Dominion Nuclear North Anna, LLC
5000 Dominion Boulevard, Glen Allen, VA 23060

Dominion®

October 4, 2004

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No. 04-587
ESP/JDH
Docket No. 52-008

DOMINION NUCLEAR NORTH ANNA, LLC
NORTH ANNA EARLY SITE PERMIT APPLICATION
RESPONSE TO AUGUST 2004 REQUEST FOR ADDITIONAL INFORMATION

In August 2004, Dominion Nuclear North Anna (Dominion) and the NRC staff held a series of telephone calls pertaining to the environmental review of the North Anna Early Site Permit application. During the calls, NRC requested additional information on five topics. The calls were documented by the NRC on August 17, 2004 (ADAMS Accession No. ML042310737). Dominion's responses to the five questions are provided in the enclosure.

It is our intent to update the North Anna ESP application to reflect our responses to these and other RAIs to support issuance of the NRC staff's draft safety and environmental evaluations scheduled for later this year. In this instance, no update to the application was required as a result of our responses.

If you have any questions or require additional information, please contact Mr. Tony Banks at 804-273-2170.

Very truly yours,

Leslie N. Hartz
Vice President-Nuclear Engineering

Enclosures:
1. Responses to August 2004 Request for Additional Information
2. Environmental Study of Lake Anna (2001 Annual Report)
3. Park Visitor and Boat Launch Data Sheets

Commitments made in this letter: None

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COMMONWEALTH OF VIRGINIA

COUNTY OF HENRICO

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Leslie N. Hartz, who is Vice President - Nuclear Engineering, of Dominion Nuclear North Anna, LLC. She has affirmed before me that she is duly authorized to execute and file the foregoing document on behalf of Dominion Nuclear North Anna, LLC, and that the statements in the document are true to the best of her knowledge and belief.

Acknowledged before me this 4TH day of October, 2004.

My Commission expires: May 31, 2006

Vicki L. Hull

Notary Public

(SEAL)

Enclosure 1

Response to August 2004 Request for Additional Information Pertaining to the Environmental Report

Environmental RAI 1 (August 17, 2004 NRC document)

Provide a figure to show location of intake structure for Unit 3 in greater detail. The area in the center of Figure 1.1-1 that covers the shoreline from north of the Unit 3 intake canal to the shoreline west of the Unit 1&2 intake is approximately what needs to be covered.

Response

The requested figure has been provided to NRC and is available in ADAMS at Accession No. ML042510382.

Application Revision

None

Environmental RAI 2 (August 17, 2004 NRC document)

Provide the reports for the past 5 years from Dominion to the State that cover the sampling and monitoring of fish and other aquatic resources downstream of the North Anna Dam. Include any analysis and conclusions that cover the recent drought years.

Response

The "Environmental Study of Lake Anna and the Lower North Anna River" annual monitoring reports prepared by Dominion for the years 1998, 1999 and 2000 have been provided to the NRC and are available in ADAMS at Accession Nos. ML020230033, ML020230115, and ML021680344, respectively. A copy of the 2001 report is provided as Enclosure 2. The 2002 and 2003 reports are in production.

A 2004 North Anna River Low Flow Monitoring Report prepared by Dominion has been provided to NRC and is available in ADAMS at Accession No. ML042450399. The report includes analysis and conclusions that cover the 2001-2002 drought years.

Application Revision

None

Environmental RAI 3 (August 17, 2004 NRC document)

Provide the recreational data (Lake Anna and Lake Anna State Park) for the years 1999 through 2003 that is available from the Virginia Department of Conservation and Recreation (VDCR). The purpose is to ascertain the potential drought impacts, if any, on recreational use of the lake and park.

Response

The 1998-2003 VDCR recreational data sheets for Virginia state parks, which identify Lake Anna State Park attendance and Lake Anna State Park boat launch (ramp) usage, are provided in Enclosure 3. Some of the data sheets were previously provided to the NRC and Pacific Northwest National Laboratory reviewers and were discussed on the telephone conference calls between NRC staff and Dominion in August 2004.

Application Revision

None

Environmental RAI 4 (August 17, 2004 NRC document)

Provide a full description and detailed analysis of the environmental effects of the transportation of advanced LWR and gas-cooled reactor spent fuel that meets the intent of 10 CFR 51.52(b). Use an acceptable methodology, such as RADTRAN 5. The transportation risk assessment must describe key input parameters and assumptions and provide justification that the best available information has been used in developing the RADTRAN 5 input values.

Response

The requested information has been provided to the NRC and is available in ADAMS at Accession No. ML042640344.

Application Revision

None

Environmental RAI 5 (August 17, 2004 NRC document)

Clarify whether or not the barking tree frog (hyla gratiosa) is present at the Surry site.

Response

The requested information has been provided to NRC and is available in ADAMS at Accession No. ML042440689.

Application Revision

None

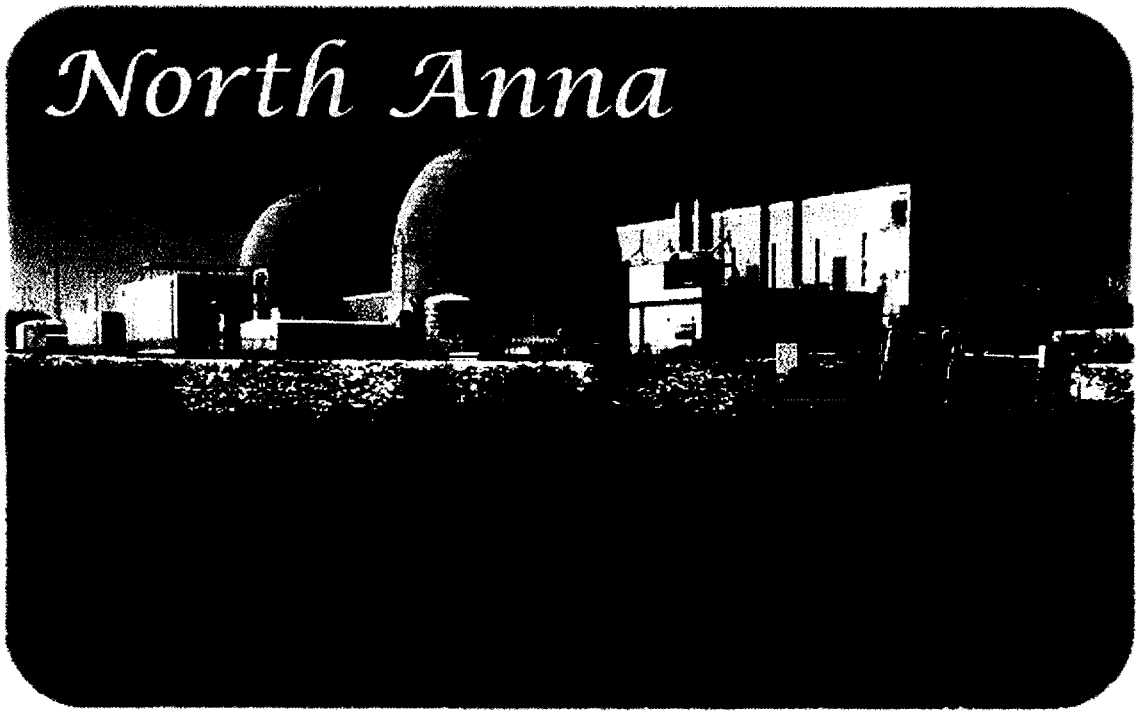
Enclosure 2

Environmental Study of Lake Anna And the Lower North Anna River Annual Report for 2001

ENVIRONMENTAL STUDY OF LAKE ANNA

AND THE LOWER NORTH ANNA RIVER

ANNUAL REPORT FOR 2001



Prepared by:

ENVIRONMENTAL BIOLOGY

ELECTRIC ENVIRONMENTAL SERVICES

In an effort to conserve our natural resources, this report is being printed on both sides of recycled paper.

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Executive Summary

Following the successful completion of the North Anna Power Station 316(a) Demonstration in 1986, Dominion (the Company) agreed to continue selected environmental monitoring studies on Lake Anna and the North Anna River. Correspondent with the recommendations in the three-year review of post-316(a) studies for 1989-1991, the Company requested and was granted a reduction in certain of the monitoring programs by the Department of Environmental Quality (DEQ). The revised annual study program was to be continued with a review every three years for possible revisions or changes. This report represents findings from monitoring programs conducted during 2001, the first year of the three year study period 2001 through 2003.

Station generation for 2001 was again outstanding with levels comparable to 1990 and 1991. Water temperature data for 2001 both in the lake and downstream were similar to historical data. A record number of fish was collected by electrofishing in 2001, hypothesized to be due primarily to a dramatic drop in lake levels during the fourth quarter sampling. This lake level drop in 2001, as in 1998, concentrated bluegill sunfish Lepomis macrochirus at several sample sites resulting in the relatively large numbers of fish collected during that period. The sampling for the first three quarters of 2001 occurred at or near normal lake level. Gill netting numbers in 2001 were higher than in 2000 but similar to historical data. In 2001, Lake Anna anglers reported 50 citation largemouth bass Micropterus salmoides (greater than 55.9 cm in length or 36 kg in weight) ranking Lake Anna as the second best trophy bass lake in the state. The 2001 hydrilla Hydrilla verticillata survey was not conducted due to air space restriction because of the September 11, 2001 incident as well as low lake levels.

In the lower North Anna River below North Anna dam the total number of fish collected by electrofishing in 2001 was greater than the 2000 catch with increases at all four stations. Also,

underwater observations of largemouth bass and smallmouth bass in 2001 continued to indicate that largemouth bass are more abundant in the upper reaches of the river below Lake Anna and smallmouth bass more abundant in the lower reaches.

In summary, the 2001 data indicate that both the lake and river downstream of the lake support a diverse and healthy fishery.

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1.0 Introduction

In 1972, the North Anna River was impounded to create Lake Anna, a 3885 hectare (9600 acres) reservoir (lake) that provides condenser cooling water for the North Anna Power Station (NAPS). Adjacent to Lake Anna is a 1376 hectare (3400 acre) Waste Heat Treatment Facility (WHTF) that receives the cooling water and transfers excess heat from the water to the atmosphere before discharging into the lake.

Aquatic monitoring studies have been conducted on Lake Anna since its inception. In January, 1984, the Company initiated an extensive Section 316(a) demonstration study (P.L. 95-500) to determine if proposed effluent limitations on thermal discharges from the power station were more stringent than necessary to assure the protection and propagation of a balanced, indigenous community of shellfish, fish and wildlife in Lake Anna and the lower North Anna River. The final report (Virginia Power 316(a) Report 1986) successfully demonstrated that the operation of the power station had not resulted in appreciable harm to the biological community. The Virginia Water Control Board (VWCB) accepted the study as a successful demonstration in September, 1986.

Subsequent to the 316(a) study, the Company committed with the VWCB to continue environmental monitoring on Lake Anna and the lower North Anna River as part of a post 316(a) agreement. Also, following each three year period of data collection, a summary report is provided with recommendations for future studies. This report presents the findings for calendar year 2001, the first year of the three year period 2001-2003.

2.0 Station Operation

North Anna Power Station (NAPS) operated at an average of 81% of capacity for 2001. The station operated at 84% and 94% of capacity for the first quarter and second quarter respectively and 80% for the third and 67.8% in the fourth quarter. The Station's Unit 1 was shutdown in September for a scheduled refueling outage. This outage resulted in the lower capacity during the third quarter. Unit 2 was out from 10/28 through 12/15 for repair to the reactor head. This combined with a short outage on 12/23 resulted in the fourth quarter percentage of 67%. The yearly average of 81% for 2001 was comparable to generation capacity in 1990, 1991 and 1996 thereby placing North Anna Power Station as an industry leader in low cost generation (Table 2.0-1).

TABLE 2.0-1 Seasonal summary of North Anna Power Station operation (percent of total station load) 1978-2001.

Year	Winter	Spring	Summer	Fall	Quarterly Average
1978	0	23	42	45	27.5
1979	43	31	44	0	29.5
1980	31	37	53	65	46.5
1981	46	80	67	82	68.8
1982	78	26	19	48	42.8
1983	53	58	96	84	72.8
1984	76	64	16	66	55.5
1985	87	96	82	62	81.8
1986	75	88	62	80	76.3
1987	92	45	23	47	51.8
1988	75	99	94	97	91.3
1989	47	26	87	65	56.3
1990	98	98	69	61	81.5
1991	63	89	84	92	82
1992	35	80	92	71	69.5
1993	49	83	79	82	73.3
1994	96	91	75	91	88.5
1995	87	64	98	97	86.5
1996	76	98	83	66	80.8
1997	98	80	97	97	93
1998	96	81	85	94	89
1999	97	90	87	93	92
2000	84	91	100	100	94
2001	84	94	80	67	81
Quarters at 75-100%	15	15	14	12	

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3.0 Lake Anna

3.1 Temperature

Methods

Lake water temperature data in 2001 were collected using continuous monitors (fixed temperature recorders) and instantaneous field surveys. Continuous temperatures were measured using Onset Optical Stowaway temperature recorders which measure and record the water temperature at one hour intervals at seven (7) stations in the lake and three (3) stations in the WHTF. These instruments were located one meter below the lake surface at the stations depicted in Figure 3.1-1, the lone exception being Station NALST10. The instrument at this station was located at a depth of three meters to account for the turbulence associated with mixing. A summary of the data recorded by these instruments for 2001 is presented in Table 3.1-1 as daily high, mean and low temperatures.

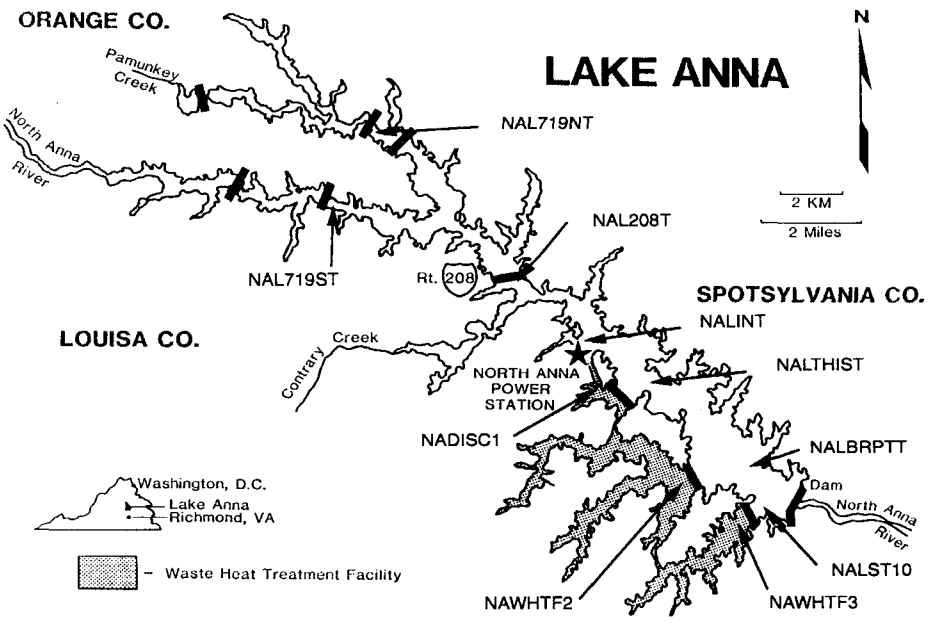


FIGURE 3.1-1 Approximate location of fixed Endeco and Onset temperature recorders in Lake Anna and WHTF

TABLE 3.1-1. SUMMARY OF NORTH ANNA FIXED RECORDER TEMPERATURE DATA DURING 2001. ALL RESULTS ARE CALCULATED FROM HOURLY TEMPERATURES (IN DEGREES CELSIUS). ALL ARE SURFACE INSTRUMENTS EXCEPT FOR NALST10 WHICH IS AT MID-DEPTH. A "*" INDICATES DATA MISSING DUE TO INSTRUMENT MALFUNCTION OR DAMAGE.

YEAR=2001 MONTH=JANUARY

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	5.0	5.1	*	8.8	7.7	13.3	12.4	20.8	14.1	14.8	10.9
HOURLY MEAN	4.2	3.9	*	5.5	5.6	10.0	10.2	17.9	12.4	11.9	8.7
HOURLY LOW	3.5	2.8	*	3.5	4.7	6.9	8.0	13.1	10.2	10.2	5.0

YEAR=2001 MONTH=FEBRUARY

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	8.8	7.3	*	8.0	9.2	10.9	11.6	19.7	16.2	14.8	11.3
HOURLY MEAN	6.4	5.6	*	5.9	7.4	9.5	10.6	18.2	14.4	12.8	9.4
HOURLY LOW	5.0	4.3	*	4.3	5.8	8.0	9.1	16.9	12.0	11.3	5.8

YEAR=2001 MONTH=MARCH

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	11.3	10.2	*	9.5	10.6	11.6	12.3	20.4	16.6	14.8	12.0
HOURLY MEAN	8.6	7.7	*	7.6	9.0	10.4	11.5	19.1	14.2	13.4	10.5
HOURLY LOW	6.6	5.4	*	6.1	7.3	9.5	10.2	14.8	12.3	12.3	8.4

YEAR=2001 MONTH=APRIL

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	21.1	20.8	*	19.0	19.4	20.0	18.2	28.6	25.7	24.0	21.0
HOURLY MEAN	15.6	15.4	*	14.4	15.2	15.5	14.7	22.9	20.2	18.9	15.5
HOURLY LOW	9.9	8.8	*	8.4	9.5	10.6	10.9	14.1	14.5	13.4	10.2

TABLE 3.1-1(CONT.). SUMMARY OF NORTH ANNA FIXED RECORDER TEMPERATURE DATA DURING 2001. ALL RESULTS ARE CALCULATED FROM HOURLY TEMPERATURES (IN DEGREES CELSIUS). ALL ARE SURFACE INSTRUMENTS EXCEPT FOR NALST10 WHICH IS AT MID-DEPTH. A "*" INDICATES DATA MISSING DUE TO INSTRUMENT MALFUNCTION OR DAMAGE.

STATION NO. 6 5 4 2 1 3 10 7 8 9

YEAR=2001 MONTH=MAY

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	25.3	25.3	24.3	23.9	23.5	23.9	22.8	31.5	29.7	27.5	24.7
HOURLY MEAN	21.9	21.8	21.8	21.7	21.7	22.1	20.1	29.8	27.1	25.6	21.8
HOURLY LOW	19.3	18.7	18.3	18.7	18.7	19.0	16.9	27.5	24.6	22.5	18.4

YEAR=2001 MONTH=JUNE

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	31.5	31.5	31.1	31.1	30.8	31.1	28.9	37.3	36.1	34.2	31.5
HOURLY MEAN	27.0	27.0	26.9	26.7	26.6	26.9	25.2	33.9	31.6	30.1	26.6
HOURLY LOW	21.8	21.5	22.1	22.1	22.1	22.8	21.7	30.0	27.1	25.7	22.8

YEAR=2001 MONTH=JULY

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	30.8	30.8	30.4	30.0	30.0	30.4	30.3	37.3	35.0	33.1	30.5
HOURLY MEAN	28.1	28.2	28.4	28.4	28.7	29.1	28.8	35.8	33.2	31.4	28.3
HOURLY LOW	25.7	25.7	26.4	26.8	27.1	27.8	27.1	34.2	30.8	29.3	26.2

YEAR=2001 MONTH=AUGUST

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	32.3	32.5	32.3	31.5	32.0	30.9	30.3	37.3	35.9	34.3	32.2
HOURLY MEAN	29.3	29.2	29.5	29.6	29.3	29.5	29.4	35.8	33.5	32.0	29.3
HOURLY LOW	26.4	26.1	26.8	27.1	27.5	27.6	28.0	34.2	31.2	29.7	26.3

TABLE 3.1-1(CONT.). SUMMARY OF NORTH ANNA FIXED RECORDER TEMPERATUREDATA DURING 2001. ALL RESULTS ARE CALCULATED FROM HOURLY TEMPERATURES (IN DEGREES CELSIUS). ALL ARE SURFACE INSTRUMENTS EXCEPT FOR NALST10 WHICH IS AT MID-DEPTH. A "*" INDICATES DATA MISSING DUE TO INSTRUMENT MALFUNCTION OR DAMAGE.

YEAR=2001 MONTH=SEPTEMBER

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	28.9	29.0	29.3	30.0	29.1	29.7	29.9	36.0	33.7	31.7	29.9
HOURLY MEAN	25.6	25.5	26.5	27.2	26.4	26.8	27.2	33.6	29.9	28.2	26.1
HOURLY LOW	21.1	21.1	22.5	23.2	22.2	22.8	22.9	30.0	25.1	23.2	21.3

YEAR=2001 MONTH=OCTOBER

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	22.3	23.3	25.4	24.3	23.2	24.0	23.2	30.2	27.3	24.7	23.4
HOURLY MEAN	18.7	19.1	20.0	20.2	20.4	20.5	21.5	27.8	24.7	22.8	20.2
HOURLY LOW	14.6	15.2	16.6	17.0	17.5	9.1	19.0	22.8	20.4	20.1	16.8

YEAR=2001 MONTH=NOVEMBER

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	17.1	17.3	18.4	18.7	18.8	*	19.4	24.7	22.3	20.8	19.6
HOURLY MEAN	13.6	13.8	15.4	15.7	16.0	*	17.0	22.1	19.1	17.9	16.0
HOURLY LOW	11.5	11.5	13.5	13.8	14.3	*	15.5	20.0	17.2	15.9	13.4

YEAR=2001 MONTH=DECEMBER

STATISTIC/ STATION	NAL719ST 6	NAL719NT 5	NAL208T 4	NALINT 2	NALTHIST 1	NALBRPTT 3	NALST10 10	NADISC1 7	NAWHTF2 8	NAWHTF3 9	NARIV601 11
HOURLY HIGH	15.0	15.4	16.1	16.0	16.5	16.6	16.6	23.8	20.4	18.3	16.8
HOURLY MEAN	10.7	11.1	12.4	12.9	13.3	14.1	14.8	21.7	17.6	15.8	13.5
HOURLY LOW	5.7	6.3	7.9	9.0	9.6	10.6	12.0	18.1	15.2	12.7	9.3

The instantaneous temperatures were measured using a Yellow Springs Model 3000 T-L-C field temperature instrument. Temperatures were measured at one (1) meter intervals, surface to bottom, at the stations shown in Figure 3.1-2. The results of these surveys are shown in Table 3.1-2.

FIGURE 3.1-2 Approximate location of thermal plume sampling stations on Lake Anna

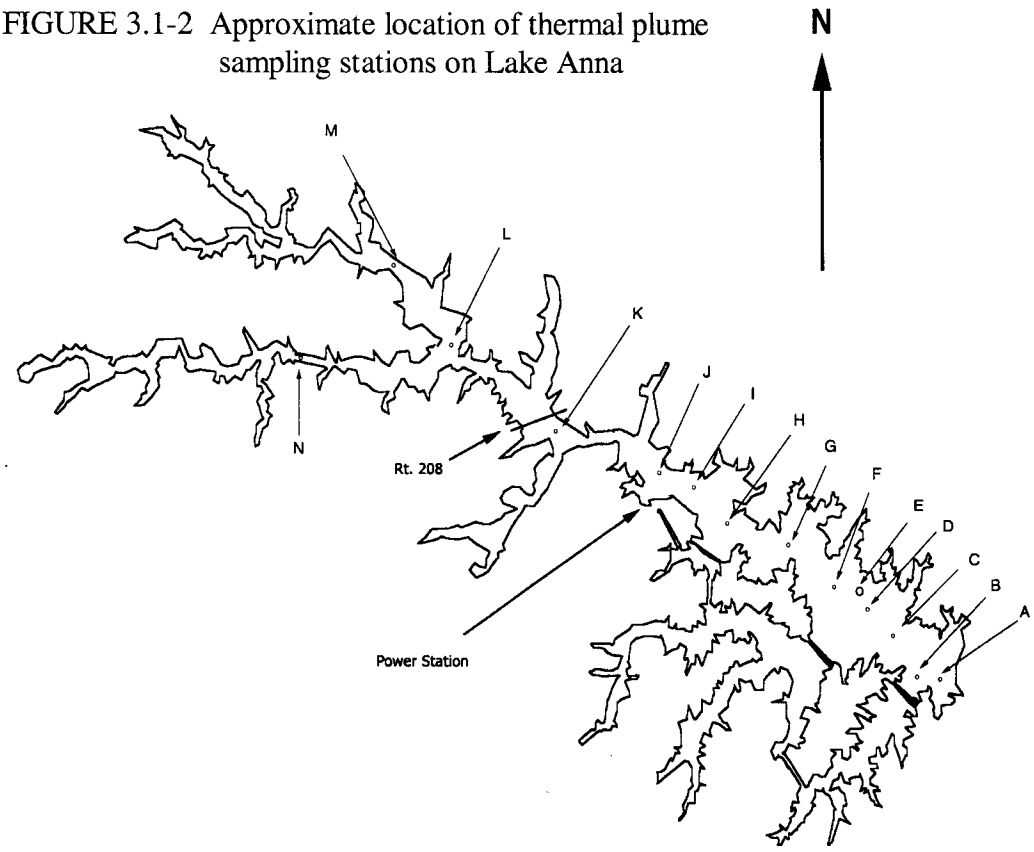


TABLE 3.1-2. NORTH ANNA LAKE SURVEY SHOWING TEMPERATURES (IN CELSIUS DEGREES) MEASURED AT ONE METER INTERVAL DEPTHS FOR STATIONS IN LAKE ANNA.

		STATION													
DATE	DEPTH (M)	A	B	C	D	E	F	G	H	I	J	K	L	M	N
02/07/2001	0	10.3	10.5	10.1	10.1	10.1	9.5	8.7	8.1	7.9	7.3	6.2	5.2	5.6	5.5
	1	10.0	10.5	10.0	10.0	10.0	9.2	8.5	7.9	7.7	7.1	5.8	5.0	5.5	5.3
	2	10.0	10.4	9.7	9.8	9.8	8.9	8.4	7.7	7.4	7.0	5.7	4.8	5.3	5.3
	3	9.9	10.4	9.0	9.2	9.2	8.8	8.3	7.6	7.3	7.0	5.6	4.8	5.3	5.2
	4	9.8	10.3	8.9	8.9	9.1	8.8	8.3	7.5	7.3	6.9	5.5	4.8	5.3	5.2
	5	9.8	10.2	8.8	8.9	9.0	8.7	8.3	7.4	7.2	6.9	5.3	4.8	5.3	5.2
	6	9.6	10.0	8.8	8.8	9.0	8.7	8.2	7.4	7.2	6.9	5.2	4.8	5.3	5.2
	7	9.5	9.8	8.8	8.8	8.9	8.7	8.2	7.3	7.2	6.8	5.1	4.8	5.3	5.2
	8	9.3	9.5	8.8	8.8	8.9	8.6	8.1	7.1	7.1	6.7	5.1		5.3	
	9	9.1	9.2	8.8	8.7	8.8	8.5	8.1	7.0	7.0	6.6	5.1			
	10	8.8	8.9	8.7	8.7	8.7	8.4	7.9	6.8	6.9	6.5	5.1			
	11	8.7	8.9	8.7	8.7	8.5	8.3	7.8	6.6	6.8	6.2	5.1			
	12	8.6	8.8	8.7	8.7	8.5	8.2	7.6	6.3	6.5	5.9	5.1			
	13	8.6	8.8	8.7	8.7	8.5	8.0	7.4	6.1	6.2	5.9	5.1			
	14	8.6	8.8	8.6	8.6	8.5	8.0	7.3	6.1		5.9				
	15	8.5	8.8	8.6	8.6	8.5	7.8	7.2	6.1						
	16	8.5	8.8	8.5	8.5	8.5	7.8	7.1							
	17	8.5		8.3	8.4	8.5	7.8	7.1							
	18	8.5		8.3	8.4	8.5	7.8	6.9							
	19	8.4		8.3	8.4		7.8	6.9							
	20	8.4					7.8								
	21	8.4													

TABLE 3.1-2(CONT.). NORTH ANNA LAKE SURVEY SHOWING TEMPERATURES (IN CELSIUS DEGREES) MEASURED AT ONE METER INTERVAL DEPTHS FOR STATIONS IN LAKE ANNA.

		STATION													
DATE	DEPTH (M)	A	B	C	D	E	F	G	H	I	J	K	L	M	N
06/06/2001	0	24.8	24.3	24.6	24.6	24.6	25.2	25.0	24.8	24.7	24.8	24.4	24.1	25.0	24.7
	1	24.6	24.3	24.5	24.3	24.3	24.4	24.4	24.2	23.9	23.9	23.8	23.5	23.7	23.5
	2	24.4	24.1	24.2	24.0	24.2	24.2	24.3	23.8	23.6	23.7	23.1	23.1	22.9	22.8
	3	24.3	24.0	23.8	23.7	24.0	23.9	24.0	23.1	23.0	23.2	22.6	22.5	22.4	22.2
	4	24.2	23.6	23.5	23.5	23.7	23.7	23.6	22.8	22.8	22.9	22.4	22.3	22.1	21.9
	5	24.1	22.9	23.3	23.3	23.4	23.6	23.2	22.6	22.7	22.8	22.2	22.1	21.8	21.7
	6	23.9	22.4	23.1	23.1	23.1	23.3	22.9	22.5	22.5	22.5	22.0	22.0	21.4	21.5
	7	23.8	21.9	23.0	22.9	22.9	22.9	22.6	22.3	22.3	22.2	21.9	22.0	21.2	21.4
	8	23.3	21.4	22.8	22.8	22.8	22.6	22.3	22.0	22.1	22.0	21.6		21.1	
	9	22.6	21.2	22.5	22.6	22.5	22.4	21.8	21.7	21.8	21.9	21.3			
	10	22.1	20.9	22.3	22.2	22.2	22.0	21.5	21.5	21.6	21.4	20.9			
	11	21.4	20.5	21.7	21.7	21.6	21.4	20.9	21.1	21.3	20.5	20.4			
	12	20.6	19.6	21.0	21.0	21.0	20.6	20.2	20.6	20.9	20.4	20.3			
	13	19.6	19.0	20.2	20.2	20.0	19.9	19.8	20.4	20.5	20.3	20.5			
	14	18.9	18.9	19.3	19.4	19.6	19.5	19.5	20.1		20.0				
	15	18.4	19.0	18.8	18.9	19.1	19.0	19.3	20.0						
	16	17.6	19.2	18.3	18.2	18.3	18.5	19.0							
	17	16.5		16.9	17.3	17.6	17.9	18.1							
	18	15.4		16.0	15.7	17.4	16.7	17.1							
	19	14.8		16.3	15.5		15.5	16.1							
	20	14.5					15.7								
	21	14.5													

TABLE 3.1-2(CONT.). NORTH ANNA LAKE SURVEY SHOWING TEMPERATURES (IN CELSIUS DEGREES) MEASURED AT ONE METER INTERVAL DEPTHS FOR STATIONS IN LAKE ANNA.

		STATION													
DATE	DEPTH (M)	A	B	C	D	E	F	G	H	I	J	K	L	M	N
11/27/2001	0	16.0	16.1	16.0	15.8	15.9	15.8	15.5	15.4	15.1	15.0	14.6	13.9	13.2	13.4
	1	15.9	16.1	15.8	15.7	15.8	15.0	15.5	15.2	15.0	15.0	14.3	13.9	13.1	13.3
	2	15.9	16.0	15.6	15.6	15.7	15.6	15.4	15.1	14.9	14.9	14.3	13.3	13.0	13.2
	3	15.8	16.0	15.5	15.5	15.6	15.6	15.3	15.0	14.7	14.8	14.1	13.1	12.9	12.7
	4	15.8	15.9	15.4	15.3	15.1	15.5	15.2	14.7	14.5	14.7	14.2	13.0	12.4	11.9
	5	15.7	15.8	15.3	15.2	15.3	15.5	15.1	14.5	14.4	14.5	13.1	12.9	11.7	11.6
	6	15.6	15.7	15.2	15.2	15.3	15.4	14.9	14.4	14.3	14.3	13.0	12.8	11.4	11.7
	7	15.4	15.6	15.2	15.2	15.2	15.2	14.7	14.3	14.3	14.0	12.8	12.8	11.4	11.7
	8	15.1	15.6	15.1	15.1	15.2	15.1	14.5	14.2	14.1	13.4	12.6			
	9	15.0	15.5	15.1	15.1	15.1	15.0	14.3	14.0	13.8	13.2	12.6			
	10	15.0	15.4	15.1	15.1	15.1	14.8	14.2	13.9	13.4	13.0	12.5			
	11	15.0	15.5	15.1	15.0	15.0	14.6	14.1	13.6	13.2	12.9	12.4			
	12	15.0	15.2	15.0	14.9	15.1	14.4	13.9	13.5	13.1	12.9	12.3			
	13	15.0	15.2	15.0	14.9	15.1	14.1	13.8	13.4	13.1	12.9	12.3			
	14	14.9	15.2	15.0	14.9	15.1	14.0	13.7	13.1		12.9	12.2			
	15	14.9	15.2	14.9	14.8	15.1	14.0	13.7	13.4			12.2			
	16	14.9	15.2	14.9	14.8		14.0	13.6							
	17	14.9		14.8	14.8		14.0	13.6							
	18	14.9		14.8	14.9		14.0	13.7							
	19	14.9		14.8	14.9		14.0	13.8							
	20	14.9					14.0								
	21	14.9													

Results

The maximum high temperature recorded for the lake in 2001 by continuous monitors was 32.5°C in August at Station NA7I9NT which is located on the Pamunkey Arm of the upper lake (Table 3.1-1). The lowest monthly temperature recorded was 2.8°C in January again at Station NAL719NT. The 2001 monthly temperature data in Table 3.1-1 are within the ranges of data reported in previous years.

The instantaneous temperature surveys were conducted in February, June and November to provide temperature data to assess seasonal thermal stratification patterns in the lake (Table 3.1-2). The February survey shows a consistent change of approximately 2°C from surface to bottom in the deeper portion of the lake.

The June survey results show a thermocline at the 12 to 15 meter depth in the lower lake which disappears in the upper, shallow portion of the lake. The November survey again shows little stratification with surface to bottom temperature of approximately 2°C from the lower lake and continuing in the upper lake. This stratification pattern in the lake is not unusual and is similar to previously reported patterns (Virginia Power 1986-2000).

3.2 Fish Population Studies - Gill Netting

Methods

The monitoring of fish assemblage abundance and species composition for Lake Anna and the WHTF continued in 2001 using the same basic sampling technologies applied since 1972. Experimental gill netting was used to capture fishes which normally inhabit the deeper strata of the lake, or exhibit a diel movement to and from the shoreline. Similar to previous years, 2001 gill net surveys were conducted during February, May, August, and December at the stations shown in Figure 3.2-1. Experimental gill nets were set near littoral drop-off areas with procedures remaining unchanged since 1972. Fish collected by gill netting were returned to the laboratory where all individuals were measured to the nearest millimeter total length and weighed to the nearest 0.1 gram. Surface water temperature (°C), dissolved oxygen (mg/l), pH and conductivity (Φmhos) were recorded at the time of each sample collection (Table 3.2-1).

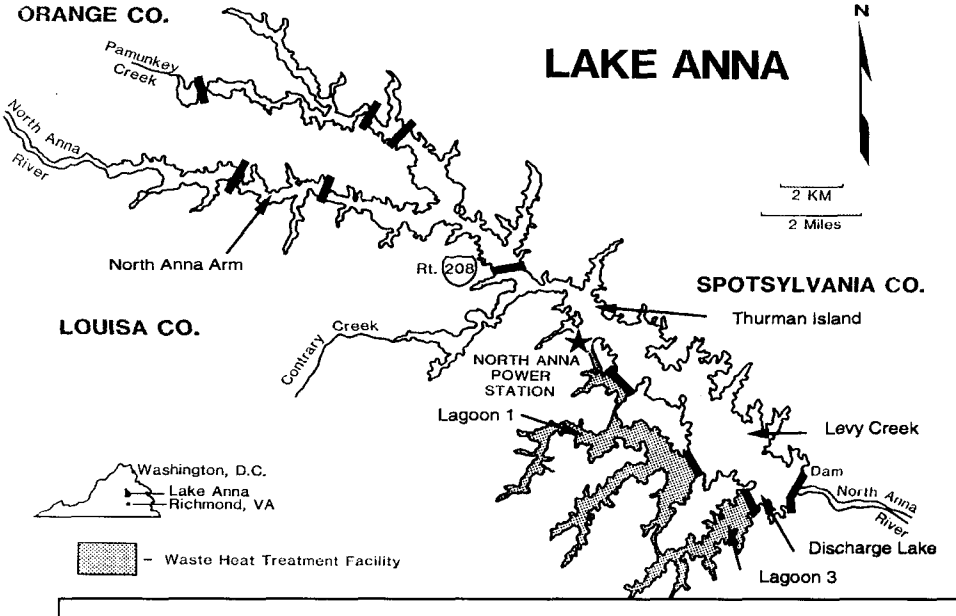


FIGURE 3.2-1 Location of Gill Netting stations on Lake Anna and WHTF

Results

Seventeen (17) species of fish representing seven (7) families were collected in Lake Anna and the WHTF by quarterly gill netting in 2001 (Table 3.2-2). In 2001, a total of 926 fish weighing 288.0 kg was collected from four stations in the lake and two stations in the WHTF (Table 3.2-3). The 2001 total number of fish (926) was higher than 2000 (710) and 1999 (670), while gill net biomass in 2001 (288.0 kg) was the same as biomass totals in 2000 and lower than 1999 (296.5 kg). Of the 926 fish collected, 764 (214.8 kg) were collected in the lake and 162 (73.1 kg) were collected in the WHTF. The February survey yielded the greatest total weight of fish collected (83.5kg) representing approximately 30% of the total weight of all fish collected from all stations and surveys combined. Striped bass and common carp accounted for approximately 50% of the biomass taken in February (Table 3.2-4). The August survey yielded the greatest total numbers of fish collected from the 2001 gill netting representing 46% of the total of all fish collected (44% of the August collection were threadfin shad Dorosoma petense).

Table 3.2-2. Fishes collected in Lake Anna by gill netting during 2001.

FAMILY	SPECIES	LAKE	WHTF
Clupeidae	Dorosoma cepedianum	X	X
	Dorosoma petenense	X	
Cyprinidae	Ctenopharyngodon idella	X	
	Cyprinus carpio	X	X
	Notropis hudsonius	X	
Catostomidae	Carpoides cyprinus	X	
Ictaluridae	Ameiurus catus	X	X
	Ameiurus nebulosus	X	
	Ictalurus punctatus	X	X
Moronidae	Morone americana	X	X
	Morone saxatilis	X	X
Centrarchidae	Lepomis gulosus	X	
	Lepomis macrochirus	X	X
	Lepomis microlophus		X
	Micropterus salmoides	X	X
	Pomoxis nigromaculatus	X	X
Percidae	Stizostedion vitreum	X	X

Table 3.2-3 also includes the average number and weight of fish collected per net set for each station for comparison of catch per unit effort by number (CPUE-N) and weight (CPUE-W). CPUE-N for all stations combined in 2001 was 38.6 fish per net while CPUE-W was 12.0 kg per net.

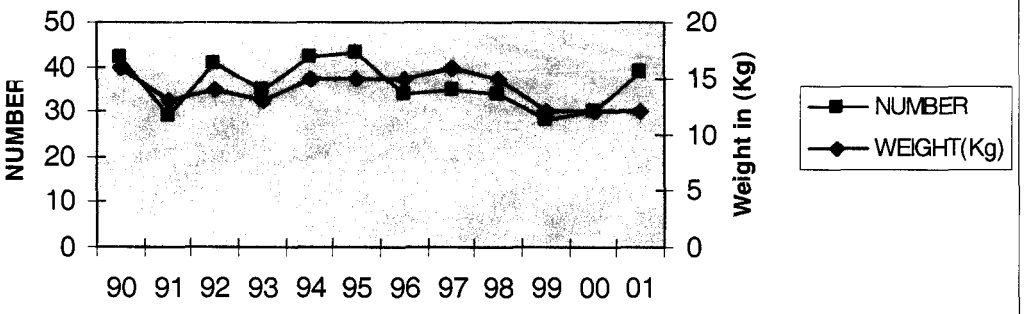
TABLE 3.2-3 NUMBER AND WEIGHT (g) OF FISHES BY STATION COLLECTED BY GILL NETTING AT LAKE ANNA DURING 2001

STATION	FEBRUARY	MAY	AUGUST	DECEMBER	TOTAL	CPUE
LAGOON 1						
NUMBER	30	35	4	23	92	23
WEIGHT	16072.8	13321	3947.5	8105	41446.3	10361.575
LAGOON 3						
NUMBER	25	16	18	11	70	17.5
WEIGHT	16883.6	4774.7	3772	6222.5	31652.8	7913.2
LEVY CREEK						
NUMBER	5	28	22	7	62	15.5
WEIGHT	4145	7658.5	3515.5	2369.7	17688.7	4422.175
LOWER LAKE						
NUMBER	9	47	17	18	91	22.75
WEIGHT	8859.1	15431.5	4380.5	12767	41438.1	10359.525
NORTH ANNA ARM						
NUMBER	51	41	352	71	515	128.75
WEIGHT	30533.9	21294.5	49175.6	22981.5	123985.5	30996.375
THURMAN ISLAND						
NUMBER	9	39	15	33	96	24
WEIGHT	7009.7	10287.5	6745	7694	31736.2	7934.05
TOTALS						
NUMBER	129	206	428	163	926	38.6
WEIGHT	83504.1	72767.7	71536.1	60139.7	287947.6	11997.8

These values are compared to CPUE in previous years in Figure 3.2-2. Over the last 10 years, CPUE-N has ranged from 42 to 28 with a mean of 30, while CPUE-W has ranged from 16 kg to 12 kg with a mean of 14 kg. Figure 3.2-2 also indicates that the size of fish collected by gill net has decreased in recent years (1999-2001) because CPUE-N has increased during this period while CPUE-W has remained steady. As mentioned above, relatively high

numbers of threadfin shad (188) were collected in August yet these small fish represented only 2.2% of the biomass that survey.

FIGURE 3.2-2 Gill Net data (1990-2001) average number and average weight (Kg)



When the catch per unit effort is compared among stations in 2001, CPUE-N ranged from a low of 15.5 fish per net at the Levy Creek Station to a high of 128.8 fish per net at the North Anna Arm Station (Table 3.2-3). CPUE-W ranged from a low of 7.9 kg per net at the Lagoon 3 Station to a high of 30.9 kg at the North Anna Arm Station. This is consistent with past data.

The numerically dominant species collected by gill netting in the lake were gizzard shad Dorosoma cepedianum, (32%), and threadfin shad (26%, Table 3.2-4). These results are similar to data collected in 2000 and 1999 and are also consistent with other years. The dominant species in the lake relative to biomass was striped bass Morone saxatilis (23%), followed by gizzard shad (20%) and common carp (19%).

The numerically dominant species collected in the WHTF in 2001 was channel catfish Ictalurus punctatus, followed by gizzard shad. The weight-dominant species in the WHTF in 2001 was common carp followed by gizzard shad, channel catfish.

Due to their relatively high numbers, gizzard shad have generally ranked high in biomass catch in both the lake and WHTF. The larger but less collected channel catfish, common carp and white catfish have consistently ranked high in biomass in both places with annual ranking depending on the variation in catch. Striped bass have consistently comprised a large portion of the biomass in the lake but not in the WHTF. A new species, quillback carp sucker Carpiodes cyprinus, was collected by gill netting in 2001. The new species was collected at the North Anna Arm Station in August. The origin of this fish is unknown but is probably the result of release from a bait bucket.

3.3 Fish Population Studies - Electrofishing

Methods

Boat electrofishing was used in 2001 to evaluate the assemblage and abundance of fish populations which normally occupy the shoreline habitat. The techniques, stations, and frequency have remained virtually unchanged since 1972. Sampling was performed in February, June, August, and December at the stations identified in Figure 3.2-1. Each station is 100 meters in length and normally includes a brush pile except for the dike stations which are comprised of uniform rip-rap.

All fish collected were either returned to the laboratory for processing or released in the field, e.g., larger game fish were measured, weighed, and released in the field. In the laboratory, at least twenty-five (25) individuals per species from each station were measured to the nearest millimeter total length and weighed to the nearest 0.1 gram. Those individuals over twenty-five (25) per species were enumerated and bulk weighed. Surface water temperature (°C), dissolved oxygen (mg/l), pH and conductivity (Φmhos) were recorded at the time of each sample collection (Table 3.2-1).

Results

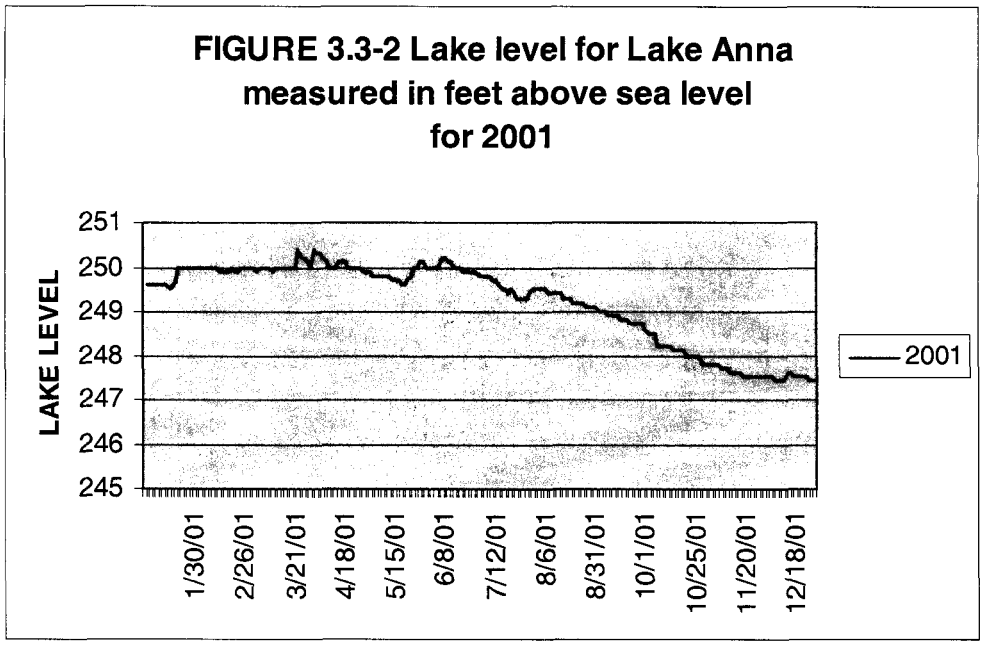
Twenty-five (25) species of fish representing ten (10) families were collected by electrofishing operations in the lake and WHTF in 2001 (Table 3.3-1).

Table 3.3-1 Fishes collected in Lake Anna and the WHTF by electrofishing during 2001.

FAMILY	SPECIES	LAKE	WHTF
Clupeidae	Alosa aestivalis	X	
	Dorosoma cepedianum	X	
Esocidae	Esox niger	X	
Cyprinidae	Cyprinella analostana	X	X
	Cyprinus carpio	X	
	Notropis hudsonius	X	X
	Notropis procne	X	X
Ictaluridae	Ameiurus catus	X	X
	Ameiurus natalis	X	X
	Ameiurus nebulosus	X	
	Ictalurus punctatus	X	X
Aphredoderidae	Aphredoderus sayanus	X	
Cyprinodontidae	Fundulus diaphanus	X	
Poeciliidae	Gambusia affinis		X
Moronidae	Morone americana	X	
Centrarchidae	Lepomis auritis	X	X
	Lepomis cyanellus	X	X
	Lepomis gibbosus	X	
	Lepomis gulosus	X	X
	Lepomis macrochirus	X	X
	Lepomis microlophus	X	X
	Micropterus salmoides	X	X
	Pomoxis nigromaculatus	X	X
Percidae	Etheostoma olmstedi	X	X
	Perca flavescens	X	

A record total of 7,213 fish weighing 88.2 kg was collected from the five stations in the lake and the four stations in the WHTF during the 2001 sampling period (Table 3.3-2). The total number of 7,213 is greater than the 1998 total of 6,991 which was the previously recorded high. Electrofishing biomass in 2001 (88.2 kg) was lower than that of 2000 (105.4 kg) as well as 1999 (106.9 kg).

During 2001, Virginia continued under a prolonged period of reduced rainfall. For the first three quarters of 2001, Lake Anna remained at a stable level ranging from 250.4 feet (normal pool is 250 feet above mean sea level) to a low of 249.4 feet. This fluctuation of less than a foot is not unusual for the lake during a normal year. The lake level began a precipitous drop in September to 247.4 feet in December (Figure 3.3-2). The first three quarter samples were collected at or near normal full pool level; first quarter (February) level at 249.9 feet; second quarter (June), level at 249.7 feet and third quarter (August) level at 249.4 feet. The fourth quarter samples were collected in December with the lake level at 247.5 feet. This drop of over 2.5 feet below normal pool dewatered much of the shallow shoreline. This lake level reduction may have concentrated shoreline fishes around remaining structure such as the dike rip-raps and resulted in a record catch of 3,564 fish (86%, bluegill) in the December collection. This is above the historical average for the fall sample and resulted in the record catch for 2001. A similar increase in numbers was also reported in 1998 when the lake level dropped due to drought conditions.

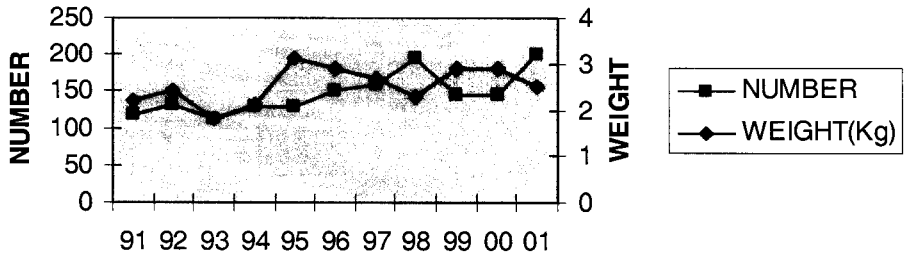


Of the 7,213 fish collected in 2001, 3,712 (51.8 kg) were collected from the lake and 3,501 (36.4 kg) were collected from the WHTF (Table 3.3-2). When the data are compared seasonally, the 2001 electrofishing results are similar to previous years with the greatest numbers of fish being collected in the winter (February – 1,895 individuals) and fall (December – 3,564 individuals) surveys. Typically, in the fall, recruitment of the young-of-year (YOY) plus the return of fish to shallow water as the weather moderates, combine to increase the number of fish available to collection by shoreline electrofishing.

Table 3.2-2 also includes the average number and weight of fish collected per electrofishing sample for each station for comparison of catch per unit effort by number (CPUE-N) and weight (CPUE-W). CPUE-N for all stations combined in 2001 was 200 fish per sample while CPUE-W was 2.5 kg per sample.

These values are compared to CPUE in previous years (Figure 3.3-3). Over the last 10 years, CPUE-N has ranged from 112 to 200 with a mean of 143, while CPUE-W has ranged from 1.8 kg to 3.1 kg with a mean of 2.5 kg. The high 2001 CPUE-N was, as discussed previously, probably the result of a low lake level in the fourth quarter thereby concentrating large numbers of small fish at dike stations. CPUE-W was average in 2001 and within the range of previous biomass estimates. It is interesting to note that biomass decreased in 2001 while fish numbers increased reflecting the relatively high numbers of small fish concentrated at dike stations. This was also noted in the 1998 collections.

FIGURE 3.3-3 Lake Anna Electrofish data (1990-2001) average number and average weight (Kg)



When the catch per unit effort among stations in 2001 is compared, CPUE-N ranged from a low of 97 fish per sample at the North Anna Arm Station to a high of 336 fish per sample at the Dike 1 – Lake Station (Table 3.3-3). CPUE-W ranged from a low of 0.9 kg per sample at the Lower Lake Station (consisting of mostly small bluegill) to a high of 3.7 kg at the North Anna Arm Station (primarily due to the capture of common carp at this station).