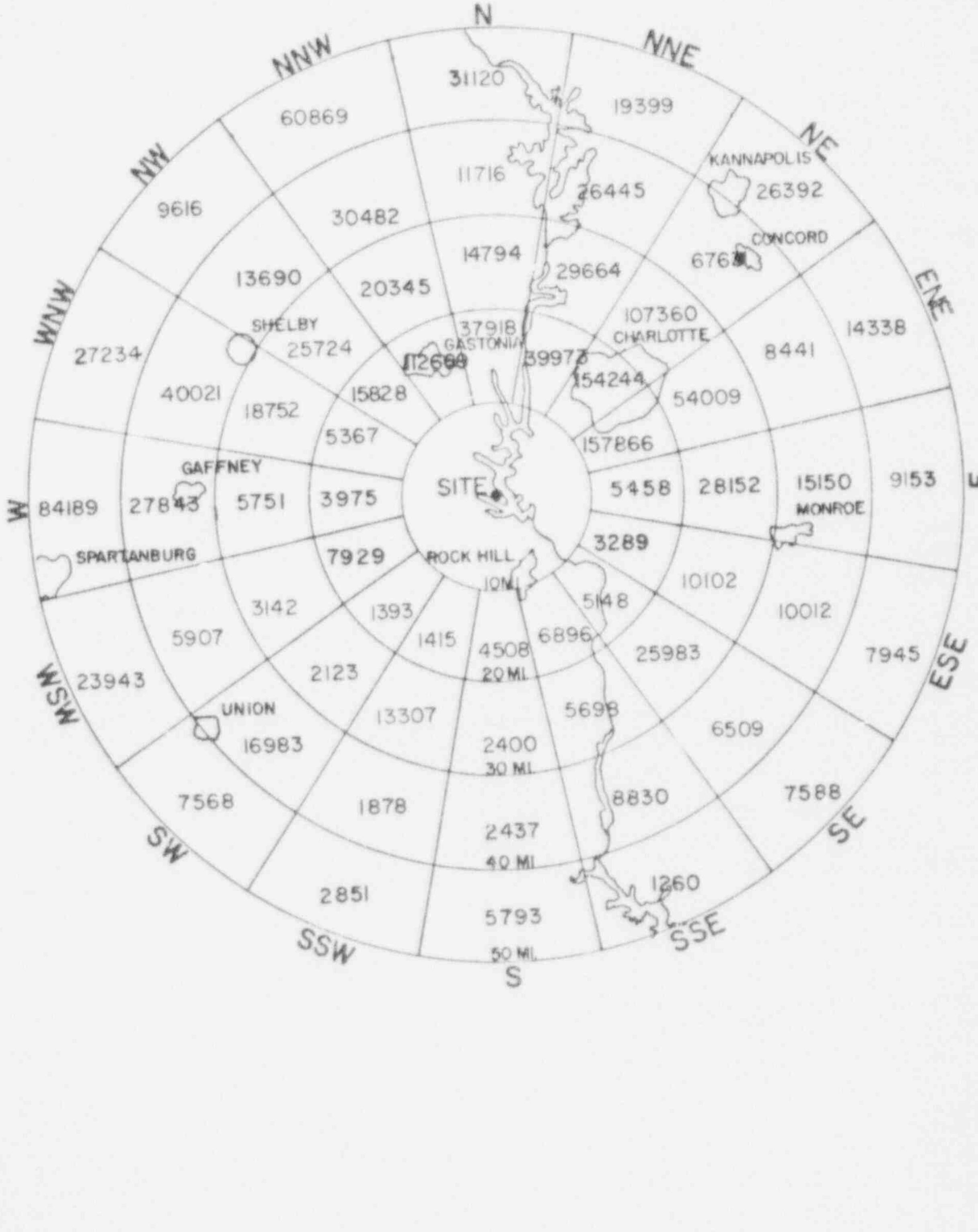


ESTIMATED POPULATION DISTRIBUTION, 1980, 10 - 50 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-9

1990

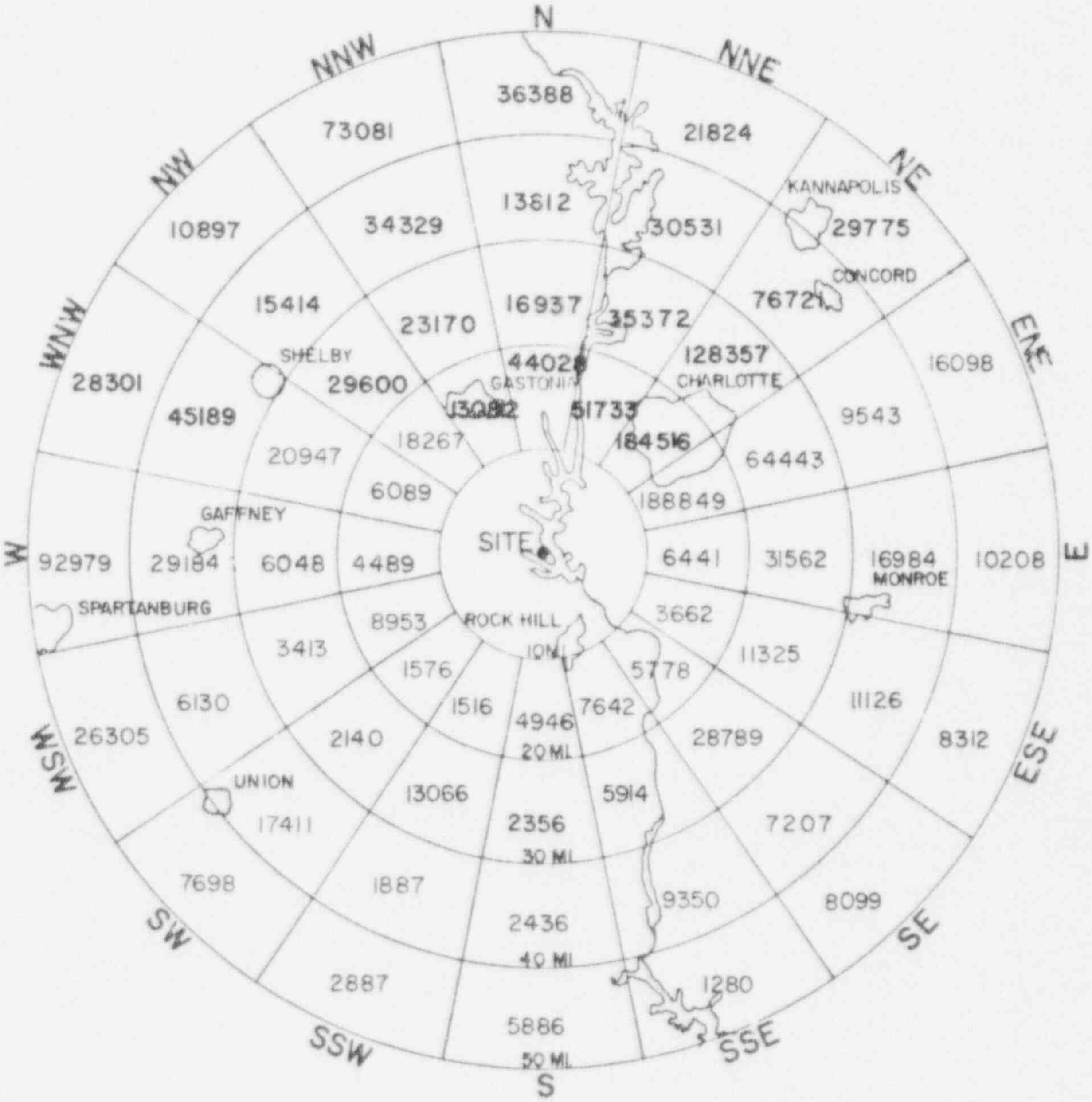


ESTIMATED POPULATION DISTRIBUTION, 1990, 10 - 50 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-10

2000

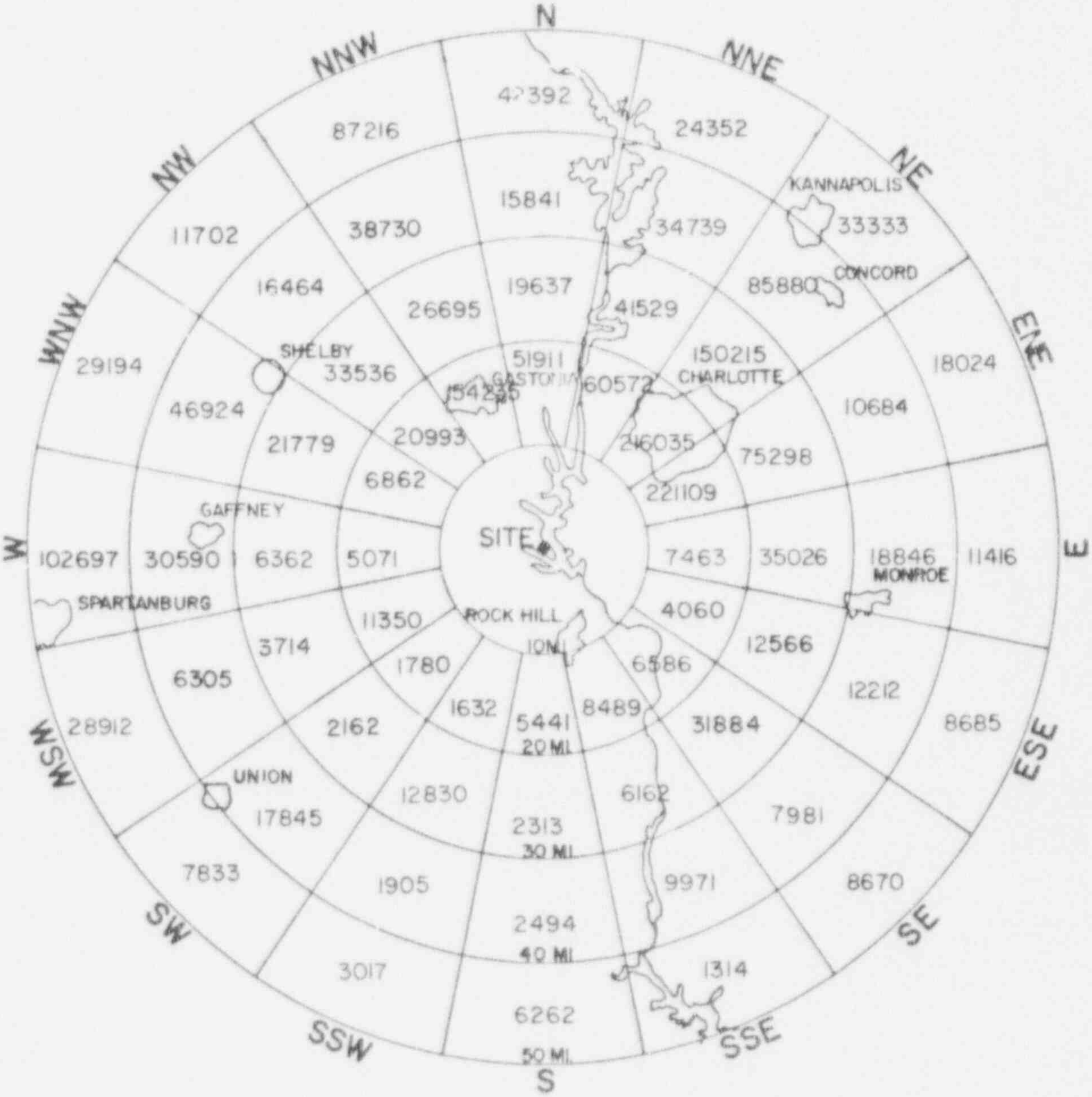


ESTIMATED POPULATION DISTRIBUTION,
2000, 10 - 50 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-11

2010

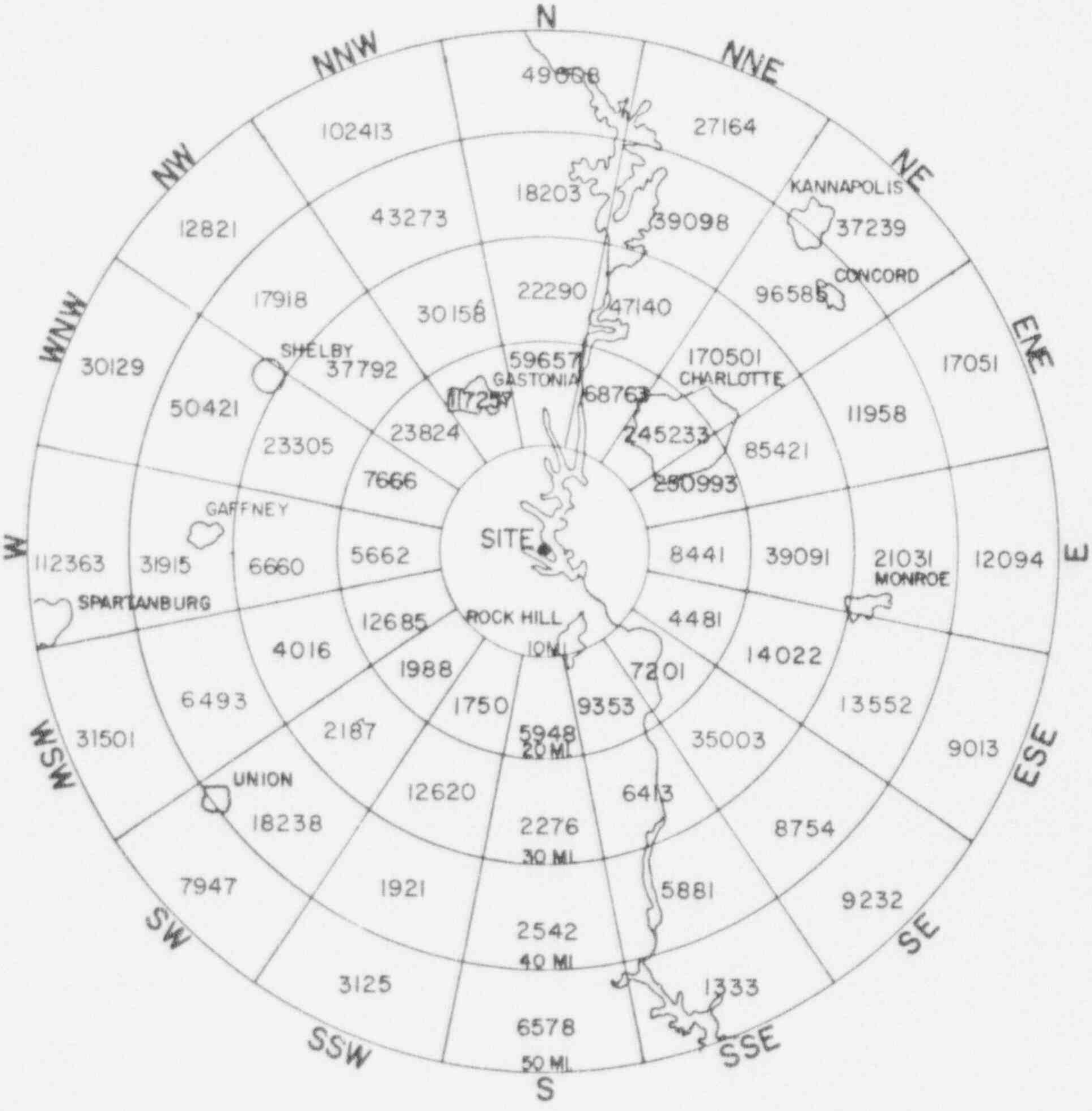


ESTIMATED POPULATION DISTRIBUTION,
2010, 10 - 50 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-12

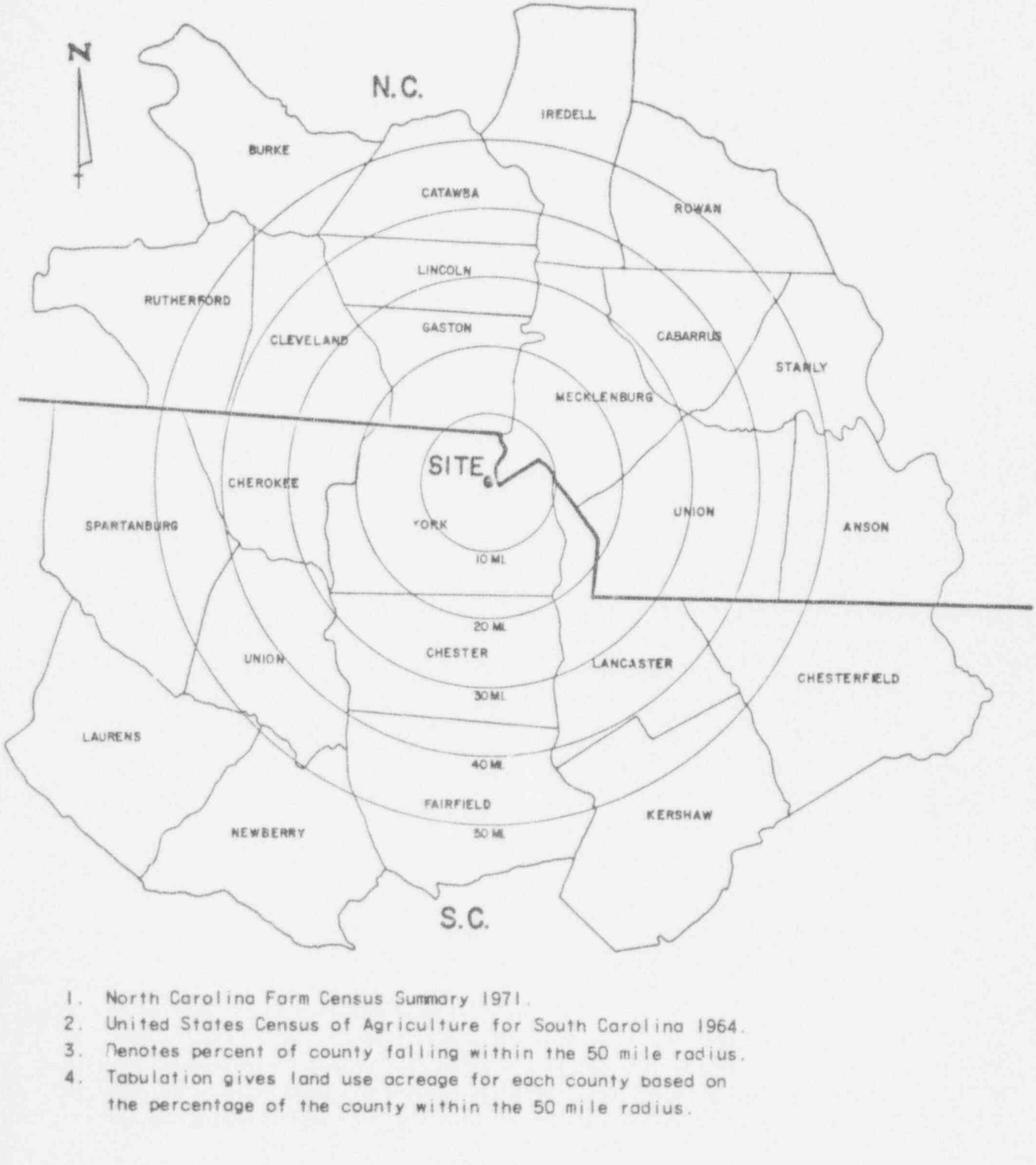
2019



ESTIMATED POPULATION DISTRIBUTION,
2019, 10 - 50 MILES

CATAWBA NUCLEAR STATION

ER Figure 4.4-13



1. North Carolina Farm Census Summary 1971.
2. United States Census of Agriculture for South Carolina 1964.
3. Denotes percent of county falling within the 50 mile radius.
4. Tabulation gives land use acreage for each county based on the percentage of the county within the 50 mile radius.

Co

NORTH
Anso
Burk
Caba
Cata
Clev
Gast
Ired
Linc
Meck
Rowa
Ruth
Stan
Unio

SOUTH

Cher
Ches
Ches
Fair
Kers
Lanc
Laur
Newb
Spar
Unio
York

North
South
TOTAL

Land Use (Acres) Within A 50 Mile Radius [4]

unty	% Total County Area [3]	Cropland Harvested	Cropland Idle	Pasture Improved	Pasture Unimproved	Other Lands
CAROLINA [1]						
n	22	6 965	4 708	5 117	992	29 623
e	11	1 193	1 153	1 077	396	8 803
rrus	97	28 771	23 299	26 635	9 028	83 222
wba	22	7 095	7 105	5 907	1 694	17 877
eland	99	41 371	51 856	41 878	8 385	96 117
on	100	14 647	23 743	18 304	7 743	56 695
eil	36	17 871	15 652	19 722	3 562	46 286
oln	100	29 956	31 623	14 486	7 370	61 054
enburg	100	18 891	28 724	20 156	11 535	85 714
h	36	20 375	10 823	14 358	4 023	37 799
erford	24	3 745	8 603	5 477	1 345	32 681
ly	45	20 195	10 872	13 027	3 998	39 006
n	100	87 540	34 139	51 404	6 786	174 001
CAROLINA [2]						
okee	100	20 459	15 918	3 148	7 536	58 311
ter	100	24 030	13 333	13 707	26 124	110 321
terfield	19	11 073	49 191	969	1 936	20 494
field	65	5 749	3 501	2 020	8 737	62 082
haw	21	6 354	2 791	279	1 573	21 986
aster	100	12 076	4 915	5 077	12 958	71 100
ens	01	371	191	89	166	1 308
erry	07	2 405	605	572	1 198	7 940
anburg	27	16 697	8 584	3 472	6 137	23 677
n	93	8 196	11 616	2 750	11 106	59 901
	100	31 231	19 695	10 906	24 715	106 421
Carolina Total		298 615	252 300	237 548	66 857	768 878
Carolina Total		138 640	130 340	42 989	102 186	540 541
TO FIFTY MILES		437 255	382 640	280 537	169 043	1 309 419

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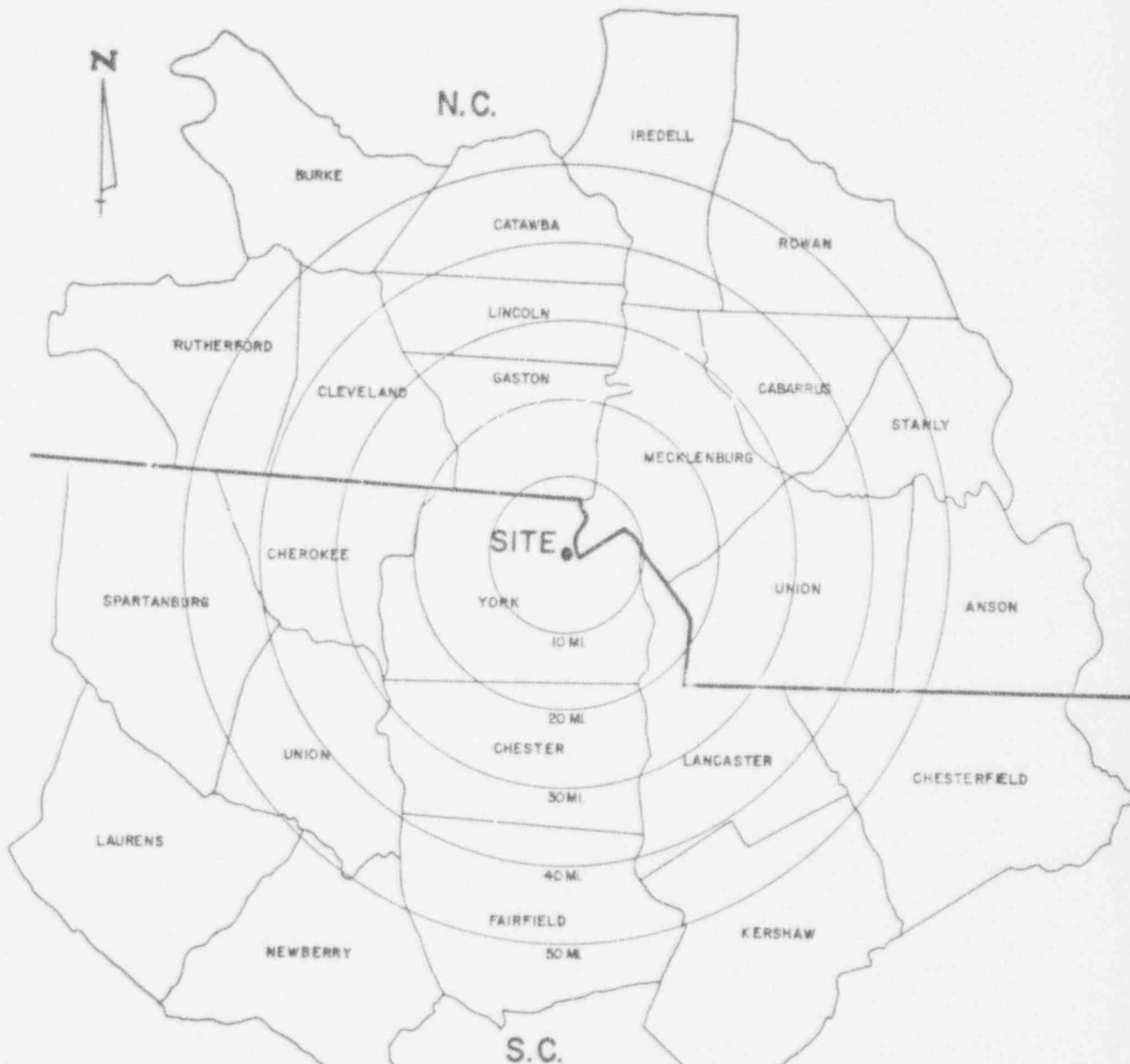
LAND USE WITHIN A 50 MILE RADIUS

CATAWBA NUCLEAR STATION

ER Figure 4.4-14



1. North Carolina Farm Census Summary 1971; January 1, 1971.
2. South Carolina Livestock and Poultry Statistics; January 1, 1970.
3. Denotes percent of county area falling within the 50 mile radius.
4. Tabulation gives the number of milk cows based on the percentage of the county within 50 miles.

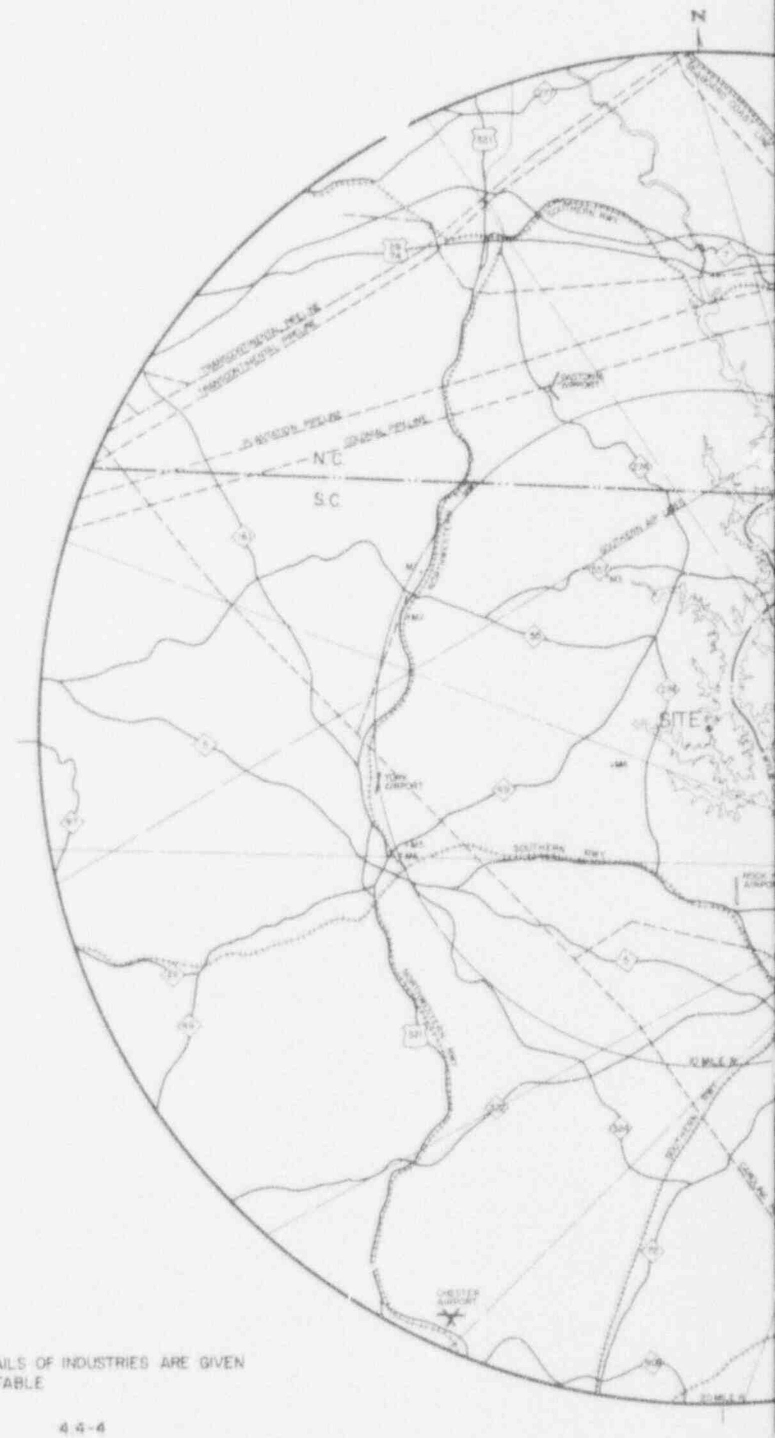
Milk Cows Within A 50 Mile Radius

County	Number of Cows in County	% County in 50 Miles[3]	Number Cows in 50 Miles[4]
North Carolina[1]			
Anson	1 002	22	221
Burke	802	11	89
Cabarrus	2 821	97	2 737
Catawba	3 971	22	874
Cleveland	3 086	99	3 056
Gaston	3 550	100	3 550
Iredell	10 111	36	3 640
Lincoln	2 562	52	1 333
Mecklenburg	2 846	100	2 846
Rowan	8 031	36	2 892
Rutherford	1 569	24	377
Stanly	2 724	45	1 226
Union	3 753	100	3 753
South Carolina[2]			
Cherokee	900	100	900
Chester	3 400	100	3 400
Chesterfield	250	19	48
Fairfield	600	65	390
Kershaw	700	21	147
Lancaster	300	100	300
Laurens	3 400	01	34
Newberry	6 200	07	434
Spartanburg	2 500	27	675
Union	800	93	744
York	2 000	100	2 000
TOTAL	67 878		35 666

MILK COWS WITHIN A 50 MILE RADIUS

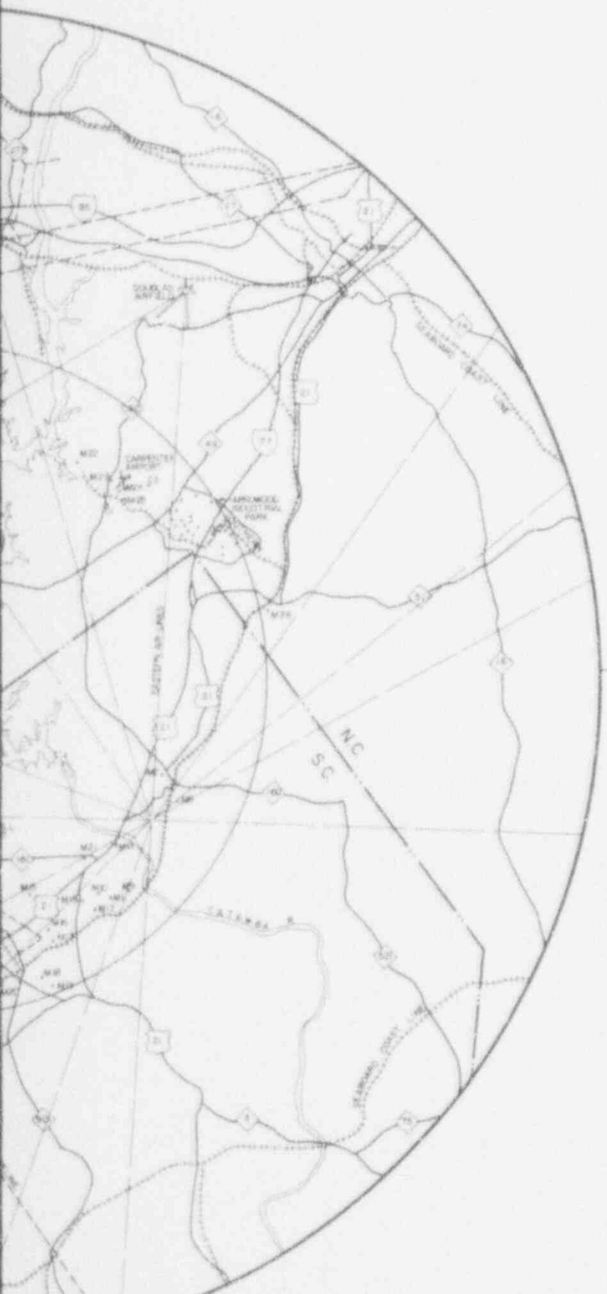
CATAWBA NUCLEAR STATION

ER Figure 4.4-15



DETAILS OF INDUSTRIES ARE GIVEN ON TABLE

4.4-4



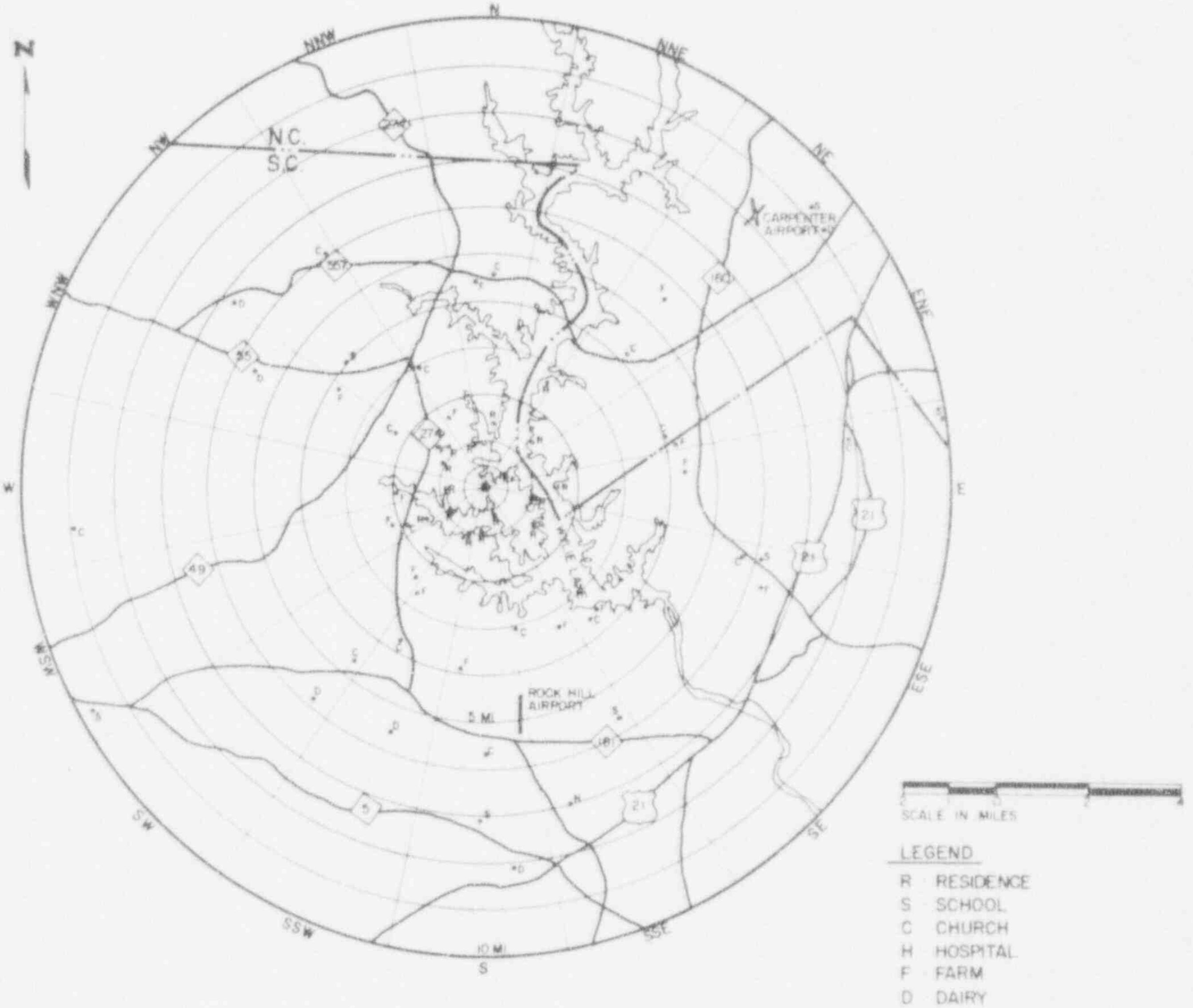
LEGEND
M - INDUSTRIES
C - CHEMICAL PLANTS

2 1 0 2 4
SCALE IN MILES

ROUTES, LOCATIONS AND
INDUSTRIES IN VICINITY

CATAWBA NUCLEAR STATION

ER Figure 4.4-16



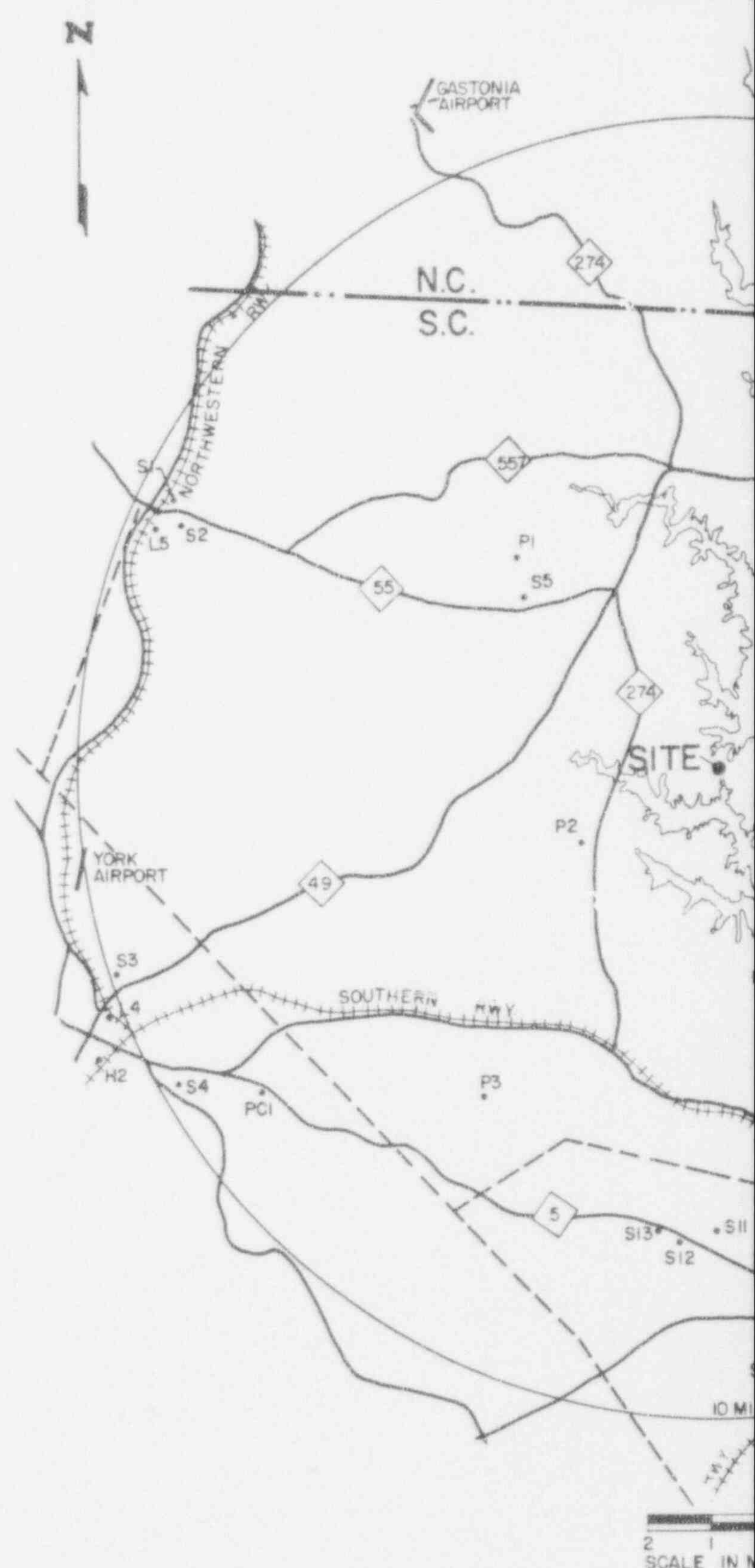
PROXIMITY OF NEAREST RESIDENCE, SCHOOL,
CHURCH, HOSPITAL, FARM & DAIRY

CATAWBA NUCLEAR STATION

ER Figure 4.4-17

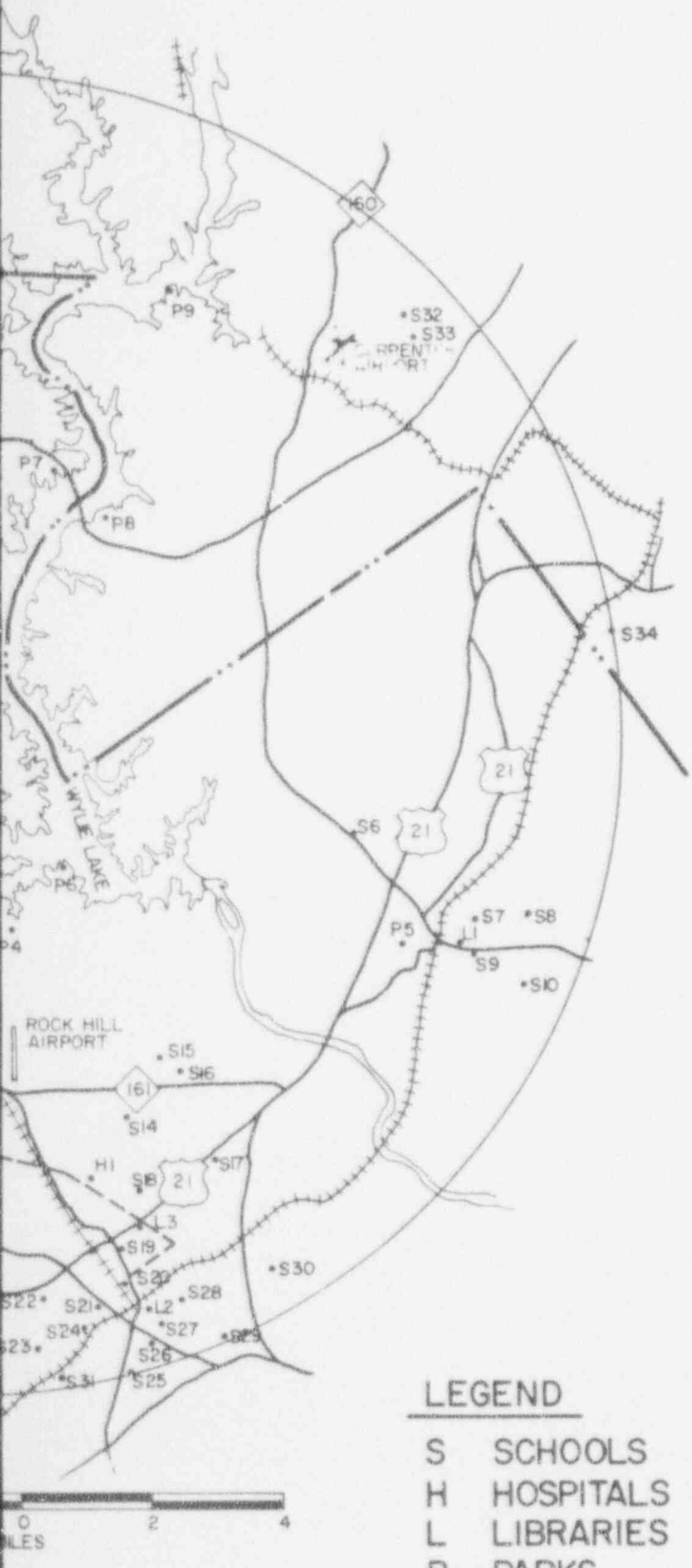
Amendment 1

PUBLIC FACIL
INSTITU



DETAILS OF PUBLIC FACILITIES &
INSTITUTIONS ARE GIVEN ON TABLE 4.4-

LITIES AND
UTIONS



LEGEND

S SCHOOLS
H HOSPITALS
L LIBRARIES
P PARKS
PC PRISON CAMPS

PUBLIC FACILITIES AND INSTITUTIONS

CATAWBA NUCLEAR STATION

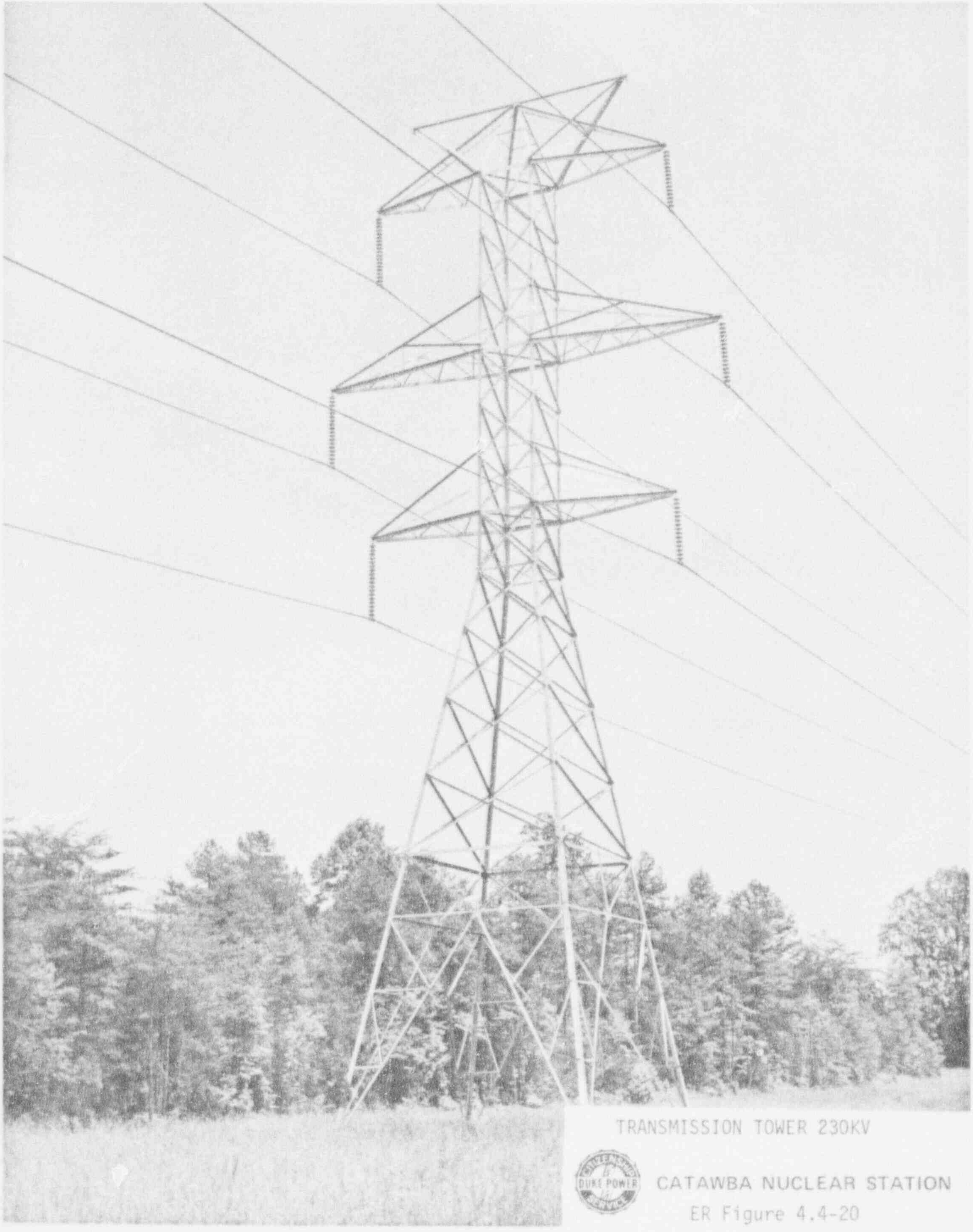
ER Figure 4.4-18

TO ALLEN
TO MCGUIRE
TO S.C. HWY NO 49
N
STANDBY NUCLEAR
SERVICE WATER POND
R/W LIMIT
230 KV
230 KV
230 KV
TO SHELBY
TO PACOLET
44 KV
ADMINISTRATION
BUILDING
CONSTRUCTION
ACCESS ROAD
DUKE POWER CO
PROPERTY LINE
R/W LIMIT
500 KV
SWITCHING
YARD
ACCESS RAILROAD
S.C. HWY NO 274
RELOCATED
ROAD 1132
TO NEWPORT
TO NEWPORT
TO NEWPORT
TO NEWPORT
ROCK HILL
0
400
800
1200
1600
2000

TRANSMISSION LINES & RIGHTS OF WAY

CATAWBA NUCLEAR STATION

ER Figure 4.4-19



TRANSMISSION TOWER 230KV

CATAWBA NUCLEAR STATION
ER Figure 4.4-20

W. GILL WYLIE, President
28 W. 40th Street
New York

W. S. LEE, Jr., Vice-Prest. & Chief Engineer
W. HARBERT MARTIN, Jr., Sec'y & Treas.
Rock Hill, S. C.

F. D. SAMPSON, Superintendent
Charlotte, N. C.

Charlotte Division

Office: 202 Southern States Trust Building

Telephone No. 333 Bell

F. D. Sampson, Superintendent

Catawba Power Company

Rock Hill, S. C.

The Company begs to announce that they will be **ready to supply** Electricity for any and all purposes **on or before** August 15, 1904.

Mr. Lee will be in the Charlotte Office every **Tuesday.**

CATAWBA POWER COMPANY ANNOUNCEMENT
AUGUST 15, 1904

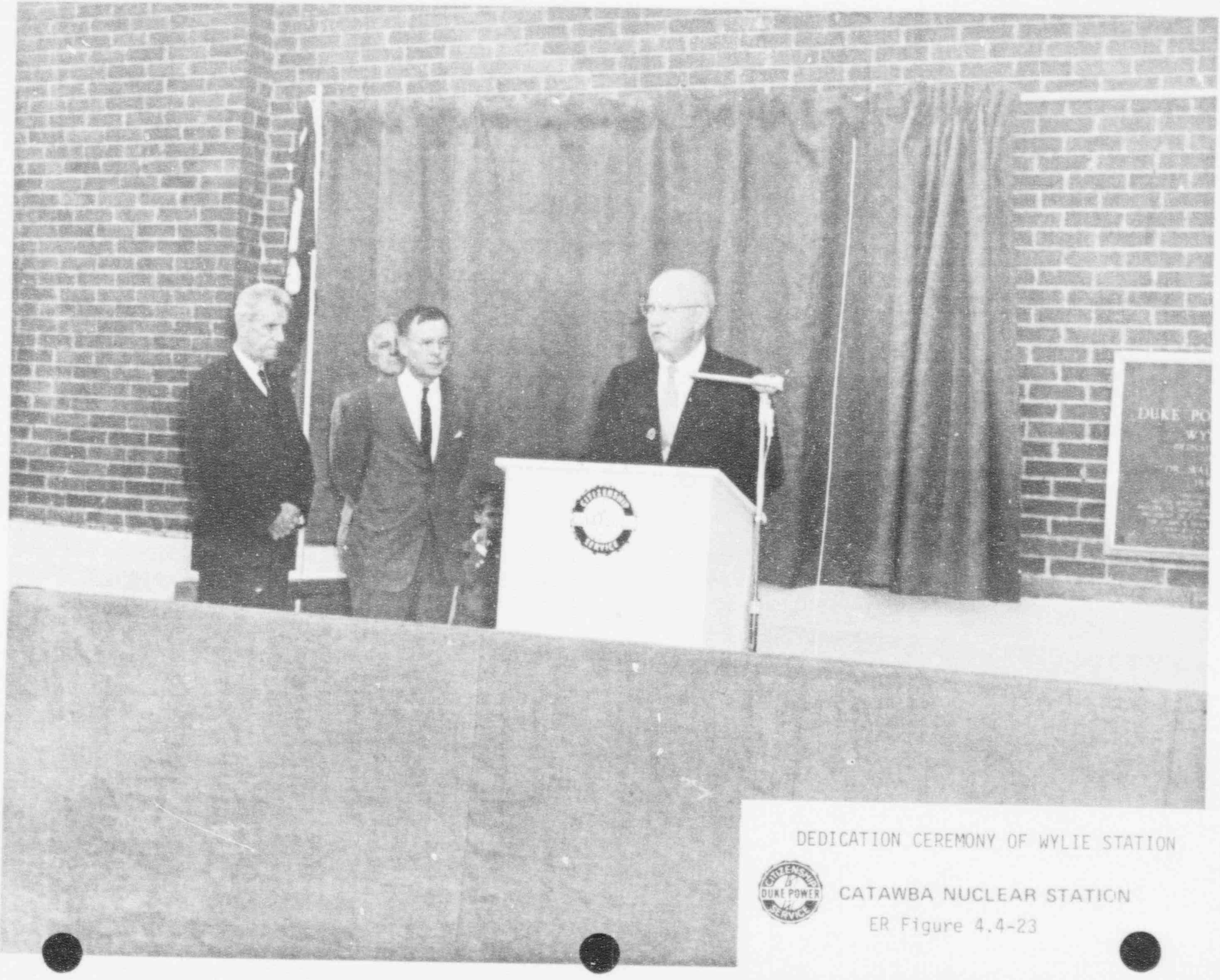
CATAWBA NUCLEAR STATION

ER Figure 4.4-21

CATAWBA STATION (1904)

CATAWBA NUCLEAR STATION

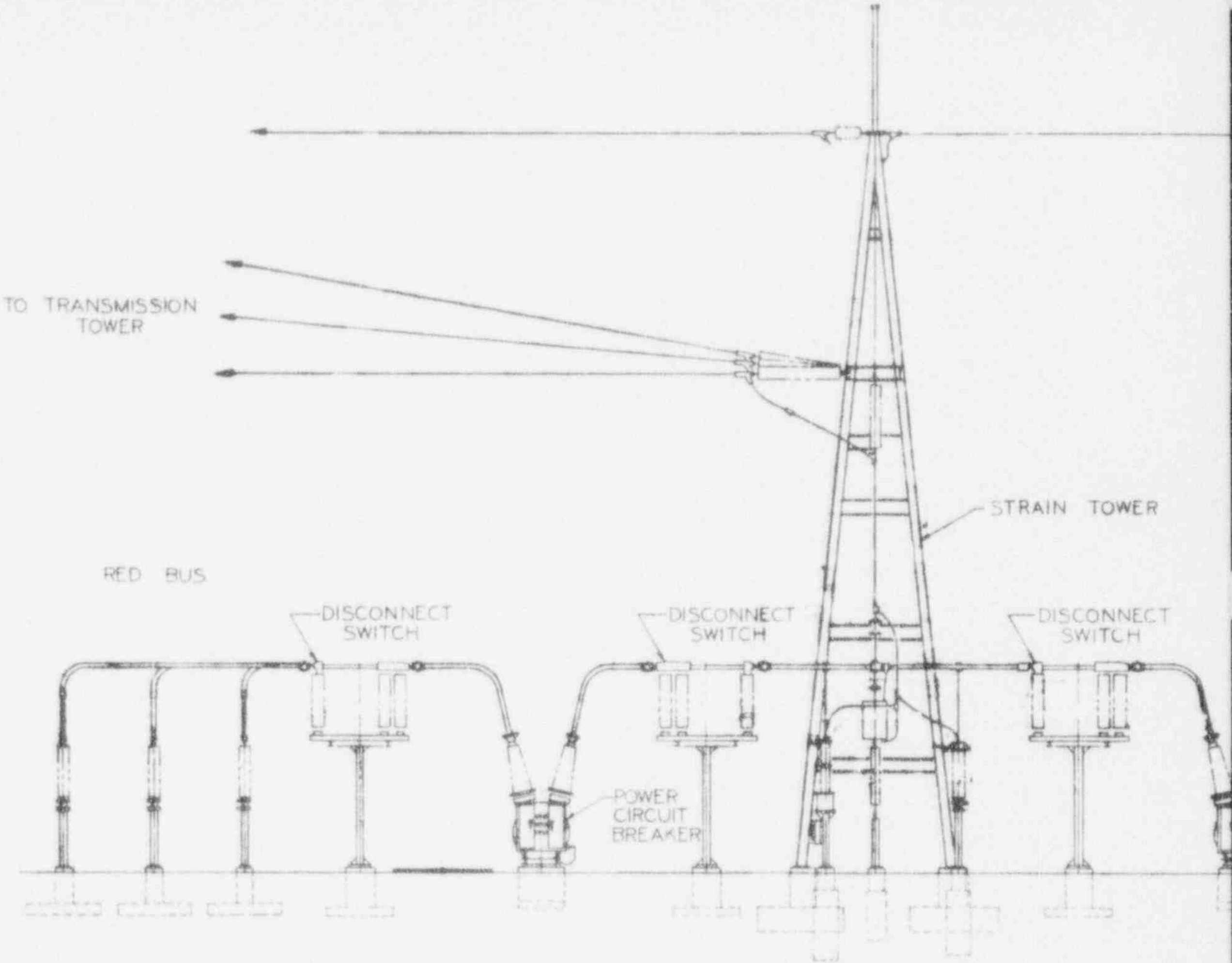
ER Figure 4.4-22



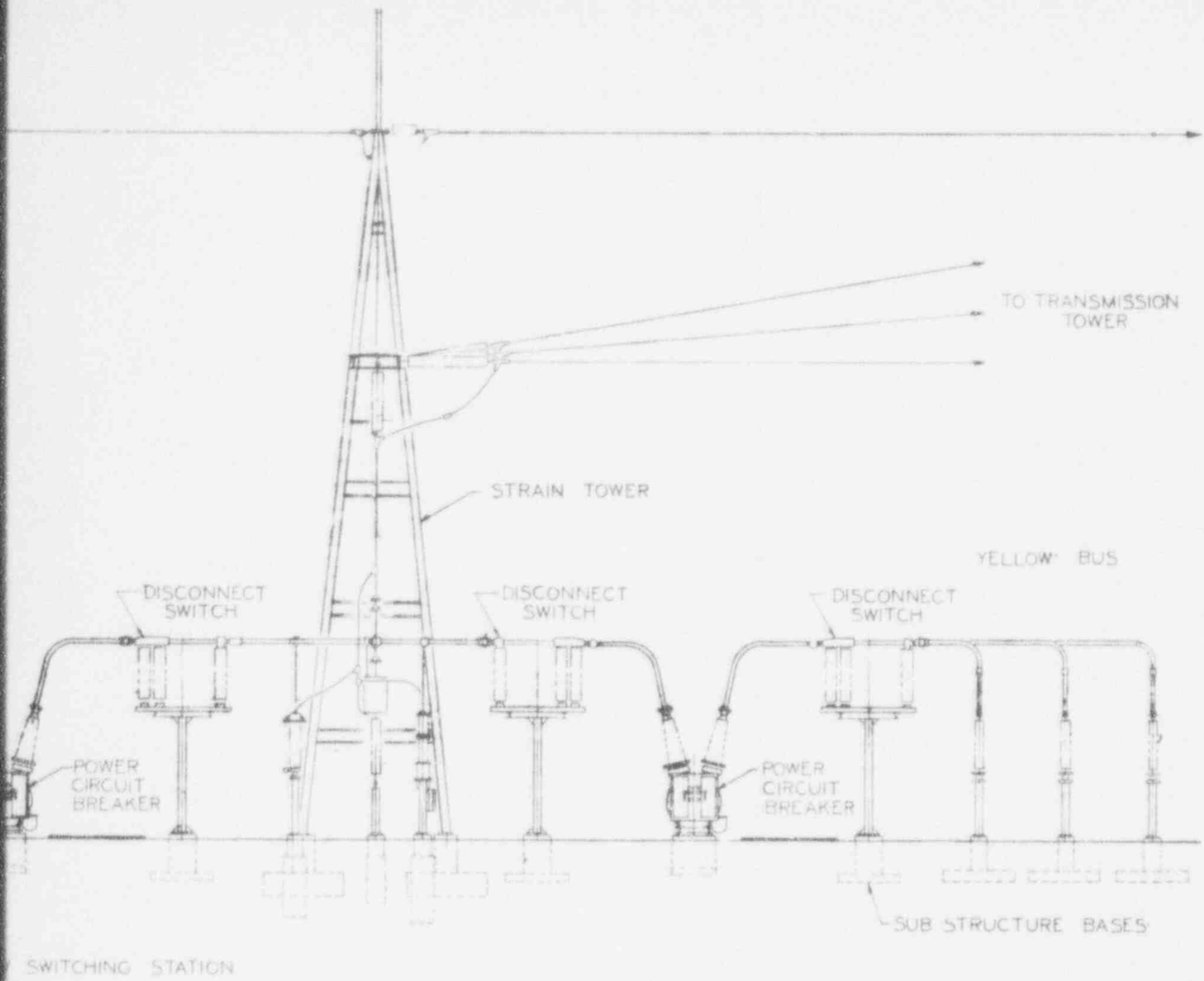
DEDICATION CEREMONY OF WYLIE STATION

CATAWBA NUCLEAR STATION

ER Figure 4.4-23



ELEVATION THRU 230 K



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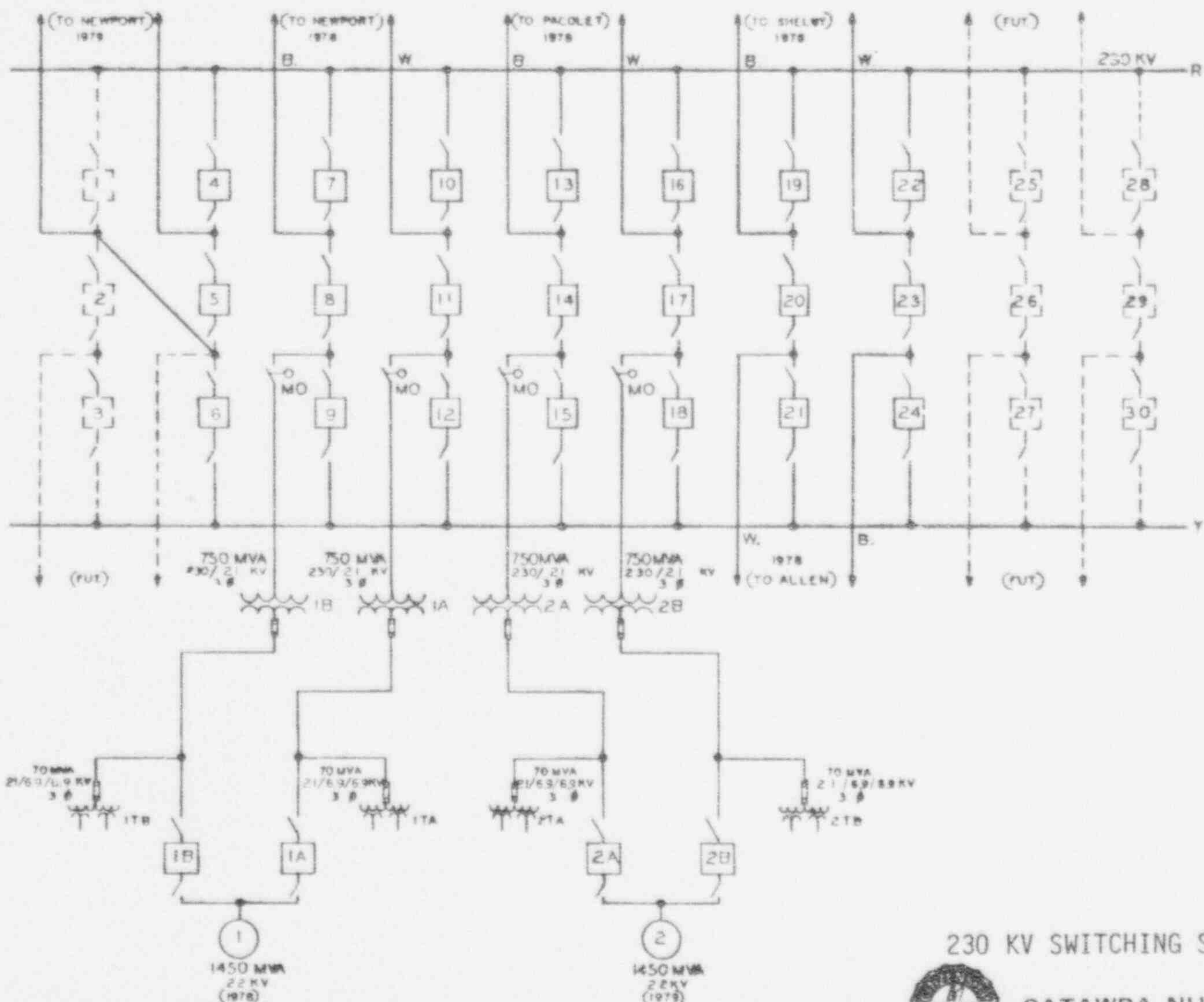
230 KV SWITCHING STATION CROSS SECTION

CATAWBA NUCLEAR STATION

ER Figure 4.4-24

Amendment 1
(New)

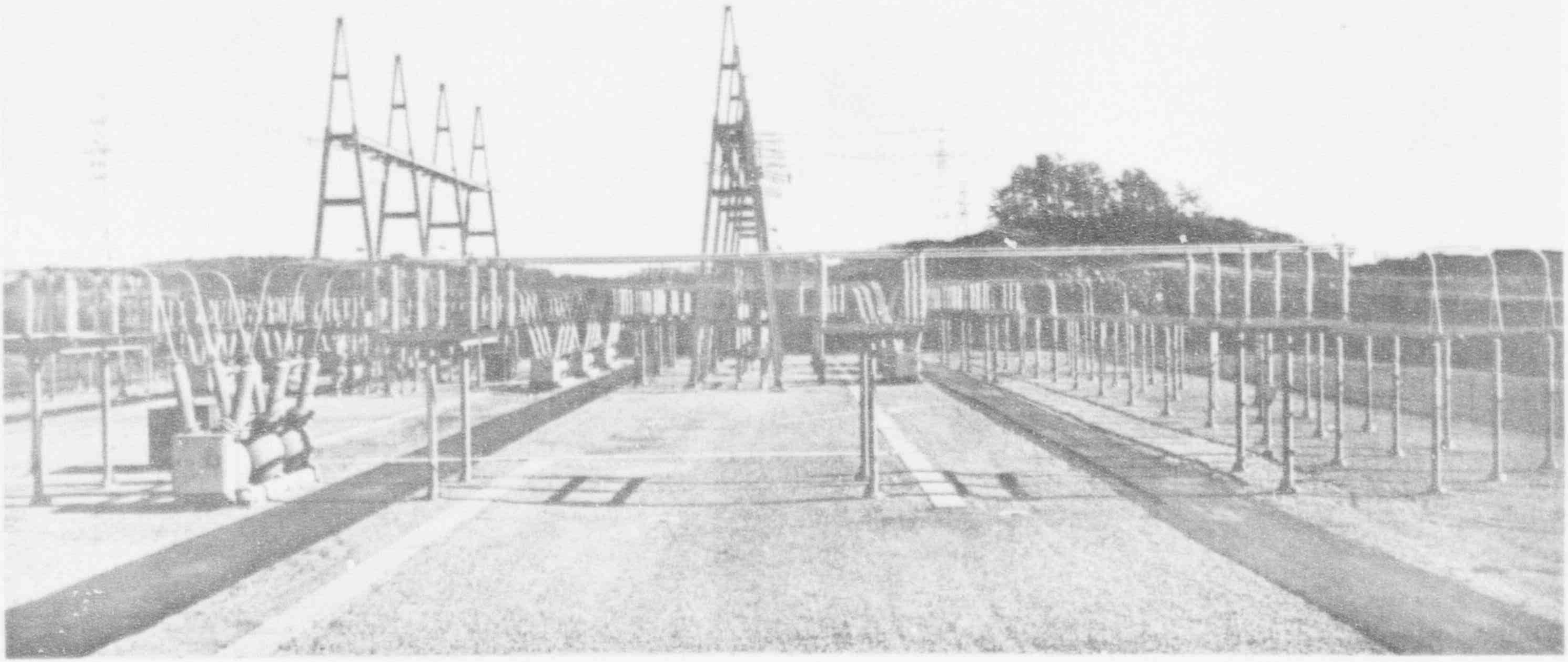


230 KV SWITCHING STATION SCHEMATIC

CATAWBA NUCLEAR STATION

ER Figure 4.4-25

Amendment 1
(New)

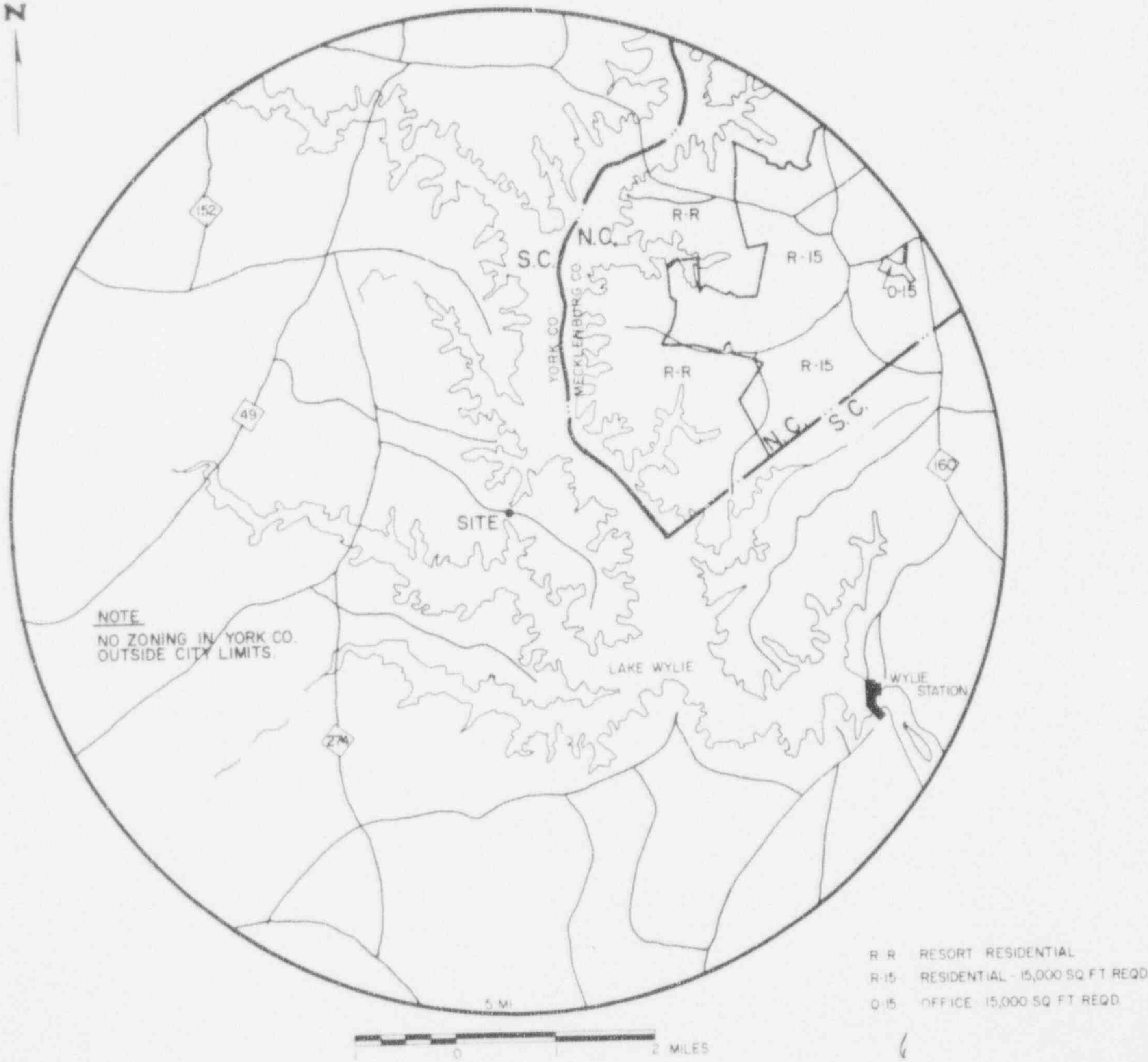


TYPICAL 230 KV SWITCHING STATION

CATAWBA NUCLEAR STATION

ER Figure 4.4-26

Amendment 1
(New)



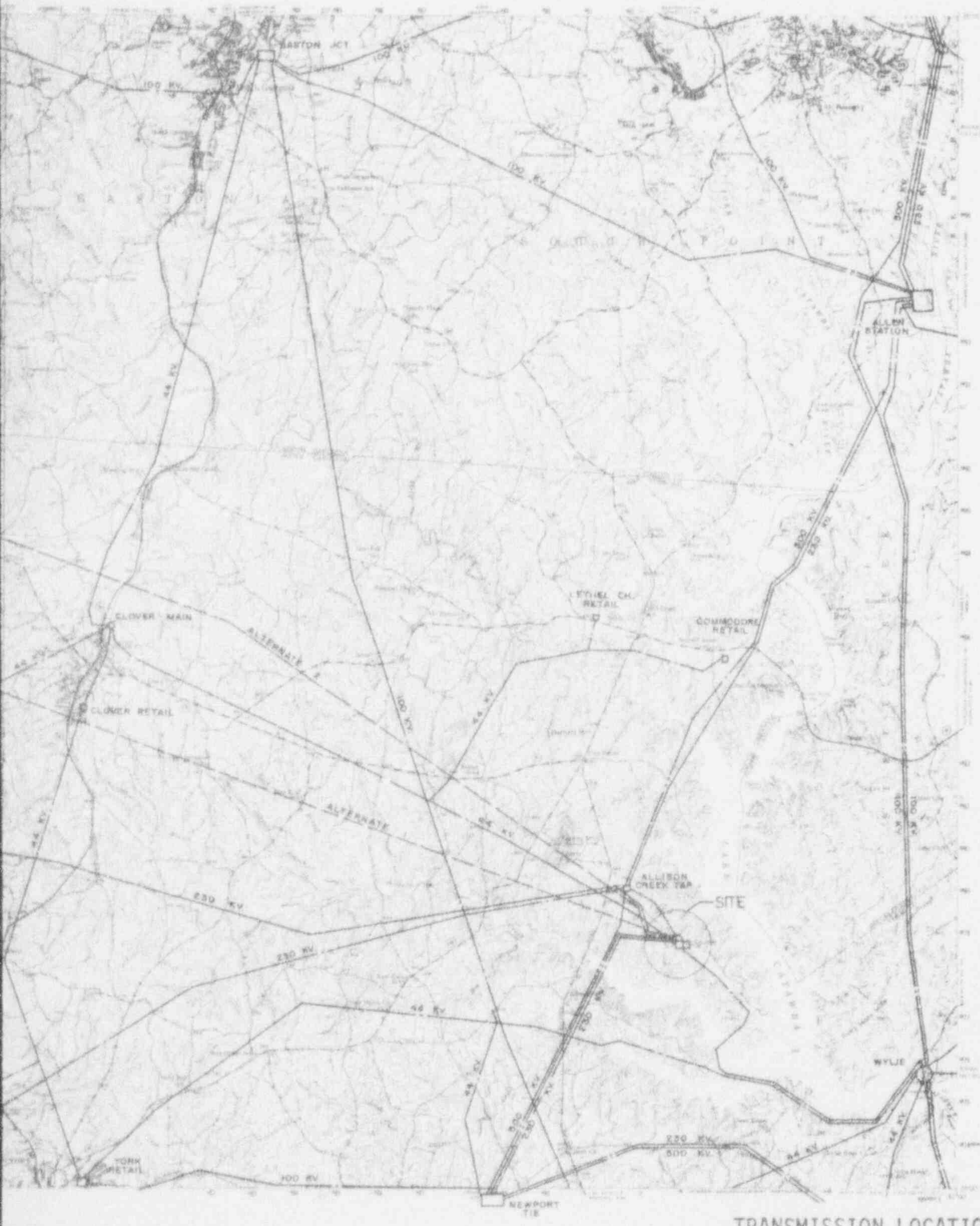
ZONING MAP

CATAWBA NUCLEAR STATION

ER Figure 4.4-27

Amendment 1
(New)


DOVER
HILLTOP
SHELBY TIE TAP
99 ISLANDS
STATION



ANSTEC
APERTURE
CARD

Also Available on
Aperture Card

TRANSMISSION LOCATIONS & TOPOGRAPHY

CATAWBA NUCLEAR STATION

ER Figure 4.4-28

Amendment 1
(New)

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NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARDS 1

9406090213-43

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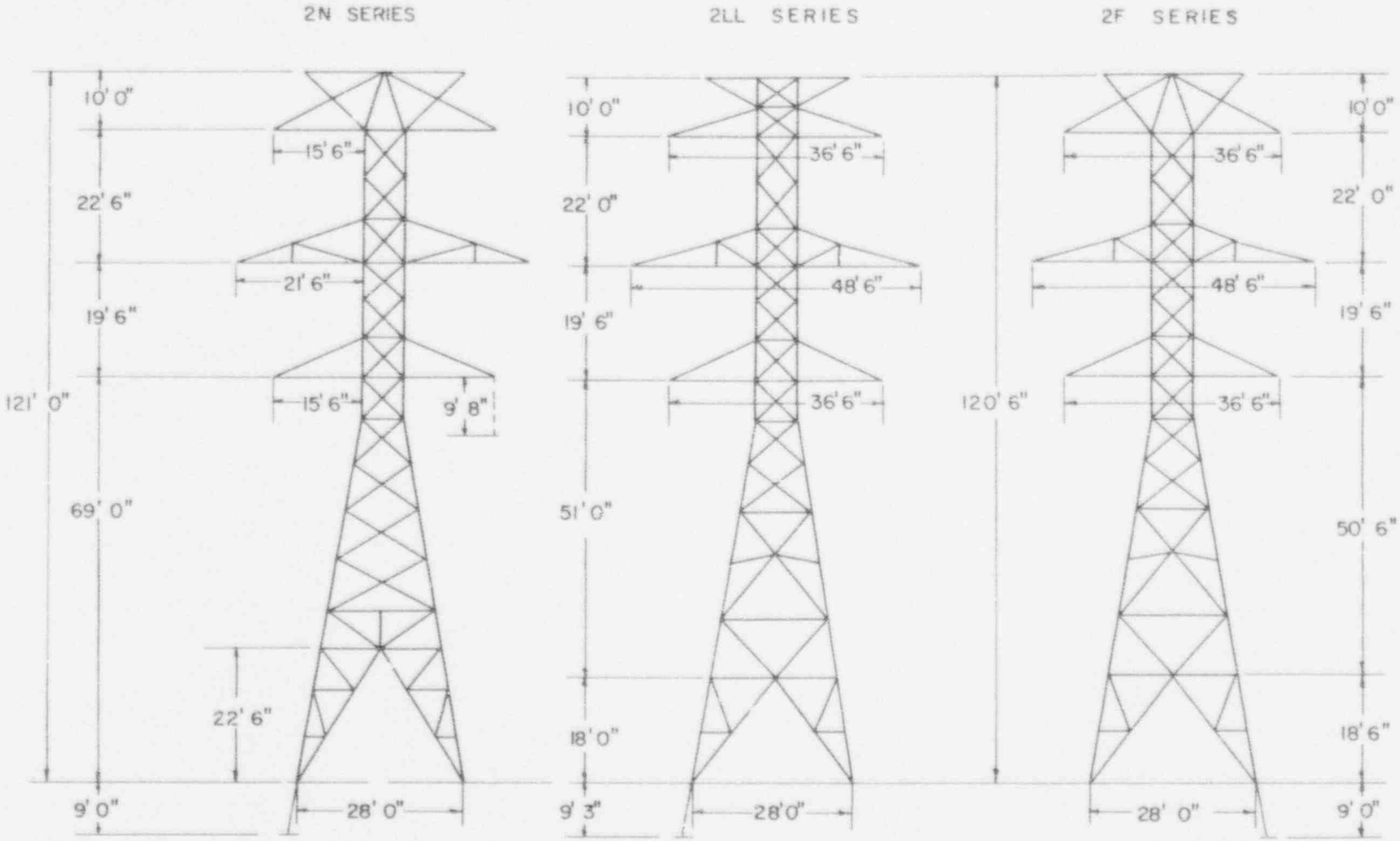
CATAWBA NUCLEAR STATION

ER Figure 4.4-30

Amendment 1
(New)

CONSTRUCTION CHARACTERISTICS OF 200 SERIES TOWERS

SCALE 1" = 20'



STANDARD TOWER BASES ARE 28' SQUARE

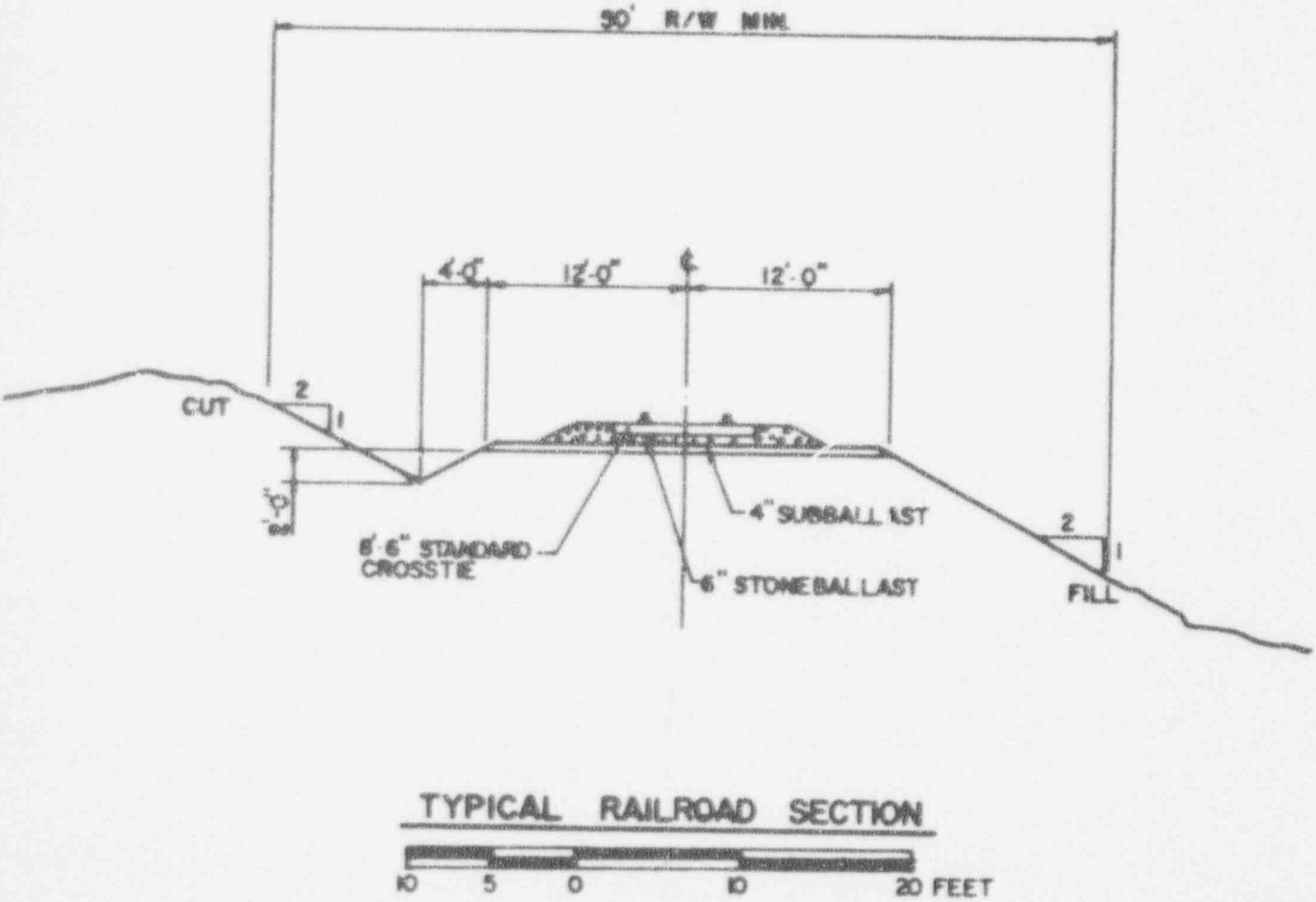
200 Series Tower

CATAWBA NUCLEAR STATION

ER Figure 4.4-31

Amendment 1 (New)


N
2 1 0 2 MILES
Proposed Bridge
Plant Site
Access Railroad
LAKE
CATAWBA



TYPICAL RAILROAD SECTION

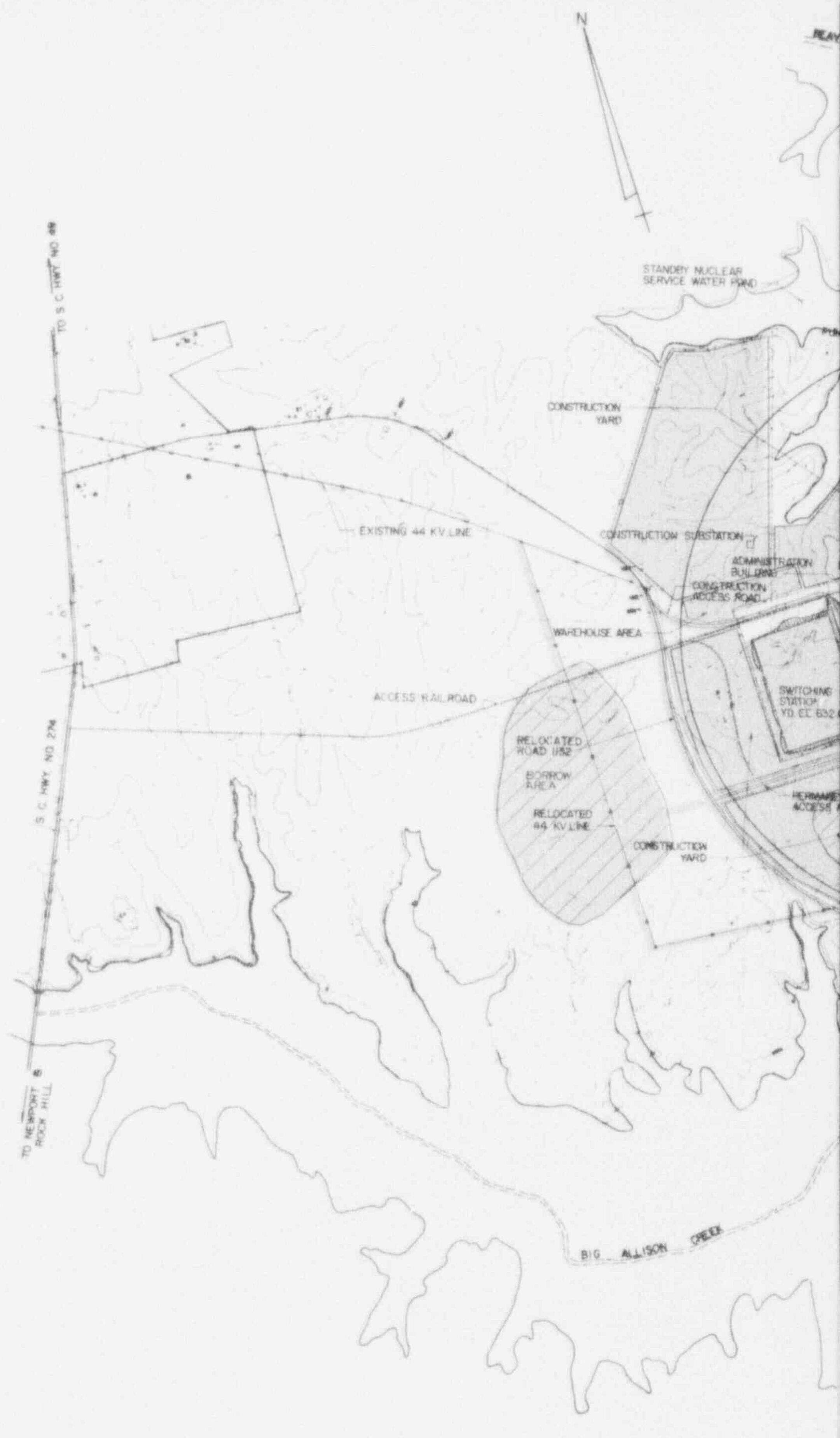
9406090213 - 44

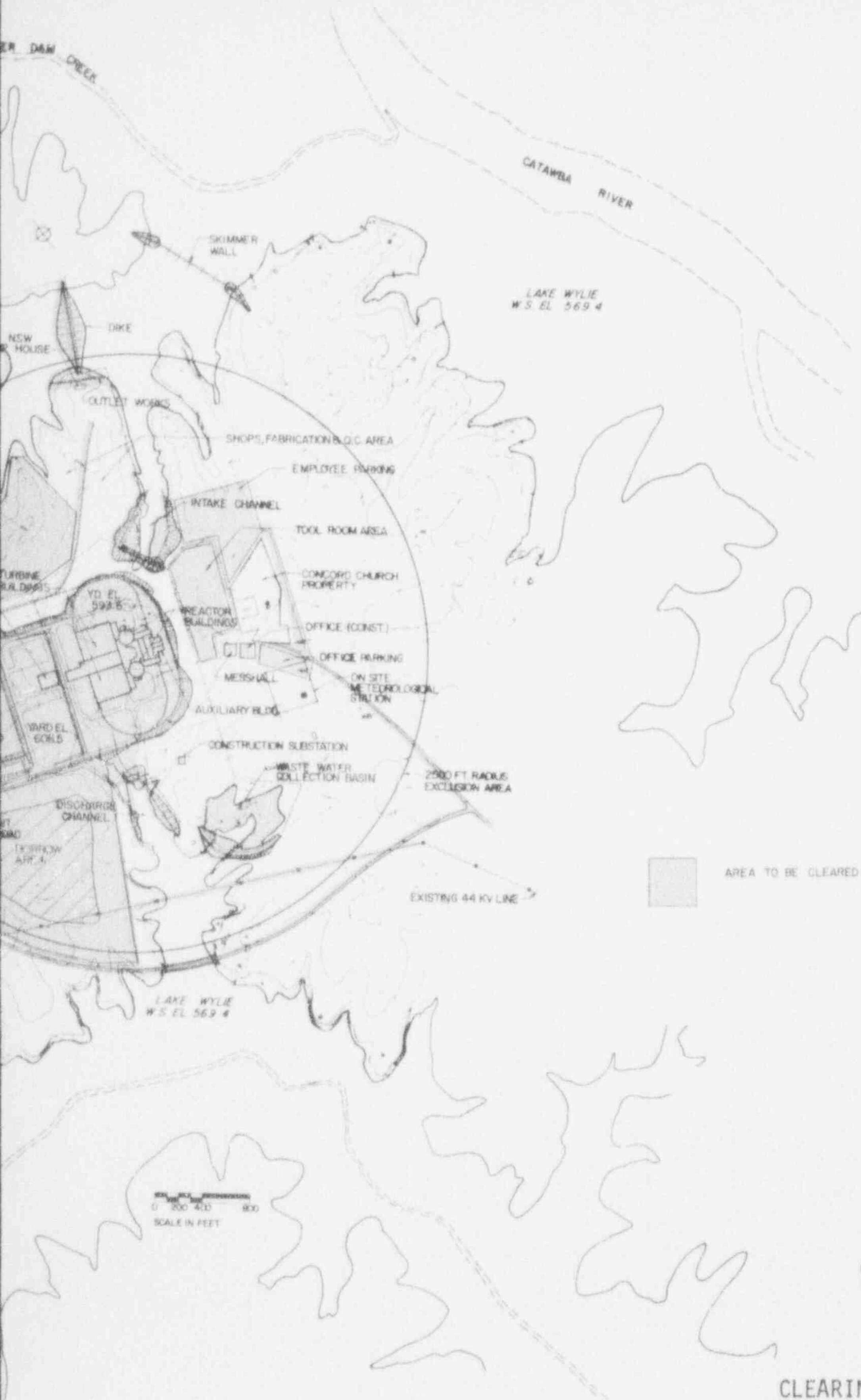
ACCESS RAILROAD (PRELIMINARY)

CATAWBA NUCLEAR STATION

ER Figure 4.5-1

Amendment 1
(New)


N
STANDBY NUCLEAR
SERVICE WATER POND
CONSTRUCTION
YARD
EXISTING 44 KV LINE
CONSTRUCTION SUBSTATION
ADMINISTRATION
BUILDING
CONSTRUCTION
ACCESS ROAD
WAREHOUSE AREA
ACCESS RAILROAD
SWITCHING
STATION
RELOCATED
ROAD 1152
BORROW
AREA
RELOCATED
44 KV LINE
CONSTRUCTION
YARD
TO S.C. HWY NO 49
S.C. HWY NO 274
TO NEWPORT &
ROCK HILL
BIG ALLISON CREEK



9406090213-45

CLEARING PLAN

CATAWBA NUCLEAR STATION

ER Figure 4.5-2

Amendment 1
(New)

Table of Contents

1

United States Department of the Interior
Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife

ESTIMATION OF FISH STANDING CROP, SPORT FISH HARVEST AND ANGLER USE FOR LAKES MOUNTAIN ISLAND, WYLIE AND NORMAN DUKE POWER COMPANY PROJECTS, NORTH AND SOUTH CAROLINA

Robert M Jenkins
Division of Fishery Research
National Reservoir Research Program
113 South East Street
Fayetteville, Arkansas 72701
May 22, 1972

cc: Director, BSFW (FR) (RBS) (Yates Barber)
Regional Director, Atlanta (RBS)
Oak Ridge National Lab (Ecol Sciences Div)
Duke Power Co (Environ Services Section)

MOUNTAIN ISLAND RESERVOIR AND LAKES WYLIE AND NORMAN
FISH STANDING CROP AND HARVEST ESTIMATES

The predictions of fish standing crop and sport fish harvest in Mountain Island, Wylie and Norman are based on correlation and multiple regression analyses of data from reservoirs throughout the United States and from comparative information on other Catawba River impoundments. Regression formulas and partial correlation results used in the forecasts appear in the following publications:

Jenkins, R M 1968. The influence of some environmental factors on standing crop and harvest of fishes in U S reservoirs. Reservoir Fishery Resources Symposium, So Div, Amer Fish Soc, Athens, Ga, April 1967. p 298-321.

Jenkins, R M and D I Morais. 1968. Effects of thirteen environmental variables on fish standing crop in reservoirs. Proc 48th Ann Conf West Assoc State Game and Fish Comm: 332-342.

Jenkins, R M 1970. The influence of engineering design and operation and other environmental factors on reservoir fishery resources. Water Resources Bulletin 6 (1): 110-119.

Jenkins, R M and D I Morais. 1971. Reservoir sport fishing effort and harvest in relation to environmental variables. In Reservoir Fisheries and Limnology, Amer Fish Soc Spec Publ No 8, p 371-384.

National Reservoir Research Program. 1971. A compilation of multiple regression formulas for use in estimating fish standing crop and angler harvest and effort in U S reservoirs. 10 p. (Attached).

The predictions for Mountain Island, Wylie and Norman are predicated on analyses of data from two groups of reservoirs (Table 1), and do not account for the effects of heated water discharges.

PREDICTED STANDING CROP

Mountain Island Reservoir is classified as a hydropower mainstream reservoir of chemical type 3 (Na-K, CO_3-HCO_3) which does not form a stable thermocline. A multiple regression (Formula 14, NRRP, 1971), which explains 47 percent of crop variability indicates that total fish crop in Mountain Island should be about 120 pounds per acre. Cove sampling during the period 1957-1965 yielded a mean of 105 pounds per acre (Table 2). The shad crop is predicted to be about 78 pounds per acre (Formula 17), compared to actual recovery of 70 pounds per acre in cove sampling. The predicted crop of sport fishes of 46 pounds per acre is much higher than the 26 pounds per acre obtained in cove sampling.

Mountain Island has a steam generating station on its shore. Cooling water for this plant is drawn from the upper end of the lake and discharged into the lower end several degrees above normal intake temperature. "The cumulative effect of this warm water on the reservoir is not known although good catches of various species of fish, especially white bass and catfish, are taken from the warm-water discharge during the winter months." (1966 No Car D-J Project Completion Report. Mimeo)

Table 1. Mean values of environmental variables in National standing crop and harvest samples compared to those estimated for Lakes Mountain Island, Wylie, and Norman with estimated angler effort and harvest at an assumed reservoir age of 20 years.

Environmental variable	National standing crop sample	National harvest sample	Mountain Island	Lake Wylie	Lake Norman
Area (acres)	15,800	14,650	3,235	12,455	32,450
Mean depth (ft)	28	35	18	22	34
Outlet depth (ft)	49	61	30	48	35 & 85
Fluctuation (ft)	17	25	5	4	12
Storage ratio	0.45	0.67	0.035	0.09	0.56
Shore development	11.8	8.5	7.7	20.8	20.6
Dissolved solids (ppm)	162	282	40	45	33
Growing season (days)	190	192	215	220	200
Age (years)	19	20	20*	20*	20*
Est. area-weighted mean values					
Angler-days/acre[2] (4.0 hrs/day)		6.7	9.0	8.5	5.6
Angler-hours/acre[2]		30.4	39.1	31.0	24.7
Harvest in lb/hour[3]		0.5	0.54	0.58	0.53
Harvest in lb/acre[4]		14.6	21	18	13

*Assumed reservoir age

2/Formula H + M (NRRP, 1971)
3/Formula M (NRRP, 1971)
4/Formula H (NRRP, 1971)

Lake Wylie is also classified as a hydropower mainstream reservoir, chemical type 3, without a stable thermocline. The predicted total standing crop is 174 pounds per acre (Formula 14) compared to 162 pounds per acre derived from cove samples (Table 2). The predicted clupeid crop is 75 pounds per acre (Formula 17), compared to field estimates of 100 pounds per acre. Predicted sport fish crop is 64 pounds per acre (Formula 2) compared to the cove sample mean of 56 pounds per acre. Predicted crop of the remaining species (primarily carp and suckers) is 35 pounds per acre compared to the field estimate of 6 pounds per acre.

Lake Norman is classified as a hydropower storage reservoir, chemical type 3, with a stable thermocline. Total fish crop is predicted to be 118 pounds per acre. Samples taken during the first three years of impoundment averaged 127 pounds per acre. The predicted clupeid crop is 55 pounds per acre (Formula 13) compared to the field estimate of 66 pounds per acre. The predicted sport fish crop is 53 pounds per acre (Formula 2) compared to the field estimate of 56 pounus per acre (Table 2). Predicted crop of the remaining species is 10 pounds per acre, compared to the field estimates of 5 pounds per acre.

In calculating standing crop, the outlet depth was considered to be 35 feet (the top of the submerged weir near the dam). If the outlet depth is considered to be 80 feet (centerline of opening in the dam), the predicted total crop would be 15 pounds per acre less (103 lb/ac). Clupeid predicted crop would be 10 pounds per acre less, the crop of other fishes 5 pounds per acre less, with no change in the predicted sport fish crop.

Species composition and relative abundance is similar in the three reservoirs (Table 2). Principal apparent differences are a higher crop of shad in Wylie and higher crops of redbreast sunfish and bluegill in Norman (the newest impoundment).

PREDICTED ANGLER HARVEST AND EFFORT

Analyses of the influence of ten environmental variables on angler effort and harvest (Jenkins and Morais, 1971) have revealed highly significant (0.01 level) negative relationships between reservoir size and angler effort and harvest per acre; between reservoir age and rate of harvest and total harvest; and a positive relation between length of growing season (frost-free days) and angling pressure and yield.

A multiple regression involving area, dissolved solids, growing season and age (Formula H) was chosen to calculate angler effort and sport fish harvest for the three reservoirs. Angler-hour estimates are based on harvest estimates (Formula H) and harvest rates (Formula M). Predictions of harvest (Table 3, Figure 1) indicate that yields per acre will be highest in Mountain Island, followed by Wylie and Norman. However, due to the influence of reservoir age, harvest from Lake Norman is predicted to be highest this year (1972) (17 lb/ac), followed by Mountain Island (16 lb/ac) and Wylie (14 lb/ac).

Predicted rates of angler harvest (100-year mean) are highest in Wylie (0.58 lb/hr), followed by Mountain Island (0.54 lb/hr) and Norman (0.53 lr/hr). In terms of annual harvest, larger Lake Norman should produce the highest 100-year mean (375,000 lb. per year), followed by

Table 2. Summary of reservoir rotenone sample results reported by the North Carolina Wildlife Resources Dept (Mountain Island, Norman) and South Carolina Wildlife Resources Dept (Wylie) in D-J completion reports, 1958-1966. "t" = less than 0.1 pounds; "p" = present

Species	Mountain Island 4-year mean (mid-point=1960)	Wylie 8-year mean (mid-point=1961)	Norman 2-year mean (mid-point=1964)
Longnose gar	t	t	-
Gizzard shad	66.0	99.5	64.8
Threadfin shad	4.1	0.8	1.5
"Minnows"	0.2	0.9	0.1
Carp	6.5	-	0.5
White sucker	-	-	2.8
Redhorse sp.	1.3	-	3.5
Carpsucker sp.	0.8	2.8	-
White catfish	1.1	0.5	0.4
Channel catfish		3.3	-
Catfishes sp.	4.1	4.7	-
Bullheads sp.	-	-	1.8
White bass	0.6	0.7	0.3
Yellow bass	-	-	0.2
Warmouth	0.1	t	1.0
Redbreast sunfish	1.4	1.8	10.4
Pumpkinseed	0.1	0.6	2.2
Bluegill	1.1	3.0	23.6
Sunfish spp.	6.9	27.0	(37.4)
Largemouth bass	5.9	6.6	3.9
White crappie	p	p	3.5
Black crappie	p		3.7
Crappie sp.	2.5	3.0	(7.2)
Darters sp.	t	t	-
Yellow perch	2.0	4.5	4.5
Total	104.6	161.7	127.3
Sport fishes total	25.8	55.7	55.5
Clupeid total	70.1	100.3	66.3

Table 3. Predicted annual sport fish harvest in Lakes Mountain Island, Wylie and Norman, in pounds per acre, through 100 years of impoundment (Formula H)

Age of Reservoir (years)	Sport fish harvest in pounds/acre		
	Mountain Island	Wylie	Norman
1	52	45	33
2	42	36	27
5	32	27	20
10	26	22	16
20	21	18	13
50	16	14	10
100	13	11	8
Mean (100 year)	18	16	12

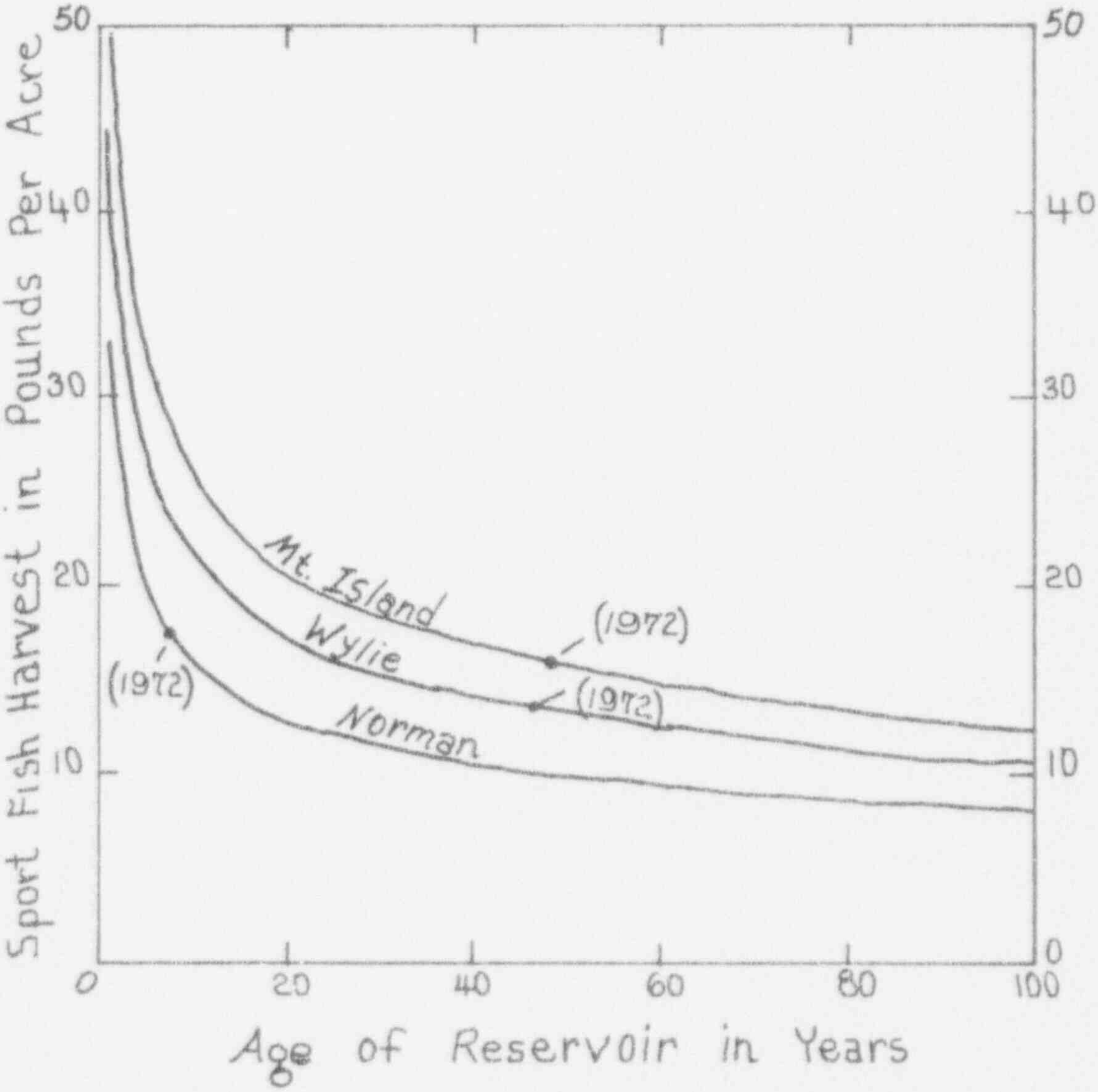


Figure 1. Comparison of predicted sport fish harvest in Mountain Island, Wylie and Norman Reservoirs through 100 years of impoundment, calculated by Formula H. Predicted harvests for the current year (1972) are indicated.

Wylie and Mountain Island (Table 4).

Total angler-days per annum are predicted to be highest on Norman, followed by Wylie and Mountain Island, which is primarily a function of surface area (Table 5). Conversely, annual angler-days per acre should be highest on Mountain Island (9.0 days/acre), compared to 8.5 days/acre on Wylie and 5.6 on Norman.

A creel census conducted on Wylie Reservoir by the South Carolina Wildlife Research Department for the period July-December 1970 (D-J Progress Report, Otho May) estimated use at 10.2 angler-hours/acre, a harvest rate at 1.4 pounds/angler-hour, and a harvest 14.2 pounds/acre. Assuming that this represents 40 percent of annual activity, totals for the year would be about 25 angler hrs./ac. (compared to our predicted 28 hrs./ac.), 1.4 lb./hr. (predicted 0.54) and 35.5 lb./ac. (predicted 15.5). This indicates that in Wylie's 45th year of impoundment, actual and predicted angler use estimates are close, but harvest rate is double that predicted.

The foregoing predictions are based on reservoirs where the mean year of estimate was 1961 (range, 1946-1969), the relative adequacy of access and angler accommodations and the geographic pattern of angler populations in relation to reservoir location were not determined and the mean reservoir age at time of estimate was 20 years (range, 2 to 107). Fishery management had not been attempted, or w infeasible or unsuccessful on many of these reservoirs. It is proba t these reservoirs can and will be managed to improve the predicte an sport fish harvests (12-18 pounds per acre) by sport fish introductions or maintenance stocking of striped bass, planned drawdowns, manipulation of forage fish populations, construction of an optimum number of fishing piers, launching ramps and other access facilities.

If optimum management is attained, maximum sustainable yield would be controlled by the productive capacity of the environment. The predicted standing crop of sport fishes in Mountain Island is 46 pounds per acre, 64 pounds per acre in Wylie and 52 pounds per acre in Norman. Standing crop as measured by rotenone sampling in mid-summer is hypothetically equal to carrying capacity. Actual mid-summer standing crop is typically about one-third greater than carrying capacity, but only about two-thirds of the fish biomass present is usually recovered following rotenone treatment. Based on a protein replacement theory advanced by D. H. Thompson (1941. In "A Symposium for Hydrobiology" p. 206-217, Univ. Wisc. Press, Madison), the maximum annual yield from these reservoirs would equal about 65 to 70 percent of the carrying capacity, or about 45 pounds per acre in Wylie, 32 pounds per acre in Mountain Island and 34 pounds per acre in Norman. Thus, a potential exists to double the predicted 100-year mean harvest in these Catawba River impoundments.

PREDICTED COMMERCIAL HARVEST

Estimation of potential annual commercial fish harvest in the two reservoirs is derived from a multiple regression with variables of mean depth, water level fluctuation, storage ratio, growing season and age (Table 6). The regression is based on a sample of 45 reservoirs where the fishery was

Table 4. Predicted annual sport fish harvest in total pounds in Lakes Mountain Island, Wylie and Norman through 100 years of impoundment (Formula H).

	Total annual sport fish harvest in pounds		
Age of Reservoir (yrs)	Mountain Island 3,235 ac.	Wylie 12,455 ac.	Norman 32,450 ac.
1	170,000	555,000	1,070,000
2	135,000	440,000	860,000
5	105,000	340,000	650,000
10	85,000	275,000	530,000
20	70,000	220,000	430,000
50	50,000	170,000	325,000
100	40,000	140,000	265,000
Mean (100 year)	60,000	190,000	375,000

Table 5. Predicted total annual angler-days in Lakes Mountain Island, Wylie and Norman through 100 years of impoundment, based on Formulas H and M, with and assumed mean angler-day length of 4.0 hours.

	Total angler-days per annum		
Age of Reservoir (yrs)	Mountain Island 3,235 ac.	Wylie 12,455 ac.	Norman 32,450 ac.
1	53,000	193,000	340,000
2	47,000	168,000	302,000
5	40,000	145,000	256,000
10	36,000	127,000	227,000
20	31,000	113,000	201,000
50	27,000	98,000	172,000
100	24,000	85,000	150,000
100 yr mean	29,000	105,000	185,000

Table 6. Predicted potential commercial fish harvest in Mountain Island Reservoir, Lake Wylie and Lake Norman through 100 years of impoundment.

	Potential harvest in pounds per acre		
Age of Reservoir (yrs)	Mountain Island	Wylie	Norman
1	2.9	2.2	1.2
2	4.0	3.0	1.7
5	6.2	4.7	2.6
10	8.7	6.6	3.6
20	12.1	9.2	5.0
50	18.8	14.8	7.8
100	26.3	20.1	10.9
Mean (100 yr)	17.7	13.6	7.4

primarily gill nets and the species harvested were buffalofish, carp, catfishes and drum. The potential commercial harvest in the three reservoirs (100-year mean) is predicted to range from 7 lb./acre in Norman to 14-18 lb./ac. in Mountain Island and Wylie. Principal species harvested would necessarily be carp, carpsuckers, redhorses and catfishes.

North Carolina Wildlife Resources Commission

CATAWBA RESERVOIR (LAKE WYLIE)

January, 1961

Extracted From
Inventory of Fish Population
in Lentic Waters

Job Completion Report
Federal Aid in Fish Restoration
Project F 5 R and F 6 R Job Number 1
January, 1961

CATAWBA RESERVOIR

Description

Catawba (Wylie) Reservoir (Figure 1) is a hydroelectric impoundment of the Duke Power Company located on the Catawba River in South Carolina, the backwater from which extends into North Carolina. Operation of the dam began in 1926. Full pool is at elevation 570 feet, the lake bottom at the dam is at elevation 507 feet, and top and bottom of the powerhouse penstocks are located at elevations 531 and 512 feet, respectively. Catawba is the second largest reservoir in the Catawba chain with a surface area of 15,455 acres and a maximum depth of 63 feet. Except after heavy rains on the watershed, Catawba Reservoir remains relatively clear. The lake receives a large proportion of its inflow from Mountain Island Reservoir immediately upstream and water level fluctuations are minor.

The current investigation was conducted during a two and one-half day period from July 21 to 23, 1965. The lake had previously been studied in 1957 to 1959.

Water Quality

No significant change from the previous limnological regimen was encountered during the 1965 investigation. Dissolved oxygen was present at all depths and water temperatures changed very little from the surface to the bottom of the reservoir (Table 1).

Fish Populations

Netting Data

During the 1965 study, four nylon trammel nets were fished for a total of eight net-days. The total net-catches for the period was 369 fish weighing 94.5 pounds (Table 2). The average catch of fish per net-day ranged from 30 to 72 and the weight from 4.3 to 19.2 pounds. By number, the abundant fishes collected were warmouth sunfish, white crappie and pumpkinseed which comprised 41.2, 10.8 and 9.5 percent, respectively, of the total net samples. By weight, the dominant species were redhorse suckers and warmouth sunfish which together comprised approximately 50 percent of the total weight of fish captured in the nets. Of lesser importance and in order of decreasing abundance were the large mouth bass, carp and longnose gar.

In 1957 to 1959, the average catch per net-day ranged from 25 to 49 fish weighing 8.9 to 14.3 pounds. The important species by number were sunfish, white catfish, white crappie and gizzard shad. The important species by weight were longnose gar, white catfish, white crappie, largemouth bass, carpsuckers and redhorse suckers.

Cove Data

One cove was selected for fish-population sampling with rotenone from the two coves previously sampled in 1957 to 1959. Results of the rotenone sample indicated a total of 4,936 fish per acre with a weight of 106 pounds (Table 2). Numerically, the abundant species were bluegill, threadfin shad and yellow perch, comprising 36.9, 32.6 and 9.1 percent of the cove sample, respectively. Gizzard shad and bluegill comprised 63.4 percent of the total weight of the cove sample. Species of lesser importance by weight were redbreast sunfish, threadfin shad and pumpkinseed.

Six fish-population samples were taken with rotenone during the preceding surveys. Results of these samples showed the number of fish per acre ranged from 3,990 to 26,170 and the weight ranged from 152.0 to 372.2 pounds. The abundant species numerically then were gizzard shad, sunfish and yellow perch; by weight, gizzard shad, sunfish and white catfish.

In the 1965 rotenone sample, threadfin shad constituted 84.5 percent of the total number of fish collected in the shad population sample (Table 2). Bluegill dominated the sunfish populations both in percent total number and weight, comprising 81.3 and 59.3 percent, respectively. The ratio of white to black crappie taken in the rotenone sample was approximately three to two.

It is evident when comparing the 1957 to 1959, and the 1965 cove samples that sunfish and gizzard shad have remained the dominant species by weight. The sunfish remain the dominant group numerically. Furthermore, it is of particular interest to note that the white perch, which is so numerous in the Yadkin-Pee Dee River System never has been collected by any method in Catawba Lake. In addition, the threadfin shad, which was introduced into the reservoir in 1961, has replaced the gizzard shad in numerical importance. The species collected in both nets and rotenone samples during the 1957 to 1959, and 1965 reservoir investigations are shown in Table 3.

Growth Studies

Largemouth bass

Data on growth of largemouth bass from Catawba Reservoir were taken from a total of 20 specimens. The total lengths of this species during the first four years of life averaged 5.7, 9.2, 14.1 and 17.2 inches (Table 4). In comparison with the age and growth study of this species in 1957 to 1959, it appears that growth, with the exception of slow growth during the second year of life, was much more rapid in 1965 (Table 5). The legal size limit of ten inches is reached by most largemouth bass early in their third year of life.

White crappie

Data on growth of white crappie in Catawba Reservoir were taken from a total of 22 specimens. The lengths of this species during the first two years of life averaged 1.6 and 5.5 inches (Table 6). This growth rate is much slower than was recorded for the species in 1957 to 1959 (Table 7).

Black crappie

A total of 21 specimens of black crappie were utilized in the Catawba Reservoir age and growth study. The total lengths of this species during the first three years of life averaged 4.1, 5.3 and 6.7 inches (Table 8). Growth of this species during the first year of life is comparable to the first year of growth recorded for this species in 1957 to 1959, however, in the previous studies the growth increment during the second year exceeded the growth rate recorded in 1965 by one inch (Table 9).

Bluegill

Growth data of bluegill from Catawba Reservoir were taken from a total of 37 specimens. The total lengths of this species during the first four years of life averaged 2.8, 4.6, 6.4 and 8.0 inches (Table 10). Except for the first year, growth was much more rapid during the following three years of life than was recorded for this species in the 1957 to 1959 age and growth studies (Table 11).

Fish Stocking

Since 1950, there have been numerous stockings of fingerling largemouth bass, bluegill and redear sunfishes. Results of rotenone samples taken in 1957 to 1959, and again in 1965 indicate these stockings have had little, if any, effect on the resident-fish populations in Catawba Reservoir.

In 1954, adult walleye were introduced into Catawba Reservoir. To date, this stocking has apparently been unsuccessful as there has been no evidence of reproduction nor have any adults been taken by fishermen nor during routine fish population sampling of the reservoir.

Catawba Reservoir was one of the three lakes originally stocked with white bass in 1952. Since that time, this pelagic species has become well established and contributes greatly to the sport fishery.

Threadfin shad were introduced into Catawba Reservoir in 1961. Since that time, this species has contributed greatly to the success of the white bass fishery, in addition to their value as forage for other predacious game fishes.

Conclusions

1. Threadfin shad, which was introduced into the reservoir in 1961, has replaced the gizzard shad in numerical importance.

2. White perch, which are so numerous in the Yadkin Pee Dee River Basin, has not been collected in Catawba Reservoir on any occasion since the impoundment was first sampled in 1957.

Recommendations

1. An accelerated program of research into reservoir limnology should be conducted to determine the problems of density currents, effects of different level intakes, quality and quantity of influent water, time of drawdown, and any other factors which may have profound effects upon the fish populations.

2. Periodic fish population checks and limnological studies should be made so that adverse environmental effects might be detected.

3. Efforts should be made to study the life history of the threadfin shad, particularly its relationship with other species.

4. Determine fishing success and fishing pressure in order to evaluate any managerial program which might be initiated as a result of research.

TABLE 1

WATER QUALITY DATA, CATAWBA RESERVOIR
JULY 22, 1965

Depth in Feet	Temp. °F	Dissolved O_2 ppm	Free CO_2 ppm	M. O. Alk. ppm	pH
Surface	87.0	7.2	2.0	18.0	7.2
5	84.2	7.0			
10	82.0	5.4			
15	79.0	4.4			
20	78.6	3.8	6.0	20.0	6.9
25	78.1	3.2			
30	76.8	2.4			
35	75.9	1.4			
40	75.7	0.4			
45	75.5	0.2	16.0	30.0	6.5

TABLE 2

RESULTS OF ROTENONE SAMPLE AND TRAMMEL NET CATCH FROM CATAWBA RESERVOIR
JULY 21 to 23, 1965

Rotenone					Trammel Net			
Area of Cove No. 2	0.76 Acre							
No. Fish/Acre	4,935.5							
Wt. Fish/Acre (lbs.)	105.9							
Young-of-Year Bass/Acre	107				No. of Net Days			8
	Total		% Total		Total		% Total	
Species	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Longnose gar	1	0.1	Tr.	0.1	3	7.3	0.8	7.[illegible]
SHAD	1447	37.5	38.6	46.6				
Gizzard	225	32.7	6.0	40.6	21	3.1	5.7	3.[illegible]
Threadfin	1222	4.8	32.6	6.0				
Carp					2	7.4	0.5	7.[illegible]
Quillback					1	0.9	0.3	0.9
Golden shiner	14	0.8	0.4	1.0	3	0.5	0.8	0.[illegible]
Notropis spp.	11	0.1	0.3	0.1				
Moxostoma spp.					21	28.3	5.7	29.9
CATFISH	54	4.3	1.4	5.3	28	7.5	7.6	7.9
White	20	3.1	0.5	3.8	23	5.8	6.2	6.[illegible]
Bullhead					2	1.1	0.5	1.[illegible]
Channel	34	1.2	0.9	1.5	3	0.6	0.8	0.[illegible]
White bass	20	0.7	0.5	0.9				
SUNFISH	1702	27.8	45.4	34.5	212	23.3	57.4	2[illegible]
Warmouth	2	0.2	Tr.	0.2	152	18.0	41.2	19.[illegible]
Redbreast	201	5.3	5.4	[illegible]	10	0.9	2.7	0.9
Pumpkinseed	116	3.9	3.1	4.9	35	2.9	9.5	3.[illegible]
Bluegill	1383	18.4	36.9	22.8	15	1.5	4.1	[illegible]
Largemouth bass	91	3.3	2.4	4.1	9	7.8	2.4	8.2
CRAPPIE	39	2.4	1.0	3.0	65	7.8	17.6	8.2
White	23	1.2	0.[illegible]	1.[illegible]	40	4.9	10.8	5.2
Black	16	1.2	0.4	1.5	25	2.9	6.8	3.[illegible]
Etheostoma spp.	29	0.1	0.8	0.1				
Yellow perch	343	3.4	9.1	4.2	4	0.6	1.1	0.[illegible]

TABLE 3

CHECK LIST OF KNOWN CATAWBA RESERVOIR FISHES

Longnose gar	Lepisosteus osseus (Linnaeus)
Bowfin	Amia calva Linnaeus
Gizzard shad	Dorosoma cepedianum (LeSueur)
Threadfin shad	Dorosoma petenense (Gunther)
Smallmouth buffalo	Ictiobus bubalus (Rafinesque)
Quillback	Capriodes cyprinus (LeSueur)
Suckermouth redhorse	Moxostoma pappillosum (Cope)
V-lip redhorse	Moxostoma collapsum (Cope)
Lake chubsucker	Erimyzon sucetta (Lacepede)
White sucker	Catostomus commersoni (Lacepede)
Goldfish	Carassius auratus (Linnaeus)
Carp	Cyprinus carpio Linnaeus
Golden shiner	Notemigonus crysoleucas (Mitchill)
Shiners	Notropis spp.
Channel catfish	Ictalurus punctatus (Rafinesque)
White catfish	Ictalurus catus (Linnaeus)
Yellow bullhead	Ictalurus natalis (LeSueur)
Brown bullhead	Ictalurus nebulosus (LeSueur)
White bass	Roccus chrysops (Rafinesque)
Warmouth	Chaenobryttus gulosus (Cuvier)
Bluespotted sunfish	Enneacanthus gloriosus (Holbrook)
Redbreast sunfish	Lepomis auritus (Linnaeus)
Green sunfish	Lepomis cyanellus (Rafinesque)
Pumpkinseed	Lepomis gibbosus (Linnaeus)
Bluegill	Lepomis macrochirus Rafinesque
Largemouth bass	Micropterus salmoides (Lacepede)
White crappie	Pomoxis annularis Rafinesque
Black crappie	Pomoxis nigromaculatus (LeSueur)
Johnny darter	Etheostoma nigrum Rafinesque
Yellow perch	Perca flavescens (Mitchill)
Walleye	Stizostedion vitreum (Mitchill)

TABLE 4

CALCULATED TOTAL LENGTH IN INCHES OF CATAWBA RESERVOIR LARGEMOUTH BASS
1965

Age Group	No. of Specimens	Length at End of Year 1	2	3	4	Length at Capture
I	9	4.7				6.6
II	8	6.1	8.6			10.0
III	2	7.7	10.2	13.6		14.4
IV	1	7.8	11.6	15.0	17.2	18.8
TOTAL FISH	20					
Mean		5.7	9.2	14.1	17.2	
Increment		5.7	2.6	3.4	2.2	

TABLE 5

CALCULATED AVERAGE LENGTHS AND GROWTH INCREMENTS
OF CATAWBA RESERVOIR LARGEMOUTH BASS
1957 to 1959

	No. of Specimens	Length at End of Year 1	2	3	4
TOTAL FISH	53				
Mean		4.9	9.4	12.9	15.0
Increment		4.9	4.7	3.3	2.0

TABLE 6

CALCULATED TOTAL LENGTH IN INCHES OF CATAWBA RESERVOIR WHITE CRAPPIE
1965

Age Group	No. of Specimens	Length at End of Year 1	2	3	4	Length at Capture
I	12	1.4				6.0
II	10	1.9	5.5			7.0
TOTAL FISH	22					
Mean		1.6	5.5			
Increment		1.6	3.9			

TABLE 7

CALCULATED AVERAGE LENGTHS AND GROWTH INCREMENTS
OF CATAWBA RESERVOIR WHITE CRAPPIE
1957 to 1959

	No. of Specimens	Length at End of Year 1	2	3	4
TOTAL FISH	40				
Mean		4.0	6.4	8.6	8.8
Increment		4.0	2.5	2.2	1.3

TABLE 8

CALCULATED TOTAL LENGTH IN INCHES OF CATAWBA RESERVOIR BLACK CRAPPIE
1965

Age Group	No. of Specimens	Length at End of Year 1	2	3	4	Length at Capture
I	14	4.4				5.8
II	5	3.9	5.3			6.6
III	2	3.0	5.4	6.7		7.5
TOTAL FISH	21					
Mean		4.1	5.3	6.7		
Increment		4.1	1.4	1.3		

TABLE 9

CALCULATED AVERAGE LENGTHS AND GROWTH INCREMENTS
OF CATAWBA RESERVOIR BLACK CRAPPIE
1957 to 1959

	No. of Specimens	Length at End of Year 1	2	3	4
TOTAL FISH	14				
Mean		4.0	6.3		
Increment		4.0	2.4		

TABLE 10

CALCULATED TOTAL LENGTH IN INCHES OF CATAWBA RESERVOIR BLUEGILL
1965

Age Group	No. of Specimens	Length at End of Year 1	2	3	4	Length at Capture
I	13	1.8				3.5
II	18	3.1	4.3			5.2
III	5	3.6	5.2	6.3		6.8
IV	1	4.3	6.1	7.1	8.0	8.1
TOTAL FISH	37					
Mean		2.8	4.6	6.4	8.0	
Increment		2.8	1.3	1.1	0.9	

TABLE 11

CALCULATED AVERAGE LENGTHS AND GROWTH INCREMENTS
OF CATAWBA RESERVOIR BLUEGILL
1957 to 1959

	No. of Specimens	Length at End of Year 1	2	3	4
TOTAL FISH	118				
Mean		3.1	4.5	5.7	6.5
Increment		3.1	1.6	1.3	0.9

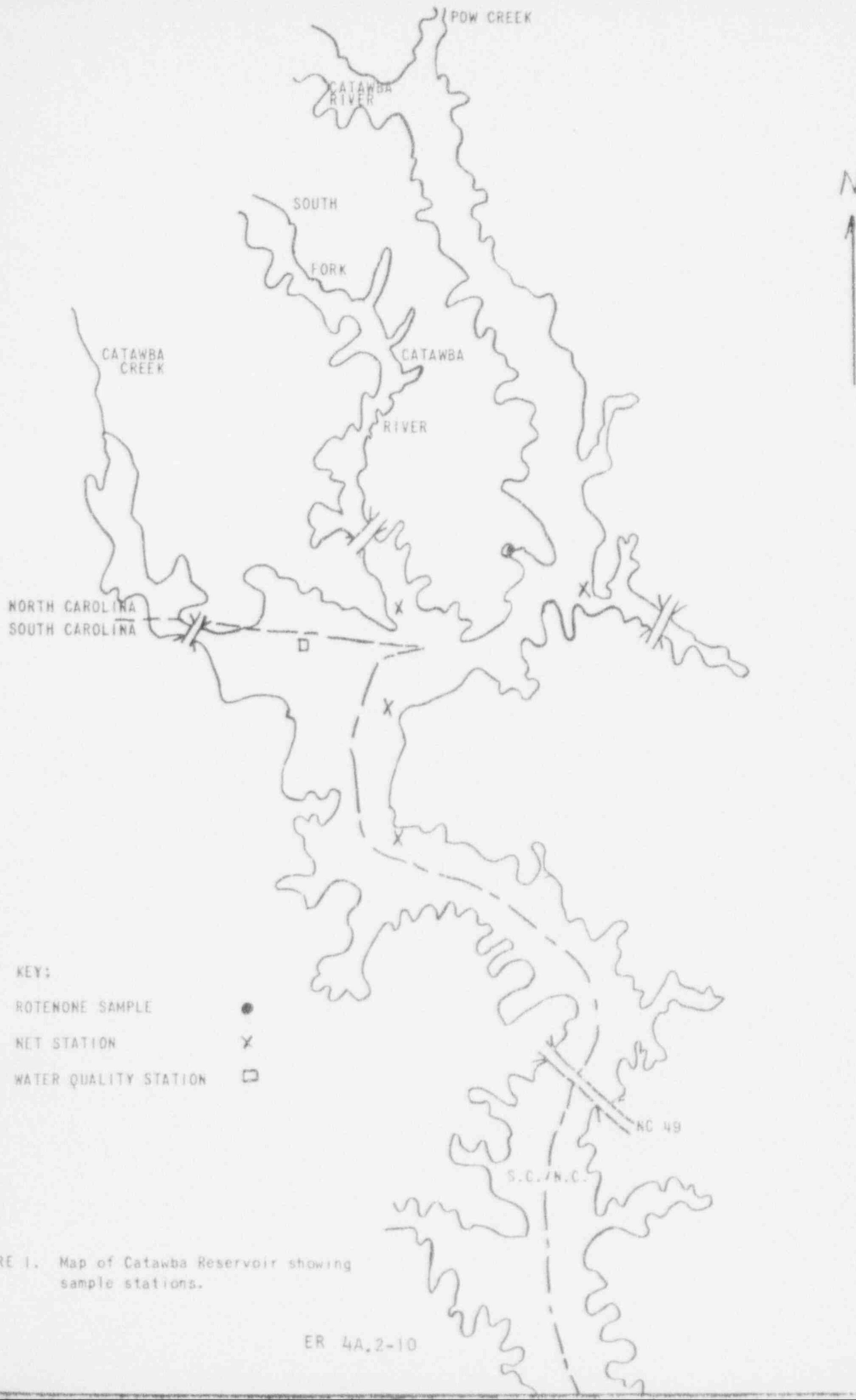


FIGURE 1. Map of Catawba Reservoir showing sample stations.

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North Carolina Wildlife Resources Commission

CATAWBA RESERVOIR (LAKE WYLIE)

June, 1966

Extracted From
Upper Catawba and Upper Yadkin
River Reservoirs - 1965 Surveys

William D. McNaughton
North Carolina Wildlife
Resources Commission
June, 1966

CATAWBA RESERVOIR

Description

Catawba Reservoir is a hydroelectric impoundment of the Duke Power Company located on the Catawba River in Gaston and Mecklenburg Counties, North Carolina and York County, South Carolina. The reservoir has a surface area of 12,455 acres, with approximately one-half of the reservoir in North Carolina (Figure 1). Operation of the dam began in 1926. Top, bottom and intake elevations are as follows:

Normal full pool elevation	570 feet
Bottom of reservoir	507 feet
Top of intake	531 feet
Bottom of intake	512 feet

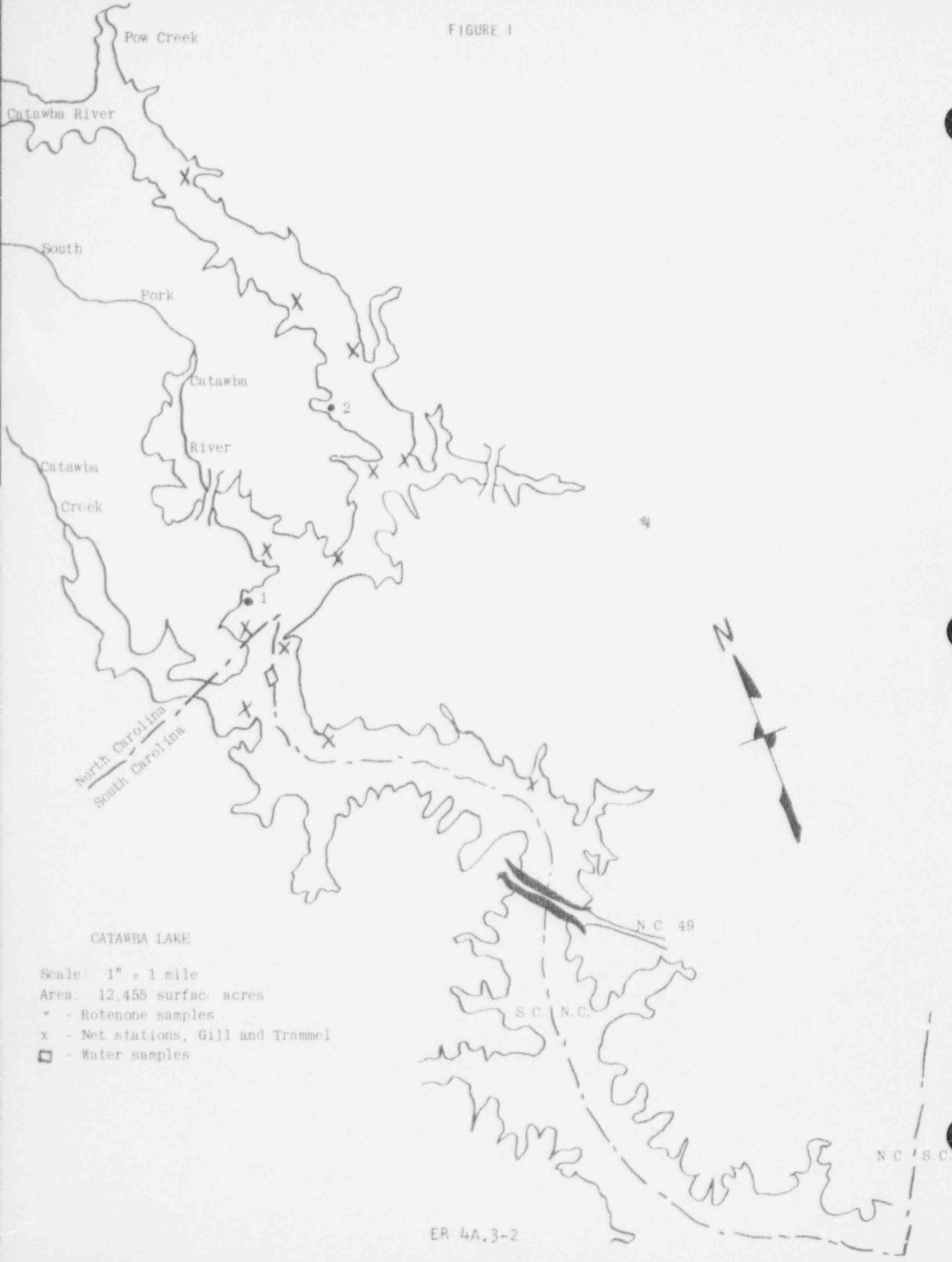
Catawba is a large reservoir with a maximum depth of 63 feet and a 325-mile shoreline. The reservoir has at least six major arms or coves and several smaller ones. Except after heavy rains on the watershed, Catawba is a clear reservoir for Piedmont North Carolina. Like most hydroelectric impoundments, Catawba receives a large volume of flow from the upstream reservoirs, although water-level fluctuation is minor. Due to the volume of flow, thermal or chemical stratification did not occur during the study and dissolved oxygen was present at all depths (Table 1).

TABLE 1.

Physical and chemical data, Catawba Reservoir, 1957, 1958, 1959

	August 26, 1957						August 4, 1958					
Depth in feet	Temp. °F.	O_2 ppm	Free CO_2 ppm	Pheno. alk. ppm	M.O. alk. ppm	pH	Temp. °F	O_2 ppm	Free CO_2 ppm	Pheno. alk. ppm	M.O. alk. ppm	pH
2	85.4	8.0	0	0	15	7.8	88.0	6.6	2.0	0	17.0	6.8
5	85.0						87.8					
10	85.0						86.5	5.8				
15	82.0	4.0					85.0					
20	81.8						83.9	3.6				
25	81.4	2.8					82.7					
30	81.2						81.7	1.6				
35	80.7	1.6	7.0	0	33	7.6	81.1					
40	79.3						80.2	0.2	12.0	0		6.8
45	79.1											
	August 12, 1959											
2	86.4	7.2	4.4	0	18	7.0						
5	85.9											
10	85.0	5.0										
15	83.0											
20	82.0	4.0										
25	81.6											
30	81.0	4.0										
35	79.3											
40	79.2											
45	79.2	3.0	10.6	0	22	6.8						

FIGURE I


Pow Creek
Catawba River
South
Fork
Catawba
River
Catawba
Creek
2
1
North Carolina
South Carolina
N
N.C. 49
S.C. N.C.
N.C. S.C.
CATAWBA LAKE
Scale: 1" = 1 mile
Area: 12,455 surfac acres
" - Rotenone samples
x - Net stations, Gill and Trammel
□ - Water samples

Fish Sampling

During the three-year study a total of 22 net days fishing was expended. The most abundant species collected, by number, were sunfish, white catfish, white crappie and gizzard shad (Table 2). The most abundant species by weight were longnose gar, white catfish, white crappie, largemouth bass, carp sucker and suckermouth redhorse.

TABLE 2.

Species composition of nylon trammel net catch from Catawba Reservoir for the years 1957, 1958, 1959

	Total number			Total weight			% total number			% total weight		
	Year			Year			Year			Year		
	57	58	59	57	58	59	57	58	59	57	58	59
No. net days	7	6	9									
Species												
Sunfish	65	56	52	7.0	5.9	6.5	30.4	37.1	11.7	7.0	11.1	6.8
Catfish	55	10	108	17.9	2.7	27.3	25.6	6.6	24.4	17.9	5.1	28.5
Gizzard shad	33	13	11	3.4	1.4	1.0	15.4	8.6	2.5	3.4	2.6	1.0
Crappie	31	49	218	4.6	6.6	27.4	14.5	32.4	49.2	4.6	12.4	28.6
Carp sucker	9	5	14	12.3	5.1	10.9	4.2	3.3	3.2	12.3	9.6	11.4
Gar	7	10		35.8	17.3		3.3	6.6		35.8	32.5	
Largemouth bass	6	5	7	11.3	13.8	5.6	2.8	3.3	1.6	11.3	25.9	5.8
Yellow perch	5	2	21	0.7	0.3	2.9	2.3	1.3	4.7	0.7	0.6	3.0
Bowfin	1			3.9			0.5			3.9		
Suckermouth redhorse	1		7	1.6		13.5	0.5		1.6	1.6		14.1
White bass	1		1	1.4		0.1	0.5		0.2	1.4		0.1
Carp		1			0.1			0.6			0.2	
Golden shiner			4			0.7			0.9			0.7

Experimental gill nets were used only two years in the Catawba survey during a total of fifteen net days. The most abundant species by number were gizzard shad, white catfish, white bass and crappie (Table 3); by weight were gizzard shad, white catfish, white bass and carp sucker.

The nylon trammel net was a more efficient fishing device than the experimental gill net. The average catch per net day for the nylon trammel net ranged from 25 to 49 fish weighing from 8.9 to 14.3 pounds. The average catch per net day for the experimental gill net ranged from 20 to 25 fish weighing from 8.3 to 8.5 pounds. The trammel net took largemouth bass each year, whereas the experimental gill net did not take any. The catch of white bass is almost opposite to that of largemouth bass. In 22 net days fishing the nylon trammel net took only two white bass, whereas in 15 net days the experimental gill net took 31 white bass.

A total of six rotenone samples were taken in Catawba Reservoir during the summers of 1957, 1958 and 1959. The number of fish per acre ranged from 3,990 to 26,170, and the weight ranged from 152.0 to 372.2 pounds (Table 4). The most abundant species numerically were gizzard shad, sunfish and yellow perch; and by weight gizzard shad, sunfish and white catfish. In the rotenone samples, the year 1959 was the most productive by both number and weight as a result of the tremendous number of gizzard shad collected that year. Even though 1959 produced over three times as many shad as any previous year, it is interesting to note the consistency in percent total number and weight of all the rotenone samples taken, especially when the two most numerous species, gizzard shad and sunfish are combined.

TABLE 3.

Species composition of experimental gill net catch from Catawba Reservoir for the years 1957, 1958

	Total number		Total weight		% total number		% total weight	
	Year		Year		Year		Year	
	57	58	57	58	57	58	57	58
No. net days	9	6						
Species								
Gizzard shad	147	56	15.0	9.2	65.9	46.7	20.2	18.0
Catfish	34	15	23.7	8.6	15.3	12.5	31.8	16.9
White bass	10	21	7.3	15.4	4.4	17.5	9.8	30.2
Sunfish	9	3	0.8	0.4	4.0	2.5	1.1	0.8
Carp sucker	8	7	8.4	7.7	3.6	5.9	11.3	15.1
Crappie	8	16	3.3	5.6	3.6	13.3	4.4	10.9
Gar	2	1	8.7	4.0	0.9	0.8	11.9	7.8
Suckermouth redhorse	2		3.2		0.9		4.3	
Golden shiner	2		0.1		0.9		0.1	
Carp	1		3.8		0.5		5.1	
Yellow perch		1		0.1		0.8		0.2

TABLE 4.

Results of rotenone samples from Catawba Reservoir for the years 1957, 1958, 1959
Cove No. 1

	Year											
	1957				1958				1959			
Cove area =	3.0 acres				3.0 acres				3.0 acres			
No. fish/acre	8,475				4,822				26,170			
Wt. fish/acre (lbs.)	225.7				140.8				372.2			
Young-of-year bass/acre	86				61				96			
	Total		% total		Total		% total		Total		% total	
Species	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.
Gizzard shad	22,080	498.1	86.9	73.6	11,273	291.3	77.9	68.9	70,789	754.7	90.2	67.6
Sunfish	1,939	86.9	7.6	12.9	1,923	56.1	13.3	13.6	4,977	151.4	6.3	13.6
Golden shiner	474	4.7	1.8	0.7	232	1.9	1.6	0.4	168	2.8	0.2	0.2
Yellow perch	418	14.0	1.6	2.1	346	11.4	2.4	2.7	640	30.1	0.8	2.7
Largemouth bass	323	29.5	1.2	4.4	217	19.6	1.5	4.6	353	47.8	0.4	4.3
Catfish	95	12.6	0.4	1.8	298	25.6	2.0	6.0	606	58.9	0.8	5.3
White bass	40	3.5	0.2	0.5	67	1.3	0.5	0.3	157	5.1	0.2	0.5
Carp sucker	35	18.8	0.1	2.7	78	7.3	0.5	1.7	73	14.3	0.1	1.3
Crappie	17	1.7	0.1	0.2	27	0.5	0.2	0.3	678	25.1	0.9	2.2
Carp	3	7.2	0.1	1.1	5	7.4	tr.	1.7	44	25.8	0.1	2.3
Notropis spp.									24	0.5	tr.	tr.

(Continued)

TABLE 4. (Continued)

Results of rotenone samples from Catawba Reservoir for the years 1957, 1958, 1959

Cove No. 2

	Year											
	1957				1958				1959			
Cove area =	1.8 acres				2.3 acres				2.3 acres			
No. fish/acre	5,338				3,990				5,655			
Wt. fish/acre (lbs.)	152.0				183.2				179.6			
Young-of-year bass/acre	108				78				62			
	Total		% total		Total		% total		Total		% total	
Species	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.	no.	wt.
Gizzard shad	6,360	133.1	[illegible]	8.8	6,952	287.7	75.8	61.3	8,419	205.4	64.7	49.7
Sunfish	2,139	82.0	[illegible]	9.9	1,270	43.2	13.8	10.3	2,872	90.7	22.1	22.0
Yellow perch	387	13.1	4.0	4.7	344	13.8	3.7	3.3	371	11.2	2.9	2.7
Golden shiner	273	1.8	2.8	0.7	64	1.3	0.7	0.3	155	4.7	1.2	1.1
Largemouth bass	208	14.5	2.2	5.3	189	14.6	2.0	3.4	143	27.2	1.1	6.6
Catfish	152	17.1	1.6	6.1	166	16.6	1.8	3.9	150	29.0	1.2	7.0
Crappie	59	4.[illegible]	[illegible].6	1.4	118	4.2	1.3	1.0	816	25.5	6.3	6.2
White bass	18	1.[illegible]	[illegible]2	0.5	52	1.9	0.6	0.4	40	4.0	0.3	1.0
Carp sucker	11	6.9	0.1	2.5	13	4.4	0.1	1.0	24	7.2	0.2	1.7
Gar	1	0.2	tr.	0.1	1	tr.	tr.	tr.				
Carp					7	32.4	0.1	7.7	6	6.4	tr.	1.5
Suckermouth redhorse					1	1.2	tr.	0.3	1	1.0	tr.	0.2
Gambusia									8	0.1	tr.	tr.
Goldfish									1	0.7	tr.	0.2

With the two species combined, in cove number one the percent total number for the three years was 94.5, 91.2 and 96.5; the percent total weight was 86.5, 82.5 and 82.2 (Table 4). The two species combined in cove number two produced 88.5, 89.6 and 86.8 percent of the total number and 78.7, 71.6 and 71.7 percent of the total weight. The range in number of young-of-year largemouth bass per acre was 61 to 96 in cove number one and from 62 to 108 in cove number two. The species collected by both rotenone and nets are shown in Table 5.

TABLE 5.

Species of fish collected from Catawba Reservoir

Longnose gar	Lepisosteus osseus (Linnaeus)
Bowfin	Amia calva Linnaeus
Gizzard shad	Dorosoma cepedianum (LeSueur)
Smallmouth buffalo	Ictiobus bubalus (Rafinesque)
Quillback	Carpiodes cyprinus (LeSueur)
White sucker	Catostomus commersoni (Lacepede)
Lake chubsucker	Erimyzon sucetta (Lacepede)
Suckermouth redhorse	Moxostoma pappillosum (Cope)

(Continued)

TABLE 5. (Continued)

V-lip redhorse	Moxostoma collapsum (Cope)
Carp	Cyprinus carpio Linnaeus
Golden shiner	Notemigonus crysoleucas (Mitchill)
Shiners	Notropis spp.
Channel catfish	Ictalurus punctatus (Rafinesque)
White catfish	Ictalurus catus (Linnaeus)
Brown bullhead	Ictalurus nebulosus (LeSueur)
Yellow bullhead	Ictalurus natalis (LeSueur)
White bass	Roccus chrysops (Rafinesque)
Largemouth bass	Micropterus salmoides (Lacepede)
Warmouth	Chaenobryttus gulosus (Cuvier)
Redbreast sunfish	Lepomis auritus (Linnaeus)
Bluespotted sunfish	Enneacanthus gloriosus (Holbrook)
Green sunfish	Lepomis cyanellus (Rafinesque)
Pumpkinseed	Lepomis gibbosus (Linnaeus)
Bluegill	Lepomis macrochirus Rafinesque
White crappie	Pomoxis annularis Rafinesque
Black crappie	Pomoxis nigromaculatus (LeSueur)
Walleye	Stizostedion vitreum (Mitchill)
Yellow perch	Perca flavescens (Mitchill)
Goldfish	Carassius auratus (Linnaeus)

Fish Growth

The data on growth of largemouth bass from Catawba Reservoir were taken from a total of 53 specimens. The average total length of the species during the first five years of life are 4.9, 9.4, 12.9, 15.0 and 17.9 inches (Table 6). Largemouth bass reach a total legal size of ten inches between their second and third year of life. This is a slower growth rate than was found in four Tennessee reservoirs (5, 7).

TABLE 6.

Calculated total length in inches of Catawba Reservoir largemouth bass

Age group	Number of fish	Length at end of year 1	2	3	4	5	6	Length at capture
I	33	5.1						8.4
II	7	4.3	9.2					12.9
III	4	4.4	9.1	12.5				13.9
IV	4	4.9	9.7	13.0	15.6			17.0
V	4	5.6	9.9	12.7	15.0	17.6		18.6
VI	1	3.7	9.7	14.7	17.5	19.1	20.3	20.8
Mean	53	4.9	9.4	12.9	15.0	17.9	20.3	
Increment		4.9	4.7	3.3	2.0	2.4	1.2	

Body scale relationship L = 0.5 + 1.9S

The data on growth of white crappie from Catawba Reservoir were taken from a total of 40 specimens. The average total lengths of this species during the first four years of life are 4.0, 6.4, 8.6 and 8.8 inches (Table 7).

TABLE 7.

Calculated total length in inches of Catawba Reservoir white crappie

Age group	Number of fish	Length at end of year 1	2	3	4	5	6	Length at capture
I	14	4.2						6.6
II	13	3.9	6.5					8.2
III	11	4.0	6.5	8.8				11.0
IV	2	3.8	5.9	7.5	8.8			9.5
Mean	40	4.0	6.4	8.6	8.8			
Increment		4.0	2.5	2.2	1.3			

Body scale relationship L = 2.3 + 1.3S

The data on growth of black crappie from Catawba Reservoir were taken from a total of fourteen specimens. The average total length of this species during the first two years of life are 4.0 and 6.3 inches (Table 8).

TABLE 8.

Calculated total length in inches of Catawba Reservoir black crappie

Age group	Number of fish	Length at end of year 1	2	3	4	5	6	Length at capture
I	7	4.1						6.0
II	7	3.9	6.3					7.7
Mean	14	4.0	6.3					
Increment		4.0	2.4					

Body scale relationship L = 2.5 + 1.0S

The data on growth rates of bluegill from Catawba Reservoir were taken from a total of 118 specimens. The average total lengths of this species during the first four years of life are 3.1, 4.5, 5.7 and 6.5 inches (Table 9). Catawba Reservoir bluegill have a faster growth rate than the same species in North Carolina coastal streams (17).

TABLE 9.

Calculated total length in inches of Catawba Reservoir bluegill

Age group	Number of fish	Length at end of year 1	2	3	4	5	6	Length at capture
I	37	3.5						4.6
II	47	2.9	4.5					5.4
III	28	3.1	4.4	5.7				6.5
IV	6	2.8	4.4	5.6	6.5			7.1
Mean	118	3.1	4.5	5.7	6.5			
Increment		3.1	1.6	1.3	0.9			

Body scale relationship L = 1.6 + 0.9S

New Introductions and Fish Stocking

Adult white bass were introduced in Catawba Reservoir in 1952. Since that time they have become well established and contribute greatly to the sport fishery.

Adult walleye were introduced in 1954, however to date, indications of success have been absent.

Since 1950, there have been numerous stockings of fingerling largemouth bass, bluegill and redear sunfish.

Management

As mentioned earlier, Catawba is a relatively clear reservoir and supports an excellent sport fishery. It is hard to say which species is the most important. Largemouth bass produce excellent fishing in spring, early summer and late fall. White bass produce excellent fishing on the spawning run in early spring and good to excellent fishing during the summer while feeding on schooling shad, and also in late fall along the shoreline and around the various points. The population samples did not show it, but Catawba also produces excellent white crappie fishing in early spring and late fall. Bluegill produce a fair fishery during their spawning season.

White perch are not present in the reservoir.

The white catfish is considered a non-game fish, however it produces a limited but good hook-and-line sport fishery, along with a small commercial fishery using catfish baskets and trotlines.

Non-game fish do not appear to be a problem in the reservoir. This is indicated by the fact that little non-game fish reproduction was recorded, and the small numbers of adults taken in proportion to other species.

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Figure 1. Sampling stations, Lake Norman.

★ Gill net and chemical stations

■ Rotenone stations

Amendment 1 (New)

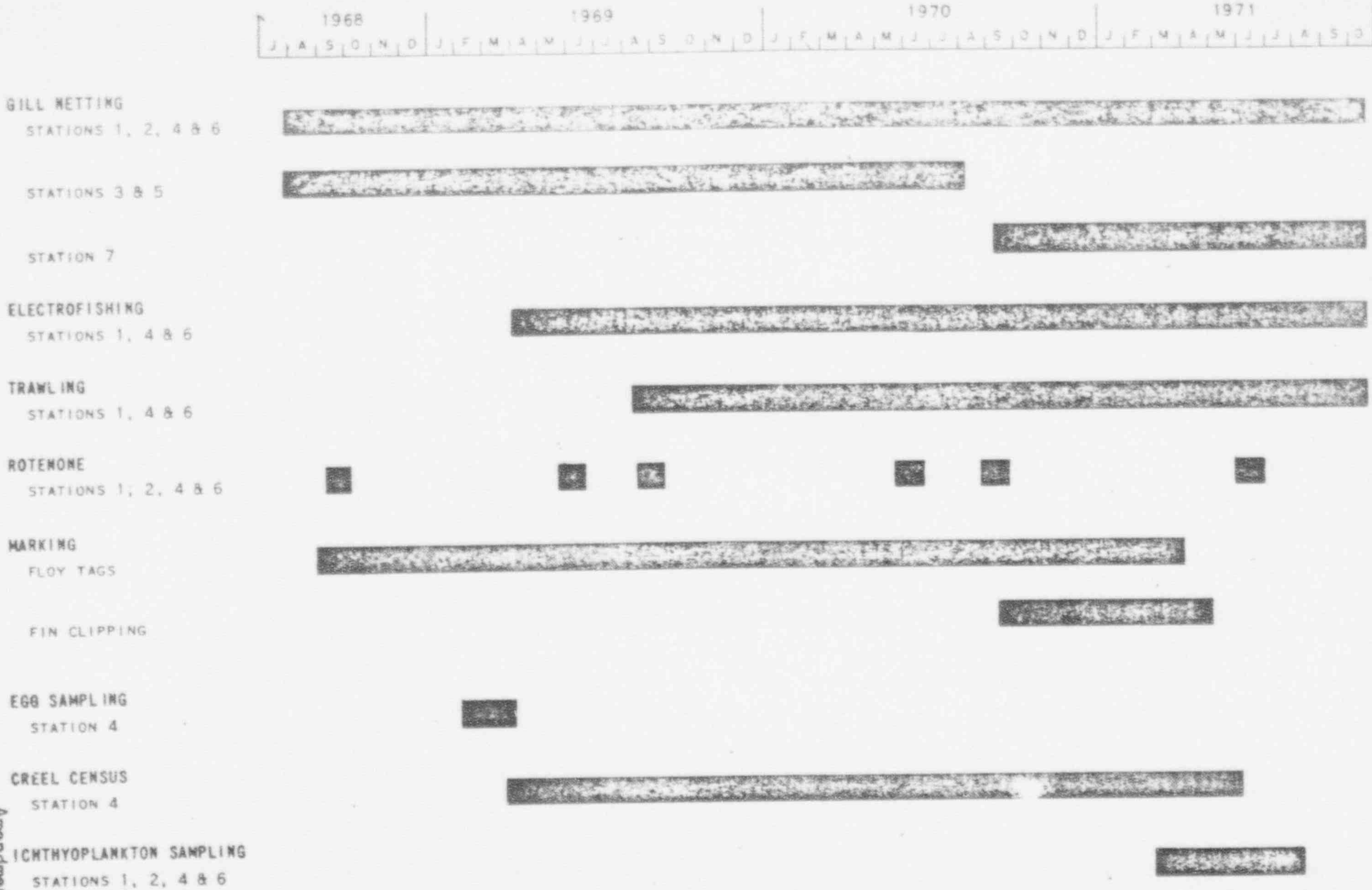

Figure 2. The span of time covered by the various sampling techniques employed during the Lake Norman Thermal Pollution Study, July, 1968 through October 1971.

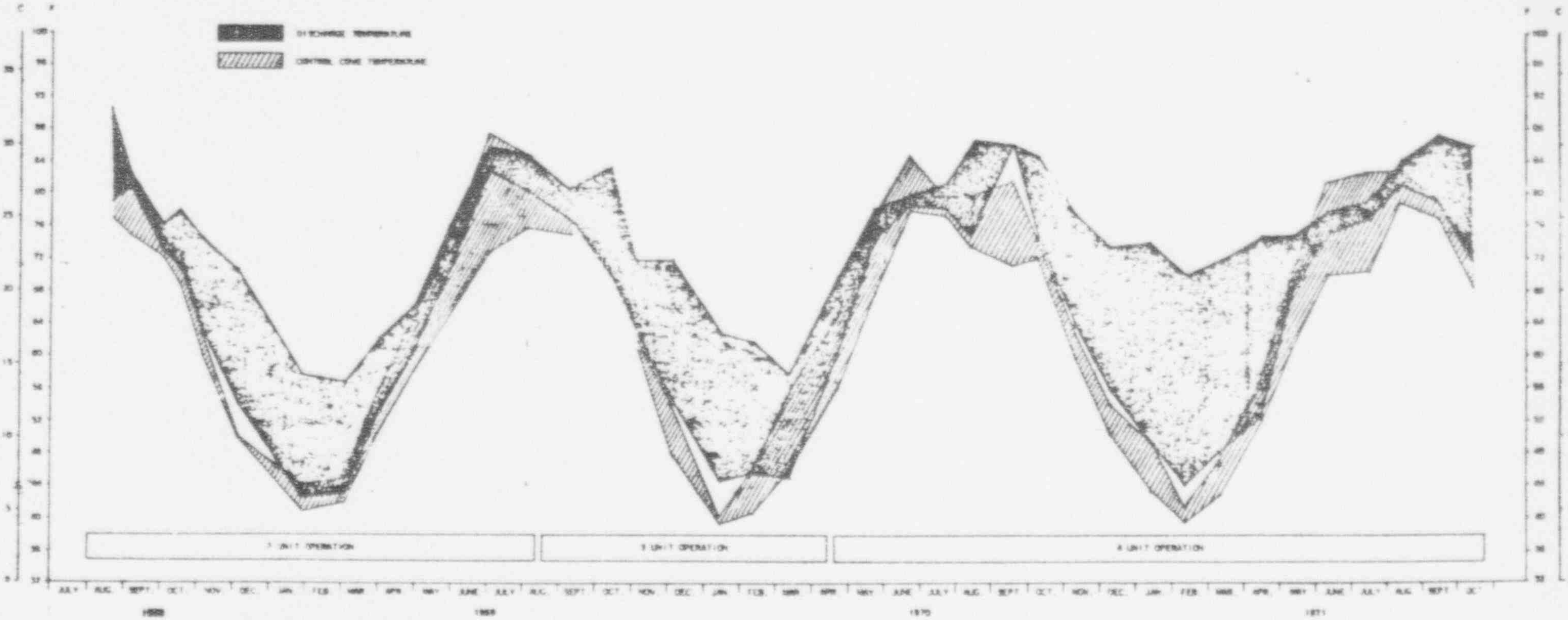

Figure 3. Temperature ranges at the discharge and control gill net sites, Lake Norman, N.C., August 1968 to October 1971. (The lined area represents the ranges of pooled data from control coves 1 and 6. No values were available for October 1969 in the controls. Dotted lines connecting the discharge points in October indicate that data was taken from station 8 instead of the gill net site.)

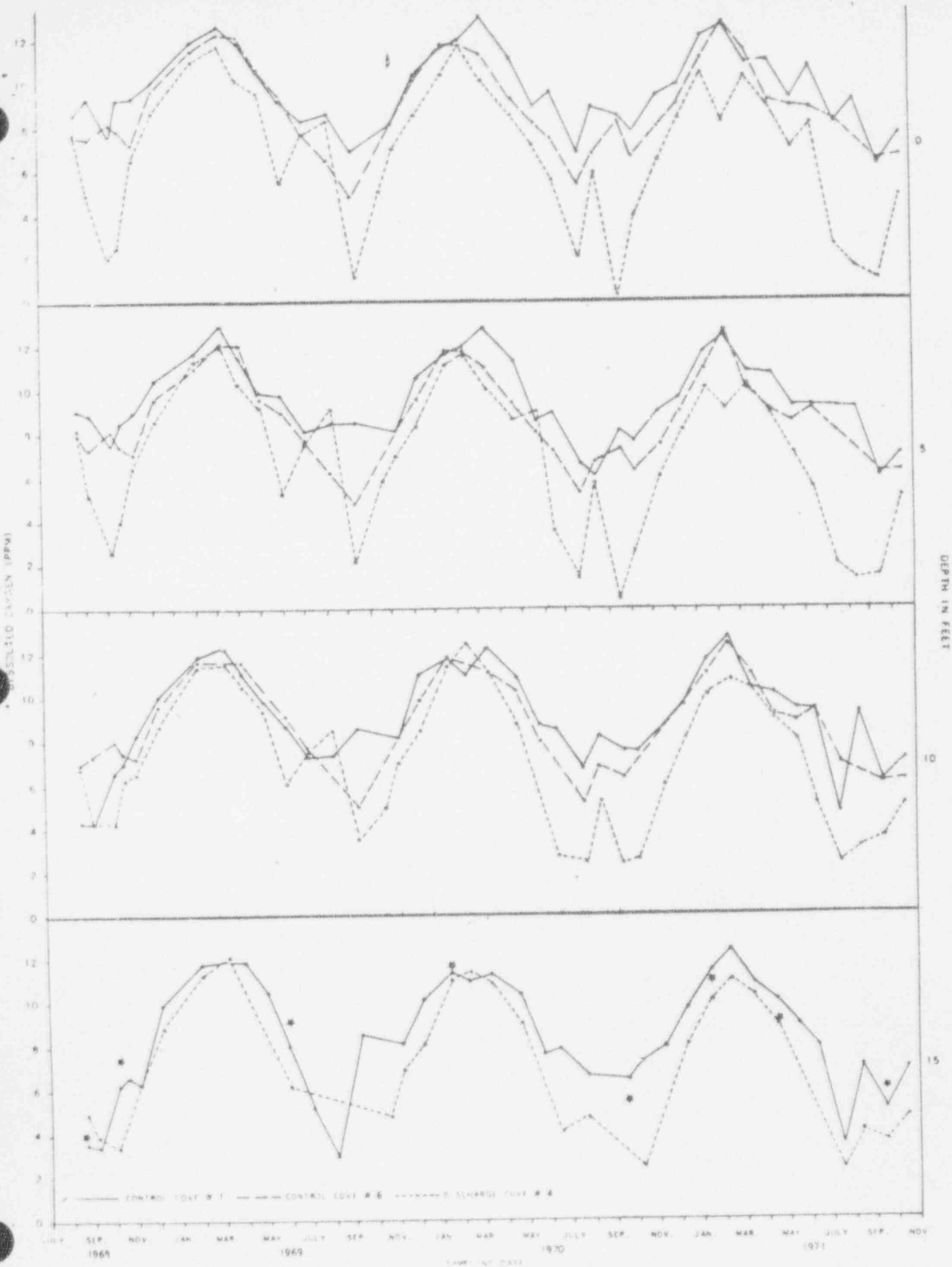

Figure 4. Monthly dissolved oxygen concentrations measured at four depths at the deep-water end of the gill net sets on Lake Norman. Determinations were made during the daylight hours from August 1968 to October 1971. (Cove #6 data at the 15 foot level were incomplete because of periodic drawdowns. What data were available are indicated by stars.)

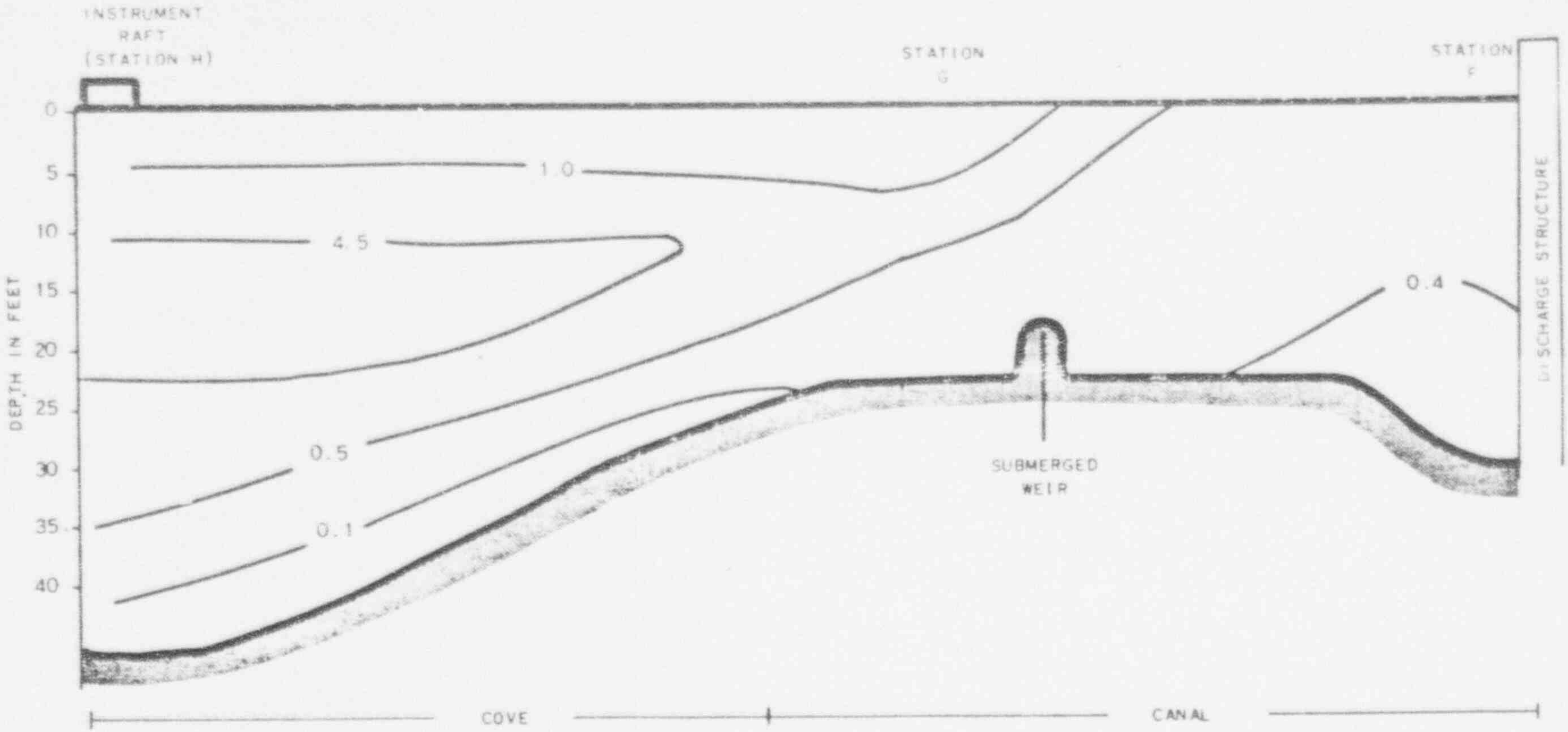

Figure 5. The distribution of dissolved oxygen concentrations (in ppm) in the Marshall Steam Station discharge canal and cove, Lake Norman, N. C., July 1970. The distance between station F and station H is approximately 0.9 miles. (The drawing is highly diagramatic and the horizontal dimensions are not to scale.)

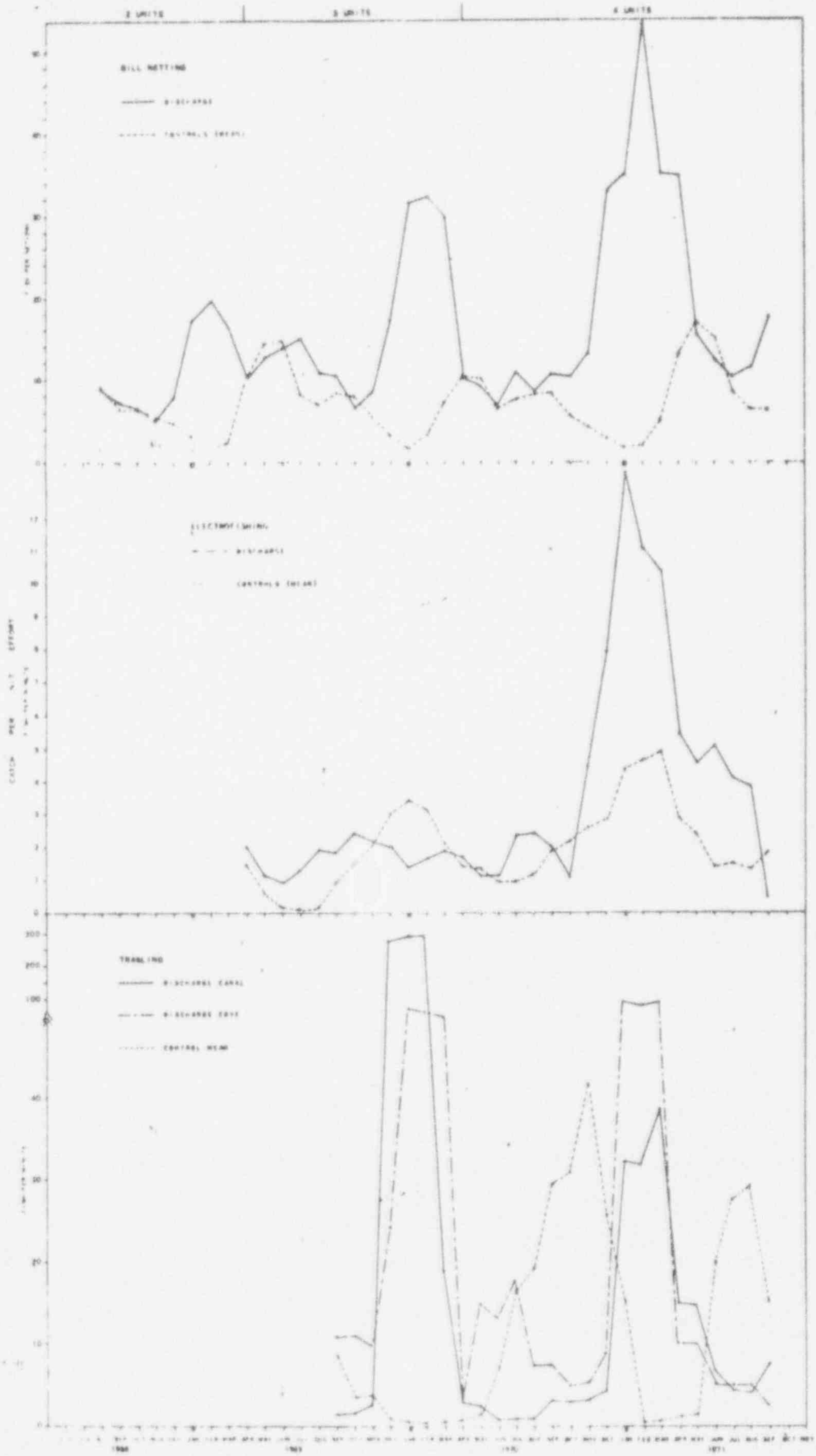

Figure 6. Gill netting, electrofishing and trawling catch rates in the Marshall Steam Station discharge and control coves, Lake Norman, N. C., July 1968 to October 1971. (The curves have been smoothed by the "ratio-to-moving-average" method to illustrate trends (Alder and Roessler, 1968).)

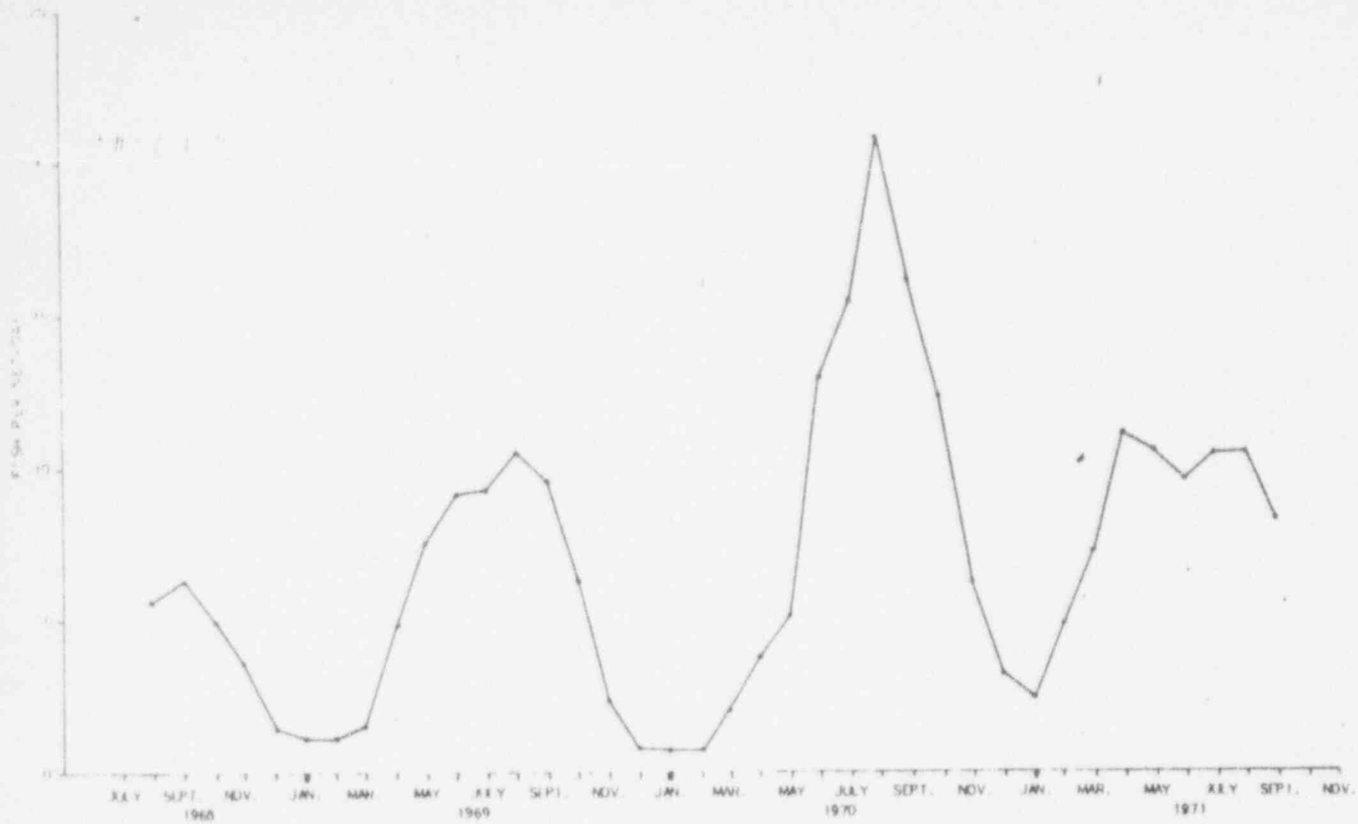

Figure 7. Gill net catch rates in the Marshall Steam Station intake cove, Lake Norman, North Carolina, July 1968 to October 1971. (The curve has been smoothed by the "ratio-to-moving-average" method to illustrate trends (Alder and Roessler, 1968).)

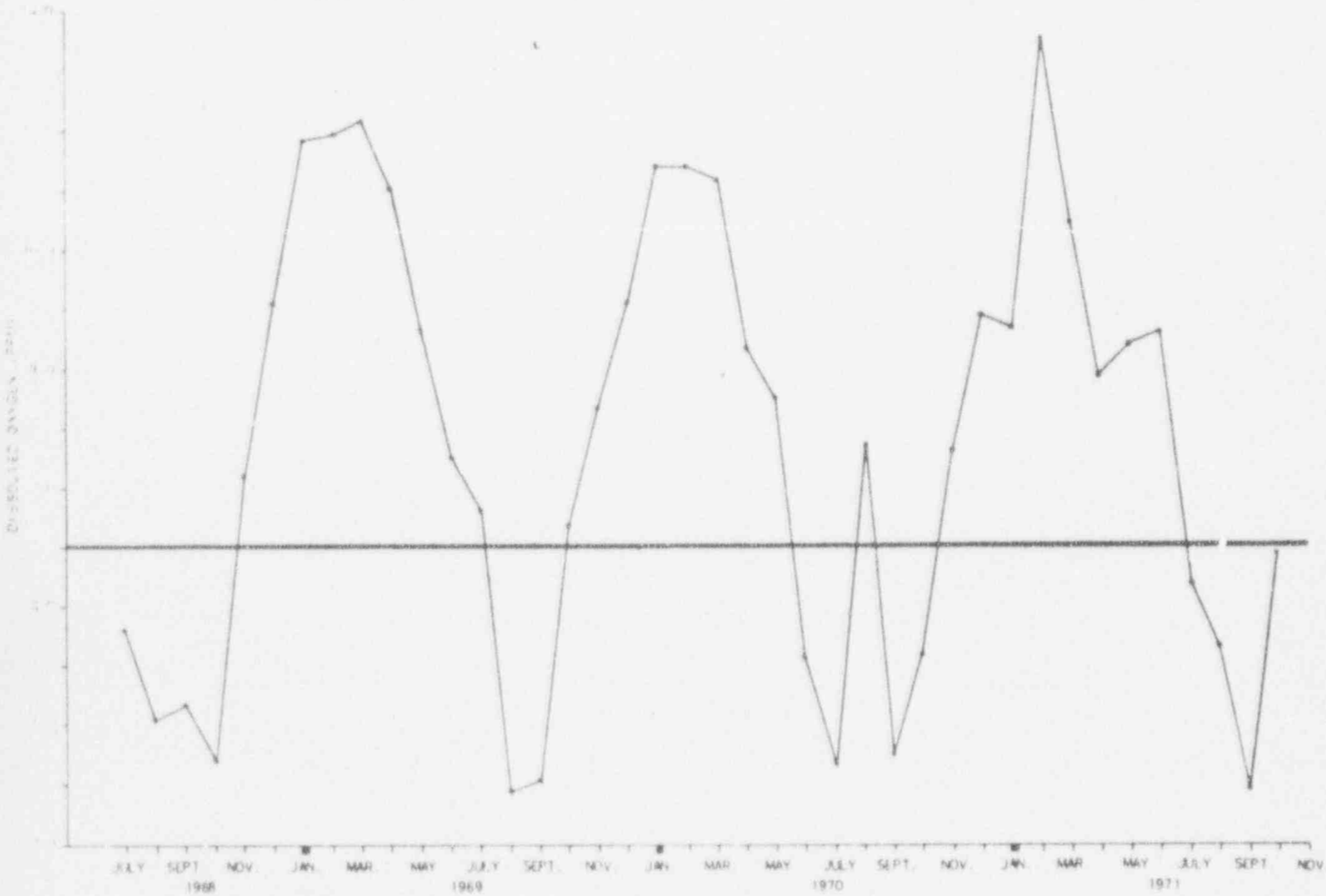

Figure 8. Highest dissolved oxygen concentrations recorded at the intake gill net station (*2) Lake Norman, North Carolina, July 1968 to October 1971. (The heavy line in the graph represents the minimum DO concentration (5 ppm) recommended by the National Technical Advisory Committee (1968) for a "diversified warm-water biota.")

Amendment 1 (New)

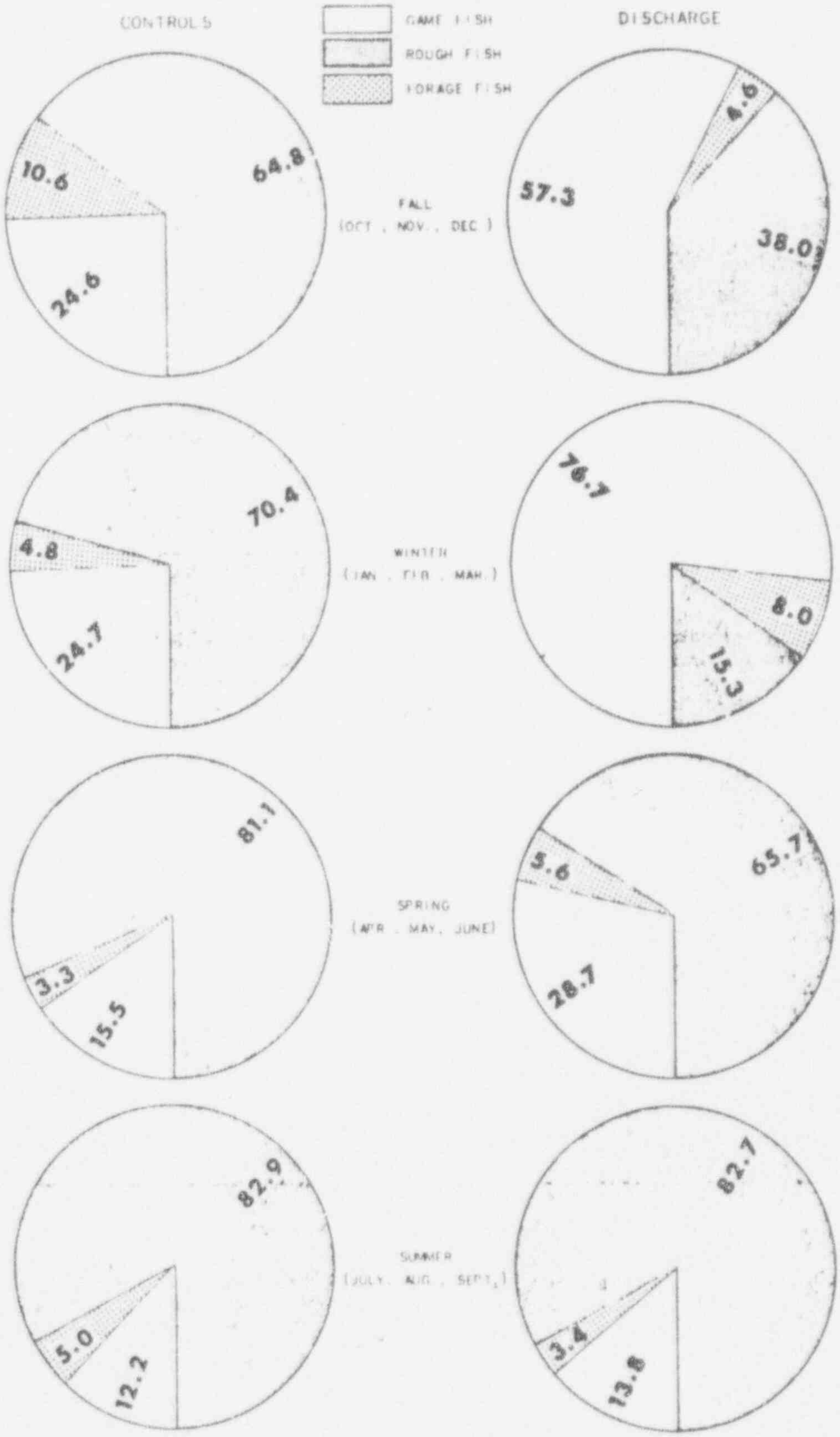

Figure 9. Quarterly changes in the monthly catch composition from the Marshall Steam Station discharge and combined control coves, Lake Norman, N. C. (All categories are presented in terms of the percent of the total weight of fish captured by means of gill netting, trawling, and electrofishing from October 1969 through September 1971.)

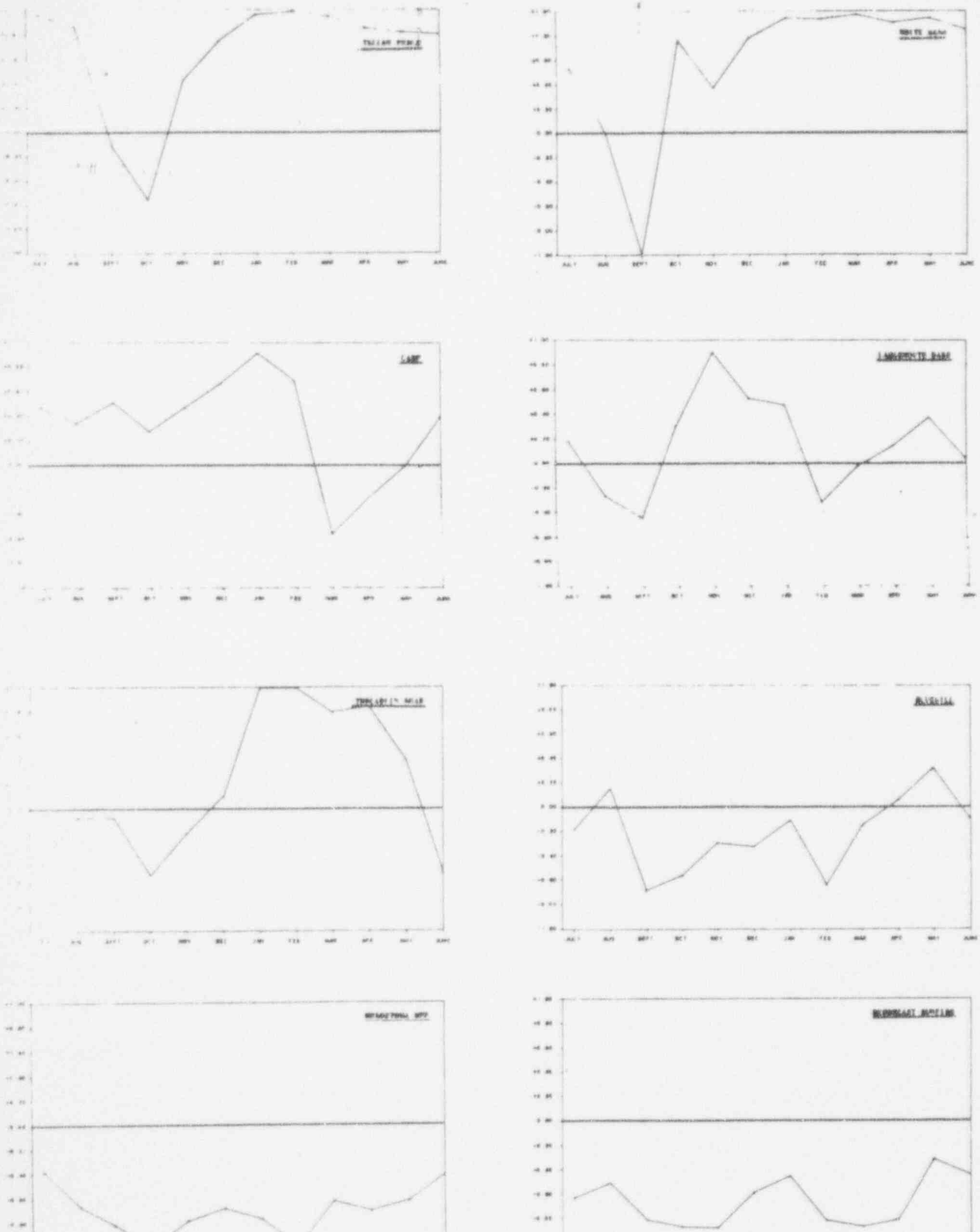

Figure 10. Seasonal fluctuations in "Attraction Index (A)" values for eight species of fishes from Lake Norman North Carolina. (Three years of monthly catch data were combined to form the "composite year" shown.)

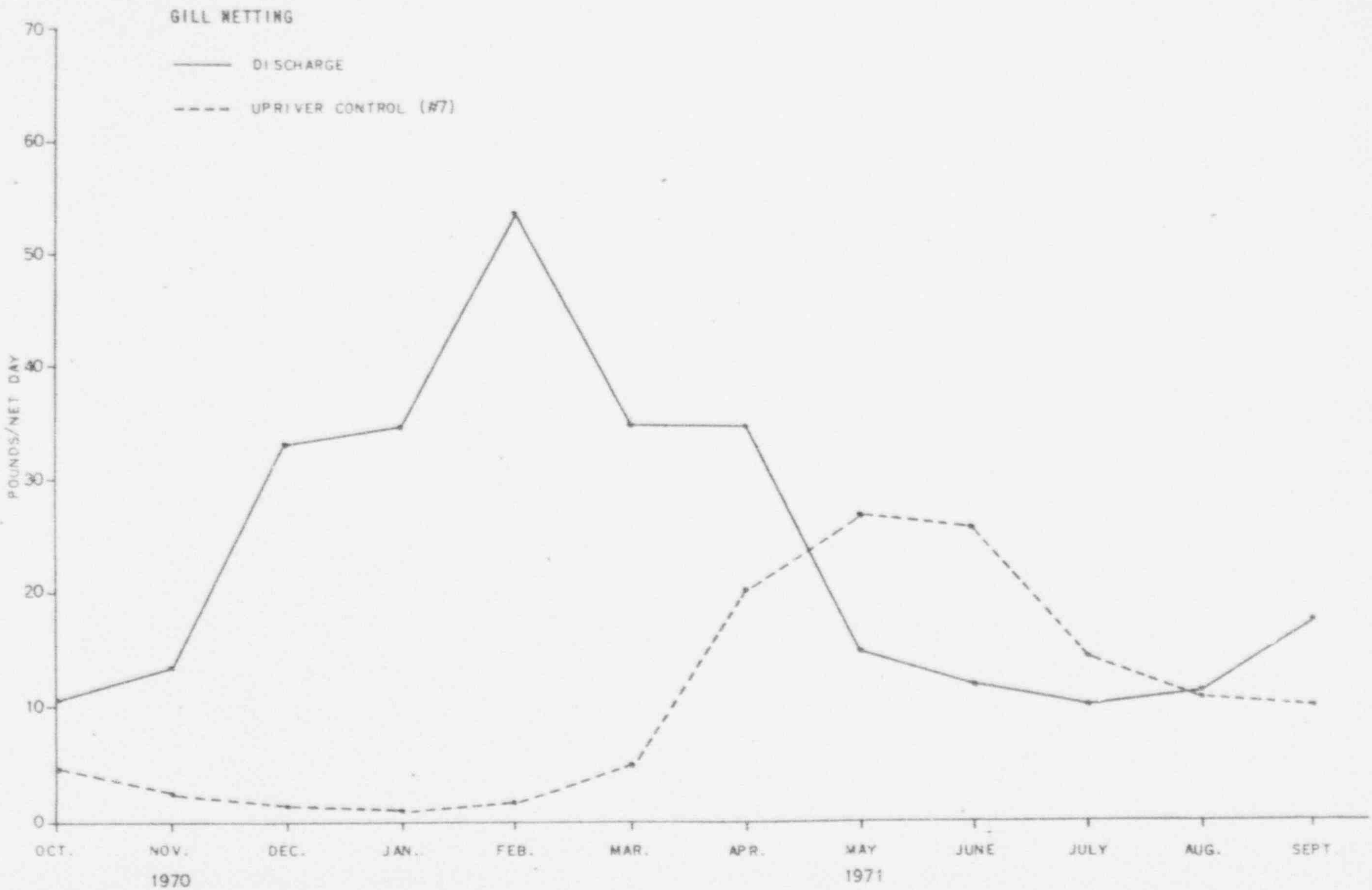

Figure 11. Gill netting catch rates in the Marshall Steam Station discharge and the upriver control station (#7), Lake Norman, N. C., October 1970-October 1971. (The curves have been smoothed by the "ratio-to-moving-average" method to illustrate trends (Alder and Roessler, 1968).)

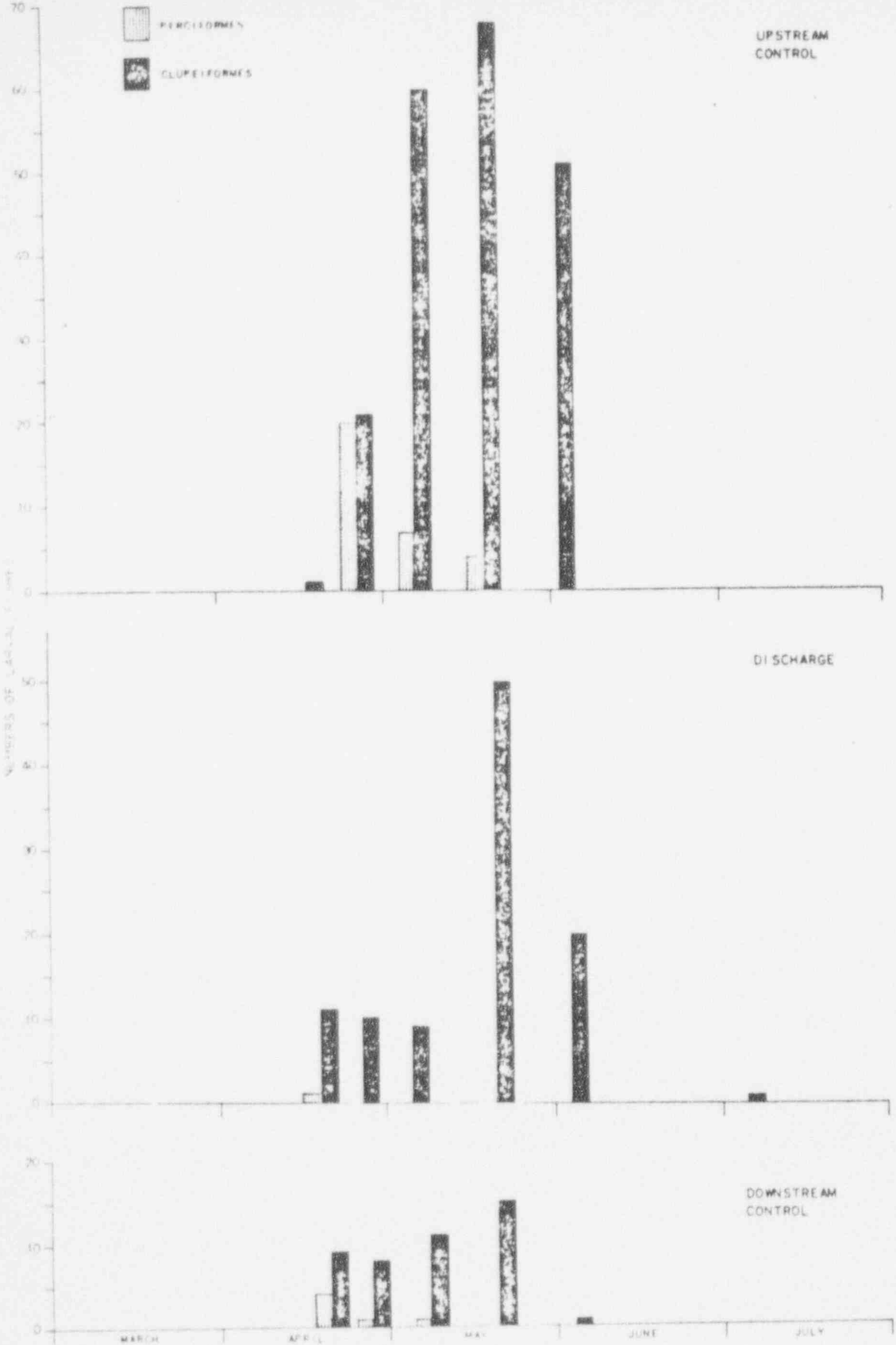

Figure 12. The temporal distribution of larval fishes in the Marshall Steam Station discharge and control coves, Lake Norman, N. C. as indicated by ichthyoplankton net samples taken between March 31, 1971 and July 22, 1971. (Adjoining bars represent samples from the same date. The effort expended in the discharge was approximately twice that expended in the controls.)

Figure 13. White bass exhibiting gas-bubble disease symptoms.

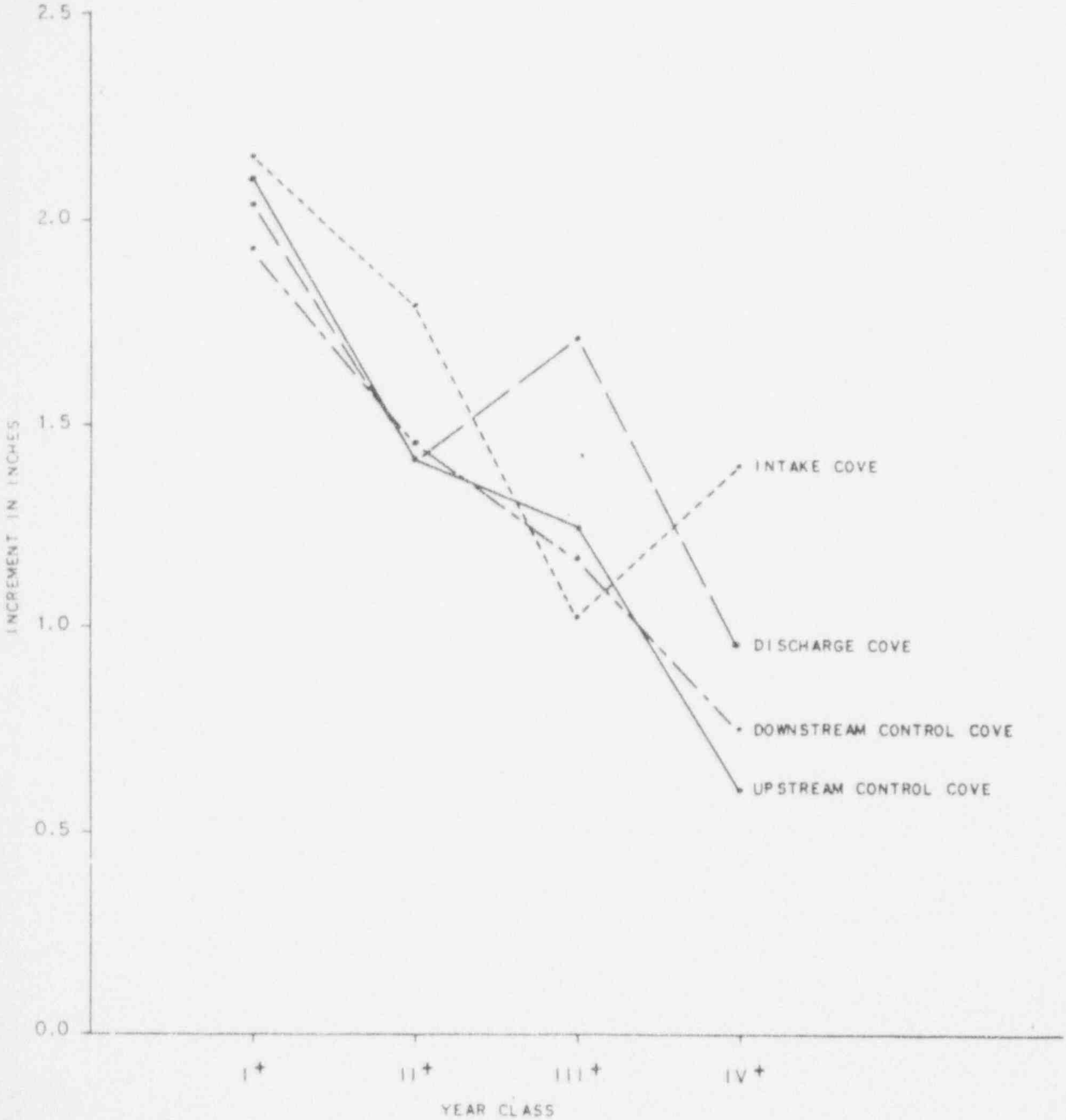

Figure 14. Mean increments of growth (computed from distance between next to last and last annulus showing on a scale) for each year class of bluegill taken in rotenone samples during week of September 22, 1969 on Lake Norman.

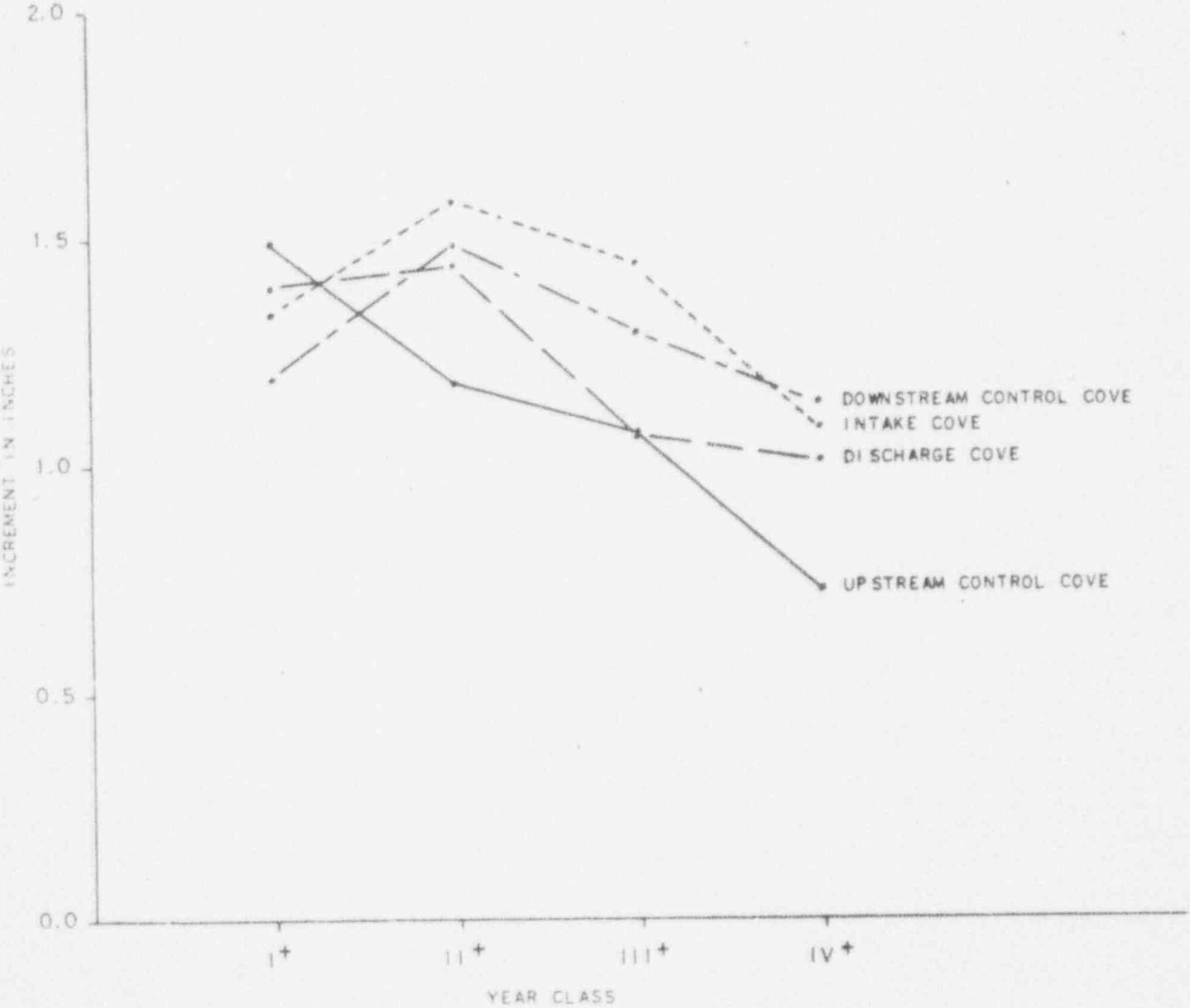

Figure 15. Mean increments of growth (computed from distance between next to last and last annulus showing on a scale) for each year class of bluegill taken in rotenone samples during week of June 22, 1970 on Lake Norman.

Amendment 1
(New)

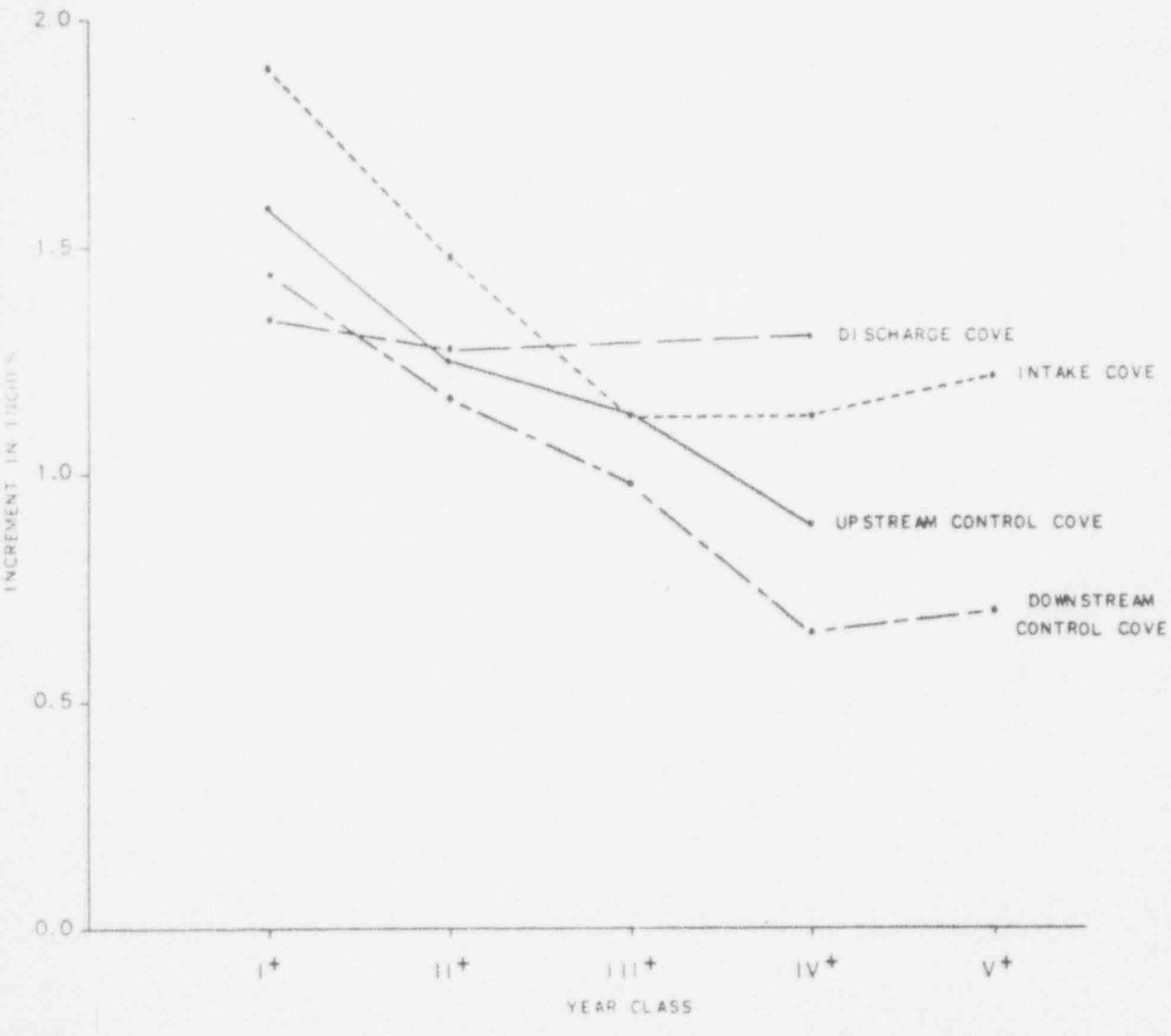

Figure 16. Mean increments of growth (computed from distance between next to last and last annulus showing on a scale) for each year class of bluegill taken in rotenone samples during week of August 17, 1970 on Lake Norman. (No III+ and only one IV+ fish were taken in the discharge.)

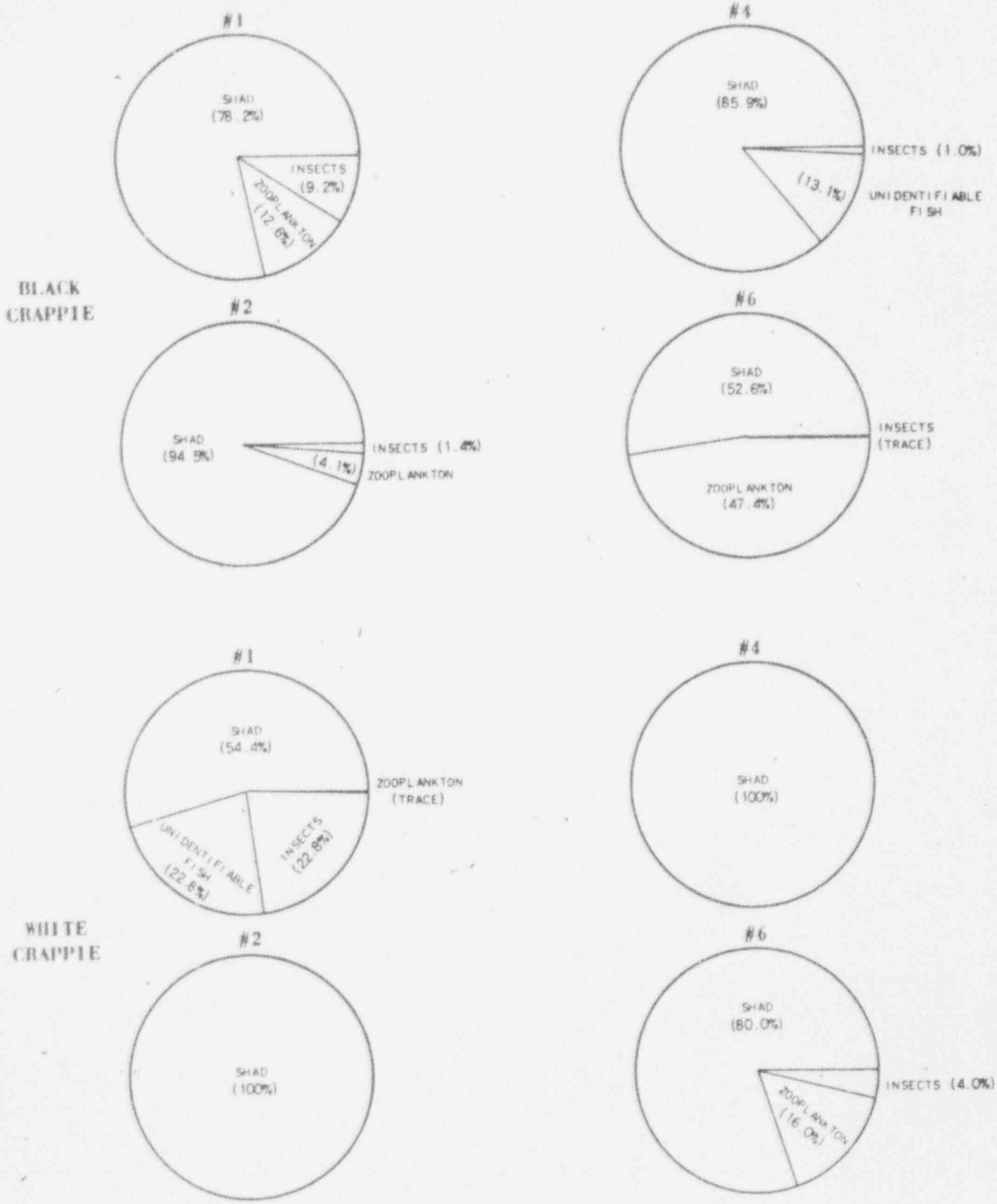

Figure 17. Black and white crappie stomach contents analyzed volumetrically from the up and downstream control stations (numbers 1 and 6) and the intake and discharge stations (numbers 2 and 4) on Lake Norman. (The diagrams shown were derived from the percentages in Tables 12. and 13. using fish captured in the winter and early spring of 1971.)

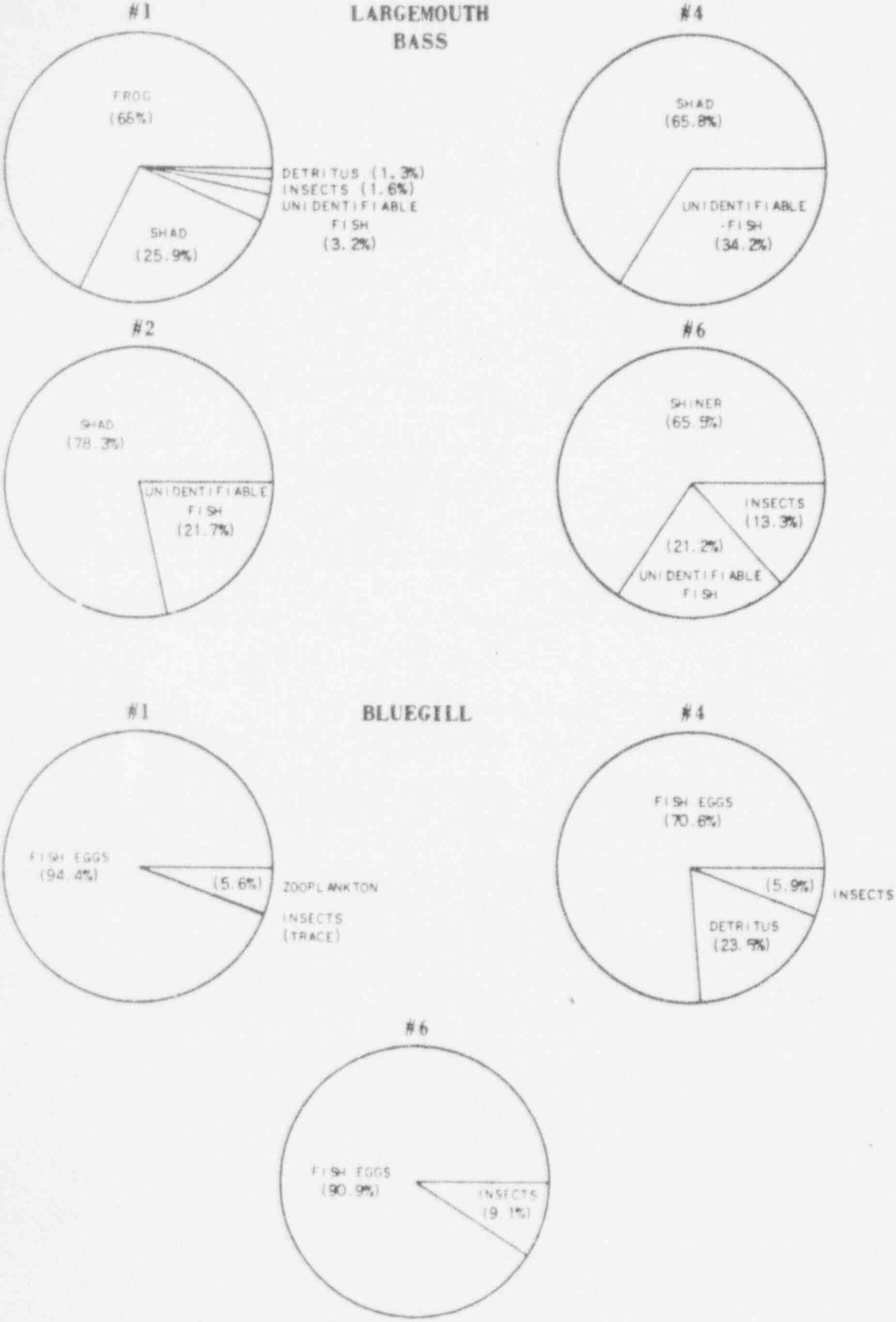

Figure 16. Largemouth bass and bluegill stomach contents analyzed volumetrically from the up and downstream control stations (numbers 1 and 6) and the intake and discharge stations (numbers 2 and 4 respectively) on Lake Norman. (The diagrams shown were derived from the percentages in Tables 14. and 17. using fish captured in the winter and early spring of 1971. No data available for bluegills from cove number 2.)

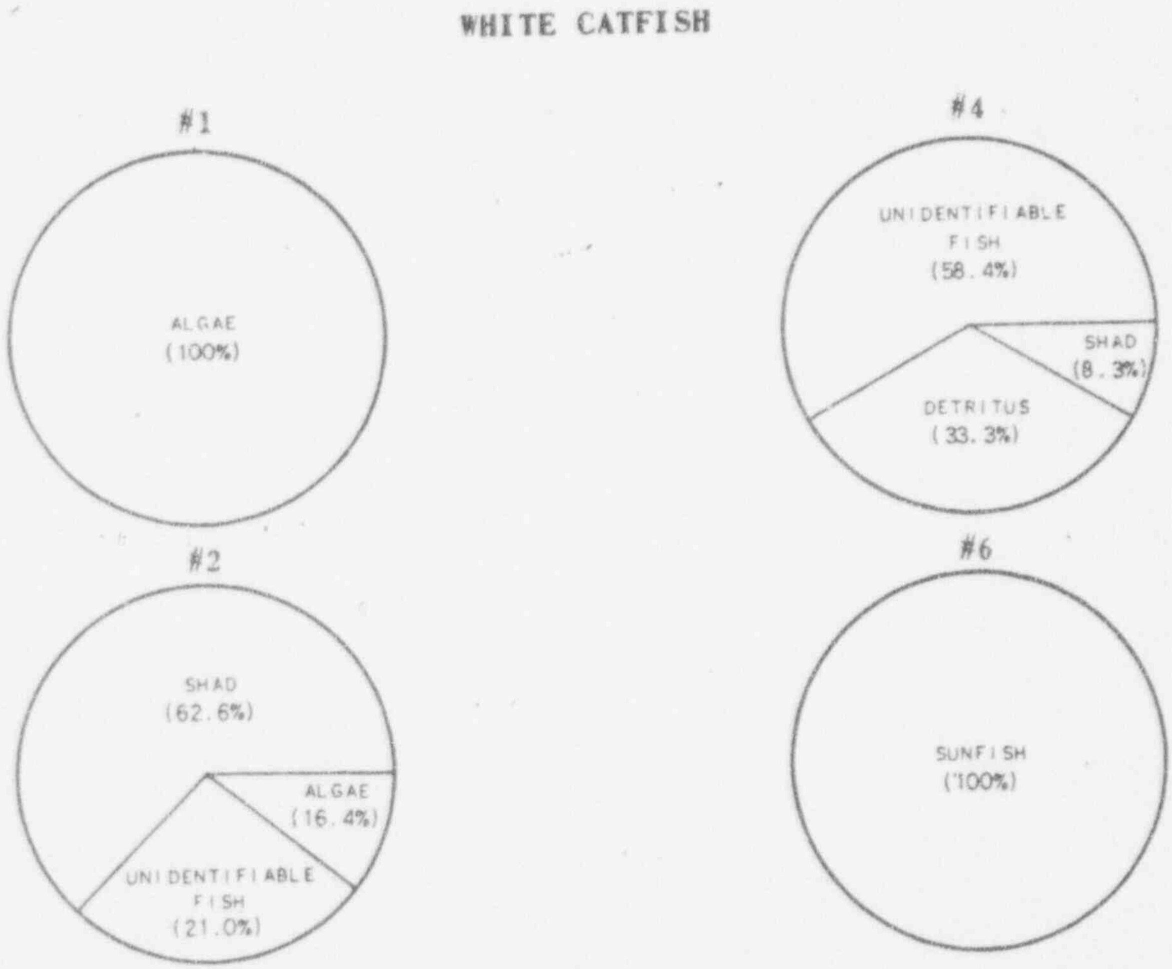

Figure 19. White catfish stomach contents analyzed volumetrically from the up and downstream control stations (numbers 1 and 6) and the intake and discharge coves (numbers 2 and 4) on Lake Norman. (Only one stomach was available from each control cove. The diagrams shown were derived from data in Table 18, using fish captured in the winter and early spring of 1971.)

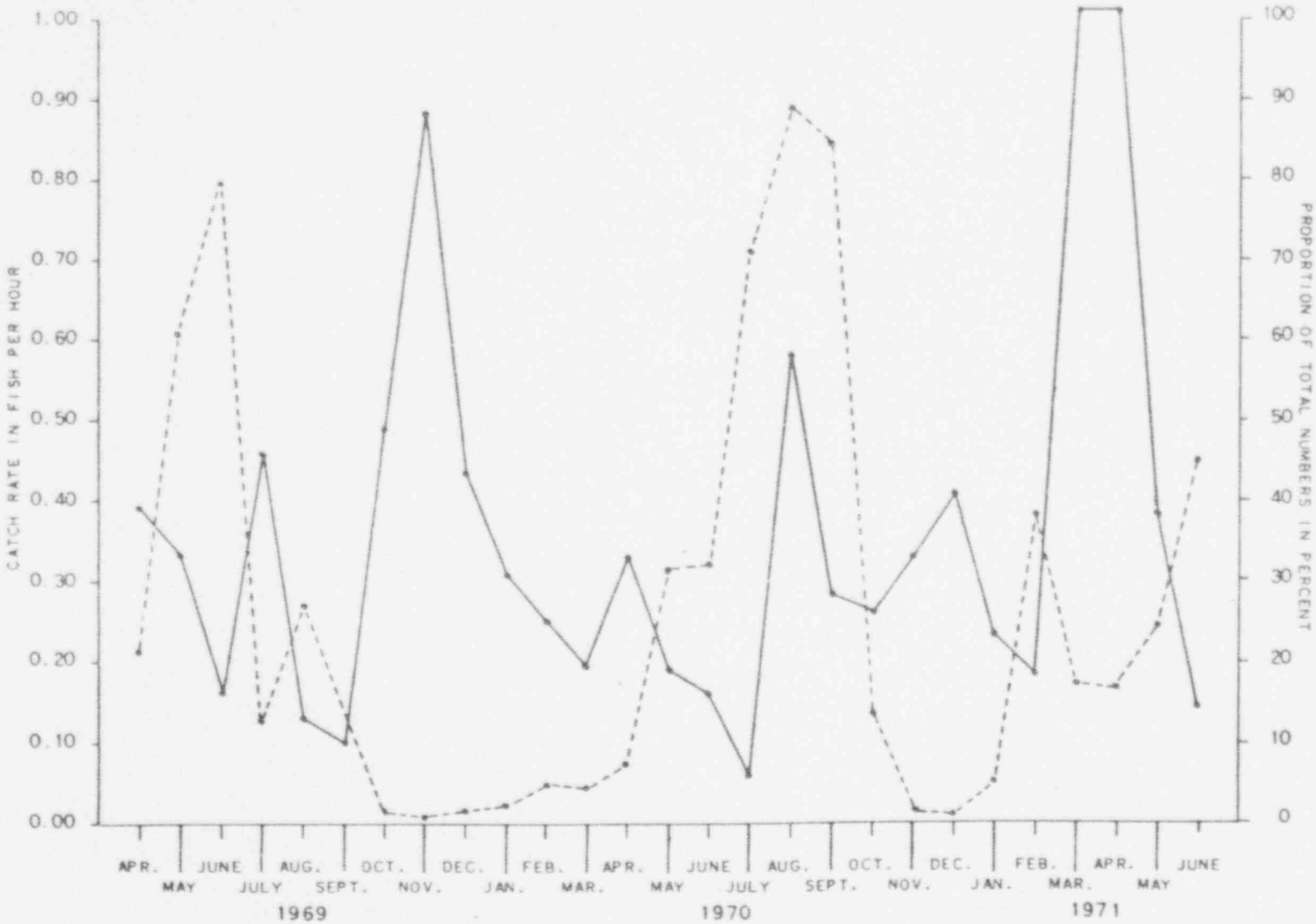

Figure 20. Monthly angler catch rates in the Plant Marshall discharge canal and cove, April 1969 - June 1971. (The dotted line represents the proportion of the total catch (numbers) contributed by nongame species.)

TABLE 1.

COMMON AND SCIENTIFIC NAMES OF FISHES COLLECTED FROM LAKE NORMAN, NORTH CAROLINA, JULY 1, 1968 TO NOVEMBER 1, 1971.

Longnose gar	*Lepisosteus osseus* (Linnaeus)
Gizzard shad	*Dorosoma cepedianum* (Lesueur)
Threadfin shad	*Dorosoma petenense* (Günther)
Carp	*Cyprinus carpio* Linnaeus
Golden shiner	*Notemigonus chrysoleucas* (Mitchill)
Satinfin shiner	*Notropis analostanus* (Girard)
Greenfin shiner	*Notropis chloristius* (Jordan and Brayton)
Creek chub	*Semotilus atromaculatus* (Mitchill)
River carpsucker	*Carpiodes carpio* (Rafinesque)
Quillback	*Carpiodes cyprinus* (Lesueur)
White sucker	*Catostomus commersoni* (Lacepède)
Silver redhorse	*Moxostoma anisurum* (Rafinesque)
Shorthead redhorse	*Moxostoma macrolepidotum* (Lesueur)
Suckermouth redhorse	*Moxostoma pappillosum* (Cope)
Smallfin redhorse	*Moxostoma robustum* (Cope)
Flathead catfish	*Pylodictis olivaris* (Rafinesque)
Channel catfish	*Ictalurus punctatus* (Rafinesque)
White catfish	*Ictalurus catus* (Linnaeus)
Blue catfish	*Ictalurus furcatus* (Lesueur)
Yellow bullhead	*Ictalurus natalis* (Lesueur)
Brown bullhead	*Ictalurus nebulosus* (Lesueur)
Black bullhead	*Ictalurus melas* (Rafinesque)
Flat bullhead	*Ictalurus platycephalus* (Girard)
Snail bullhead	*Ictalurus brunneus* (Jordan)
Mosquitofish	*Gambusia affinis* (Baird and Girard)
Striped bass	*Morone saxatilis* (Walbaum)
White bass	*Morone chrysops* (Rafinesque)
Largemouth bass	*Micropterus salmoides* (Lacepède)
Warmouth	*Lepomis gulosus* (Cuvier)
Pumpkinseed	*Lepomis gibbosus* (Linnaeus)
Redbreast sunfish	*Lepomis auritus* (Linnaeus)
Bluegill	*Lepomis macrochirus* Rafinesque
Black crappie	*Pomoxis nigromaculatus* (Lesueur)
White crappie	*Pomoxis annularis* Rafinesque
Yellow perch	*Perca flavescens* (Mitchill)
Johnny darter	*Etheostoma nigrum* Rafinesque
Swamp darter	*Etheostoma fusiforme* (Girard)

TABLE 2.

THE CRITERIA USED TO SEPARATE MONTHLY FISH SAMPLES FROM LAKE NORMAN, N. C. INTO ROUGH, GAME AND FORAGE FISH CATEGORIES.

ROUGH FISH	GAME FISH	FORAGE FISH
Bullheads	Crappies	Threadfin shad
Catfishes	White bass	Shiners
Carp	Striped bass	Pumpkinseed
Gar	Largemouth bass ≥ 5"	Gizzard shad < 7"
Suckers	Yellow perch ≥ 7"	Yellow perch < 7"
Carpsuckers	Bluegill ≥ 5"	Bluegill < 5"
Gizzard shad ≥ 7"	Redbreast sunfish ≥ 5"	Largemouth bass < 5"
	Warmouth ≥ 5"	Redbreast sunfish < 5"
		Warmouth < 5"

TABLE 3.

DIVERSITY INDICES CALCULATED FROM POPULATION SAMPLES TAKEN WITH ROTENONE, LAKE NORMAN, N. C., FALL 1968 TO SPRING 1971.

	COVE NUMBER 1	COVE NUMBER 2	COVE NUMBER 4	COVE NUMBER 6
Fall 1968	2.429	2.763	2.330	2.052
Spring 1969	2.886	1.745	1.743	1.797
Fall 1969	2.388	2.786	2.343	2.556
Spring 1970	2.043	2.731	2.625	2.415
Fall 1970	2.238	2.109	1.807	2.052
Spring 1971	2.955	1.831	2.799	2.2[illegible]1
Spring Mean	2.628	2.102	2.389	2.164
Fall Mean	2.352	2.553	2.160	2.220
Overall Mean	2.490	2.328	2.275	2.192

TABLE 4.

THE STANDING CROP IN POUNDS PER ACRE
AS INDICATED BY ROTENONE SAMPLES FROM
COVES NUMBER 1, 2, 4, AND 6, LAKE NORMAN,
FALL 1968 THROUGH SPRING 1971.

The numbers in parentheses indicate the proportions in percent contributed by game species.

	COVE NUMBER 1	COVE NUMBER 2	COVE NUMBER 4	COVE NUMBER 6
Fall 1968	175.9 (33)	152.6 (17)	171.1 (21)	63.2 (32)
Spring 1969	152.6 (34)	213.2 (15)	69.3 (48)	41.5 (55)
Fall 1969	209.2 (9)	181.0 (14)	116.4 (24)	45.9 (26)
Spring 1970	94.1 (45)	130.0 (25)	640.8 (60)	124.1 (24)
Fall 1970	106.3 (45)	180.0 (23)	99.8 (41)	80.7 (32)
Spring 1971	141.1 (36)	93.4 (34)	126.6 (27)	72.4 (35)
Composite Spring*	133.0 (37)	144.1 (22)	238.1 (52)	75.1 (34)
Composite Fall*	160.1 (25)	171.6 (18)	125.1 (28)	63.7 (31)
Summary*	146.5 (31)	158.1 (20)	180.9 (44)	69.2 (33)

*Weighted Means

TABLE 5.

SEASONAL CHANGES IN "ATTRACTION-AVOIDANCE" WITH REGARD TO THE MARSHALL STEAM STATION DISCHARGE COVE AS MEASURED BY THE "ATTRACTION INDEX."

Index values were based upon three years of catch data. Asterisks indicate statistically significant, numerical differences between the discharge and control coves as determined by AOV testing (P ≤ 0.05).

SPECIES	SPRING Apr., May, June	SUMMER July, Aug., Sept.	FALL Oct., Nov., Dec.	WINTER Jan., Feb., Mar.
Longnose gar	+0.88	+0.81	+0.97*	+1.00*
Yellow perch	+0.82	+0.79*	+0.28	+0.96*
White catfish	+0.14	+0.70	+0.85*	+1.00*
Golden shiner	+0.59	+0.32	+0.36	+0.71
Carp	+0.03	+0.36	+0.36	-0.30
Gizzard shad	+0.06	+0.30	-0.15	+0.31
White bass	+0.93*	-0.30	+0.67	+0.95*
Striped bass	+0.68	-1.00	+0.92*	+0.97*
Threadfin shad	+0.60	-0.14	-0.21	+1.00*
Black crappie	-0.67*	-0.27	+0.21	+0.37
Largemouth bass	+0.18*	-0.08	+0.41	-0.07
Warmouth	-0.05	+0.46	-0.39	+0.58
Bullheads 1/	+0.19	+0.17	-0.43	-0.56
Notropis spp. 2/	+0.32	+0.52*	-0.23	-0.40
White crappie	-0.57	-0.41	+0.37	-0.06
Quillback	-0.41	-0.94	-0.67*	0.00
Pumpkinseed	-0.19	-1.00	-0.48	-0.20
Etheostoma spp. 3/	-0.21	-1.00	-0.88	-0.62
Bluegill	-0.01	-0.26	-0.37	-0.18
Moxostoma spp. 4/	-0.58	-0.62	-0.87	-0.73
Redbreast sunfish	-0.59	-0.66	-0.82	-0.76
Mosquitofish	-1.00	-1.00	-1.00	-1.00

1/ Bullheads - Mostly *Ictalurus platycephalus*

2/ *Notropis* spp. - Mostly *Notropis analostanus*

3/ *Etheostoma* spp. - Mostly *Etheostoma nigrum*

4/ *Moxostoma* spp. - Mostly *Moxostoma anisurum*

Amendment 1
(New)

TABLE 6.

CORRELATION COEFFICIENTS BETWEEN THE NUMERICAL ABUNDANCE OF THREE SPECIES OF FISHES IN THE MARSHALL STEAM STATION DISCHARGE AREA ON LAKE NORMAN, N.C., AND TEMPERATURE RISE, DISSOLVED OXYGEN CONCENTRATIONS AND FORAGE FISH ABUNDANCE (LOG NUMBERS OF THREADFIN SHAD).

Temperature and dissolved oxygen measurements were taken at the one foot depth.

SPECIES	TEMPERATURE RISE ABOVE AMBIENT	O_2 CONCENTRATION	LOG NUMBERS OF THREADFIN SHAD
White bass	0.662 1/	0.418 1/	0.240
Largemouth bass	0.275 2/	0.199	-0.004
Threadfin shad	0.323 2/	0.256	--

1/ Significant at the 0.01 level

2/ Significant at the 0.10 level

TABLE 7.

A SUMMARY OF THE ICHTHYOPLANKTON AND METER NET SAMPLING CONDUCTED IN THE VICINITY OF THE MARSHALL STEAM STATION, LAKE NORMAN, N.C. BETWEEN MARCH 31, 1971 AND JULY 22, 1971

COVE	TOTAL EFFORT IN MINUTES	TOTAL FISH LARVAE	PERCENT PROLARVAE	PERCENT POSTLARVAE
Upstream control	138	215	10.2	89.8
Intake	160	3	--	100.0
Discharge	270	102	87.3	12.7
Downstream control	135	50	6.0	94.0

TABLE 8.

THE PERCENT INCIDENCE AND MEAN INTENSITY FOR SEVERAL TAXA OF METAZOAN PARASITES COLLECTED FROM A MIXED GROUP OF FISHES FROM LAKE NORMAN, N.C., DECEMBER 1969 THROUGH JUNE 1970.

These data represent complete host autopsies only.

NUMBER EXAMINED	DISCHARGE		INTAKE		CONTROL COVES	
	18 1/		4 2/		11 3/	
	PERCENT INCIDENCE	MEAN INTENSITY	PERCENT INCIDENCE	MEAN INTENSITY	PERCENT INCIDENCE	MEAN INTENSITY
Monogenea	33.3	3.1	25.0	7.0	45.5	39.0
Digenea (adults)	6.1	0.1	0.0	0.0	18.2	0.2
(larvae)	22.2	10.9	75.0	12.5	36.4	5.3
Cestoda (adults)	16.7	0.9	0.0	0.0	9.1	0.4
(larvae)	27.8	3.2	25.0	0.5	18.2	6.4
Acanthocephala (adults)	44.5	3.8	0.0	0.0	45.5	6.5
(larvae)	6.1	0.3	25.0	0.5	18.2	1.2
Nematoda	33.3	0.8	75.0	2.8	27.3	3.6
Mollusca (glochidia)	0.0	0.0	0.0	0.0	45.5	1.5
Hirudinea	6.1	0.1	0.0	0.0	0.0	0.0
Copepoda	38.9	4.1	75.0	1.5	63.6	13.2

1/ Largemouth bass (7), bluegill (3), yellow perch (2), black crappie (2), white bass (1), carp (1), warmouth (1) and gizzard shad (1).

2/ Bluegill (2), black crappie (1) and redbreast sunfish (1).

3/ Largemouth bass (3), bluegill (2), white crappie (1), yellow perch (1), redbreast sunfish (2), warmouth (1) and quillback (1).

TABLE 9

INCIDENCE OF OBVIOUS EXTERNAL SYMPTOMS OF GAS-BUBBLE DISEASE (MOSTLY "POPEYE") IN FISHES COLLECTED IN THE DISCHARGE COVE OF THE MARSHALL STEAM STATION BY GILL NETS (G), TRAWLING (T) AND ELECTROFISHING (E), WINTER 1969-70 AND WINTER 1970-71

SPECIES	SAMPLING METHOD	DECEMBER NO.	DECEMBER GBD*	DECEMBER %	JANUARY NO.	JANUARY GBD*	JANUARY %	FEBRUARY NO.	FEBRUARY GBD*	FEBRUARY %	MARCH NO.	MARCH GBD*	MARCH %	APRIL NO.	APRIL GBD*	APRIL %	MAY NO.	MAY GBD*	MAY %
1969 - 1970																			
Bluegill	E	38	0	0	41	3	7.3	50	0	0	92	1	1.1	60	1	1.7	60	5	8.3
Warmouth	E	3	0	0	1	1	100.0	2	0	0	3	0	0	0	0	0	0	0	0
Threadfin Shad	T	399	0	0	4,327	0	0	1,656	0	0	34	0	0	127	1	0.8	28	0	0
1970 - 1971																			
White Bass	G E T	6	0	0	98	0	0	75	0	0	133	78	58.6	24	17	70.8	12	6	50.0
Largemouth Bass	E	7	0	0	5	0	0	5	0	0	16	2	12.5	25	3	12.0	11	0	0
Bluegill	E	38	1	2.6	85	3	3.5	34	8	23.5	28	5	17.9	82	10	12.2	132	12	9.1
Redbreast Sunfish	E	6	0	0	7	0	0	1	1	100.0	0	0	0	0	0	0	4	0	0
Yellow Perch	E	7	0	0	6	0	0	32	0	0	119	1	0.8	205	0	0	28	0	0
Satinfin Shiner	E	7	0	0	13	1	7.7	18	4	22.2	16	0	0	27	0	0	8	0	0
Golden Shiner	E	3	0	0	6	0	0	4	1	25.0	6	1	16.7	15	1	6.7	1	0	0
Threadfin Shad	E	421	0	0	474	40	8.4	498	90	18.1	27	9	33.3	66	6	10.0	204	0	0
Carp	E	0	0	0	0	0	0	0	0	0	0	0	0	4	1	25.0	7	0	0
Black Crappie	G E	4	0	0	15	0	0	5	0	0	13	0	0	3	1	33.3	2	0	0
Flat Bullhead	G	0	0	0	0	0	0	0	0	0	0	0	0	2	1	50.0	0	0	0
White Crappie	E	0	0	0	0	0	0	1	0	0	4	0	0	2	1	50.0	0	0	0
Warmouth	E	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	100.0

* Gas-bubble disease

TABLE 10

COMPARISONS BETWEEN MEAN GROWTH INCREMENTS
FOR EACH YEAR CLASS OF BLUEGILL TAKEN BY ROTENONE
FROM FOUR COVES ON LAKE NORMAN.

[illegible] 1 and 6 are the up and downstream control coves and 2 and 4 are the intake and discharge coves respectively. A negative number indicates that the second mean of the pair was larger than the first.

DATE	AGE GROUP	COVE COMPARISON	"T" VALUE
9-24-69	I+	1 vs 2	-0.28
		1 vs 4	0.51
		1 vs 6	1.76*
		6 vs 4	-1.02
		6 vs 2	-1.42
	II+	1 vs 2	-3.10***
		1 vs 4	0.00
		1 vs 6	-0.37
		6 vs 4	0.33
		6 vs 2	-2.41**
	III+	1 vs 2	1.38
		1 vs 4	-2.03*
		1 vs 6	0.52
		6 vs 4	-1.93*
		6 vs 2	0.81
6-23-70	I+	1 vs 2	1.48
		1 vs 4	0.99
		1 vs 6	2.86**
		6 vs 4	-1.89*
		6 vs 2	-1.19
	II+	1 vs 2	-2.14**
		1 vs 4	-2.02*
		1 vs 6	-2.80***
		6 vs 4	0.39
		6 vs 2	0.68

DATE	AGE GROUP	COVE COMPARISON	"T" VALUE
6-23-70	III+	1 vs 2	-2.26**
		1 vs 4	0.90
		1 vs 6	-2.47**
		6 vs 4	2.40**
		6 vs 2	-1.03
	IV+	1 vs 2	-2.75**
		1 vs 4	-2.43**
		1 vs 6	-3.57***
		6 vs 4	1.07
		6 vs 2	0.43
8-18-70	I+	1 vs 2	-1.05
		1 vs 4	1.84*
		1 vs 6	0.78
		6 vs 4	0.65
		6 vs 2	-1.82*
	II+	6 vs 2	-2.04*
		6 vs 4	-0.84
	III+	1 vs 2	0.27
		1 vs 6	0.82
		6 vs 2	-0.59
	IV+	1 vs 2	-1.55

* Two-tailed "t" test significant at 0.1 level.
** Significant at 0.05 level.
*** Significant at 0.01 level.

TABLE 11.

MEAN CONDITION FACTORS AND "T" TESTS OF DIFFERENCES BETWEEN MEANS FOR THE DISCHARGE AND UPSTREAM (#1) AND DOWNSTREAM (#6) CONTROL COVES ON LAKE NORMAN.

Fish were captured by means of gill nets, electrofishing, and trawling. Condition factor = weight/length^3.

PERIOD	SPECIES	SIZE RANGE (INCHES)	MEAN CONDITION FACTOR		LEVEL OF SIGNIFICANCE FOR "T" TEST OF DIFFERENCE
			DISCHARGE	CONTROL (DESIGNATE)	
Summer 1969	Bluegill	(5.1-6.0)	2.32	2.66 (#1&6)	N.S.*
Winter 1970	Bluegill	(5.1-6.0)	3.28	2.46 (#1&6)	0.01
Summer 1970	Bluegill	(5.1-6.0)	2.34	2.33 (#1&6)	N.S.
Winter 1970	Largemouth bass	(7.1-8.0)	1.66	1.52 (#1)	N.S.
Winter 1970	Largemouth bass	(10.0-11.9)	2.30	1.90 (#1)	0.001
Winter 1971	Largemouth bass	(11.1-12.0)	4.54	4.36 (#6)	N.S.
Winter 1971	White bass	(13.1-14.0)	5.24	5.79 (#1)	0.10
Summer 1969	Carp	(14.1-15.0)	4.61	4.61 (#1&6)	N.S.
Winter 1970	Carp	(15.1-16.0)	4.92	4.47 (#1&6)	N.S.
Summer 1970	Black crappie	(5.1-6.0)	1.86	2.02 (#1&6)	N.S.

* N.S. - nonsignificant.

TABLE 12.

STOMACH CONTENTS OF BLACK CRAPPIE
TAKEN AT FOUR DIFFERENT SAMPLING SITES,
NOVEMBER THROUGH MARCH 1970 AND 1971.

Fish ranged in size from 6.1 inches to 14.9 inches.

	UPSTREAM CONTROL (#1)			INTAKE (#2)			DISCHARGE (#4)			DOWNSTREAM CONTROL (#6)		
Number Stomachs Examined	20 (17)*			6			11 (10)*			4		
Percent Stomachs Empty	5.0 (5.8)*			0.0			27.3 (30.0)*			0.0		
FOOD ITEM	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME
Teleostomi												
Dorosoma spp.	9	26.3	78.2	8	66.6	94.5	10	66.6	85.9	1	25.0	52.6
Unidentifiable	12	15.8	-	-	-	-	5	33.3	13.1	-	-	-
Insecta												
Diptera												
Chironomidae	381	52.6	3.8	36	33.3	1.4	-	-	-	11	50.0	T
Coleoptera	2	10.5	0.4	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	1	16.7	T	1	11.1	1.0	1	25.0	T
Ephemeroptera												
Baetidae	94	15.8	5.0	-	-	-	-	-	-	-	-	-
Crustacea												
Cladocera	10,055	47.4	12.2	430	33.3	2.7	-	-	-	2,019	75.0	47.4
Copepoda	398	31.6	0.4	392	33.3	1.4	-	-	-	39	50.0	T

- Indicates no data.
T Represents percentages less than 0.1.
* Stomach content volumes not determined in 1970. Numbers in parenthesis indicate number of stomachs used for volumetric analysis in 1971.

TABLE 13.

STOMACH CONTENTS OF WHITE CRAPPIE
TAKEN AT FOUR DIFFERENT SAMPLING SITES,
FEBRUARY THROUGH MARCH 1971.

Fish ranged in size from 8.2 to 11.9 inches.

	UPSTREAM CONTROL (#1)			INTAKE (#2)			DISCHARGE (#4)			DOWNSTREAM CONTROL (#6)		
Number Stomachs Examined	13			3			3			2		
Percent Stomachs Empty	7.7			0.0			33.3			0.0		
FOOD ITEMS	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME
Teleostomi												
Dorosoma	5	25.0	54.4	3	100.0	100.0	3	100.0	100.0	1	50.0	80.0
Unidentifiable	3	16.7	22.8	-	-	-	-	-	-	-	-	-
Insecta												
Diptera												
Chironomidae	141	91.6	3.8	-	-	-	-	-	-	33	100.0	4.0
Megaloptera	1	8.3	T	-	-	-	-	-	-	-	-	-
Ephemeroptera												
Baetidae	54	75.0	19.0	-	-	-	-	-	-	-	-	-
Crustacea												
Cladocera	50	8.3	T	-	-	-	-	-	-	1,060	50.0	16.0
Copepoda	-	-	-	-	-	-	-	-	-	10	50.0	T

- Indicates no data.
T Represents percentages less than 0.1.

TABLE 14

STOMACH CONTENTS OF LARGEMOUTH BASS
TAKEN AT FOUR DIFFERENT SAMPLING SITES,
NOVEMBER THROUGH MARCH 1969, 1970, AND 1971

Fish ranged in size from 7.0 inches to 18.2 inches.

	UPSTREAM CONTROL (#1)			INTAKE (#2)			DISCHARGE (#4)			DOWNSTREAM CONTROL (#6)		
Number Stomachs Examined	13			5			24 (13)*			7		
Percent Stomachs Empty	46.2			40.0			45.8 (53.8)*			0.0		
FOOD ITEM	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME
Amphibia												
Rana spp.	1	14.3	68.0	-	-	-	-	-	-	-	-	-
Teleostomi												
Dorosoma	8	28.6	25.9	2	66.6	78.3	14	61.6	65.8	-	-	-
Notropis spp.	-	-	-	-	-	-	-	-	-	3	42.8	65.5
Unidentifiable	2	28.6	3.2	1	33.3	21.7	13	46.1	34.2	3	42.8	21.2
Insecta												
Diptera												
Chironomidae	1	14.3	T	-	-	-	-	-	-	-	-	-
Tipulidae	-	-	-	-	-	-	-	-	-	7	28.6	6.2
Megaloptera	1	14.3	1.6	-	-	-	-	-	-	-	-	-
Ephemeroptera												
Baetidae	1	14.3	T	-	-	-	-	-	-	17	14.3	7.1
Organic												
Detritus	-	14.3	1.3	-	-	-	-	-	-	-	-	-

- Indicates no data.
T Represents percentages less than 0.1.
* Stomach content volumes were not determined in 1969 and 1970. Numbers in parenthesis indicate the number of stomachs used for volumetric analysis in 1971.

TABLE 15

STOMACH CONTENTS OF WHITE BASS
TAKEN AT TWO DIFFERENT SAMPLING SITES
NOVEMBER THROUGH MARCH 1969, 1970, AND 1971

Fish ranged in size from 8.9 to 18.2 inches.

	UPSTREAM CONTROL (#1)			DISCHARGE (#4)		
Number of Stomachs Examined	7 (5)*			74 (16)*		
Percent of Stomachs Empty	42.8 (40.0)*			28.3 (62.5)*		
FOOD ITEMS	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME
Teleostomi						
Dorosoma	4	75.0	30.8	111	66.0	96.9
Unidentifiable	2	50.0	69.2	144	15.5	3.1

TABLE 16

STOMACH CONTENTS OF STRIPED BASS
TAKEN AT TWO DIFFERENT SAMPLING SITES
NOVEMBER THROUGH MAY 1969, 1970, AND 1971

Fish ranged in size from 11.3 to 1[illegible].5 inches.

	COVE (#4)			COVE (#6)		
Number of Stomachs Examined	38 (10)*			2		
Percent of Stomachs Empty	18.4 (30.0)*			0		
FOOD ITEMS	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME
Teleostomi						
Dorosoma	79	64.6	100.0	4	100.0	100.0
Unidentifiable	36	51.6				

Indicates no data

* Stomach content volumes not determined in 1969 and 1970. Number in parenthesis indicates number of stomachs used for volumetric analysis in 1971

TABLE 17.

STOMACH CONTENTS OF BLUEGILL
TAKEN AT FOUR DIFFERENT SAMPLING SITES,
FEBRUARY THROUGH APRIL, 1970 AND 1971.

Fish ranged in size from 6.3 to 8.1 inches.

	UPSTREAM CONTROL (#1)			DISCHARGE (#4)			DOWNSTREAM CONTROL (#6)		
Number Stomachs Examined	16			12 (6)*			5		
Percent Stomachs Empty	12.5			25.0 (16.6)*			0.0		
FOOD ITEM	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME
Teleostomi									
Dorosoma	-	-	-	1	11.1	-	-	-	-
Unidentifiable	-	-	-	2	22.2	-	-	-	-
Eggs	4,300	38.6	94.4	1,167	33.3	70.6	988	80.0	90.0
Insecta									
Diptera									
Chironomidae	17	64.4	T	-	-	-	43	40.0	9.1
Culicidae	1	7.1	T	-	-	-	-	-	-
Hemiptera	-	-	-	-	-	-	-	-	-
Ephemeroptera	2	14.3	T	-	-	-	-	-	-
Isoptera	-	-	-	2	22.2	5.9	-	-	-
Crustacea									
Cladocera	1,171	42.2	5.6	-	-	-	-	-	-
Copepoda	14	15.8	T	-	-	-	-	-	-
Organic Detritus	-	21.4	-	-	44.4	23.5	-	-	-
Fly Ash	-	-	-	-	33.3	-	-	-	-

- Indicates no data.
T Represents percentages less than 0.1.
* Stomach content volumes were not determined in 1970. Numbers in parenthesis indicate number of stomachs used for volumetric analysis in 1971.

TABLE 18.

STOMACH CONTENTS OF WHITE CATFISH
TAKEN FROM FOUR DIFFERENT SAMPLING SITES,
OCTOBER THROUGH MAY 1970 AND 1971.

Fish ranged in size from 8.2 to 15.0 inches.

	UPSTREAM CONTROL (#1)			INTAKE (#2)			DISCHARGE (#4)			DOWNSTREAM CONTROL (#6)		
Number Stomachs Examined	1			30			10 (9)*			3		
Percent Stomachs Empty	0.0			30.0			70.0 (12.9)*			66.7		
FOOD ITEM	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME	NUMBER OF ITEMS	PERCENT FREQUENCY OCCURRENCE	PERCENT TOTAL VOLUME
Teleostoma												
Dorosoma	-	-	-	28	71.5	62.6	[illegible]	66.6	3.3	-	-	-
Centrarchidae	-	-	-	-	-	-	-	-	-	1	100.0	100.0
Unidentifiable	-	-	-	4	14.3	21.0	[illegible]	66.6	53.4	-	-	-
Insecta												
Diptera												
Chironomidae	-	-	-	2	9.5	-	-	-	-	-	-	-
Filamentous Algae	-	100.0	100.0	-	14.3	16.4	-	-	-	-	-	-
Organic Detritus	-	-	-	-	-	-	-	33.3	33.3	-	-	-

- Indicates no data.

* Stomach content volumes not determined in 1970. Numbers in parenthesis indicate number of stomachs used for volumetric analysis in 1971.

TABLE 19.

SOME STATISTICS OF THE CREEL CENSUS
TAKEN EACH SATURDAY FROM APRIL, 1969 THROUGH JUNE, 1971
IN THE MARSHALL STEAM STATION DISCHARGE COVE.

	2-UNIT	3-UNIT OPERATION				4-UNIT OPERATION			
	SPRING 1969	SUMMER 1969	FALL 1969	WINTER 1970	SPRING 1970	SUMMER 1970	FALL 1970	WINTER 1971	SPRING 1971
Average Fisherman Interviews per day	46.8	24.9	20.6	45.0	57.8	13.7	50.5	89.7	94.2
Average Party Size	2.3	2.4	1.8	1.9	2.1	2.2	2.2	2.0	2.3
Average Time Fished per Fisherman	3.7	3.4	3.3	3.5	3.0	2.9	3.2	3.1	1.8
Average Distance Traveled per Party[1]	20.5	14.1	16.3	19.0	22.4	18.3	22.5	21.5	24.4
Number of Fish per Fisherman-trip	1.3	0.8	1.8	1.1	0.7	0.8	0.9	0.7	1.2
Number of Fish per Fisherman-hour	0.4	0.2	0.6	0.3	0.2	0.3	0.3	0.2	0.7
Dominant Species in the Catch	carp	white bass	white bass	white bass	white bass	white catfish	white bass	largemouth bass	white bass

[1] Average Distance Traveled per Party = One-way distance in miles.

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5 ALTERNATIVES TO CATAWBA NUCLEAR STATION

Catawba Units 1 and 2 are needed to meet customers' requirements for electrical energy in 1979, 1980 and thereafter. The peak demands experienced and expected on the Duke Power system for the years 1962 through 1980 are tabulated and discussed in Section 2.3. Demonstrated load growth and long lead times necessary to perform environmental engineering, pursue regulatory proceedings, perform design, obtain timely delivery of high quality equipment and build plants on schedule make it incumbent on Duke to choose a specific site in time to perform all necessary work in an orderly and timely fashion. It would be remiss for Duke or any other utility to delay, to waiver, or to be less than forthright in making necessary commitments to meet anticipated public needs for electric energy. This could seriously dislocate the economy of the area served.

Based on its considerable experience and upon every reasonable assurance that a suitable generating facility could be built and operated safely, with minimum possible adverse effect on the environment, Duke's management did not consider the alternative of deliberately not building new power generating facilities. Such an alternative is not acceptable to Duke Power nor to the public it serves.

In accordance with Duke's practice in planning new generating facilities, a number of alternatives have been considered to develop the optimum plan to meet anticipated needs. The important alternatives are discussed below.

5.1 ALTERNATIVE TYPES OF GENERATION

The needed increment of capacity to be added by Catawba Units 1 and 2 is approximately 2360 MWe. The types of generation which might be considered to furnish all or part of this needed increment of capacity are hydro, fossil-fueled steam, combustion turbines, nuclear-fueled steam, purchased power and "exotic" sources.

5.1.1 HYDRO AND COMBUSTION TURBINE CAPACITY

On a practical basis, neither hydro nor combustion turbine capacity could be considered. Duke's total existing hydro capacity of about 1,002,000 kw built in seven plants over a period of nearly 70 years is less than one-seventh of the total present capability of the Duke system and less than one-half of the planned capacity at Catawba. The characteristically low flows of streams in the Duke territory further limit the usefulness of hydro capacity to short term peaking service. There remain only a very few hydro sites suitable for development for peaking service, and none in the Duke territory for base load service. For example, the Federal Power Commission lists[1] 66 locations in all of North and South Carolina where undeveloped hydroelectric potential exists indicating 4.2 billion kilowatt hours to be the total annual energy potential of all 66 sites combined. This is only about one-fourth the annual energy generation planned for Catawba Nuclear Station.

[1] Hydroelectric Power Resources of the United States, Developed and Undeveloped, January 1, 1968, Federal Power Commission.

Likewise, combustion turbine units are small (20,000 - 50,000 kw) and are not suitable for base load service. Duke's total existing combustion turbine capacity, about 624,000 kw in 25 units, is less than one-third of needed capacity at Catawba. Duke's cost per net kw hour for combustion units was approximately 9.89 mills for fuel and 0.86 mills operating costs, for a total cost of 10.75 mills or about twice the expected cost for nuclear generation
1 at Catawba. The turbines were (in 1971) in use an average of 35 percent of the time. The capital cost at present for Duke's largest gas turbine is $126 per kw installed. Even if an adequate supply of oil or gas were available, use of this type generation for around-the-clock service would be poor stewardship of the economic resources of Duke's customers and of the nation's oil or gas resources.

5.1.2 PURCHASED POWER

Power in the amount to be generated by Catawba Nuclear Station is not presently available nor will power in this quantity become available in the foreseeable future. If such quantities of power became available, the production costs of such power may be competitive with production costs by Catawba; however, the additional transmission costs would remove any such power from a competitive category.

5.1.3 "EXOTIC" SOURCES OF POWER

Magnetohydrodynamics, solar power, tidal power, fusion and other sources of energy have been reviewed as alternatives to Catawba since some of these may some day be practical.

A great deal of research is now being done on such sources and Duke Power is contributing to segments of this research. None of them provide a practical alternative today; however, if they become practical, we will evaluate them from an environmental and economic standpoint and use them to supply our customers' power needs.

5.1.4 NUCLEAR AND FOSSIL FUELED STEAM-ELECTRIC CAPACITY

Duke's comprehensive fuel studies in which economics of fossil fuels versus nuclear fuel were studied, have shown that a nuclear fuel plant would result in lowest system costs. Due to difficulties involved in obtaining adequate quantities of oil, which will have to be imported from foreign countries, oil fired units are not considered feasible in this area. Coal would have to be available at about 39 cents per million Btu to be competitive with nuclear. During 1971, Duke's average cost for coal was 45.26 cents per million Btu and there are no indications of improvement in the price situation in near future. Also fossil fuels do not offer any substantial environmental advantage over the use of nuclear fuels.

5.2 ALTERNATIVE SITES FOR NEW CAPACITY

Following the addition of two units at McGuire, System Planning studies
indicated that for system stability, location for the next major generation
would still lie in the central part of Duke service area. Economic and
engineering studies compared the Catawba site on Lake Wylie with a site on
1 Lake Norman, a site on Wateree Lake and a site in central South
Carolina. Catawba site was found to be the most desirable primarily because
of proximity to major system transmission facilities and the availability
of condenser cooling water. Environmentally, the site compared favorably
to the other sites. The site is well suited to construction of a large
coal-fired station if the nuclear alternative were not available. The
following major factors were favorable to the location of a nuclear station
at Catawba:

a. By blending the surface water with the cool bottom waters from Lake Wylie, the temperature of the warmed condenser discharge can be reduced appreciably.

b. Low transmission costs due to proximity to the major load centers and existing transmission systems.

c. Duke already owned most of the land required for the plant and the surrounding exclusion area.

d. Minimum relocation required of people and access facilities.

e. Soil and subsurface conditions well suited for construction of large generating facility.

5.2.1 ALTERNATE PLANT SITES AND TRANSMISSION LINES

1. Central South Carolina Site
The topographic and geologic features of the plant site and the proposed transmission lines are characteristic of the Piedmont Upland of South Carolina. The relief ranges from nearly level to steep but is prevailingly gently sloping to moderately steep. The underlying rock formations range from Granite Gneiss and Schist around the plant site to a Mica Schist-Gneiss complex in the northwestern.

The area around the plant site and transmission lines contain many textile plants around Interstate 85, and some pulpwood is produced in the general area.

2. Wateree
The Wateree site is located in the lower Piedmont and Upper Sand Hills Regions of South Carolina. The topography of the site and transmission lines is characteristic of the Piedmont with gently sloping hills, but the soil has a higher sand content indicating the transition into the Sand Hills section of South Carolina.

The geology in the immediate plant site area consists of a Granite and Granite-Diorite complex. The proposed Bush River Line contains various igneous and metamorphic rock formations. The Newport Line runs over formations of Mica Gneiss, Schist, Amphibolite and basic intrusives. The proposed Oakboro Line runs into the Carolina Slate Belt consisting of bedded Argillites.

The area of the plant site and transmission lines contains pulpwood plantations, farming and some textile manufacturing plants.

3. Site D (Lake Norman)
This site and all the proposed transmission lines are located in the Piedmont Uplands and have the characteristic topography of the Piedmont. The geology is similar for the plant site and the transmission lines. Formations of Granite and Granite-Diorite complex are present along with Mica Gneiss, Schist and Amphibolite. Around Oakboro, some bedded Argillites are present along with the preceding formations.

The area around the plant site is mainly textile manufacturing or related industries. Some farming and pulpwood production is also present.

Tables 5.2-1 and 5.2-2 show the estimated land use, productivity, and dollar value of the land in the vicinity of the alternate plant sites and the proposed transmission lines.

5.3 ALTERNATIVE COOLING SYSTEM

The only feasible alternate to the proposed lake cooling system is the use of evaporative cooling towers.[1] Oceans and larger rivers are not available in the Piedmont Carolinas and dry cooling towers are uneconomical and have not yet been used in this size facility nor have the environmental effects been assessed.

A sparger system and lake cooling with a holding pond and connecting canal were also studied as possible alternative cooling systems. These alternatives were deleted due to adverse effects as described in Section 7.4. The preliminary layouts for each alternative are shown in Figures 5.3-1 through 5.3-6 respectively:

1) Lake Cooling with Holding Pond and Connecting Canal.
2) Sparger Canal System
3) Natural Draft Cooling Towers - Open Cycle (Supplemental Cooling)
1 4) Natural Draft Cooling Towers - Closed Cycle
5) Mechanical Draft Cooling Towers - Open Cycle (Supplemental Cooling)
6) Mechanical Draft Cooling Towers - Closed Cycle

As explained in Subsection 7.4.2, mechanical draft cooling towers are a more economical choice for the Catawba site than natural draft towers.

2 For closed cycle cooling towers, service water discharge ($\Delta T \approx 8F$) will have only minor thermal effects on Lake Wylie. For the supplemental cooling tower system, it was assumed that the cooling towers would remove up to 68 percent of
2 the rejected heat (91 percent plant factor). See Table 5.3-4 for cooling tower, details and Table 5.3-3a for the economic impact of different cooling water systems. The skimmer wall and submerged weir discussed in Subsection 4.1.4 would not be built since the cooling towers would control the discharge temperature.

To make a supplemental cooling tower system economically feasible, it is necessary to use less cooling water and a greater condenser temperature rise than would be used for a lake cooling system.

The economic impact of varying the flow rate through the condensers is shown in Table 5.3-3.

The computer program described in Subsection 4.1.6 was modified to model the heat loss from the cooling towers, and water temperatures and effected surface areas were computed by month for the 20 year period, 1951-1970. These results are shown in Table 5.3-1.

Over the 20 simulated years, the average discharge temperatures by month are:

January	61.7 F	July	92.4 F
February	61.8 F	August	91.9 F
March	66.7 F	September	87.9 F
April	77.8 F	October	77.9 F
May	82.2 F	November	69.5 F
June	87.9 F	December	62.3 F

[1]See Subsection 4.1.9

5.3.1 EFFECTS OF MECHANICAL AND NATURAL DRAFT COOLING TOWERS

5.3.1.1 Chemical Effects

Assuming a cooling tower evaporating rate of 65 cfs and water with 55 ppm dissolved solids, 10 tons per day of solids will concentrate as the result of evaporative losses in the cooling tower. Water conditioning chemicals will add approximately 3 tons per day to cooling tower water. Thus solids to be removed by blowdown and drift will contain 80 percent materials originating in the lake water and 20 percent materials added to the water for biocidal, corrosion and silt control purposes.

The expected cooling tower water treatment would add the following chemicals:

	Pounds/Day/Unit
Sodium-Zinc Polyphosphate (1)	140
Cationic Polyelectrolyte (2)	70
Chlorine	300
Sulfuric Acid	2700

The closed cycle cooling system will use a water flow rate of 750,000 gpm per unit. A drift loss of 0.05 percent or less will remove no more than 375 gpm per unit and a blowdown rate of 0.21 percent will send 1575 gpm per unit blowdown to the condenser cooling water discharge. Treatment of cooling tower blowdown for re-cycling is not anticipated. Treatment of cooling tower blowdown prior to discharge to the lake will be provided as required by regulatory agencies.

The addition of polyphosphate and sulfuric acid will be continuous, chlorine will be added 1-2 hours a day and the cationic polyelectrolyte will be added 1-2 times a week.

The application rate for the polyphosphate will be 140 lbs/day or 6 ppm based on the volume of blowdown and drift removals from the cooling water for 1 unit. The concentration of total phosphate in the system will be 6-9 ppm PO_4 and polyphosphates will range between 4 to 6 ppm PO_4. Analyses will monitor both polyphosphate and ortho phosphate.

Cooling tower processes of aeration and slug treatments with chlorine and polyelectrolytes break down some organic wastes including nitrogenous compounds in the makeup water from the lake. A tabulated analysis of lake water and the projected analysis of blowdown and drift water after treatment and ten cycles of concentration is listed in Table 5.3-2.

(1) Typical analysis 56.4% P_2O_5

10.8% ZnO

32.8% Na_2O

(2) Typical analysis: Diethyl-diallyl ammonium chloride, a cationic polyelectrolyte approved for use in potable water treatment.

Chlorine will be applied to the cooling water once a day as a shock treatment. The objective will be to feed the amount of chlorine necessary to establish and to maintain a free residual of chlorine of 0.5 ppm but not to exceed 1.0 ppm as measured by the orthotolodine-arsenite test method.

The amount of chlorine required will vary with the seasonal changes in water temperature and quality. A maximum chlorine demand of 8 ppm may be associated with manganous ions in hypolymnetic water in late Summer and Fall. The median annual rate of chlorination is expected to be 5 ppm.

The closed cycle cooling system of each unit will have an approximate volume of 7.5 million gallons. The maximum chlorine application of 8 ppm will feed 500 pounds of chlorine into the water in 1.5 to 2 hours, and the median application of 5 ppm will be about 300 pounds for one unit.

Intermittent application of chlorine to a free residual initially reacts with nitrogenous compounds to form chloramines or combined chlorine compounds. The chloramines oxidize to varying degrees while chlorine is present in the free form. After the application of chlorine ceases makeup water adds amino compounds to the system, the combined forms of chlorine then breakdown by circulating through the system six times an hour.

Some chlorine is scrubbed into the atmosphere in the cooling tower. Most of the chlorine forms soluble chlorides and their concentration varies with the chlorine feed rate and the blowdown-drift loss rate to approach an equilibrium concentration.

5.3.1.2 Ecological Effects

Conclusions from meteorological and biological studies associated with a 1143 Mw Unit 1 of the Forked River Station, owned by Jersey Central Power and Light Company and located on the Atlantic Coast, even though a marine installation, has significance in predicting the effects of drift from natural draft towers in Duke's particular locale. In fact, many of the plant species (flora) that were monitored are also common to the Piedmont Carolinas. Some of these species which were found to be most sensitive to salt deposition from the operation of natural draft cooling towers are: Highbush Blueberry, Poison Ivy, Virginia Creeper, Wild Black Cherry, Red Maple and Serviceberry.

The following conclusions concerning drift from natural draft cooling towers are quoted from the Forked River Nuclear Station, Environmental Report (Docket No. 50-363):

a. Exposure of vegetation typical of the Forked River environs to airborne salt concentrations of about 100 μg per meter^3 for several hours would result in foliar injury to deciduous species during the growing season. Such injury does not occur at about 60 μg per meter^3. Evergreens appear to be less sensitive.

b. Airborne salt concentrations above 10 μg per meter^3 may have long term effects on the general vigor and distribution of plant types.

The methods as used to determine the airborne salt concentrations for the Forked River Nuclear Station were employed in computing the airborne salt concentrations expected from the operation of natural draft cooling towers at the Catawba site. It was found that the highest short term exposure of vegetation would be 0.24 μg per meter^3 which is well below the concentration of airborne salt known to affect coastal vegetation, much of which is also common to this area.

In conclusion, the effects of drift from natural draft cooling towers at Catawba upon the vegetation during the growing season in the site environs would be minimal and should be limited to the immediate vicinity around the cooling towers.

For either natural or mechanical draft towers, the potential for ice accumulation and subsequent damage to vegetation, particularly pine trees, would be greatly increased during unstable (looping) meteorological conditions accompanied by temperatures below 32°F. Icing and resulting floral damage would be increased during typical warm frontal ice storms, particularly in the case of mechanical draft towers.

Discharges of the cooling tower blowdown into the average river flow of 4400 cfs, see Subsection 2.4.4, would result in an increase of approximately one percent in the river water dissolved solids. This small increase in dissolved solids would be expected to have no significant biological effects.

5.4 ALTERNATIVE RADIOACTIVE WASTE TREATMENT SYSTEMS

One alternate Liquid Waste System was evaluated. This alternative system did not incorporate the same degree of segregation of equipment drains and waste streams as the Liquid Waste System in the present Catawba design. Consequently, none of the liquid waste processed by this alternate system would be reused; and the radioactive liquid discharges from the station, while far below 10 CFR 20 limits, would be somewhat greater than those resulting from the present Catawba design.

Several alternate design concepts were considered for the Gaseous Waste System. One concept was to provide long-term holdup capacity for potentially radioactive gases in the waste gas tanks permitting considerable decay of radioactivity before release. Discharge of these gases from the station would result in acceptable offsite concentrations of radioactivity, however, the Gaseous Waste Disposal System in the Catawba design is planned to operate without normal discharge of radioactive gases from the waste gas tanks. Another alternate concept considered was the Freon gas-trapping process, announced in late 1970 by Oak Ridge National Laboratory (ORNL). The Gaseous Waste Disposal
2 System in the Catawba design achieves the same objective as the ORNL System.

Two alternatives for reducing station releases of radioactive iodine were considered. These were carbon filtration systems for the condenser air ejector and auxiliary building ventilation system. These were rejected because their cost is far more than is justified by their small value for iodine removal (See subsection 7.6.7.

The radioactive waste systems for Catawba were selected because, they meet the design objective of reducing levels of radioactivity in effluents to as low as practicable.

Amendment 2

ER Table 5.2-1 Amendment 1 (New)

Land Use
Plant Alternatives and Transmission Lines

Plant Location	Transmission Lines	KV	Length[1] (miles)	R/W Width(Ft.)	Land Use in Area of Transmission Lines (Est.) % Woodland	% Agriculture	% * Industry	% * Residential	Line Crossings Major Highways	Interstate Highways	Parks & Rec.	Historic	Waterways
Central South Carolina Site	Fold-in of Oconee to Newport	500	.50	200	100	-	-	-	None	None	None	None	None
	to Cliffside	500	35	200	43	33	5	19	2	1	None	None	2
Wateree	to Bush River	500	56	200	41	27	12	20	7	2	None	None	1
	to Newport	500	53	200	45	35	7	13	8	1	None	None	1
	to Oakboro	500	63	200	44	41	6	9	10	None	None	None	2
Site D (Lake Norman)	to Marshall	500	16	200	54	40	-	6	2	1	None	None	1
	to McGuire	500	7	200	37	55	-	8	1	None	None	None	None
	to Point X	500	5	200	88	10	-	2	1	1	None	None	None
	Point X to Oakboro	500	35	200	51	23	9	17	5	2	None	None	1

*Although some industrial and residential sites are in the area of the transmission lines, none of these sites will be disturbed by the transmission lines.

1. Length of required access road is the same as the transmission line length.

Productivity and Dollar Value of Alternate Plant Sites and Transmission Lines

			Woodland						Agriculture						Industry*	Rural Residential*	
Plant Location	Transmission Line	Total Area of R/W (Acres)	Acres	Prod. Per Acre Per Year	Unit Value	Gross Value /Acre	Est. R/W Cost /Acre	Land Value (Est.)	Acres	Prod. Per Acre Per Year	Unit Value	Gross Value /Acre	Est. R/W Cost /Ac.	Est. Land Value /Acre	Acres	Acres	Av. Cost Per House $
Central South Carolina Site	Fold-in of Oconee-Newport	12		130 [3] Bd.Ft.	32.67[2] /MBF	4.25	1200	600	-	-	-	-	-	-	-	-	-
	to Cliffside	848		130 Bd.Ft.	32.67 /MBF	4.25	1200	600	280	427 lbs[4] Cotton	.27 /lb.	115.29	1200	600	42	161	15,900[6]
	to Bush River	1358	557	570 [1] Bd.Ft.	32.67 /MBF	18.62	500	250	367	427 lbs Cotton	.27 /lb.	115.29	500	250	163	271	15,900
Wateree	to Newport	1285	578	130 Bd.Ft.	32.67 /MBF	4.25	800	400	450	427 lbs Cotton	.27 /lb.	115.29	800	400	90	167	15,900
	to Oakboro	1527	672	570 Bd.Ft.	32.67 /MBF	18.62	1200	600	626	427 lbs Cotton	.27 /lb.	115.29	1200	600	92	137	15,900
	to Marshall	388	210	130 Bd.Ft.	32.67 /MBF	4.25	1300	1300	155	23 bu[5] Soy B.	2.83 /bu	65.09	1300	1300	-	23	15,900
Site D (Lake Norman)	to McGuire	170	63	130 Bd.Ft.	32.67 /MBF	4.25	1300	1300	94	23 bu[5] Soy B.	2.83 /bu	65.09	1300	1300	-	13	15,900
	to Point X	121	106	130 Bd.Ft.	32.67 /MBF	4.25	2000	2000	13	23 bu[5] Soy B.	2.83 /bu	65.09	2000	2000	-	2	15,900
	Point X to Oakboro	848	433	130 Bd.Ft.	32.67 /MBF	4.25	2000	2000	195	23 bu[5] Soy B.	2.83 /bu	65.09	2000	[illegible]	76	144	15,900

1 Soil-Site Relationships, Stand Structure, and Yields of Slash and Loblolly Pine Plantations in the Southern U. S. by Coile & Shumacker

2 Crescent Land & Timber Corp. Annual Forestry Report No. 32, 1971

3 Forest Statistics for the Piedmont of South Carolina 1967, U. S. Forest Service

4 "South Carolina Crop & Livestock Reporting Service Monthly Report," November 1972

5 North Carolina Agricultural Statistics, 1971 issue

6 Metrolina Atlas by Clay & Orr

*Although some industrial and residential sites are in the area of the transmission lines, none of these sites will be disturbed by the transmission lines.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS-- SUPPLEMENTAL COOLING TOWERS

1951

MO	Q1	Q2	Q3	Q4	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	49.9	64.2	57.6	51.6	1.7	49.9	17.0	4567.	173.5	424.7	112.5	249.4	.0	702.5	0.	1662.	1662.
2	50.0	64.3	58.9	52.5	2.6	50.0	17.0	4347.	172.3	424.7	117.8	285.0	.0	702.5	0.	1702.	1702.
3	53.6	67.9	62.9	57.5	3.9	53.6	17.0	3384.	164.1	424.7	113.0	282.1	.0	702.5	0.	1686.	1686.
4	62.6	76.9	71.3	65.6	3.0	62.6	17.0	3978.	151.5	424.7	100.4	245.5	.0	702.5	0.	1626.	1626.
5	70.6	79.6	75.5	73.1	2.5	70.6	16.0	4123.	108.4	424.7	50.6	158.8	.0	702.5	0.	1461.	1461.
6	81.1	89.1	86.1	84.1	3.0	81.1	17.0	2532.	98.5	424.7	48.7	108.4	.0	702.5	0.	1373.	1373.
7	85.4	93.4	90.3	86.3	.9	85.4	17.0	1234.	88.2	424.7	40.5	420.7	.0	380.1	0.	1354.	1354.
8	85.7	93.7	90.5	86.5	.8	85.7	17.0	1709.	87.0	424.7	39.3	236.3	.0	453.1	0.	1240.	1240.
9	80.8	88.8	85.0	80.8	.0	80.8	17.0	1587.	92.5	424.7	32.0	176.9	.0	277.2	0.	1003.	1003.
10	72.0	80.0	76.7	72.2	.2	72.0	17.0	1564.	98.7	424.7	43.6	249.5	.0	376.6	0.	1193.	1193.
11	55.5	69.4	65.0	60.5	5.0	55.5	17.0	1814.	176.8	424.7	115.6	193.3	.0	702.5	0.	1613.	1613.
12	51.9	65.2	59.7	54.5	2.6	51.9	17.0	3052.	181.7	424.7	118.2	266.2	.0	702.5	0.	1693.	1693.

1952

MO	Q1	Q2	Q3	Q4	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	55.6	69.9	63.3	57.9	2.3	55.6	17.0	3417.	174.9	424.7	113.6	252.7	.0	702.5	0.	1668.	1668.
2	49.7	64.0	53.7	52.1	2.4	49.7	17.0	5233.	177.4	424.7	121.4	295.5	.0	702.5	0.	1722.	1722.
3	55.1	69.4	64.9	56.2	1.1	55.1	17.0	13295.	170.6	424.7	121.7	306.5	.0	702.5	0.	1726.	1726.
4	63.4	77.7	72.6	65.9	2.5	63.4	17.0	5161.	159.1	424.7	109.6	272.4	.0	702.5	0.	1668.	1668.
5	75.1	83.1	80.6	77.7	2.6	75.1	17.0	3501.	96.2	424.7	50.0	140.5	.0	702.5	0.	1424.	1424.
6	85.5	93.5	90.5	87.9	2.4	85.5	17.0	3226.	89.9	424.7	49.5	110.7	.0	702.5	0.	1377.	1377.
7	86.9	94.9	91.2	88.5	1.6	86.9	17.0	2914.	89.1	424.7	41.0	74.9	.0	695.0	0.	1325.	1325.
8	85.1	93.1	89.2	86.6	1.5	85.1	17.0	2764.	88.3	424.7	39.9	65.5	.0	613.7	0.	1232.	1232.
9	81.2	89.2	84.5	81.4	.2	81.2	17.0	3998.	93.1	424.7	32.2	19.9	.0	236.7	0.	806.	806.
10	65.5	75.5	71.2	68.2	2.7	65.5	15.0	2611.	131.4	424.7	77.9	164.7	.0	702.5	0.	1501.	1501.
11	56.0	70.3	65.5	60.5	4.5	56.0	17.0	1585.	178.4	424.7	116.8	410.2	.0	702.5	0.	1833.	1833.
12	49.6	63.9	59.0	54.0	4.4	49.6	17.0	1683.	187.9	424.7	122.4	285.0	.0	702.5	0.	1722.	1722.

1953

MO	Q1	Q2	Q3	Q4	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	54.3	68.0	61.5	56.4	2.1	54.3	17.0	3141.	171.0	424.7	106.2	229.9	.0	702.5	0.	1634.	1634.
2	51.6	65.9	60.6	53.7	2.1	51.6	17.0	5914.	175.9	424.7	110.4	292.7	.0	702.5	0.	1716.	1716.
3	55.7	70.0	65.5	57.6	1.9	55.7	17.0	7339.	168.3	424.7	120.0	301.7	.0	702.5	0.	1717.	1717.
4	63.7	78.0	72.9	67.4	3.7	63.7	17.0	3505.	154.1	424.7	135.0	262.4	.0	702.5	0.	1650.	1650.
5	78.2	86.2	83.2	81.0	2.8	78.2	17.0	2828.	91.0	424.7	50.2	112.7	.0	702.5	0.	1381.	1381.
6	82.8	90.8	88.3	86.3	3.5	82.8	17.0	2424.	89.7	424.7	49.4	121.5	.0	702.5	0.	1388.	1388.
7	86.6	94.6	91.5	88.5	1.9	86.6	17.0	2288.	88.1	424.7	40.4	94.9	.0	695.8	0.	1344.	1344.
8	84.8	92.8	89.6	86.1	1.3	84.8	17.0	1946.	91.1	424.7	41.4	186.6	.0	555.1	0.	1299.	1299.
9	80.8	88.8	85.0	80.8	.0	80.8	17.0	1752.	91.7	424.7	31.6	144.4	.0	298.4	0.	991.	991.
10	71.1	79.1	75.8	71.3	.2	71.1	17.0	1491.	101.7	424.7	45.2	282.0	.0	379.1	0.	1233.	1233.
11	56.0	70.3	65.5	59.5	3.5	56.0	17.0	1229.	178.8	424.7	117.0	695.2	.0	702.5	0.	2118.	2118.
12	49.1	63.4	57.0	51.8	2.7	49.1	17.0	2984.	182.3	424.7	118.6	257.3	.0	702.5	0.	1695.	1695.

NOTES* COLUMNS 'Q1-Q4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'COOL' IS AMOUNT OF COOLING IN DEG. F. PROVIDED BY THE 17 DEG. RANGE TOWER.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
SUPPLEMENTAL COOLING TOWERS

1954

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	50.7	65.0	58.5	52.0	1.3	50.7	17.0	6261.	179.1	424.7	116.4	261.0	.0	702.5	0.	1684.	1684.
2	52.6	66.9	61.5	55.1	2.5	52.6	17.0	4583.	172.2	424.7	117.8	285.1	.0	702.5	0.	1702.	1702.
3	55.2	69.5	65.0	57.4	2.2	55.2	17.0	6288.	167.7	424.7	119.5	300.4	.0	702.5	0.	1715.	1715.
4	70.0	84.3	78.7	72.7	2.7	70.0	17.0	4349.	150.6	424.7	99.9	245.1	.0	702.5	0.	1623.	1623.
5	71.7	79.7	77.3	74.1	2.4	71.7	17.0	3820.	100.0	424.7	62.5	147.[illegible]	.0	702.5	0.	1437.	1437.
6	82.6	90.6	87.6	85.3	2.7	82.6	17.0	2900.	91.3	424.7	50.4	113.[illegible]	.0	702.5	0.	1382.	1382.
7	86.8	94.8	91.7	87.7	.9	86.8	17.0	1370.	88.2	424.7	40.5	370.6	.0	412.7	0.	1337.	1337.
8	85.7	93.7	90.5	86.0	.3	85.7	17.0	1445.	84.1	424.7	37.7	283.2	.0	354.3	0.	1184.	1184.
9	84.3	92.3	88.4	84.3	.0	84.3	17.0	988.	86.4	424.7	29.2	242.9	.0	148.9	0.	932.	932.
10	70.0	79.0	75.1	70.0	.0	70.0	16.0	713.	107.9	424.7	49.8	514.6	.0	194.4	0.	1291.	1291.
11	53.2	67.5	62.6	54.6	1.4	53.2	17.0	849.	168.0	424.7	109.5	847.5	.0	585.2	0.	2135.	2135.
12	46.8	61.1	56.1	51.1	4.3	46.8	17.0	1887.	173.8	424.7	112.6	122.2	.0	702.5	0.	1536.	1536.

1955

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	47.6	61.9	56.9	51.9	4.3	47.6	17.0	1833.	175.7	424.7	114.0	157.8	.0	702.5	0.	1575.	1575.
2	48.9	63.2	57.8	52.4	3.5	48.9	17.0	3218.	168.9	424.7	115.3	278.1	.0	702.5	0.	1690.	1690.
3	53.1	67.4	62.3	58.1	5.0	53.1	17.0	2600.	157.3	424.7	108.2	268.4	.0	702.5	0.	1661.	1661.
4	67.0	81.3	75.6	69.7	2.7	67.0	17.0	3934.	145.4	424.7	96.2	234.8	.0	702.5	0.	1604.	1604.
5	73.7	82.7	80.2	77.7	4.0	73.7	16.0	2352.	101.1	424.7	61.8	168.8	.0	702.5	0.	1459.	1459.
6	76.3	84.3	81.8	78.8	2.5	76.3	17.0	1557.	90.7	424.7	50.0	719.5	.0	702.5	0.	1987.	1987.
7	85.5	93.5	90.4	87.4	1.9	85.5	17.0	2009.	84.1	424.7	38.3	169.9	.0	577.6	0.	1295.	1295.
8	84.0	92.0	88.8	85.8	1.8	84.0	17.0	2412.	82.0	424.7	36.6	45.2	.0	579.4	0.	1168.	1168.
9	78.9	86.9	83.0	78.9	.0	78.9	17.0	1466.	86.3	424.7	29.2	177.7	.0	229.8	0.	948.	948.
10	64.8	77.8	73.2	68.2	3.4	64.8	12.0	1877.	145.4	424.7	90.9	365.9	.0	702.5	0.	1729.	1729.
11	54.0	68.3	63.4	56.9	2.9	54.0	17.0	1241.	167.6	424.7	109.2	560.2	.0	702.5	0.	1964.	1964.
12	45.6	59.9	55.0	47.5	1.9	45.6	17.0	1031.	181.8	424.7	118.2	708.8	.0	697.6	0.	2131.	2131.

1956

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	44.6	58.9	53.9	47.9	3.3	44.6	17.0	1400.	173.2	424.7	112.2	424.4	.0	702.5	0.	1837.	1837.
2	47.9	6[illegible].2	58.0	51.1	3.2	47.9	15.0	4234.	181.0	424.7	125.7	308.5	.0	702.5	0.	1742.	1742.
3	50.9	65.2	60.1	54.6	3.7	50.9	17.0	3487.	160.6	424.7	110.5	274.9	.0	702.5	0.	1673.	1673.
4	60.3	74.6	69.0	62.8	2.5	60.3	17.0	4793.	150.4	424.7	99.6	244.2	.0	702.5	0.	1621.	1621.
5	73.7	82.7	79.5	76.9	3.2	73.7	16.0	3159.	99.9	424.7	61.1	143.2	.0	702.5	0.	1431.	1431.
6	79.8	87.8	85.2	81.7	2.4	79.3	17.0	1203.	94.9	424.7	55.2	857.5	.0	738.4	0.	2171.	2171.
7	84.2	92.2	89.0	84.5	.3	84.2	17.0	1226.	83.3	424.7	37.9	386.4	.0	344.8	0.	1277.	1277.
8	83.9	91.9	88.7	84.2	.3	83.9	17.0	1278.	85.5	424.7	38.4	336.9	.0	325.7	0.	1211.	1211.
9	76.6	84.6	80.7	76.6	.0	76.6	17.0	1612.	89.7	424.7	30.7	164.1	.0	267.8	0.	977.	977.
10	68.9	79.9	75.3	71.3	2.4	68.9	14.0	2411.	118.6	424.7	63.9	58.7	.0	748.5	0.	1414.	1414.
11	53.7	68.0	61.6	56.8	3.1	53.7	17.0	2636.	165.5	424.7	107.8	244.1	.0	702.5	0.	1645.	1645.
12	57.4	71.7	64.4	59.8	2.4	57.4	17.0	2131.	159.6	424.7	98.7	207.6	.0	702.5	0.	1593.	1593.

NOTES: COLUMNS 'O1-O4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'COOL' IS AMOUNT OF COOLING IN DEG. F. PROVIDED BY THE 17 DEG. RANGE TOWER.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
SUPPLEMENTAL COOLING TOWERS

1957

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	49.9	64.2	57.1	52.3	2.4	49.9	17.0	2804.	169.1	424.7	104.9	225.9	.0	702.5	0.	1627.	1627.
2	52.4	66.7	61.2	54.0	1.6	52.4	17.0	6735.	166.6	424.7	113.8	273.7	.0	702.5	0.	1681.	1681.
3	51.9	66.2	61.2	54.3	2.4	51.9	17.0	5407.	166.3	424.7	114.6	286.5	.0	702.5	0.	1695.	1695.
4	66.8	81.1	75.4	68.2	1.4	66.8	17.0	7877.	147.0	424.7	97.3	237.8	.0	702.5	0.	1609.	1609.
5	75.4	83.4	80.4	77.9	2.5	75.4	17.0	3105.	91.5	424.7	50.4	113.5	.0	702.5	0.	1383.	1383.
6	81.1	89.1	86.1	82.2	1.1	81.1	17.0	6870.	86.4	424.7	47.4	104.8	.0	702.5	0.	1366.	1366.
7	83.8	91.8	88.7	85.7	1.9	83.8	17.0	2312.	87.2	424.7	40.0	86.1	.0	691.1	0.	1329.	1329.
8	80.7	88.7	85.5	81.5	.8	80.7	17.0	1714.	87.4	424.7	39.4	234.0	.0	452.7	0.	1238.	1238.
9	80.0	88.0	83.1	80.1	.1	80.0	17.0	3135.	86.7	424.7	29.4	9.4	.0	218.0	0.	768.	768.
10	63.7	75.7	70.5	66.0	2.3	63.7	13.0	3711.	137.2	424.7	85.9	191.1	.0	702.5	0.	1541.	1541.
11	56.8	71.1	64.2	57.9	1.1	56.8	17.0	6589.	160.6	424.7	100.1	221.0	.0	702.5	0.	1609.	1609.
12	49.8	64.1	57.0	50.9	1.1	49.8	17.0	5874.	170.1	424.7	105.6	227.9	.0	702.5	0.	1631.	1631.

1958

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	42.8	57.1	50.6	44.1	1.3	42.8	17.0	6207.	181.7	424.7	118.0	265.6	.0	702.5	0.	1693.	1693.
2	39.7	56.0	50.4	42.5	2.9	39.7	15.0	5386.	191.5	424.7	136.7	340.0	.0	702.5	0.	1795.	1795.
3	47.5	62.8	57.7	50.2	2.7	47.5	16.0	5475.	175.0	424.7	123.3	311.2	.0	702.5	0.	1737.	1737.
4	61.3	75.6	70.0	62.4	1.1	61.3	17.0	10305.	150.1	424.7	99.4	243.8	.0	702.5	0.	1621.	1621.
5	73.8	82.8	79.7	75.0	1.2	73.8	16.0	8299.	106.0	424.7	65.0	154.4	.0	702.5	0.	1453.	1453.
6	79.4	87.4	84.4	81.5	2.1	79.4	17.0	3646.	88.3	424.7	48.5	108.0	.0	702.5	0.	1372.	1372.
7	85.4	93.4	89.6	86.7	1.3	85.4	17.0	3511.	86.2	424.7	39.4	70.3	.0	672.4	0.	1293.	1293.
8	83.6	91.6	87.6	85.1	1.5	83.6	17.0	2714.	85.7	424.7	38.6	61.4	.0	582.5	0.	1193.	1193.
9	80.0	88.0	84.1	80.0	.0	80.0	17.0	1938.	88.0	424.7	29.9	103.7	.0	303.6	0.	950.	950.
10	66.4	76.4	72.5	68.5	2.1	66.4	15.0	2189.	121.7	424.7	65.4	154.0	.0	820.0	0.	1586.	1586.
11	58.2	72.5	67.1	61.6	3.4	58.2	17.0	1618.	160.3	424.7	100.0	269.7	.0	702.5	0.	1657.	1657.
12	45.7	60.0	52.9	48.0	2.3	45.7	17.0	2960.	171.6	424.7	106.4	230.4	.0	702.5	0.	1636.	1636.

1959

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	47.5	61.8	54.7	48.9	1.4	47.5	17.0	4816.	168.9	424.7	104.7	225.2	.0	702.5	0.	1626.	1626.
2	49.5	63.8	57.9	52.4	2.9	49.5	17.0	3502.	165.3	424.7	108.6	258.6	.0	702.5	0.	1660.	1660.
3	51.4	65.7	60.6	54.6	3.2	51.4	17.0	4021.	159.3	424.7	109.5	272.3	.0	702.5	0.	1668.	1668.
4	63.3	77.6	71.9	65.0	1.7	63.3	17.0	6115.	144.4	424.7	95.5	232.6	.0	702.5	0.	1600.	1600.
5	74.7	83.7	80.5	78.2	3.5	74.7	16.0	2879.	98.4	424.7	60.0	140.2	.0	702.5	0.	1426.	1426.
6	79.2	87.2	84.2	81.3	2.1	79.2	17.0	3675.	86.5	424.7	47.5	105.1	.0	702.5	0.	1366.	1366.
7	84.0	92.0	88.8	85.8	1.8	84.0	17.0	2497.	80.8	424.7	36.6	27.7	.0	672.6	0.	1242.	1242.
8	85.5	93.5	89.5	86.7	1.2	85.5	17.0	3297.	82.1	424.7	36.7	55.8	.0	388.5	0.	988.	988.
9	80.1	88.1	83.2	80.2	.1	80.1	17.0	5016.	84.9	424.7	28.6	6.6	.0	206.8	0.	752.	752.
10	69.9	79.9	74.8	70.3	.4	69.9	15.0	9617.	110.7	424.7	58.9	107.2	.0	546.1	0.	1248.	1248.
11	54.5	68.8	61.8	55.9	1.4	54.5	17.0	4862.	159.2	424.7	99.1	218.1	.0	702.5	0.	1604.	1604.
12	46.9	62.2	54.9	48.5	1.6	46.9	16.0	5208.	175.8	424.7	113.4	253.2	.0	702.5	0.	1670.	1670.

NOTES: COLUMNS '01-04' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'COOL' IS AMOUNT OF COOLING IN DEG. F. PROVIDED BY THE 17 DEG. RANGE TOWER.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
SUPPLEMENTAL COOLING TOWERS

1960

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	48.2	62.5	55.3	49.4	1.2	48.2	17.0	5268.	166.4	424.7	103.0	220.4	.0	702.5	0.	1617.	1617.
2	46.5	60.8	55.4	47.3	.8	46.5	17.0	13097.	168.5	424.7	115.0	277.2	.0	702.5	0.	1688.	1688.
3	44.5	58.8	54.3	46.1	1.6	44.5	17.0	9053.	172.9	424.7	123.2	310.7	.0	702.5	0.	1734.	1734.
4	65.7	80.0	74.3	66.7	1.0	65.7	17.0	10573.	147.5	424.7	97.6	238.7	.0	702.5	0.	1611.	1611.
5	71.4	80.4	77.3	73.3	1.9	71.4	16.0	5282.	102.5	424.7	62.7	148.0	.0	702.5	0.	1440.	1440.
6	80.1	88.1	85.1	82.3	2.2	80.1	17.0	3571.	85.8	424.7	47.1	103.8	.0	702.5	0.	1364.	1364.
7	83.7	91.7	87.9	85.3	1.6	83.7	17.0	2717.	83.7	424.7	38.1	66.5	.0	640.1	0.	1253.	1253.
8	85.1	93.1	89.1	85.9	.8	85.1	17.0	4813.	82.7	424.7	37.0	56.7	.0	391.0	0.	992.	992.
9	80.3	88.3	83.4	80.4	.1	80.3	17.0	3610.	86.1	424.7	29.1	8.4	.0	211.1	0.	759.	759.
10	69.6	79.6	74.6	71.0	1.4	69.6	15.0	3816.	116.1	424.7	62.1	116.8	.0	583.3	0.	1303.	1303.
11	57.0	71.3	64.9	59.5	2.5	57.0	17.0	3201.	167.9	424.7	109.5	249.1	.0	702.5	0.	1654.	1654.
12	44.8	59.1	53.3	49.1	4.3	44.8	17.0	2405.	195.1	424.7	132.2	308.0	.0	702.5	0.	1762.	1762.

1961

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	45.8	60.1	53.7	48.5	2.7	45.8	17.0	3344.	187.0	424.7	121.8	276.[illegible]	.0	702.5	0.	1712.	1712.
2	49.5	63.8	58.4	51.8	2.3	49.5	17.0	5252.	174.2	424.7	119.1	288.[illegible]	.0	702.5	0.	1709.	1709.
3	55.3	69.6	64.6	57.3	2.0	55.3	17.0	6583.	165.0	424.7	113.7	284.1	.0	702.5	0.	1690.	1690.
4	57.2	71.5	66.4	58.9	1.7	57.2	17.0	7558.	158.7	424.7	109.2	271.3	.0	702.5	0.	1666.	1666.
5	71.0	80.0	76.9	73.2	2.2	71.0	16.0	4612.	106.9	424.7	65.6	156.0	.0	702.5	0.	1456.	1456.
6	80.1	88.1	85.1	81.8	1.7	80.1	17.0	4575.	88.9	424.7	48.9	109.0	.0	702.5	0.	1374.	1374.
7	85.2	93.2	89.4	86.4	1.2	85.2	17.0	3692.	87.6	424.7	40.2	72.5	.0	697.9	0.	1323.	1323.
8	83.1	91.1	87.2	84.0	.9	83.1	17.0	4374.	88.7	424.7	40.2	66.2	.0	630.4	0.	1250.	1250.
9	84.0	92.0	87.2	84.2	.2	84.0	17.0	3113.	89.0	424.7	30.4	12.9	.0	219.3	0.	776.	776.
10	70.0	78.0	74.7	70.7	.7	70.0	17.0	1722.	104.4	424.7	46.6	229.6	.0	450.3	0.	1256.	1256.
11	61.2	75.5	69.1	64.1	2.9	61.2	17.0	2840.	168.0	424.7	109.6	249.5	.0	702.5	0.	1654.	1654.
12	49.0	63.3	56.9	50.4	1.4	49.0	17.0	6461.	183.8	424.7	119.6	270.3	.0	702.5	0.	1701.	1701.

1962

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	45.9	60.2	53.7	47.1	1.2	45.9	17.0	6690.	182.0	424.7	118.3	266.3	.0	702.5	0.	1694.	1694.
2	50.6	64.9	59.6	52.9	2.3	50.6	17.0	5533.	180.2	424.7	123.4	301.3	.0	702.5	0.	1732.	1732.
3	51.4	65.7	61.2	53.2	1.8	51.4	17.0	7688.	171.4	424.7	122.2	308.1	.0	702.5	0.	1729.	1729.
4	63.4	77.7	72.6	64.8	1.4	63.4	17.0	9166.	157.0	424.7	108.1	268.2	.0	702.5	0.	1660.	1660.
5	78.8	86.8	83.8	81.0	2.2	78.8	17.0	3532.	91.7	424.7	50.6	113.9	.0	702.5	0.	1383.	1383.
6	80.2	88.2	85.2	81.8	1.6	80.2	17.0	4897.	88.6	424.7	48.7	108.6	.0	702.5	0.	1373.	1373.
7	84.7	92.7	89.6	86.1	1.4	84.7	17.0	1682.	86.6	424.7	39.6	275.4	.0	504.6	0.	1331.	1331.
8	84.3	92.3	89.1	84.6	.3	84.3	17.0	1211.	87.4	424.7	39.4	366.6	.0	319.6	0.	1238.	1238.
9	79.6	87.6	83.7	79.6	.0	79.6	17.0	1250.	91.1	424.7	31.3	229.5	.0	212.5	0.	989.	989.
10	69.3	78.3	75.0	70.0	.7	69.3	16.0	1333.	112.4	424.7	59.7	426.9	.0	449.1	0.	1473.	1473.
11	52.7	67.0	62.1	57.6	4.9	52.7	17.0	2033.	164.2	424.7	106.9	29.9	.0	702.5	0.	1428.	1428.
12	44.4	58.7	53.8	48.8	4.4	44.4	17.0	1609.	182.1	424.7	118.4	323.2	.0	702.5	0.	1751.	1751.

NOTES: COLUMNS '01-04' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'COOL' IS AMOUNT OF COOLING IN DEG. F. PROVIDED BY THE 17 DEG. RANGE TOWER.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
SUPPLEMENTAL COOLING TOWERS

1963

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	46.2	60.5	54.1	49.6	3.4	46.2	17.0	2654.	185.5	424.7	120.7	273.5	.0	702.5	0.	1707.	1707.
2	43.8	58.1	54.0	50.5	6.7	43.8	17.0	2009.	179.2	424.7	122.6	79.5	.0	702.5	737.	1508.	2246.
3	56.7	71.0	66.0	58.7	2.0	56.7	17.0	6566.	163.9	424.7	113.0	282.0	.0	702.5	0.	1686.	1686.
4	65.4	79.7	74.1	69.3	3.9	65.4	17.0	3046.	152.5	424.7	101.1	248.5	.0	702.5	0.	1629.	1629.
5	73.8	81.8	79.3	76.8	3.0	73.8	17.0	3060.	94.6	424.7	58.9	137.4	.0	702.5	0.	1418.	1418.
6	80.0	88.0	85.0	82.8	2.8	80.0	17.0	2792.	89.1	424.7	49.0	109.4	.0	702.5	0.	1375.	1375.
7	84.2	92.2	89.1	86.1	1.9	84.2	17.0	2180.	87.3	424.7	40.0	128.4	.0	666.7	0.	1347.	1347.
8	84.3	92.3	89.1	85.6	1.3	84.3	17.0	1933.	87.6	424.7	39.6	176.9	.0	512.6	0.	1241.	1241.
9	79.4	87.4	83.6	79.6	.2	79.4	17.0	1937.	91.8	424.7	31.7	113.6	.0	331.9	0.	994.	994.
10	70.6	78.6	75.3	71.8	1.2	70.6	17.0	2309.	99.5	424.7	44.0	70.4	.0	558.8	0.	1197.	1197.
11	57.2	71.5	65.2	60.4	3.2	57.2	17.0	2606.	170.2	424.7	111.1	253.9	.0	702.5	0.	1662.	1662.
12	41.7	56.0	50.1	44.7	3.0	41.7	17.0	3465.	190.7	424.7	129.0	298.7	.0	702.5	0.	1746.	1746.

1964

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	48.2	62.5	56.0	49.8	1.6	48.2	17.0	4836.	177.8	424.7	115.5	258.2	.0	702.5	0.	1679.	1679.
2	44.3	58.6	53.3	46.9	2.6	44.3	17.0	4799.	179.0	424.7	122.4	298.3	.0	702.5	0.	1727.	1727.
3	54.5	68.8	63.8	57.5	3.0	54.5	17.0	4327.	164.1	424.7	113.1	282.3	.0	702.5	0.	1687.	1687.
4	63.0	77.3	72.1	64.8	1.8	63.0	17.0	7206.	151.3	424.7	103.9	256.5	.0	702.5	0.	1639.	1639.
5	74.0	82.0	79.0	76.7	2.7	74.0	17.0	2946.	92.2	424.7	50.9	114.6	.0	702.5	0.	1385.	1385.
6	81.2	89.2	86.2	84.0	2.8	81.2	17.0	2771.	88.2	424.7	48.5	107.9	.0	702.5	0.	1372.	1372.
7	84.2	92.2	88.4	85.3	1.1	84.2	17.0	3982.	84.4	424.7	38.5	67.6	.0	657.5	0.	1273.	1273.
8	86.3	94.3	90.3	87.1	.8	86.3	17.0	5074.	84.7	424.7	38.1	59.9	.0	562.2	0.	1170.	1170.
9	80.4	88.4	83.6	80.5	.1	80.4	17.0	3974.	89.8	424.7	30.8	14.0	.0	226.4	0.	786.	786.
10	63.6	75.6	70.5	64.4	.8	63.6	13.0	10454.	144.7	424.7	90.9	205.6	.0	702.5	0.	1568.	1568.
11	60.2	74.5	67.6	61.3	1.1	60.2	17.0	6396.	163.6	424.7	102.2	227.1	.0	702.5	0.	1620.	1620.
12	51.1	65.4	58.8	52.4	1.3	51.1	17.0	5985.	175.9	424.7	114.2	254.4	.0	702.5	0.	1672.	1672.

1965

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	48.4	62.7	56.2	49.3	.9	48.4	17.0	8262.	177.6	424.7	115.3	257.6	.0	702.5	0.	1678.	1678.
2	48.3	62.6	57.3	50.4	2.1	48.3	17.0	5982.	178.3	424.7	122.1	297.3	.0	702.5	0.	1725.	1725.
3	50.4	64.7	60.2	52.8	2.4	50.4	17.0	5821.	172.7	424.7	123.1	310.6	.0	702.5	0.	1733.	1733.
4	65.0	79.3	73.7	66.9	1.9	65.0	17.0	6167.	151.6	424.7	100.5	246.8	.0	702.5	0.	1626.	1626.
5	77.0	85.0	82.0	79.2	2.2	77.0	17.0	3594.	93.2	424.7	51.5	116.5	.0	702.5	0.	1388.	1388.
6	77.0	85.0	82.0	79.2	2.2	77.0	17.0	3494.	91.0	424.7	50.1	112.6	.0	702.5	0.	1381.	1381.
7	83.8	91.8	88.0	84.6	.8	83.8	17.0	5460.	86.6	424.7	39.6	71.0	.0	682.3	0.	1304.	1304.
8	84.6	92.6	88.7	85.5	.9	84.6	17.0	4753.	88.6	424.7	40.1	65.9	.0	609.2	0.	1228.	1228.
9	80.8	88.8	84.0	81.0	.2	80.8	17.0	3461.	89.9	424.7	30.8	14.1	.0	225.8	0.	785.	785.
10	65.9	75.9	71.0	67.3	1.4	65.9	15.0	3799.	122.9	424.7	66.1	128.9	.0	772.7	0.	1515.	1515.
11	55.8	70.1	63.8	58.4	2.6	55.8	17.0	3139.	171.5	424.7	112.0	256.3	.0	702.5	0.	1667.	1667.
12	49.8	64.1	57.6	53.1	3.3	49.8	17.0	2426.	182.0	424.7	118.4	266.7	.0	702.5	0.	1694.	1694.

NOTES: COLUMNS '01-04' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'COOL' IS AMOUNT OF COOLING IN DEG. F. PROVIDED BY THE 17 DEG. RANGE TOWER.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
SUPPLEMENTAL COOLING TOWERS

1966

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	43.5	57.8	51.4	45.9	2.4	43.5	17.0	3415.	184.8	424.7	120.2	271.9	.0	702.5	0.	1704.	1704.
2	44.9	60.2	54.8	47.7	2.8	44.9	16.0	5045.	190.9	424.7	133.9	331.6	.0	702.5	0.	1784.	1784.
3	52.3	66.6	62.2	54.4	2.1	52.3	17.0	6711.	175.8	424.7	125.5	317.3	.0	702.5	0.	1746.	1746.
4	60.4	74.7	70.7	66.7	6.3	60.4	17.0	1831.	158.4	424.7	109.0	342.0	.0	702.5	650.	1737.	2387.
5	72.2	81.2	78.7	76.2	4.0	72.2	16.0	2139.	107.3	424.7	65.8	353.6	.0	702.5	0.	1654.	1654.
6	77.5	85.5	82.6	80.5	3.0	77.5	17.0	2608.	94.2	424.7	52.1	118.2	.0	702.5	0.	1392.	1392.
7	82.9	90.9	87.2	85.0	2.1	82.9	17.0	2880.	90.8	424.7	41.9	77.5	.0	708.2	0.	1343.	1343.
8	82.4	90.4	87.2	84.2	1.8	82.4	17.0	2001.	89.9	424.7	40.8	167.9	.0	560.8	0.	1284.	1284.
9	77.3	85.3	81.0	78.0	.7	77.3	17.0	2796.	95.7	424.7	42.0	51.5	.0	368.3	0.	982.	982.
10	65.0	76.0	72.6	68.6	3.6	65.0	14.0	2294.	137.4	424.7	86.8	164.4	.0	702.5	0.	1516.	1516.
11	54.8	69.1	62.8	56.6	1.8	54.8	17.0	4626.	172.7	424.7	112.8	258.7	.0	702.5	0.	1671.	1671.
12	46.8	61.1	54.7	48.6	1.8	46.8	17.0	4958.	185.3	424.7	120.6	273.2	.0	702.5	0.	1706.	1706.

1967

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	50.0	64.3	57.8	52.6	2.6	50.0	17.0	3038.	181.2	424.7	117.8	265.0	.0	702.5	0.	1691.	1691.
2	41.9	58.2	52.6	45.8	3.9	41.9	15.0	3881.	194.6	424.7	139.0	345.6	.0	702.5	0.	1807.	1807.
3	56.4	70.7	65.7	62.4	6.0	56.4	17.0	2178.	167.5	424.7	115.5	289.1	.0	702.5	848.	1699.	2548.
4	64.7	79.0	74.[illegible]	69.4	5.1	64.3	17.0	1271.	157.5	424.7	105.7	1081.1	.0	702.5	239.	2472.	2710.
5	68.3	80.3	77.[illegible]	72.0	4.3	67.7	13.0	1414.	136.1	424.7	93.3	1173.3	.0	702.5	0.	2530.	2530.
6	78.8	86.9	84.4	81.4	2.9	78.5	17.0	1498.	96.0	424.7	55.3	729.0	.0	702.5	0.	2007.	2007.
7	82.0	90.0	86.2	84.2	2.2	82.0	17.0	2703.	88.9	424.7	40.9	74.6	.0	713.1	0.	1342.	1342.
8	80.9	88.9	[illegible].0	81.9	1.0	80.9	17.0	4342.	92.3	424.7	42.0	71.7	.0	658.9	0.	1290.	1290.
9	75.0	83.0	78.8	75.4	.4	75.0	17.0	4601.	96.8	424.7	42.6	53.3	.0	371.9	0.	989.	989.
10	66.0	77.0	72.5	68.3	2.3	66.0	14.0	3888.	138.2	424.7	87.4	194.6	.0	702.5	0.	1547.	1547.
11	51.5	65.8	59.6	53.7	2.2	51.5	17.0	4358.	181.0	424.7	118.5	275.2	.0	702.5	0.	1702.	1702.
12	51.0	65.3	58.8	52.7	1.7	51.0	17.0	4491.	177.3	424.7	115.2	257.2	.0	702.5	0.	1677.	1677.

1968

MO	01	02	03	04	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	43.9	58.2	51.8	45.1	1.2	43.9	17.0	7382.	185.5	424.7	120.7	273.4	.0	702.5	0.	1707.	1707.
2	41.9	56.2	51.5	44.5	2.6	41.9	17.0	5265.	188.8	424.7	133.8	331.1	.0	702.5	0.	1781.	1781.
3	53.3	67.6	62.7	57.2	3.9	53.3	17.0	3429.	169.9	424.7	117.2	293.9	.0	702.5	0.	1708.	1708.
4	61.8	76.1	71.1	66.5	4.7	61.8	17.0	2746.	160.7	424.7	110.7	275.7	.0	702.5	0.	1674.	1674.
5	68.6	79.6	76.2	73.5	4.9	68.6	14.0	2692.	126.1	424.7	86.1	213.6	.0	702.5	0.	1553.	1553.
6	78.3	86.3	83.3	80.7	2.4	78.3	17.0	3313.	90.2	424.7	49.7	111.3	.0	702.5	0.	1378.	1378.
7	83.3	91.3	87.5	84.8	1.5	83.3	17.0	3873.	88.5	424.7	40.7	74.0	.0	710.9	0.	1339.	1339.
8	84.2	92.2	88.3	85.2	1.0	84.2	17.0	3988.	89.1	424.7	40.4	66.8	.0	613.1	0.	1234.	1234.
9	79.3	87.3	84.0	80.5	1.2	79.3	17.0	2496.	96.0	424.7	42.2	23.2	.0	556.9	0.	1143.	1143.
10	66.6	77.6	72.6	69.3	2.7	66.6	14.0	2876.	134.9	424.7	79.7	171.0	.0	702.5	0.	1513.	1513.
11	53.7	68.0	61.7	56.5	2.8	53.7	17.0	3392.	172.1	424.7	112.4	257.4	.0	702.5	0.	1669.	1669.
12	43.0	57.3	51.4	46.5	3.5	43.0	17.0	2937.	190.5	424.7	128.9	298.5	.0	702.5	0.	1745.	1745.

NOTES: COLUMNS '01-04' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'COOL' IS AMOUNT OF COOLING IN DEG. F. PROVIDED BY THE 17 DEG. RANGE TOWER.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

PREDICTED TEMPERATURES AND AREAS FOR 1951-70 METEOROLOGICAL AND HYDROLOGICAL CONDITIONS--
SUPPLEMENTAL COOLING TOWERS

1969

MO	O1	O2	O3	O4	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	43.5	57.8	52.0	46.3	2.8	43.5	17.0	3732.	194.0	424.7	131.5	305.8	.0	702.5	0.	1758.	1758.
2	42.4	57.7	52.3	45.3	2.9	42.4	16.0	4514.	189.7	424.7	133.0	329.1	.0	702.5	0.	1779.	1779.
3	48.2	62.5	58.1	51.3	3.1	48.2	17.0	4620.	178.0	424.7	126.9	321.5	.0	702.5	0.	1754.	1754.
4	62.4	76.7	71.6	64.9	2.5	62.4	17.0	5242.	155.3	424.7	106.8	264.6	.0	702.5	0.	1654.	1654.
5	71.8	80.8	77.7	74.2	2.4	71.8	16.0	4219.	107.3	424.7	65.8	156.7	.0	702.5	0.	1457.	1457.
6	79.7	87.7	84.7	81.2	1.5	79.7	17.0	5106.	90.3	424.7	49.8	111.5	.0	702.5	0.	1379.	1379.
7	84.5	92.5	88.7	85.6	1.1	84.5	17.0	3980.	87.7	424.7	40.2	72.7	.0	692.3	0.	1318.	1318.
8	80.5	88.5	84.6	81.9	1.4	80.5	17.0	3057.	89.0	424.7	40.3	66.6	.0	622.5	0.	1243.	1243.
9	77.3	85.3	81.0	77.8	.5	77.3	17.0	3569.	95.1	424.7	41.7	50.6	.0	370.7	0.	983.	983.
10	67.0	78.0	72.9	68.7	1.7	67.0	14.0	4420.	130.3	424.7	76.7	162.5	.0	702.5	0.	1497.	1497.
11	51.0	65.3	59.1	53.3	2.3	51.0	17.0	4100.	177.6	424.7	116.1	268.2	.0	702.5	0.	1689.	1689.
12	44.0	58.3	51.9	46.3	2.3	44.0	17.0	4040.	184.3	424.7	119.8	270.8	.0	702.5	0.	1702.	1702.

1970

MO	O1	O2	O3	O4	EX-4	AMB	COOL	FLOW	A	B	C	D	E	F	G	WYLIE	TOTAL
1	41.0	55.3	49.4	42.9	1.9	41.0	17.0	5440.	190.4	424.7	128.8	298.0	.0	702.5	0.	1744.	1744.
2	43.0	59.3	53.7	46.8	3.8	43.0	15.0	3960.	197.2	424.7	141.0	352.2	.0	702.5	0.	1818.	1818.
3	50.0	64.3	59.8	54.1	4.1	50.0	17.0	3440.	172.5	424.7	123.0	310.3	.0	702.5	0.	1733.	1733.
4	62.0	76.3	71.2	65.7	3.7	62.0	17.0	3480.	157.5	424.7	108.4	269.2	.0	702.5	0.	1662.	1662.
5	71.0	81.0	77.8	74.0	3.0	71.0	15.0	4190.	118.6	424.7	77.7	189.9	.0	702.5	0.	1513.	1513.
6	77.0	85.0	82.1	80.0	3.0	77.0	17.0	2690.	94.0	424.7	51.9	117.7	.0	702.5	0.	1391.	1391.
7	81.0	89.0	85.7	82.5	1.5	81.0	17.0	3900.	89.1	424.7	47.9	95.5	.0	868.5	0.	1526.	1526.
8	82.0	90.0	86.1	82.7	.7	82.0	17.0	5920.	89.3	424.7	40.4	67.0	.0	632.9	0.	1254.	1254.
9	82.0	90.0	85.2	82.1	.1	82.0	17.0	5910.	90.6	424.7	31.1	15.2	.0	228.3	0.	790.	790.
10	67.0	79.0	75.0	67.0	.0	67.0	13.0	867.	139.6	424.7	87.5	833.4	.0	416.9	0.	1902.	1902.
11	51.0	65.3	60.5	56.0	5.0	51.0	17.0	1770.	173.8	424.7	113.5	218.2	.0	702.5	0.	1633.	1633.
12	50.0	64.3	59.3	54.3	4.3	50.0	17.0	1801.	174.6	424.7	113.2	174.4	.0	702.5	0.	1589.	1589.

NOTES: COLUMNS 'O1-O4' ARE TEMPERATURES IN DEGREES FAHRENHEIT AT POINTS 1-4 FIGURE 4.1-7.
COLUMN 'EX-4' IS EXCESS TEMP. ABOVE AMBIENT IN DEG. F. AT POINT 4.
COLUMN 'AMB' IS AMBIENT TEMP. IN DEG. F.
COLUMN 'COOL' IS AMOUNT OF COOLING IN DEG. F. PROVIDED BY THE 17 DEG. RANGE TOWER.
COLUMN 'FLOW' IS THE FLOW THROUGH THE LAKE IN CFS.
COLUMNS 'A-F' ARE THE AREAS(ACRES) IN LAKE SECT.'A-F' FIG. 4.1-7 WITH TEMP.3DEG. OR MORE ABOVE AMB.
COLUMN 'G' IS THE AREA(ACRES) 5 DEG. OR MORE ABOVE AMB. IN SECT. 'G' FIG. 4.1-7.
COLUMN 'WYLIE' IS THE SUM OF COLUMNS 'A-F'.
COLUMN 'TOTAL' IS THE SUM OF 'G' PLUS 'WYLIE'.

ER Table 5.3-2

EXPECTED WATER ANALYSES

	Catawba River 10' Intake	Cooling Tower 10 Cycles Concentration	Comments
pH	7.0	7.3	
Color APHA	3	25	
Turbidity JTU	8	60	
Conductivity	55	700	Chlorides, sulfates increase conductivity, CO_2 is released to atmosphere.
Alkalinity	15	15	With sulfuric acid for pH adjustment the total alkalinity remains nearly constant.
Hardness as $CaCO_3$ mg/l	14	140	
Calcium as Ca mg/l	4.3	43	
Magnesium as Mg mg/l	1.0	10	
Iron Total Fe mg/l	0.4	4	
Manganese, Mn, mg/l	0.05	0.5	
Chloride, Cl, mg/l	7	80	
Fluoride, F, mg/l	0.15	1.5	
Ammonia Nitrogen NH_3-N mg/l	0.2	2	
Nitrate, NO_3, mg/l	0.8	8	
Phosphate, PO_4 mg/l	0.3	10	Includes polyphosphate treatment
Silica, SiO_2 mg/l	10	100	
Sulfate, SO_4, mg/l	4	150	Includes sulfuric acid added
Sodium Na mg/l	9	100	
Potassium	1	10	
Dissolved Solids mg/l	55	600	Includes added treatments
Suspended Solids	10	100	
BOD_5 mg/l	5	30	Cooling tower processes will lower total of BOD_5.
Total Organic Carbon mg/l	6	35	Lowered by cooling tower.

Amendment 1
(New)

ER Table 5.3-3

Economic Comparison of Flow Rates in Supplemental Cooling Towers

Particulars	Condenser Delta T 16 F	Condenser Delta T 24 F	Condenser Delta T 28 F
A. Technical Data[1]			
1. Rejected Heat (Btu / hour)	15.8×10^9	15.8×10^9	15.8×10^9
2. Tower Range (F)	8	12	14
3. Approach (F)	16	20	22
4. Wet Bulb Temperature (F)	77	77	77
5. Condenser Temperature Difference TD (F)	6	6	6
6. Turbine Maximum Back Pressure (in. of Hg.)	2.41	3.04	3.40
7. Condenser Cooling Water Flow (GPM)	1.97×10^6	1.32×10^6	1.13×10^6
B. Economics	$	$	$
1. Condenser First Cost	2,573,000	2,446,000	2,428,000
2. Condenser Erection Cost	515,000	489,000	486,000
3. Tubes First Cost	2,976,000	2,457,000	2,270,000
4. Tubes Installation Cost	157,000	105,000	90,000
5. Pump Capacity Cost[3]	9,595,000	6,468,000	5,504,000
6. Pump Operating Cost Inc. Maintenance[5]	7,419,000	5,013,000	4,256,000
7. Fan Capacity Cost[2]	1,839,000	1,285,000	1,122,000
8. Fan Operating Cost Incl. Maintenance[4]	953,000	676,000	581,000
9. Tower First Cost[8]	8,330,000	6,400,000	5,834,000
10. Capacity Penalty Due to Higher Back Pressure[6]	9,032,000	20,406,000	27,533,000
11. Fuel Penalty Due to Higher Back Pressure[7]	432,000	994,000	1,356,000
Total	43,821,000	46,739,000	51,460,000

Amendment 1
(New)
Amendment 2
(Entire page revised)

1. Per plant
2. Capacity at $269 per kw
3. Pump BHP for 75 feet head, and 78 percent overall efficiency, capacity at $269 per kw.
4. Fuel and powerhouse operation and maintenance costs at $104 per kw, 67 percent fan use. Includes cooling tower operation and maintenance at 100 percent of fuel costs.
5. Fuel and powerhouse operation and maintenance costs at $104 per kw. Includes operation and maintenance at 100 percent of fuel cost.
6. Capacity penalty at $269 per kw.
7. Assumes maximum heat rate for 2 months in a year - capitalized cost of fuel
8. Includes tower first cost, tower basin cost, and land preparation cost.

ER Table 5.3-3a

Economic Comparison of Different Cooling Water Systems

Particulars	Lake Cooling	Cooling Towers Summer Helper	Cooling Towers Closed Cycle	Cooling Towers Winter Helper
A. Technical Data[1]				
1. Rejected Heat (Btu / hour)	15.8×10^9	15.8×10^9	15.8×10^9	15.8×10^9
2. Tower Range (F)	-	12	24	15
3. Approach (F)	-	20	12	10
4. Wet Bulb Temperature (F)	-	77	77	44
5. Condenser Temperature Difference TD (F)	6	6	6	6
6. Turbine Maximum Back Pressure (in. of Hg)	2.41	3.04	3.35	3.04
7. Condenser Cooling Water Flow (GPM)	1.97×10^6	1.32×10^6	1.32×10^6	1.32×10^6
8. Condenser Delta T. (F)	16	24	24	24
B. Economics[1]	$	$	$	$
1. Condenser First Cost	2,573,000	2,446,000	2,446,000	2,446,000
2. Condenser Erection Cost	515,000	489,000	489,000	489,000
3. Tubes First Cost	2,976,000	2,457,000	2,457,000	2,457,000
4. Tubes Installation Cost	157,000	105,000	105,000	105,000
5. Pump Capacity Cost	2,943,000[8]	6,468,000[3]	6,468,000[3]	6,468,000[3]
6. Pump Operating Cost Incl. Maintenance[5]	2,275,000	5,013,000	5,013,000	5,013,000
7. Fan Capacity Cost[2]	-	1,285,000	2,965,000	6,419,000
8. Fan Operating Cost Incl. Maintenance[4]	-	676,000	1,539,000	3,325,000
9. Tower First Cost[9]	-	6,400,000	10,900,000	20,600,000
10. Capacity Penalty Due to Higher Back Pressure[6]	9,032,000	20,406,000	25,745,000	20,406,000
11. Fuel Penalty Due to Higher Back Pressure[7]	432,000	994,000	1,257,000	994,000
	20,903,000	46,739,000	59,384,000	68,722,000

1. Per plant
2. Capacity at $269 per kw
3. Pump BHP for 75 feet head, and 78 percent overall efficiency, capacity at $269 per kw.
4. Fuel and powerhouse operation and maintenance costs at $104 per kw, 67 percent fan use. Includes cooling tower operation and maintenance at 100 percent of fuel costs.
5. Fuel and powerhouse operation and maintenance costs at $104 per kw. Includes operation and maintenance at 100 percent of fuel cost.
6. Capacity penalty at $269 per kw.
7. Assumes maximum heat rate for 2 months in a year - capitalized cost of fuel
8. Pump BHP for 23 feet head, and 78 percent overall efficiency, capacity at $269 per kw.
9. Includes tower first cost, tower basin cost, and land preparation cost.

ER Table 5.3-4

Catawba Nuclear Station, Cooling Tower Details

	Closed Cycle		Supplemental Cycle	
	Mechanical Draft	Natural Draft	Mechanical Draft	Natural Draft
No. of Towers	4	2	4	1
Height	65 ft	500 ft	60	280 ft
Diameter Top and Botton	434 ft by 75 ft / 55 ft	300 ft by 490 ft	252 ft by 76 ft / 56 ft	Later by 340 ft
Water Flow	750,000 gpm	750,000 gpm	750,000 gpm	472,000 gpm
% Drift(6)	0.2%	0.03%	0.2%	0.03%
Blowdown Rate (1)	.21%	.25%	None	None
Blowdown Dilution (5)	2.1%	2.1%	None	None
Vertical Velocity	28.5 mph	7.5 mph	28.5 mph	7.5 mph
Temperature of Gas Leaving the Tower (4)	102.4°F	103.3°F	Later	Later
Active Chlorine(2)	1 ppm	1 ppm	None	None
Organics	None added	None added	None added	None added
Anti-corrosive Agents(3)	5-6 ppm	5-6 ppm	None	None

(1) Possible rate to maintain 10 concentrations.

(2) Chlorine is added to the water only one hour per day.

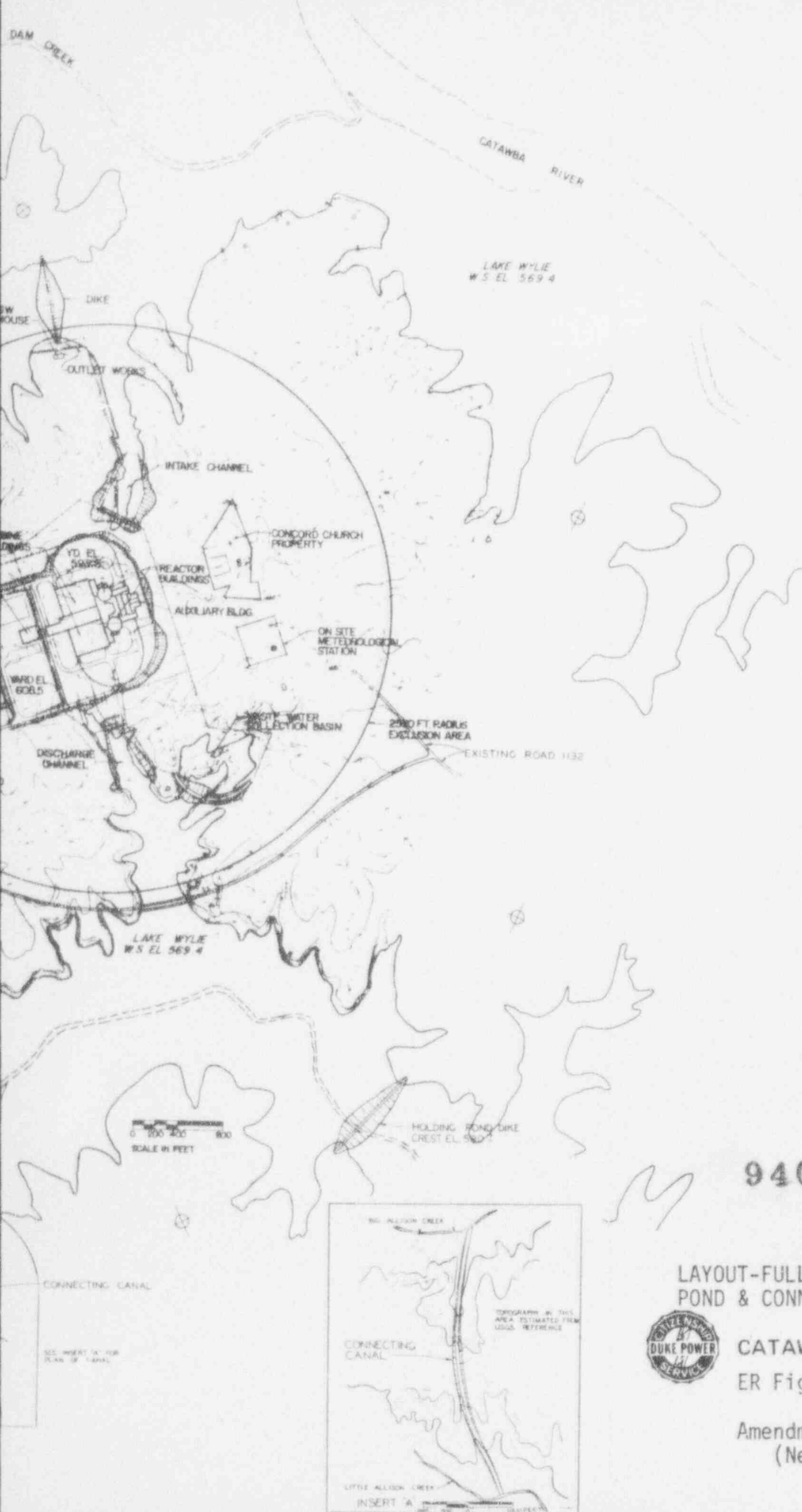
(3) Based on a proposed use of Calgon TG10.

(4) Dependent on tower design

(5) Plant blowdown divided by plant service water of 123,400 gpm.

(6) Marley Corp.


N
BEAVER
STANDBY NUCLEAR
SERVICE WATER POND
TO S.C. HWY NO. 49
EXISTING ROAD 1132
ADMINISTRATION
BUILDING
CONSTRUCTION
ACCESS ROAD
SWITCHING
STATION
YD EL 632.0
ACCESS RAILROAD
RELOCATED
ROAD 1132
PERMANENT
TO NEWPORT &
ROCK HILL
BIG ALLISON CREEK

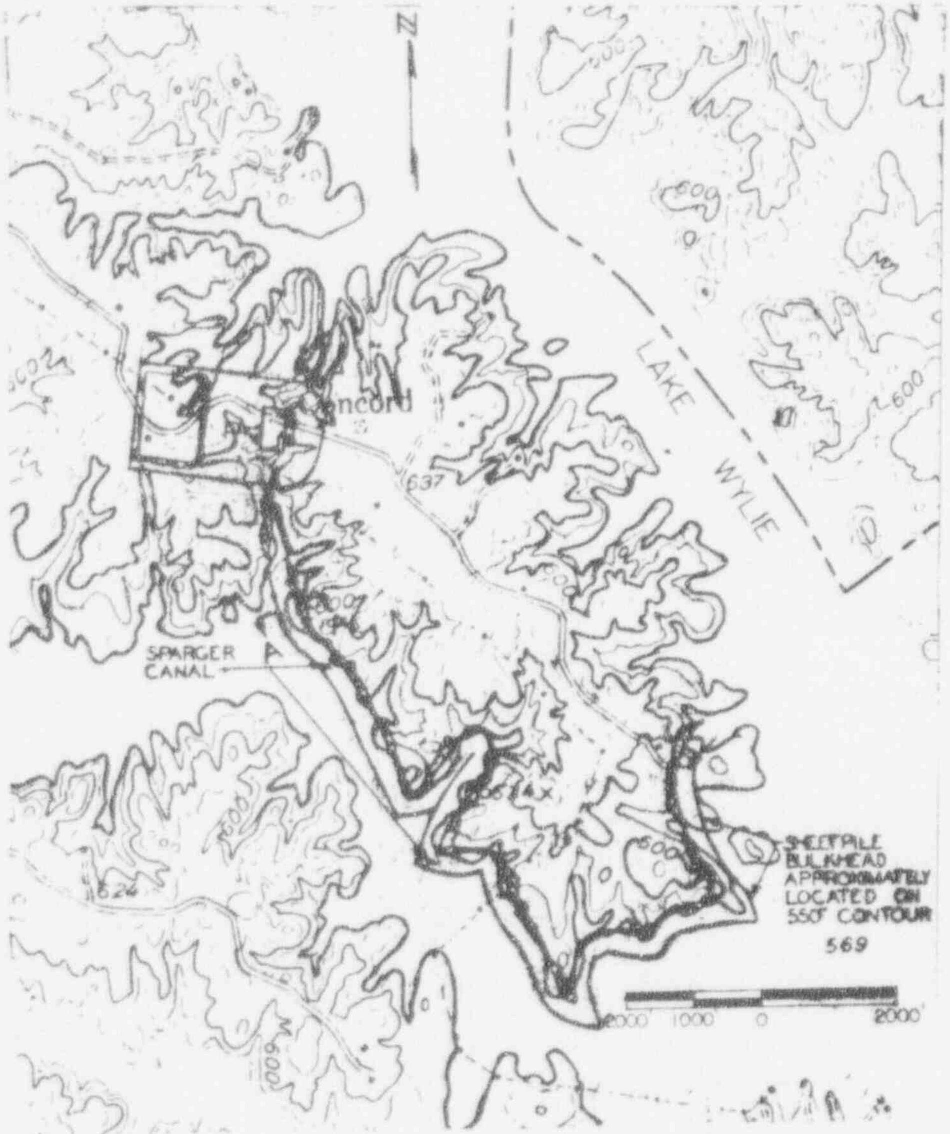


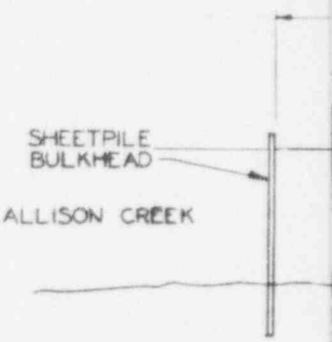
LAYOUT-FULL LAKE COOLING WITH HOLDING POND & CONNECTING CANAL (PRELIMINARY)

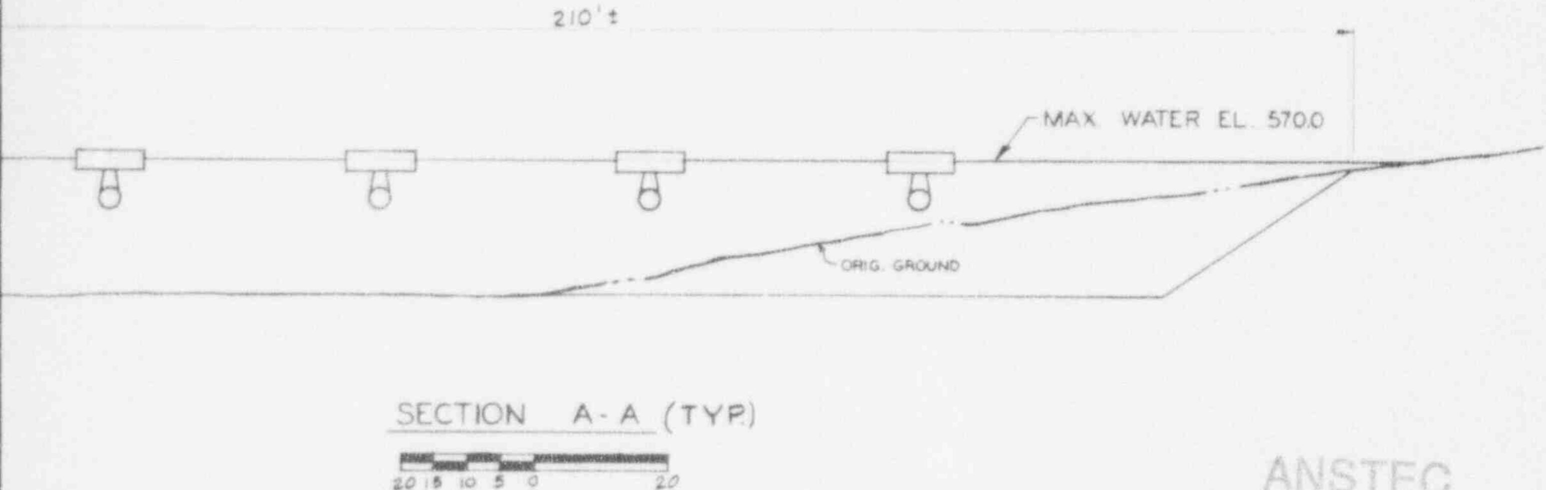
CATAWBA NUCLEAR STATION

ER Figure 5.3-1

Amendment 1
(New)


N
LAKE WYLIE
Concord
637
600
SPARGER CANAL
SHEETPILE BULKHEAD APPROXIMATELY LOCATED ON 550' CONTOUR
2000 1000 0 2000


SHEETPILE BULKHEAD
ALLISON CREEK



9406090213-47

LAYOUT-SPARGER CANAL (PRELIMINARY)

CATAWBA NUCLEAR STATION
ER Figure 5.3-2

Amendment 1
(New)


BEAVER
N
STANDBY NUCLEAR SERVICE WATER POND
TO S.C. HWY NO. 49
ADMINISTRATION BUILDING
CONSTRUCTION ACCESS ROAD
SWITCHING STATION YD EL 632.0
ACCESS RAILROAD
RELOCATED ROAD 1132
S.C. HWY NO. 274
TO NEWPORT & ROCK HILL
BIG ALLISON CREEK

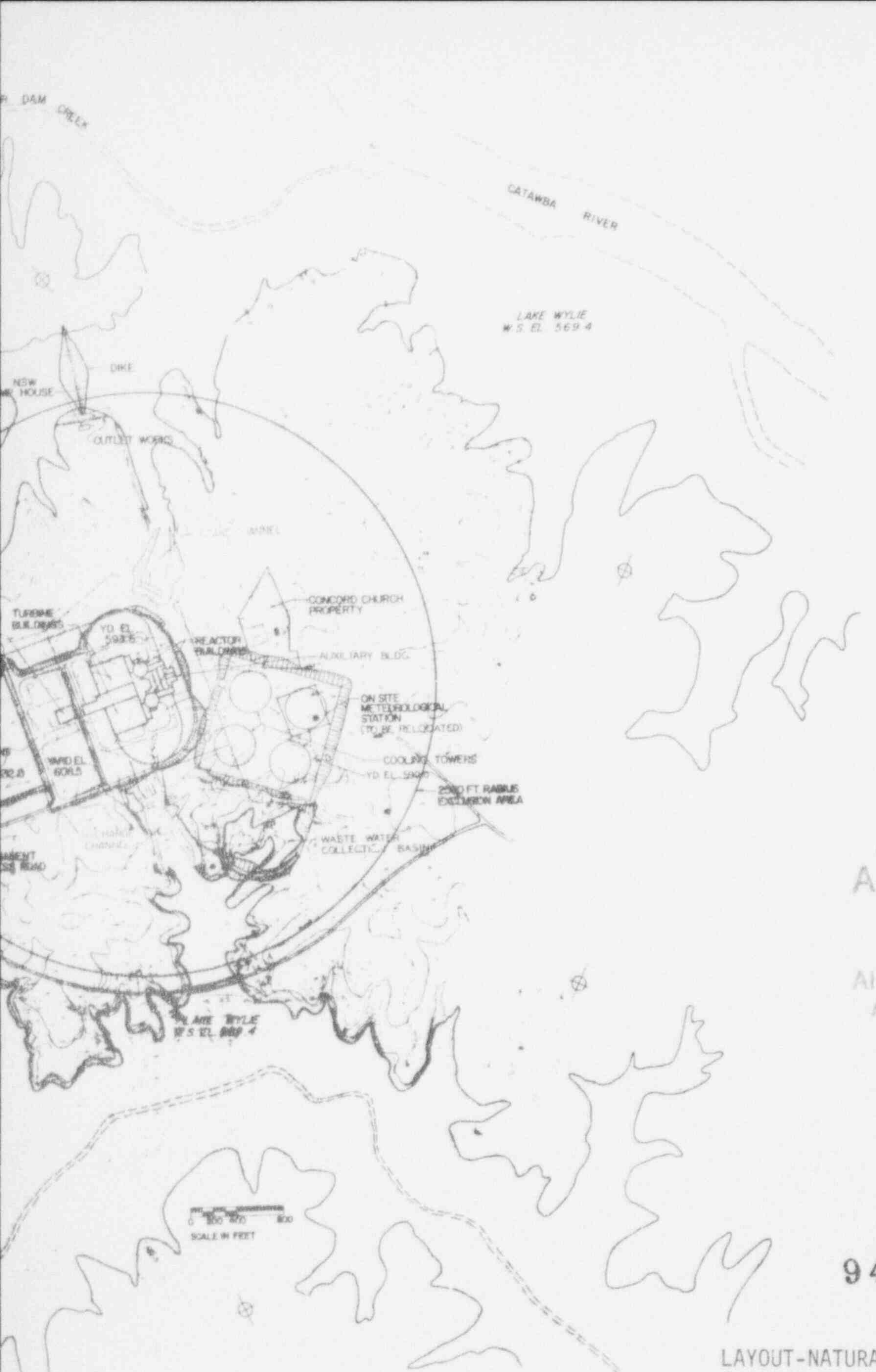
LAYOUT-NATURAL DRAFT SUPPLEMENTARY
COOLING TOWERS (OPEN CYCLE)
(PRELIMINARY)

CATAWBA NUCLEAR STATION

ER Figure 5.3-3

Amendment 1
(New)


N
STANDBY NUCLEAR SERVICE WATER POND
TO S.C. HWY NO 49
ADMINISTRATION BUILDING
CONSTRUCTION ACCESS ROAD
ACCESS RAILROAD
RELOCATED ROAD 1132
S.C. HWY NO. 274
TO NEWPORT & ROCK HILL
BIG ALLISON CREEK



LAYOUT-NATURAL DRAFT COOLING TOWERS
(CLOSED CYCLE) (PRELIMINARY)

CATAWBA NUCLEAR STATION

ER Figure 5.3-4

Amendment 1
(New)


N
STANDBY NUCLEAR SERVICE WATER POND
TO S.C. HWY NO 49
ADMINISTRATION BUILDING
CONSTRUCTION ACCESS ROAD
RELOCATED ROAD 1132
S.C. HWY NO 274
TO NEWPORT & ROCK HILL
BIG ALLISON CREEK

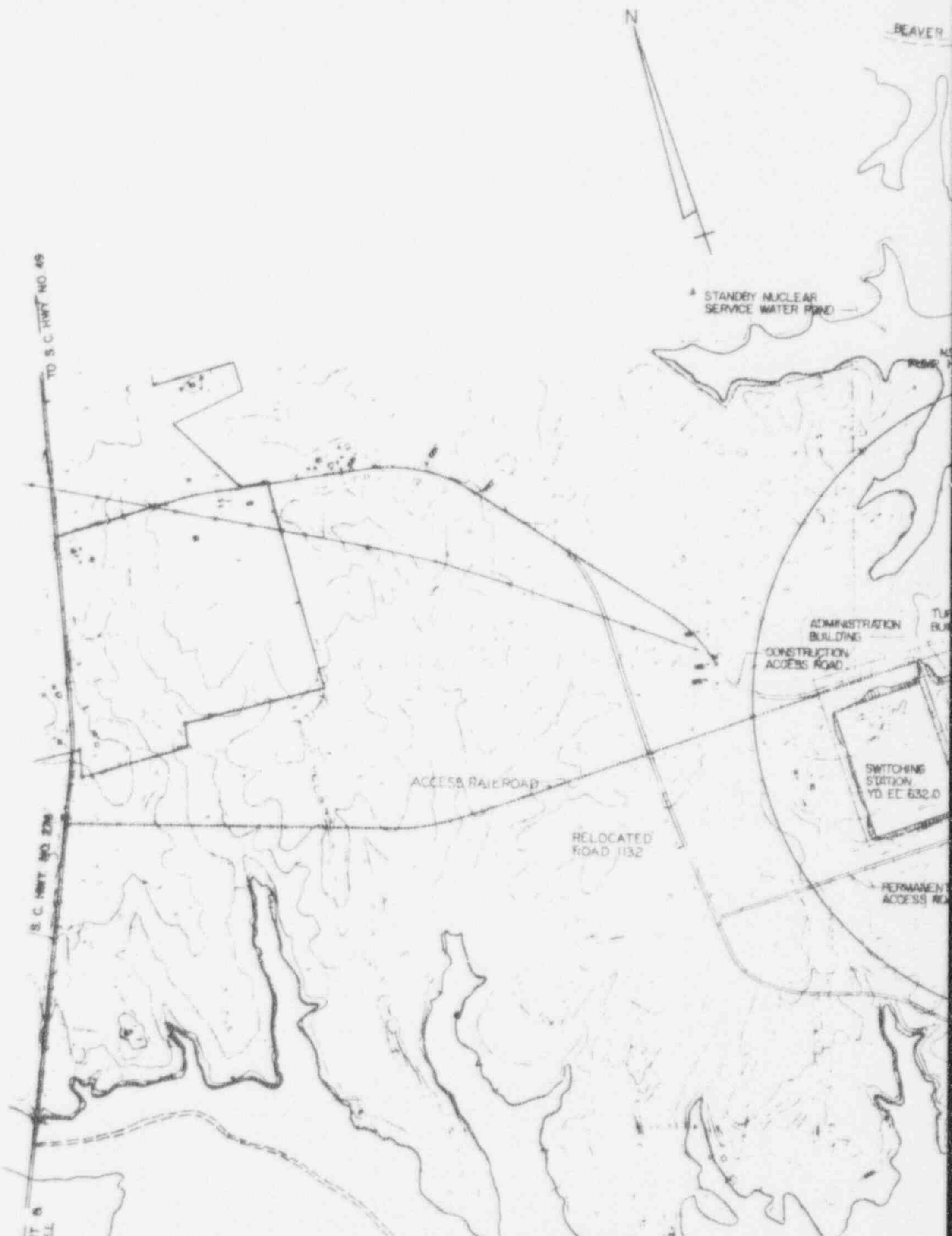
LAYOUT-MECHANICAL DRAFT SUPPLEMENTARY
COOLING TOWERS (OPEN CYCLE) (PRELIMINARY)

CITIZENSHIP DUKE POWER SERVICE

CATAWBA NUCLEAR STATION

ER Figure 5.3-5

Amendment 1
(New)



N
BEAVER
STANDBY NUCLEAR SERVICE WATER POND
TO S.C. HWY NO. 49
ADMINISTRATION BUILDING
CONSTRUCTION ACCESS ROAD
SWITCHING STATION YD. EL 632.0
ACCESS RAILROAD
RELOCATED ROAD 1132
S.C. HWY NO.
TO NEWPORT & ROCK HILL
BIG ALLISON CREEK

9406090213-51

LAYOUT-MECHANICAL DRAFT COOLING TOWERS (CLOSED CYCLE) (PRELIMINARY)

CATAWBA NUCLEAR STATION

ER Figure 5.3-6

Amendment 1
(New)

TABLE OF CONTENTS

6 REGULATION AND COORDINATION WITH GOVERNMENT AGENCIES

6.1 FEDERAL AGENCIES

a. The Atomic Energy Commission, under the Atomic Energy Act as amended, has regulatory jurisdiction over design, construction and operation of the plant, specifically with regard to the nuclear aspects relating to assurances of public health and safety. Application, with supporting documents, is presently being filed for a construction permit for the two units. On an appropriate schedule, application will be filed for the operating license for the two units, a license for each of the reactor operators and senior operators, licenses to own and possess nuclear materials in the form of nuclear fuel and license to use gamma ray sources in nondestructive testing of piping and other materials during construction and maintenance. Frequent surveillance of construction, operation and maintenance will be performed by the Division of Compliance of the Atomic Energy Commission. The environmental impact of Catawba will be assessed by the Atomic Energy Commission in accordance with 10 CFR 50 Appendix D.

b. The Federal Power Commission, under the Federal Power Act as amended, has licensing jurisdiction over the Catawba Dam (also known as Wylie Dam) and Lake Wylie that it impounds. The license for Project 2232 was issued September 17, 1958, and included Catawba Dam plus ten other hydroelectric plants on the Catawba-Wateree River in North and South Carolina. The Catawba development (constructed in 1904 and redeveloped in 1925) is located at river mile 138.5 on Catawba River near Fort Mill, South Carolina. The original license reserved seven sites for thermal electric generating stations, three of which are located on Lake Norman and one on Lake Wylie which is the site of the present development, Catawba Nuclear Station. Any major modifications to the Catawba-Wateree development covered by Project 2232, including Catawba Dam are subject to approval of the Federal Power Commission.

c. Other Federal Agencies

During the planning and development of this facility, Duke has and will continue to cooperate with a number of federal agencies having specific areas of environmental interest. Examples include the Fish and Wildlife Service, the Bureau of Outdoor Recreation, the Geological Survey, the Army Corps of Engineers, the Public Health Service, the Federal Aviation Administration, the Forest Service, the Soil Conservation Service and the Water Quality and Air Pollution Control Offices of the Environmental Protection Agency.

6.2 STATE AGENCIES

a. The South Carolina Public Service Commission requires, prior to beginning construction of a generating plant, that the need for the plant be established and a Certificate to Construct a Major Facility Under Chapter 15, 1971 Session Laws of South Carolina 58-1801 be issued by that agency. Duke will file an application for such a certificate in the immediate future.

b. The South Carolina Pollution Control Authority administers the regulations concerning water and air pollution in the state. For many years, the Company has worked closely with this agency and their staff to assure that Duke's facilities are conceived, planned, designed, built and operated in accordance with their regulations and good pollution control practices. The Lake Wylie waters were included in Duke's continuing water quality sampling program, and the data obtained has been useful in the continuing review of future plants in the generating complex. This program has been coordinated with and the data collected shared with the South Carolina Pollution Control Authority. The South Carolina Pollution Control Authority must provide certification of compliance with applicable water standards as a condition precedent to Duke obtaining an operating license. Prior to announcement of Catawba, plans were reviewed with the South Carolina Pollution Control Authority. Following additional discussions in the ensuing months, applications will be filed for:

   1. A permit for the discharge of warmed cooling water into Lake Wylie.

   2. Certification that there is reasonable assurance that this discharge will not violate the applicable water quality standards. Whereas this section of the Catawba River is not navigable as determined by the FPC licensing of Project 2232, this certification is similar to that required by Section 21b of the Water Quality Improvement Act of 1970.

   At the appropriate time, additional applications will be filed before the Authority for permits covering conventional sewage and waste treatment facilities, first to serve the temporary construction buildings and later to serve the plant. Any effluents from these facilities will fully comply with the water quality standards of the receiving body.

c. North Carolina Board of Water and Air Resources - Although this project is located in South Carolina, coordination is necessary with the Board because water in North Carolina will be used for cooling purposes.

d. The South Carolina State Board of Health has responsibilities in the areas of vector control, sanitation, environmental radioactivity and other public health matters. Duke's vector control program, conducted on its hydroelectric reservoirs and other projects has been closely coordinated with the State Board of Health for more than 40 years. In planning its projects such as Catawba, the Company works cooperatively with the State Board of Health to develop high-quality standards of sanitation that, when adopted by the Boards of Health in the counties involved, assure high sanitary quality and environmental protection with respect to shoreline developments around the periphery of these lakes. The Company and the Division of Radiological Health, State Board of Health will consummate an agreement of cooperation with respect to radiological matters.

e. The South Carolina Wildlife Resources Department and Duke have cooperated for many years in programs directly related to Lake Wylie and other Duke lands and reservoirs. In addition to the many commercial marinas to facilitate public recreation, the Company built six public access areas on Lake Wylie which are maintained jointly by Duke, South Carolina Wildlife Resources Department, and York County.

f. North Carolina Wildlife Resources Commission - Coordination with the Commission will be necessary because a portion of the lake waters are in North Carolina.

g. The South Carolina Department of Parks, Recreation and Tourism coordinates and promotes the development of recreation opportunities in the state. The construction of Catawba Nuclear Station will have no adverse effect on the current use nor on the very large potential for expansion of recreation on Lake Wylie.

h. From time to time there will be coordination with several additional state agencies such as the Highway Commission on road relocations and moving heavy loads, the State Highway Patrol regarding emergency plans, and others.

6.3 LOCAL AGENCIES

a. York County Manager

Plans for Catawba Nuclear Station will be discussed with the County Manager, who, as responsible county executive, will receive copies of application papers that the Company files with the Atomic Energy Commission.

b. York County Commissioners

Plans for the Catawba Nuclear Station and its relationship to the environment will be discussed with the Chairman and the minority leader of the County Commission prior to announcement of the project. From time to time, other matters will be coordinated with the County Commission.

c. York County Health Department

Plans for Catawba Nuclear Station and its relationship to the environment will be discussed with the County Health Officer prior to public announcement. Duke will coordinate its activities with the Health Department in all appropriate matters.

d. York County Police, Sheriff's Department, Civil Defense Agency

Emergency plans and appropriate security measures will be developed in coordination with the appropriate agencies.

e. Other agencies

Understandably with a project of this magnitude, there will be from time to time coordination with departments and officials of the county and nearby cities and towns.

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7 BENFFIT-COST ANALYSIS

7.1 INTRODUCTION

This benefit-cost analysis is in three parts. The first analysis compares the economics of developing Catawba site as a nuclear-fueled generating station with an alternative fossil-fueled plant of similar capacity.

In the second part of the analysis the two alternatives of dissipation of surplus heat discharged by the plant i.e. lake cooling and use of cooling towers have been compared. The third is an economic comparison of the Catawba Nuclear Station with similar size generation facilities at alternative sites. Detailed studies of foundation conditions, geology, seismology, hydrology, groundwater flora and fauna and environmental effects have been done for a nuclear plant on Lake Wylie. Studies in respect of other alternatives are based on data collected in the course of preliminary surveys or where such surveys are not available, on reasonable assumptions.

In addition to the most important considerations of geographical location, type of fuel and source of condenser cooling water, the environmental and social impacts of the different alternatives have also been considered.

The economic and environmental benefits of building this additional generating capacity as a nuclear plant at the present site are evident by the analyses.

7.2 CATAWBA STATION VS ALTERNATIVES

The following alternatives have been considered:

Alternative 1	Nuclear Station at Lake Wylie - Full lake cooling with submerged weir, skimmer wall. (Approximate costs for weir and skimmer wall respectively are $300,000 and $1,200,000.)
Alternative 1(a)	Fossil-Fuel Station at Lake Wylie - Full lake cooling with submerged weir, skimmer wall.
Alternative 1(b)	Nuclear Station at Lake Wylie - Partial lake cooling with mechanical draft cooling towers to provide supplemental cooling, designed for June, July, August weather conditions and a permissible 5 degrees excess temperature at Wylie hydro tailrace (skimmer and submerged weir were excluded).
Alternative 1(c)	Fossil-Fuel Station at Lake Wylie - Partial lake cooling with mechanical draft cooling towers designed as for 1(b).
1 Alternative 1(d)	Nuclear Station at Lake Wylie - Closed cycle mechanical draft cooling towers.
Alternative 2	Nuclear Station at Site 'D' Lake Norman with full lake cooling.
Alternative 3	Nuclear Station in central South Carolina with full lake cooling.
Alternative 4	Nuclear Station on Wateree Lake with full lake cooling.

Site 'E', a second site on Lake Norman, has not been considered as an alternative because the environmental impacts of Site 'E' are almost identical to Site 'D'.

The alternative of not building a generating plant has not been considered for the following reasons:

a. Such large bulk of power (16.1 billion kwh annually) cannot be purchased from neighboring utilities, since their reserves are limited and they are faced with a similar challenge to keep pace with growing demands of electricity.

b. Duke is a public utility and is morally and legally obliged to meet the demand of electricity in its service area. Even temporary interruptions in power supply will have serious repercussions.

7.2.1 ENVIRONMENTAL SITE DATA FOR ALTERNATIVE SITES

a. Nuclear Station at Site D Lake Norman with full lake cooling (approximately three miles northeast of McGuire Nuclear Station Site).

1) Environmental consideration would be similar to the McGuire Nuclear Station Site. Wildlife and vegetation are typical of the Piedmont Carolinas - the land is characterized by abandoned farmland - old field succession is particularly noticeable and subclimax stands of short-leaf and scrub pines are conspicuous. The aquatic ecology would be very similar to that described for the McGuire Station environs (William B. McGuire Nuclear Station Environmental Report, Docket Nos 50-369 and 50-370).

2) Fifty miles of 500 kv transmission corridors would have to be cleared.

3) Approximately 341 acres of possible wildlife habitat would be removed due to construction of the station. The exclusion area (450 acres) presently consists of 220 acres of wooded land, 118 acres of water and 112 acres which consist of untilled farmland.

4) Reduced recreational potential and access to the lake would occur.

5) No cool hypolimnetic water will be available for condenser cooling due to the operation of McGuire and Marshall Stations which are also located on Lake Norman.

6) Possibility of interaction with McGuire Station cooling water discharge.

b. Nuclear Station, cooling lake site, Central South Carolina.

1) Approximately 10,000 acres of land would be cleared and inundated for the creation of a cooling lake.

2) The transformation of a land resource (agricultural lands, forest products and land for homes and industry) into a water resource, will create a water supply, fishery resource and recreational development.

3) The permanent loss of wildlife habitat would result in a corresponding loss in certain wildlife inhabitants, while other wildlife such as waterfowl would be greatly enhanced. There are no known rare or endangered species inhabiting this area of the Piedmont Carolinas.

4) The aquatic flora and fauna of this newly created reservoir should be identical to the organisms found in other impoundments of the Piedmont region.

c. Nuclear Station on Wateree Lake, South Carolina with full lake cooling.

1) Terrestrial and aquatic flora and fauna will be very similar to other possible sites within the Piedmont Carolinas.

2) 153 miles of 500 kv transmission corridors would be cleared.

3) The lake has no industrial uses at present.

4) Approximately 346 acres of land would be cleared for the construction and subsequent operation of a nuclear plant at the Wateree site. The proposed exclusion area (450 acres) presently consists of 84 acres of cleared land, 307 acres of mixed hardwoods and pine and 59 acres of water.

7.3 CATAWBA PLANT, NUCLEAR VS COAL ALTERNATIVE

7.3.1 INTRODUCTION

As discussed in Subsection 5.1.4, coal is the only viable alternative to nuclear fuel in the Duke service area. Table 7.3-1 shows a generation cost comparison between nuclear fuel and coal at Catawba site. This comparison updates the relative economics of these two alternatives to 1979 cost levels, when the first Catawba unit is expected to be commercially operated. In spite of higher initial costs, generation by nuclear fuel is more economical. The financial benefit, considering investment and operating costs, for the Catawba capacity of 2360 mw is over $65 million in favor of nuclear generation.

Other advantages of a nuclear plant are discussed in Subsections 7.3.2 through 7.3.8.

7.3.2 TRANSPORTATION OF FUEL

Periodically, newly fabricated fuel assemblies will be shipped to Catawba from a manufacturing plant, and spent fuel assemblies shipped from Catawba to a nuclear fuel reprocessing facility. Eleven shipments of new fuel will be received in a normal year. The newly fabricated fuel assemblies have not been irradiated, and their shipment poses no unusual hazards. If a major vehicle accident should occur, the scene of the accident would be cleaned of any significant amounts of uranium present. If plutonium recycle should be employed at Catawba, special shipping precautions would be taken due to the toxicity of plutonium. The spent fuel will be shipped in heavily armored, sealed casks to a nuclear fuel reprocessing plant. Such a plant is under construction in South Carolina a few hours by truck or rail from Catawba. Transportation of spent fuel will require the shipment of an average of 144 assemblies annually. Spent fuel casks must demonstrate ability to limit any radioactive releases to the amounts specified by Federal Regulation even under hypothetical accident conditions.

The alternative coal-fired steam-electric generating station would have required an average of 5.5 million tons of coal per year. This coal would be shipped in train load lots from West Virginia and surrounding areas over a distance of several hundred miles. Two trains of 90 cars each would be required every day.

No credit, however, is taken for the difference in environmental impact between eleven shipments of new fuel plus the very special and protected shipments of 144 radioactive spent fuel assemblies per year and over 700 trains per year of coal.

7.3.3 IRRETRIEVABLE CONSUMPTION OF NON-REPLENISHABLE RESOURCES

It is estimated that the two nuclear units at Catawba will utilize 750,000 pounds of natural uranium per year, whereas, 11,000,000,000 pounds (5.5 million tons) of coal would have been burned by the alternative fossil-fueled plant of equal generation capacity. Moreover, plutonium which can be used as a nuclear fuel, will be a by-product of generation by nuclear fuel at Catawba. No attempt, however, is made here to evaluate the relative impact of these alternatives with respect to irretrievable consumption of resources.

7.3.4 RADIOACTIVITY - GASES, LIQUIDS AND SOLIDS

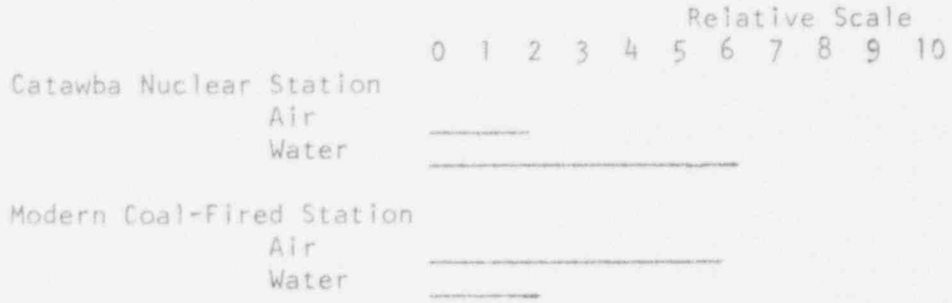
Studies by the U. S. Public Health Service, Bureau of Radiological Health have shown that a pressurized water nuclear power plant results in less radiation exposure of the public due to radioactivity in gaseous effluents than does a modern coal-fired plant, which was the alternative to Catawba.(1) This surprising fact was explained in the summary report of the hearings on the Environmental Effects of Producing Electric Power by the Joint Committee on Atomic Energy of the Congress of the United States as follows:

"An interesting corollary to the air pollution problem from fossil fuel power plants concerns the radiochemical analyses of flyash samples which were obtained from the combustion of pulverized coal and fuel oil. From these analyses, estimates were made of the quantities of radium-226 and radium-228 which would be discharged from a 1,000 megawatt coal-burning power plant. Comparisons of these data on the release of fission products such as iodine and Kr 85 from nuclear power generating stations shows that when the physical and biological properties of these radionuclides are taken into consideration, the conventional fossil-fueled plants discharge relatively greater quantities of radioactive material into the atmosphere than nuclear power plants of comparable size. While no one would suggest that the amount of radium being discharged into the atmosphere of our large cities is a health hazard, the above example does emphasize the 'clean air' which is being discharged from our nuclear power plant facilities."

A coal-fired plant releases some radium, thorium and their daughter products in the drainage from the ash storage basin to the waterway. The alpha radioactivity in this drainage water may be a significant fraction of the U. S. Public Health Service drinking water limits for the contained radioactivity.(2) On the other hand, the Catawba Nuclear Station will process all of its radioactive liquid waste to reduce the amounts of radioactivity so that all water as it is released to the environment will be well within AEC limits and the U. S. Public Health Service drinking water limits for the contained radioactivity. The radioactivity released in either case will be diluted even further in the receiving water.

(1) Martin, J. E., etal, "Radioactivity from Fossil Fuel and Nuclear Power Plants," IAEA Symposium, 1970.
(2) Roheman, F. A., "Analyzing the Effect of Flyash on Water Pollution," Environmental Protection Agency.

The comparison of total radioactivity released can be graphically illustrated as follows:



In other words, in regard to radioactivity released into air and water, the Catawba Nuclear Station would be essentially equal to a modern coal-fired station. In either case, the radioactivity released is well within permissible limits.

7.3.5 AIR POLLUTION

In evaluating the air pollution characteristics of a large coal-fired station as an alternate to Catawba Nuclear Station, it must be recognized that neither alternate presents an air pollution problem. Air pollution control equipment for a coal-fired equivalent to Catawba Nuclear Station is a paramount factor. We have assumed that a coal-fired alternate plant would be equipped with all necessary pollution control equipment to eliminate air pollution problems. Low-level radioactive releases to the environment, although only a fraction of recognized limits, are about the same for each type station. Either station will meet all applicable pollution control limits; however, a nuclear station is the preferred choice since it completely avoids emission of combustion products.

7.3.6 ACCIDENTS

It is obvious that the potential risk to the health and safety of the general public from an accident which releases radioactivity is greater for a nuclear plant than for a conventional fossil-fueled plant. The spectrum of possible accidents that release radioactivity ranges from insignificant to serious. In every case, the design features and administrative procedures of the Catawba Nuclear Station work to reduce both the environmental consequences of events and their frequency of occurrence. All credible postulated events which could release radioactivity to the environment have been considered in the design of Catawba. There is no credible accident that, when evaluated realistically, would significantly affect the health and safety of the public.

7.3.7 THERMAL EFFECTS

Thermal effects of large electric generating stations, using cooling lakes as a source and receptor of condenser cooling water, are well established in this area. It is desirable that thermal station designs conform with field proven guidelines. Catawba Nuclear Station, due to a lower thermal efficiency, will require more condensing water than an equivalent fossil fired station. Consequently, larger water supplies and greater heat dissipating areas must be provided to assure compliance with established criteria. With responsible recognition of this basic difference between fossil and nuclear fueled stations, the thermal effects are analogous.

7.3.8 LAND USE

The land requirements of a fossil-station must also provide for ash and coal storage areas. These add substantially to the land requirement for actual operation of a coal-fired station of 2360 MWe generation capacity. Approximately an additional 200 acres would be required for ash and coal storage.

7.3.9 SUMMARY

The ultimate environmental cost of the coal-fired alternate compared to Catawba Nuclear Station may be the importance attached to ultimate refuse produced by the two different types of input energy. A coal-fired equivalent would produce 1.25×10^6 cubic yards of ash (enough coal ash to cover one and one-fifth square miles one foot deep) each year while Catawba, on the same operating schedule, would produce about seven cubic yards of highly radioactive solidified waste -- both require long range care. Moreover, fossil plants are responsible for large quantities of SO_2 and NO_x emissions. Satisfactory equipment for removal of these objectionable gaseous products on commercial scale and at a reasonable expense is yet to be developed.

Based on the foregoing comparison with the alternative of fossil-fuel generation, Duke considers a nuclear station at the Catawba site to have decided environmental advantages.

7.4 ALTERNATE HEAT DISSIPATION METHODS

The condenser cooling water system planned for Catawba is described in Subsection 4.1.4. Alternative areas were investigated for locating various constituants of the cooling water system. Several coves were examined before the locations of the intake and discharge structures were finalized. The location of the structures as shown on Figure 2.2-3 requires shorter canals, and less earthwork than other alternatives. The selected sites, in addition to being most economical, cause minimum disturbance to the surrounding land and wildlife when compared to alternatives.

The final locale for the underwater weir was chosen after careful examination of several sections of the lake. The location of the weir as shown on Figure 4.1-2 intercepts cool water inflow from all the tributaries with significant drainage areas upstream of Wylie Dam and enables use of maximum quantities of available hypolimnetic water for the condenser cooling system during summer and early fall. Since the weir is placed at a narrow section of the lake, involving a minimum quantity of dumping into the lake, the impact on Lake Wylie waters is minimal.

For the condenser cooling water system two alternative delta T's of 12 F and 16 F were considered. From a biological point of view, the difference between a 16 F delta T and a 12 F delta T is insignificant. There is no clear advantage to a lower discharge temperature (12 F delta T) when considering the well being of various fish species within the discharge area. Any advantage is, however, minimized considering that the increased intake flows required to maintain a smaller delta T would result in recirculation, an increase in intake velocities, a larger mixing zone, and a lower dissipation rate. A minimum delta T of 16 F was found to result in an economical design and insignificant adverse effects on aquatic biota.

For dissipation of surplus heat from the plant to the atmosphere, the following alternate systems were considered:

a) Lake Wylie cooling as adopted by Duke.

b) Lake Wylie cooling with a holding pond on Big Allison Creek and a connecting canal between Big Allison Creek and Little Allison Creek.

1 c) A system of spargers located in a channel running along the shore line of Lake Wylie.

d) Mechanical cooling towers.

e) Natural draft cooling towers.

The alternate b made available additional areas in Big Allison Creek and Little Allison Creek for heat dissipations, but the following drawbacks rendered this alternative unacceptable:

i) The construction of a dike across Big Allison Creek would seriously hamper boat access to a large number of vacation and permanent homes along the creek.

ii) Big Allison Creek upstream of the dike would be warmed by heated condenser discharge from one bank to the other, affecting fishing, swimming and other recreational activities in the creek portion of the lake adversely. Similarly, Little Allison Creek being a narrow stream of water, would be affected adversely.

Alternate c involved use of a large number of floating spray modules in the
discharge canal, Big Allison Creek arm of the lake, and Catawba River on the
1 shore of the peninsula. About 470 spargers in a channel approximately 19000
feet long are needed to reduce the water temperature to 90 F during summer
months. For winter months a larger number of spargers, about 640 in a
26000 foot long channel, are required to meet the water quality standard.
Assuming a 42 F intake temperature, water at about 50 F would be discharged
into the lake at the end of the sparger canal.

This concept is still in its developmental stage and has not been tested insofar as can be determined on a steam generating plant of this size; therefore, its reliability is still unproven. Additionally, the sparger units are likely to surround the general area with a fine water spray causing objectionable fogging and icing conditions, especially during cold weather. This will affect recreational activities on the lake adversely.

Alternate d is compared with lake cooling in Subsection 7.4.1.

Alternate e, natural draft cooling towers, are compared to Mechanical draft cooling towers in Subsection 7.4.2.

Operating Conditions for Each Alternate System

a) Lake Wylie Cooling

During the warmer months all four condenser circulating water pumps would
be operated to maintain a 16 F temperature rise across the condenser. In
1 the spring and fall, only three CCW pumps would be needed to maintain 1.5
in. Hga. back pressure in the condenser and the temperature rise would
be about 19 F. Then in the winter only two pumps would be needed to maintain 1.5 in. Hga. back pressure with a corresponding temperature rise
across the condenser of approximately 26 F.

During the warmer months when surface water temperatures reach certain conditions, portions of the skimmer wall will be opened to allow some of the cool bottom water to mix with the warmer surface waters and thereby controlling the inlet water temperature to the station.

b) Lake Wylie Cooling with a Holding Pond on Big Allison Creek.

Same operating conditions as a) above.

c) A System of Spargers

The Condenser Circulating Water Pumps would supply water to the condenser and then the water would flow back down to the lake where series of spargers would spray the warmed water up out of the lake.

d) Mechanical Cooling Towers, Closed Cycle

Make-up water pumps would supply lake water to the cooling towers to replace the water losses due to evaporation, drift and blowdown. The tower design is set by the summer months. During the warmer months, all the condenser circulating water pumps would be operated, drawing water from the tower basins and pumping it through the condenser and back to the tower water boxes. Also, all the tower fans would be operating. As the weather cools, tower fans can be stopped as long as the back pressure can be maintained at its set point. Water losses due to drift and evaporation would decrease as fans are shut down. The amount of blowdown is proportional to the water losses from drift and evaporation and to the quality of the make-up water.

e) Natural Draft Tower

i) Wet, Supplemental Cycle

The tower design is set by the spring months. The condenser circulating water pumps would draw water from the Intake Canal and pump the water through the condenser, then tower pumps would discharge the water to the top of the towers where the water would flow by gravity through the tower and back to the lake. No blowdown is required with this system. No chemical treatment of the water is planned and the condenser would be cleaned the same as with lake cooling as described in Subsection 4.1.4. The drift is proportional to the air flow. The evaporation is proportional to the air flow, the wet bulb temperature and the turbine load. 1

ii) Wet, Closed Cycle

The tower design is set by the summer months. The condenser circulating water pumps would draw water from the tower basin and pump it through the condenser and back to the tower water boxes. Make-up water pumps would supply lake water to the cooling tower. Water losses due to drift and evaporation would vary slightly with season. The amount of the blowdown is proportional to the water losses from drift and evaporation and to the quality of the make-up water and service water.

Operating Conditions Closed Cycle-Cooling Tower Blowdown and Service Water

Treatment of cooling tower blowdown for re-cycling is not anticipated. Treatment of cooling tower blowdown prior to discharge to the lake will be provided as required by regulatory agencies.

An intake structure similar to but smaller than that shown on ER Figure 4.1-4 would be placed in approximately the same location as shown for the condenser cooling water intake structure on ER Figure 2.2-3 if cooling towers were used. The concrete structure would support the three service water pumps, three cooling tower makeup water pumps and all motors, valves, screens and filters.

Steam generator blowdown, cooling tower blowdown and service water will be discharged to the lake through a discharge structure similar to but
1 smaller than that shown on ER Figure 4.1-5. The warmed water will be floated to the lake's surface with a minimum amount of mixing. The combined discharge water temperature will be designed not to exceed 103 F.

7.4.1 ALTERNATE OF COOLING TOWER TO LAKE WYLIE COOLING

Lake Wylie has the capability to provide ample cooling water for the existing 1155 MW Allen fossil-fueled steam plant and the 2360 MWe Catawba Nuclear Plant. Heat that is added to a lake or river will eventually be transferred to the atmosphere by a combination of three processes: radiation, conduction and evaporation. For given meteorological conditions, it is possible to estimate the relative quantities of heat transferred by each method and thus to determine the increased evaporation a given heat load will cause. A chart prepared by Derek Brady of Johns Hopkins University[1] has been used which estimates that 56 percent of the added heat will be lost by evaporation. A similar chart published by Harbeck[2] gives nearly the same result.

The full load cooling water requirement of the Catawba plant is 4500 cfs at 16 F condenser rise. By using the latent heat of vaporization, the percentage of heat lost by evaporation and an assumed station load factor of 80 percent, the induced evaporation may be calculated:

4500 cfs x 16 F x .80 x .56 (Btu/lb)/1050 (Btu/lb) = 31 cfs

Current cooling towers evaporate about 1.6 percent of the cooling water flow for 16 F condenser rise in the summer. Drift losses are estimated at 0.2 percent, so the total loss for the ultimate generating capcity at Lake Wylie is 1.8 percent of 4500 cfs multiplied by the load factor of 80 percent or about 65 cfs.

1 The alternative of closed cycle cooling towers for Catawba plant, therefore, involves an additional consumptive loss of 34 cfs, or 21.9 mgd.

The value of water in Lake Wylie has been determined in Subsection 7.6.1 as $1530 per cfs annually. Thus, the benefit associated with lake cooling due to savings in water supply is approximately $52,000 annually. At an interest rate of six percent, representing the approximate current cost of municipal bond issues, the capitalized equivalent of this saving is $8,700,000.

Heavy evaporative loss of water combined with the unavoidable "Drift Loss" from conventional cooling towers (mechanical) creates thick fog on cold and humid days, which results in hazardous driving conditions on highways in the area and icing on transmission lines. Although technology for control of fogs is available, the economic costs to the industry render its application impracticable.[3]

[1]Derek K. Brady, "Principles of Heat Dissipation and Thermal Plumes in Three Dimensions," presented at the Westinghouse S hool for Environmental Management, Colorado State University, Ft. Collins, Colorado, July 19, 1971.

[2]Earl Harbeck, Jr., "Estimating Forced Evaporation from Cooling Ponds," Journal of Power Division, American Society of Civil Engineers, v.90, no. PO3, Proc. Paper 4061, pp 1-9.

[3]Veldhuizen, H. and Ledbetter, J: "Cooling Tower Fog; Control and Abatement"; Journal of the Air Pollution Control Association, January 1971, Volume 21, No. 1.

7.4.2 COMPARISON OF MECHANICAL DRAFT AND NATURAL DRAFT COOLING TOWERS

In comparing lake cooling to the alternative evaporative cooling towers at this site, conventional Mechanical Draft cooling towers have been considered. The economic and environmental impact of using Natural Draft cooling towers has also been studied and compared with Mechanical Draft cooling towers in Table 7.4-1. Factors common to both alternatives have been excluded in this comparison.

It is evident that Mechanical Draft cooling towers would be a better choice for this site, should it become necessary to employ a cooling method other than lake cooling.

The Mechanical Draft wet cooling tower design is optimized for a range of 20°F to 28°F and an approach of 10°F to 14°F.

7.4.3 DRY COOLING TOWERS

Dry cooling towers are not considered as an alternate for the Catawba Nuclear Station for the following reasons:

a) The turbine exhaust pressure is predicted as 6 to 8 inches Hg. absolute during the summer months. The turbine manufacturers presently do not market a 1200 MW nuclear unit for these exhaust pressures. To operate at these pressures would require multiple units with all the associated equipment for multiple turbine-generators.

b) The investment cost for a mechanical draft dry tower is approximately 3 times greater than a mechanical draft wet tower.(1)

c) With dry cooling towers, generation costs would be approximately 16% higher than with wet cooling towers. This would result from a much higher capital cost for the dry cooling equipment, plus the high capacity and energy penalties.(2)

(1) R. M. Jimeson and G. G. Adkins, "Waste Heat Disposal in Power Plants," presented at a symposium on Cooling Towers, American Institute of Chemical Engineers at Houston, Texas.

(2) K. A. Oleson, G. I. Silvestri, V. S. Ivins, S. W. W. Mitchell "Dry Cooling Affects More Than Costs," Electrical World, July 1, 1972.

7.5 CATAWBA AT LAKE WYLIE SITE VS OTHER SITES

In selecting the Catawba site for locating Duke's third nuclear plant, an economic comparison with other possible sites was made. The three most feasible sites out of many potential generating sites under study were investigated in considerable depth.

One site on existing Lake Norman in North Carolina is located on a large peninsula owned completely by Duke. The plant site arrangement makes it possible to intake cool water on the downstream side of the peninsula and discharge it on the upstream side. The site's location in relation with the Duke transmission system would require the construction of a 500 kv switching station and 50 miles of additional 500 kv lines.

The second site would be a new development in central South Carolina. The
plant will depend on a new reservoir for its condenser cooling and service
water supply. This reservoir with an approximate surface area of 9500 acres
1 will be created by impounding a creek. The plant will draw its water supply
from one arm of the reservoir and discharge the warmed water into another
arm. Adequate length of recirculation path will be provided to insure dis-
sipation of surplus heat. For this alternate site, construction of a 500
kv switching station with related transmission facilities will also be re-
quired.

The third site would be on existing Wateree Lake in South Carolina. The plant would be arranged to draw cool water from a cove on the upstream side of the plant and discharge on the downstream side. This site requires the construction of a 500 kv switching station and about 153 miles of 500 kv transmission lines.

The present site of Catawba Nuclear Station was found to be most economical primarily because of the presence of cooling-water supply facilities and Duke's prior ownership of land within the exclusion area.

Table 7.5-1 shows a comparison of the cost of Catawba with the other three alternatives.

7.6 BENEFITS AND COSTS

The 'benefits' and 'costs' of building the two nuclear generating units of Catawba Nuclear Station on Lake Wylie site have been discussed and compared with other alternatives as far as practical in terms of dollars. Where it is not possible to assign dollar values to the benefits and costs, these have been expressed in other units, like kwh, pounds, etc.

7.6.1 WATER SUPPLY

Catawba Nuclear Station will draw its requirement of condenser cooling water from Lake Wylie. After being warmed, the water will be discharged back into the lake, where it will lose the surplus heat by radiation, convection and evaporation. Depending upon the method of dissipation, water will be lost in this process. Estimated evaporative loss for each alternative is given in Table 7.6-1. Alternative 1(a) accounts for the minimum loss, whereas Alternative 1(d) will have the maximum evaporative loss, with other alternatives
1 having intermediate values.

The evaporative loss has been quantified in Tables 7.6-6a and 7.6-6b and the value assigned in these tables is the greater of the following two values:

a. <u>Cost of Hydroelectric Generation Lost</u>

The relative position of the hydro power generation on Catawba system in Duke's yearly load curve is above the base load steam station and under the combustion and gas turbines. (Figure 7.6-1) The water lost by evaporation will, therefore, not affect the peaking capacity of the hydro units, except for slightly reducing the capacity factor. As such, loss of capacity has not been treated as a 'cost' to the project. Assuming an overall efficiency of 80 percent and total head of 257 feet on all hydro units, Wylie hydro station through Wateree hydro station, loss of generation is as follows:

$$\frac{1 \text{ cfs} \times 257 \text{ ft. head} \times 8760 \text{ (hours)} \times 0.80 \text{ (efficiency)}}{11.8} = 153{,}000 \text{ kwh annually}$$

Cost of replacement of this energy at the average cost of generation during 1971, 5.21 mills/kwh, is $800 per cfs.

b. <u>Value of Water To A City, Town or Industrial Undertaking</u>

For the proposed Clinchfield Development on the Broad River in the Piedmont Carolina region, the value of storage for Municipal withdrawals has been established at 0.65¢/1000 gal. On this basis, the present day value of 1 cfs = 235 million gallons annually is $1530/annually.

7.6.2 FISH

It can be assumed that many of the fishes will emigrate from discharge waters with temperatures exceeding 90 F and most of the fishes will emigrate from the discharge water exceeding 93 F. The average area affected by discharge temperatures exceeding 90 F will be largest in July with a consequent loss in fish habitat. This area will be 2530 acres for Catawba Nuclear Station using lake cooling (Alternative 1) and 620 acres for Catawba Nuclear Station using cooling towers (Alternative 1b). If the closed cycle cooling tower alternative (Alternative 1d) is adopted, no thermal effects on fish will be noted. The areas affected by discharged temperatures exceeding 90 F for the fossil-fueled plant will be approximately 1640 and 410 acres for Alternatives
1 1(a) and 1(c) respectively; it was assumed that the area needed to cool a fossil-fueled plant was 65 percent of that for a nuclear plant because of the smaller volume of water needed to cool a fossil-fueled plant of identical capacity. The area affected by the same capacity nuclear plant located at Site 'D' on Lake Norman (Alternative 2) would be somewhat greater than the 2530 acres for Alternative 1 because no hypolimnetic water would be available for cooling during the summer. Alternative 4 requires the creation of a 9500 acre reservoir in central South Carolina and utilizes full lake cooling. The area affected by discharge temperatures for this reservoir would also be somewhat greater than 2530 acres.

The above figures are highly conservative because of the assumptions that the loss of fish habitat during one period (July) of the year means a loss for the total year and that all discharge waters above 90 F are unsuitable as fish habitat. Furthermore, the benefits to the fish population derived from an increase in the overwintering population of threadfin shad have not been determined.

7.6.3 RECREATION

Lake Wylie is now a popular recreation area.

Surveys show that in 1970, 536,896 days of recreational use were enjoyed by the tourist segment through visits to the county park, access areas and commercial camping areas. The present value to the tourist segment is $1,488,201 as shown in Table 7.6-2.

In addition, 1643 waterfront lots have been developed at Lake Wylie. These lots have 599,945 visitor days of recreational use annually by permanent and seasonal residents. The resulting annual value to Lake Wylie residents is $2,999,770 as shown in Table 7.6-3.

Combining the above benefits, the recreational value of Lake Wylie is found to be $4,487,971.

Some types of recreation use may be conditioned by construction and operation of the proposed plant. If all the value for recreation in the area influenced by the plant is assumed lost, the cost would be $27,563 as shown in Table 7.6-4.

In actuality, all the value for recreation in this area would not be lost, and some activities may be enhanced. However, as this is difficult to predict dependably, the above conservative estimate is recommended.

7.6.4 LAND USE

In order to arrive at a value per acre of land for timber growing purposes around Lakes Wylie and Norman, the value of the timber that the land is capable of producing must be discounted to the present. Crescent's timber yield studies indicate that on an average acre in the subject locations optimum timber growth and optimum return on investment will be received by growing planted timber to an age of 35 years. During the 35 year life of the forest Duke will selectively thin the trees; once at age 15 and again at age 25, with all the remaining trees harvested at age 35.

The latest timber yield tables[1] for the piedmont plateau of North Carolina show the following yields:

First thinning at age 15 - 10 cords per acre at \$ 6 per cord = \$ 60 per acre
Second thinning at age 25 - 15 cords per acre at \$ 7 per cord = \$105 per acre
Harvest cut at age 35 - 29 cords per acre at \$10 per cord = \$290 per acre

Average expenses over the 35 year period would be:

Year 1	- Initial investment for reforestation	- \$30 per acre
Years 1-35	- Property taxes	- \$ 2.25 per acre[2]
Years 1-35	- Management costs	- \$ .63 per acre[3]
Years 15, 25, 35	- Timber sales expense	- \$ .30 per acre[4]

The value of the subject area for timber growing purposes is \$30 per acre at a rate of return of 7.2 percent after taxes (Table 7.6-5).

The following costs due to loss of forestry production can then be computed for the various options:

Option	Acres Lost		Cost Per Acre	Total Cost
Alternative 1	334	x	\$30	\$ 10,020
Alternative 1(a)	538	x	\$30	\$ 16,140
Alternative 1(b)	400	x	\$30	\$ 12,000
Alternative 1(c)	592	x	\$30	\$ 17,760
Alternative 1(d)	429	x	\$30	\$ 12,870
Alternative 2	341	x	\$30	\$ 10,230
Alternative 3	10,000	x	\$30	\$300,000
Alternative 4	346	x	\$30	\$ 10,380

1

[1] Soil - Site Relationships, Stand Structure and Yields of Slash and Loblolly Pine Plantations in the Southern United States, By Coile & Schumacher. p. 121.

[2] Composite rate, paid in 1971, of property taxes on Crescent's forest lands in York and Mecklenburg Counties.

[3] From the account books of Crescent Land & Timber Corporation.

[4] Cost of timber sales per acre for 1971, from Crescent Land & Timber Corporation books.

[5] Timber depletion rate for 1972 - \$1.65 per cord (pine).

7.6.5 WILDLIFE

A survey by the U. S. Fish and Wildlife Service in 1965[1] on benefits and costs of wildlife development for recreational purposes is evaluated by applying a range of derived values to visitor days (12 hours). The survey revealed that on land suitable for hunting of wildlife, such as the land in Lake Wylie watershed, the average number of hunting trips per acre per year is 6.25 times. It also revealed that the average hunting trip was 5/12 visitor days and that the net benefit of the trip was $2.20 per visitor day.

The amount of land suitable for wildlife which will be cleared for the construction and subsequent operation of the proposed power plant will be determined by the source of power generation. The alternative sources of power generation and the net annual benefit due to the hunting available on site lands prior to clearing are as follows:

	Option	Loss of Wildlife Habitat Due to Clearing	Net Annual Benefit From Hunting on Lands Prior to Clearing
	Alternative 1	334 Acres	$ 1,920
	Alternative 1(a)	538 Acres	$ 3,100
1	Alternative 1(b)	400 Acres	$ 2,300
	Alternative 1(c)	592 Acres	$ 3,400
	Alternative 1(d)	429 Acres	$ 2,470
	Alternative 2	341 Acres	$ 1,960
	Alternative 3	10,000 Acres	$57,500
	Alternative 4	346 Acres	$ 1,990

The Lake Wylie watershed lands owned by Duke Power Company are managed by a subsidiary, Crescent Land & Timber Corporation. Much of this land is suitable for Wildlife and is open to the public for hunting and recreation. As a result of good management techniques, the impact of clearing several hundred acres of possible wildlife habitat will be minimized.

7.6.6 ECONOMIC DEVELOPMENT

Based on studies made by the Economic Research Department of the United States Chamber of Commerce, the 84 full-time industrial jobs created by the regular operation of Catawba Nuclear Station will, through the goods and services required by these employees and their families, mean the following to adjacent communities:

- 55 - new jobs in non-manufacturing
- $278,000 - annual increase in retail sales
- 81 - additional automobiles
- 3 - more retail establishments
- $192,300 - annual bank deposits
- $596,400 - more personal income annually

[1] National Survey of Fishing and Hunting. 1965. Resource Publication 27. United States Department of the Interior, U. S. Government Printing Office, Washington, D. C.

State and Local Taxes

Under present law in South Carolina, new industry is exempt from property tax, excluding school taxes, for various periods of time depending on the size of the investment. Considering the investment in Catawba Nuclear Station, Duke would presently be exempt from property taxes, except school taxes, for a period of almost 20 years. It is, however, understood and believed that legislation will be enacted that would reduce the present 20 year exemption period to five years. In this event, Duke will pay approximately \$16.4 million annually in state and local taxes for the first five years after Catawba Nuclear Station goes into operation and approximately \$17 million per year thereafter. This \$17 million annual figure should be
1 regarded as only an estimate of combined state and local taxes since this total was calculated on an overall plant cost basis and approximately equals 2.6 percent of the estimated cost of the plant and can be divided into the following components:

\$13,400,000	South Carolina Taxes
	York County Property Taxes -
3,000,000	School
600,000	Other*
\$17,000,000	Total

*For the first five years, Duke will be exempt from paying non-school property taxes.

Due to the uncertainty associated with the tax exemption status of Catawba and the necessity of using estimations in making cost calculations, the tax figures listed above should not be construed to precisely represent those tax liabilities which will actually be realized for Catawba Nuclear Station.

The economic impact of the project is summarized below:

Construction Phase:

2,100	Peak employment
1,500	Average employment
\$129,000,000	Total construction payroll

Regular Operating Phase:

84	Employment
\$ 1.2 million	Annual payroll
\$17 million	State and local taxes

7.6.7 ADDITIONAL RADIOACTIVE EFFLUENT REDUCTION

A design objective of the waste disposal systems is that releases of radioactivity in effluents be as far below the limits specified in 10CFR20 as practicable. According to 10CFR20, this means, "as low as is practicably achievable taking into account the state of technology, and the economics of improvements in relation to benefits to the public health and safety and in relation to the utilization of atomic energy in the public interest."

The design of the liquid waste disposal system meets the design objective because it has the capability of processing liquid waste as effectively as determined necessary during operation. This is true because all releases are deliberate.

Any deliberate releases from the waste gas tanks would be under such circumstances that the environmental impact would be negligible compared to non-deliberate release of radioactivity. Normal operation estimates of effluents and doses received are given in section 4.2. In order to determine whether or not these releases are "as low as practicable" it is necessary to compare the cost of reducing them with the value of reducing them. It is appropriate to perform this analysis for iodine rather than noble gases because means of controlling iodine are commercially available but large scale removal of noble gas in low concentration streams is still impractical. Population thyroid dose from the releases described in Subsection 4.2.3 are shown on Table 7.6-7. Reduction of these doses could be considered a measure of "benefit to the public health and safety". The incremental costs of these "benefits" shown on Table 7.6-7 are all considerably in excess of the $12-$120 range of values of a man-rem suggested by the National Academy of Sciences.[1] It should also be noted that the man-thyroid-rem has less significance than the (whole body) man-rem and therefore has less value. It is concluded that the anticipated releases of radioactivity in effluents are as low as practicable.

(1) "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation", Report of the Advisory Committee on the Biological Effects of Ionizing Radiation, National Academy of Science, November, 1972, p. 70.

2 7.6.8 SUMMARY AND CONCLUSION

A summary of the benefits and costs associated with the development of the
Catawba Nuclear Station as compared to other alternatives is shown in Tables
7.6-6a and 7.6-6b. Table 7.6-6a compares Catawba site with three alternative
sites, assuming nuclear generation and full lake cooling. Table 7.6-6b de-
tails the benefits and costs of a nuclear and a fossil-fuel generating station
at the Lake Wylie site, with alternative methods of dissipating surplus heat
discharged by the plants, i.e., lake cooling and the use of partial and closed
1 cycle cooling towers. It is clear from these tables that of the four sites
considered, the Lake Wylie site is the most appropriate for development in
order to meet Duke's commitments in 1979-1980, that the benefits of a nuclear
station on Lake Wylie are far in excess of the costs and that Alternative 1
with full lake cooling affords the optimum mode for power generation. The
conclusions are overwhelmingly in favor of a nuclear station at the Lake
Wylie site.

ER Table 7.6-7

COST OF POPULATION DOSE REDUCTION

Source	Anticipated[1] Population Dose as Designed (man-thyroid-rem/yr)	Cost of[2] Reduction by Carbon Filters ($/yr)	Incremental Cost of Reduction ($/man-thyroid-rem)
Auxiliary Bldg Ventilation System	6.1	129,000	23,500
Condenser Air Ejector System	.28	3,750	15,000

(1) Inhalation dose based on the releases given in ER subsection 4.2 3, atmospheric diffusion given in PSAR subsection 2.3.5, and population given in PSAR Fig. 2.1-6 and 2.1-12.

(2) Costs include initial purchase, installation, replacement costs and capital costs, but not costs for space, filter disposal, or miscellaneous maintenance.

cycle cooling towers. It is clear from these tables that of the four sites considered, the Lake Wylie site is the most appropriate for development in
1 order to meet Duke's commitments in 1979-1980, that the benefits of a nuclear station on Lake Wylie are far in excess of the costs and that Alternative 1 with full lake cooling affords the optimum mode for power generation. The conclusions are overwhelmingly in favor of a nuclear station at the Lake Wylie site.

ER Table 7.3-1

1 Economic Benefits of Nuclear vs Fossil Fuel at Catawba[3]

Basic Data	Nuclear	Coal
Plant Cost Per kw	$269[1]	$198
Annual Fixed Charge Rate	16%	16%
Heat Rate, Btu Per kwh	10,000	8,700
Energy Per Year - kwh/kw/yr	7,000	7,000
Fuel Costs - ¢/million Btu	20	50[2]
Cost Comparison		
Annual Costs Per kw:		
Fixed Charges	$43.04	$31.68
Operation and Maintenance	1.78	1.78
Fuel	14.0	30.45
Insurance	0.83	.16
Total	$59.65	$64.07
Annual Savings With Nuclear Per kw	$ 4.42	
Capitalized value of savings at 2360 Mw and 16 percent Fixed Charge rate = Total Economic Benefit of Nuclear Selection	$65 195 000	
Break-even value to be competitive - ¢/million Btu		43

[1]Excluding cost of transmission lines.

[2]Projected cost of coal in 1979.

1 [3]Economic studies are based on a plant life of 28 years and an interest rate of 7.5 percent.

ER Table 7.4-1
Comparison of Mechanical Draft and
Natural Draft Cooling Towers

Particulars	Mech. Draft	Natural Draft
A. TECHNICAL DATA [1]		
1. Rejected Heat (Btu/hour)	15.8×10^9	15.8×10^9
2. Range (F)	24	24
3. Approach (F)	12	18
4. Wet Bulb Temperature (F)	77 [2]	76
5. Condenser Temperature Difference TD (F)	6	6
6. Turbine Absolute Back Pressure (in. of Hg)	3.35	3.85
7. Condenser Cooling Water Flow (GPM)	1.32×10^6	1.32×10^6
B. ECONOMICS		
1. Capital Cost ($)	8 780 000 [3]	21 800 000 [4]
2. Fan Capacity Cost	2 965 000 [5]	-
3. Pump Capacity Cost	6 468 000 [6]	6 468 000 [6]
4. Fan Operating Cost Incl. Maintenance	1 539 000 [7]	-
5. Pump Operating Cost Incl. Maintenance	5 013 000 [8]	5 013 000 [8]
6. Capacity Penalty Due to Higher Back Pressure	-	8 847 000 [9]
7. Fuel Penalty Due to Higher Back Pressure	-	448 000 [10]
Total	$ 24 765 000	$ 42 576 000

FOOTNOTES

1) Assumes Once-Through Cooling Towers
2) 1 F above that for Natural Draft to allow for recirculation
3) Based on Dickey and Cates estimate + 15 percent for variation (Marley Company, Kansas City, Mo.)
4) Assumed 50 percent Relative Humidity for Design - based on Dickey and Cates estimate + 15 percent for variation
5) Capacity at $269 per kw
6) Pump BHP for 75 feet head, and 78 percent overall efficiency, capacity at $269 per kw
7) Fuel and powerhouse operation and maintenance costs at $104 per kw, 67 percent Fan use. Includes cooling tower operation and maintenance at 100 percent of fuel cost.
8) Fuel and powerhouse operation and maintenance costs at $104 per kw. Includes cooling tower operation and maintenance at 100 percent of fuel cost
9) Capacity penalty at $269 per kw
10) Assumes maximum heat rate for 2 months in a year - capitalized cost of fuel

ER Table 7.4-1 - continued
Comparison of Mechanical Draft and
Natural Draft Cooling Towers
(Once-Through System)

Particulars	Mech. Draft	Natural Draft
C. ENVIRONMENTAL IMPACT		
1. Thermal Effect		
Highest Cold Water Temperature During Summer Months (F)	89	94 (Larger Mixing Zone)
2. Land Use Approximate Area Required (Acres)	65	30
3. Consumptive Loss (gpm)	23 800	23 800
4. Icing and Fogging in the Local Area	Distinct possibility on cold, humid days or during periods with persistent radiation inversions	Less possibilities of low-level effects due to elevated plume release and plume rise; however, definite possibility of increase in low stratus clouds during certain conditions.
5. Aesthetics	Cover substantial area but low structures and can be treated architecturally to mitigate adverse aesthetic effects on the countryside	Tall (400 ft +) conspicuous structures are generally not pleasing in appearance

ER Table 7.5-1
Catawba Nuclear Station
On Lake Wylie vs
Other Sites

Cost in $1 000

	Plant	Transmission Lines	Substation	Total
Catawba on Lake Wylie(Alt. 1)	621 196	11 072	13 632	645 900
Site D on Lake Norman (Alt. 2)	621 711	11 841	19 524	653 076
1 Site in Central South Carolina with full lake cooling (Alt. 3)	627 358	7 924	25 000	660 282
Site on Wateree Lake (Alt. 4)	624 665	36 754	13 632	675 051

ER Table 7.6-1

Estimated Evaporative Loss For Alternatives

Alternative No.	Description	Evaporative Loss (Cfs)
1	Nuclear plant on Lake Wylie with lake cooling	31
1(a)	Fossil plant on Lake Wylie with lake cooling	20
1(b)	Nuclear plant on Lake Wylie with partial cooling towers	35
1(c)	Fossil plant on Lake Wylie with partial cooling towers	23
1(d)	Nuclear plant on Lake Wylie with 100 percent cooling towers	65
2	Nuclear plant on Lake Norman with lake cooling	31
3	Nuclear plant in central South Carolina with full lake cooling	31
4	Nuclear plant on Wateree Lake with lake cooling	31

1

ER TABLE 7.6-2

BASIS FOR ESTIMATES OF RECREATIONAL USE AT LAKE WYLIE BY TOURISTS

TYPE USE	NO. USERS	USER DAYS PER TYPE	USER DAYS	RATE	TOTAL VALUE
Public Access Areas	715,877[1]	1/3[3]	238,626	$1.40[4]	$ 334,076.
Organized Group Areas	87,662[1]	2 [4]	175,324	$5.00[4]	876,620.
Commercial Areas	260,189[1]	1/3[3]	86,729	$1.40[4]	121,420.
Non-resident Visits to Vacation Homes	93,651[2]	1/3[3]	31,217	$5.00[4]	156,085.
			531,896		$ 1,488,201.

[1]Based on surveys of Access Areas by Duke Power in 1970.

[2]Present use based on survey of Lake Norman in 1970 by Duke Power Company.

[3]Arbitarily set.

[4]Based on A Study by the N. C. Forest Service Based on Supplement Number I to Senate Document No. 97.

ER TABLE 7.6-3

RESIDENTIAL RECREATION USE AT LAKE WYLIE

Total Lots[1]	1643
Private Lots	119
Leased Lots	1524

88% allotted as transient recreation[1]	1446
1 12% allotted as permanent recreation[1]	197
Average yearly visits per transient resident[1]	80.64
(Conservatively considered as 80.64 12 hour recreation days)	
Average yearly visits per permanent resident[1]	363
(Conservatively adjusted to 232 12 hour recreation days)	
Average household population[2]	3.66
Value per recreation day[3]	$5.00

Number of Recreation Days

1446 lots x 3.66 persons/lot x 80.64 recreation days/person = 426,776 recreation days

197 lots x 3.66 persons/lot x 232 recreation days/person = 167,277 recreation days

Total Recreation Days 594,053

Value of Residential Recreation Use

594,053 recreation days x $5.00 value/day = $2,870,265.

[1]Based on 1970 survey of lots at Lake Norman by Duke Power Company.

[2]United States Census of Population 1960.

[3]A Study by the N. C. Forest Service Based on Supplement Number 1 to Senate Document No. 97.

ER TABLE 7.6-4
POSSIBLE DECRFASE IN RECREATION VALUE

Value of the lake for tourist use	$1,488,201.
Value of the lake to recreation residents	2,970,265.
Total value of the lake for recreation	$4,458,466.

Surface area of the lake	12,455 acres
Recreational value per acre	$358.00
Area influenced by plant	77 acres

$\frac{\$4,458,466 \text{ value}}{12,455 \text{ acres}}$ = \$358. / acre value x 77 acres = \$27,563. decrease

ER TABLE 7.6-5
DISCOUNTED CASH FLOW ANALYSIS ON AN AVERAGE ACRE OF PLANTED LOBLOLLY PINE

Year	Cost & Income Item	Cash Flow B/Taxes	Depletion	Taxable Income	Cash Flow For Taxes	Cash Flow A/Taxes	PW 6%	PW 8%
0	Investment	-$30.00	$	$	$	-$30.00	-$30.00	-$30.00
1-35	Property taxes	- 2.25				1.17 [2]	- 16.96	- 13.64
1-35	Management costs	- .63				.33	4.78	- 3.85
15	Timber sales expense	- .30				.16	.07	- .05
25	Timber sales expense	- .30				.16	.04	- .02
35	Timber sales expense	- .30				.16	.02	- .01
15	First Thinning	+ 60.00	16.50	43.50	14.75 [1]	45.25	18.88	+ 14.26
25	Second Thinning	+105.00	24.75	80.25	27.20	77.80	18.13	+ 11.36
35	Harvest	+290.00	47.85	242.15	82.09	207.91	27.04	+ 14.05
							+$12.18	-$ 7.90

(1) Capital Gains tax rate (Composite used = 33.90%
(2) Corporate income tax rate used = 48.00%

Primary Impact and Population or Resource Affected	Unit of Measure	Alternative 1(a) Cost	Alternative 1(a) Benefit	Alternative 1(b) Cost	Alternative 1(b) Benefit	Alternative 2(a) Cost	Alternative 2(a) Benefit
ECONOMIC IMPACT OF PLANT							
Power Benefit Base Load	$ - Mwh/yr	$646 million	16 540 000	$659 million	16 540 000	$478 million	16 540 000
Generating Cost	$/yr	$140,8 million		$146,8 million		$ $151.2 million	
Reserve Capacity	Increase in System Reserve		8%		8%		8%
ENVIRONMENTAL IMPACT OF PLANT							
1. Impact on Water							
1.1 Consumption for Power Production	$/yr	$47 430	-	$53 550	-	$30 600	-
1.2 Radioactive Waste Discharged	Manrems/yr	16.0	-	16.0	-	-	-
1.3 Natural Water Drainage	Statement	Impound 51 Acres	-	Impound 51 Acres	-	-	-
1.4 Fishery Resources	Acres	2 580	-	650	-	1 680	-
2. Impact on Air							
2.1 Chemical Discharge to Ambient Air							
2.1.1 Air Quality Chemicals							
.1 CO_2	Ton/year	-	-	-	-	14 200	-
.2 SO_2	Ton/year	-	-	-	-	84 000	-
.3 NO_x	Ton/year	-	-	-	-	49 000	-
.4 Particulate	Ton/year	-	-	-	-	7 010	-
.5 Ash Collected	Statement	-	-	-	-	846 000	-
2.2 Radionuclide Discharged to Ambient Air	Mcnrems/yr	5.3	-	5.3	-	27.0	-
2.3 Fogging and Icing	Statement	Minor along periphery of mixing zone under adverse atmospheric condition	-	Considerable increase in fog possible immediately downwind of plant	-	Same as for Alternate 1(a)	-
3. Temporary Impacts of Construction							
3.1 Land Disturbance	Acres	200	-	200	-	200	-
3.2 Air Quality	Statement	Negligible	-	Negligible	-	Negligible	-
3.3 Water Quality	Statement	Negligible	-	Negligible	-	Negligible	-
3.4 Water Diversion	Statement	Negligible	-	Negligible	-	Negligible	-
3.5 Spoilage	Statement	Negligible	-	Negligible	-	Negligible	-

Table 7.6-6
Catawba Nuclear Station Alternatives

Alternative 2(b) Cost	Alternative 2(b) Benefit	Alternative 3 Cost	Alternative 3 Benefit	Alternative 4 Cost	Alternative 4 Benefit	Alternate 5 Cost	Alternate 5 Benefit	Remarks
$485 million	16 540 000	$551 million	16 540 000	$695 million	16 540 000	$675 Million	16 540,000	
$154.8 million		$141.9 million		$154.1 million		$145.4 Million	-	
	8%		8%		8%	-	8%	
35 190	-	$47 430	-	$99 450	-	$47 430	-	
-	-	16.0	-	16.0	-	16	-	
-	-	Impound about 50 Acres	-	Impound about 50 Acres	-	Impound about 50 Acres	-	
420	-	2 580 +	-	-	-	2530	-	
14 200	-	-	-	-	-	-	-	
84 000	-	-	-	-	-	-	-	
49 000	-	-	-	-	-	-	-	
7 010	-	-	-	-	-	-	-	
846 000	-	-	-	-	-	-	-	
27.0	-	5.3	-	5.3	-	5.3	-	
Same as for Alternate 1(b)	-	Same as for Alternate 1(a)		Pronounced increase in fog possible downwind of plant	-	Same as for Alternate 1a	-	Refer to Section 2.4-1
200	-	200		200		200	-	
Negligible	-	Negligible	-	Negligible	-	Negligible	-	
Negligible	-	Negligible	-	Negligible	-	Negligible	-	
Negligible	-	Negligible	-	Negligible	-	Negligible	-	
Negligible	-	Negligible	-	Negligible	-	Negligible	-	

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Primary Impact and Population or Resource Affected	Unit of Measure	Alternative 1(a)		Alternative 1(b)		Alternative 2(a)	
		Cost	Benefit	Cost	Benefit	Cost	Benefit
SOCIAL IMPACT OF PLANT							
1. Operational Fuel Disposition							
1.1 Fuel Transport	Statement	12 Shipments/year	-	12 Shipments/year	-	65 700 Cars/yr	-
1.2 Fuel Storage	Statement	-	-	-	-	1 250 000 Tons	-
1.3 Waste Product	Statement	189 Truck Shipments/yr	-	189 Truck Shipments/yr	-	1 100 000 Tons/yr to Storage	-
2. Land Use and Property Values							
2.1 Permanent Land for Plant	Acre	134	-	147	-	338	-
2.2 Exclusion Area	Acre	480	-	480	-	-	-
2.3 Residential							
.1 Permanent Homes	Statement	Relocation of 1 Residence	-	-	-	Relocation of 1 Residence	
.2 Summer and Mobile Homes	Statement	Relocation of 19 Homes	-	Relocation of 13 Homes	-	Relocation of 16 Homes	
2.4 Forestry	Acres - $	334 $10 020		347 $10 410		538 $16 140	
2.5 Recreation	Value $/yr	27 563		27 563		-	-
2.6 Wildlife	Value $/yr	1 920		2 000		3 100	
3. Historical and Archaeological Sites							
3.1 Accessibility		No Impact	Indian Grounds Located	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located
3.2 Setting of Historical Site		No Impact	Indian Grounds Located	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located
4. Community Benefits							
4.1 Local Taxes	$/yr		$16.5 million		$16.8 million	-	$12.1 million
4.2 New Jobs/Income	No/$		84 - $1 200 000		84 - $1 200 000	-	107 - $1 500 000
5. Aesthetics							
5.1 Plant		Insignificant		Slight Due to Cooling Towers		Significant Due to Coal Yard and Stack	
5.2 Transmission Facilities		Insignificant		Insignificant		Insignificant	
6. Temporary Impacts of Construction							
6.1 Housing	Statement	Minor		Minor		Minor	
6.2 Schools	Statement	Insignificant		Insignificant		Insignificant	
6.3 Traffic	Statement	Small Increase		Small Increase		Small Increase	
6.4 Community Services	Statement	Small Increase		Small Increase		Small Increase	
6.5 Economics - Construction Wages	$	-	$129 million		$131 million		$95 million

R Table 7.6-6
or Catawba Nuclear Station Alternatives
Continued

Alternative 2(b) Cost	Alternative 2(b) Benefit	Alternative 3 Cost	Alternative 3 Benefit	Alternative 4 Cost	Alternative 4 Benefit	Alternative 5 Cost	Alternative 5 Benefit	Remarks
65 700 Cars/ year	-	12 Shipments/ year		12 Shipments/ year	-	12 Shipments/yr	-	
1 250 000 Tons	-	-	-	-	-	-	-	
1 100 000 Tons/yr to Storage	-	189 Truck Shipments/yr	-	189 Truck Shipments/yr	-	189 Truck Shipments/yr	-	
352	-	141		236	-	146	-	
-	-	480	-	480	-	480	-	
-		Relocation of 3 Homes		-	-	Relocation of 2 Residences	-	
Relocation of 10 Homes		-		-	-	Relocation of 5 Homes	-	
552 $16 560		341 $10 230		450 $13 500		346 $10 380	-	
-	-	27 563A		-		$27 563*	-	
3 180		1 960		3 580		$1 990	-	
No Impact	Indian Grounds Located	No information		No information		No information	-	
No Impact	Indian Grounds Located	No information		No information		No Information	-	
-	$12.6 million	-	$16.5 million	-	$17.9 million	-	$16.5 Million	
-	107 = $1 500 000	-	84 = $1 200 000	-	84 - $1 200 000	-	84 - $1 200,000	
Considerable due to Cooling Towers		Insignificant		Significant		Insignificant	-	
Insignificant		Insignificant		Insignificant		Insignificant	-	
Minor Insignificant Small increase Small increase	$96 million	Minor Insignificant Small increase Small increase	$130 million	Minor Insignificant Small increase Small increase	$150 million	Minor Insignificant Small increase Small increase -	- - - - $135 Million	

ER Table 7.5-6a

Benefit-Cost Comparison of Alternative Sites for Nuclear Generation

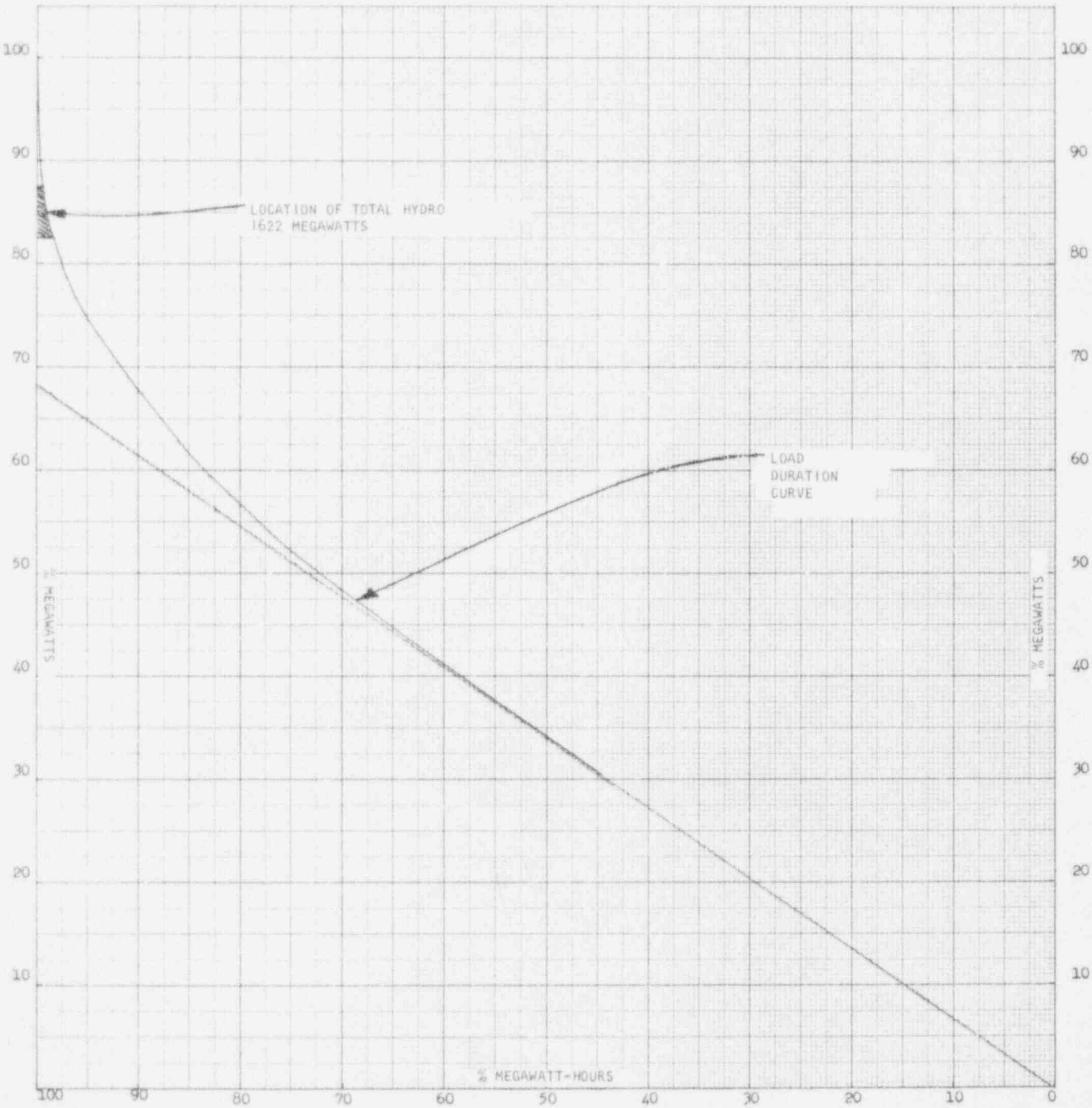
Primary Impact and Population or Resource Affected	Unit of Measure	Alternative 1 Cost	Alternative 1 Benefit	Alternative 2 Cost	Alternative 2 Benefit	Alternative 3 Cost	Alternative 3 Benefit	Alternative 4 Cost	Alternative 4 Benefit	Remarks
ECONOMIC IMPACT OF PLANT										
Power Benefits Base Load	$ - MWh/yr	$646 Million	16 540 000	$653 Million	16 540 000	$660 Million	16 540 000	$ 75 Million	16 540 000	
Generating Cost	$/yr	$146.8 Million	-	$141.9 Million	-	$143 Million	-	$145.4 Million	-	
Reserve Capacity	Increase in System Reserve	-	8%	-	8%	-	8%	-	8%	
ENVIRONMENTAL IMPACT OF PLANT										
1. Impact on Water										
1.1 Consumption for Power Production	$/yr	$47 430	-	$47 430	-	$47 430	-	$47 430	-	
1.2 Radioactive Waste Discharged	Manrems/yr	16.0	-	16.0	-	16.0	-	16.0	-	
1.3 Natural Water Drainage	Statement	Impound 51 Acres	-	Impound about 50 Acres	-	Impound about 9500 Acres	-	Impound about 50 Acres	-	
1.4 Fishery Resources	Acres	2 530	-	2 530*	-	-	7 000	2 530	-	
2. Impact on Air										
2.1 Chemical Discharge to Ambient Air										
2.1.1 Air Quality Chemicals										
.1 CO_2	Ton/year	-	-	-	-	-	-	-	-	
.2 SO_2	Ton/year	-	-	-	-	-	-	-	-	
.3 NO_x	Ton/year	-	-	-	-	-	-	-	-	
.4 Particulate	Ton/year	-	-	-	-	-	-	-	-	
.5 Ash Collected	Statement	-	-	-	-	-	-	-	-	
2.2 Radionuclide Discharged to Ambient Air	Manrems/yr	5.3	-	5.3	-	5.3	-	5.3	-	
2.3 Fogging and Icing	Statement	Minor along periphery of mixing zone under adverse atmospheric condition.	-	Same as for Alternative 1	-	Same as for Alternative 1	-	Same as for Alternative 1	-	Refer to Subsection 2.6.1
3. Temporary Impacts of Construction										
3.1 Land Disturbance	Acres	200	-	200	-	200	-	200	-	
3.2 Air Quality	Statement	Negligible	-	Negligible	-	Negligible	-	Negligible	-	
3.3 Water Quality	Statement	Negligible	-	Negligible	-	Negligible	-	Negligible	-	
3.4 Water Diversion	Statement	Negligible	-	Negligible	-	Negligible	-	Negligible	-	
3.5 Spoilage	Statement	Negligible	-	Negligible	-	Negligible	-	Negligible	-	
SOCIAL IMPACT OF PLANT										
1. Operational Fuel Disposition										
1.1 Fuel Transport	Statement	15 Shipments per year	-	15 Shipments per year	-	15 Shipments per year	-	15 Shipments per year	-	
1.2 Fuel Storage	Statement	-	-	-	-	-	-	-	-	
1.3 Waste Product	Statement	189 Truck Shipments per year	-	189 Truck Shipments per year	-	189 Truck Shipments per year	-	189 Truck Shipments per year	-	
2. Land Use and Property Values										
2.1 Permanent Land for Plant	Acre	134	-	141	-	134	-	146	-	
2.2 Exclusion Area	Acre	450	-	450	-	450	-	450	-	
2.3 Residential										
.1 Permanent Homes	Statement	-	-	Relocation of 5 Residences	-	Relocation of 90 Residences	-	Relocation of 2 Residences	-	
.2 Summer and Mobile Homes	Statement	Relocation of 19 Residences	-	-	-	-	-	Relocation of 5 Residences	-	
2.4 Forestry	Acres - $	334 - $19 020	-	341 - $10 230	-	10 000 - $300 000	-	346 - $10 380	-	
2.5 Recreation	Value $/yr	27 561	-	27 563‡	-	-	3 580 000	27 563‡	-	
2.6 Wildlife	Value $/yr	1 920	-	1 960	-	57 500	-	1 990	-	
3. Historical and Archaeological Sites										
3.1 Accessibility	-	No Impact	Indian Grounds Located	No Information	-	No Information	-	No Information	-	
3.2 Setting of Historical Site	-	No Impact	Indian Grounds Located	No Information	-	No Information	-	No Information	-	
4. Community Benefits										
4.1 Local Taxes	$/yr	-	$16.4 Million	-	$16.6 Million	-	$16.8 Million	-	$17.1 Million	Refer to Subsection 7.5.6
4.2 New Jobs/Income	No/$	-	84 - $1 200 000	-	84 - $1 200 000	-	84 - $1 200 000	-	84 - $1 200 000	
5. Aesthetics										
5.1 Plant	-	Insignificant	-	Insignificant	-	Insignificant	-	Insignificant	-	
5.2 Transmission Facilities	-	Insignificant	-	Insignificant	-	Insignificant	-	Insignificant	-	
6. Temporary Impacts of Construction										
6.1 Housing	Statement	Minor	-	Minor	-	Minor	-	Minor	-	
6.2 Schools	Statement	Insignificant	-	Insignificant	-	Insignificant	-	Insignificant	-	
6.3 Traffic	Statement	Small Increase	-	Small Increase	-	Small Increase	-	Small Increase	-	
6.4 Community Services	Statement	Small Increase	-	Small Increase	-	Small Increase	-	Small Increase	-	
6.5 Economics - Construction Wages	$	-	$129 Million	-	$130 Million	-	$131 Million	-	$135 Million	

ER Table 7.6-6b

Benefit-Cost Comparisons of Alternative Schemes for Catawba Nuclear Station on Lake Wylie

Primary Impact and Population or Resource Affected	Unit of Measure	Alternative 1 Cost	Alternative 1 Benefit	Alternative I(a) Cost	Alternative I(a) Benefit	Alternative I(b) Cost	Alternative I(b) Benefit	Alternative I(c) Cost	Alternative I(c) Benefit	Alternative I(d) Cost	Alternative I(d) Benefit
ECONOMIC IMPACT OF PLANT											
Power Benefits Base Load	E - MWh/yr	$646 Million	16 540 000	$678 Million	16 540 000	$655 Million	16 540 000	$685 Million	16 540 000	$664 Million	16 540 000
Generating Cost	$/yr	$149.8 Million	-	$151.2 Million	-	$143.9 Million	-	$154.8 Million	-	$147.6 Million	-
Reserve Capacity	Increase in System Reserve	-	8%	-	8%	-	8%	-	8%	-	8%
ENVIRONMENTAL IMPACT OF PLANT											
1. Impact on Water											
1.1 Consumption for Power Production	$/yr	$47 430	-	$30 600	-	$53 550	-	$35 190	-	$39 450	-
1.2 Radioactive Waste Discharge	Manrems/yr	15.3	-	-	-	16.0	-	-	-	15.9	-
1.3 Natural Water Drainage	Statement	Impound 51 Acres	-	-	-	Impound 51 Acres	-	-	-	Impound about 50 Acres	-
1.4 Fishery Resources	Acres	1 530	-	1 640	-	620	-	410	-	-	-
2. Impact on Air											
2.1 Chemical Discharge to Ambient Air											
2.1.1 Air Quality Chemicals											
.1 CO_2	Ton/year	-	-	14 200	-	-	-	14 200	-	-	-
.2 SO_2	Ton/year	-	-	84 000	-	-	-	84 000	-	-	-
.3 NO_x	Ton/year	-	-	49 000	-	-	-	49 000	-	-	-
.4 Particulate	Ton/year	-	-	7 010	-	-	-	7 010	-	-	-
.5 Ash Collected	Statement	-	-	846 000	-	-	-	846 000	-	-	-
2.2 Radionuclide Discharged to Ambient Air	Manrems/yr	5.3	-	27.0	-	5.3	-	27.0	-	5.3	-
2.3 Fogging and Icing(1)	Statement	Minor along periphery of mixing zone under adverse atmospheric condition.	-	Same as for Alternative 1	-	Considerable increase in fog possible immediately downwind of plant.	-	Same as for Alternative 1(b)	-	Pronounced increase in fog possible downwind of plant.	-
3. Temporary Impacts of Construction											
3.1 Land Disturbance	Acres	200	-	200	-	220	-	220	-	225	-
3.2 Air Quality	Statement	Negligible	-	Negligible	-	Negligible	-	Negligible	-	Negligible	-
3.3 Water Quality	Statement	Negligible	-	Negligible	-	Negligible	-	Negligible	-	Negligible	-
3.4 Water Diversion	Statement	Negligible	-	Negligible	-	Negligible	-	Negligible	-	Negligible	-
3.5 Spoilage	Statement	Negligible	-	Negligible	-	Negligible	-	Negligible	-	Negligible	-
SOCIAL IMPACT OF PLANT											
1. Operational Fuel Disposition											
1.1 Fuel Transport	Statement	15 Shipments per year	-	65 700 Cars per year	-	15 Shipments per year	-	65 700 Cars per year	-	15 Shipments per year	-
1.2 Fuel Storage	Statement	-	-	1 250 000 Tons	-	-	-	1 250 000 Tons	-	-	-
1.3 Waste Product	Statement	189 Truck Shipments per year	-	1 100 000 Tons per year to storage	-	189 Truck Shipments per year	-	1 100 000 Tons per year to storage	-	189 Truck Shipments per year	-
2. Land Use and Property Values											
2.1 Permanent Land for Plant	Acre	134	-	338	-	180	-	372	-	206	-
2.2 Exclusion Area	Acre	450	-	-	-	450	-	-	-	450	-
2.3 Residential											
.1 Permanent Homes	Statement	-	-	-	-	-	-	-	-	-	-
.2 Summer and Mobile Homes	Statement	Relocation of 19 Residences	-	Relocation of 16 Residences	-	Relocation of 19 Residences	-	Relocation of 16 Residences	-	Relocation of 19 Residences	-
2.4 Forestry	Acres - $	334 - $10 020	-	538 - $16 140	-	400 - $12,000	-	592 $17 760	-	429 - $17 870	-
2.5 Recreation	Value $/yr	27 563	-	-	-	27 563	-	-	-	27 563	-
2.6 Wildlife	Value $/yr	1 920	-	3 100	-	2300	-	3 900	-	2 470	-
3. Historical and Archaeological Sites											
3.1 Accessibility	-	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located
3.2 Setting of Historical Site	-	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located	No Impact	Indian Grounds Located
4. Community Benefits											
4.1 Local Taxes	$/yr	-	$16.4 Million(2)	-	$12.1 Million	-	$16.6 Million	-	$12.3 Million	-	$16.9 Million
4.2 New Jobs/Income	No/$	-	84 - $1 200 000	-	107 - $1 500 000	-	84 - $1 200 000	-	107 - $1 500 000	-	84 - $1 200 000
5. Aesthetics											
5.1 Plant	-	Insignificant	-	Significant due to Coal Yard and Stack,	-	Slight due to Cooling Towers	-	Considerable due to Cooling Towers,	-	Considerable due to Cooling Towers	-
5.2 Transmission Facilities	-	Insignificant	-	Insignificant	-	Insignificant	-	Insignificant	-	Insignificant	-
6. Temporary Impacts of Construction											
6.1 Housing	Statement	Minor	-	Minor	-	Minor	-	Minor	-	Minor	-
6.2 Schools	Statement	Insignificant	-	Insignificant	-	Insignificant	-	Insignificant	-	Insignificant	-
6.3 Traffic	Statement	Small Increase	-	Small Increase	-	Small Increase	-	Small Increase	-	Small Increase	-
6.4 Community Services	Statement	Small Increase	-	Small Increase	-	Small Increase	-	Small Increase	-	Small Increase	-
6.5 Economics - Construction Wages	$	-	$129 Million	-	$95 Million	-	$131 Million	-	$96 Million	-	$137 Million

Notes: (1) Refer to Subsection 2.4.1. (2) Refer to Subsection 7.6.6.



LOAD DURATION CURVE 1990
BASED ON 1971

CATAWBA NUCLEAR STATION

ER Figure 7.6-1

Referenced List of Additional
Information in Response to
Atomic Energy Commission's Letter of January 18, 1973

Catawba Nuclear Station
Environmental Report
Docket Nos. 50-413 and 50-414

Docket Nos. 50-413
and 50-414

REQUEST FOR ADDITIONAL INFORMATION

ENVIRONMENTAL IMPACT REVIEW

Site, Environs, Thermal, and Hydraulic	Reference
1. Supply the following information on water flow at the Wylie Dam, the Mountain Island Dam, and the South Fork of the Catawba River where it joins the Catawba River.	2.4.4
A. Average maximum, minimum, and overall average flow for (1) one day, (2) seven days, (3) 30 days, and (4) a year.	
B. Repeat the above for the probabilities (1) 1 in 5 years, (2) 1 in 10 years, and (3) 1 in 20 years.	
C. Years of record for which values are taken.	
2. What is the normal operating schedule of the Wylie and Mountain Island hydro-electric plants? What are the ranges of water flows through the turbine, and how long are they operated? Do the plants operate on weekends or holidays? Is there or will there be any interaction between the thermal power plants on Lake Wylie and any of the hydro stations insofar as power generation is concerned?	2.4.4
3. Provide the following information, if available, from data gathered at the proposed plant site; otherwise use the nearest location where the information has been gathered.	
A. What is the frequency and duration of wind speeds less than 3 mph? What probability is there that a period of such low wind speed would persist, uninterrupted, for seven or more days?	2.4.1
B. Supply the monthly average dew point, and the variation from the average. How does this vary from year to year?	2.4.1
C. What is the monthly average gross solar radiation and how does this vary from year to year?	2.4.1
D. Provide monthly rainfall averages.	2.4.1
E. Average turbulence class (over 10 years), using either the Pasquill or Smith-Singer classification.	(1)
F. Frequency distribution of turbulence classes in each month or season, averaged over 10 years or so.	(1)

2 (1) Information received from Weather Records Center in Asheville, N. C. and forwarded to ORNL.

Amendment 1
Amendment 2

Reference

G. Atmospheric lapse rate (change of temperature and potential temperature with height) at dawn, morning, early afternoon, and at night, averaged per month or per season over 10 years or so. (1)

2 H. Correlation of turbulence class with wind speed and lapse rate. (1)

I. Saturation deficit chart for the Charlotte, N.C., area. (1)

J. Wind velocity, temperature and stability class when relative humidity is greater than 90%. Averages and frequency distribution per season. (1)

4. Supply synoptic temperature and dissolved oxygen vertical profiles at 5-ft intervals for each month for Lake Wylie. This should be for several locations including at least above the Wylie Dam, in section D (as noted in ER), near the Allen Steam Plant, and above the dam of Mountain Island Lake and the Catawba River immediately below the Wylie Dam. Provide average ranges by month and supply years of record. 3.9

5. What is the extent and frequency of drawdown of Lake Wylie? Supply a volume-area table and curve for Lake Wylie at 5-ft intervals. 2.4.4 4.1.4

6. Supply a topographic map of the lake bottom of the sections noted in the ER for description of thermal effects. Contour interval should be no greater than 10-ft and in the area of the intake and discharge for the nuclear plant and Big Allison Embayment, the Standby Nuclear Service Water Pond, and the Waste Water Retention Pond, the contour interval should be 5-ft. What is the total length of the shoreline in the sections A-F at full pond and maximum drawdown? What is this in percentage of total shoreline in Lake Wylie? 4.1.4 4.1.5

7. What is the cross-section of the Catawba River below the Wylie Dam? Supply this for a location about 1/2 mile below the dam and again about 2 miles. 2.4.4

8. Supply drawings of the construction details for the Catawba Nuclear Station of (a) the skimmer wall at the intake canal, (b) the intake structure, (c) outfall, (d) intake and discharge channels, (e) waste water collection basin, and (f) underwater weir. Include several appropriate cross-sections, and the type, volume, and source of material as applicable. 4.1.4 4.3.3.6 4.5.2

2 (1) Information received from Weather Records Center in Asheville, N. C. and forwarded to ORNL.

Amendment 1
Amendment 2

Reference

9. What are the lengths of condenser cooling water lines between condenser intake and outfall structures for each unit? What are the dimensions of the condenser tube? What material is used for the lines to and from the condensers? 4.1.4

10. Physical Effects of Thermal Discharge

    A. Supply the basic assumptions and derivations of the variable in the equation for Area A on p. 4.1-8 of the ER. 4.1.5

    B. Show derivation of heat exchange coefficient, K, and the diffusivity of equation (1) on p. 4.1-8 of the ER. 4.1.5

    C. Show derivation of equation (2) on p. 4.1-9 of ER. 4.1.5

    D. Describe the procedure in detail for developing a set of isotherms on the lake surface, and give a sample calculation. 4.1.5

11. What is the disposition of the material removed from the traveling screens? Where does the trash trough on the intake structure lead? 4.1.4

12. Supply a table of water usage in the plant, omitting internal closed cycle systems. For example, condenser cooling water, sanitary water, etc. Indicate source and disposition of water and chemical treatment. 4.3.3.1

13. Supply a table of surface areas in each of the sections defined in the ER at 570 ft msl (full pond) and at 5 ft increments to 535 ft msl. 4.1.5

14. Provide water quality information on Mt. Island Lake (ahead of the dam) and the Catawba River (immediately below Wylie Station). Include: 3.9

    A. phosphate and

    B. total nitrates.

15. Provide details of the intake and discharge for Mt. Island Dam and Wylie Dam. Indicate elevations for each intake and discharge. 2.4.4

16. Indicate details of the Allen Steam Plant including: 3.1.1

    A. Intake

Reference

1. plot plan
2. size and centerline elevation of openings
3. flow
4. number of pumps
5. velocity at the trash racks and screens

B. Condenser

1. lowest ΔT
2. monthly ΔT
3. inlet and outlet temperature by month (average)
4. method of cleaning tubes

C. Discharge

1. plot plan
2. flow
3. centerline elevation of opening

D. Travel time - provide travel time from condenser inlet to the end of the discharge piping.

17. Provide a detailed evaluation of the effect of Catawba Nuclear Station on early stratification of the lake. Indicate historical and predicted onset of stratification, and explain the basis for your prediction. 4.1.5

18. Provide dissolved nitrogen concentration by month and by depth for the winter period for the Catawba site. 4.1.6.4

19. What is the applicant doing to promote recreation in the area within 5 miles of the plant? Have they provided recreation parks for picnicking, camping, water sports, etc? Provide a map showing recreational areas. Discuss plans for an information center, if any. 3.3

20. A comment in the Environmental Report referred to solid waste disposal problems in the area. What is being done to improve the situation, and what is the present status of the situation? 3.8

21. What is the use of the Concord Church property? Give more information on the historical aspect of the property. 4.4.1

22. Discuss road relocation in more detail. How much traffic is on the road? What is at the end of the road? What is its use? What is the cost (economic and environmental) of relocating the road? Discuss proposed public area to be built near the new bridge. 4.4.1 3.3

		Reference
23.	What is the land use and zoning in a 5-mile radius?	4.4.1
24.	Supply an artist sketch of the plant.	2.2
25.	Discuss any archeological surveys or diggings other than those discussed in the ER that have been done in the area. Are further studies planned?	4.4.3.1
26.	Give the location of the closest residence, the closest school, the closest church, the closest hospital, the closest farm, and the dairy herd in each of sixteen 22.5° sectors about the site. The location (distance) in the sector need only be specified if they are less than 10 miles from the site.	4.4.1
27.	List the major products (dairy, orchard, vegetable, etc.) from farms about the site. Describe the location of the major types of farming in relation to the site. Provide the value of crops grown in York and Mecklenburg Counties in 1970 or 1971.	4.4.1
28.	Provide an aerial photograph that shows the area around the plant within 2 miles.	4.4.1
29.	Provide a map showing all residences (temporary and permanent) and farms within 2 miles of the site.	4.4.1
30.	Provide a site plan which shows construction buildings, facilities, roads, construction yards, etc., which will be removed after construction.	4.5
30A.	Discuss the Arrowood Industrial Park in terms of number of industrial types, numbers of employees, projected growth, etc.	4.4.1

<u>Water - Biological</u>

31.	Indicate the fish species found between Wylie Dam and Fishing Creek Lake.	4.1.6
32.	Identify phytoplankton species present in Lake Wylie. Provide relative abundance at least bi-monthly.	4.1.7
33.	Indicate the location of all sampling stations for collecting biological information. Provide a map identifying sampling stations in the intake and discharge areas.	4.1.8

Reference

34. Provide the results of any zooplankton and phytoplankton entrainment studies which have been conducted at Duke Power Company power plants. 4.1.7

In support of this information, give details of the power plant which can be used in evaluating the studies. These should include the following data on the plant being studied:

A. intake design

1. size
2. location
3. flow
4. velocity

B. condenser

1. ΔT
2. maximum outlet temperature

C. time-temperature relationship

35. Provide the data and/or results of benthic studies which have been conducted on Lake Wylie. 4.1.8

36. Provide an evaluation of the probable impact of the thermal discharge on spawning success at the Catawba site. 4.1.6.2

37. Provide an indication of the frequency of impingement losses of fish at other Duke power plants where approach velocities are similar to the proposed Catawba design. 4.1.6.3

38. Provide the measured nitrogen gas concentration for the Marshall Steam Plant area during the winter of 1970-1971 and 1971-1972. 4.1.6.4

Ecology of the Area

39. Provide more specific information concerning the site itself:

A. Vegetation survey listing relative abundance, age classes and precent composition by major species within the area which will be disturbed during the course of construction of Catawba Nuclear Station and its transmission lines. 3.4.1

Reference

B. Specific information of faunal composition is required relative to population densities; actual numbers of mammalian and avian species occurring within the immediate area circumscribed by site boundaries and transmission line rights-of-way. This information must include best estimates of occurrence of transient species, as well as information regarding any unusual habitat preferences which may be ascribed to species mentioned. 4.1.3.2

C. Provide a large contour map of the geographic area lying within a 50-mile radius of the Catawba site, showing site location, other generating facilities (steam plants and hydroelectric sites), transmission line corridors (existing as well as proposed and alternates), ecological and meteorological sampling stations, location of substations (existing and proposed), and switching assemblies. Alternative site locations and associated transmission line routes should be provided. 1.

D. Indicate the location of terrestrial sampling stations for collecting biological information. This should include a description of the type and frequency of sampling proposed. 4.1.3.2

Other Construction Considerations

40. What is the proposed method of disposal of land clearing debris and other trash and garbage associated with construction? Include a map showing cut and fill areas along with areas where no clearing is proposed. 4.5 4.5.2

41. What techniques will be used in seeding, sodding, etc.? What are possible alternatives to complete clearing? 4.5.2

42. How much "beefing up" of local roadways will be required for transport of heavy construction machinery, nuclear fuel, radwaste, etc.? What impact is expected as a result? 4.5

43. What noise levels will exist at varying distances from the plant during the construction period? During operation? What is the environmental effect of these levels? 4.5.3

44. Provide a more detailed list of construction schedule highlights. 2.3.1

45. Give construction and operation details for the railroad spur to be constructed. Assess the impact from an economic and environmental 4.5.4

		Reference
	standpoint. Provide a map showing the routing and describe land usage of the areas involved.	
46.	Assess the impact of construction of the underwater weir and the intake skimmer wall. Include the type of material used, the volume of material, and the source of the material.	4.5.2
2 46A.	Evaluate the interaction caused by the elevated temperatures with municipal and industrial wastes downstream of Wylie Dam. This should include an evaluation of dissolved oxygen, increased toxicity of chemicals, alteration of species composition of aquatic organisms and changes in cost of purification and/or suitability of water for domestic water supplies.	4.1.5.1
2 46B.	Identify private waste treatment facilities on Lake Wylie in the area between the Catawba intake and the Wylie Dam. Evaluate the interaction of the Catawba discharge water with the waste effluent from these facilities.	4.1.5.1
46C.	Evaluate the possibility of algal blooms in the emergency cooling water pond which could result from construction of the dam across Beaver Dam Creek.	4.3.5
46D.	Discuss methods being considered for dealing with possible Asiatic clam infestation similar to that at Allen Steam Plant.	4.1.4
47.	Give the construction details of the switching station.	4.4.1.1

Chemical Discharge

48.	Provide a simple block diagram showing the various sources of chemical discharge to the waste water collection basin. Include in this a full lising of chemicals involved and the average and maximum concentrations and volumes expected from each source.	4.3.3.6
49.	Specify the expected treatment for the steam generator blowdown in case of tube defects.	4.3.3.7
50.	No treatment is specified for control of organic growth in the station service water system. Is any treatment to be used in this system and if used, what will it be?	4.1.4
51.	Describe the filter bed supply system for the station water supply, including the average volume of water treated, the volume of filtering material used, the average frequency and volume of flushing to the collection basin and the disposal of the solids after collection in the collection basin.	4.3.2

Reference

52. Describe the waste water collection basin giving dimensions, frequency and type of monitoring, rate of effluent flow, point of discharge into the river. 4.3.3.6

53. Regarding the sewage treatment system, what is the estimated load for the temporary and permanent systems? What is the frequency and disposal method for the sewage solids? Estimate the amount of Cl_2 required on a per day basis for each system. What will be the average flow of effluent and residual chlorine content of this flow to the waste water collection basin? Provide a description of monitoring procedures to be used and identify the form of the chlorine being measured. 4.3.3.2 4.3.3.3

54. What disposal is made of the activated carbon filters used for cleaning up the laundry waste water? Give amounts used. 4.3.3.4

55. Provide chemical analysis of the intake water from the Catawba River arm of Lake Wylie to include a) BOD, b) ammonia-nitrogen, c) total organic carbon and d) total dissolved solids. 5.3.1.1

56. What disposal will be made of possible oil and other organic spillage in the turbine building and other similar buildings? 4.3.3.6

57. What is the average volume of water expected to be processed through the demineralizer bed in the treated water system? 4.3.4

58. In connection with the demineralizer bed what pH will the mixed regenerative solution have? 4.3.4

59. What pH will be maintained in the waste basin and what provision are made for controlling this? 4.3.3.6

60. What, if any, monitoring will be carried out to check for heavy metal contamination in the reactor and waste basin effluent? 4.3.3.6

61. Is the use of anti-corrosives, such as chromate, contemplated? If so, what amounts? 4.3.3.4

62. Is the "station water supply" synonymous with the potable water supply? If not, what is the source of potable water? What is the amount of Cl_2 used and what biocide treatment is given to this supply? 4.3.2

Reference

63. Indicate the chemicals, quantities, and disposal of all degreasing and cleaning solutions used prior to start up. 4.3.3.4

64. Indicate the methods to be used for disposing of garbage and other nonradioactive trash during operation. 4.3.3.1

Transmission Lines and Related Facilities

65. Contour maps are required showing existing substations and points at which Catawba Nuclear Station transmission lines will connect with existing systems, locations of existing transmission corridors, proposed rights-of-way for Catawba lines, and delineation of alternate routes. 4.4.2

66. Information is required regarding geologic, topographic, aesthetic, and economic criteria involved in selection of proposed and alternate transmission line routes. 4.4.2

67. Land use information is required stating the total acreage of land diverted from its original use and what percentage of the total land use within areas occupied by the plant site and proposed transmission corridors is attributable to agriculture, pasture lands, recreation, etc. What is the value of this land in dollars and productivity? What land use practices will be allowed on transmission line rights-of way after construction? 4.4.2

68. What road construction is required in terms of both proposed and alternate transmission line routes? What will be the disposition of such access roads after construction? 4.4.2

69. Show schematic of tower base setting, dimensions, type material, and describe the type and size mechanical equipment that will be used to set towers and string wire? What will be the environmental impact of this construction in the corridors? 4.4.2 4.4.2.1

70. What specific management practices will be followed on transmission corridors after construction? 4.4.2

A. What will be frequency of bush-hogging, clearing?

B. Will herbicides be used? If so, what are specific chemicals, concentrations applied, and frequency of application?

C. What specific types of vegetation will be seeded?

Need for Power		Reference
71.	Provide the reserve requirements of the system in terms of the reserve criteria. List the reserve criteria. Particular emphasis should be placed on the reserve requirements for 1978-1980.	2.3
72.	List the potential neighboring system with which the applicant could be connected in 1979-1980? Did the applicant consider such tie-ins to regional power grids? Clarify commitments made with neighboring utilities.	2.3
72A.	Summarize Duke Power Company's method of load forecasting.	2.3
72B.	Provide the 1972 peak load.	2.3
72C.	Clarify Table 2.3-2 of the Environmental Report.	2.3
73.	What is the estimated cost of replacement power if purchased? Supply data to support conclusion that power can not be purchased from neighboring utilities.	2.3
74.	What are the capital, fuel, and operating costs for gas turbines in the Duke Power Company system? What is plant factor for existing gas turbines?	5.1.1
75.	What is the estimated scheduled downtime per year for each of the five nuclear plants in the applicant's system in 1979-1980?	2.3

Other Cost Considerations

76.	What interest rate and what plant life were assumed in the economic studies?	7.3.1
77.	What is the expected tax contribution to local and state governments from the plant? Discuss tax exemption status of this plant.	7.6.6

Alternative Cooling Modes

78.	Show location and dimensions of alternative cooling structures open and closed-cycle in relation to plant site and local topography (include a description of intake and outfall structures). Particular emphasis should be placed on the mechanical draft closed-cycle system.	5.3

		Reference
78A.	Describe the service water system for the plant using a closed-cycle alternative to include expected discharge temperatures.	7.4
79.	Supply information concerning amounts source and chemical concentration and biological effects associated with blowdown and drift from mechanical and natural draft towers.	5.3.1
80.	Discuss biological effects of biocides and anti-corrosive agents associated with cooling towers for a freshwater environment.	5.3.1.2
81.	Specify operating conditions for each alternative system. Would this change with season?	7.4
82.	How much blowdown would be required in a closed-cycle system and provide details of cooling tower treatment.	5.3.1.1
83.	Supply expected operating ranges and approach temperatures for a closed-cycle system. Discuss the anti-corrosive agents and biocide treatment proposed for this system, with particular emphasis on chlorine.	5.3.1.1 7.4.2
84.	What is the normal incidence of fog in the area and how much would this be increased by wet cooling towers?	2.4.1
85.	What is the predicted magnitude and frequency of a visible plume in the case of wet cooling towers?	2.4.1
86.	Supply a more detailed evaluation of dry cooling towers as an alternative.	7.4.3
87.	Were spray modules, canals, cooling ponds, and different intake and outfall configurations considered as alternatives? If so, what are the results of these studies? If not, supply estimates of such systems.	7.4
88.	Provide economic costs and the expected environmental impact of all alternatives.	7.6.7
89.	Provide an economic comparison of high flow rates vs low flow rates in supplemental cooling towers.	5.3

Alternate Sites	Reference
90. Provide additional site environmental data to include land use data and expected ecological impact of each alternative site.	7.2.1
91. How many people would be displaced, and how many buildings removed to construct the plant?	7.6.7
92. Indicate the positive and negative values for each of the alternative sites. Give the reason each site was rejected.	7.6.7
Commitment of Resources	
93. Identify all materials used in the plant which are either (a) usually reclaimed, (b) precious metals, (c) strategic and critical materials stockpiled in the U. S., or (d) generally known to have small natural reserves. State, in metric units, the total inventory or cumulative quantity of each material, the quantity that is expected to be reclaimed, and the quantity that will be unrecoverable.	4.10
Radiological Effects	
94. List and describe the anticipated or planned cooperative radiological monitoring programs with state and federal agencies in the Catawba nuclear plant area. (see ER, page 4.2 - 10)	4.2.6
95. Summarize in tabular form the analytical sensitivity or the detection sensitivity and the type of analysis to be performed for each of the proposed kind of samples.	4.2.6
96. Provide estimates of the amount of recirculation of radionuclides through Lake Wylie to the Catawba plant cooling water intake. Give expected concentrations of radionuclides in Lake Wylie and all the downstream lakes through Lake Wateree. List all assumptions made in determining the quantities.	4.2.2
97. List the assumptions made and dose models used in determining the dose estimates given on ER 4.2.5.	4.2.5.1
98. Give the doses calculated and assumptions made in reaching the decision to exclude terrestrial pathways to man from gaseous waste releases. (see page ER 4.2-4)	4.2.5.1
99. Provide doses to biota other than man. Give assumptions and models.	4.2.5.3

Reference

100. Identify the sites of fuel fabrication, fuel reprocessing, and radwaste disposal - including distances from the Catawba plant. Provide calculations of the estimated direct radiation exposure to man attributable to the transportation of these materials, including assumptions and models. 4.2.9

101. Provide an estimate of the total external dose and total population direct radiation. Include models and assumptions. 4.2.10