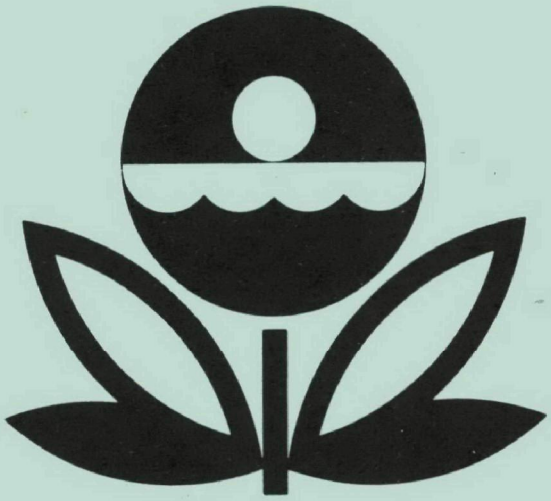
U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

PELICAN LAKE

ST. LOUIS COUNTY

MINNESOTA

EPA REGION V

WORKING PAPER No. 118

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

NATIONAL ENVIRONMENTAL RESEARCH CENTER - CORVALLIS, OREGON

and

NATIONAL ENVIRONMENTAL RESEARCH CENTER - LAS VEGAS, NEVADA

☆GPO—697-032

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WITH THE COOPERATION OF THE

MINNESOTA POLLUTION CONTROL AGENCY

AND THE

MINNESOTA NATIONAL GUARD

OCTOBER, 1974

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F O R E W O R D

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 Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

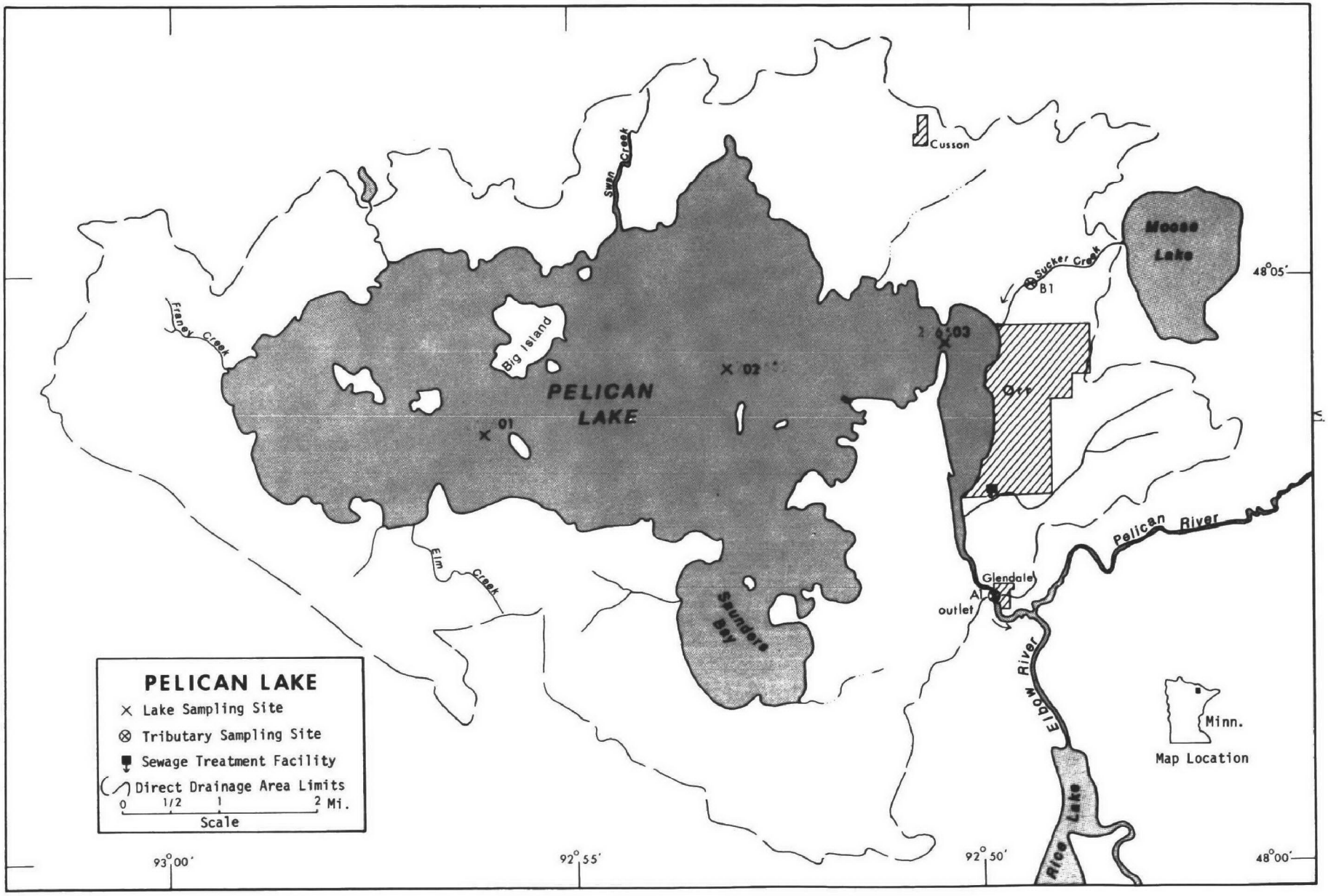
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


PELICAN LAKE
Lake Sampling Site
Tributary Sampling Site
Sewage Treatment Facility
Direct Drainage Area Limits
0 1/2 1 2 Mi.
Scale
PELICAN LAKE
Big Island
Swan Creek
Cusson
Moose Lake
Sucker Creek
B1
48°05'
Franey Creek
01
02
03
Elm Creek
Spunsore Bay
Glendale
outlet
Pelican River
Elbow River
Alice Lake
Minn.
Map Location
93°00'
92°55'
92°50'
48°00'

PELICAN LAKE

STORET NO. 2765

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Pelican Lake is mesotrophic; water quality in this lake was relatively good during the sampling year. Of the 60 Minnesota lakes sampled in the fall when essentially all were well-mixed, 42 had more mean total phosphorus, 39 had more mean dissolved phosphorus, and 49 had more mean inorganic nitrogen. For all 80 lakes sampled, 64% had more mean chlorophyll a, and 65% had less mean Secchi disc transparency.

Although Survey limnologists did not observe any algal concentrations or weed problems, there was some depression of dissolved oxygen with depth at stations 1 and 2 and near depletion at station 3 in July. They noted a distinct hydrogen-sulfide odor in the deep samples at station 3.

B. Rate-Limiting Nutrient:

A significant change in nutrients occurred in the algal assay sample between the time of collection and the beginning of the assay, and the results are not reliable. However, the lake data indicate phosphorus limitation in July and September (N/P ratios were 21/1 and 15/1, respectively) and nitrogen limitation in October (N/P ratio was 6/1).

C. Nutrient Controllability:

1. Point sources--During the sampling year, Pelican Lake received a total phosphorus load at a rate less than that proposed by Vollenweider (in press) as "permissible" (i.e., an oligotrophic rate--see page 12). Of this load, it is estimated that the Village of Orr contributed only about 14%.

Because of the location of the Orr discharge near the outlet of the lake (and thus not likely to affect the main body of the lake) and the relatively small contribution to the total phosphorus load, it is concluded that point-source phosphorus control would have little effect on the trophic condition of Pelican Lake.

2. Non-point sources--The phosphorus export of Sucker Creek during the sampling year was somewhat higher but similar to that of other unimpacted Minnesota streams studied elsewhere (see page 12).

The combined contribution of phosphorus from all non-point sources is estimated at about 83% of the total phosphorus load reaching the lake during the sampling year.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry*:

1. Surface area: 10,945 acres.
2. Mean depth: 7.9 feet.
3. Maximum depth: 38 feet.
4. Volume: 86,466 acre/feet.
5. Mean hydraulic retention time: 3.3 years.

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

1. Tributaries -

Name	Drainage area†	Mean flow†
Sucker Creek	7.4 mi^2	4.2 cfs
Minor tributaries & immediate drainage -	44.8 mi^2	32.4 cfs
Totals	52.2 mi^2	36.6 cfs

2. Outlet -

Elbow River	69.3 mi^{2}††	36.6 cfs

C. Precipitation†††:

1. Year of sampling: 37.1 inches.
2. Mean annual: 36.7 inches.

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* DNR lake survey map (1960); mean depth by random-dot method.
† Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
†† Includes area of lake.
††† See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Pelican Lake was sampled three times during the open-water season of 1972 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 vi). During each visit, a single depth-integrated (15 feet or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon 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 15 feet at station 1, 26 feet at station 2, and 14 feet at station 3.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake was essentially well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

Parameter	Minimum	Mean	Median	Maximum
		FALL VALUES (10/22/72)		
Temperature (Cent.)	2.0	2.4	2.3	2.8
Dissolved oxygen (mg/l)	11.6	12.2	12.1	12.8
Conductivity (μmhos)	75	80	80	85
pH (units)	7.0	7.1	7.0	7.2
Alkalinity (mg/l)	34	36	36	38
Total P (mg/l)	0.016	0.033	0.033	0.047
Dissolved P (mg/l)	0.008	0.020	0.020	0.029
NO_2 + NO_3 (mg/l)	0.040	0.044	0.040	0.060
Ammonia (mg/l)	0.060	0.068	0.065	0.080
		ALL VALUES		
Secchi disc (inches)	42	67	67	88

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Number per ml
07/10/72	1. Flagellates	362
	2. Anabaena	354
	3. Microcystis	271
	4. Chroococcus	181
	5. Merismopedia	136
	Other genera	670
	Total	1,974
09/07/72	1. Microcystis	4,910
	2. Melosira	934
	3. Anabaena	873
	4. Tabellaria	632
	5. Aphanocapsa	542
	Other genera	2,501
	Total	10,482
10/22/72	1. Flagellates	843
	2. Dinobryon	738
	3. Microcystis	407
	4. Asterionella	331
	5. Cryptomonas	75
	Other genera	603
	Total	2,997

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
07/10/72	01	12.6
	02	22.0
	03	24.7
09/07/72	01	8.3
	02	8.6
	03	4.5
10/22/72	01	6.6
	02	8.3
	03	7.0

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff month of April when extra samples were collected, and the colder months when one or more samples were omitted depending on the site. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota 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 loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the nutrient loads, in lbs/mi^2/year, in Sucker Creek at B-1 and multiplying by the ZZ area in mi^2.

The Village of Orr declined participation in the Survey, and nutrient loads were estimated at 2.5 lbs P and 7.5 lbs N/capita/year.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Orr	315*	Trickling filter	0.030**	Pelican Lake

2. Known industrial - None

* Anonymous, 1973.
** Estimated at 100 gal/capita/day.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Sucker Creek	410	7.4
b. Minor tributaries & immediate drainage (non-point load) -	2,480	44.7
c. Known municipal -		
Orr	790	14.2
d. Septic tanks* -	160	2.9
e. Known industrial - None	-	-
f. Direct precipitation** -	1,710	30.8
Total	5,550	100.0

2. Outputs -

Lake outlet - Pelican River 2,970

3. Net annual P accumulation - 2,580 pounds

* Estimated 261 lakeshore dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/ yr	% of total
a. Tributaries (non-point load) -		
Sucker Creek	10,840	5.7
b. Minor tributaries & immediate drainage (non-point load) -	65,450	34.4
c. Known municipal -		
Orr	2,360	1.2
d. Septic tanks* -	6,130	3.2
e. Known industrial - None	-	-
f. Direct precipitation** -	105,440	55.4
Total	190,220	100.0

2. Outputs -

Lake outlet - Pelican River 75,580

3. Net annual N accumulation - 114,640 pounds

* Estimated 261 lakeshore dwellings; see Working Paper No. 1.
** See Working Paper No. 1.

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

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
Sucker Creek	55	1,461

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters 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".

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	0.5	0.2	17.4	10.5
grams/m^2/yr	0.06	0.03	2.0	1.2

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

"Dangerous" (eutrophic rate)	0.16
"Permissible" (oligotrophic rate)	0.08

V. LITERATURE REVIEWED

Anonymous, 1973. Wastewater disposal facilities inventory. MPCA, Minneapolis.

Schilling, Joel, 1974. Personal communication (lake map). MPCA, Minneapolis.

Vollenweider, Richard A., (in press). Input-output models. Schweiz. A. Hydrol.

VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 2765 PELICAN LAKE

TOTAL DRAINAGE AREA OF LAKE 69.30

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
27658A1	69.30	10.80	6.70	11.70	39.30	109.40	93.00	57.40	28.60	30.00	19.40	15.50	15.70	36.62
27658B1	7.42	1.16	0.59	1.36	4.00	12.20	10.80	6.88	3.16	4.34	2.07	1.48	1.89	4.18
27657Z7	61.90	11.69	6.90	11.30	35.90	94.00	88.70	49.40	22.50	25.40	15.30	12.00	14.60	32.42

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 69.30
SUM OF SUB-DRAINAGE AREAS = 69.32
TOTAL FLOW IN = 437.53
TOTAL FLOW OUT = 437.50

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27658A1	10	72	21.20	14	21.00				
	11	72	13.00	14	13.00				
	12	72	13.10						
	1	73	10.00						
	2	73	5.32	23	4.90				
	3	73	11.20	19	12.00				
	4	73	41.70	2	26.00	18	40.00	30	64.00
	5	73	84.70	21	78.00				
	6	73	78.90	19	76.00				
	7	73	71.90	19	61.00				
	8	73	65.60	24	58.00				
	9	73	15.30	24	13.00				
27658B1	10	72	2.15	14	2.10				
	11	72	1.14	14	1.20				
	12	72	1.48						
	1	73	1.02						
	2	73	0.44	23	0.40				
	3	73	1.22	19	1.30				
	4	73	4.60	2	2.50	18	3.90	30	6.20
	5	73	8.31	21	8.20				
	6	73	8.64	19	8.40				
	7	73	8.12	19	6.90				
	8	73	6.86	24	6.10				
	9	73	2.08	24	1.80				
27657Z7	10	72	16.10	14	16.00				
	11	72	9.49	14	9.60				
	12	72	11.50						
	1	73	10.20						
	2	73	5.14	23	4.80				
	3	73	10.20	19	11.00				
	4	73	35.30	2	23.00	18	35.00	30	55.00
	5	73	69.60	21	63.00				
	6	73	71.10	19	69.00				
	7	73	55.30	19	50.00				
	8	73	48.30	24	43.00				
	9	73	12.20	24	10.00				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

276501
48 03 35.0 092 56 10.0
PELICAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0017 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	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/10	16 20	0000			67	90	7.80	35	0.110	0.100	0.030	0.011
	16 20	0004	20.5	8.0		90	7.70	35	0.060	0.090	0.032	0.010
	16 20	0013	19.9	6.0		90	7.30	36	0.070	0.110	0.033	0.010
72/09/07	16 25	0000			66	95	7.50	36	0.070	0.100	0.022	0.011
	16 25	0004	15.9	9.0		88	7.40	35	0.060	0.100	0.027	0.012
	16 25	0015	15.5	11.8		88	7.50	38	0.060	0.100	0.023	0.010
72/10/22	11 35	0000			77	80	7.05	37	0.040	0.060	0.033	0.021
	11 35	0004	2.3	12.4				36	0.040	0.060	0.032	0.019
	11 35	0015	2.3	11.6		80	7.20	35	0.040	0.060	0.020	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/07/10	16 20	0000	12.6J
72/09/07	16 25	0000	8.3J
72/10/22	11 35	0000	6.6J

J* VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

276502
48 04 00.0 092 53 12.0
PELICAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0031 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATFR TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/10	17 00	0000			60	90	8.10	39	0.080	0.090	0.033	0.010
	17 00	0004	20.7	8.6		90	8.10	36	0.100	0.110	0.040	0.011
	17 00	0015	20.1	7.8		90	8.00	35	0.080	0.090	0.034	0.012
	17 00	0025	19.9	7.6		90	7.60	35	0.070	0.080	0.036	0.010
72/09/07	15 55	0000			66	90	7.60	34	0.060	0.100	0.028	0.012
	15 55	0004	16.3	9.1		89	7.60	34	0.060	0.090	0.031	0.011
	15 55	0015	15.9	6.5		93	7.60	33	0.060	0.090	0.029	0.010
	15 55	0020	15.9	8.8		85	7.50	31	0.070	0.100	0.027	0.009
	15 55	0026	15.8	6.9		90	7.35	33	0.060	0.090	0.028	0.010
72/10/22	11 10	0000			88	75	7.05	34	0.040	0.070	0.034	0.020
	11 10	0004	2.6	12.0		80	7.00	34	0.050	0.080	0.033	0.020
	11 10	0015	2.7	12.1		80	7.20	35	0.060	0.080	0.035	0.023
	11 10	0022	2.8	12.1		80	7.00	34	0.040	0.080	0.036	0.022

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/07/10	17 00	0000	22.0J
72/09/07	15 55	0000	8.6J
72/10/22	11 10	0000	8.3J

J* VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

276503
48 04 10.0 092 50 28.0
PELICAN LAKE
27 MINNESOTA

11EPALES 2111202
3 0018 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	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/07/10	17 35	0000			42	95	9.60	42	0.100	0.120	0.036	0.011
	17 35	0004	21.6	9.2		95	9.60	41	0.080	0.100	0.027	0.011
	17 35	0014	18.6	0.3		110	7.30	51	0.070	0.580	0.108	0.019
72/09/07	15 40	0000				88	7.50	32	0.070	0.110	0.027	0.012
	15 40	0004	17.1	7.6		88	7.50	35	0.050	0.010	0.022	0.008
	15 40	0010	15.0	7.6		88	7.30	34	0.060	0.120	0.019	0.010
72/10/22	10 55	0000			72	85	7.15	37	0.050	0.070	0.041	0.029
	10 55	0004	2.0	12.8		80	7.10	38	0.040	0.060	0.047	0.028
	10 55	0009	2.3	12.3		78	7.00	36	0.040	0.060	0.016	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/07/10	17 35	0000	24.7J
72/09/07	15 40	0000	4.5J
72/10/22	10 55	0000	7.0J

J* VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY DATA

DATE 74/10/30

2765A1 LS2765A1
48 02 00.0 092 50 00.0
PELICAN RIVER
27 7.5 ORR
0/PELICAN LAKE
CO HWY 23 BRDG W GLENDALE BELOW ORR STP
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
72/10/14	17 00		0.042	0.670	0.092	0.007	0.031
72/11/14	15 30		0.025	0.720	0.049	0.005K	0.027
73/01/15	16 00		0.035	0.760	0.180	0.013	0.030
73/02/23	16 00		0.034	0.800	0.252	0.016	0.035
73/04/02	14 30		0.010K	0.840	0.005K	0.014	0.065
73/04/19	11 00		0.046	1.720	0.033	0.005K	0.020
73/04/30	11 00		0.010K	1.000	0.020	0.009	0.035
73/05/21	14 00		0.024	1.200	0.036	0.010	0.030
73/06/19	11 00		0.046	1.680	0.057	0.028	0.065
73/07/19	20 00		0.010K	2.300	0.064	0.060	0.095
73/08/24	18 00		0.010K	0.580	0.028	0.025	0.060
73/09/24	14 00		0.023	1.440	0.086	0.026	0.030

K VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 74/1 /30

27655R1 LS27655R1
45 05 00.0 092 49 30.0
SUCKER CREEK(MOOSE LAKE OUTLET)
27 7.5 ORR
I/PELICAN LAKE
US 53 BRDG .5 MI N ORR VILLAGE LIMITS
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 N+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
72/10/14	16 35		0.140	1.350	0.240	0.007	0.066
72/11/1[illegible]	15 49		0.155	1.40[illegible]	0.250	0.005	0.062
73/03/19	16 25		0.[illegible]82	1.700	0.260	0.048	0.100
73/04/12	11 15		0.022	0.800	0.015	0.00K	0.050
73/04/30	11 40		0.015	1.[illegible]00	0.020	0.005K	0.015
73/05/21	14 15		0.01[illegible]	1.[illegible]00	0.046	0.024	0.050
73/06/19	10 45		0.07[illegible]	1.[illegible]10	0.052	0.023	0.035
73/07/19	20 15		0.07[illegible]	1.320	0.040	0.017	0.035
73/08/24	15 15		0.073	1.700	0.052	0.011	0.080
73/09/24	14 20		0.01[illegible]	0.790	0.061	0.017	0.030

K VALUE KNOWN TO BE LESS
THAN INDICATED