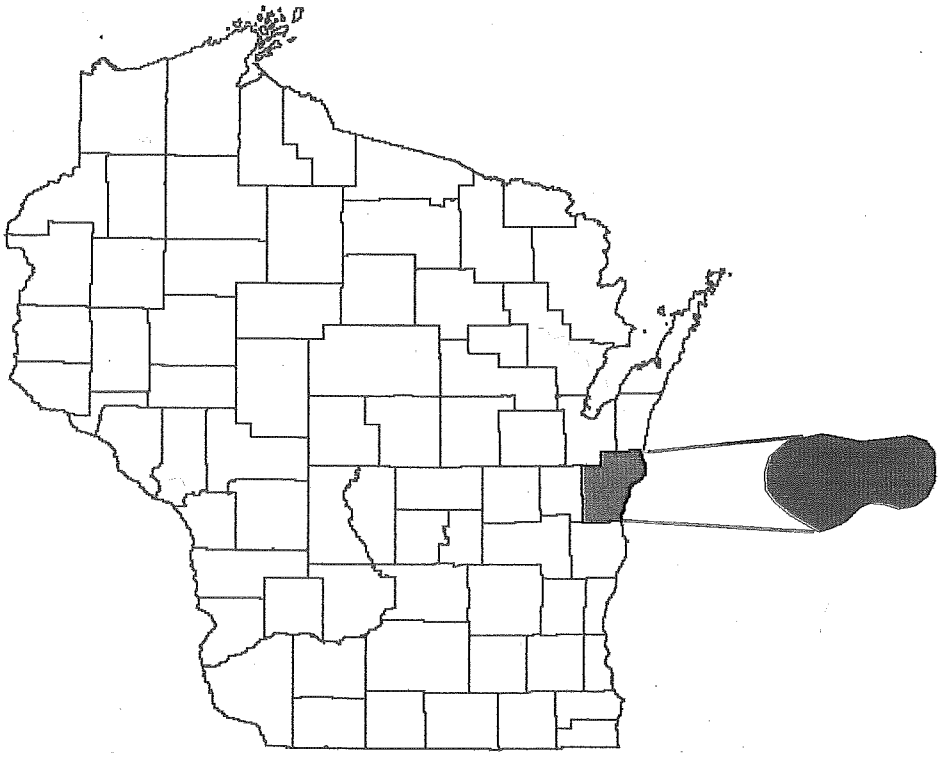
1994 Limnological Assessment of Tuma Lake Manitowoc County, Wisconsin



Submitted by Scott Szymanski
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Green Bay, WI

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Introduction

Tuma Lake (T21N R23E Sec. 17) in Manitowoc County is a 14 acre seepage lake averaging 11 feet in depth with a maximum depth of 36 feet. A public boat access is located on the northwest side of the lake. Primary species of fish include northern pike, largemouth bass and panfish.

In 1994, Tuma Lake was monitored as part of the Twin-Door-Kewaunee (TDK) Basin assessment. The TDK basin assessment lakes were chosen based on their ecological and recreational importance, the potential for significant anthropogenic impacts, and the lack of recent data. Among the goals of the program are:

1) Identification of high quality lakes that should receive highest priority for protection and/or management efforts.

2) Identification of lakes affected by non-point source pollution.

3) Identification of lakes which need monitoring.

4) Determination of information and criteria needed to make land management decisions.

The water quality data gathered from these lakes is also used in preparation of the 305b report to Congress, for dissemination to citizens, and to update Surface Water Inventories.

Methods

Water samples were collected in bottles provided by the Wisconsin State Laboratory of Hygiene (SLOH) and preserved following "Handling and Preservation Handbook" protocol (1988). Samples were taken at one meter below the surface and one meter above the bottom using a Van Dorn bottle. Winter samples were analyzed for total and dissolved phosphorus. They were monitored again during spring turnover for calcium, hardness, magnesium, potassium, sodium, silica, iron, alkalinity, color, turbidity, solids, nitrate-nitrites, ammonia, total Kjeldahl nitrogen, total phosphorus, dissolved phosphorus, and surface chlorophyll a. Finally, the lakes were monitored in June, July, and August for total and ortho phosphorus, and surface chlorophyll a. Water samples were chilled on ice and sent to the SLOH for analysis.

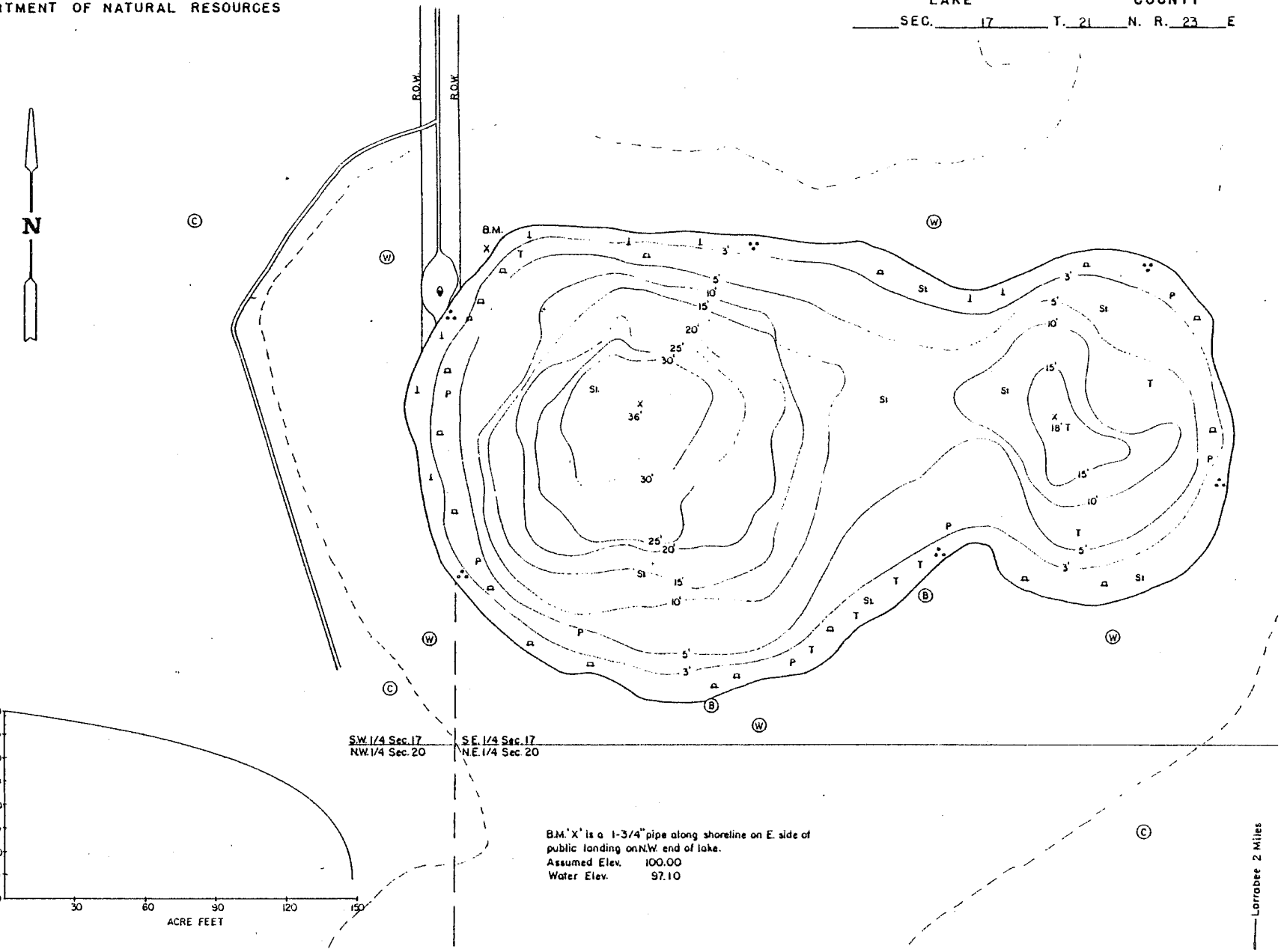
Temperature and dissolved oxygen (D.O.) profiles were obtained using either a YSI Model 54A D.O./Temp. meter or a YSI Model 3800 water quality data logger. pH readings were measured by using either an Orion 230A portable pH meter or the YSI datalogger. Conductivity readings were gathered using either an Orion Model 126 meter or the YSI datalogger. Secchi depth was determined during ice-free months.

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

LAKE SURVEY MAP

LAKE _____ COUNTY _____

SEC. 17 T. 21 N. R. 23 E



B.M. 'X' is a 1-3/4" pipe along shoreline on E. side of public landing on N.W. end of lake.
Assumed Elev. 100.00
Water Elev. 97.10

EQUIPMENT RECORDING SONAR MAPPED AUGUST (MONTH) 1973 (YEAR)

TOPOGRAPHIC SYMBOLS

- (B) Brush
- (PW) Partially wooded
- (W) Wooded
- (C) Cleared
- (P) Pastured
- (A) Agricultural
- B.M. Bench Mark
- Dwelling
- Resort
- Camp
- Steep slope
- Indefinite shoreline
- Marsh
- Spring
- Intermittent stream
- Permanent inlet
- Permanent outlet
- Dam
- D.N.R. State owned land

LAKE BOTTOM SYMBOLS

- P. Peat
- Mk. Muck
- C. Clay
- M. Marl
- Sd. Sand
- Sl. Silt
- Gr. Gravel
- R. Rubble
- Br. Bedrock
- B Boulders
- Stumps & Snags
- Rock danger to navigation
- T Submergent vegetation
- Emergent vegetation
- Floating vegetation
- Brush shelters

◇ Access ◇ Access with Parking ◆ Boat Livery

Drawn by: J. Kuehn
Field work by: D. Boese & J. O'Brien

SPECIES OF FISH	Abundant	Common	Present
Muskie			
N. Pike			X
Walleye		X	
L.M. Bass		X	
S.M. Bass			
Panfish	X		
Trout			

WATER AREA 13.9 ACRES
UNDER 3 FT. 14 %
OVER 20 FT. 14 %
MAX. DEPTH 36 FEET.
TOTAL ALK. 103 P.P.M.
VOLUME 198.0 ACRE FT.
SHORELINE 6.0 MILES

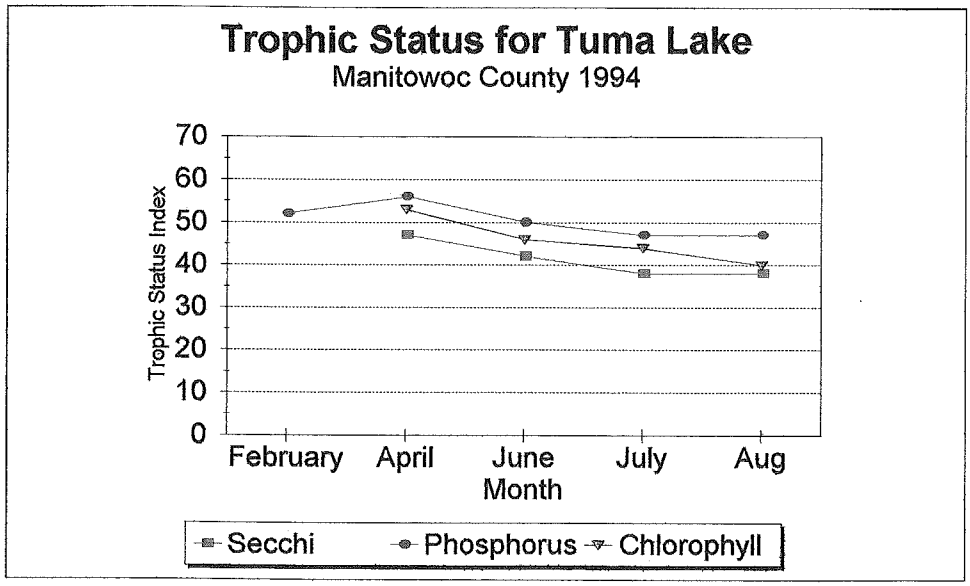
1994 Tuma Lake Monitoring Data
Manitowoc County

STORET #363030 Master Waterbody #0087900

Date	Depth meters	Chl a ug/l	Tot P mg/l	NO_2+NO_3 mg/l	Alk mg/l	D.O. ppm	pH su	Temp. °C	Cond umhos	Secchi (M) %CC
2/17/94	1	---	0.021	---	---	10.2	8.52	1.4	181	---
	9	---	0.061	---	---	3.7	8.44	3.5	188	---
4/11/94	1	10.6	0.035	0.030	81	9.4	---	8.2	181	2.4
	9.5	---	0.089	0.007	103	0.4	---	4.8	225	100%
6/27/94	1	4.67	0.016	---	---	7.8	8.91	23.4	174	3.58
	8	---	0.095	---	---	0.7	6.93	5.7	150	20%
7/18/94	1	3.41	0.012	---	---	7.9	9.02	24.3	166	4.57
	9.3	---	0.094	---	---	0.7	6.88	5.4	184	0%
8/15/94	1	1.88	0.012	---	---	8.2	8.44	22.0	165	4.57
	9	---	0.106	---	---	0.0	7.75	5.5	222	---

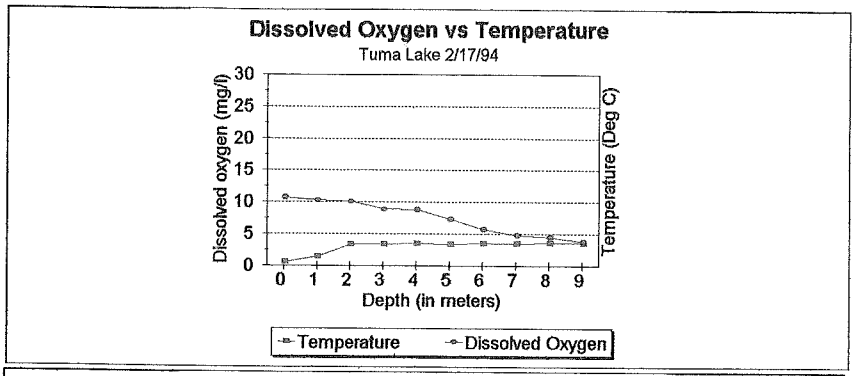
Tuma Lake Trophic Status

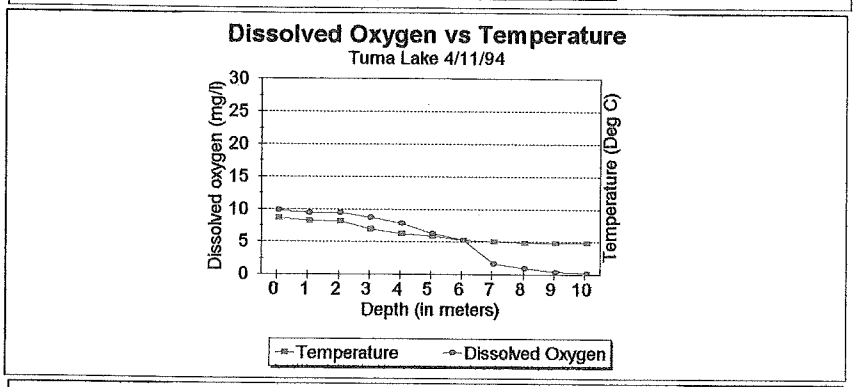
Month	Secchi Value (M)	Secchi TSI	Phosphorus Value (mg/l)	Phosphorus TSI	Chlorophyll Value (ug/l)	Chlorophyll TSI
February				52		
April	2.4	47	0.035	56	10.6	53
June	3.58	42	0.016	50	4.67	46
July	4.57	38	0.012	47	3.41	44
Aug	4.57	38	0.012	47	1.88	40
1994 Average	**3.78**	**41**	**0.019**	**51**	**5.14**	**47**

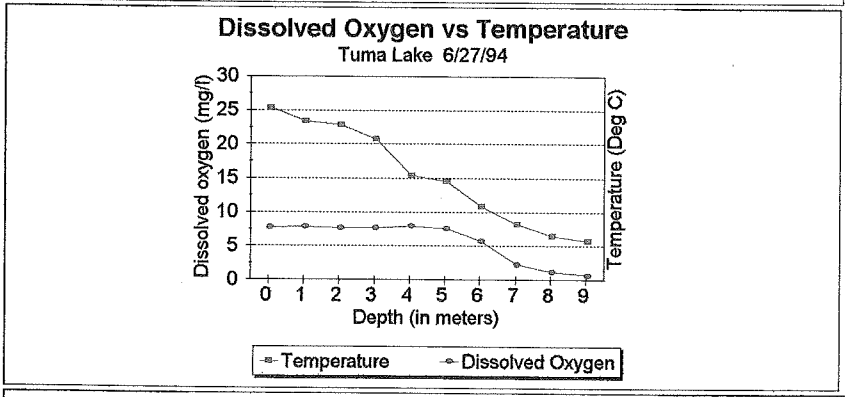


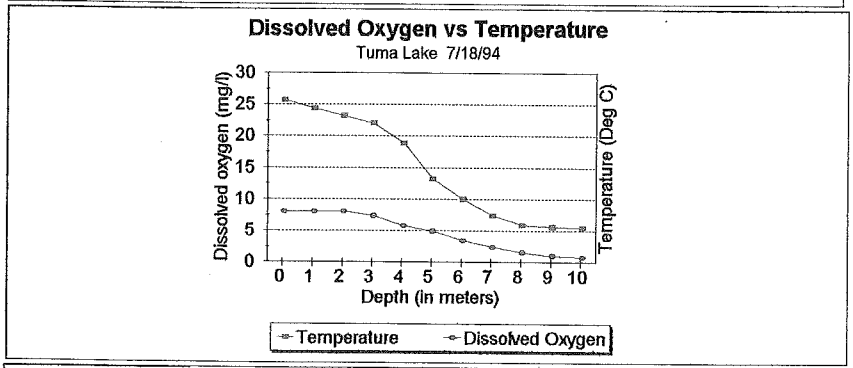
Trophic Category Descriptions

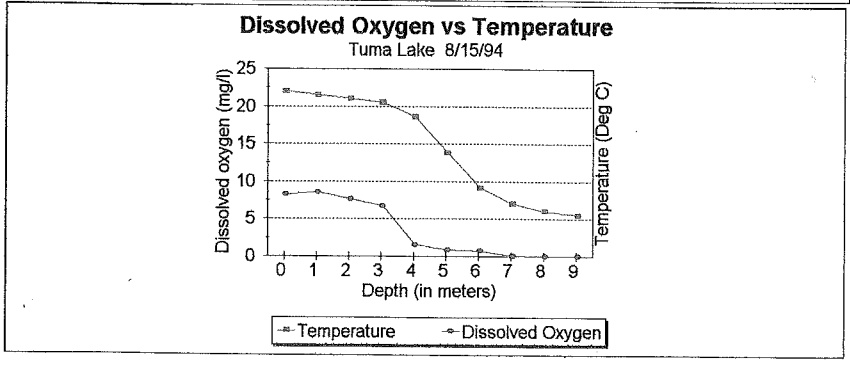
Category	TSI	Lake Characteristics
Oligotrophic	1 - 40	Clear water; oxygen rich at all depths, except if close to mesotrophic border; then may have low or no oxygen; cold-water fish likely in deeper lakes.
Mesotrophic	41 - 50	Moderately clear; increasing probability of low to no oxygen in bottom waters.
Eutrophic	51 - 70	Decreased water clarity; probably no oxygen in bottom waters during summer; warm-water fisheries only; blue-green algae likely in summer in upper range; plants also excessive.
Hypereutrophic	70 - 100	Heavy algal blooms throughout the summer; if >80, fish kills likely in summer and rough fish dominate.


Dissolved Oxygen vs Temperature
Tuma Lake 2/17/94
Dissolved oxygen (mg/l)
Temperature (Deg C)
Depth (in meters)
Temperature
Dissolved Oxygen


Dissolved Oxygen vs Temperature
Tuma Lake 4/11/94
Dissolved oxygen (mg/l)
Temperature (Deg C)
Depth (in meters)
Temperature
Dissolved Oxygen


Dissolved Oxygen vs Temperature
Tuma Lake 6/27/94
Dissolved oxygen (mg/l)
Temperature (Deg C)
Depth (in meters)
Temperature
Dissolved Oxygen


Dissolved Oxygen vs Temperature
Tuma Lake 7/18/94
Dissolved oxygen (mg/l)
Temperature (Deg C)
Depth (in meters)
Temperature
Dissolved Oxygen


Dissolved Oxygen vs Temperature
Tuma Lake 8/15/94
Dissolved oxygen (mg/l)
Temperature (Deg C)
Depth (in meters)
Temperature
Dissolved Oxygen

Results and Discussion

Tuma Lake is mesotrophic based on phosphorus concentration, chlorophyll a concentration, and Secchi depth as expressed in Wisconsin's Trophic State Index (WTSI) (Lillie, Graham, and Rasmussen 1993). Average surface phosphorus levels of 19 ug/l and chlorophyll concentrations of 5 ug/l indicate that nuisance algae blooms are not likely. Secchi disk measurements averaged 3.8 meters.

Dissolved oxygen and temperature profiles reveal that epilimnic water column dissolved oxygen concentrations remain around 8 ppm throughout the summer. Dissolved oxygen concentrations fell below the State standard of 5 ppm at a depth of 4 to 6 meters during the summer. Winter dissolved oxygen readings remained well above 5 ppm down to a depth of 7 meters. Under these conditions, winterkill is not likely.

With an alkalinity of around 100 mg/l, Tuma Lake can be classified as moderately hardwater lake. Surface pH reading were between 8.5 and 9.0 with bottom readings one-half to one and one-half units lower. Risk of acidification is minimal.

Tuma Lake is fringed by a tree-lined wetland but there are no other adjoining wetlands. Upland areas are mainly agricultural with only two homes in the immediate drainage basin. The upper north shore of the lake is entirely set aside in the CRP program.

At present, water quality for Tuma Lake is good. Because the watershed size is only one square mile, significant changes in the immediate area of the lake will have direct impacts on lake water quality. For this reason, caution should be exercised if near-lake development occurs.

Acknowledgements

Special thanks to Greg Cleereman (WRM/LMD) for significantly contributing to the sampling effort and to Mike Hronek (WS/LMD) for developing the cover page of this report.

Lake Management Program