U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT
ON
HIGH FALLS POND
BUTTS, LAMAR, AND MONROE COUNTIES
GEORGIA
EPA REGION IV
WORKING PAPER No. 289

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

and

NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA

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REPORT
ON
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WITH THE COOPERATION OF THE

GEORGIA DEPARTMENT OF NATURAL RESOURCES

AND THE

GEORGIA NATIONAL GUARD

June 1975

CONTENTS

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Georgia Department of Natural Resources for professional involvement and to the Georgia National Guard for conducting the tributary sampling phase of the Survey.

J. Leonard Ledbetter, Director of the Environmental Protection Division; Ralph S. Howard, Jr., Environmental Affairs Coordinator; Gene B. Welsh, Chief of the Water Protection Branch; Edward T. Hall, Jr., Unit Coordinator; and Broughton A. Caldwell, R. Marshall Gaddis, William D. Kennedy, and Kenneth W. Martin, Environmental Specialists, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary lake reports, and provided critiques most useful in the preparation of this Working Paper series.

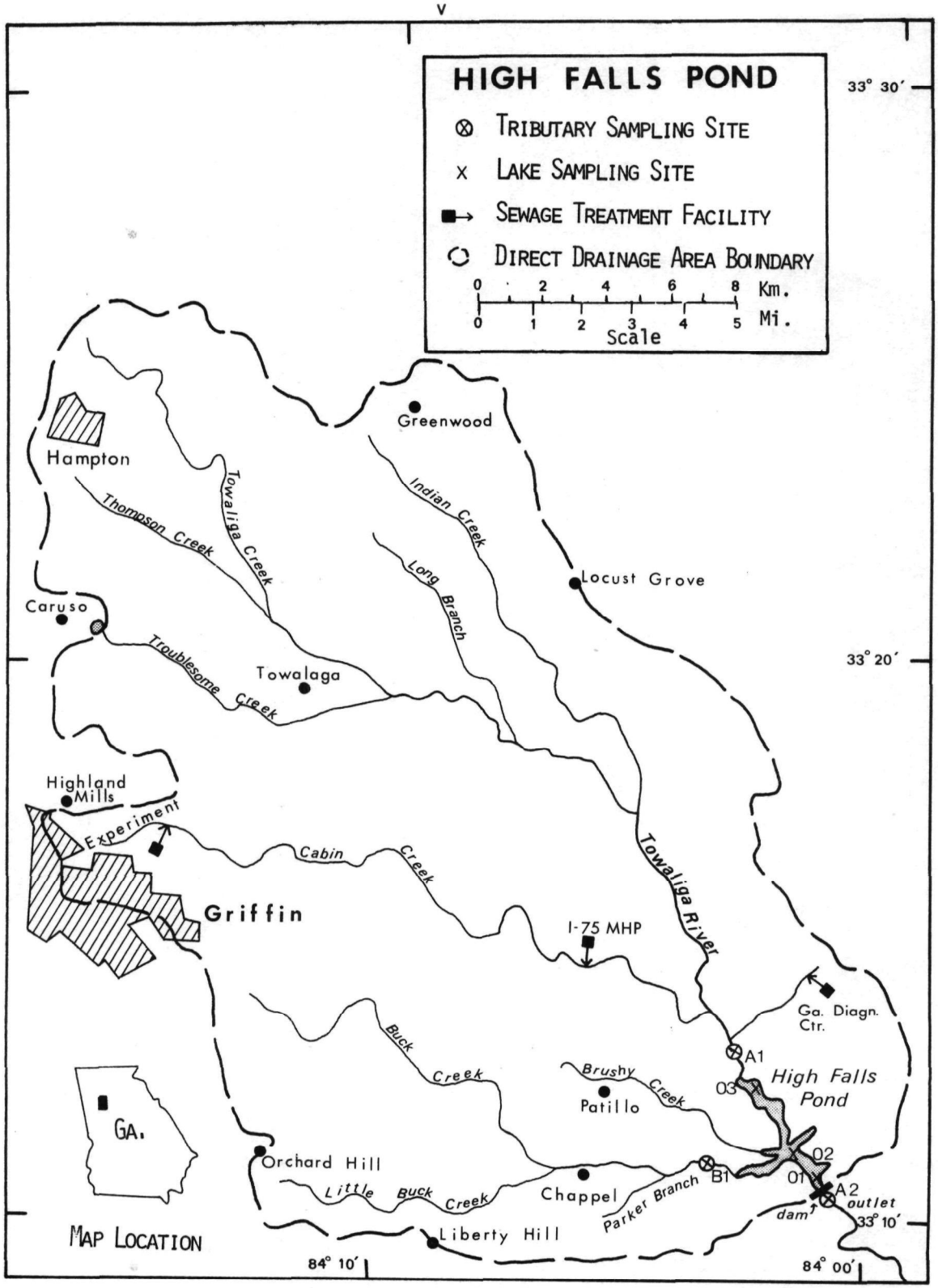
Major General Joel B. Paris, III, then the Adjutant General of Georgia, and Project Officer Lt. Colonel John R. Ranier, who directed the volunteer efforts of the Georgia National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF GEORGIA

LAKE NAME	COUNTY
Allatoona	Bartow, Cherokee, Cobb
Blackshear	Crisp, Dooly, Lee, Sumpter
Blue Ridge	Fannin
Burton	Rabun
Chatuge	Towns, GA; Clay, NC
Clark Hill	Columbia, Elbert, Lincoln, McDuffie, Wilks, GA; Abbeville, McCormick, SC
Harding	Harris, GA; Chambers, Lee, AL
Hartwell	Franklin, Hart, Stephens, GA; Anderson, Oconee, Pickens, SC
High Falls	Butts, Lamar, Monroe
Jackson	Butts, Jasper, Newton
Nottely	Union
Seminole	Decatur, Seminole, GA; Jackson, FL
Sidney Lanier	Dawson, Forsyth, Gwinnett, Hall, Lumpkin
Sinclair	Baldwin, Hancock, Putnam
Walter F. George	Clay, Quitman, Stewart, GA; Barbour, Henry, Russell, AL


HIGH FALLS POND
TRIBUTARY SAMPLING SITE
LAKE SAMPLING SITE
SEWAGE TREATMENT FACILITY
DIRECT DRAINAGE AREA BOUNDARY
0 2 4 6 8 Km.
0 1 2 3 4 5 Mi.
Scale
33° 30′
33° 20′
33° 10′
84° 10′
84° 00′
Greenwood
Hampton
Thompson Creek
Towaliga Creek
Indian Creek
Long Branch
Locust Grove
Caruso
Troublesome Creek
Towalaga
Highland Mills
Experiment
Cabin Creek
Towaliga River
Griffin
I-75 MHP
Ga. Diagn. Ctr.
A1
Buck Creek
Brushy Creek
High Falls Pond
O3
Patillo
O2
O1
B1
A2
outlet
dam
Orchard Hill
Little Buck Creek
Chappel
Parker Branch
Liberty Hill
GA.
MAP LOCATION

HIGH FALLS POND*

STORET NO. 1319

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that High Falls Pond is eutrophic. This lake ranked eleventh in overall trophic quality when the 14 Georgia lakes sampled in 1973 were compared using a combination of six parameters**. Ten lakes had less median total phosphorus, eight had less median dissolved phosphorus, three had less inorganic nitrogen, 13 had less mean chlorophyll a, and ten had greater Secchi disc transparency. Marked depression of dissolved oxygen with depth occurred at all stations in June and September, 1973.

Survey limnologists noted submerged and emergent vegetation along much of the shoreline near sampling station 1.

High Falls Pond is one of the two Georgia water bodies listed in "Problem lakes of the United States" (Ketelle and Uttormark, 1971).

B. Rate-Limiting Nutrient:

The algal assay results indicate that High Falls Pond was phosphorus limited at the time the assay sample was collected (06/22/73). The lake data indicate phosphorus limitation in September as well but nitrogen limitation in November.

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* Table of metric conversions--Appendix A.

** See Appendix B.

C. Nutrient Controllability:

1. Point sources--During the sampling year, the phosphorus contributions of domestic point sources amounted to 63.7% of the total phosphorus load. The Griffin wastewater treatment plant contributed 59.3%, the Georgia Diagnostic Center wastewater treatment plant contributed 3.7%, and the I-75 Mobile Park wastewater treatment plant contributed 0.8% of the total phosphorus load.

The wastewater treatment plant serving the Dundee (textile) Mills at Griffin was not sampled nor were nutrient loads estimated. However, on the basis of the nutrient export rates of the Towaliga River at station A-1 (see below), it appears the nutrient contributions of this point source probably were not significant, although the volume of wastes may have been quite large (design flow = 7,570 m^3/day).

The present loading rate of 8.07 g/m^2/year is over four times the rate proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic rate (see page 14). However, the mean hydraulic retention time of High Falls Pond is a short 14 days, and it is likely that Vollenweider's model does not apply. Nonetheless, the existing trophic condition of the lake is evidence of excessive nutrient loads.

It is calculated that 90% phosphorus removal at the domestic point sources noted above would reduce the phosphorus load to High Falls Pond by 57+% and reduce the loading rate to 3.44 $g/m^2/yr$. In view of the questionable applicability of Vollenweider's model, it is likely that the indicated degree of phosphorus reduction would result in a significant improvement in the trophic condition of High Falls Pond.

2. Non-point sources--The phosphorus contributions of non-point sources accounted for 36.2% of the total phosphorus load during the sampling year. The Towaliga River contributed 27.7%, and Buck Creek contributed 5.7% of this load. Ungaged tributaries were estimated to have contributed 2.6%.

The nutrient export rates of the Towaliga River and Buck Creek were quite low during the sampling year (see page 14) and compare very well with nearby unimpacted Tussahaw Creek, tributary to Jackson Lake*, in which the nutrient export rates were 13 kg P and 300 kg N per square kilometer of drainage area during the sampling year.

* Working Paper No. 290.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 2.43 kilometers^2.
2. Mean depth: 3.7 meters.
3. Maximum depth: 7.3 meters.
4. Volume: 8.991 x 10^6 m^3.
5. Mean hydraulic retention time: 14 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Towaliga River	383.3 km^2	5.4 m^3/sec
Buck Creek	101.0 km^2	1.4 m^3/sec
Minor tributaries & immediate drainage -	46.6 km^2	0.7 m^3/sec
Totals	530.9 km^2	7.5 m^3/sec

2. Outlet -

Towaliga River	533.3 km^2**	7.5 m^3/sec

C. Precipitation***:

1. Year of sampling: 157.9 centimeters.
2. Mean annual: 123.1 centimeters.

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† Hall, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Total area adjusted to equal sum of subdrainage areas plus the area of the lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

High Falls Pond was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and from a number of depths at each station (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the three stations for phytoplankton identification and enumeration; and during the first visit, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 4.6 meters at station 1, 4.6 meters at station 2, and 3.0 meters at station 3.

The results obtained are presented in full in Appendix D and are summarized in the following table.

SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR HIGH FALLS LAKE
STORET CODE 1319

PARAMETER	1ST SAMPLING (6/22/73) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (9/ 8/73) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/ 8/73) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	19.6 - 30.6	25.2	25.1	20.5 - 28.3	25.6	26.2	15.1 - 15.6	15.4	15.4
DISS OXY (MG/L)	0.1 - 10.4	4.1	0.4	0.1 - 7.1	3.3	3.0	6.4 - 9.2	8.0	8.0
CNDCTVY (MCROMO)	57. - 93.	75.	80.	74. - 175.	100.	88.	72. - 80.	76.	74.
PH (STAND UNITS)	6.9 - 8.7	7.8	8.0	6.5 - 8.4	7.3	7.1	7.2 - 7.8	7.5	7.4
TOT ALK (MG/L)	20. - 35.	28.	28.	24. - 47.	35.	34.	34. - 37.	36.	36.
TOT P (MG/L)	0.023 - 0.078	0.049	0.047	0.022 - 0.052	0.039	0.037	0.042 - 0.082	0.056	0.050
ORTHO P (MG/L)	0.002 - 0.010	0.005	0.005	0.005 - 0.014	0.009	0.009	0.012 - 0.030	0.020	0.020
NO2+NO3 (MG/L)	0.040 - 0.360	0.115	0.080	0.030 - 0.080	0.046	0.040	0.020 - 0.040	0.029	0.030
AMMONIA (MG/L)	0.060 - 0.510	0.203	0.120	0.040 - 1.580	0.327	0.060	0.040 - 0.070	0.046	0.040
KJEL N (MG/L)	0.600 - 1.100	0.791	0.800	0.600 - 1.900	1.056	1.000	0.400 - 0.800	0.562	0.550
INORG N (MG/L)	0.110 - 0.600	0.318	0.310	0.070 - 1.630	0.372	0.110	0.060 - 0.100	0.075	0.075
TOTAL N (MG/L)	0.640 - 1.180	0.906	0.850	0.640 - 1.950	1.101	1.030	0.430 - 0.830	0.591	0.575
CHLRPYL A (UG/L)	7.8 - 17.3	11.1	8.1	12.7 - 25.5	20.6	23.7	5.0 - 20.5	12.8	12.8
SECCHI (METERS)	0.9 - 1.3	1.0	0.9	0.9 - 1.2	1.1	1.1	0.9 - 1.0	1.0	1.0

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
06/22/73	1. Golenkinia	266
	2. Lyngbya	251
	3. Microcystis	133
	4. Nitzschia	103
	5. Staurastrum	89
	Other genera	1,048
	Total	1,890
09/08/73	1. Dactylococcopsis	6,995
	2. Oscillatoria	1,454
	3. Lyngbya	1,385
	4. Raphidiopsis	762
	5. Merismopedia	554
	Other genera	2,176
	Total	13,326
11/08/73	1. Flagellates	959
	2. Dactylococcopsis	806
	3. Cryptomonas	457
	4. Mesostigma	436
	5. Glenodinium	261
	Other genera	1,110
	Total	4,029

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
06/22/73	01	7.8
	02	17.3
	03	8.1
09/08/73	01	23.7
	02	12.7
	03	25.5
11/07-08/73	01	-
	02	5.0
	03	20.5

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.006	0.394	0.1
0.010 P	0.016	0.394	2.7
0.020 P	0.026	0.394	8.9
0.050 P	0.056	0.394	11.0
0.025 P + 0.5 N	0.031	0.894	10.4
0.050 P + 1.0 N	0.056	1.394	23.0
1.0 N	0.006	1.394	0.1

2. Filtered and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.003	0.374	0.1
0.010 P	0.013	0.374	2.7
0.020 P	0.023	0.374	7.6
0.050 P	0.053	0.374	10.8
0.025 P + 0.5 N	0.028	0.874	10.1
0.050 P + 1.0 N	0.053	1.374	21.3
1.0 N	0.003	1.374	0.1

3. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity in High Falls Pond was low at the time the assay sample was taken. Increasing yields with increasing concentrations of orthophosphorus show that the lake was limited by phosphorus at that time. Note that the addition of only nitrogen resulted in a yield no different than the control.

The lake data further substantiate phosphorus limitation at the time the sample was taken; i.e., mean N/P ratios on June 22, 1973, and on September 8, 1973, were 41/1 or greater. The November 8, 1973, data indicate nitrogen limitation; i.e., the mean N/P ratio was 4/1.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Georgia National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of January and February when two samples were collected. Sampling was begun in March, 1973, and was completed in February, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Georgia District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads, in $kg/km^2/year$, at station B-1 and multiplying by the ZZ area in km^2.

The operators of the Georgia Diagnostic Center and Griffin wastewater treatment plants provided monthly effluent samples and corresponding flow data. Monthly effluent samples also were received from the I-75 Mobile Park wastewater treatment facility; however, flow data were not provided, and nutrient loads were estimated at 1.134 kg P and 3.401 kg N/capita/year (the analytical data are included in Appendix E).

* See Working Paper No. 175.

The Dundee Mills waste treatment facility in Griffin was not sampled, and the nutrient contributions of this source are unknown. However, this source appears not to have been significant during the Survey sampling year (see discussion, page 2).

A. Waste Sources:

1. Known muncipal* -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Georgia Diagnostic Center	2,500	act. sludge	238.5	Unnamed Stream/ Towaliga River
Griffin	4,000	trickling filter	3,277.8	Cabin Creek
I-75 Mobile Park	135**	act. sludge	51.1***	Cabin Creek

2. Known industrial* -

Name	Type Waste	Treatment	Design Flow (m^3/d)	Receiving Water
Dundee Mills, Inc., Griffin	domestic, textile	aer. pond, settling tank	7,570.0	Cabin Creek

* Anonymous, 1972.
** Steele, 1973.
*** Estimated at 0.3785 m^3/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Towaliga River	5,435	27.7
Buck Creek	1,110	5.7
b. Minor tributaries & immediate drainage (non-point load) -	515	2.6
c. Known municipal -		
Georgia Diagnostic Center	720	3.7
Griffin	11,620	59.3
I-75 Mobile Park	155	0.8
d. Septic tanks* -	5	<0.1
e. Known industrial -		
Dundee Mills, Inc.	?	-
f. Direct precipitation** -	45	0.2
Total	19,605	100.0

2. Outputs -

Lake outlet - Towaliga River 14,915

3. Net annual P accumulation - 4,690 kg.

* Estimate based on 12 lakeshore residences; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Towaliga River	136,875	70.2
Buck Creek	23,110	11.9
b. Minor tributaries & immediate drainage (non-point load) -	10,670	5.5
c. Known municipal -		
Georgia Diagnostic Center	450	0.2
Griffin	20,555	10.6
I-75 Mobile Park	460	0.2
d. Septic tanks* -	130	<0.1
e. Known industrial -		
Dundee Mills, Inc.	?	-
f. Direct precipitation** -	2,625	1.4
Total	194,875	100.0

2. Outputs -

Lake outlet - Towaliga River 189,415

3. Net annual N accumulation - 5,460 kg.

* Estimate based on 12 lakeshore residences; see Working Paper No. 175.
** See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Towaliga River	14	357
Buck Creek	11	229

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" rate is the rate at which the receiving water would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	8.07	1.93	80.2	2.2

Vollenweider loading rates for phosphorus (g/m^2/yr) based on mean depth and mean hydraulic retention time of High Falls Pond:

"Dangerous" (eutrophic rate)	1.82
"Permissible" (oligotrophic rate)	0.91

V. LITERATURE REVIEWED

Anonymous, 1972. Georgia municipal and industrial wastewater treatment facilities associated with reservoirs. GA Dept. of Nat. Resources, Atlanta.

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Steele, James N., 1973. Personal communication (I-75 MHP waste treatment plant; population served). Hugh Steele, Inc., Forest Park.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VII. APPENDICES

APPENDIX A

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX B

LAKE RANKINGS

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500- MEAN SEC	MEAN CHLORA	15- MIN DO	MEDIAN DISS P	INDEX NO
1301	ALLATOONA RESERVOIR	62 (8)	54 (7)	46 (6)	31 (4)	31 (0)	62 (7)	286
1302	BLACKSHEAR LAKE	38 (5)	31 (4)	0 (0)	100 (13)	100 (13)	15 (2)	284
1303	CHATUGE LAKE	85 (11)	85 (11)	92 (12)	69 (9)	31 (0)	62 (7)	424
1304	CLARK HILL RESERVOIR	54 (7)	62 (8)	62 (8)	54 (7)	31 (0)	46 (6)	309
1309	JACKSON LAKE	8 (1)	8 (1)	15 (2)	8 (1)	69 (9)	8 (1)	116
1310	LAKE SIDNEY LANIER	69 (9)	46 (6)	77 (10)	77 (10)	31 (0)	85 (10)	385
1311	NOTTELY RESERVOIR	77 (10)	69 (9)	69 (9)	62 (8)	31 (0)	85 (10)	393
1312	LAKE SEMINOLE	31 (4)	15 (2)	38 (5)	46 (6)	92 (12)	31 (4)	253
1313	SINCLAIR LAKE	46 (6)	38 (5)	54 (7)	23 (3)	31 (0)	62 (7)	254
1314	LAKE EUFAULA	15 (2)	23 (3)	31 (4)	15 (2)	77 (10)	23 (3)	184
1316	BLUE RIDGE LAKE	92 (12)	92 (12)	85 (11)	85 (11)	85 (11)	85 (10)	524
1317	LAKE HARDING	0 (0)	0 (0)	8 (1)	38 (5)	31 (0)	0 (0)	77
1318	BURTON LAKE	100 (13)	100 (13)	100 (13)	92 (12)	31 (0)	100 (13)	523
1319	HIGH FALLS LAKE	23 (3)	77 (10)	23 (3)	0 (0)	31 (0)	38 (5)	192

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS P
1301	ALLATOONA RESERVOIR	0.020	0.150	443.167	7.489	14.900	0.005
1302	BLACKSHEAR LAKE	0.035	0.250	468.091	1.855	11.700	0.014
1303	CHATUGE LAKE	0.014	0.110	382.778	6.339	14.900	0.005
1304	CLARK HILL RESERVOIR	0.024	0.150	439.250	6.715	14.900	0.007
1309	JACKSON LAKE	0.094	0.530	461.385	14.577	14.800	0.027
1310	LAKE SIDNEY LANIER	0.016	0.180	396.417	5.431	14.900	0.004
1311	NOTTELY RESERVOIR	0.015	0.130	405.667	6.656	14.900	0.004
1312	LAKE SEMINOLE	0.040	0.405	456.133	6.760	11.800	0.010
1313	SINCLAIR LAKE	0.028	0.230	440.667	8.006	14.900	0.005
1314	LAKE EUFAULA	0.048	0.345	457.667	9.083	14.400	0.011
1316	BLUE RIDGE LAKE	0.010	0.105	394.889	3.078	13.000	0.004
1317	LAKE HARDING	0.114	0.640	467.538	7.438	14.900	0.045
1318	BURTON LAKE	0.007	0.100	363.889	2.733	14.900	0.003
1319	HIGH FALLS LAKE	0.047	0.115	459.444	15.075	14.900	0.009

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1316	BLUE RIDGE LAKE	524
2	1318	BURTON LAKE	523
3	1303	CHATUGE LAKE	424
4	1311	NOTTELY RESERVOIR	393
5	1310	LAKE SIDNEY LANIER	385
6	1304	CLARK HILL RESERVOIR	309
7	1301	ALLATOONA RESERVOIR	286
8	1302	BLACKSHEAR LAKE	284
9	1313	SINCLAIR LAKE	254
10	1312	LAKE SEMINOLE	253
11	1319	HIGH FALLS LAKE	192
12	1314	LAKE EUFAULA	184
13	1309	JACKSON LAKE	116
14	1317	LAKE HARDING	77

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR GEORGIA 1/9/75

LAKE CODE 1319 HIGH FALLS POND

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 533.5

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1319A1	383.3	5.97	8.55	12.18	7.39	5.64	4.39	4.11	2.61	2.35	2.44	4.42	4.96	5.40
1319A2	533.5	8.33	11.89	16.93	10.28	7.84	6.12	5.72	3.62	3.28	3.40	6.17	6.88	7.52
1319B1	101.0	1.59	2.24	3.20	1.95	1.47	1.16	1.08	0.68	0.62	0.65	1.16	1.30	1.42
1319ZZ	46.6	0.76	1.10	1.56	0.93	0.74	0.57	0.54	0.34	0.31	0.31	0.59	0.62	0.70

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 533.5
SUM OF SUB-DRAINAGE AREAS = 530.9
TOTAL FLOW IN = 90.47
TOTAL FLOW OUT = 90.47

NOTE *** LAKE AREA=2.6 SQ KM. NOT INCLUDED IN SUM OF SUB-DRAINAGE AREAS

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1319A1	3	73	11.81	10	4.87				
	4	73	11.95	4	7.05				
	5	73	7.70	1	3.51				
	6	73	5.49	4	4.47				
	7	73	6.14	2	3.57	24	3.43		
	8	73	12.54						
	9	73	1.70	19	1.84				
	10	73	1.33	18	1.10				
	11	73	3.00	9	3.40				
	12	73	5.21	10	2.58				
	1	74	14.13	7	5.44	11	3.45		
	2	74	20.25	12	6.14	26	4.76		
1319A2	3	73	16.40	10	6.77				
	4	73	16.62	4	9.83				
	5	73	10.73	1	4.90				
	6	73	7.65	4	6.23				
	7	73	8.55	2	4.96	24	4.76		
	8	73	17.44						
	9	73	2.38	19	2.61				
	10	73	1.84	18	1.56				
	11	73	4.19	9	4.76				
	12	73	7.25	10	3.57				
	1	74	19.71	7	7.59	11	4.81		
	2	74	25.34	12	7.67	26	5.95		

TRIBUTARY FLOW INFORMATION FOR GEORGIA 1/9/75

LAKE CODE 1319 HIGH FALLS POND

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
131981	3	73	3.09	10	1.27				
	4	73	3.17	4	1.87				
	5	73	2.01	1	0.91				
	6	73	1.44	4	1.19				
	7	73	1.61	2	0.93	24	0.91		
	8	73	3.28						
	9	73	0.45	19	0.48				
	10	73	0.34	18	0.28				
	11	73	0.79	9	0.91				
	12	73	1.36	10	0.68				
	1	74	3.77	7	1.44	11	0.91		
	2	74	4.76	12	1.44	26	1.10		
1319ZZ	3	73	1.50						
	4	73	1.50						
	5	73	1.02						
	6	73	0.71						
	7	73	0.79						
	8	73	1.64						
	9	73	0.23						
	10	73	0.17						
	11	73	0.40						
	12	73	0.65						
	1	74	1.81						
	2	74	2.35						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/11/26

131901
33 10 46.0 084 01 14.0
HIGH FALLS LAKE
13207 GEORGIA

11EPALES
3

2111202
0019 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/06/22	16 00	0000	30.6	10.3	50	70	8.10	26	0.070	0.800	0.050	0.007
	16 00	0005	28.5	10.4		62	8.00	23	0.060	0.600	0.060	0.005
	16 00	0010	21.8	0.2		57	7.50	20	0.180	0.600	0.130	0.003
	16 00	0015	19.6	0.1		90	6.90	34	0.510	0.800	0.050	0.002K
73/09/08	09 45	0000	28.3	7.1	46	82	8.10	28	0.050	1.400	0.050	0.014
	09 45	0008	25.5	0.2		86	6.60	36	0.140	1.000	0.030	0.009
	09 45	0015	21.2	0.1		135	6.70	41	0.780	1.500	0.040	0.009
73/11/08	14 39	0000	15.5		40	72	7.40	36	0.050	0.400	0.040	0.012
	14 39	0005	15.5	7.4		72	7.20	35	0.050	0.400	0.030	0.019
	14 39	0014	15.4	6.4		73	7.20	34	0.070	0.500	0.030	0.020

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/06/22	16 00	0000	0.034	7.8
	16 00	0005	0.036	
	16 00	0010	0.052	
	16 00	0015	0.023	
73/09/08	09 45	0000	0.033	23.7
	09 45	0008	0.037	
	09 45	0015	0.030	
73/11/08	14 39	0000	0.048	
	14 39	0005	0.046	
	14 39	0014	0.042	

K : VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

131902
33 11 13.0 084 01 36.0
HIGH FALLS LAKE
13207 GEORGIA

11EPALES
3

2111202
0015 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/06/22	16 30	0000	30.3		37	80	8.20	29	0.070	0.600	0.040	0.004
	16 30	0005	26.5	8.3		63	8.10	22	0.100	0.900	0.160	0.005
	16 30	0010	22.5	0.4		62	7.60	23	0.190	0.700	0.130	0.002K
	16 30	0013	20.7	0.3		80	7.10	35	0.450	1.000	0.150	0.010
73/09/08	10 10	0000	28.1	6.8	45	80	8.40	30	0.050	0.800	0.040	0.009
	10 10	0005	26.9	3.0		74	7.20	24	0.040	0.700	0.030	0.008
	10 10	0008	25.0			83						
	10 10	0015	20.5	1.0		175	6.50	47	1.580	1.900	0.050	0.005
73/11/07	14 54	0000	15.6		36		7.70	36	0.040	0.800	0.030	0.023
	14 54	0005	15.5	8.0		73	7.40	37	0.040	0.600	0.020	0.020
	14 54	0010	15.4	8.0		74	7.30	34	0.040	0.500	0.020	0.017

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/06/22	16 30	0000	0.045	17.3
	16 30	0005	0.065	
	16 30	0010	0.047	
	16 30	0013	0.045	
73/09/09	10 10	0000	0.031	12.7
	10 10	0005	0.047	
	10 10	0015	0.022	
73/11/07	14 54	0000	0.063	5.0
	14 54	0005	0.044	
	14 54	0010	0.052	

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/11/26

131903
33 12 03.0 084 01 58.0
HIGH FALLS LAKE
13207 GEORGIA

11EPALES 2111202
3 0012 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/06/22	16 55	0000	29.4		35	80	8.70	34	0.060	0.800	0.060	0.007
	16 55	0005	25.1	6.1		85	8.00	28	0.120	0.800	0.360	0.010
	16 55	0010	21.8	0.4		93	7.40	32	0.420	1.100	0.080	0.004
73/09/08	10 40	0000	28.1	6.0	37	90	8.40	34	0.060	1.000	0.050	0.011
	10 40	0004	27.1	5.0		89	7.10	34	0.050	0.600	0.040	0.007
	10 40	0008	25.5	0.8		105	6.60	42	0.190	0.600	0.080	0.006
73/11/08	15 13	0000	15.3		39	80	7.80	37	0.040	0.700	0.020	0.022
	15 13	0001	15.3	9.2		80						
	15 13	0006	15.1	9.0		80	7.70	36	0.040	0.600	0.040	0.030

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/06/22	16 55	0000	0.050	8.1
	16 55	0005	0.078	
	16 55	0010	0.061	
73/09/08	10 40	0000	0.049	25.5
	10 40	0004	0.049	
	10 40	0008	0.052	
73/11/08	15 13	0000	0.082	20.5
	15 13	0006	0.072	

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/12/04

1319A1 1319A1
33 13 00.0 084 03 00.0
TOWALIGIA RIVER
13241 15 BARNESVILLE
I/HIGH FALLS POND
ST HWY 36 BRDG AT N END OF LAKE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/10	08 50		0.290	1.450	0.420	0.031	0.095
73/04/04	09 20		0.290	1.150	0.168	0.022	0.070
73/05/01	12 30		0.357	1.000	0.360	0.031	0.065
73/06/04	13 30		0.399	0.210	0.046	0.033	0.070
73/07/02	14 10		0.320	0.250	0.017	0.054	0.090
73/07/24			0.360	1.150	0.357	0.066	0.130
73/09/19	12 50		0.294	0.460	0.052	0.113	0.190
73/10/18	13 30		0.340	0.450	0.038	0.115	0.185
73/11/09	13 25		0.230	0.450	0.029	0.138	0.165
73/12/10	10 10		0.430	0.300	0.048	0.068	0.113
74/01/07	15 00		0.390	0.500	0.045	0.025	0.090
74/01/11	14 30		0.400	0.200	0.040	0.035	0.085
74/02/12	14 30		0.420	0.600	0.055	0.025	0.070
74/02/26	14 30		0.340	0.200	0.030	0.020	0.075

ETRIEVAL DATE 74/12/04

1319A2 1319A2
33 10 30.0 084 01 00.0
TOWALIGA RIVER
13 15 BARNESVILLE
0/HIGH FALLS POND
BRDG BELO DAM SEC RD 1698
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/10	09 30		0.220	1.320	0.046	0.014	0.050
73/04/04	09 55		0.180	1.540	0.399	0.036	0.105
73/05/01	11 00		0.154	0.660	0.086	0.009	0.045
73/06/04	14 00		0.176	0.390	0.058	0.022	0.060
73/07/02	13 50		0.024	0.400	0.011	0.009	0.030
73/07/24			0.147	0.340	0.022	0.010	0.035
73/09/19	13 25		0.015	0.690	0.021	0.010	0.050
73/10/18	14 00		0.027	0.850	0.168	0.016	0.040
73/11/09	13 50		0.016	0.550	0.019	0.007	0.040
73/12/10	10 30		0.024	0.600	0.036	0.012	0.060
74/01/07	15 15		0.300	0.400	0.050	0.025	0.095
74/01/11	14 50		0.310	0.300	0.055	0.020	0.075
74/02/12	15 00		0.252	0.900	0.085	0.020	0.105
74/02/26	15 00		0.252	0.300	0.035	0.020	0.100

STORET RETRIEVAL DATE 74/12/04

131981 131981
33 11 00.0 084 18 00.0
BUCK CREEK
13 15 BARNESVILLE
T/HIGH FALLS POND
US HWY 75 BRDG
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/03/10	09 15		0.168	0.975	0.063	0.008	0.030
73/04/04	09 40		0.168	0.370	0.147	0.007	0.035
73/05/01	10 43		0.180	0.720	0.115	0.005K	0.020
73/06/04	13 45		0.220	0.200	0.050	0.008	0.025
73/07/02	14 20		0.220	0.210	0.037	0.008	0.020
73/07/24			0.010K	0.360	0.018	0.008	0.040
73/09/19	13 10		0.138	0.370	0.040	0.009	0.035
73/10/18	13 45		0.198	0.275	0.046	0.012	0.020
73/11/09	13 35		0.081	0.300	0.020	0.008	0.035
73/12/10	10 20		0.160	0.300	0.040	0.008	0.010
74/01/07	15 10		0.224	0.100	0.055	0.005K	0.015
74/01/11	14 40		0.192	0.100	0.080	0.005K	0.005
74/02/12	14 45		0.200	0.500	0.090	0.007	0.025
74/02/26	14 45		0.176	0.200	0.045	0.005	0.035

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 75/01/06

1319AA AS1319AA P002500
33 12 50.0 084 03 30.0
GEORGIA DIOGNOSTIC CENTER
13241 15 BARNESVILLE
T/HIGH FALLS POND
UNNAMED STREAM/TOWALIGA RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/05/07	09 30								
CP(T)-			0.085	4.900	0.095	5.700	6.200	0.072	0.075
73/05/07	14 30								
73/06/07	10 00								
CP(T)-			0.052	4.100	0.076	5.060	5.500	0.075	0.072
73/06/07	15 00								
73/07/10	09 30								
CP(T)-			0.010K	3.600	0.067	4.000	4.600	0.075	0.072
73/07/10	14 30								
73/09/05	09 00								
CP(T)-			1.260	5.540				0.069	0.069
73/09/05	14 00								
73/10/02	09 30		0.300	5.900	0.190	13.700	15.200	0.048	0.048
73/11/05	08 45								
CP(T)-			0.190	6.900	0.110	8.400	8.700	0.038	0.038
73/11/05	12 45								
73/12/03	09 10								
CP(T)-			1.600	8.400	0.190	10.000	11.000	0.073	0.063
73/12/03	13 00								
74/01/08	08 30								
CP(T)-			1.680	3.400	0.110	9.950	9.950	0.049	0.049
74/01/09	12 30								
74/02/05	07 45								
CP(T)-								0.072	0.069
74/02/05	13 35								
74/03/04	08 00								
CP(T)-			0.160	2.400	0.050	8.900	9.800	0.068	0.068
74/03/04	12 30								
74/04/01	08 00								
CP(T)-			0.040	2.600	0.050K	6.600	7.800	0.065	0.072
74/04/01	14 30								

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 75/01/06

131921 TF131921 P018000
33 16 40.0 084 15 30.0
GRIFFIN
13207 1:250000 ATLANTA
T/HIGH FALLS POND
CABIN CREEK/TOWALIGA RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/04/12	14 00		3.800	12.600	7.200	6.400	8.100	1.320	0.886
73/05/15	08 00		8.400	7.700	3.500	10.500	11.500	1.080	0.990
73/06/15	08 00		2.200	14.700	6.300	5.900	9.520	1.200	0.907
73/07/16	16 00		7.800	13.200	6.900	9.700	11.500	1.260	0.900
73/08/14	08 00		4.600	10.500	0.880	3.100	17.000	1.170	0.844
73/09/14	08 00		9.300	5.100	1.900	11.200	11.500	1.200	0.788
73/10/11	08 00		14.800	5.700	3.300	12.000	12.000	1.110	0.809
73/11/12	09 30		13.000	7.200	3.690	8.800	10.000	1.140	0.826
73/12/12	08 00		17.000	10.500	3.500	8.700	10.800	1.050	0.809
74/01/11	08 00		9.900	4.900	1.300	6.400	7.300	1.200	0.810
74/02/12	13 00		7.400	7.800	3.450	5.800	7.700	1.320	0.879
74/03/13	08 00		9.600	4.600	1.750	4.900	5.600	1.200	0.868
74/04/11	08 00		8.500	4.200	0.820	3.900	4.850	1.260	0.945

STORET RETRIEVAL DATE 75/01/06

131931 AS131931 P000135
33 14 30.0 084 06 00.0
I-75 MOBILE PARK
13 15 BARNESVILLE
T/HIGH FALLS POND
CABIN CREEK/TOWALIGA RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/05/10	10 00								
CP(T)-			0.035	5.000	0.150	8.800	9.300		
73/05/10	20 00								
73/06/18	07 00								
CP(T)-			0.010K	1.900	0.360	8.400	8.800		
73/06/18	18 00								
73/07/23	08 00								
CP(T)-			0.050	4.100	1.000	5.600	9.500		
73/07/23	16 00								
73/08/23	08 00								
CP(T)-			0.062	5.700	0.151	11.600	13.000		
73/08/23	16 00								
73/09/25	08 00								
CP(T)-			0.300	1.300	0.010K	12.900	12.900		
73/09/25	16 00								
73/10/23	08 00								
CP(T)-			0.140	3.200	0.034	9.000	9.800		
73/10/23	16 00								
73/11/26	09 00								
CP(T)-			0.140	2.600	0.140	7.000	7.500		
73/11/26	16 30								
74/01/01	08 00								
CP(T)-			0.280	4.800	0.310	11.200	13.000		
74/01/01	15 00								
74/02/11	08 00								
CP(T)-			0.520	4.900	0.120	8.300	9.100		
74/02/11	16 00								
74/03/14	10 00								
CP(T)-			1.360	2.800	0.250	9.700	10.500		
74/03/14	18 00								
74/04/24	09 00								
CP(T)-			0.320	4.800	1.000	8.400	9.200		
74/04/24	18 00								
74/05/23	09 00								
CP(T)-			0.767	6.300	1.850	5.100	8.800		
74/05/23	17 00								

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 75/01/06

131931 AS131931 P000135
33 14 30.0 084 06 00.0
I-75 MOBILE PARK
13 15 BARNESVILLE
T/HIGH FALLS POND
CABIN CREEK/TOWALIGA RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
74/06/03	09 00								
CP(T)-			0.160	2.000	0.081	7.900	8.100		
74/06/03	17 00								