Eagle Lake near Kansasville, Wisconsin
Water-Quality Data Summary

This summary covers the period October 1993 to September 1996, which is the period of water-quality monitoring of Eagle Lake by the U.S. Geological Survey (USGS). Emphasis in this summary is on data collected during 1996. All data collected during 1996 is included. Data from previous years is included in graphs to illustrate changes or trends.

In reviewing the data, it may be helpful to refer to the methods and explanations of physical and chemical characteristics sections in the USGS annual lake data report "Water-Quality and Lake-Stage Data for Wisconsin Lakes, Water Year 1996" and to Shaw and others (1994) "Understanding Lake Data."

Lake description and sampling locations:

Eagle Lake is classified as a shallow drainage lake, with one inlet and one intermittent outlet. The average depth of Eagle Lake is 6 feet, the surface area is 509 acres (0.80 square miles), and the lake's watershed area is 6.99 square miles. The water-quality sampling site is located at the deepest point in the lake at a depth of about 12 feet. Lake stage was monitored at the Jochimsen residence, which is located on the east side of the lake. The locations of the monitoring sites are shown in Figure 1.

Hydrologic conditions during water year 1996:

Annual variability in lake condition often reflects variability in climatic and hydrologic conditions. Air temperature in southeastern Wisconsin was, on the average, 2.2 $^{\circ}$ F cooler than normal for the period December 1995 through March 1996; April and May was 4.0 $^{\circ}$ F cooler than normal; and the period June through August was 1.3 $^{\circ}$ F cooler than normal (National Oceanic and Atmospheric Administration "Climatological Data--Wisconsin"). Precipitation during water year 1996 was 103 percent of normal precipitation for southeastern Wisconsin (Pamela Naber-Knox, UW-Extension, Geological and Natural History Survey, written commun., 1996). Watershed runoff in the region of Eagle Lake was between 100 and 120 percent of long-term average runoff (Holmstrom and others, 1997, "Water Resources Data--Wisconsin").

Lake Data for 1996:

The following presents some highlights of data given in the tables and shown in the figures.

Lake-stage fluctuations:

Lake stages were read intermittently by Virginia Jochimsen , and by the USGS on sampling dates. The stages ranged from 10.51 feet on September 25 to 12.09 feet on June 5. This range of fluctuation is slightly higher than the average of the previous 3 years of monitoring. Stage values are listed in Table 1 and shown in the table on the top half of Figure 2.

Lake-depth profiles:

Vertical profiles of water temperature, dissolved oxygen, pH, and specific conductance are typical of a shallow, mixed lake and are somewhat similar to those from the previous years. Last year the lake became slightly thermally stratified whereas it had not stratified before. These profiles, which were measured over the deepest point in the lake, are listed in Table 2 and shown in Figure 2. During the February through August sampling period, complete water-column mixing was observed on all sampling dates. The lake did not thermally stratified through the summer. No anoxic (devoid of oxygen) regions developed at any depth. The anoxic zone is unable to support fish. The pH, which ranged between 7.4 and 8.8, is common for southeastern Wisconsin lakes and poses no problems for aquatic life.

Chemical constituents:

Analyses of water samples collected on April 22 for selected chemical constituents for chemical characterization of the lake are shown in Figure 2. Samples collected at 1.5 and 11-foot depths show similar constituent concentrations, as would be expected under mixed water column conditions. The constituent values for color, chlorophyll a, chloride, calcium, magnesium, pH, alkalinity, total nitrogen, and total phosphorus are within regional values for this area as described by Lillie and Mason in "Limnological Characteristics of Wisconsin Lakes," 1983, Technical Bulletin No. 138, Department of Natural Resources.

The ratio of dissolved nitrogen to dissolved phosphorus was 165:1, based on the surface concentrations on April 22. This ratio suggests the lake is phosphorus limited, which means algal growth is dependent on the amount of available phosphorus rather than available nitrogen.

Three common measures of water quality used as indices are concentrations of near-surface total-phosphorus and chlorophyll a, and Secchi depth. Total phosphorus concentrations ranged from 0.026 mg/L on June 12 to 0.087 mg/L on July 29, chlorophyll a ranged from 11 µg/L on April 22 to 41 µg/L on July 29, and Secchi depths ranged from 1.0 m on August 20 to 1.5 m on June 12. Surface total phosphorus and chlorophyll a concentrations, and Secchi depths for the 1993-96 period are shown on

Figure 3.

Total phosphorus concentration 1.5 feet above the lake bottom at the center site ranged from 0.029 mg/L on April 22 to 0.079 mg/L on July 29. These total phosphorus concentrations are similar to surface concentrations and indicate that phosphorus release from the bottom sediments is not a major problem.

Lake condition:

Water-quality index:

Lillie and Mason (1983) classified all Wisconsin lakes using a random data set collected in the summer (July and August). The index, shown on page 12 of "Water-Quality and Lake-Stage data for Wisconsin Lakes, Water Year 1996," is based on surface total-phosphorus and chlorophyll a concentrations, and Secchi depths. According to the index, surface total-phosphorus and Secchi depths in Eagle Lake indicate "poor" water quality, and chlorophyll a concentrations indicate "very poor" water quality.

Lillie and Mason (1983) also provided a means of comparing the condition of Eagle Lake with other lakes in southeastern Wisconsin. The comparison in Table 4 shows the percentage distribution of southeastern Wisconsin lakes within each condition group and the relative position of Eagle Lake.

Trophic status:

Another means of assessing the nutrient, or trophic, status of a lake is to use Carlson's Trophic State Index (TSI). The 1996 TSI data is listed in Table 3. Figure 4 is a graphical illustration of the variation in Trophic State Indices for Eagle Lake during the 4 year study period. The data from 1996 show the lake to be eutrophic, or a lake with high nutrient levels.

Table 1. Lake stages for Eagle Lake near Kansasville, Wisconsin, 1996 water year

LOCATION.--Lat 42°42'30", long 88°06'55", in SE 1/4 NE 1/4 (corrected), sec.22, T.3 N., R.20 E., Racine County, Hydrologic Unit 07120006, 1.5 mi northwest of Kansasville.

DRAINAGE AREA.--6.1 mi^2.

PERIOD OF RECORD --1936-64, 1975-77, 1979, and February 1993 to current year (intermittent). Unpublished intermittent records from October 1940 to July 1979.

GAGE.--1936-79, nonrecording gage at different datum; 1993-96, assumed datum, staff located at residence of observer, Virginia Jochimsen.

EXTREMES FOR PERIOD 1936-64, 1975-77, 1979.--Maximum gage height observed, 7.80 ft, July 1, 1942; minimum observed, 4.31 ft, Jan. 22, 1964.

EXTREMES FOR PERIOD 1993-96.--Maximum gage height observer, 12.25 ft, Apr. 22, 1993; minimum observer, 10.37 ft, Feb. 2, 1993.

EXTREMES FOR CURRENT YEAR.--Maximum gage height observed, 12.09 ft, June 5; minimum observed, 10.51 ft, Sept. 25.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1995 TO SEPTEMBER 1996

DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	11.54	---	---	---	---
2	---	11.65	---	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---	11.53	---	---
4	11.29	---	---	---	---	---	---	---	---	---	---	10.83
5	---	---	---	---	11.28	---	---	---	12.09	---	---	---
6	---	---	---	---	---	---	11.49	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	11.23	---
8	---	11.63	---	---	---	---	---	11.48	---	---	---	---
9	---	---	---	---	---	---	---	---	---	---	---	---
10	---	---	---	---	11.39	---	11.47	---	---	11.41	---	---
11	11.47	---	---	---	---	---	---	---	---	---	---	10.79
12	---	---	---	---	---	---	---	---	11.68	---	---	---
13	---	---	---	---	---	---	---	---	---	---	---	---
14	---	---	---	---	---	---	---	---	---	---	11.09	---
15	---	11.69	---	---	---	---	---	11.59	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	11.79	---	---	11.37	---	---
18	11.39	---	---	---	---	---	---	---	---	---	---	10.75
19	---	---	---	---	---	---	---	---	11.75	---	---	---
20	---	---	---	---	---	---	---	---	---	---	11.01	---
21	---	---	---	---	---	---	---	---	---	---	10.99	---
22	---	11.71	---	---	---	---	11.79	11.85	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	11.79	---	---	11.33	---	---
25	11.43	---	---	---	---	---	---	---	---	---	---	10.51
26	---	---	---	---	---	---	---	---	11.71	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	10.89	---
29	---	---	---	---	---	---	---	11.63	---	11.26	---	---
30	---	11.76	---	---	---	11.51	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	11.29	---	---

Table 2. Lake-depth profiles for Eagle Lake near Kansasville, Wisconsin, 1996 water year

WATER-QUALITY DATA

DATE	SAMPLING DEPTH (FEET) (00003)	TEMPERATURE WATER (DEG C) (00010)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STANDARD UNITS) (00400)	OXYGEN, DISSOLVED (MG/L) (00300)
FEB 1996					
05...	3.00	2.5	680	7.5	6.7
05...	5.00	3.0	675	7.5	6.4
05...	7.00	3.0	671	7.5	6.1
05...	9.00	3.5	675	7.5	3.9
05...	11.0	4.0	678	7.5	3.4
05...	12.0	4.0	691	7.4	2.8
05...	13.0	--	--	--	--
APR					
22...	1.50	12.0	554	8.0	9.9
22...	3.00	12.0	554	8.0	9.8
22...	5.00	12.0	554	8.0	9.8
22...	7.00	12.0	553	8.0	10.1
22...	9.00	12.0	555	8.0	10.8
22...	11.0	12.0	555	8.0	11.1
22...	12.5	--	--	--	--
JUN					
12...	1.50	18.5	463	8.8	12.2
12...	3.00	18.5	463	8.8	12.1
12...	5.00	17.5	464	8.8	11.9
12...	7.00	17.5	466	8.7	11.3
12...	9.00	17.0	475	8.6	10.0
12...	10.5	16.0	487	8.4	8.6
12...	12.0	--	--	--	--
JUL					
29...	1.50	23.5	454	8.7	8.9
29...	2.00	23.5	453	8.7	8.8
29...	3.00	23.5	452	8.7	8.7
29...	4.00	23.5	452	8.7	8.6
29...	5.00	23.5	454	8.7	8.6
29...	6.00	23.5	453	8.7	8.4
29...	7.00	23.0	456	8.6	8.0
29...	8.00	23.0	453	8.6	7.8
29...	9.00	23.0	457	8.6	7.3
29...	10.0	23.0	458	8.5	7.0
29...	11.0	23.0	459	8.5	6.5
29...	12.5	--	--	--	--
AUG					
20...	1.50	26.0	448	8.6	8.9
20...	2.00	25.5	445	8.6	8.7
20...	3.00	25.0	446	8.6	8.5
20...	4.00	25.0	448	8.6	8.5
20...	5.00	24.5	449	8.6	7.9
20...	6.00	24.5	450	8.5	7.5
20...	7.00	24.5	451	8.5	6.6
20...	8.00	24.5	453	8.4	5.4
20...	9.00	24.5	454	8.4	5.6
20...	10.0	24.5	453	8.4	5.8
20...	11.0	24.0	456	8.3	4.7
20...	12.5	--	--	--	--

Table 3.--Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Eagle Lake, 1996 water year

[- indicates not applicable; -- indicates no data available]

Date	Secchi Disk			Sampling	Total Phosphorus			Chlorophyll a		Dissolved Ortho-phosphate Phosphorus
	Depth (meters)	Depth (feet)	T.S.I.	Depth (feet)	Conc. (mg/L)	Conc. (µg/L)	T.S.I	Conc. (µg/L)	T.S.I.	Conc. (mg/L)
04/22/96	1.3	4.3	56	1.5	0.033	33	55	11	53	<0.002
	-	-	-	11	0.029	29	-	-	-	<0.002
06/12/96	1.5	4.9	54	1.5	0.026	26	53	12	54	--
	-	-	-	11	0.031	31	-	-	-	--
07/29/96	1.1	3.6	59	1.5	0.087	87	63	41	63	--
	-	-	-	11	0.079	79	-	-	-	--
08/20/96	1.0	3.3	60	1.5	0.082	82	62	30	61	--
	-	-	-	11	0.078	78	-	-	-	--

Table 4. Regional lake condition and percentage distribution of southeastern lakes

	Parameter		Percentage distribution of lakes in southeast Wisconsin within parameter ranges
	Total Phosphorus (mg/L)		
	<0.010	best condition	7
	0.010-0.020		21
	0.020-0.030		15
	0.030-0.050		21
Eagle Lake Values	0.050-0.100		21
	0.100-0.150		3
	>0.150	worst condition	12
	Chlorophyll a (µg/L)		
	0-5	best condition	22
	5-10		31
	10-15		14
	15-30		12
Eagle Lake Values	>30	worst condition	22
	Secchi depth (feet)		
	>19.7	best condition	1
	9.8-19.7		9
	6.6-9.8		26
Eagle Lake Values	3.3-6.6		31
	<3.3	worst condition	33

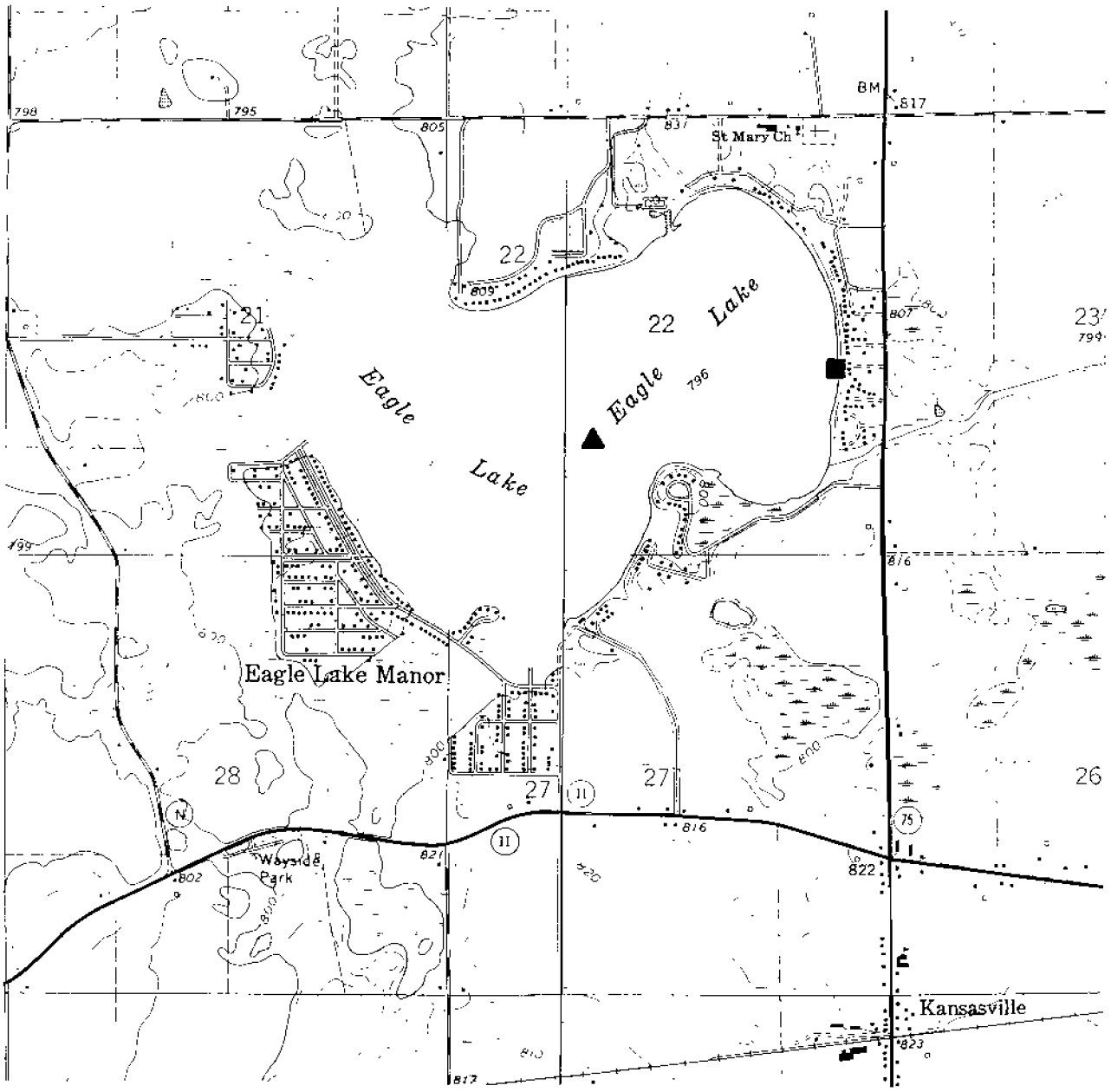

Figure 1. Locations of water-quality and lake-stage monitoring sites on Eagle Lake near Kansasville, Wisconsin.

LOCATION.--Lat 42°42'07", long 88°07'24", in SE 1/4 SW 1/4 sec.22, T.3 N., R.20 E., Racine County, Hydrologic Unit 07120006, 1.5 mi northwest of Kansasville.

DRAINAGE AREA.--6.99 mi^2.

PERIOD OF RECORD.--February 1993 to current year.

REMARKS.--Lake sampled near center at the deep hole. Lake ice-covered during February measurements. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 05 TO AUGUST 20, 1996

(Milligrams per liter unless otherwise indicated)

	Feb. 05		Apr. 22		June 12		July 29		Aug. 20	
Depth of sample (ft)	3.0	12	1.5	11	1.5	11	1.5	11	1.5	11
Lake stage (ft)	11.28		11.79		11.68		11.26		11.01	
Specific conductance (µS/cm)	680	691	554	555	463	487	454	459	448	456
pH (units)	7.5	7.4	8.0	8.0	8.8	8.4	8.7	8.5	8.6	8.3
Water temperature (°C)	2.5	4.0	12.0	12.0	18.5	16.0	23.5	23.0	26.0	24.0
Color (Pt-Co. scale)	---	---	25	20	---	---	---	---	---	---
Turbidity (NTU)	---	---	2.7	2.5	---	---	---	---	---	---
Secchi-depth (meters)	---		1.3		1.5		1.1		1.0	
Dissolved oxygen	6.7	2.8	9.9	11.1	12 2	8.6	8.9	6.5	8.9	4.7
Hardness, as CaCO3	---	---	260	260	---	---	---	---	---	---
Calcium, dissolved (Ca)	---	---	53	53	---	---	---	---	---	---
Magnesium, dissolved (Mg)	---	---	30	30	---	---	---	---	---	---
Sodium, dissolved (Na)	---	---	17	17	---	---	---	---	---	---
Potassium, dissolved (K)	---	---	4	4	---	---	---	---	---	---
Alkalinity, as CaCO3	---	---	150	160	---	---	---	---	---	---
Sulfate, dissolved (SO4)	---	---	63	63	---	---	---	---	---	---
Chloride, dissolved (Cl)	---	---	41	41	---	---	---	---	---	---
Fluoride, dissolved (F)	---	---	0.2	0.2	---	---	---	---	---	---
Silica, dissolved (SiO2)	---	---	6.0	6.0	---	---	---	---	---	---
Solids, dissolved, at 180°C	---	---	342	340	---	---	---	---	---	---
Nitrogen, NO2 + NO3, diss. (as N)	---	---	0.30	0.29	---	---	---	---	---	---
Nitrogen, ammonia, dissolved (as N)	---	---	<0.03	<0.03	---	---	---	---	---	---
Nitrogen, organic, total (as N)	---	---	0.90	0.80	---	---	---	---	---	---
Nitrogen, amm. + org., total (as N)	---	---	0.90	0.80	---	---	---	---	---	---
Nitrogen, total (as N)	---	---	1.2	1.1	---	---	---	---	---	---
Phosphorus, total (as P)	---	---	0.033	0.029	0.026	0.031	0.087	0.079	0.082	0.078
Phosphorus, ortho, dissolved (as P)	---	---	<0.002	<0.002	---	---	---	---	---	---
Iron, dissolved (Fe) µg/L	---	---	<10	<10	---	---	---	---	---	---
Manganese, dissolved (Mn) µg/L	---	---	0.6	<0.4	---	---	---	---	---	---
Chlorophyll a, phytoplankton (µg/L)	---	---	11	---	12	---	41	---	30	---

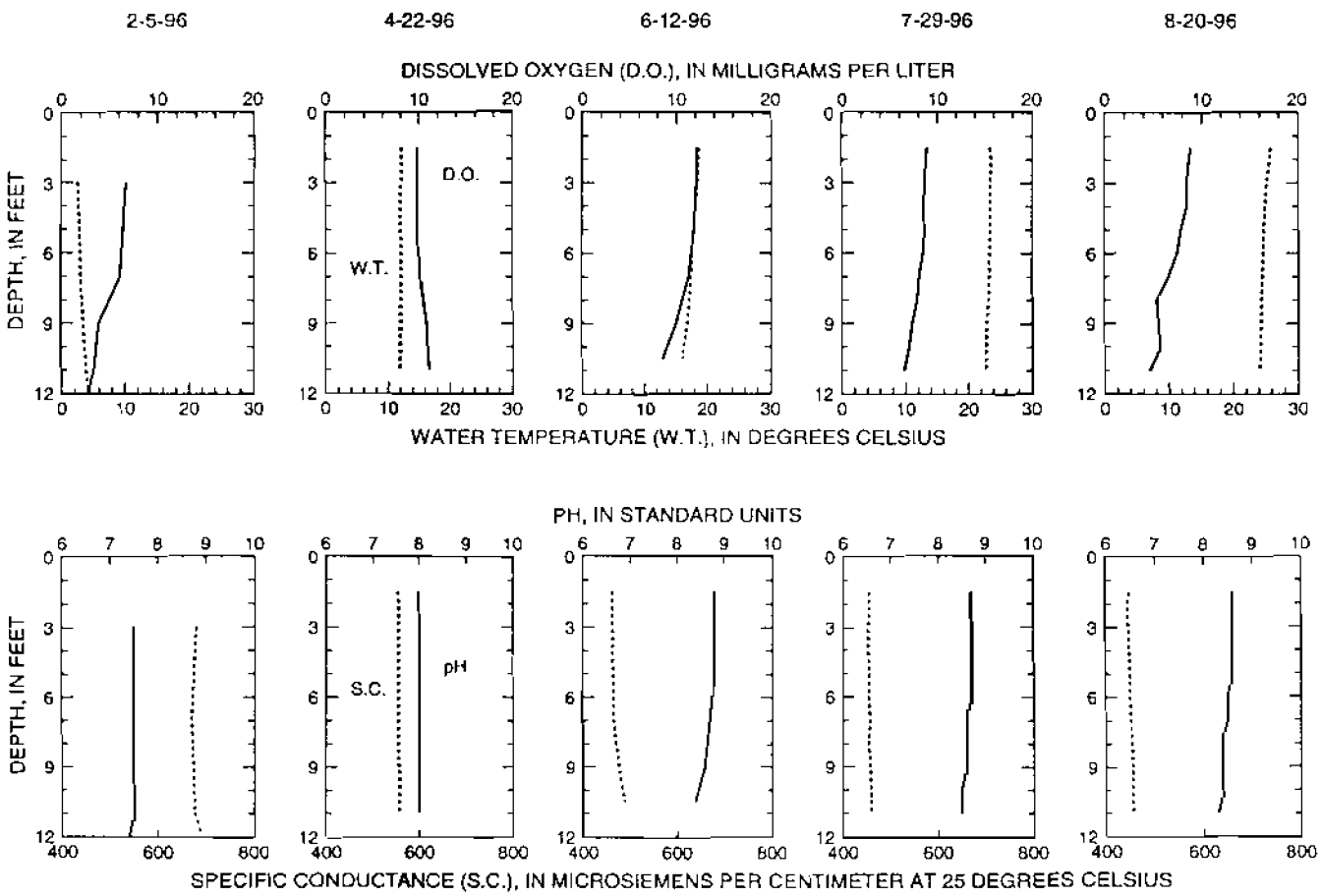

Figure 2. Water-quality data and depth profiles for Eagle Lake near Kansasville, Wisconsin, 1996 water year

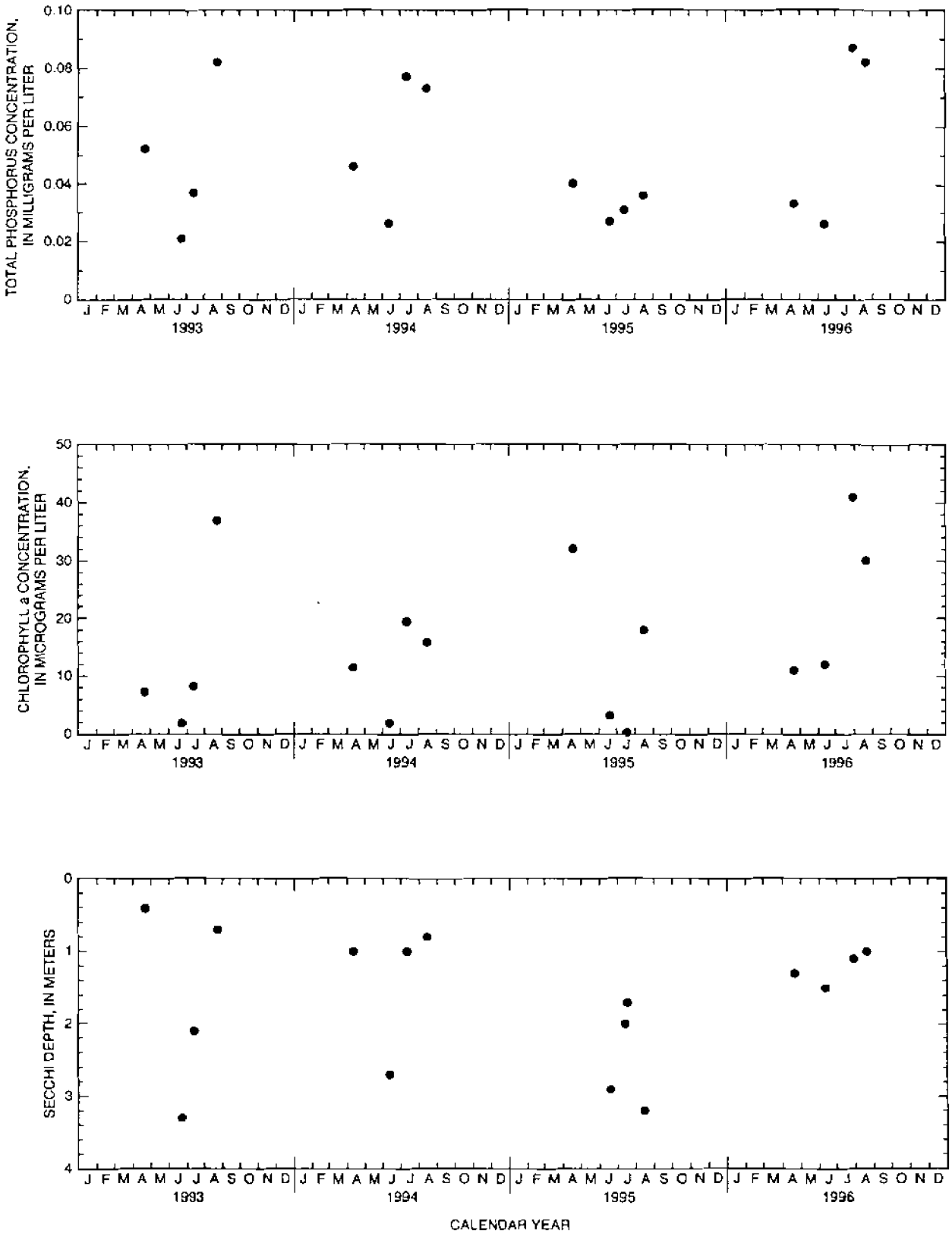

Figure 3. Surface total phosphorus and chlorophyll a concentrations, and Secchi depths for Eagle Lake (Deep Hole) near Kansasville, Wisconsin.

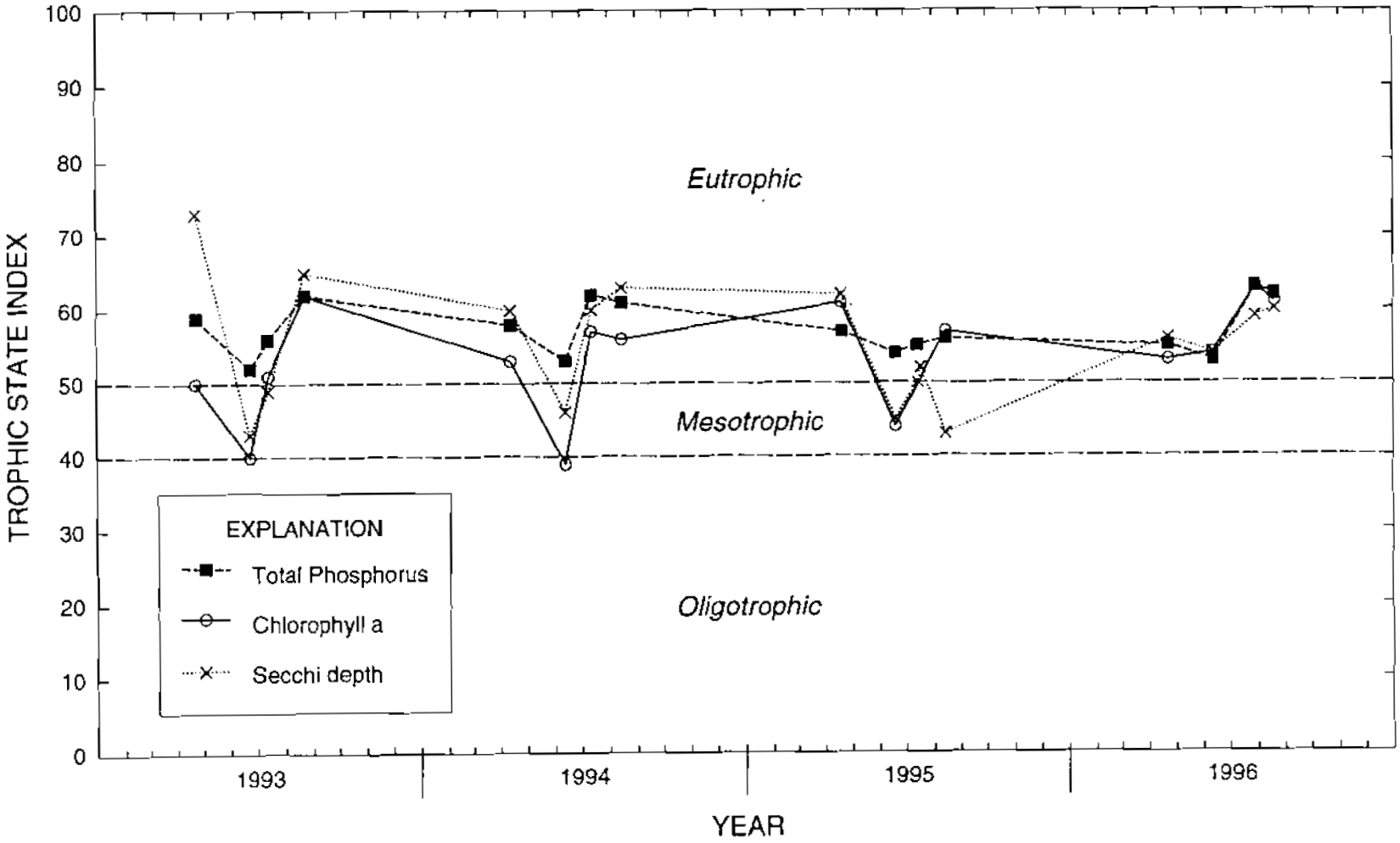

Figure 4. Trophic state indices for Eagle Lake near Kansasville, Wisconsin