Powers Lake at Powers Lake, WI
Water-Quality Data Summary

This summary covers the period April 1998 to September 2000, which is the period of water-quality monitoring of Powers Lake by the U.S. Geological Survey (USGS). Emphasis in this summary is on data collected during 2000. All data collected during 2000 are included. Data from previous years are 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 2000" and to Shaw and others (1994) "Understanding Lake Data."

Lake description and sampling locations:

Powers Lake is classified as a drainage lake, with one inlets and one outlets. The average depth of Powers Lake is 4.9 meters, the surface area is 448 acres (0.70 square miles), and the lake's watershed area is 3.4 square miles. The water-quality sampling site is located at the deepest point in the lake at a depth of about 10 meters. Lake stage was monitored at the outlet, which is located along the west shoreline of the lake. The locations of the monitoring sites are shown in Figure 1.

Hydrologic conditions during 2000 water year :

Annual variability in lake condition often reflects variability in climatic and hydrologic conditions. Air temperature in Southeast Wisconsin was, on the average, 5.68 °F warmer than normal for the period December 1999 through March 2000; April and May was 0.55 °F warmer than normal; and the period June through August was 1.0 °F cooler than normal (National Oceanic and Atmospheric Administration "Climatological Data--Wisconsin"). Precipitation during water year 2000 was 121 percent of normal precipitation for Southeast Wisconsin (Pamela Naber- Knox, UW-Extension, Geological and Natural History Survey, written commun.,2000). Watershed runoff in the region of Powers Lake was between 121 and 140 percent of long-term average runoff (Garn and others, 2001, "Water Resources Data--Wisconsin").

Lake Data for 2000:

The following summarizes some highlights of data given in the tables and shown in the figures:

Lake-stage fluctuations:

Lake stages were measured by the USGS on sampling dates. The stages ranged from 9.86 feet on April 10 to 10.52 feet on July 10. This range of fluctuation is similar to the previous 13 years of monitoring. Stage values are 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 exhibit no abnormalities and are similar to those from the previous years. These profiles, which were measured over the deepest point in the lake, are listed in Table 1 and shown in Figure 2. During the February through August sampling period, complete water-column mixing was observed on April 10. The lake did become thermally stratified through the summer. In June the of water was not anoxic at any depth (devoid of oxygen), and by August the lower 0.5 meters were anoxic. The anoxic zone is unable to support fish. The pH, which ranged between 7.2 and 8.2, is common for Southeast Wisconsin lakes and poses no problems for aquatic life.

Chemical constituents:

Analyses of water samples collected on April 10 for selected chemical constituents for chemical characterization of the lake are shown in Figure 2. Samples collected at a depth of 0.5 and 10 meters show similars 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 #:1, based on the surface concentrations on April 14. This ratio suggests the lake is phosphorus/nitrogen limited, which means algal growth is dependent on the amount of phosphorus/nitrogen available rather than available nitrogen /phosphorus.

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 0.008 mg/L on July 10 to 0.019 mg/L on June 6, chlorophyll a ranged from 1.31 µg/L on April 10 to 4.0 µg/L on June 6, and Secchi depths ranged from 3.4 m on July 10 and August 8 to 5.6 m on April 10.

Surface total phosphorus and chlorophyll a concentrations, and Secchi depths for the 1999-2000 period are shown on Figure 3. No trends are apparent from the previous data.

Total phosphorus concentration 0.5 meters above the lake bottom at the main site ranged from 0.013 mg/L on April 10 to 0.060 mg/L on August 8. These total phosphorus concentrations observed during anoxic periods are indicative of a minor phosphorus release from the bottom sediments.

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 14 of "Water-Quality and Lake-Stage data for Wisconsin Lakes, Water Year 2000," is based on surface total-phosphorus and chlorophyll a concentrations, and Secchi depths. According to the index, surface total-phosphorus, chlorophyll a concentrations, and Secchi depths in Powers Lake indicate "very good" water quality.

Lillie and Mason (1983) also provided a means of comparing the condition of Powers Lake with other lakes in Southeast Wisconsin. The comparison in Table 3 shows the percentage distribution of Southeast Wisconsin lakes within each condition group and the relative position of Powers 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 2000 TSI data is listed in Table 2. The bottom plot on Figure 3 is a graphical illustration of the variation in Trophic State Indices for Powers Lake during the 15 year study period. The data from 2000 show the lake to be mesotrophic, or a lake with moderate nutrient levels.

Table 1. Lake – depth profiles for Powers Lake at Powers Lake, Wisconsin, 2000 water year.

	WATER - QUALITY DATA				
DATE	SAMPLING DEPTH (M) (00098)	TEMPERATURE WATER (DEG C) (00010)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STANDARD UNITS) (00400)	OXYGEN, DISSOLVED (MG/L) (00300)
FEB					
09...	0.5	0.9	495	8.2	14.3
09...	1	2.2	481	8.2	13.7
09...	2	2.4	479	8.2	13.4
09...	3	2.6	477	8.1	12.8
09...	4	2.6	479	8.1	12.9
09...	5	2.9	479	8.1	12.9
09...	6	3.1	476	8	12
09...	7	3.3	479	8	10.4
09...	8	3.4	482	7.9	10.1
09...	9	3.7	494	7.8	7.2
09...	10	4.7	508	7.7	4.6
09...	10.5	--	--	--	--
APR					
10...	0.5	7.7	498	8.2	11.1
10...	1	7.7	498	8.2	11
10...	2	7.7	500	8.2	11
10...	3	7.7	500	8.2	10.9
10...	4	7.7	499	8.2	10.9
10...	5	7.7	500	8.2	10.9
10...	6	7.7	500	8.2	10.8
10...	7	7.7	500	8.2	10.8
10...	8	7.7	499	8.2	10.7
10...	9	7.7	499	8.2	10.7
10...	10	7.7	500	8.2	10.7
10...	10.5	--	--	--	--
JUN					
06...	0.5	19.2	483	8.1	9.8
06...	1	19	483	8.2	9.8
06...	2	18.7	484	8.2	9.7
06...	3	18.6	481	8.2	9
06...	4	18.4	480	8.2	10.4
06...	5	18	480	8.2	9.9
06...	6	17.8	481	8.2	9.2
06...	7	16	492	7.8	5.6
06...	8	14.9	504	7.6	3.4
06...	9	14.1	514	7.5	1.5
06...	10	13	514	7.4	0.1
06...	10.5	--	--	--	--
JUL					
10...	0.5	24.3	463	8	8.4
10...	1	24.2	460	8.1	8.4
10...	2	24.2	460	8.1	8.4

Table 1. Lake – depth profiles for Powers Lake at Powers Lake, Wisconsin, 2000 water year – continued.

	WATER - QUALITY DATA				
DATE	SAMPLING DEPTH (M) (00098)	TEMPERATURE WATER (DEG C) (00010)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH WATER WHOLE FIELD (STANDARD UNITS) (00400)	OXYGEN, DISSOLVED (MG/L) (00300)
10...	3	24.2	460	8.1	8.5
10...	4	24.2	460	8.1	8.8
10...	5	24.2	460	8.1	8.6
10...	6	23.1	470	7.9	5.6
10...	7	20.8	474	7.4	1.4
10...	8	19.5	480	7.3	0
10...	9	17.1	495	7.2	0
10...	10	14.6	517	7.3	0
10...	10.5	--	--	--	--
AUG					
08...	0.5	25	480	8.1	8.9
08...	1	25	481	8.1	8.7
08...	2	25	483	8.2	8.6
08...	3	24.7	480	8.1	8.7
08...	4	24.6	482	8.1	8.7
08...	5	24.6	485	8.1	8.6
08...	6	23.8	485	8	6.8
08...	7	22.5	496	7.6	3.1
08...	8	20.3	502	7.3	0.5
08...	9	17.8	511	7.2	0.8
08...	10	15.6	538	7.2	0
08...	10.5	--	--	--	--

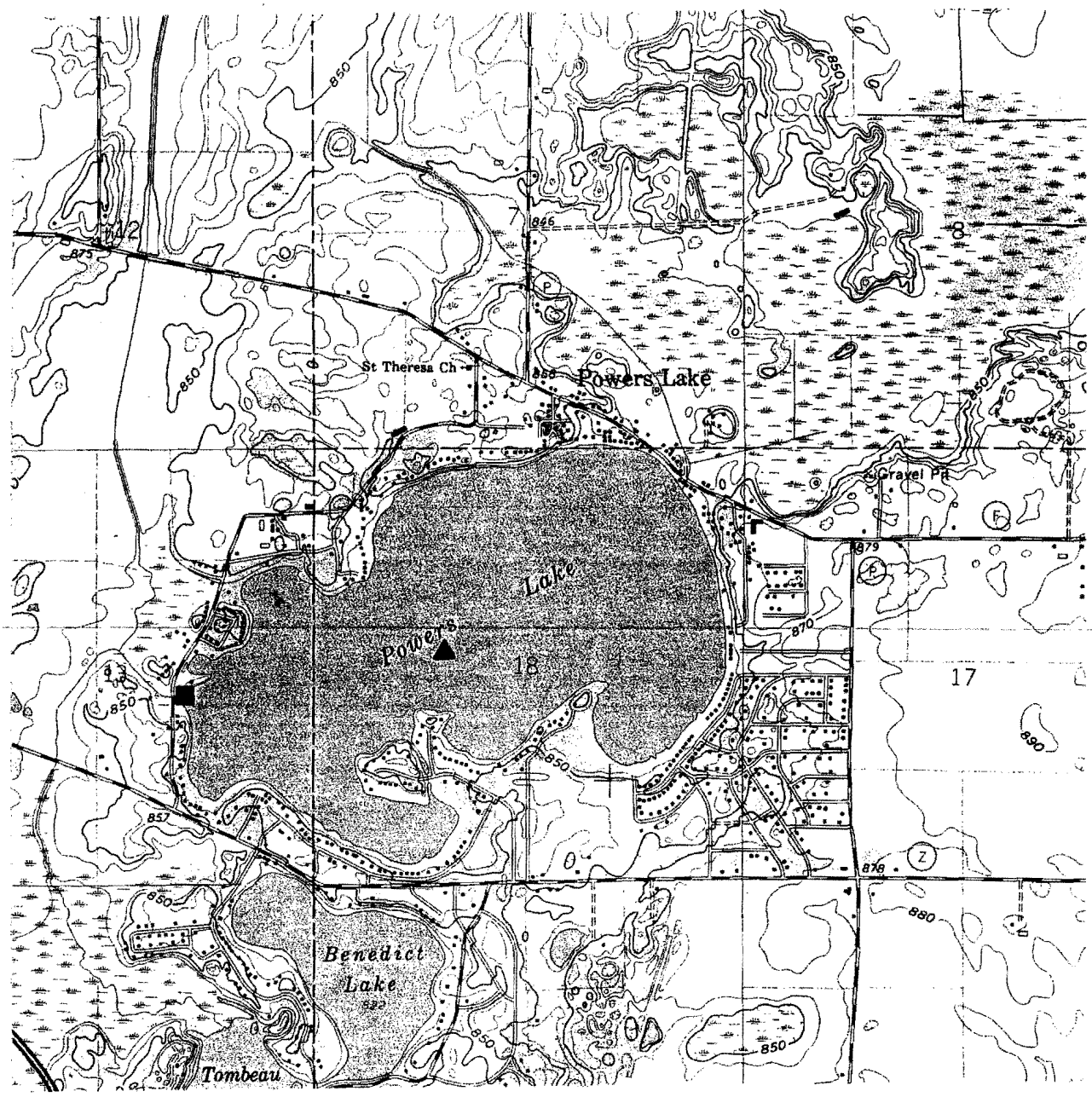
Table 2. Water clarity and water-quality analyses and their associated Trophic State Indices (TSI) for Powers Lake, 2000 water year

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

Date	Secchi Disk			Sampling	Total Phosphorus			Chlorophyll a		Dissolved Ortho-phosphate Phosphorus
	Depth (meters)	Depth (feet)	TSI	Depth (meters)	Conc. (mg/L)	Conc. (ug/L)	TSI	Conc. (ug/L)	TSI	Conc. (mg/L)
04/10/00	5.60	18.4	35	0.5	0.012	12	47	1.31	37	<0.002
	-	-	-	10.0	0.013	13	-	-	-	--
06/06/00	4.10	13.5	40	0.5	0.019	19	51	4.00	45	--
	-	-	-	10.0	0.019	19	-	-	-	--
07/10/00	3.40	11.2	42	0.5	0.008	8	44	3.00	43	<0.002
	-	-	-	10.0	0.042	42	-	-	-	--
08/08/00	2.35	7.7	48	0.5	0.013	13	48	3.80	45	--
	-	-	-	10.0	0.060	60	-	-	-	--

Table 3. Condition of Powers Lake relative to other southeastern Wisconsin Lakes

	Parameter (late-summer values)	Percentage distribution of lakes in southeast Wisconsin within parameter ranges	
	Total Phosphorus (mg/L)		
	<0.010	best condition	7
Powers Lake Values	0.010-0.020		21
	0.020-0.030		15
	0.030-0.050		21
	0.050-0.100		21
	0.100-0.150		3
	>0.150	worst condition	12
	Chlorophyll a (µg/L)		
Powers Lake Values	0-5	best condition	22
	5-10		31
	10-15		14
	15-30		12
	>30	worst condition	22
	Secchi depth (meters)		
	>6.0	best condition	1
Powers Lake Values	3.0-6.0		9
	2.0-3.0		26
	1.0-2.0		31
	<1.0	worst condition	33



EXPLANATION

▲ Water-quality monitoring site

■ Lake-stage monitoring site

Figure 1. Locations of water-quality and lake-stage monitoring sites on Powers Lake at Powers Lake, Wisconsin.

423246088175800 POWERS LAKE AT POWERS LAKE, WI

LOCATION.--Lat 42°32'46", long 88°17'58", in NW 1/4 SE 1/4 sec.13, T.1 N., R.18 E., Walworth County, Hydrologic Unit 07120006, at Powers Lake.
DRAINAGE AREA.--3.42 mi^2.
PERIOD OF RECORD.--March 1986 to August 1996, and April 1998 to current year.
REMARKS.--Lake sampled near center at the deep hole. Lake ice-covered during February sampling. Water-quality analyses done by Wisconsin State Laboratory of Hygiene.

WATER-QUALITY DATA, FEBRUARY 09 TO AUGUST 08, 2000
(Milligrams per liter unless otherwise indicated)

	Feb-9		Apr-10		Jun-6		Jul-10		Aug-8		
Lake stage (ft)	9.91		9.86		10.49		10.52		10.32		
Secchi-depth (m)	---		5.6		4.1		3.4		3.4		
Chlorophyll a, phytoplankton (µg/L)	---		1.31		4		3		3.8		
Depth of sample (m)	0.5	10.0	0.5	10.0	0.5	10.0	0.5	10.0	0.5	8.0	10.0
Water temperature (°C)	0.9	4.2	7.7	7.7	19.2	13.0	24.3	14.6	25.0	20.3	15.6
Specific conductance (µS/cm)	495	508	498	500	483	514	463	517	480	502	538
pH (units)	8.2	7.7	8.2	8.2	8.1	7.4	8.0	7.3	8.1	7.3	7.2
Dissolved oxygen (mg/L)	14.3	4.6	11.1	10.7	9.8	0.1	8.4	0.0	8.9	0.5	0.0
Phosphorus, total (as P)	0.017	0.018	0.012	0.013	0.019	0.019	0.008	0.042	0.013	0.022	0.060
Phosphorus, ortho, dissolved (as P)	---	---	<0.002	---	---	---	<0.002	---	---	---	---
Nitrogen, NO2 + NO3, diss. (as N)	---	---	0.04	---	---	---	<0.010	---	---	---	---
Nitrogen, ammonia, dissolved (as N)	---	---	<0.013	---	---	---	<0.013	---	---	---	---
Nitrogen, amm. + org., total (as N)	---	---	0.58	---	---	---	---	---	---	---	---
Nitrogen, ammonia + org. diss. (as N	---	---	---	---	---	---	0.68	---	---	---	---
Nitrogen, total (as N)	---	---	0.62	---	---	---	---	---	---	---	---
Color (Pt-Co. scale)	---	---	13	---	---	---	---	---	---	---	---
Turbidity (NTU)	---	---	1.7	---	---	---	---	---	---	---	---
Hardness, (as $CaCO_3$)	---	---	220	---	---	---	---	---	---	---	---
Calcium, dissolved (Ca)	---	---	37	---	---	---	---	---	---	---	---
Magnesium, dissolved (Mg)	---	---	32	---	---	---	---	---	---	---	---
Sodium, dissolved (Na)	---	---	18	---	---	---	---	---	---	---	---
Potassium, dissolved (K)	---	---	2.2	---	---	---	---	---	---	---	---
Alkalinity, (as $CaCO_3$)	---	---	176	---	---	---	---	---	---	---	---
Sulfate, dissolved (SO_4)	---	---	33.3	---	---	---	---	---	---	---	---
Chloride, dissolved (Cl)	---	---	38.4	---	---	---	---	---	---	---	---
Silica, dissolved (SiO_2)	---	---	7.2	---	---	---	---	---	---	---	---
Solids, dissolved, at 180°C	---	---	282	---	---	---	---	---	---	---	---
Iron, dissolved (Fe) µg/L	---	---	<10	---	---	---	---	---	---	---	---
Manganese, dissolved (Mn) µg/L	---	---	<0.4	---	---	---	---	---	---	---	---

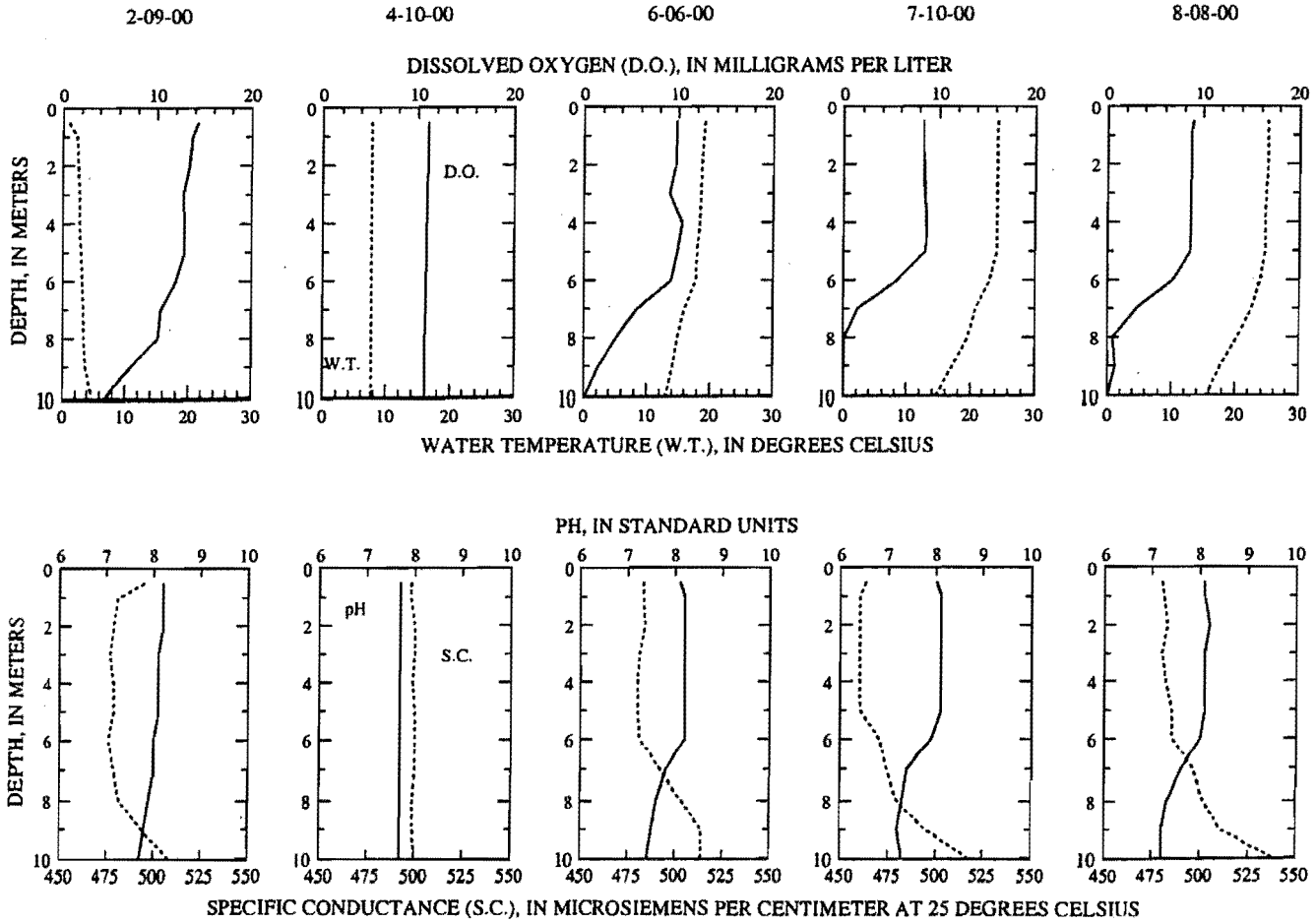


Figure 2. Water-quality data and depth profiles for Powers Lake at Powers Lake, Wisconsin, 2000 water year.

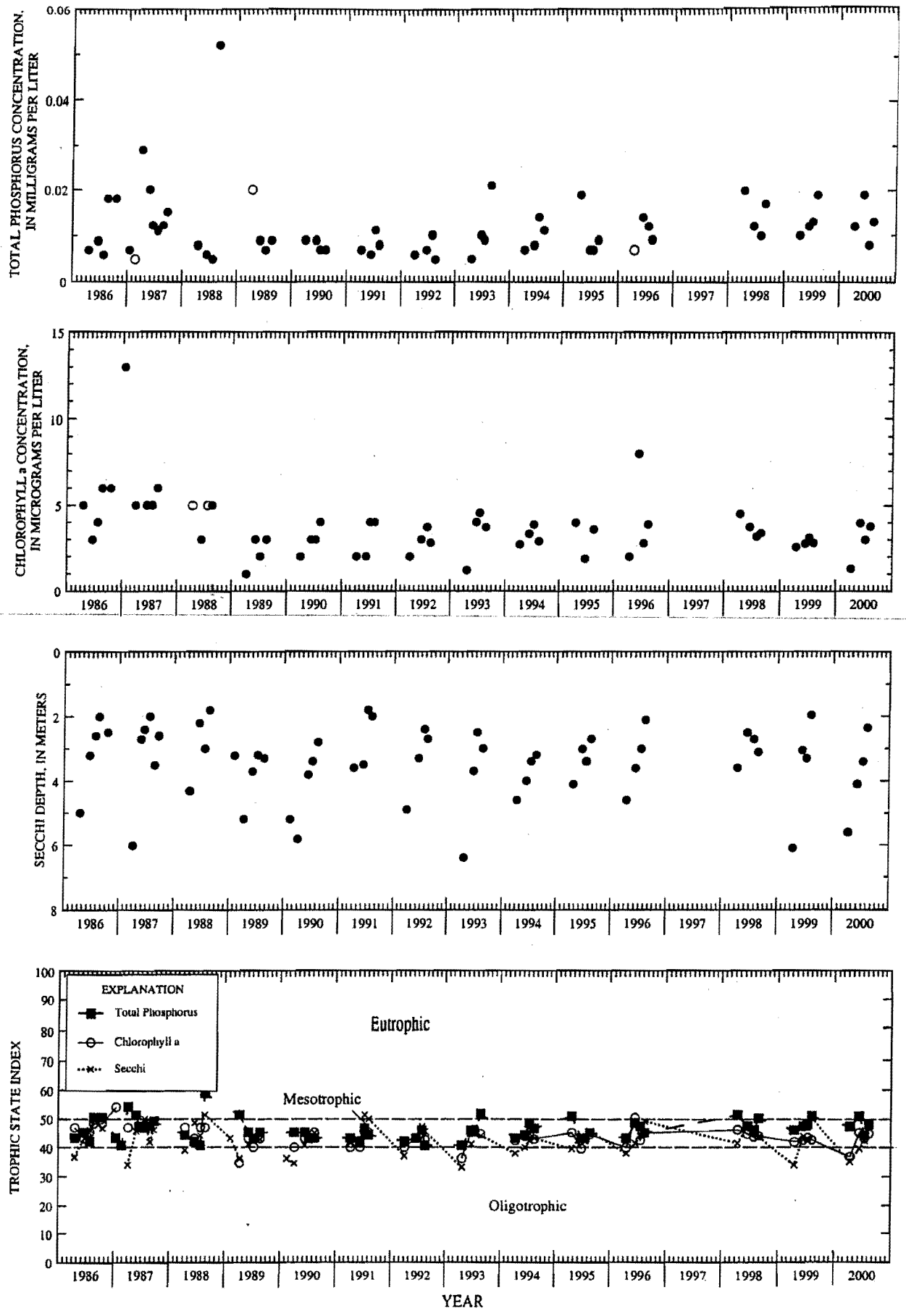


Figure 3. Surface total phosphorus, chlorophyll a concentrations, secchi depths, and TSI data for Powers Lake at Powers Lake, Wisconsin.