

WATER QUALITY SURVEY - PIGEON LAKE - MANITOWOC CO.

prepared by: Tim Rasman

December 15, 1978

Water quality monitoring on a quarterly basis was conducted in 1978 on Pigeon Lake, Manitowoc County. The Town of Liberty Sanitary District No. 1 requested the survey.

The purpose of this report is to make an interpretation of the results of the survey. Sawyer (1947) concluded that a concentration of 0.01 mg/l dissolved phosphorous, particularly during spring turnover or mixing, would create an abundance of organics (algae or aquatic vegetation). He also concluded that a concentration of 0.3 mg/l inorganic nitrogen would create the potential for the same.

Pigeon Lake is a 77 acre, maximum 67 feet deep hardwater lake. Alkalinities during the 1978 quarterly survey ranged from a low of 178 mg/l as  $\text{CaCO}_3$  in the epilimnion on the July 24, 1978 sample, to a high of 214 mg/l in the hypolimnion on the March 8, 1978 sample. Average alkalinities were 197 mg/l during the survey year. Soluble phosphorous levels were low during the year. They equaled Sawyer's limits in the lower portion of the hypolimnion on the March 8 and April 26 sample dates. The inorganic forms of nitrogen were somewhat high. Periodic algae blooms as well as scattered accumulations of aquatic vegetation seem likely at these levels. Hydrologically the lake is a seepage type basin with gravel and marl as the primary bottom type in the littoral zone. Weed beds made up of *Myriophyllum* are scattered on the north and south shores. Oxygen depletion was the greatest during summer stratification. In the 20 meter profile it went from almost 9 mg/l on the surface to 7.5 mg/l at 9 meters. From 10 meters to 20 meters it went from 1.2 mg/l to 0. In the winter D.O. was still 2.7 mg/l at 15 meters. Complete thermal and D.O. mixing occurred in the spring and fall.



State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

Lake Michigan District Headquarters  
Box 3600  
Green Bay, WI 54303

Anthony S. Earl  
Secretary

July 27, 1978

IN REPLY REFER TO: \_\_\_\_\_

Mr. Jim Dehorme  
Federal Building  
325 E. Walnut  
Green Bay, WI 54301

Dear Jim:

Quarterly monitoring of Pigeon Lake - Manitowoc County was conducted on July 24, 1978. Water chemistry samples were taken along with a temperature and dissolved oxygen profile from the 20 meter level. The DO profile indicated oxygen depletion at the 10 meter level less than 2 mg/l; nothing unusual for this time of the year. Vegetation, particularly myriophyllum or milfoil was extensive along the Northeast shore. Secchi disk reading or transparency in the water column was 2.8 m.; very good for this time of the year. Results of the water chemistry samples will not be received for 2-3 weeks. All analyses are run in Madison, than retrieved on our computer terminal here in Green Bay.

Pigeon Lake has been monitored on a quarterly basis for the past two years. The potential for abundant algae blooms along with nuisance type vegetation does exist based upon our previous water chemistry samples. Using Sawyer's nutrient limits of 0.01 mg/l for dissolved phosphorous and 0.3 mg/l for the inorganic forms of nitrogen; Pigeon Lake has exceeded these levels.

Sawyer (1947) states that nutrient levels above these, particularly during spring overturn, will result in some kind of increase in organics either algae or aquatic weeds. The levels in Pigeon Lake do not appear much over

Lake Michigan District personnel conducted approximately 75 lake monitoring surveys from 1975 to the present. The purpose of this report is to summarize the data relating nutrient concentrations, particularly dissolved or ortho-phosphorous and the inorganic forms of nitrogen ( $\text{NH}_4 + \text{NO}_3 + \text{NO}_2$  as N), to the productivity of a lake. How productive a lake is can be indicated by the accumulation of algae, imparting a green or brown color to the water and/or by the presence of aquatic vegetation. The more nutrients (nitrogen and phosphorous) the more abundant will be the concentration of algae or aquatic vegetation.

Nitrogen and phosphorous concentrations and the corresponding effect on algae and vegetation numbers has been documented by many researchers: (Sawyer, 1947; American Water Works Association, 1966; Volensweider, 1968; Edmondson, 1976; Lee, 1971; Ryther and Dunstan, 1971; Maloney et al., 1972; Powers et al., 1972; Martin and Goff, 1972; Shannon and Brezonik, 1972). Sawyer (1947) found phosphorous concentrations of 0.01 mg/l and nitrogen concentrations of 0.3 mg/l, particularly during spring turnover, sufficient to give the lake a high potential for an abundance of algae or aquatic vegetation.

Alkalinity or carbonate hardness, that portion of the hardness attributed to the bicarbonate plus carbonate, will be used to differentiate soft from hardwater lakes. Concentrations less than 80 mg/l as  $\text{CaCO}_3$  will be given soft water designation, 80-125 mg/l as  $\text{CaCO}_3$  moderately hard water and greater than 125 mg/l hard water. Alkalinity does not by

itself reflect the lakes productivity but indicates the geology of the watershed. A clay or limestone subsoil will traditionally create a hard water situation.

Productivity potential mentioned in the following discussion relate to Sawyer's formula. Approximately 55 lakes have been discussed, the other 20 are in those counties transferred to other districts.

Sawyer limits; as a result we should only expect pulses or periodic blooms in algae and scattered accumulations of weeds. As far as identifying any particular source it is difficult without a more thorough survey that our Department would conduct with the Department of Health. Based on our previous data I can only say that Pigeon Lake will experience periodic algae blooms and scattered infestations of aquatic weeds, as long as the nitrogen and phosphorous levels remain what they are.

If I can be of further service, feel free to contact me here in Green Bay. My phone number is 497-4048.

Sincerely,

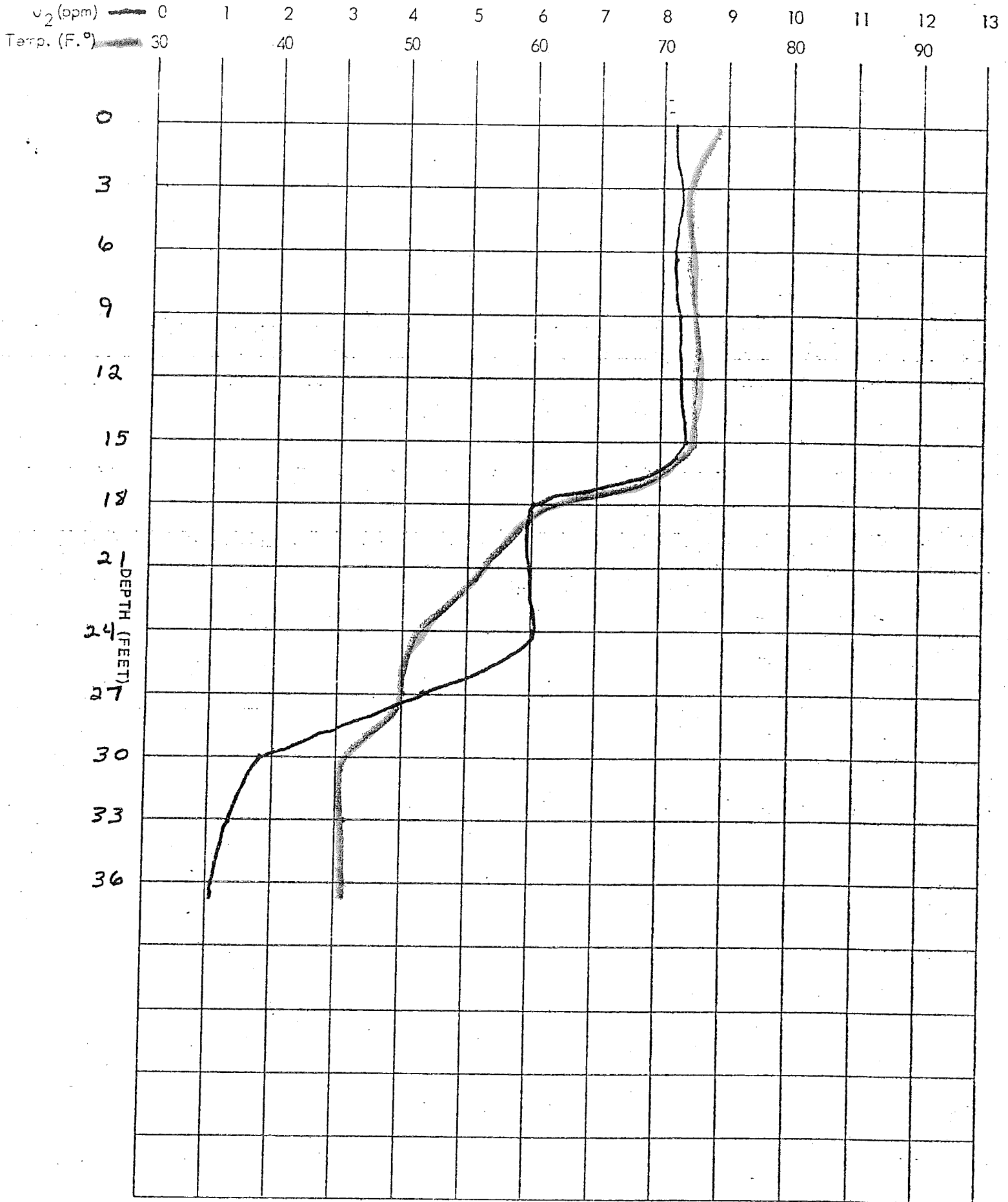
A handwritten signature in black ink, appearing to read 'Tim Rasman', with a stylized flourish at the end.

Tim Rasman

Biologist

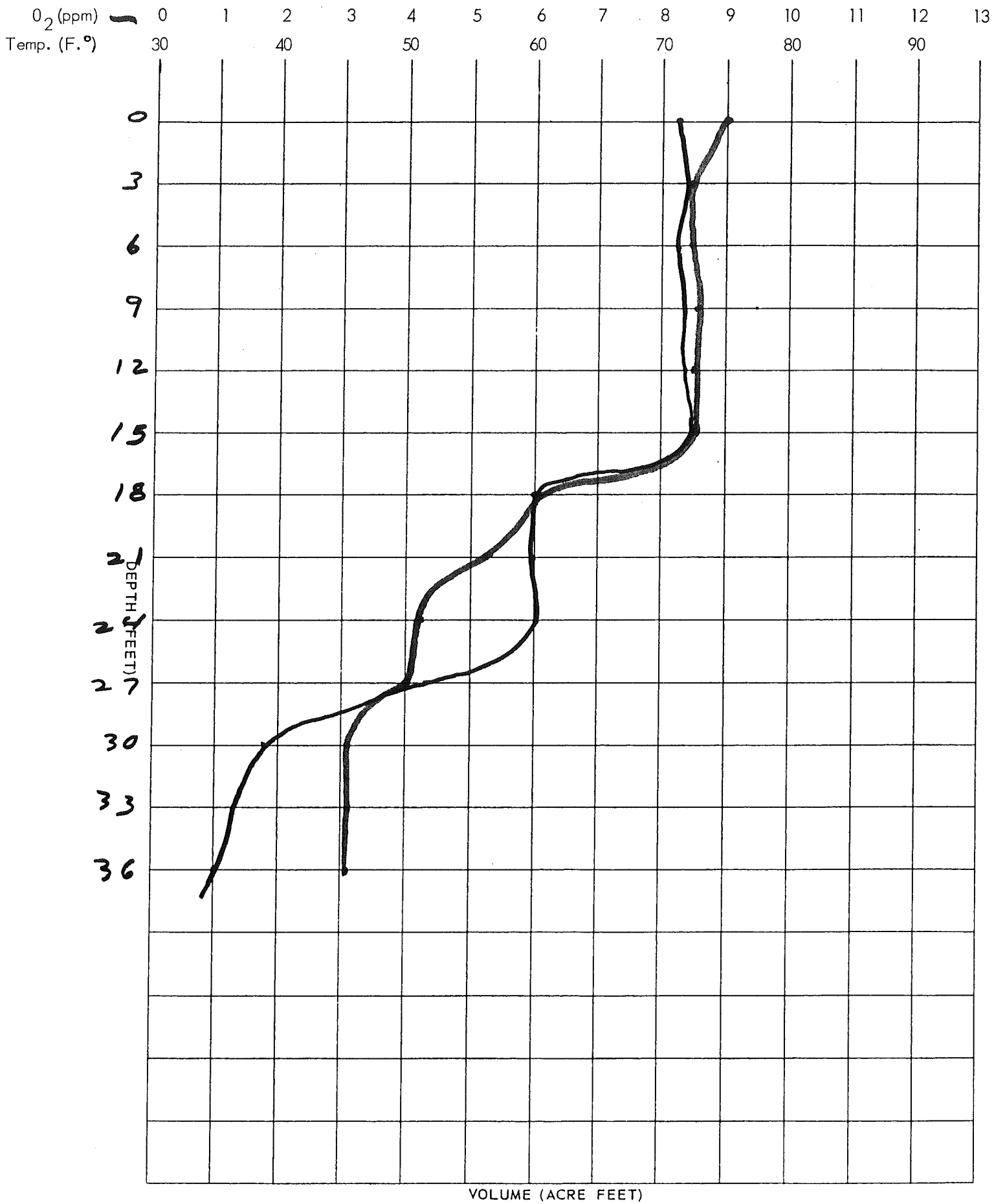
TR:ds

OXYGEN, TEMPERATURE,



Date of Collection July 30, 1974

# OXYGEN, TEMPERATURE, VOLUME PROFILE



Date of Collection .....

# OXYGEN, TEMPERATURE, VOLUME PROFILE

	0	1	2	3	4	5	6	7	8	9	10	11	12	13
O <sub>2</sub> (ppm)	30													
Temp. (F.°)	30				50		60		70		80		90	
	°C	D.O.	PH											
TOP	0	24	8.2	8.4	← PH									
	3	23	8.3											
	6	23	8.2											
	9	23	8.3											
Feet	12	23	8.3											
	15	23	8.4											
16-17' THERMOCLINE	18	16	6.0											
	21	14	6.0											
DEPTH (FEET)	24	11	6.0											
	27	10	4.3											
	30	8	1.8											
	33	8	1.2											
	36	8	1.0											
Bottom			9.9											

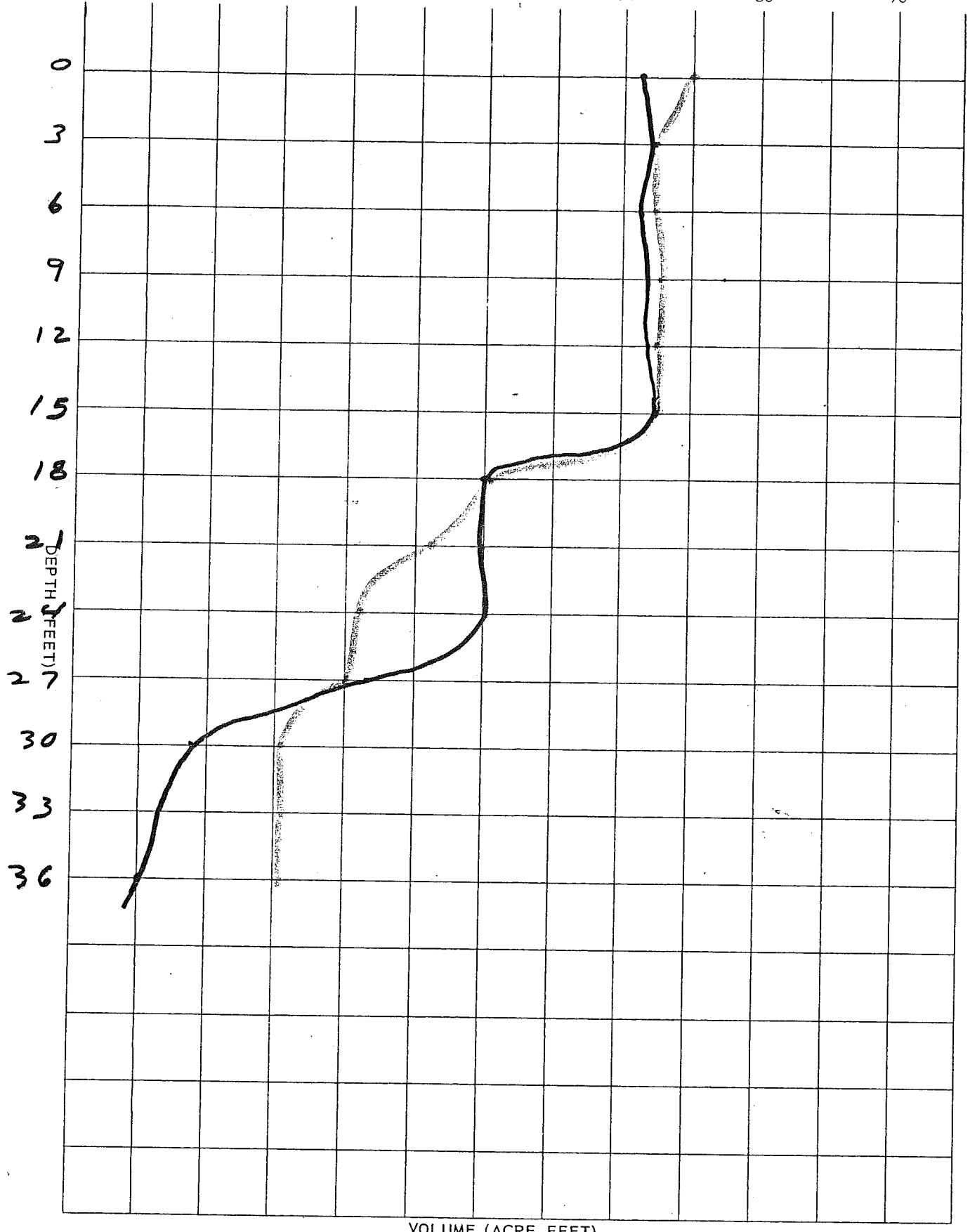
VOLUME (ACRE FEET)

Date of Collection .....



GEN. TEMPERATURE, VOLUME PROFILE

O<sub>2</sub> (ppm)    0    1    2    3    4    5    6    7    8    9    10    11    12    13  
 Temp. (F.°)    30    40    50    60    70    80    90



VOLUME (ACRE FEET)

Date of Collection .....



Possible Weed Problem Area

Public access

Milfoil

Milfoil Bed

Weed Bed

marsh

30 25

y's  
camp



60

50

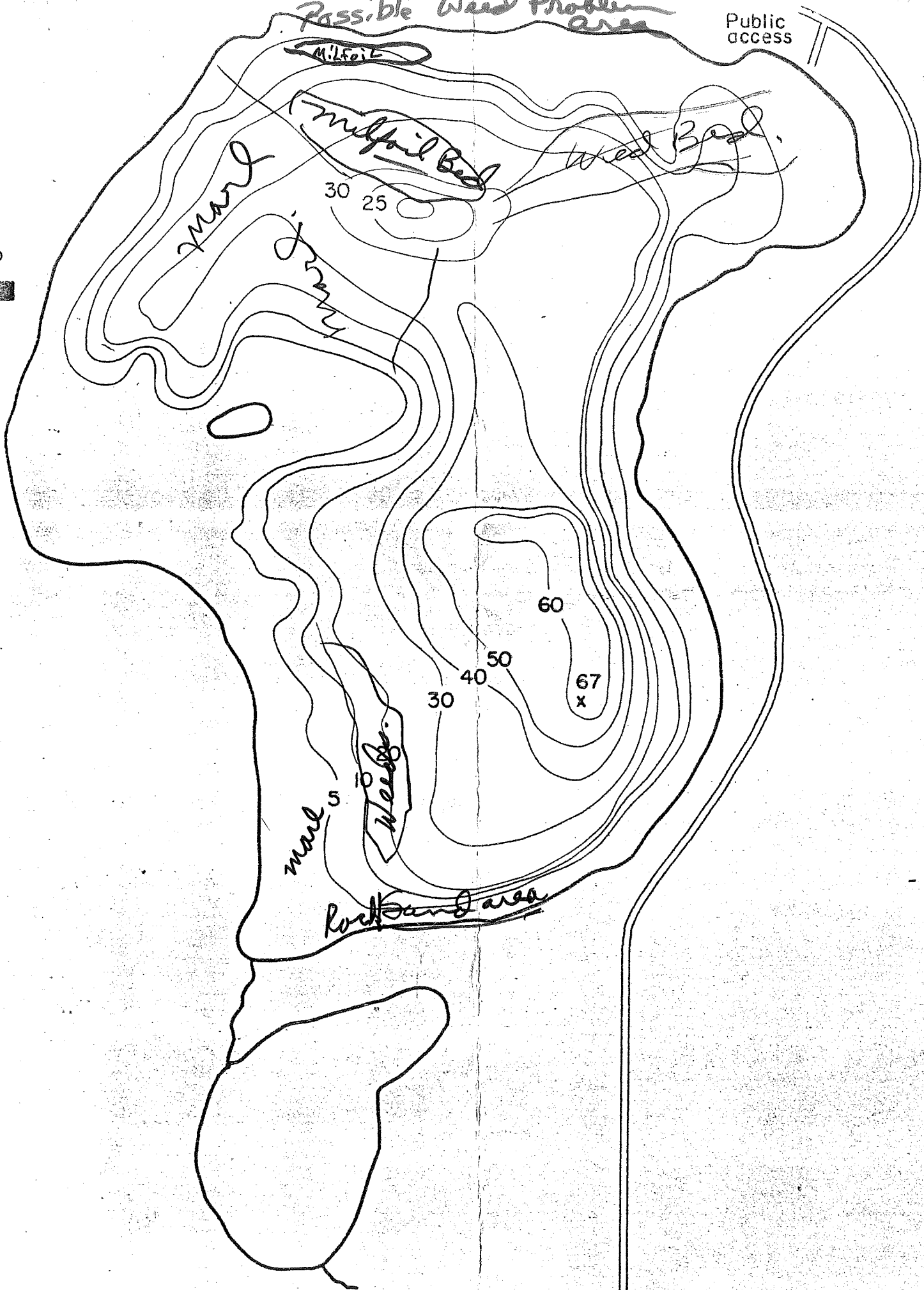
67  
x

30

Weeds

marsh

Rockland area



Sample Description Pigeon LAKE MANITOWOC Co.  
 Field No. 1 Deepest Area

Send Report To:

Department of Natural Resources	
CITY	Box 3600
WISCONSIN	Green Bay, Wisconsin 54303

		CK	
Statistical & Record Card No.	0 1		Temp. (°C) Field <u>50 51</u>
Collection Date	0 7 3 0 7 4		D.O. (mg/l) Field <u>62 53 64</u>
Time	10:00		pH (su) Field <u>8.5 8.6 8.7</u>
Collection Site: Co.	Manitowoc		BOD Estimate <u>&lt; 10</u>
Town			MFFCC Estimate
Range		✓	5-Day BOD (mg/l) <u>6.1</u>
Sec.			Total Solids mg/l <u>63 64 65</u>
DB			Sus. Solids mg/l <u>66 67 68</u>
Sub Basin I			Vol. Sus. Solids mg/l <u>69 70 71</u>
II			*Fecal Coliform <u>72 73 74 75 76</u>
III			*Samples for both water chemistry and water bacteriology should be submitted in separate bottles.
IV			Statistical & Record Card No. <u>0 2</u>
V			Entries 3-49 Same as Card 01
Mi. From Mouth		✓	Total Org. N mg/l <u>61</u>
Water Location L=0, Mid=5, Rt.=9		✓	NO <sub>3</sub> -N + NO <sub>2</sub> -N mg/l <u>05</u>
Depth in Meters 0=Surf., 9=Interface		✓	NH <sub>3</sub> -N mg/l <u>4.3</u>
Flow CFS		✓	Total Phosphorus mg/l <u>0.3</u>
Laboratory Sample No.		✓	Alkalinity, Total (CaCO <sub>3</sub> ) mg/l <u>79.4</u>
Date Received	AUG - 6 74	✓	Hardness mg/l <u>208</u>
Date Reported	JUL 31 74 09350	✓	Color su <u>71 72</u>
		✓	Chlorides mg/l <u>2</u>
			Additional Analysis:
		✓	NO <sub>2</sub> -N .007 mg/l
		✓	pH = 8.1

S. L. Inhorn, M.D., Director  
 Wisconsin State Laboratory of Hygiene  
 Madison, Wisconsin 53706