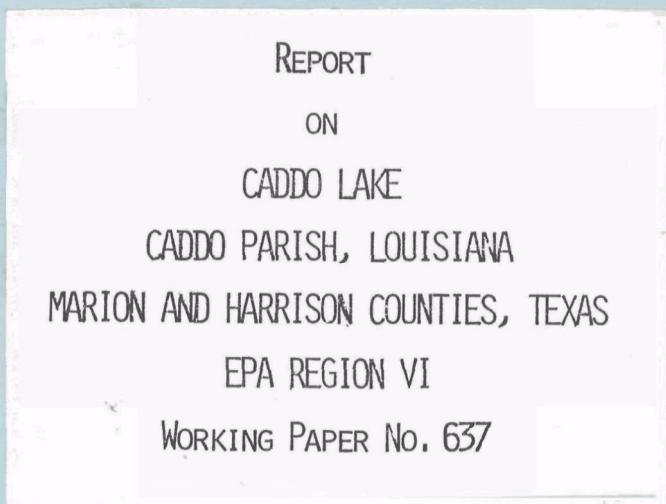


**U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY
WORKING PAPER SERIES**



**CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON
and
ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA**

REPORT
ON
CADDY LAKE
CADDY PARISH, LOUISIANA
MARION AND HARRISON COUNTIES, TEXAS
EPA REGION VI
WORKING PAPER No. 637

WITH THE COOPERATION OF THE
LOUISIANA WILD LIFE AND FISHERIES COMMISSION
AND THE
LOUISIANA NATIONAL GUARD
MARCH, 1977

REPORT ON CADDO LAKE
CADDO PARISH, LOUISIANA
MARION AND HARRISON COUNTIES, TEXAS
EPA REGION VI

by
National Eutrophication Survey
Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and
Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 637

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater 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 nonpoint 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 freshwater 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 the U.S. Environmental Protection Agency and to augment plans implementation by the states.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control and to the Texas Water Quality Board for professional involvement, to the Louisiana and Texas National Guards for conducting the tributary sampling phase of the Survey, and to those Louisiana and Texas wastewater treatment plant operators who provided effluent samples and flow data.

Robert A. Lafleur, Chief; J. Dale Givens, Assistant Chief; Lewis R. Still, Biologist; Louis Johnson, Biologist; Lee Cau-barreaux, Biologist; Darrell Reed, Engineer; Dempsey Alford, Biologist; and Elwood Goodwin, Water Quality Control Technician, all of the Louisiana Wild Life and Fisheries Commission, Division of Water Pollution Control; and Hugh C. Yantis, Jr., Executive Director of the Texas Water Quality Board; John B. Latchford, Jr., Director; and the staff of the Texas Water Quality Board Field Operations Division reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

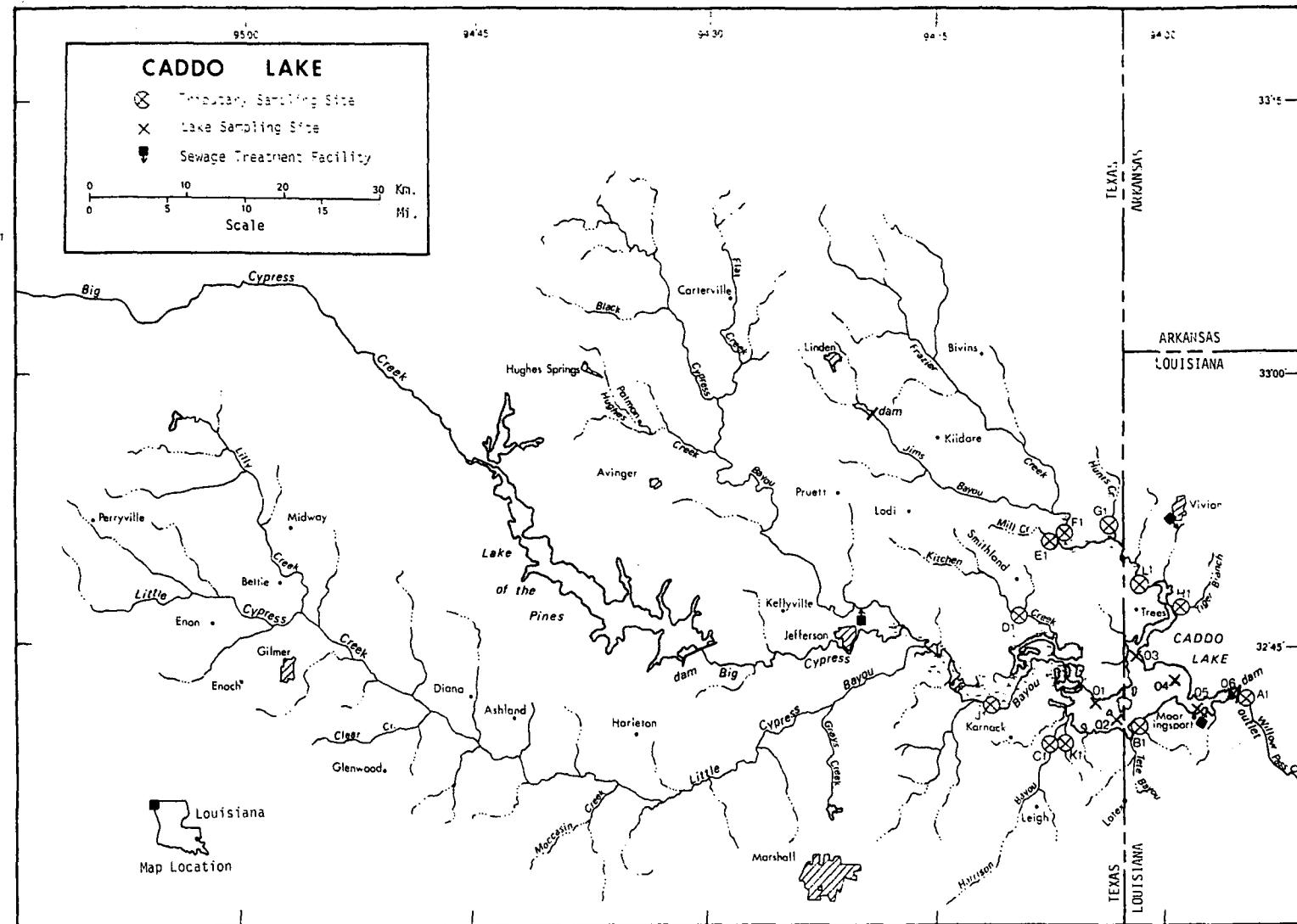
Major General O'Neil Daigle, Jr., the Adjutant General of Louisiana, and Project Officer Colonel Lawrence P. Dupre, who directed the volunteer efforts of the Louisiana National Guardsmen; and Major General Thomas Bishop, the Adjutant General of Texas, and Project Officer William L. Seals, who directed the volunteer efforts of the Texas National Guardsmen are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF LOUISIANA

<u>LAKE NAME</u>	<u>PARISH</u>
Anacoco Lake	Vernon
Lake Bistineau	Bienville, Webster
Black Bayou	Caddo
Black Lake	Natchitoches and Red River
Bruin Lake	Tensas
Bundick Lake	Beauregard
Caddo Lake	Caddo (Menon and Harrison in Texas)
Cocodrie Lake	Concordia
Cocodrie Lake (Lower)	Rapides
Concordia Lake	Concordia
Cotile Lake	Rapides
Cross Lake	Caddo
D'Arbonne Lake	Union
False River Lake	Pointe Coupee
Indian Creek Reservoir	Rapides
Saline Lake	LaSalle
Turkey Creek Lake	Franklin
Lake Vernon	Vernon
Lake Verret	Assumption



REPORT ON CADDO LAKE, LOUISIANA

STORET NO. 4807

I. CONCLUSIONS

A. Trophic Condition:*

Survey data indicate that Caddo Lake is eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses of each lake.

Secchi disc visibility in this humic lake was poor and potential for primary production, as measured by algal assay control yield, was moderate to high. Chlorophyll a levels ranged from 2.4 µg/l to 95.0 µg/l, with a mean of 21.3 µg/l. Of the 19 Louisiana lakes sampled in 1974, 12 had higher total phosphorus levels, 17 had higher inorganic nitrogen, and 14 had higher orthophosphorus values than Caddo Lake.

Survey limnologists reported emergent vegetation along 80% of the shoreline and an oily surface scum on the lake during all sampling occasions.

B. Rate-Limiting Nutrient:

Algal assay results for the spring sampling season suggested near colimitation in Caddo Lake by phosphorus and nitrogen. In the autumn assay, growth increases accompanied

*See Appendix E.

the addition of phosphorus to the Stations 01 to 03 sample, but in the Stations 04 to 06 sample, growth response was achieved with the addition of nitrogen. Mean inorganic nitrogen to orthophosphorus (N/P) ratios in the lake were 7/1 and less than 6/1, respectively, during March and November, suggesting nitrogen limitation and 14/1 during May, suggesting near-colimitation by the two.

C. Nutrient Controllability:

1. Point sources -

During the sampling year, the mean annual phosphorus load from point sources was estimated to be approximately 3.5% of the total load reaching Caddo Lake. The city of Jefferson contributed 3.0% of that load.

The phosphorus loading of $0.73 \text{ g P/m}^2/\text{yr}$ for Caddo Lake is less than the "eutrophic" load proposed by Vollenweider (1975) for lakes with such volume and detention time. However, loading calculations yield an apparent net export of phosphorus and nitrogen from the lake. This could be due to an underestimation of nutrient loadings from the six ungaged tributaries entering Caddo Lake (see Section IV-E) or to the lack of nutrient load estimations for the Longhorn Ordnance Plant or other undetected and unmeasured point sources. Any addition to the existing phosphorus loading of this lake should be carefully evaluated until a complete nutrient budget for the lake can be determined.

2. Nonpoint sources -

The phosphorus load from nonpoint sources was 96.5% of the total reaching the lake during the sampling year. Cypress Bayou contributed 74.7%, Monterey Lake Outlet contributed 10.5%, and the ungaaged tributaries and immediate drainage were estimated to have contributed 5.0% of the nonpoint source phosphorus load.

In general, few lakes are nitrogen limited as a result of low nitrogen. Rather, excessive phosphorus levels shift limitations to nitrogen or other factors. Regardless of the primary nutrient limitation suggested by either algal assay or nutrient ratios, the most feasible approach to nutrient control, if desirable, is through available phosphorus control technology and subsequent establishment of phosphorus limitation within the water body.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below.

Lake surface area and mean depth was provided by the State of Louisiana, maximum depth was estimated on the basis of Survey data; tributary flow data were provided by the Louisiana and Texas District Offices of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 132.09 km².
2. Mean depth: 1.8 meters.
3. Maximum depth: 3.0 meters.
4. Volume: 231.896 x 10⁶ m³.
5. Mean hydraulic retention time: 42 days.

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

1. Tributaries -

<u>Name</u>	<u>Drainage area(km²)</u>	<u>Mean flow (m³/sec)</u>
C-1 Harrison Bayou	112.9	0.93
D-1 Kitchen Creek	88.8	0.73
J-1 Cypress Bayou	5,542.6	46.05
L-1 Monterey Lake Outlet	909.1	7.48
Minor tributaries and immediate drainage -	<u>321.1</u>	<u>3.73</u>
Totals	6,974.5	58.92
2. Outlet - A-1 Willow Pass Creek (Twelvemile Bayou)	7,107.0	64.20

C. Precipitation:

1. Year of sampling: 156.1 cm.
2. Mean annual: 113.7 cm.

III. LAKE WATER QUALITY SUMMARY

Caddo Lake was sampled four times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from six stations on the lake and from one or more depths at each station (see map, page V). During each visit, depth-integrated samples were collected from each station for chlorophyll a analysis and phytoplankton identification and enumeration. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 1.5 meters at Stations 01, 04, 05, and 06, and 1.8 meters at Stations 02 and 03. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

CADDY LAKE
STORET CODE 4807

PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(3/23/74)						(5/31/74)						(8/26/74)					
	N*	RANGE		MEDIAN	MAX DEPTH RANGE		N*	RANGE		MEDIAN	MAX DEPTH RANGE		N*	RANGE		MEDIAN	MAX DEPTH RANGE	
		S*** = 6	(METERS)		S*** = 6	(METERS)		S*** = 6	(METERS)		S*** = 6	(METERS)		S*** = 6	(METERS)		S*** = 6	(METERS)
TEMPERATURE (DEG CENT)																		
0.-1.5 M DEPTH	11	15.8-	17.5	16.8	0.0-	1.5	12	25.9-	27.9	26.9	0.0-	1.5	10	28.8-	30.4	29.4	0.0-	1.5
MAX DEPTH**	6	15.8-	17.4	16.8	1.5-	1.8	6	25.9-	27.9	26.5	0.6-	1.5	6	28.8-	30.4	29.3	0.0-	1.8
DISSOLVED OXYGEN (MG/L)																		
0.-1.5 M DEPTH	5	7.4-	9.4	8.8	1.5-	1.5	6	6.8-	7.6	7.1	0.6-	1.5	9	3.6-	7.0	5.4	0.0-	1.5
MAX DEPTH**	6	7.2-	9.4	8.7	1.5-	1.8	6	6.8-	7.6	7.1	0.6-	1.5	5	3.6-	7.0	5.4	0.0-	1.8
CONDUCTIVITY (UMHOS)																		
0.-1.5 M DEPTH	11	91.-	169.	106.	0.0-	1.5	12	139.-	222.	187.	0.0-	1.5	10	126.-	261.	134.	0.0-	1.5
MAX DEPTH**	6	92.-	169.	107.	1.5-	1.8	6	139.-	222.	186.	0.6-	1.5	6	130.-	261.	134.	0.0-	1.8
pH (STANDARD UNITS)																		
0.-1.5 M DEPTH	11	6.2-	7.4	6.8	0.0-	1.5	12	7.2-	8.4	7.7	0.0-	1.5	9	7.1-	7.2	7.1	0.0-	1.5
MAX DEPTH**	6	6.2-	6.9	6.7	1.5-	1.8	6	7.3-	7.9	7.5	0.6-	1.5	5	7.1-	7.2	7.1	0.0-	1.8
TOTAL ALKALINITY (MG/L)																		
0.-1.5 M DEPTH	11	10.-	21.	14.	0.0-	1.5	12	10.-	17.	11.	0.0-	1.5	0	*****-*****	*****	*****-*****		
MAX DEPTH**	6	10.-	19.	16.	1.5-	1.8	6	10.-	17.	11.	0.6-	1.5	0	*****-*****	*****	*****-*****		
TOTAL P (MG/L)																		
0.-1.5 M DEPTH	11	0.035-0.055	0.042	0.0-	1.5	12	0.046-0.060	0.051	0.0-	1.5	0	*****-*****	*****	*****-*****				
MAX DEPTH**	6	0.038-0.054	0.040	1.5-	1.8	6	0.050-0.060	0.054	0.6-	1.5	0	*****-*****	*****	*****-*****				
DISSOLVED ORTHO P (MG/L)																		
0.-1.5 M DEPTH	11	0.007-0.020	0.010	0.0-	1.5	12	0.006-0.020	0.007	0.0-	1.5	0	*****-*****	*****	*****-*****				
MAX DEPTH**	6	0.007-0.020	0.011	1.5-	1.8	6	0.006-0.012	0.007	0.6-	1.5	0	*****-*****	*****	*****-*****				
N02+N03 (MG/L)																		
0.-1.5 M DEPTH	11	0.020-0.080	0.030	0.0-	1.5	12	0.020-0.140	0.030	0.0-	1.5	0	*****-*****	*****	*****-*****				
MAX DEPTH**	6	0.020-0.080	0.040	1.5-	1.8	6	0.020-0.140	0.035	0.6-	1.5	0	*****-*****	*****	*****-*****				
AMMONIA (MG/L)																		
0.-1.5 M DEPTH	11	0.020-0.060	0.040	0.0-	1.5	12	0.030-0.060	0.040	0.0-	1.5	0	*****-*****	*****	*****-*****				
MAX DEPTH**	6	0.020-0.050	0.040	1.5-	1.8	6	0.030-0.060	0.040	0.6-	1.5	0	*****-*****	*****	*****-*****				
KJELDAHL N (MG/L)																		
0.-1.5 M DEPTH	11	0.600-0.700	0.600	0.0-	1.5	12	0.500-0.900	0.700	0.0-	1.5	0	*****-*****	*****	*****-*****				
MAX DEPTH**	6	0.600-0.700	0.600	1.5-	1.8	6	0.500-0.700	0.650	0.6-	1.5	0	*****-*****	*****	*****-*****				
SECCHI DISC (METERS)	6	0.9-	1.2	1.1			6	0.6-	1.2	0.8			6	0.5-	0.9	0.7		

* N = NO. OF SAMPLES

** MAXIMUM DEPTH SAMPLED AT EACH SITE

*** S = NO. OF SITES SAMPLED ON THIS DATE

CANOO LAKE
STRETE CODE 4807

PHYSICAL AND CHEMICAL CHARACTERISTICS

(11/11/74)

MAX
DEPTH
RANGE

PARAMETER	N*	RANGE	MEDIAN	DEPTH (METERS)	
TEMPERATURE (DEG CENT)					
0.-1.5 M DEPTH	12	16.2- 17.2	16.8	0.0-	1.5
MAX DEPTH**	6	16.3- 17.2	16.7	1.5-	1.5
DISSOLVED OXYGEN (MG/L)					
0.-1.5 M DEPTH	12	4.8- 8.4	7.3	0.0-	1.5
MAX DEPTH**	6	4.8- 8.4	7.3	1.5-	1.5
CONDUCTIVITY (UMHOS)					
0.-1.5 M DEPTH	12	58.- 109.	84.	0.0-	1.5
MAX DEPTH**	6	58.- 109.	84.	1.5-	1.5
pH (STANDARD UNITS)					
0.-1.5 M DEPTH	12	5.3- 6.4	5.5	0.0-	1.5
MAX DEPTH**	6	5.3- 6.3	5.5	1.5-	1.5
TOTAL ALKALINITY (MG/L)					
0.-1.5 M DEPTH	12	10.- 16.	11.	0.0-	1.5
MAX DEPTH**	6	10.- 16.	11.	1.5-	1.5
TOTAL P (MG/L)					
0.-1.5 M DEPTH	12	0.043-0.079	0.061	0.0-	1.5
MAX DEPTH**	6	0.047-0.079	0.068	1.5-	1.5
DISSOLVED ORTHO P (MG/L)					
0.-1.5 M DEPTH	12	0.008-0.020	0.015	0.0-	1.5
MAX DEPTH**	6	0.009-0.019	0.017	1.5-	1.5
NO2+NO3 (MG/L)					
0.-1.5 M DEPTH	12	0.020-0.030	0.020	0.0-	1.5
MAX DEPTH**	6	0.020-0.030	0.020	1.5-	1.5
AMMONIA (MG/L)					
0.-1.5 M DEPTH	12	0.030-0.330	0.045	0.0-	1.5
MAX DEPTH**	6	0.030-0.330	0.045	1.5-	1.5
KJELLAHL N (MG/L)					
0.-1.5 M DEPTH	12	0.500-0.900	0.600	0.0-	1.5
MAX DEPTH**	6	0.500-0.900	0.600	1.5-	1.5
SECCHI DISC (METERS)					
	6	0.9- 1.3	1.1		

* N = NO. OF SAMPLES

** MAXIMUM DEPTH SAMPLED AT EACH SITE

*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

<u>Sampling Date</u>	<u>Dominant Genera</u>	<u>Algal Units per ml</u>
03/23/74	1. <u>Melosira</u> 2. <u>Chlamydomonas</u> 3. <u>Flagellates</u> 4. <u>Raphidiopsis</u> 5. <u>Nitzschia</u>	4,960 1,114 861 709 607
	Other genera	<u>3,493</u>
	Total	11,744
05/31/74	1. <u>Lyngbya</u> 2. <u>Melosira</u> 3. <u>Dactylococcopsis</u> 4. <u>Nitzschia</u> 5. <u>Microcystis</u>	15,979 2,527 1,957 1,957 1,141
	Other genera	<u>7,255</u>
	Total	30,816
06/03/74	1. <u>Lyngbya</u> 2. <u>Melosira</u> 3. <u>Pennate diatom</u> 4. <u>Microcystis</u> 5. <u>Merismopedia</u>	18,932 5,177 1,923 1,331 1,035
	Other genera	<u>7,543</u>
	Total	35,941

2. Chlorophyll a -

<u>Sampling Date</u>	<u>Station Number</u>	<u>Chlorophyll a ($\mu\text{g/l}$)</u>
03/23/74	01	4.9
	02	8.7
	03	5.4
	04	10.1
	05	10.9
	06	11.0
05/31/74	01	28.1
	02	28.1
	03	28.1
	04	95.0
	05	16.9
	06	25.3
08/26/74	01	15.8
	02	20.5
	03	11.3
	04	25.0
	05	27.6
	06	22.4
11/11/74	01	2.4
	02	2.5
	03	7.1
	04	11.9
	05	6.0
	06	8.0

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. 03/23/74 - Stations 01-05

<u>Spike(mg/l)</u>	<u>Ortho P Conc.(mg/l)</u>	<u>Inorganic N Conc.(mg/l)</u>	<u>Maximum Yield (mg/l-dry wt.)</u>
Control	0.017	0.069	1.0
0.05 P	0.067	0.069	1.8
0.05 P + 1.0 N	0.067	1.069	16.6
1.00 N	0.017	1.069	1.4

b. 11/11/74 - Stations 01-03

<u>Spike(mg/l)</u>	<u>Ortho P Conc.(mg/l)</u>	<u>Inorganic N Conc.(mg/l)</u>	<u>Maximum Yield (mg/l-dry wt.)</u>
Control	0.010	M*	0.6
0.05 P	0.060	M	2.3
0.05 P + 1.0 N	0.060	M	14.2
1.00 N	0.010	M	0.5

c. 11/11/74 - Stations 04-06

<u>Spike(mg/l)</u>	<u>Ortho P Conc.(mg/l)</u>	<u>Inorganic N Conc.(mg/l)</u>	<u>Maximum Yield (mg/l-dry wt.)</u>
Control	0.016	0.087	2.2
0.05 P	0.066	0.087	2.4
0.05 P + 1.0 N	0.066	1.087	17.0
1.00 N	0.016	1.087	3.6

*Missing.

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potentials for primary production were moderate to high in Caddo Lake at the times of sampling. In the spring assay, spikes with either phosphorus or nitrogen alone produced slight increases in assay yield, suggesting near colimitation by the two nutrients. Maximum yield was achieved with the simultaneous addition of both nutrients.

In the autumn assay, the control yield of the assay for Stations 01 to 03 was much lower than that for Stations 04 to 06. This is possibly attributable to the proximity of Stations 04 to 06 to the Mooringsport sewage treatment plant outfall. The assay for Stations 01 to 03 showed a growth response to the addition of phosphorus, suggesting phosphorus limitation, while the Stations 04 to 06 assay showed response to the addition of nitrogen. Again, simultaneous additions of both phosphorus and nitrogen resulted in maximum assay yields.

The mean N/P ratios in the lake data were 7/1 and less than 6/1 for March and November suggesting nitrogen limitation. The N/P ratio of 14/1 during May sampling suggests borderline phosphorus limitation (an N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

It should be noted that significant chemical changes took place in Louisiana lake samples between collection and assay analysis. The assay data should be considered in this context and until such differences are resolved, used with caution for any prediction of actual lake conditions. Such chemical changes are likely to alter the control yield as well as modifying the N/P ratio.

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Louisiana and Texas National Guards collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff month of February when two samples were collected. Sampling was begun in June 1974, and was completed in April 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Louisiana and Texas District Offices of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in kg/km²/yr, in Harrison Bayou, Kitchen Creek, and Monterey Lake outlet at Stations C-1, D-1, and L-1, and multiplying the means by the ZZ area in km².

The operators of the Jefferson and Mooringsport wastewater treatment plants provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known municipal -

<u>Name</u>	<u>Population Served*</u>	<u>Treatment*</u>	<u>Mean Flow (m³/d x 10³)</u>	<u>Receiving Water</u>
Jefferson	2,866	Stabilization pond	2.116	Black Cypress Bayou
Mooringsport	850	Trickling filter	0.246	Caddo Lake

2. Known industrial -

<u>Name</u>	<u>Product</u>	<u>Treatment</u>	<u>Mean Flow (m³/d x 10³)</u>	<u>Receiving Water</u>
Longhorn Ordnance Plant	Ammunition	Trickling filter	Unknown	Caddo Lake

*Sewage treatment plant questionnaires.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

<u>Source</u>	<u>kg P/yr</u>	<u>% of total</u>
a. Tributaries (nonpoint load) -		
C-1 Harrison Bayou	2,655	2.7
D-1 Kitchen Creek	360	0.9
J-1 Cypress Bayou	72,560	74.7
L-1 Monterey Lake Outlet	10,200	10.5
b. Minor tributaries and immediate drainage (nonpoint load) -		
	4,815	5.0
c. Known municipal STP's -		
Jefferson	2,930	3.0
Mooringsport	485	0.5
d. Septic tanks* -		
	260	0.3
e. Known industrial -		
Longhorn Ordnance Plant	Unknown	---
f. Direct precipitation** -		
	<u>2,310</u>	<u>2.4</u>
Totals		100.0

2. Output -

A-1 Willow Pass Creek (Twelvemile Bayou)	103,390
3. Net annual P export*** -	6,315

*Estimate based on 58 lakeside residences, 1 state park, and 130 camps.

**Estimated (see NES Working Paper No. 175).

***Export probably due to unknown sources and/or sampling error.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

<u>Source</u>	<u>kg N/yr</u>	<u>% of total</u>
a. Tributaries (nonpoint load) -		
C-1 Harrison Bayou	21,710	1.5
D-1 Kitchen Creek	14,310	1.0
J-1 Cypress Bayou	1,052,130	72.6
L-1 Monterey Lake Outlet	147,470	10.2
b. Minor tributaries and immediate drainage (nonpoint load) -		
	55,230	3.8
c. Known municipal STP's -		
Jefferson	4,880	0.3
Mooringsport	1,500	0.1
d. Septic tanks* -		
	9,795	0.7
e. Known industrial -		
Longhorn Ordnance Plant	Unknown	---
f. Direct precipitation** -		
	<u>142,605</u>	<u>9.8</u>
Totals	1,449,630	100.0

2. Outputs -

A-1 Willow Pass Creek 1,775,590
 (Twelvemile Bayou)

3. Net annual N export*** - 325,960

*Estimate based on 58 lakeside residences, 1 state park, and 130 camps.

**Estimated (see NES Working Paper No. 175).

***Export probably due to unknown sources and/or sampling error.

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

<u>Tributary</u>	<u>kg P/km²/yr</u>	<u>kg N/km²/yr</u>
Harrison Bayou	24	192
Kitchen Creek	10	161
Cypress Bayou	13	190
Monterey Lake Outlet	11	162

E. Mean Nutrient Concentration in Ungaged Streams:

<u>Tributary</u>	<u>Mean Total P (mg/l)</u>	<u>Mean Total N (mg/l)</u>
B-1 Tete Bayou	0.086	0.943
E-1 Mill Creek	0.038	0.598
F-1 James Bayou	0.044	0.657
G-1 Hunts Creek	0.046	1.050
H-1 Tiger Branch	0.056	0.985
K-1 Saunders Branch	0.062	0.637

Nutrient levels for the above ungaged tributaries are all comparable to those levels in the measured tributaries entering Caddo Lake.

F. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between "eutrophic" and "oligotrophic".

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

<u>Total Yearly Phosphorus Loading (g/m²/yr)</u>	
Estimated loading for Caddo Lake	0.73
Vollenweider's "eutrophic" loading	0.74
Vollenweider's "oligotrophic" loading	0.37

V. LITERATURE REVIEWED

- Ketelle, Martha J. and Paul D. Uttermark. 1971. Problem Lakes in the United States. U.S. Environmental Protection Agency Project #16010 EHR. University of Wisconsin, Madison, Wisconsin.
- Shampine, W. J. 1971. Chemical, Biological, and Physical Data for the Major Lakes and Reservoirs in Louisiana. Louisiana Dept. of Public Works, #5. Baton Rouge, Louisiana.
- U.S. Environmental Protection Agency. 1975. National Eutrophication Survey Methods 1973-1976. Working Paper No. 175. National Environmental Research Center, Las Vegas, Nevada, and Pacific Northwest Environmental Research Laboratory, Corvallis, Oregon.
- Vollenweider, R. A. 1975. Input-Output Models With Special Reference to the Phosphorus Loading Concept in Limnology. Schweiz. Z. Hydrol. 37:53-84.

VI. APPENDICES

APPENDIX A
CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

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
TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR LOUISIANA

04/11/77

LAKE CODE 2206 CADDO LAKE

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 7107.0

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS)												MEAN
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
2206A1	7107.0	87.22	106.19	117.51	112.70	153.48	63.71	20.73	6.57	10.19	12.83	28.23	53.80	64.20
2206C1	112.9	1.161	1.472	1.614	1.926	2.294	0.651	0.212	0.074	0.142	0.187	0.510	0.906	0.926
2206D1	88.8	0.906	1.161	1.274	1.529	1.812	0.510	0.167	0.057	0.113	0.147	0.396	0.708	0.729
2206J1	5542.6	57.48	72.49	79.29	94.58	112.70	31.43	16.23	3.62	7.02	9.20	25.49	44.74	46.05
2206L1	909.1	9.46	11.89	13.03	15.57	18.46	5.18	1.70	0.59	1.16	1.50	4.19	7.36	7.48
2206ZZ	453.2	4.76	5.95	6.51	7.76	9.23	2.58	0.85	0.28	0.57	0.76	2.10	3.68	3.73

SUMMARY

TOTAL DRAINAGE AREA OF LAKE =	7107.0	TOTAL FLOW IN =	709.27
SUM OF SUB-DRAINAGE AREAS =	7106.7	TOTAL FLOW OUT =	773.16

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW		DAY	FLOW		DAY	FLOW	
					DAY	MONTH		DAY	MONTH		DAY	MONTH
2206A1	6	74	186.891	9	151.212							
	7	74	12.743	6		22.512						
	8	74	1.557	8		1.076						
	9	74	101.941	7		61.731						
	10	74	88.632	5		123.178						
	11	74	203.315	1		99.109						
	12	74	188.307	7		237.295						
	1	75	152.345	6		187.741						
	2	75	317.149	6		444.574	24		196.802			
	3	75	213.792	24		250.038						
	6	74	3.766	8		4.276						
	7	74	0.091	6		0.142						
2206C1	8	74	0.048	8		0.023						
	9	74	1.614	7		0.595						
	10	74	0.651	7		0.708						
	11	74	3.370	1		1.104						
	12	74	2.775	7		0.991						
	1	75	1.727	6		2.152						
	2	75	4.304	6		13.309	24		1.388			
	3	75	2.067	24		2.690						
	4	75	1.784	5		1.218						
	6	74	2.945	9		6.966						
	7	74	0.071	6		0.110						
2206D1	8	74	0.037	8		0.020						
	9	74	1.274	7		0.453						
	10	74	0.510	7		0.765						
	11	74	2.633	1		0.850						
	12	74	2.180	7		2.973						
	1	75	1.586	6		1.954						
	2	75	4.361	6		14.045	24		1.926			
	3	75	2.492	24		2.294						

TRIBUTARY FLOW INFORMATION FOR LOUISIANA

04/11/77

LAKE CODE 2206 CADDO LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2206J1	6	74	184.060	5	211.810				
	7	74	4.474	6	7.192				
	8	74	2.294	8	1.161				
	9	74	79.287	7	29.733				
	10	74	35.113	7	54.935				
	11	74	185.759	1	62.580				
	12	74	135.921	7	176.697				
	1	75	84.951	6	105.905				
	2	75	211.810	6	654.119	22	72.774		
	3	75	101.657	24	131.956				
		74	30.299	8	34.547				
		74	0.736	6	1.133				
2206L1	8	74	0.368	10	0.249				
	9	74	13.026	7	4.729				
	10	74	6.881	5	8.212	18	3.851		
	11	74	36.529	10	12.884				
	12	74	22.370	6	26.051				
	1	75	9.911	11	17.103				
	2	75	44.457	8	143.850	22	20.586		
	3	75	25.542	7	20.813	22	26.250		
	4	75	11.836	19	16.933				

APPENDIX C
PHYSICAL AND CHEMICAL DATA

STORED RETRIEVAL DATE 76/01/16
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

480701
32 42 04.0 044 04 25.0
CAUJO LAKE
48 TEXAS

DATE FROM TO	TIME OF DAY	DEPTH FEET	WATER TEMP CENT	TIEFLES			2111202 2009 FEET DEPTH						
				00010 DO	00300 TRANSP	00094 CONDCTRY SECCHI	00400 PH	00410 TALK	00510 NH3-N CACO3	00625 TOTAL	00630 N N-TOTAL		
				MG/L	INCHES	MICRUMHU	ST	MG/L	MG/L	MG/L	MG/L		
74/03/23	10 10	0000	16.0			42	94	6.20	10K	0.040	0.600	0.070	0.016
	10 10	0005	15.8		7.4		94	6.20	10K	0.050	0.600	0.080	0.020
74/05/31	14 45	0000	27.6			42	130	7.40	13	0.060	0.700	0.050	0.020
	14 45	0002	27.6		7.2		139	7.40	17	0.060	0.500	0.140	0.012
74/08/26	09 20	0000	29.6		3.6	33	137	7.20					
	09 20	0004	29.6				138						
74/11/11	09 50	0000	16.2		4.8	50	61	5.34	10	0.040	0.500	0.020K	0.013
	09 50	0005	16.3		4.8		61	5.31	10	0.060	0.600	0.020	0.017

DATE FROM TO	TIME OF DAY	DEPTH FEET	PHOS-TOT MG/L P	00665		32217		00031	
				CHLRPHYL	INCOT LT	A	REMNING	PERCENT	
				UG/L					
74/03/23	10 10	0000	0.055		4.9				
	10 10	0005	0.054						
74/05/31	14 45	0000	0.055		28.1				
	14 45	0002	0.056						
74/08/26	09 20	0000			15.8				
74/11/11	09 50	0000	0.056		2.4				
	09 50	0005	0.075						

— K VALUE KNOWN TO BE LESS THAN —
INDICATED

STO-ET RETRIEVAL DATE 76/01/16
 NATL EUTROPHICATION SURVEY
 EPA-LAS VEGAS

480702
 3C 41 01.0 044 0.3 06.0
 CADDO LAKE
 43 TEXAS

DATE FROM TO	TIME OF DAY	DEPTH FEET	ATMOS- TEMP CENT	00300 MS/L	00377 SECCHI INCHES	00944 FIELD MICROMHO	THERMALS		2111END 0009 FEET DEPTH			00630 N02&N03 MG/L	00671 PHOS-DIS ORTHO MG/L P
							00400 PSU	00410 TALK CACO3	00510 NH3-N TOTAL MG/L	00620 TOT KJEL N MG/L	00630 N-TOTAL MG/L		
74/03/23	10 35	0000	16.6		48	91	6.70	10K	0.040	0.700	0.030		0.013
	10 35	0005	16.5		9.4		6.70	14	0.040	0.700	0.040		0.016
74/06/03	11 00	0000	26.6			30	190	4.45	15	0.040	0.800	0.020	0.007
	11 00	0005	26.3		7.0		186	7.90	14	0.030	0.700	0.020K	0.009
74/08/26	09 40	0000	24.2		3.6	30	134	7.20					
	09 40	0006	24.2		3.6		134	7.20					
74/11/11	10 10	0000	16.3		7.0	78	60	5.45	11	0.060	0.700	0.020	0.016
	10 10	0005	16.4		7.2		58	5.45	11	0.050	0.500	0.030	0.019

DATE FROM TO	TIME OF DAY	DEPTH FEET	PHOS-TOT MG/L P	32217 CHLRPHYL UG/L	00031 INC DT LT PERCENT
					4 REMNING
74/03/23	10 35	0000	0.051	8.7	
	10 35	0005	0.050		
74/06/03	11 00	0000	0.049	28.1	
	11 00	0001			50.0
	11 00	0004			1.0
	11 00	0005	0.052		
74/08/26	09 40	0000		20.5	
74/11/11	10 10	0000	0.065	2.5	
	10 10	0005	0.058		

— K VALUE KNOWN TO BE LESS THAN
 INDICATED —

STATION RETRIEVAL DATE 78/01/15
 NATL EUTROPHICATION SURVEY
 EPA-LAS VEGAS

480703
 32 44 38.0 044 01 46.0
 CADDOW LAKE
 48 TEXAS

11EPALES
 3 2111202
 0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	ACQUA WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00044 CONDUTCTV FIELD MICROMHO	00400 PH SU	00410 TALK CACO ₃ MG/L	00510 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
74/03/23	10 45	0000	17.5		48	164	6.40	21	0.060	0.700	0.050	0.016
	10 45	0006	17.4	7.2		164	6.25	14	0.050	0.700	0.050	0.013
74/05/31	14 30	0000	27.4			222	7.20	10K	0.060	0.900	0.060	0.010
	14 30	0003	27.9	6.8		222	7.40	10K	0.050	0.700	0.050	0.012
74/08/26	09 55	0000	30.4	6.0	36	261	7.10					
	09 55	0005	30.4	5.4		261	7.10					
74/11/11	09 30	0000	16.8	5.2	36	98	5.43	10K	0.080	0.800	0.020K	0.012
	09 30	0005	16.6	5.4		99	5.35	10K	0.330	0.900	0.020	0.015

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL UG/L	00031 INCOT LT A PERMINING PERCENT
74/03/23	10 45	0000	0.035	5.4	
	10 45	0006	0.034		
74/05/31	14 30	0000	0.051	28.1	
	14 30	0003	0.060		
74/08/26	09 55	0000		11.3	
74/11/11	09 30	0000	0.068	7.1	
	09 30	0005	0.079		

— K VALUE KNOWN TO BE LESS THAN
 INDICATED —

STOPET RETRIEVAL DATE 76/01/16
 NATL EUTROPHICATION SURVEY
 EPA-LAS VEGAS

480704
 32 43 25.6 043 57 19.0
 CADDO LAKE
 43 TEXAS

DATE FROM TO	TIME OF DAY	DEPTH FEET	00-010 WATER TEMP CENT	00300 DO MG/L	01077 TRANSF SECCHI INCHES	00044 CONDICTVY FIELD MICROMHO	116400S 3		2111202 0009 FEET DEPTH			00671 PHOS-DIS ORTHO MG/L P
							00400 PH SI	00410 ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	
74/03/23	10 55	0000	17.0		48	108	7.40	14	0.020	0.600	0.030	0.008
	10 55	0005	16.9	9.4		109	6.80	12	0.020	0.500	0.020	0.007
74/06/03	11 15	0000	26.3		29	174	8.20	10	0.040	0.700	0.030	0.006
	11 15	0005	25.9	7.2		181	7.55	10	0.040	0.600	0.040	0.006
74/08/26	10 10	0000	28.8	7.0	24	130	7.20					
74/11/11	10 30	0000	17.2	8.4	50	109	6.43	16	0.030	0.800	0.020K	0.008
	10 30	0005	17.2	8.4		109	6.34	10	0.030	0.500	0.020	0.009

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL UG/L	00031 INCDT LT A REMNING PERCENT		
74/03/23	10 55	0000	0.045		10.1		
	10 55	0005	0.039				
74/06/03	11 15	0000	0.051	95.0			
	11 15	0001			50.0		
	11 15	0004			1.0		
	11 15	0005	0.050				
74/08/26	10 10	0000		25.0			
74/11/11	10 30	0000	0.043	11.9			
	10 30	0005	0.047				

— K VALUE KNOWN TO BE LESS THAN
 INDICATED —

STORED RETRIEVAL DATE 76/01/16
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

480705
32 41 40.0 043 7/ 43.0
CADDY LAKE
48 TEXAS

11EPALES
3 211120Z
0004 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 00 TRANSP	00077 SECCHI INCHES	00044 CONDUCTVY FIELD MICROMHO	00400 PH SIU	00410 ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00525 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/03/23	11 15	0000	16.9		42	106	6.90	14	0.020	0.600	0.030	0.007
	11 15	0005	16.8	8.6		108	6.90	14	0.040	0.600	0.040	0.010
74/06/03	11 30	0000	27.2		48	188	7.85	11	0.040	0.700	0.020	0.006
	11 30	0005	26.4	7.0		186	7.35	11	0.040	0.600	0.030	0.006
74/08/26	10 25	0000	29.4	6.0	22	126	7.20					
	10 25	0005	29.4	5.4		132	7.10					
74/11/11	10 50	0000	16.7	7.6	37	71	5.71	10K	0.060	0.600	0.030	0.020
	10 50	0005	16.8	7.4		70	5.61	16	0.030	0.500	0.020K	0.018

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLORPHYL UG/L	00031 INCOT LT PERCENT
74/03/23	11 15	0000	0.038	10.9	
	11 15	0005	0.038		
74/06/03	11 30	0000	0.046	16.9	
	11 30	0001			50.0
	11 30	0004			1.0
	11 30	0005	0.051		
74/08/26	10 25	0000		27.6	
74/11/11	10 50	0000	0.057	6.0	
	10 50	0005	0.048		

— K VALUE KNOWN TO BE LESS THAN
INDICATED —

STORED RETRIEVAL DATE 76/01/16
 NATL EUTROPHICATION SURVEY
 EPA-LAS VEGAS

480706
 32 42 20.0 045 55 14.0
 CADDO LAKE
 48 TEXAS

11EPALES
 3 2111202
 0009 FEET DEPTH

DATE	TIME	DEPTH	WATER OF TO TEMP CENT	00010 DO	00300 TRANSP	00017 SECCHI INCHES	00094 CONDUTVY FIELD MICROMHO	00400 PH SU	00410 TALK CACO3	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
74/03/23	11 25	0000	16.9			37	106	7.20	10	0.040	0.600	0.030	0.008
	11 25	0005	16.8		8.8		105	6.90	10	0.040	0.600	0.030	0.008
74/06/03	11 40	0000	27.5			24	201	7.80	11	0.050	0.800	0.020	0.007
	11 40	0005	26.7		7.0		199	7.80	10	0.030	0.700	0.020	0.006
74/08/26	10 40	0000	28.9		6.0	20	134	7.10					
	10 40	0005	28.9		5.0		134	7.10					
74/11/11	11 00	0000	17.0		8.2	46	97	6.09	15	0.030	0.700	0.020K	0.011
	11 00	0005	16.9		8.0		97	5.88	12	0.040	0.600	0.020	0.017

DATE	TIME	DEPTH	PHOS-TOT	00665 CHLRPHYL A UG/L	32217 INC DT LT REMNING PERCENT	00031
FROM OF TO	DAY	FEET	MG/L P			
74/03/23	11 25	0000	0.035		11.0	
	11 25	0005	0.042			
74/06/03	11 40	0000	0.051		25.3	
	11 40	0001			50.0	
	11 40	0005	0.056		1.0	
74/08/26	10 40	0000			22.4	
74/11/11	11 00	0000	0.056		8.0	
	11 00	0005	0.069			

— K VALUE KNOWN TO BE LESS THAN
 INDICATED —

APPENDIX D

**TRIBUTARY AND WASTEWATER
TREATMENT PLANT DATA**

STORET RETRIEVAL DATE 75/11/28
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

2206A1
32 42 20.0 093 55 00.0
WILLOW PASS CREEK
22 15 MCKRINGSPT
O/CADDY LAKE
CADDY LAKE SPILLWAY .25 MI ABCVE BLACK B
115PALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME CF DAY	DEPTH FEET	CO630 N-C2&NC3 MG/L	CO625 TOT KJEL MG/L	CO610 NH3-N MG/L	00671 PHCS-DIS MG/L F	00665 PHCS-TOT MG/L F
74/06/09	09 20		0.012	0.700	C.020	0.010	0.055
74/07/06	12 45		0.012	1.200	0.025	0.015	0.110
74/08/08	13 37		0.012	0.800	0.015	0.005	0.075
74/09/07	12 00		0.028	0.750	0.020	0.005	0.040
74/10/05	09 50		0.032	1.100	0.035	0.010	0.030
74/11/01	15 10		0.024	0.800	C.040	C.010	C.040
74/12/07	CE 10		0.008	0.600	0.015	0.015	0.050
75/01/06	09 30		0.016	0.400	0.016	0.010	0.030
75/02/06	09 45		0.024	0.500	0.024	0.030	0.040
75/02/24	CE 45		0.016	0.650	0.024	0.016	0.060
75/03/24	09 20		0.016	2.000	C.040	0.016	0.040

STORED RETRIEVAL DATE 75/11/28
NATL EUTROPHIFICATION SURVEY
EPA- LAS VEGAS

220681
32 40 40.0 094 01 40.C
TETE BAYOU
22 7.5 POTTERS PT
T/CADDE LAKE
2NDARY RD BRDG 3 MI SW ST HW 169 JCT
11EPALÉS 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	00630 NC2&N23	00625 TET KJEL	00610 NH3-N	00671 PHOS-CIS	00665 FFCS-TET	
FROM	OF	N-TOTAL	N	TOTAL	CRTHC			
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L F	MG/L P	
74/06/08	12	20		0.036	0.800	0.040	0.025	0.095
74/07/06	12	15		0.012	0.800	0.015	0.025	0.090
74/08/08	12	53		0.018	1.100	0.040	0.045	0.160
74/09/07	12	30		0.068	1.100	0.165	0.035	0.115
74/10/07	10	50		0.024	0.900	0.050	0.030	0.130
74/11/01	14	50		0.020	1.300	0.165	0.020	0.130
74/12/07	09	41		0.024	0.700	0.020	0.015	0.060
75/01/06	10	00		0.016	0.900	0.032	0.015	0.040
75/02/06	09	15		0.016	0.400	0.032	0.032	0.040
75/02/24	09	00		0.016	0.400	0.024	0.016	0.040
75/03/24	09	50		0.024	1.700	0.032	0.024	0.050

STORED RETRIEVAL DATE 75/11/28
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

2206C1
32 35 45.0 094 07 25.0
HARRISON RAYON
22 7.5 FEETERS PT
T/CADDY LAKE
2NDRY RD BRDG 1.25 MI W ST HWY 2457 JCT
11EPAL 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	AC2&AC3	00630	CC625	CC610	00671	00665
FROM	TO	FEET	N-TOTAL	TCT	KJSL	N+3-N	PHCS-CIS	PHCS-TCT
		DAY	MG/L	MG/L	MG/L	MG/L	MG/L F	MG/L P
74/06/08		11 02		0.044	0.500	0.035	0.035	0.095
74/07/06				0.140	0.500	0.025	0.050	0.120
74/08/08		10 55		0.116	0.300	0.015	0.065	0.100
74/09/07		10 15		0.084	0.800	0.045	0.090	0.140
74/10/07		11 45		0.032	0.400	0.020	0.055	0.090
74/11/01		12 30		0.032	0.900	0.025	0.085	0.210
74/12/07		12 44		0.008	1.200	0.020	0.040	0.110
75/01/06		11 35		0.048	0.400	0.024	0.015	0.040
75/02/06		11 00		0.016	0.300	0.024	0.032	0.050
75/02/24		11 00		0.016	0.600	0.032	0.024	0.060
75/03/24		11 45		0.024	1.000	0.032	0.024	0.060
75/04/05		10 35		0.010	1.300	0.020	0.015	0.020

STORED RETRIEVAL DATE 75/11/28
NATL EUTROPHIFICATION SURVEY
EPA- LAS VEGAS

2206C1
32 46 45.0 094 09 32.0
KITCHEE CREEK
22 7.5 SMITHLAND
T/CADDY LAKE
2NDRY RE BRDG 2.25 MI S ST HWY 49 JCT
11:PALES 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	NC2EN03	00630	00625	CC61C	00671	00665
FROM	OF		N-TOTAL	TCT KJEL	N	N-E-N	PHGS-CIS	PHGS-TOT
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L	MG/L F	MG/L P
74/06/09	11	25		0.032	0.600	0.036	0.016	0.045
74/07/06	13	50		0.088	0.500	0.025	0.025	0.060
74/08/08	11	45		0.040	0.900	0.070	0.020	0.065
74/09/07	11	00		0.060	0.500	0.055	0.015	0.025
74/10/07	10	25		0.024	0.300	0.015	0.010	0.025
74/11/01	13	15		0.032	0.700	0.045	0.020	0.070
74/12/07	10	54		0.008	0.600	0.020	0.010	0.030
75/01/06	11	00		0.024	0.400	0.024	0.010	0.020
75/02/06	10	30		0.016	0.800	0.040	0.016	0.020
75/02/24	10	00		0.024	0.300	0.068	0.008	0.020
75/03/24	10	55		0.048	0.800	0.048	0.016	0.040

STORRET RETRIEVAL DATE 75/11/28
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

2206E1
32 50 50.0 094 07 30.0
MILL CREEK
22 7.5 TREES
T/CAUCCE LAKE
2NDRY RD BRDG 3 MI NE ST HWY 49 JCT
110PALES 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	NO2&NO3	00630	00625	00610	00671	00665
FROM	CF		N-TOTAL	TOT KJEL	N	NHE-N	FHCS-CIS	FHCS-TOT
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L	MG/L F	MG/L P
74/06/08	14	25		0.044	0.700	C.025	0.020	0.065
74/07/06	12	50		0.080	0.400	0.025	0.020	C.060
74/08/10	10	50		0.052	0.700	0.100	0.040	0.060
74/09/07	10	35		0.048	0.400	0.030	0.015	C.030
74/10/05	09	30		0.024	0.300	0.045	0.010	0.040
74/10/18	14	30		0.024	0.500	C.C55	0.015	C.030
74/11/01	13	00		0.024	0.600	C.025	0.015	C.040
74/12/06	12	00		0.008	0.700	C.027	0.010	0.040
75/02/08	11	50		0.016	0.600	0.024	0.008	C.020
75/02/22	11	30		0.008	0.400	0.024	0.008	0.045
75/03/22	10	30		0.009	0.550	0.018	0.009	0.030
75/04/05	12	39		0.005	0.300	C.015	C.010	C.010
75/04/19	13	40		0.035	1.250	C.090	0.015	0.030

STORED RETRIEVAL DATE 75/11/26
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

2206FI
32 51 15.0 CS4 06 40.0
JAMES BAYOU
22 7.5 TSPS
T/CADDY LAKE
2NDRY RD BRDG 4 MI NE ST HWY 49 JCT
11 PALES 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	NC2&NC3	00630	00625	0061C	00671	00665
				TOT KJEL	N	TOTAL	PHOS-DIS	PHOS-TOT
FROM	OF		N-TOTAL	MG/L	MG/L	MG/L	MG/L F	MG/L F
TO	DAY	FEET	MG/L					
74/06/08	14	35		0.096	0.500	0.030	0.020	0.050
74/07/06	12	45		0.080	0.600	0.020	0.020	0.065
74/08/10	10	40		0.008	1.600	0.025	0.010	0.120
74/09/07	09	25		0.044	0.500	0.040	0.020	0.035
74/10/05	09	15		0.040	0.400	0.025	0.015	0.040
74/10/18	10	40		0.024	0.400	0.055	0.020	0.035
74/11/10	11	00		0.012	0.500	0.035	0.015	0.040
74/12/06	13	00		0.008	0.800	0.065	0.015	0.032
75/01/11	08	30		0.008	0.300	0.016	0.010	0.030
75/02/08	14	50		0.008	0.650	0.016	0.016	0.025
75/02/22	09	30		0.008	0.400	0.024	0.016	0.050
75/03/06	11	05		0.016	0.900	0.032	0.008	0.060
75/03/22	11	30		0.009	0.500	0.018	0.010	0.030
75/04/05	09	30		0.015	0.350	0.015	0.015	0.015
75/04/19	10	50		0.035	1.050	0.050	0.020	0.040

STORET RETRIEVAL DATE 75/11/28
NATL EUTROPIFICATION SURVEY
EPA- LAS VEGAS

2206G1
32 51 50.0 CS4 03 45.0
HUNTS CREEK
22 7.5 TREES
T/CADDY LAKE
2NDAY RD ERDG 4 MI W OF VIVIAN
116PALES 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	NC2&N03	CC625	CC610	00671	C0665
FROM	OF		N-TOTAL	TCT KJEL	NF3-N	PHOS-DIS	PHOS-TOT
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L F	MG/L F
74/06/08	14	50	0.028	1.900	0.040	0.025	0.033
74/07/06	12	35	0.080	2.700	0.240		
74/08/10	10	30	0.044	0.950	0.065	0.030	0.100
74/09/07	09	10	0.048	0.600	0.032	0.015	0.035
74/10/05	08	30	0.048	0.400	0.030	0.015	0.045
74/10/18	09	30	0.040	0.700	0.025	0.015	0.045
74/11/10	10	00	0.012	1.000	0.035	0.015	0.060
74/12/06	14	00	0.008	0.700	0.020	0.020	0.060
75/01/11	07	30	0.008	0.800	0.024	0.015	0.040
75/02/08	05	25	0.016	1.100	0.048	0.008	0.030
75/02/22	08	40	0.024	0.500	0.048	0.016	0.040
75/03/22	10	30	0.018	0.650	0.033	0.010	0.040
75/04/05	08	30	0.020	0.450	0.030	0.015	0.015
75/04/19	10	30	0.055	1.800	0.115	0.020	0.050

STORIT RETRIEVAL DATE 75/11/28
NATL EUTROPHICATION SURVEY
SPA - LAS VEGAS

220641
32 47 15.0 093 58 45.0
TIGER BRANCH
22 12 VIVIAN
T/CADOC LAKE
BRUG ST HWY 1 5.5 MI S CITY CENTER VIVIA
111PAL-S 2111204
4 CCCC FreqT Depth

DATE	TIME	DEPTH	NC28NC3	00630	CC625	CC610	00671	00665
FROM	CF		N-TOTAL	TOT	KJFL	NF3-N	PHCS-DIS	PHCS-TOT
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L	MG/L F	MG/L F
74/06/09	09	40		0.040		1.200	C.060	0.021
74/07/06	13	00		0.016		0.900	0.030	0.015
74/08/08	12	13		0.008		1.200	C.025	0.015
74/09/07	11	35		0.068		1.400	0.185	0.025
74/10/07	10	15		0.016		C.500	0.020	0.005
74/11/01	13	40		0.032		1.400	C.075	C.025
74/12/07	10	20		0.008		0.600	0.025	0.015
75/01/06	10	30		0.008		C.900	C.040	C.010
75/02/06	10	00		0.009		0.800	0.048	C.008
75/02/22	09	20		0.008		0.700	0.024	0.008
75/03/24	10	20		0.024		1.000	C.048	C.008

STORED RETRIEVAL DATE 75/11/28
NATL EUTROPHICATION SURVEY
EPA - LAS VEGAS

2206JI
32 41 50.0 094 11 20.0
CYPRESS BAYOU
22 HARRISON CO
T/CADDU LAKE
BRDG ST HWY 43 2.25 MI NW OF KARNACK
113PALES 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	NC26NU3	00630	00625	00610	00671	00665
FROM	OF		N-TOTAL	TOT KJEL	N	TOTAL	PHEOS-CIS	PHEOS-TOT
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L	MG/L P	MG/L P
74/06/08	10	CC		0.072	0.500	0.040		0.025
74/07/06				0.012	0.800	0.015	0.020	0.080
74/08/08	11	20		0.004	0.600	0.010	0.005K	0.050
74/09/07	10	35		0.056	0.950	0.110	0.020	0.055
74/10/07	11	15		0.056	0.500	0.025	0.015	0.035
74/11/01	12	00		0.040	0.400	0.045	0.030	0.070
74/12/07	12	15		0.024	0.500	0.010	0.020	0.050
75/01/06	12	30		0.048	0.700	0.040	0.020	0.045
75/02/06	11	00		0.016	0.900	0.024	0.016	0.060
75/02/22	10	30		0.032	0.600	0.032	0.016	0.060
75/03/24	11	25		0.016	1.100	0.032	0.016	0.040

— K VALUE KNOWN TO BE LESS THAN —
INDICATED

STORED RETRIEVAL DATE 75/11/28
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

2206K1
32 40 40.0 094 01 40.0
SAUNDERS BRANCH
22 7.5 FEETERS FT
T/CADDY LAKE
2NDRY RD BRDG 0.5 MI W OF ST RD 2457
11CPALIS 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	NO2&NO3	00630	00625	00610	00671	00665
FROM	OF		N-TOTAL	TOT KJEL	NF3-N	TOTAL	PHC5-CIS	PHC5-TOT
TO	DAY	FEET	MG/L	MG/L	MG/L	MG/L	MG/L P	MG/L P
74/06/08	11	15		0.048	0.500K	0.030	0.035	0.100
74/07/06	10	45		0.116	0.700	0.015	0.045	0.075
74/09/07	10	30		0.064	0.300	0.030	0.045	0.065
74/10/07	12	30		0.024	0.200	0.005	0.035	0.060
74/11/01	12	20		0.024	0.800	0.015	0.025	0.120
74/12/07	12	50		0.024	0.700	0.020	0.015	0.050
75/01/06	11	30		0.016	0.500	0.032	0.020	0.050
75/02/06	11	15		0.040	0.200	0.024	0.016	0.030
75/02/24	11	15		0.040	0.350	0.029	0.017	0.030
75/03/24	12	10		0.032	1.600	0.032	0.024	0.040

— K VALUE KNOWN TO BE LESS THAN —
INDICATED

STORET RETRIEVAL DATE 75/11/28
NATL EUTROPHIFICATION SURVEY
EPA- LAS VEGAS

2206L1
32 4E 27.0 C94 C1 59.0
MONTEREY LAKE OUTLET
22 7.5 TRFFS
I/CADDC LAKE
BNK UNIMPROVED RD XING SEC 16
115PALES 2111204
4 0000 FEET DEPTH

DATE	TIME	DEPTH	NC2&NO3	00630	00625	CC61C	00671	00665
FROM	OF		N-TOTAL	TCT KJEL	NF3-K	TCTAL	FHCS-EIS	FHCS-TST
TC	DAY	FEET	MG/L	MG/L	MG/L	MG/L	MG/L P	MG/L P
74/06/08	13	45		0.112	0.500	C.040	0.020	0.060
74/07/06	13	20		0.020	0.800	C.015	0.020	0.070
74/08/10	11	10		0.020	0.600	0.070	0.005K	0.035
74/09/07	14	30		0.048	0.500	0.035	0.015	0.040
74/10/05	10	30		0.024	0.400	0.015	0.015	0.035
74/10/18	14	40		0.032	0.400	0.015	0.010	0.032
74/11/10	12	00		0.012	0.600	C.020	0.015	0.050
74/12/06	15	00		0.016	0.600	C.025	0.010	0.040
75/01/11	13	00		0.008	C.600	0.016	0.010	0.030
75/02/08	10	40		0.008	0.300	C.016	0.008	0.030
75/02/22	10	30		0.008	1.000	0.040	0.008	0.060
75/03/07	11	30		0.008	C.700	0.016	0.016	0.050
75/03/22	13	30		0.009	0.500	0.015	0.009	0.030
75/04/15	14	50		0.020	0.850	C.035	0.015	0.040

— K VALUE KNOWN TO BE LESS THAN
INDICATED —

STORET RETRIEVAL DATE 75/11/26
NATL EUTROPHIFICATION SURVEY
EPA- LAS VEGAS

2206XA PD2206XA P002866
32 47 05.0 054 20 CC.C
JEFFERSON
22 7.5 JEFFERSON TX
T/CADDY LAKE
BLACK CYPRESS BAYOU
11EPALES 2141204
4 CCOC FEET DEPTH

DATE	TIME	DEPTH	NC26N03	00625	CC61C	00671	00665	50051	50053
FROM	OF		N-TOTAL	TCT KJEL	NF3-N	PHOS-DIS	PHOS-TOT	FLCK	CONDUIT
TO	DAY	FEET	MG/L	MG/L	MG/L	TOTAL	CRTD	RATE	FLCK-MGD
74/10/15	09	30		0.280	5.600	0.590	6.200	6.600	0.300
74/11/15	14	30		0.320	6.400	0.720	4.400	4.700	0.350
74/12/02	14	00		0.320	6.600	0.860	4.200	5.500	0.300
75/01/18	12	50		0.160	10.500	2.200	4.500	5.500	0.400
75/02/05	10	30		0.160	1.700	0.360	0.245	0.520	1.400
75/03/12	09	00		0.080	13.000	2.600	4.900	5.900	0.250
75/04/05	11	00		0.050	14.500	4.800	5.100	5.900	0.300
75/05/13	16	30		0.150	6.500	0.200	3.900	3.800	1.400
75/06/04	09	00		0.100	5.000	0.050K	2.500	3.200	1.800
75/07/03	14	00		0.100	9.200	0.130	5.100	6.000	0.400
75/08/10	13	00		0.150	6.200	0.325	6.700	7.200	0.300

— K VALUE KNOWN TO BE LESS THAN —
INDICATED

STCAST RETRIEVAL DATE 75/11/28
NATL EUTROPHICATION SURVEY
EPA- LAS VEGAS

220621 T 220621 P CCCC650
32 41 15.0 093 57 30.0
MORNINGSPORT
22 15 MORNINGSPORT
E/CADDIE LAKE
CADDIE LAKE
116 PALES 2141204
4 0000 EEST D-8TH

APPENDIX E
PARAMETRIC RANKINGS OF LAKES
SAMPLED BY NES IN 1974
STATES OF LOUISIANA AND TEXAS

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 ORTHO P
2201	ANACOCO LAKE	0.031	0.080	455.833	8.700	10.400	0.007
2202	BRUIN LAKE	0.057	0.250	450.333	16.350	15.000	0.012
2203	LAKE BISTINEAU	0.061	0.100	458.000	12.933	13.200	0.018
2204	BLACK BAYOU	0.046	0.090	453.417	17.818	12.200	0.009
2205	BUNDICK LAKE	0.157	0.135	469.667	20.467	10.600	0.073
2207	COCODRIE LAKE	0.090	0.400	479.000	35.300	7.700	0.026
2208	COTILE LAKE	0.037	0.100	442.333	12.650	14.000	0.011
2209	CONCORDIA LAKE	0.076	0.080	468.333	32.950	14.800	0.009
2210	CROSS LAKE	0.057	0.080	475.250	38.385	11.400	0.010
2211	D'ARBONNE LAKE	0.038	0.100	458.250	6.800	13.200	0.011
2212	FALSE RIVER LAKE	0.082	0.130	442.500	24.550	14.900	0.023
2213	INDIAN CREEK	0.031	0.150	458.333	21.467	14.800	0.010
2214	SALINE LAKE	0.111	0.350	493.000	15.333	9.600	0.025
2215	TURKEY CREEK LAKE	0.176	0.170	477.833	21.967	14.600	0.033
2216	LAKE VERRET	0.163	0.100	481.428	62.028	12.000	0.056
2217	LAKE VERNON	0.018	0.120	436.667	4.900	14.400	0.007
2219	BLACK LAKE	0.077	0.150	454.000	12.733	11.600	0.015
2220	COCODRIE	0.106	0.050	478.333	33.433	11.800	0.014
4807	CADDY LAKE	0.049	0.070	463.562	20.125	10.000	0.008

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 ORTHO P
2201	ANACOCO LAKE	92 (16)	83 (14)	67 (12)	89 (16)	83 (15)	94 (17)
2202	BRUIN LAKE	61 (11)	11 (2)	83 (15)	61 (11)	0 (0)	50 (9)
2203	LAKE BISTINEAU	50 (9)	58 (9)	61 (11)	72 (13)	42 (7)	33 (6)
2204	BLACK BAYOU	72 (13)	72 (13)	78 (14)	56 (10)	50 (9)	81 (14)
2205	BUNDICK LAKE	11 (2)	33 (6)	33 (6)	44 (8)	78 (14)	0 (0)
2207	COCODRIE LAKE	28 (5)	0 (0)	11 (2)	11 (2)	100 (18)	17 (3)
2208	COTILE LAKE	83 (15)	58 (9)	94 (17)	83 (15)	33 (6)	61 (11)
2209	CONCORDIA LAKE	44 (8)	83 (14)	39 (7)	22 (4)	14 (2)	81 (14)
2210	CROSS LAKE	56 (10)	83 (14)	28 (5)	6 (1)	72 (13)	69 (12)
2211	D'ARBONNE LAKE	78 (14)	58 (9)	56 (10)	94 (17)	42 (7)	56 (10)
2212	FALSE RIVER LAKE	33 (6)	39 (7)	89 (16)	28 (5)	6 (1)	28 (5)
2213	INDIAN CREEK	92 (16)	28 (5)	50 (9)	39 (7)	14 (2)	69 (12)
2214	SALINE LAKE	17 (3)	6 (1)	0 (0)	67 (12)	94 (17)	22 (4)
2215	TURKEY CREEK LAKE	0 (0)	17 (3)	22 (4)	33 (6)	22 (4)	11 (2)
2216	LAKE VERRET	6 (1)	58 (9)	6 (1)	0 (0)	56 (10)	6 (1)
2217	LAKE VERNON	100 (18)	44 (8)	100 (18)	100 (18)	28 (5)	100 (18)
2219	BLACK LAKE	39 (7)	22 (4)	72 (13)	78 (14)	67 (12)	39 (7)
2220	COCODRIE	22 (4)	100 (18)	17 (3)	17 (3)	61 (11)	44 (8)
4807	CADDY LAKE	67 (12)	94 (17)	44 (8)	50 (9)	89 (16)	89 (16)