REPORT

ON

WEST OKOBOJI LAKE

DICKINSON COUNTY

IOWA

EPA REGION VII

WORKING PAPER No. 508

WITH THE COOPERATION OF THE

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND THE

IOWA NATIONAL GUARD

AUGUST, 1976

CONTENTS

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 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 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 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 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 Iowa Department of Environmental Quality for professional involvement, to the Iowa National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Water Quality Division of the Department of Environmental Quality provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

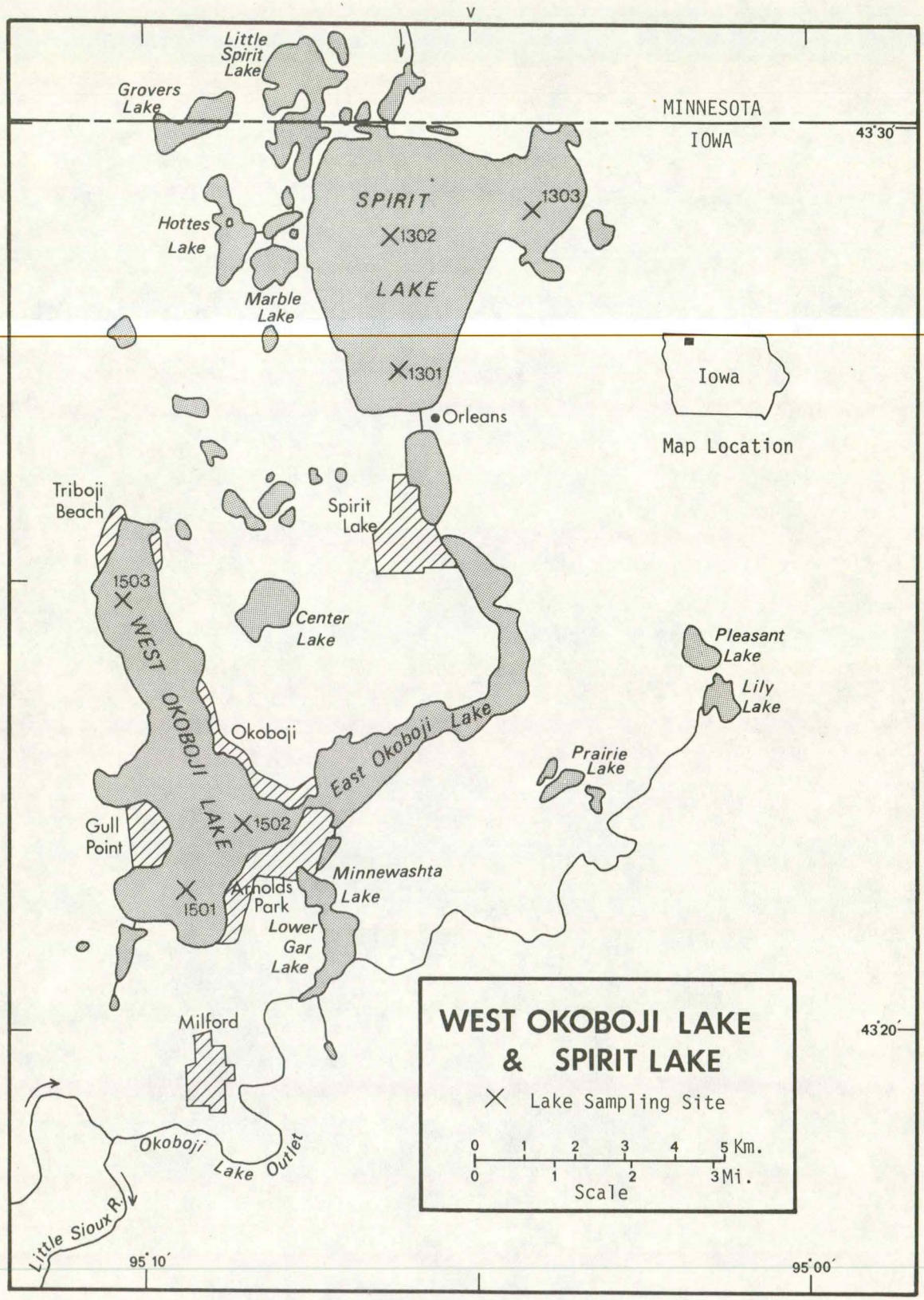
Major General Joseph G. May, the Adjutant General of Iowa, and Project Officer Colonel Cleadeth P. Woods, who directed the volunteer efforts of the Iowa National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IOWA

LAKE NAME	COUNTY
Ahquabi	Warren
Big Creek Reservoir	Polk
Black Hawk	Sac
Clear	Cerro Gordo
Darling	Washington
Lost Island	Clay, Palo Alto
MacBride	Johnson
Prairie Rose	Shelby
Rathbun Reservoir	Appanoose, Wayne
Red Rock Reservoir	Marion
Rock Creek	Jasper
Silver	Worth
Spirit	Dickinson
Viking	Montgomery
West Okoboji	Dickinson


Little Spirit Lake
Grovers Lake
MINNESOTA
IOWA
43°30'
SPIRIT LAKE
1303
1302
1301
Hottes Lake
Marble Lake
Orleans
Iowa
Map Location
Triboji Beach
Spirit Lake
1503
WEST OKOBOJI LAKE
Center Lake
Pleasant Lake
Lily Lake
Okoboji
East Okoboji Lake
Prairie Lake
Gull Point
1502
1501
Arnolds Park
Minnewashta Lake
Lower Gar Lake
Milford
WEST OKOBOJI LAKE & SPIRIT LAKE
Lake Sampling Site
0 1 2 3 4 5 Km.
0 1 2 3 Mi.
Scale
43°20'
Okoboji Lake Outlet
Little Sioux R.
95°10'
95°00'

WEST OKOBOJI LAKE

STORET NO. 1915

I. INTRODUCTION

West Okoboji Lake was included in the National Eutrophication Survey as a water body of interest to the Iowa Department of Environmental Quality. Tributaries and nutrient sources were not sampled, and this report relates only to the lake sampling data.

West Okoboji Lake, the second largest in surface area of the Iowa Great Lakes, has the greatest mean depth and largest drainage area of these lakes. The topography of the watershed is characterized as a gently-rolling terrain with marshlands of various sizes scattered throughout. Most of the watershed area is cropland. In another study, animal feedlots in the watershed were shown to be major contributors of nutrients (Anonymous, 1974).

II. CONCLUSIONS

A. Trophic Condition:

Survey data and a report by others (Bachmann and Jones, 1974) indicate that West Okoboji Lake is eutrophic. It ranked second in overall trophic quality when the 15 Iowa lakes and reservoirs sampled in 1974 were compared using a combination of six parameters*. However, based on their more extensive studies, Bachman and Jones (op. cit.) consider West Okoboji Lake to be of better trophic quality than Spirit Lake which ranked first using using Survey data.

* See Appendix A.

One of the other Iowa water bodies had less and one had the same median total phosphorus, nine had less and one had the same median dissolved phosphorus, none of the other water bodies had less median inorganic nitrogen and mean chlorophyll a, and none had greater mean Secchi disc transparency. Survey limnologists reported a phytoplankton bloom in July, but no higher aquatic vegetation was noted.

Some of the Survey lake data can be compared to data collected during the period of 1971-1972 (Bachman and Jones, op. cit). The dissolved oxygen concentration show marked depression at the deepest site during 1971-1972 as well as in 1974. Water clarity (as measured by a Secchi disc) was greater in 1974, and chlorophyll a levels apparently were higher (possibly indicating an increase in primary productivity since 1972).

West Okoboji presently satisfies an important recreational need in the area. The lake is in danger of advanced cultural eutrophication due to the high nutrient load received from agricultural practices in the watershed (Anonymous, op. cit.).

B. Rate-Limiting Nutrient:

The algal assay results indicate that West Okoboji Lake was phosphorus limited in April and nitrogen limited in September. These results are substantiated by the lake data which indicate limitation by phosphorus and nitrogen at the respective sampling times.

III. LAKE CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 14.93 kilometers^2.
2. Mean depth: 13.7 meters.
3. Maximum depth: 40.8 meters.
4. Volume: 204.541 x 10^6 m^3.

B. Precipitation*:

1. Year of sampling: 71.8 centimeters.
2. Mean annual: 70.5 centimeters.

† Table of metric equivalents--Appendix B.
†† Harrison, 1975.
* See Working Paper No. 175, "...Survey Methods, 1973-1976".

IV. LAKE WATER QUALITY SUMMARY

West Okoboji Lake was sampled three 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 a number of depths at three stations on the lake (see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and third visits, 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 18.3 meters at station 1, 39.6 meters at station 2, and 10.7 meters at station 3.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not preserved properly and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR WEST LAKE OKOBOJI
STORET CODE 1915

PARAMETER	1ST SAMPLING (4/22/74) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 9/74) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/23/74) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	6.8 - 7.6	7.1	6.9	12.8 - 23.8	20.6	22.5	14.1 - 17.4	16.8	17.3
DISS OXY (MG/L)	10.4 - 11.8	11.5	11.6	0.2 - 8.2	6.2	7.6	0.0 - 8.8	7.1	8.2
CNDCTVY (MCROMO)	290. - 297.	292.	291.	375. - 461.	436.	450.	382. - 389.	385.	386.
PH (STAND UNITS)	****** -**********			7.9 - 8.9	8.4	8.5	6.9 - 8.1	7.9	8.0
TOT ALK (MG/L)	196. - 212.	204.	204.	****** -**********			218. - 276.	231.	226.
TOT P (MG/L)	0.031 - 0.041	0.036	0.035	****** -**********			0.046 - 0.422	0.096	0.052
ORTHO P (MG/L)	0.003 - 0.011	0.005	0.004	****** -**********			0.017 - 0.389	0.048	0.024
NO2+NO3 (MG/L)	0.030 - 0.070	0.042	0.040	****** -**********			0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.020 - 0.040	0.027	0.030	****** -**********			0.020 - 2.230	0.290	0.040
KJEL N (MG/L)	0.800 - 1.700	0.946	0.900	****** -**********			0.800 - 3.200	1.173	0.900
INORG N (MG/L)	0.050 - 0.110	0.069	0.070	****** -**********			0.040 - 2.250	0.310	0.060
TOTAL N (MG/L)	0.840 - 1.770	0.988	0.940	****** -**********			0.820 - 3.220	1.193	0.920
CHLRPYL A (UG/L)	5.1 - 6.8	5.7	5.1	6.3 - 14.4	9.4	7.4	6.8 - 10.7	8.1	6.9
SECCHI (METERS)	3.7 - 3.7	3.7	3.7	2.4 - 3.4	3.0	3.4	2.1 - 2.6	2.4	2.4

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/22/74	1. Cyclotella sp.	1,395
	2. Fragilaria sp.	930
	3. Flagellates	465
	4. Melosira sp.	62
	5. Peridinium sp.	31
	Other genera	155
	Total	3,038
07/09/74	1. Flagellates	642
	2. Aphanocapsa sp.	471
	3. Aphanizomenon sp.	285
	4. Fragilaria sp.	157
	5. Schroederia sp.	71
	Other genera	271
	Total	1,897
09/23/74	1. Oocystis sp.	164
	2. Sphaerocystis sp.	144
	3. Microcystis sp.	144
	4. Flagellates	123
	5. Melosira sp.	82
	Other genera	205
	Total	862

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/22/74	1	5.1
	2	5.1
	3	6.8
07/09/74	1	6.3
	2	7.4
	3	14.4
09/23/74	1	6.8
	2	6.9
	3	10.7

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. April sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.005	0.072	0.1
0.050 P	0.055	0.072	1.0
0.050 P + 1.0 N	0.055	1.072	25.1
1.0 N	0.005	1.072	0.1

b. September sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.075	0.272	3.8
0.050 P	0.125	0.272	4.0
0.050 P + 1.0 N	0.125	1.272	15.5
1.0 N	0.075	1.272	10.3

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of West Okoboji Lake was low in April but moderately high in September, 1974. In the April assay, a significant increase in yield occurred with the addition of phosphorus alone but not with the addition of only nitrogen. In the September assay, a significant increase in yield occurred with the addition of nitrogen alone but not with the addition of only phosphorus. Thus, phosphorus limitation is indicated in the April sample, and nitrogen limitation is indicated in the September sample.

The lake data substantiate these findings. In April, the mean inorganic nitrogen to orthophosphorus ratio was 14 to 1, and in September it was 6 to 1.

V. LITERATURE REVIEWED

Anonymous, 1974. Management plan for water quality - Iowa Great Lakes. Eugene A. Hickok and Associates, Wayzata, Minnesota.

Bachmann, Roger W., and John R. Jones, 1974. Water quality in the Iowa Great Lakes. MS, Dept. Zoo. & Ent., IA St. U., Ames.

Harrison, Harry M., 1975. Personal communication (lake morphometry). IA Cons. Comm., Des Moines.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

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
1901	LAKE ACQUABI	0.062	0.335	469.333	8.600	8.200	0.009
1902	BIG CREEK RESERVOIR	0.046	6.465	438.500	16.867	14.800	0.011
1903	BLACK HAWK LAKE	0.185	0.130	488.167	49.740	15.000	0.020
1904	CLEAR LAKE	0.059	0.070	465.125	17.400	8.600	0.010
1905	LAKE DARLING	0.077	1.475	482.500	13.817	9.200	0.012
1906	LOST ISLAND LAKE	0.146	0.065	421.167	36.100	8.400	0.021
1907	LAKE MACBRIDE	0.061	2.035	458.444	17.067	15.000	0.010
1908	PRAIRIE ROSE LAKE	0.056	0.210	463.667	17.350	8.600	0.010
1909	RATHBUN RESERVOIR	0.071	1.170	475.889	12.039	14.000	0.008
1910	RED ROCK LAKE	0.180	1.880	473.400	14.730	14.000	0.104
1911	ROCK CREEK LAKE	0.065	1.400	480.500	18.367	8.400	0.007
1912	SILVER LAKE	0.193	0.565	482.667	95.300	10.000	0.034
1913	SPIRIT LAKE	0.041	0.090	422.667	12.622	9.000	0.007
1914	VIKING LAKE	0.075	0.130	459.000	26.033	14.200	0.017
1915	WEST LAKE OKOBOJI	0.046	0.060	380.444	7.722	15.000	0.017

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	INDEX NO
1901	LAKE ACQUABI	57 (8)	50 (7)	43 (6)	93 (13)	100 (14)	79 (11)	422
1902	BIG CREEK RESERVOIR	89 (12)	0 (0)	79 (11)	57 (8)	21 (3)	50 (7)	296
1903	BLACK HAWK LAKE	7 (1)	68 (9)	0 (0)	7 (1)	7 (0)	21 (3)	110
1904	CLEAR LAKE	71 (10)	86 (12)	50 (7)	36 (5)	75 (10)	64 (8)	382
1905	LAKE DARLING	29 (4)	21 (3)	14 (2)	71 (10)	57 (8)	43 (6)	235
1906	LOST ISLAND LAKE	21 (3)	93 (13)	93 (13)	14 (2)	89 (12)	14 (2)	324
1907	LAKE MACBRIDE	64 (9)	7 (1)	71 (10)	50 (7)	7 (0)	64 (8)	263
1908	PRAIRIE ROSE LAKE	79 (11)	57 (8)	57 (8)	43 (6)	75 (10)	64 (8)	375
1909	RATHBUN RESERVOIR	43 (6)	36 (5)	29 (4)	86 (12)	39 (5)	86 (12)	319
1910	RED ROCK LAKE	14 (2)	14 (2)	36 (5)	64 (9)	39 (5)	0 (0)	167
1911	ROCK CREEK LAKE	50 (7)	29 (4)	21 (3)	29 (4)	89 (12)	96 (13)	314
1912	SILVER LAKE	0 (0)	43 (6)	7 (1)	0 (0)	50 (7)	7 (1)	107
1913	SPIRIT LAKE	100 (14)	79 (11)	86 (12)	79 (11)	64 (9)	96 (13)	504
1914	VIKING LAKE	36 (5)	68 (9)	64 (9)	21 (3)	29 (4)	32 (4)	250
1915	WEST LAKE OKOBOJI	89 (12)	100 (14)	100 (14)	100 (14)	7 (0)	32 (4)	428

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1913	SPIRIT LAKE	504
2	1915	WEST LAKE OKOBOJI	428
3	1901	LAKE ACQUABI	422
4	1904	CLEAR LAKE	382
5	1908	PRAIRIE ROSE LAKE	375
6	1906	LOST ISLAND LAKE	324
7	1909	RATHBUN RESERVOIR	319
8	1911	ROCK CREEK LAKE	314
9	1902	BIG CREEK RESERVOIR	296
10	1907	LAKE MACBRIDE	263
11	1914	VIKING LAKE	250
12	1905	LAKE DARLING	235
13	1910	RED ROCK LAKE	167
14	1903	BLACK HAWK LAKE	110
15	1912	SILVER LAKE	107

APPENDIX B

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 C

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/03/11

191501
43 22 25.0 095 09 35.0 3
WEST LAKE OKOBOJI
19 IOWA

11EPALES 2111202
0028 FEET DEPTH CLASS 00

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
74/04/22	13 30	0000	6.8		144	290		206	0.040	1.700	0.070	0.011
	13 30	0005	6.8	11.8		291		208	0.030	0.900	0.040	0.005
	13 30	0015	6.8	11.8		290		204	0.020	0.900	0.030	0.004
	13 30	0023	6.8	11.6		290		204	0.030	0.900	0.040	0.005
74/07/09	14 10	0000	22.5	8.2	132	450	8.60					
	14 10	0005	22.6	8.2		449	8.60					
	14 10	0015	22.5	7.8		450	8.60					
	14 10	0030	22.0	7.6		446	8.50					
	14 10	0045	18.7	5.4		418	8.30					
	14 10	0060	16.6	4.8		401	8.20					
74/09/23	11 20	0000	17.4	8.6	96	386	8.06	226	0.040	1.300	0.020K	0.032
	11 20	0005	17.3	8.2		385	8.03	220	0.040	0.900	0.020K	0.026
	11 20	0017	17.3	8.2		386	8.03	222	0.040	0.900	0.020K	0.024
	11 20	0025	17.3	8.2		385	8.00	276	0.020	0.900	0.020	0.021

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/22	13 30	0000	0.041	5.1	
	13 30	0005	0.034		
	13 30	0015	0.038		
	13 30	0023	0.035		
74/07/09	14 10	0000		6.3	
	14 10	0004			50.0
	14 10	0030			1.0
74/09/23	11 20	0000	0.060	6.8	
	11 20	0005	0.051		
	11 20	0017	0.058		1.0
	11 20	0025	0.053		

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/12/23

191502
43 21 37.0 095 08 43.0
WEST LAKE OKOBOJI
19059 IOWA

11EPALES 2111202
3 0075 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
74/04/22	15 00	0000	6.9		144	292		204	0.030	1.000	0.040	0.004
	15 00	0005	6.9	11.6		291		204	0.020	0.900	0.040	0.004
	15 00	0025	6.9	11.6		291		196	0.030	1.000	0.040	0.004
	15 00	0050	6.9	11.6		291		210	0.020	0.800	0.040	0.004
	15 00	0070	6.9	11.6		291		206	0.020	0.900	0.040	0.005
74/07/09	13 30	0000	23.2	8.0	132	457	8.60					
	13 30	0005	23.2	8.2		457	8.60					
	13 30	0015	23.1	8.0		459	8.60					
	13 30	0028	22.8	8.0		452	8.90					
	13 30	0050	17.4	5.0		408	8.20					
	13 30	0070	16.0	2.4		400	8.00					
	13 30	0090	13.4	0.2		379	7.90					
	13 30	0105	12.8	0.2		375	7.90					
74/09/23	10 30	0000	17.4	8.0	104	386	8.05	232	0.040	0.900	0.020K	0.024
	10 30	0005	17.4	8.2		386	8.06	228	0.040	1.100	0.020K	0.023
	10 30	0025	17.4	7.8		387	8.01	220	0.030	0.800	0.020K	0.025
	10 30	0050	17.4	8.0		387	8.02	222	0.040	0.800	0.020K	0.027
	10 30	0080	17.3	7.8		387	8.00	222	0.040	0.900	0.020K	0.032
	10 30	0105	14.3	0.0		384	6.97	248	1.700	2.300	0.020K	0.017
	10 30	0130	14.1	0.0		389	6.87	246	2.230	3.200	0.020K	0.389

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/22	15 00	0000	0.033	5.1	
	15 00	0005	0.033		
	15 00	0025	0.031		
	15 00	0050	0.034		
	15 00	0070	0.040		
74/07/09	13 30	0000		7.4	
	13 30	0004			50.0
	13 30	0028			1.0
74/09/23	10 30	0000	0.046	6.9	
	10 30	0005	0.051		
	10 30	0025	0.050		
	10 30	0050	0.058		
	10 30	0080	0.071		
	10 30	0105	0.318		
	10 30	0130	0.422		
	10 30	0134			

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/12/23

191503
43 24 52.0 095 10 28.0
WEST LAKE OKOBOJI
19059 IOWA

11EPALES 2111202
3 0040 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
74/04/22	15 30	0000	7.5		144	297		200	0.030	0.900	0.040	0.005
	15 30	0005	7.6	11.6		296		212	0.040	0.800	0.050	0.004
	15 30	0025	7.5	11.6		294		200	0.020	0.800	0.040	0.003
	15 30	0035	7.5	10.4		294		200	0.020	0.800	0.040	0.003
74/07/09	11 20	0000	23.8	7.4	96	461	8.60					
	11 20	0005	23.7	7.8		461	8.50					
	11 20	0019	23.6	7.6		460	8.50					
	11 20	0032	23.4	7.4		458	8.60					
74/09/23	10 00	0000	17.1	8.4	84	383	8.14	226	0.030	1.000	0.020K	0.022
	10 00	0005	17.1	8.6		383	8.15	220	0.020K	0.900	0.020K	0.020
	10 00	0015	17.0	8.4		383	8.12	236	0.020K	0.900	0.020K	0.019
	10 00	0035	16.9	8.8		382	8.13	218	0.020K	0.800	0.020K	0.017

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/22	15 30	0000	0.035	6.8	
	15 30	0005	0.037		
	15 30	0025	0.037		
	15 30	0035	0.035		
74/07/09	11 20	0000		14.4	
	11 20	0002			50.0
	11 20	0019			1.0
74/09/23	10 00	0000	0.046	10.7	
	10 00	0005	0.052		
	10 00	0015	0.050		
	10 00	0035	0.049		

K VALUE KNOWN TO BE
LESS THAN INDICATED