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**HARRIS NUCLEAR PLANT
1997 ENVIRONMENTAL MONITORING REPORT**

August 1998

Environmental Services Section

CAROLINA POWER & LIGHT COMPANY
New Hill, North Carolina

Preface

This copy of the report is not a controlled document as detailed in the *Environmental Services Section Biology Program Procedures and Quality Assurance Manual*. Any changes made to the original of this report subsequent to the date of issuance can be obtained from:

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Metric-English Conversion and Units of Measure

Length

1 micron (μm) = 4.0×10^{-5} inch
 1 millimeter (mm) = 1000 μm = 0.04 inch
 1 centimeter (cm) = 10 mm = 0.4 inch
 1 meter (m) = 100 cm = 3.28 feet
 1 kilometer (km) = 1000 m = 0.62 mile

Area

1 square meter (m^2) = 10.76 square feet
 1 hectare (ha) = 10,000 m^2 = 2.47 acres

Volume

1 milliliter (ml) = 0.034 fluid ounce
 1 liter = 1000 ml = 0.26 gallon
 1 cubic meter = 35.3 cubic feet

Weight

1 microgram (μg) = 10^{-3} mg or
 10^{-6} g = 3.5×10^{-8} ounce
 1 milligram (mg) = 3.5×10^{-5} ounce
 1 gram (g) = 1000 mg = 0.035 ounce
 1 kilogram (kg) = 1000 g = 2.2 pounds
 1 metric ton = 1000 kg = 1.1 tons
 1 kg/hectare = 0.89 pound/acre

Temperature

Degrees Celsius ($^{\circ}\text{C}$) = $5/9$ ($^{\circ}\text{F}-32$)

Specific conductance

$\mu\text{S}/\text{cm}$ = Microsiemens/centimeter

Turbidity

NTU = Nephelometric Turbidity Unit

Water Chemistry Abbreviations

Cl ⁻ - Chloride	TOC - Total organic carbon	Cu - Total copper
SO ₄ ²⁻ - Sulfate	TS - Total solids	Hg - Total mercury
Ca ²⁺ - Total calcium	TDS - Total dissolved solids	Ni - Total nickel
Mg ²⁺ - Total magnesium	TSS - Total suspended solids	Pb - Total lead
Na ⁺ - Total sodium	Al - Total aluminum	Se - Total selenium
TN - Total nitrogen	As - Total arsenic	Zn - Total zinc
NH ₃ -N - Ammonia nitrogen	Cd - Total cadmium	
TP - Total phosphorus	Cr - Total chromium	

Executive Summary

Harris Reservoir supplies makeup water to the closed-cycle cooling system for the Harris Nuclear Plant. The Harris Nuclear Plant discharges primarily cooling tower blowdown along with low volume waste discharges into the reservoir near the main dam.

Nutrient concentrations, including total phosphorus and total nitrogen concentrations, remained stable for the reporting period (1993-1997) and were in an acceptable range for a productive reservoir in this area. The concentrations of most chemical constituents did not exhibit any consistent statistically significant temporal changes and were in ranges which were not considered detrimental to the biological community.

No nuisance algal blooms were observed in Harris Reservoir during 1997; however, at a single location, the chlorophyll *a* concentration exceeded the state water quality standard during May. Algal blooms have been a concern in previous years because blooms indicate increased nutrient loading which can degrade water quality.

Monitoring of biofouling organisms continued in 1997. Asiatic clams were found in low to moderate numbers in the main reservoir service water system, the cooling water makeup system, and the emergency service water system. The presence of Asiatic clams in these systems did not affect power plant operations. No clams were found in the power plant's fire protection system. Zebra mussels, another potential biofouling organism, were not collected in the main or the auxiliary reservoirs. To date, this organism has not been found in North Carolina waters.

Hydrilla continued to be present in the auxiliary reservoir during 1997. The attempt to control hydrilla in the auxiliary reservoir by releasing grass carp in the fall of 1994 and 1996 appeared to be effective in reducing quantity and area covered by this vegetation. A supplemental stocking of grass carp in the auxiliary reservoir was done in the fall of 1997. These fish are expected to help prevent the proliferation of aquatic vegetation.

HARRIS NUCLEAR PLANT 1997 ENVIRONMENTAL MONITORING REPORT

Reservoir Description

The main body of Harris Reservoir has a surface area of 1680 ha; the auxiliary reservoir has a surface area of 130 ha (Appendix 1). The main reservoir has a maximum depth of 18 m, a mean depth of 5.3 m, a volume of $8.9 \times 10^7 \text{ m}^3$, a full-pool elevation of 67.1 m National Geodetic Vertical Datum (NGVD), and an average residence time of 28 months. The reservoir began filling in December 1980, and full-pool elevation was reached in February 1983. The 64.5-km shoreline is mostly wooded, and the 183.9-km² drainage area is mostly rolling hills with land used primarily for forestry and agriculture. The conversion of areas from forestry or agricultural purposes to residential uses continues in many areas of the drainage.

Harris Reservoir has a "Class C" water quality classification (NCDEM 1994a). Class C waters are suitable for aquatic life propagation and maintenance of biological integrity (including fishing and fish), wildlife, secondary recreation, agriculture, and any other usage except for primary recreation or as a source of water supply for drinking, culinary, or food processing purposes (NCDEM 1994b).

Historical Overview

Harris Reservoir was constructed to supply cooling tower makeup and auxiliary reservoir makeup water to the 900-MW Harris Nuclear Plant which began commercial operation in May 1987. In 1986 the bottom waters of the reservoir near the main dam began receiving National Pollutant Discharge Elimination System (NPDES)-permitted wastewater discharges from the power plant cooling tower. Tributaries also receive NPDES-permitted discharges from the Harris Energy and Environmental Center and from wastewater treatment plants at Apex and Holly Springs.

The environmental monitoring programs that were conducted after Harris Nuclear Plant initiated commercial operation determined that Harris Reservoir was a typical southeastern, moderately productive reservoir with seasonal oxygen-deficient subsurface waters, elevated nutrient and algal concentrations, an abundance of rooted shallow-water aquatic plants, and a productive sport fishery.

Throughout its history, the reservoir has increased in biological productivity. Nutrient loadings from point and nonpoint sources increased the algal biomass of Harris Reservoir from a low/moderate range to a moderate/high range within the period 1986-1989. In 1994, Harris Reservoir was described as support-threatened because of elevated nutrient levels (primarily total nitrogen) (NCDEM 1995). Support-threatened reservoirs are those that fully support their designated uses but may not fully support uses in the future (unless pollution control action is taken) because of anticipated sources or adverse pollution trends (NCDEM 1994a). The annual mean total nitrogen concentration increased through 1993, but from 1993 to 1996 concentrations remained similar. Total phosphorus concentrations remained stable during 1993 through 1996 and at levels acceptable for southeastern, productive reservoirs.

With the increase in nutrients, an increase in algal biomass (as estimated by chlorophyll *a* concentrations) was observed throughout much of the reservoir. On at least one occasion each year from 1989 to 1994, the chlorophyll *a* concentration was above the North Carolina water quality standard (40 $\mu\text{g/liter}$) in Harris Reservoir. During 1995 and 1996 no measured chlorophyll *a* concentration exceeded 40 $\mu\text{g/liter}$. Chlorophyll *a* concentrations above 40 $\mu\text{g/liter}$ imply algal blooms and potential water quality degradation.

In 1984 the reservoir was colonized by the Asiatic clam (*Corbicula fluminea*). This nonnative organism has the potential to block power plant pipes and tubes in raw-water systems. Although densities remained at low levels during 1991 and 1992, the presence of shells along the shoreline in many areas has indicated that the clam has continued to spread throughout the main reservoir. Asiatic clams have not interfered with power plant operations at the Harris Nuclear Plant.

The aquatic plant hydrilla (*Hydrilla verticillata*) was initially found in 1988 growing in the White Oak Creek arm. Within a two-year period, this nonnative species had displaced native species and become the dominant littoral zone plant species. Since 1990 creeping water primrose (*Ludwigia uruguayensis*) has also increased its littoral zone coverage in the main reservoir. Hydrilla and water primrose were observed in the auxiliary reservoir in 1993 and by 1994 they were widespread. The distribution and abundance of hydrilla and water primrose in 1996 were similar to 1995 distribution and abundance patterns. Despite these shifts in the structure of the aquatic macrophyte community, the community has not impacted Harris Nuclear Plant operations.

Objectives

The primary objective of the 1997 Harris Nuclear Plant nonradiological environmental monitoring program was to provide an assessment of the effect of power plant operations on the water quality in Harris Reservoir. Secondary objectives of the program were to document any other environmental factors impacting water quality and to document the introduction and expansion of nonnative plant and animal populations in the reservoir. These objectives have also been addressed in previous reports (e.g., CP&L 1991, 1992, 1994a, 1994b, 1996a, 1996b, 1997).

Methods

Key indicators of the water quality of Harris Reservoir were assessed at various locations in the reservoir (Figure 1 and Table 1). These key indicators were used to describe and interpret the environmental quality of the reservoir and were included if there was an occurrence or the potential for a significant change, trend, or an abnormal event. Other items were included as key indicators when there was environmental, public, or regulatory interest.

The 1997 environmental program included monitoring the reservoir's: (1) limnological characteristics (water quality, water chemistry, and chlorophyll *a*), (2) Asiatic clam populations, (3) distribution of aquatic vegetation, (4) possible introductions of the zebra mussel and the quagga mussel and (5) a roving-point access creel survey. Sampling methods for all monitoring, except the creel survey, in 1997 were similar to those used in 1995 (CP&L 1996b) (Table 2). Creel survey methods were developed and implemented (July, 1997) by the North Carolina

Wildlife Resources Commission. No largemouth bass fishing tournaments were monitored. An assessment of the Thomas Creek fishery recovery following a fish kill resulting from the effects of Hurricane Fran was conducted on October 20, 1997. A summary of this assessment was included in the Harris Plant Annual Environmental (Nonradiological) Operating Report, Appendix B.

Supporting data summaries and appropriate statistical analyses were used to describe and interpret the environmental quality of the reservoir (Table 3). Monthly precipitation data from Sanford, North Carolina, during 1993 to 1997 are presented as a reference to interpret the environmental data (Figure 2).

All analytical testing, except total phosphorus analyses, completed in support of the Harris Reservoir environmental monitoring program was performed by testing laboratories that are certified by North Carolina Division of Water Quality's (NCDWQ) Laboratory Certification Program to perform water and wastewater testing. The validity of these data was assured through CP&L's quality control program. For calculation of means in this report, concentrations of less than the reporting limit were assumed to be at one-half the reporting limit.

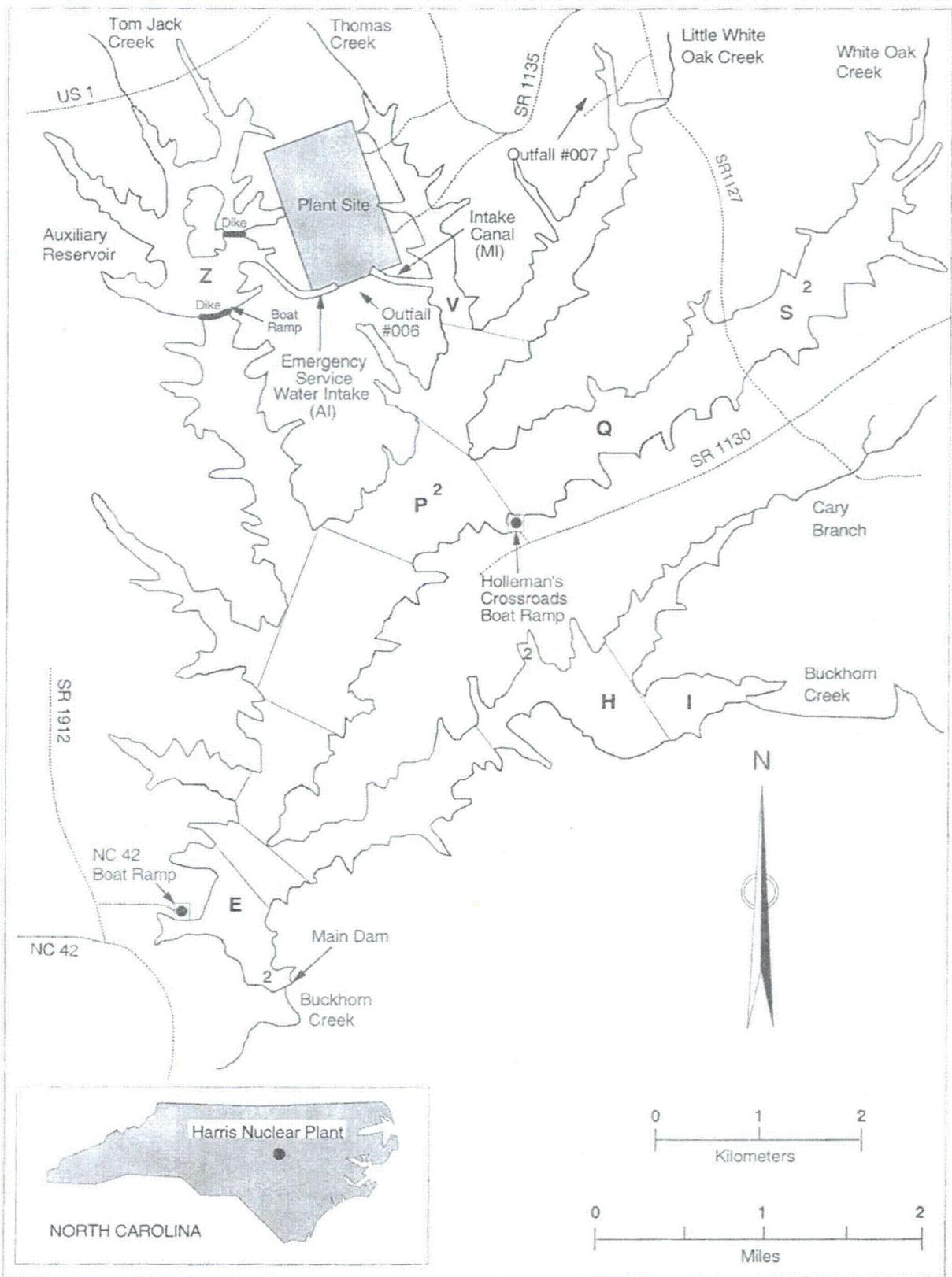


Figure 1. Sampling areas and stations at Harris Reservoir during 1997.

Table 1. Environmental monitoring program at Harris Reservoir for 1997.

Program	Frequency	Location
Limnology ⁽¹⁾		
Water quality (temperature, dissolved oxygen, pH, conductivity, Secchi disk transparency)	Jan, May, Jul, Nov	Stations E2, H2, P2, and S2 (surface to bottom at 1-m intervals)
Water chemistry	Jan, May, Jul, Nov	Stations E2, H2, P2, and S2 (surface samples at all stations, bottom sample at E2 only)
Chlorophyll <i>a</i>	Jan, May, Jul, Nov	Stations E2, H2, P2, and S2
Biofouling monitoring surveys		
Asiatic clam (<i>Corbicula</i>)	May, Nov	Emergency service water and cooling tower makeup system intake structures
Zebra mussel	Jan, May, Jul, Nov	Areas E, P or Q, and V
Aquatic vegetation survey	Nov	Areas V and Z

⁽¹⁾ Sampling frequency for water quality, water chemistry, and chlorophyll *a* parameters was reduced from alternate months (Jan, Mar, May, Jul, Sep, and Nov) during 1996 to quarterly (Jan, May, Jul, and Nov) during 1997.

Table 2. Field sampling and laboratory methods followed in the 1997 environmental monitoring program at Harris Reservoir.

Program	Method
Water quality	Temperature, dissolved oxygen, pH, and conductivity were measured with calibrated Martek Mark XV [®] and YSI [®] instruments. Measurements were taken from surface to bottom at 1-m intervals. Water clarity was measured with a Secchi disk.
Water chemistry	Surface (Stations E2, H2, P2, and S2) and bottom samples (Station E2) were collected with a nonmetallic Van Dorn sampler, transferred to appropriate containers, transported to the laboratory on ice, and analyzed according to accepted laboratory methods.
Phytoplankton	Equal amounts of water from the surface, the Secchi disk transparency depth, and twice the Secchi disk transparency depth were obtained with a Van Dorn sampler and mixed in a plastic container. A 250-ml subsample was taken and preserved with 5 ml of "M3" fixative.
Chlorophyll <i>a</i>	Equal amounts of water from the surface, the Secchi disk transparency depth, and twice the Secchi disk transparency depth were obtained with a Van Dorn sampler, placed in a plastic container and mixed, then a 1000-ml subsample was collected in a dark bottle. All samples were placed on ice and returned to the laboratory. In the laboratory a 250-ml subsample from each depth was analyzed according to Strickland and Parsons (1972) and APHA (1992).
Asiatic clam	Seven samples were collected with a petite Ponar from the emergency service water and cooling tower makeup intake structures. Samples were sieved through a No. 5 U.S. Standard Testing Sieve (4mm mesh). The sieved material was preserved with 5% formalin and returned to the laboratory where the clams were counted and measured. Results were recorded on the Harris Nuclear Plant Biofouling Investigation Form.
Zebra mussel	An artificial substrate sampler, constructed of a PVC frame and fitted with removable PVC plates, was placed near the cooling tower makeup intake structure. This sampler, the dock at the Holleman's boat ramp, or the water quality station marker buoy was visually inspected for the presence of mussels during routine water quality or Asiatic clam survey monitoring.
Aquatic vegetation survey	Portions of the shoreline and/or littoral zone of the main reservoir Harris Plant intake canal and auxiliary reservoir were systematically surveyed by boat to document the presence of aquatic vegetation specifically hydrilla and creeping water primrose.

Table 3. Statistical analyses performed on data collected for the 1997 environmental monitoring program at Harris Reservoir.

Program	Variable	Statistical test/model ^①	Main effect(s)	Interaction term
Limnology	Water temperature, conductivity, Secchi disk transparency depth, and selected chemical variables	One-way, block on month Two-way, block on month	Station Station, year	Station-by-year
Water chemistry	Monitoring variables	One-way, block on month Two-way, block on month	Station Station, year	Station-by-year
Phytoplankton	Density and chlorophyll <i>a</i>	One-way, block on month Two-way, block on month	Station Station, year	Station-by-year

^①Statistical tests used were one-way and two-way analysis of variance models. A Type I error rate of 5% ($\alpha = 0.05$) was used to judge the significance of all tests. Fisher's protected least significant difference (LSD) test was applied to determine where differences in means occurred.

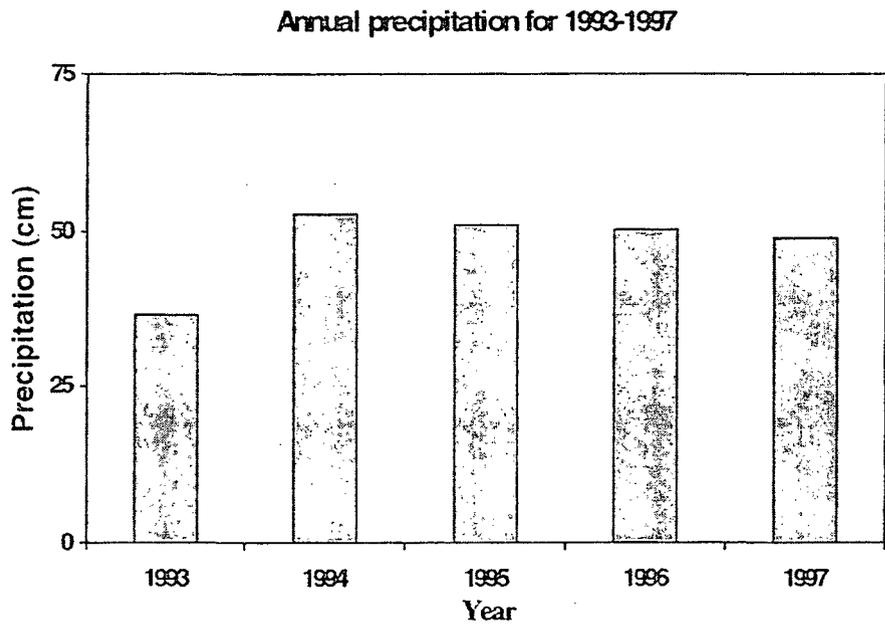
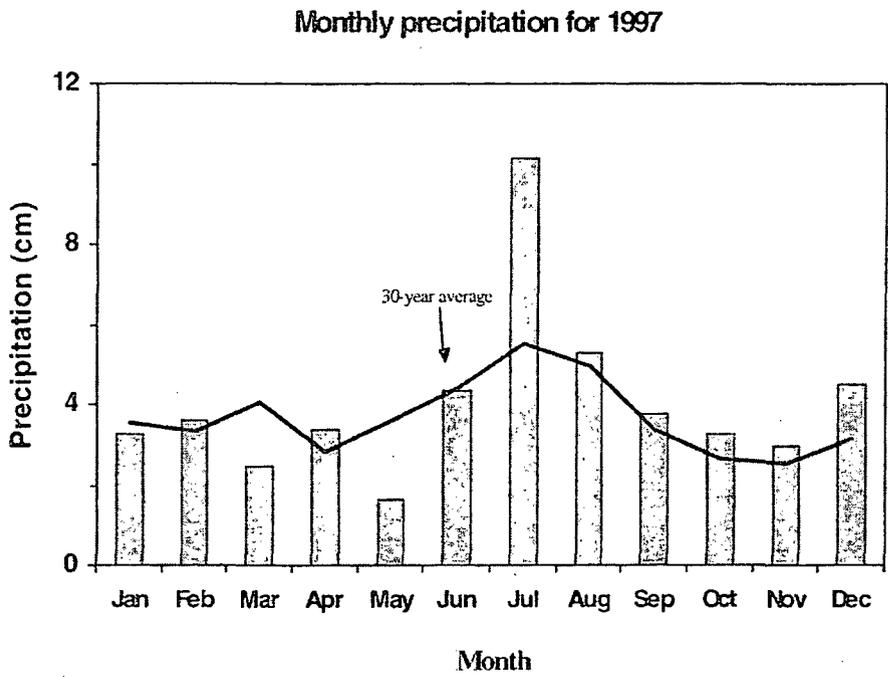


Figure 2. Monthly and yearly precipitation recorded at Sanford, North Carolina, 1993-1997 (source: The State Climatologist, North Carolina State University).

Results of Environmental Monitoring at Harris Reservoir During 1997

Limnology

Annual precipitation

- Annual precipitation at Sanford, North Carolina, during 1997 (110.6 cm) was less than the thirty-year average and less than the precipitation which fell during 1995 (162.7 cm) and 1996 (143.0 cm). The absence of major hurricanes which increased total precipitation during 1996 explains in part why total precipitation during 1997 probably did not exceed the 30-year average (Figure 2).

Temperature and Dissolved Oxygen

- During 1997 Harris Lake surface water temperatures ranged from 9.5 to 28.7°C (Appendix 1). The waters at all reservoir stations were stratified during May and July and were freely circulating during January and November. Portions of the hypolimnion were anoxic (i.e., conditions where dissolved oxygen concentrations are less than 1 mg/liter) at all stations during July (Appendix 1). This bottom-water oxygen decline is typical during the warm summer months in Harris Reservoir and in other southeastern productive water bodies when well-defined thermoclines develop and block bottom waters from mixing with the upper, more oxygenated waters.

Water Clarity

- The Secchi disk transparency depth (a water clarity indicator) annual mean value was significantly less in the upper reservoir compared to the other stations (S2 < P2 = E2 = H2) during 1997 (Appendix 3). This spatial pattern is typical for Harris Reservoir. Except for an increased annual mean Secchi disk transparency value during 1995, Secchi disk transparency values remained similar from 1993 through 1997.
- There were no significant spatial trends for solids (i.e., total solids, total dissolved solids, and total suspended solids) or turbidity during 1997 for surface waters at Stations E2, H2, P2, and S2; nor were there any consistent statistically significant temporal trends for these variables during the period 1993-1997 (Appendices 3 and 4).

Algal Biomass

- During May 1997 at Station S2, there was a single occurrence when mean chlorophyll *a* concentration exceeded the North Carolina water quality standard of 40 µg/liter (NCDEM 1992) (Appendix 5). Prior to 1997, chlorophyll *a* concentrations have not exceeded the water quality standard since January 1994. Algal densities were moderately high (74,140 units/ml) during May 1997. The numerically dominant taxa were a yellow-green algae (*Chrysochromulina* spp. at 39,961 units/ml), a diatom (*Melosira distans* at 7,288 units/ml), and a flagellated algae (*Cryptomonas erosa* at 7,288 units/ml). These algae, unlike the blue-green algae, typically do not cause nuisance blooms sufficient to degrade water quality.
- Annual mean chlorophyll *a* concentrations did not indicate any consistent spatial (1997 only) or temporal (1993-1997) trends (Appendices 3 and 4).

Nutrients (surface waters)

- During 1997 annual mean total phosphorus concentrations were significantly greater at Station E2 compared to concentrations at Stations H2 and P2 (Appendix 3). Annual mean total phosphorus concentrations were similar at Stations E2 and S2.
- There were no significant spatial differences among stations for mean nitrogen (i.e., ammonia-N, nitrate + nitrite-N, and total nitrogen) concentrations in Harris Reservoir during 1997 (Appendix 3). There were no statistically significant temporal trends for nutrient concentrations during the 1993-1997 period (Appendix 4).

Ions (surface waters)

- Except for annual mean magnesium and sodium concentrations which were significantly greater at the main lake Stations E2, H2, and P2 than the upstream Station S2, there were no spatial differences in ion concentrations during 1997 (Appendix 3).
- With the exception of annual mean chloride concentrations which were significantly less for 1997 compared to concentrations during 1993-1996, there were no consistent temporal trends for the other ion concentrations during the 1993-1997 comparison period (Appendix 4).

pH, Total Alkalinity, Total Organic Carbon, and Hardness

- The median pH in the surface waters of Harris Reservoir was 7.0 during 1997 (Appendix 1).
- In 1997 total alkalinity, total organic carbon, and hardness concentrations were not statistically different among stations (Appendix 3).
- There were no consistent significant temporal trends in annual mean total organic carbon, total alkalinity, or hardness concentrations during the 1993-1997 comparison period (Appendix 4).

Trace Metals and Metalloids (surface waters)

- Mean concentrations of trace elements in Harris Reservoir were generally low in 1997 with most concentrations less than or near their respective laboratory reporting limits (Appendix 2). No significant spatial trends were observed during 1997 (Appendix 3). During 1997 aluminum ranged from < 50 to 486 µg/liter with the greater value recorded in a headwater region where aluminum concentrations may have been influenced by watershed sources located upstream of the reservoir (Appendices 2 and 3).
- There were no significant temporal differences among trace element concentrations in Harris Reservoir for the period 1993 to 1997 (Appendix 4).

Chemical Constituents in the Bottom Waters at Station E2

- The concentrations of most chemical constituents in the bottom waters remain within a range expected for productive, southeastern reservoir waters and were not considered detrimental to the biological community.
- In the bottom waters at Station E2, there were no significant differences among years (1993-1997) for solids (total, dissolved, and suspended solids), turbidity, nutrients (total nitrogen, nitrate + nitrite-N, ammonia-N, and total phosphorus), total organic carbon, ions (calcium, chloride, magnesium, sodium, and sulfate), total alkalinity, hardness, and metals (Appendices 2 and 6). There was extreme variability in chemical concentrations between periods of stratification and periods of uniform mixing throughout the water column. This variability was the probable cause for being unable to detect any significant temporal differences in the chemical constituents in bottom waters.

Biofouling Monitoring Surveys

Asiatic Clam

- Asiatic clams caused no operational problems for the Harris Nuclear Plant nor were they collected from the fire protection system during 1997.
- During 1997 no Asiatic clams were collected from the main reservoir service water system Bays 1B-SB and 1A-SA indicating lower densities than observed in 1996. Mean clam densities in the main reservoir cooling water makeup system were similar during 1996 and 1997 (Appendix 7). Clams were present only in samples collected from main reservoir cooling water makeup system Bay 1X. Mean clam densities were also similar in the auxiliary reservoir service water system during 1996 and 1997. Clams were collected from auxiliary reservoir service water system Bays 6 and 8 during April 1997 and from Bays 1 and 6 during October 1997. All Asiatic clams collected during 1997 were approximately 2-4 years old based on their size ranges.

Zebra Mussel and Quagga Mussel

- No zebra mussels (*Dreissena polymorpha*) or quagga mussels (*D. bugensis*), potentially serious biofouling organisms to power plant operations, were found in Harris Reservoir or the auxiliary reservoir during 1997. Zebra mussels and quagga mussels are not expected to thrive in Harris Reservoir because concentrations of alkalinity, calcium, total hardness, and pH are suboptimal for mussel growth and reproduction (Claudi and Mackie 1993).

Aquatic Vegetation

- A visual survey of the intake canal in Harris Reservoir made during 1997 revealed that hydrilla (*Hydrilla verticillata*), a non-native submersed plant, and creeping water primrose (*Ludwigia uruguayensis*) were established in approximately the same locations and existed in amounts similar to those observed during 1996. Although these aquatic plants were well established in this region, no impacts to the Harris Plant have occurred nor are they expected because of the low velocity of water drawn from the main reservoir into the cooling tower makeup water intake structure.

- During November 1997 hydrilla was present in a patchy distribution of plants throughout the littoral zone of the auxiliary reservoir. The size and extent of hydrilla stands in the auxiliary reservoir during 1997 were considerably diminished from the size and extent of stands observed in 1996.
- Approximately 800 grass carp (*Ctenopharyngodon idella*) were released into the auxiliary reservoir during the fall of 1997, with 400 released on the north side of the dike separating the intake and discharge sides of the auxiliary reservoir and 400 released on the south side of the dike at the boat ramp. These fish and the 800 stocked in 1994 and again in 1996 were released to control the growth and spread of aquatic vegetation. The fish released in 1994 and 1996 apparently were of sufficient size and number during 1997 to decrease the size and extent of hydrilla stands to a patchy distribution of plants which did not reach the water surface.

CONCLUSIONS

During 1997 the Harris Reservoir continued to show characteristics of a typical southeastern, biologically productive reservoir with seasonally occurring oxygen-deficient subsurface waters, elevated nutrient concentrations, and an abundance of rooted shallow-water aquatic plants.

The environmental monitoring program conducted in 1997 continued to provide an assessment of the effects of the Harris Nuclear Plant's operation on the various components of the aquatic environment. Most key indicators of the environmental quality in Harris Reservoir were unchanged from the previous five years. Nutrient concentrations have been a concern in Harris Reservoir since phosphorous and nitrogen concentrations increased rapidly in the late 1980s and early 1990s. Water quality assessments determined that nutrient concentrations have remained stable since 1993 and at levels acceptable for southeastern, productive reservoirs. The annual mean total nitrogen concentrations were similar during the 1993-1997 comparison period. Assessments of other water quality parameters, including solids (total, dissolved, and suspended solids), turbidity, total organic carbon, ions (calcium, chloride, magnesium, sodium, and sulfate), total alkalinity, hardness, and metals, indicate few if any consistent statistically significant spatial or temporal trends with none of these variables at concentrations which would be detrimental to the aquatic community.

The frequency and severity of nuisance algal blooms, as indicated by chlorophyll *a* concentrations, continued to lessen in recent years. For only the second year since 1994 has a measured chlorophyll *a* concentration exceeded the North Carolina water quality standard of 40 µg/l. Reservoir-wide chlorophyll *a* concentrations demonstrated no consistent statistically significant temporal trend for the 1993-1997 period and no nuisance algal blooms dominated by bluegreen algae were observed.

The presence of Asiatic clams in the Harris Nuclear Plant emergency service water system did not impact plant operations in 1997 and no clams were observed in the fire protection system. During 1997 no Asiatic clams were collected from the main reservoir service water system Bays 1B-SB and 1A-SA indicating lower densities than observed in 1996. Mean clam densities in the main reservoir cooling water makeup system were similar during 1996 and 1997. Clams were present only in samples collected from main reservoir cooling water makeup system Bay 1X.

Mean clam densities were also similar in the auxiliary reservoir service water system during 1996 and 1997. Clams were collected from auxiliary reservoir service water system Bays 6 and 8 during April 1997 and from Bays 1 and 6 during October 1997. All Asiatic clams collected during 1997 were approximately 2-4 years old based on their size ranges.

Neither the zebra mussel nor the quagga mussel were found in the main reservoir or the auxiliary reservoir during 1997. These biofouling organisms have yet to be found in North Carolina. Due to potential biofouling impact to Harris Nuclear Plant operations, monitoring was continued.

Based on surveys conducted during 1997, the aquatic plants hydrilla and creeping water primrose were well established in the littoral zone throughout the intake canal of the main reservoir. Hydrilla also was observed in a patchy distribution throughout the littoral zone of the auxiliary reservoir but was less abundant and did not reach the water surface as was the case during 1996. The reduced size and extent of aquatic vegetation stands in the auxiliary reservoir indicates that grass carp released in the fall of 1994 and 1996 markedly reduced the amount and areal coverage of hydrilla during 1997. A supplemental stocking of 800 grass carp was conducted during 1997. These fish are expected to prevent the proliferation of aquatic vegetation in the auxiliary reservoir. No operational impacts have occurred at the Harris Nuclear Plant because of aquatic vegetation biofouling.

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Appendix 1. Water temperature, dissolved oxygen, conductivity, pH, and Secchi disk transparency data collected from Harris Reservoir during 1997.

January 8, 1997

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (µS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	9.5	10.3	10.0	10.7	10.6	10.8	9.9	9.0	83	77	77	69	6.9	6.9	6.5	6.2	1.6	1.9	1.3	0.8
1.0	9.5	10.3	10.0	10.7	10.4	10.6	9.9	8.8	83	77	78	69	6.9	6.9	6.5	6.3				
2.0	9.5	10.3	10.0	10.7	10.1	10.5	9.9	8.7	83	77	79	69	6.9	6.9	6.5	6.3				
3.0	9.5	10.3	10.0	10.7	10.0	10.3	9.8	8.5	83	77	79	69	6.9	6.9	6.5	6.3				
4.0	9.5	10.2	10.0	10.7	9.9	10.1	9.7	8.5	83	79	79	69	6.8	6.9	6.5	6.3				
5.0	9.5	9.5	10.0	10.6	9.8	8.0	9.6	8.0	83	80	79	70	6.8	6.9	6.5	6.2				
6.0	9.5	9.4	10.0		9.8	7.9	9.5		83	81	79		6.8	6.9	6.5					
7.0	9.5	9.4	10.0		9.8	7.9	9.4		83	82	79		6.8	6.8	6.5					
8.0	9.5	9.4	10.0		9.8	7.9	9.2		83	82	79		6.8	6.8	6.5					
9.0	9.5	9.4	9.9		9.9	7.7	9.0		83	82	79		6.8	6.6	6.5					
10.0	9.5		9.9		9.9		7.0		83		79		6.8		6.5					
11.0	9.4				9.8				83				6.8							
12.0	9.4				9.6				83				6.8							
13.0	9.4				9.6				83				6.8							
14.0	9.4				9.6				83				6.8							
15.0	9.4				9.5				83				6.8							
16.0	9.4				9.5				83				6.8							
17.0	9.3				8.7				83				6.6							

May 5, 1997

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (µS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	19.8	21.5	19.6	21.3	9.6	9.1	9.5	8.6	85	78	81	63	7.0	7.0	6.5	5.9	1.5	1.2	1.3	0.5
1.0	18.5	18.7	18.5	18.7	9.6	9.3	9.2	7.5	85	78	81	65	7.0	7.0	6.5	5.9				
2.0	17.3	18.3	17.8	18.5	9.6	8.3	8.6	7.1	85	78	81	64	7.0	7.0	6.5	5.9				
3.0	17.1	18.1	17.7	18.3	8.3	8.0	8.1	6.8	85	78	81	64	7.0	7.0	6.5	5.9				
4.0	17.0	17.8	17.6	18.2	8.1	6.7	7.8	6.4	85	78	81	63	7.0	7.0	6.4	5.8				
5.0	17.0	16.8	17.3	16.8	8.1	5.6	7.4	2.1	85	78	83	68	7.0	7.0	6.4	5.6				
6.0	16.9	16.1	17.1		8.0	4.4	7.0		85	78	83		7.0	6.9	6.4					
7.0	16.8	15.7	16.8		7.5	3.8	6.4		85	75	83		6.9	6.9	6.3					
8.0	16.4	15.4	16.6		6.5	2.9	6.1		85	72	83		6.8	6.8	6.3					
9.0	16.1	15.3	16.4		6.1	1.0	5.3		85	71	85		6.8	6.2	6.2					
10.0	15.8		16.3		5.3		5.2		87		86		6.6		6.1					
11.0	15.5				4.8				87				6.6							
12.0	15.3				4.3				88				6.5							
13.0	15.2				3.8				91				6.5							
14.0	14.6				1.8				93				6.4							
15.0	13.8				0.5				110				6.3							
16.0	13.3				0.1				115				6.2							

Appendix I (continued)

July 2, 1997

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (µS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	28.7	28.5	27.6	27.5	8.2	8.6	7.9	8.3	89	86	87	87	8.7	8.2	7.7	6.9	1.2	1.2	1.3	1.3
1.0	28.8	27.7	27.4	26.9	7.9	7.6	7.8	8.3	88	86	88	87	8.8	8.2	7.8	6.9				
2.0	27.4	27.2	27.2	26.8	6.1	6.5	7.0	7.8	86	84	86	86	8.4	7.9	7.6	6.8				
3.0	25.6	25.7	26.9	25.9	1.6	0.8	5.8	0.8	90	87	86	89	7.8	7.6	7.5	6.4				
4.0	23.9	23.6	23.6	23.9	0.3	0.2	0.2	0.2	95	92	92	102	7.7	7.5	6.9	6.3				
5.0	22.3	21.5	21.8	22.7	0.2	0.2	0.1	0.2	100	97	93	114	7.6	7.4	6.8	6.2				
6.0	21.5	20.3	20.9		0.1	0.2	0.1		103	99	94		7.6	7.3	6.8					
7.0	20.5	19.8	20.1		0.2	0.1	0.1		104	101	97		7.5	7.4	6.8					
8.0	19.8	19.5	19.6		0.2	0.1	0.1		101	105	101		7.5	7.1	6.8					
9.0	19.5	19.0	19.2		0.1	0.1	0.1		97	112	108		7.4	6.5	6.7					
10.0	19.1				0.1				99				7.4							
11.0	18.6				0.1				100				7.3							
12.0	17.3				0.1				110				7.2							
13.0	16.4				0.1				127				7.1							
14.0	15.7				0.1				134				7.0							
15.0	15.4				0.1				140				6.9							
16.0	14.5				0.1				158				6.6							
17.0	14.4				0.1				171				6.4							

November 11, 1997

Depth (m)	Temperature (°C)				Dissolved oxygen (mg/L)				Conductivity (µS/cm)				pH				Secchi disk depth (m)			
	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2	E2	H2	P2	S2
0.2	15.2	15.4	14.9	13.8	7.9	9.2	9.5	9.6	87	85	81	78	7.0	7.3	7.0	7.3	1.2	1.4	1.5	1.9
1.0	15.2	15.3	14.9	13.7	7.8	9.0	9.4	9.5	87	84	81	78	6.9	7.3	7.0	7.3				
2.0	15.2	14.6	14.8	13.3	7.8	8.8	9.3	9.4	87	82	81	77	6.9	7.2	7.0	7.3				
3.0	15.2	14.4	14.6	13.2	7.7	8.5	9.1	9.3	87	81	81	78	6.9	7.1	7.0	7.3				
4.0	15.2	14.4	14.5	12.9	7.7	8.1	8.8	9.2	87	81	80	79	6.9	7.1	6.9	7.2				
5.0	15.0	14.3	14.4		7.5	7.0	8.5		87	80	80		6.9	7.0	6.8					
6.0	15.0	14.3	14.3		7.4	6.9	8.4		87	80	80		6.9	7.0	6.8					
7.0	15.0	14.3	14.3		7.3	6.8	8.1		87	80	80		6.9	6.9	6.7					
8.0	15.0	14.3	14.3		7.3	6.6	7.8		87	80	80		6.9	6.9	6.6					
9.0	15.0	14.3			7.2	6.5			87	80			6.9	6.9						
10.0	15.0				7.2				87				6.9							
11.0	15.0				7.2				87				6.9							
12.0	15.0				7.1				87				6.9							
13.0	14.9				7.0				87				6.9							
14.0	14.9				7.0				87				6.9							
15.0	14.9				7.0				87				6.9							
16.0	14.9				6.9				87				6.9							

Appendix 2. Concentrations of chemical variables in Harris Reservoir during 1997.[®]Station E2

Month	Alkalinity	Hardness	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na	TN	NH ₃ -N	NO ₃ ⁻ + NO ₂ ⁻ -N
Jan	13	15	8.9	13	3.3	1.7	8.9	0.4	< 0.07	0.03
May	11	14	3.3	13	3.2	1.4	7.7	0.5	< 0.07	< 0.02
Jul	12	17	3.0	12	3.9	1.7	8.5	0.9	< 0.07	< 0.02
Nov	23	19	12	13	4.3	2.0	12	0.7	< 0.07	0.20

Month	TP	TOC	Turbidity	TS	TDS	TSS	Al	Cd	Cu	Hg
Jan	0.041	6.5	3.8	91	73	< 6	< 50	< 0.5	1.9	< 0.20
May	0.025	6.6	3.7	34	73	< 6	90	< 0.5	1.7	< 0.20
Jul	0.039	7.5	4.8	50	21	< 6	< 50	< 0.5	1.2	< 0.20
Nov	0.051	10	3.4	40	55	< 6	< 50	< 0.5	1.1	< 0.20

Station H2

Month	Alkalinity	Hardness	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na	TN	NH ₃ -N	NO ₃ ⁻ + NO ₂ ⁻ -N
Jan	13	16	8.6	13	3.7	1.6	9.3	0.8	< 0.07	< 0.02
May	10	15	3.0	13	3.5	1.5	7.7	0.6	< 0.07	< 0.02
Jul	12	16	2.8	11	3.8	1.7	8.3	0.8	< 0.07	< 0.02
Nov	5.7	19	11	13	4.2	2.0	12	0.6	< 0.07	0.15

Month	TP	TOC	Turbidity	TS	TDS	TSS	Al	Cd	Cu	Hg
Jan	0.028	6.6	3.0	69	79	< 6	< 50	< 0.5	1.3	< 0.20
May	0.032	6.6	5.0	45	43	< 6	106	< 0.5	7.7	< 0.20
Jul	0.035	5.6	6.1	49	39	< 6	< 50	< 0.5	< 1.0	< 0.20
Nov	0.031	8.2	2.9	54	39	< 6	< 50	< 0.5	< 1.0	< 0.20

Station P2

Month	Alkalinity	Hardness	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na	TN	NH ₃ -N	NO ₃ ⁻ + NO ₂ ⁻ -N
Jan	12	15	8.8	14	3.4	1.6	8.9	0.8	< 0.07	< 0.02
May	11	15	3.3	14	3.5	1.5	8.0	0.6	< 0.07	< 0.02
Jul	12	17	2.9	10	3.9	1.7	8.5	0.9	< 0.07	< 0.02
Nov	15	18	10	11	4.0	1.9	11	0.5	< 0.07	0.13

Month	TP	TOC	Turbidity	TS	TDS	TSS	Al	Cd	Cu	Hg
Jan	0.029	7.1	4.0	88	68	< 6	< 50	< 0.5	1.4	< 0.20
May	0.026	7.0	4.9	32	53	< 6	88	< 0.5	1.5	< 0.20
Jul	0.038	6.4	5.3	55	23	6	< 50	< 0.5	< 1.0	< 0.20
Nov	0.027	7.6	2.9	43	47	< 6	< 50	< 0.5	< 1.0	< 0.20

Appendix 2 (continued)

Station S2

Month	Alkalinity	Hardness	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na	TN	NH ₃ -N	NO ₃ ⁻ + NO ₂ ⁻ -N
Jan	9.6	14	8.3	13	3.4	1.5	7.7	1.5	< 0.07	0.14
May	7.6	14	2.3	15	3.3	1.3	6.1	0.9	< 0.07	< 0.02
Jul	13	18	2.8	11	4.2	1.8	8.6	0.8	< 0.07	< 0.02
Nov	17	18	10	13	4.1	1.9	11	0.5	< 0.07	0.06

Month	TP	TOC	Turbidity	TS	TDS	TSS	Al	Cd	Cu	Hg
Jan	0.035	6.1	11	46	103	< 6	174	< 0.5	1.2	< 0.20
May	0.066	8.8	24	59	72	11	486	< 0.5	1.5	< 0.20
Jul	0.034	6.1	3.8	58	36	< 6	< 50	< 0.5	1.6	< 0.20
Nov	0.016	7.6	2.0	49	33	< 6	< 50	< 0.5	< 1.0	< 0.20

Station E2 (bottom)

Month	Alkalinity	Hardness	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na	TN	NH ₃ -N	NO ₃ ⁻ + NO ₂ ⁻ -N
Jan	13	18	9.2	14	4.2	1.9	11	0.7	< 0.07	0.04
May	24	18	3.6	14	4.3	1.7	9.7	1.4	0.7	< 0.02
Jul	50	22	3.1	3.3	5.4	2.0	8.8	2.5	2.1	< 0.02
Nov	15	19	11	14	4.2	2.0	12	0.7	< 0.07	0.2

Month	TP	TOC	Turbidity	TS	TDS	TSS	Al	Cd	Cu	Hg
Jan	0.039	7.4	4.1	84	98	< 6	< 50	< 0.5	3.2	< 0.20
May	0.099	7.3	17	54	88	9	59	< 0.5	1.8	< 0.20
Jul	0.24	8.2	4.4	87	74	7	75	< 0.5	1.4	< 0.20
Nov	0.047	8.4	3.1	59	52	< 6	64	< 0.5	1.5	< 0.20

^①Units are in mg/L except for trace metals and metalloids ($\mu\text{g/L}$), turbidity (NTU), total alkalinity (mg/L as CaCO₃), and hardness (calculated as mg equivalents CaCO₃/L).

Appendix 3. Means, ranges, and spatial trends of selected limnological variables from the surface waters of Harris Reservoir during 1997.[Ⓢ]

Variable	Station			
	E2	H2	P2	S2
Solids (mg/liter)				
Total	54 (34-91)	54 (45-69)	55 (32-88)	53 (46-59)
Total dissolved	56 (21-73)	50 (39-79)	48 (23-68)	61 (33-103)
Total suspended	< 6	< 6	< 6 (< 6-6)	< 6 (< 6-11)
Turbidity (NTU)	3.9 (3.8-4.8)	4.2 (2.9-6.1)	4.3 (2.9-5.3)	10 (2.0-24)
Secchi disk transparency (m)	1.4 ^a (1.2-2.6)	1.4 ^a (1.2-1.9)	1.4 ^a (1.3-1.5)	1.1 ^b (0.5-1.9)
Chlorophyll <i>a</i> (µg/liter)	25.1 (10.2-39.2)	22.2 (8.7-35.9)	25.9 (11.7-38.6)	22.0 (1.2-51.2)
Nutrients (mg/liter)				
Ammonia-N	< 0.07	< 0.07	< 0.07	< 0.07
Nitrate + Nitrite-N	0.06 (< 0.02-0.20)	< 0.05 (< 0.02-0.15)	0.04 (< 0.02-0.13)	0.05 (< 0.02-0.14)
Total nitrogen (TN)	0.6 (0.4-0.9)	0.7 (0.6-0.8)	0.7 (0.5-0.9)	0.9 (0.5-1.5)
Total phosphorus (TP)	0.039 ^a (0.025-0.051)	0.032 ^b (0.028-0.35)	0.030 ^b (0.026-0.038)	0.038 ^{ab} (0.016 -0.066)
TN:TP [Ⓢ]	17 (9-22)	22 (18-27)	24 (20-26)	27 (14-43)
Total organic carbon (mg/liter)	7.8 (6.5-10)	6.7 (5.6-8.2)	7.0 (6.4-7.6)	7.2 (6.1-8.8)
Ions (mg/liter)				
Calcium	3.7 (3.2-4.3)	3.8 (3.4-4.2)	3.7 (3.4-4.0)	3.7 (3.3-4.2)
Chloride	6.7 (3.0-12)	6.2 (2.8-11)	6.3 (2.9-10)	5.9 (2.3-10)
Magnesium	1.7 ^a (1.4-2.0)	1.7 ^{ab} (1.5-2.0)	1.6 ^a (1.5-1.9)	1.6 ^b (1.3-1.9)
Sodium	9.2 ^a (7.7-12)	9.2 ^a (7.7-12)	9.0 ^a (8.0-11)	8.3 ^b (6.1-10)
Sulfate	13 (12-13)	12 (11-13)	12 (10-14)	13 (11-15)
Total alkalinity (mg/liter as CaCO ₃)	15 (11-23)	10 (5.7-13)	12 (11-15)	12 (7.6-17)
Hardness (calculated as mg equivalents CaCO ₃ /liter)	16 (14-19)	16 (15-19)	16 (15-18)	16 (14-18)
Conductivity (µS/cm)	86 ^a (83-89)	82 ^a (77-86)	82 ^a (77-87)	74 ^b (63-87)

Appendix 3 (continued)

Variable	N.C. water quality standard	Station			
		E2	H2	P2	S2
Metals (µg/liter)					
Aluminum	None	< 50 (< 50-90)	< 50 (< 50-106)	< 50 (< 50-88)	178 (< 50-486)
Cadmium	2	< 0.5	< 0.5	< 0.5	< 0.5
Copper	75 ^③	1.5 (1.1-1.9)	2.5 (<1.0-7.7)	1.0 (<1.0-1.5)	1.2 (<1.0-1.6)
Mercury	0.012	< 0.02	< 0.02	< 0.02	< 0.02

① Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$). Sample size equaled 4 for all variables unless otherwise noted. The variable TN:TP was not subjected to statistical analyses.

② Variable was not subjected to statistical analyses.

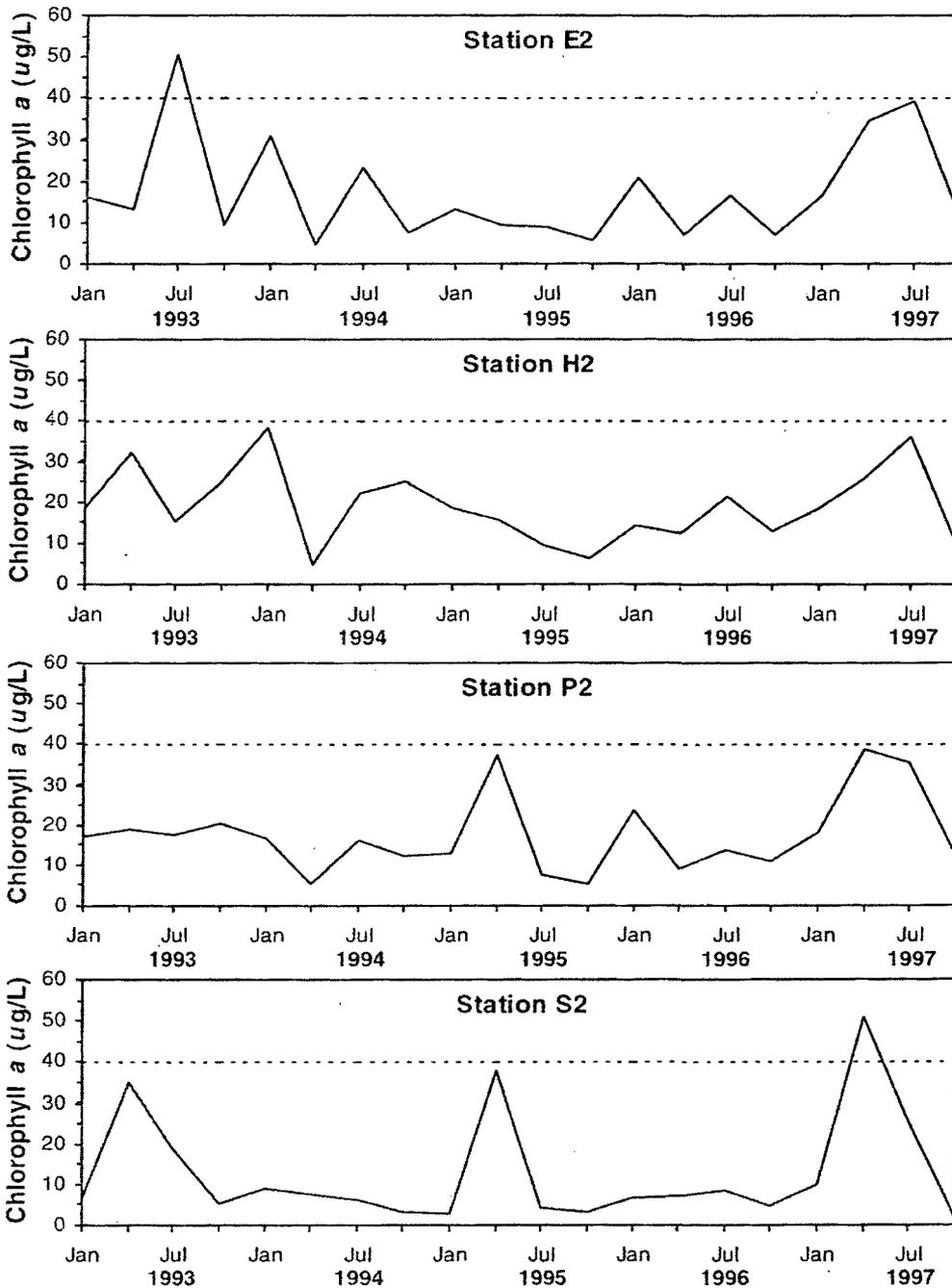
③ This value is an action level, not a water quality standard. An action level is for toxic substances which are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics, or associated waste characteristics (NCDEM 1994b).

Appendix 4. Temporal trends of selected limnological variables from the surface waters of Harris Reservoir at Stations E2, H2, P2 and S2, 1993-1997.^①

Variable	Year				
	1993	1994	1995	1996	1997
Solids (mg/liter)					
Total	64 ^c	69 ^{bc}	74 ^b	89 ^a	54 ^d
Total dissolved	50 ^c	65 ^{ab}	62 ^{bc}	78 ^a	54 ^{bc}
Total suspended	4.6	3.2	2.8	4.4	3.7
Turbidity (NTU)	4.0	3.4	2.6	4.7	5.7
Secchi disk transparency (m)	1.4 ^b	1.5 ^b	2.0 ^a	1.6 ^b	1.3 ^b
Chlorophyll <i>a</i> (µg/liter)	20.0 ^{ab}	14.5 ^{bc}	12.4 ^c	12.3 ^c	23.8 ^a
Nutrients (mg/liter)					
Ammonia-N	0.04	0.04	0.03	0.05	0.03
Nitrate + nitrite-N	0.07	0.05	0.03	0.03	0.05
Total nitrogen	0.63	0.69	0.66	0.86	0.74
Total phosphorus	0.030	0.032	0.033	0.032	0.035
TN:TP ^②	22	25	22	27	22
Total organic carbon (mg/liter)	7.4 ^a	6.1 ^c	7.1 ^{ab}	6.5 ^{bc}	7.2 ^a
Ions (mg/liter)					
Calcium	3.6 ^b	3.6 ^b	4.0 ^a	3.9 ^{ab}	3.7 ^b
Chloride	8.0 ^b	9.3 ^a	9.9 ^a	9.8 ^a	6.3 ^c
Magnesium	1.8 ^b	1.8 ^{bc}	1.9 ^a	1.7 ^{bc}	1.7 ^c
Sodium	8.8 ^b	11 ^a	12 ^a	9.2 ^b	8.9 ^b
Sulfate	12 ^c	14 ^a	14 ^a	13 ^{ab}	13 ^b
Total alkalinity (mg/liter as CaCO ₃)	12 ^c	13 ^{bc}	15 ^a	13 ^b	12 ^{bc}
Hardness (mg equivalents CaCO ₃ /liter)	16 ^b	16 ^b	18 ^a	17 ^b	16 ^b
Conductivity (µS/cm)	64 ^c	92 ^a	96 ^a	80 ^b	81 ^b
Metals (µg/liter)					
Aluminum	69	74	38	58	76
Cadmium	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Copper	1.9	1.3	1.1	2.0	1.5
Mercury	< 0.05	< 0.05	0.1	0.1	0.1

^①Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Means followed by the same superscript were not significantly different ($P > 0.05$). Data were rounded to conform to significant digit requirements. The mean separation technique may yield separations which are obscured by data rounding.

^②Variable was not subjected to statistical analyses.



Appendix 5. Chlorophyll *a* concentrations by station in Harris Reservoir, 1993-1997.
 Note: The North Carolina water quality standard is 40 µg/liter.

Appendix 6. Temporal trends of selected limnological variables from the bottom waters of Harris Reservoir at Station E2, 1993-1997.^①

Variable	Year				
	1993	1994	1995	1996	1997
Solids (mg/liter)					
Total	79 ^b	81 ^b	85 ^b	113 ^a	71 ^b
Total dissolved	68	75	77	87	78
Total suspended	7	6	4	4	6
Turbidity (NTU)	7.0	6.6	4.9	4.0	7.2
Nutrients (mg/liter)					
Ammonia-N	0.50	0.27	0.26	0.09	0.70
Nitrate + nitrite-N	0.10	0.08	0.06	0.19	0.07
Total nitrogen	1.0	1.1	0.9	1.3	1.3
Total phosphorus	0.10	0.10	0.10	0.15	0.11
TN:TP ^②	12	17	12	12	14
Total organic carbon (mg/liter)	7.8	6.8	7.2	7.4	7.8
Ions (mg/liter)					
Calcium	4.2	4.1	4.6	4.6	4.5
Chloride	8.8 ^c	10 ^{ab}	12 ^a	9.7 ^{abc}	6.8 ^c
Magnesium	2.0	2.0	2.1	2.0	1.9
Sodium	9.9	12	13	10	10
Sulfate	12	15	16	14	11
Total alkalinity (mg/liter as CaCO ₃)	20	19	20	25	26
Hardness (mg equivalents CaCO ₃ /liter)	19	18	20	20	19
Metals (µg/liter)					
Aluminum	65	80	53	42	56
Copper	3.6	2.3	2.3	2.2	1.9
Cadmium	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Mercury	< 0.05	< 0.05	0.1	0.1	0.1

^①Fisher's protected least significant difference test was applied only if the overall F test for the treatment was significant. Annual means followed by the same superscript were not significantly different (P > 0.05).

^②Variable was not subjected to statistical analyses.

Appendix 7. Mean density (clams/m²) and range of Asiatic clams collected from the Harris Nuclear Plant emergency service water system (e.g., intake canals and structures and the fire protection system), 1993-1997.

Location	Mean density of live clams ^①				
	1993	1994	1995	1996	1997
Main reservoir					
Intake canal	4 (0-14)	7 (0-14)	14 (0-14)	NS	NS
Service water system	0	25 (0-86)	371 (0-948)	97 (0-388)	0
Cooling water makeup	0	22 (0-86)	280 (0-1121)	11 (0-43)	22 (0-86)
Auxiliary reservoir					
Intake canal	0	22 (0-86)	75 (0-201)	NS	NS
Service water system	0	7 (0-29)	43 (0-216)	431 (129-2026)	452 (43-1591)
Fire protection system	0	0	0	0	0

^①Density estimates were calculated by multiplying the number of live clams collected by the expansion factor of 43.1.

NS = Not sampled