A PLAN FOR THE CONTROL OF NONPOINT SOURCES IN THE BASS LAKE WATERSHED

A Small-Scale Watershed Project Through The
Wisconsin Nonpoint Source Water Pollution Abatement Program

May 1986

Plan Prepared Cooperatively By:

Wisconsin Department of Natural Resources — Nonpoint Source Program

Wisconsin Department of Natural Resources — Lake Management Program

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A Plan for the Control of Nonpoint Sources in the Bass Lake Watershed

I. Purpose and Legal Status

Bass Lake, a small lake in southwestern Marinette County, has experienced substantial degradation over the last 10 to 20 years. During December 1984, articles appearing in the Wisconsin State Journal and the Milwaukee Journal referred to Bass Lake as a lake that has died. In essence, this plan describes the game plan necessary to resurrect Bass Lake.

This plan was prepared jointly by the Department of Natural Resources, Marinette County Land Conservation Committee and their staff and the Soil Conservation Service staff located in Marinette County. Within the Department of Natural Resources, nonpoint source program staff, lake management program staff and fish management staff all participated in the preparation of this plan.

A. Purpose of the Watershed Plan

This plan has been prepared to guide the implementation of a Small-scale Watershed Project for the Bass Lake Watershed in Marinette County as part of the Wisconsin Nonpoint Source Water Pollution Abatement Program. The plan is divided into three portions:

1. Watershed Assessment;
2. Detailed Program for Implementation; and
3. Project Evaluation.

The purposes of the Watershed Assessment portion of the plan are to:

1. identify the water quality or water resources problems in Bass Lake;
2. identify the water quality or water resources objectives for Bass Lake that can be achieved through a nonpoint source control project;
3. identify the level of pollutant control needed to achieve the objectives;
4. identify and rank the significant nonpoint sources; and

5. estimate the best management practices that will achieve the pollutant control.

The purpose of the Detailed Program for Implementation portion of the plan is to outline a strategy to assist landowners and land operators in installing best management practices to control the nonpoint sources. This strategy must include:

1. a cost share budget based on the estimated cost of the best management practices and expected participation rates;

2. a schedule for implementation activities;

3. a description of information and education activities;

4. a summary of fiscal management procedures; and

5. an estimate of technical assistance needs of counties, cities and villages..

The purpose of the Project Evaluation portion of the plan is to identify procedures and schedules for determining project progress and accomplishment. This includes estimating pollutant load reductions due to the installation of best management practices and measuring changes in water quality.

B. Legal Status of the Watershed Plan

This plan has been prepared under the authority of the Wisconsin Nonpoint Source Water Pollution Abatement Program described in s. 144.25, Wisconsin Statutes and Chapter NR 120 of the Wisconsin Administrative Code. This plan has also been prepared with the assistance of the newly created Lake Management Program as authorized in chapter 33, Wisconsin Statutes.

This plan is the basis for cost share and local assistance grants through the Nonpoint Source Water Pollution Abatement Program administered by the Department of Natural Resources. The Wisconsin Statutes and Chapter NR 120 of the Wisconsin Administrative Code, however, govern the conduct of the Nonpoint Source Water Pollution Abatement Program. In the event a discrepancy occurs between this plan and the statutes of the administrative rules or if the statutes or administrative rules are changed, the statutes and rules override this plan.

This plan, once approved through the procedures described in Chapter NR 121, Wisconsin Administrative Code, is an update of the Areawide Water Quality Management Plan for the Upper Green Bay Basin.

II. WATERSHED ASSESSMENT

A. Physical Description of the Watershed and Lake

Bass Lake, shown in Figure 1, is a 37 acre lake located in the southwestern part of Marinette County (sections 30 and 31 of T31N, R20E). It is fed by both land surface runoff and a number of springs around and in the lake. There is small outlet stream in the southeast shore of the lake.

In the early to mid 1960's when a public access was developed, this 65 foot deep lake had dissolved oxygen levels suitable to support a diverse fishery. Based on the these favorable water quality conditions, fish managers stocked rainbow trout on a trial basis in the spring of 1965. A trout fishery popular to nearby residents developed. However, in 1975 a fishery survey conducted by the Department of Natural Resources found no trout present. Fish managers found insufficient dissolved oxygen levels below 5 feet in depth and suspended stocking trout. A fish kill occurred in the early spring of 1985. The section of this report entitled "Water Resources Problems in Bass Lake" describes the existing conditions in more detail.

Figure 2 shows the entire Bass Lake Watershed. The total drainage area to Bass Lake is 488 acres, (0.76 $mi.^2$). The dominant land use of the Bass Lake Watershed is dairy farming with about 325 acres under cultivation. Two large dairy operations, each with between 200 and 300 milk cows (a total of about 700 animal units), are located north of the lake and can be seen in Figure 2. Wooded wetlands surround much of the lake.

The topography of the watershed is undulating. The slopes vary from 2 to 16 percent. The slopes for cropland fields are included in Table 1, located later in this plan in the section entitled "Assessment of Nonpoint Sources". The cropland is generally on Emmet and Menominee soils. These soils have a fine sandy loam or loamy sand surface layer and are underlain by a calcareous loamy till of substantial clay content at 20 to 40 inches in depth.

B. Water Resource Conditions in Bass Lake

Currently, Bass Lake is a eutrophic lake, very rich in nutrients with excessive algae. These present conditions adversely affect the existing uses of the lake including fishing, swimming, boating and aesthetic enjoyment. Excessive algae blooms and the 1985 fish kill are the visual signs of the lakes problems.

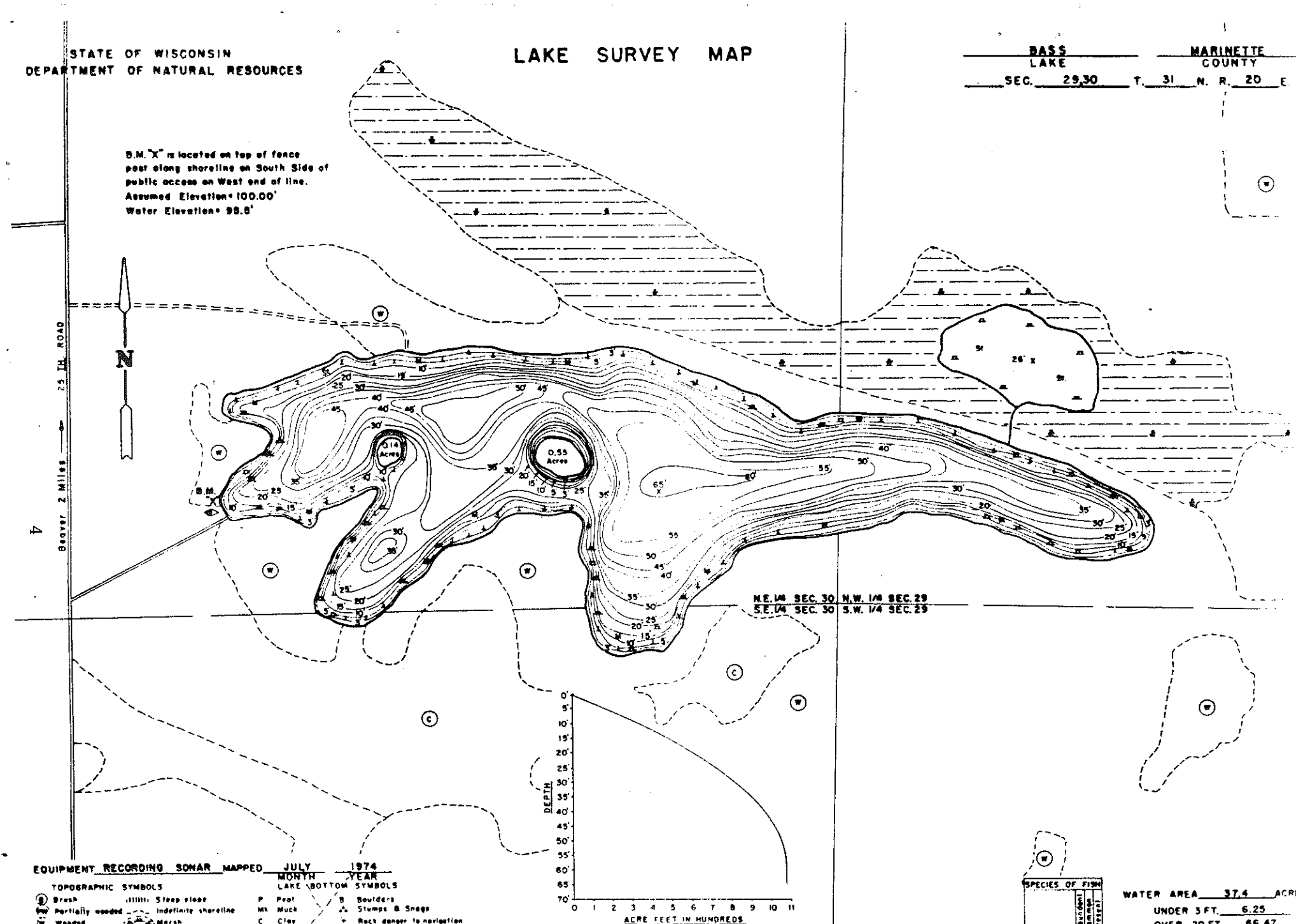
Chlorophyll a concentrations, an indicator of the mass of algae, are high during the spring but lower levels are found during the summer. Much of the algae consists of blue-green species which

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

LAKE SURVEY MAP

BASS LAKE — MARINETTE COUNTY
SEC. 29,30 T. 31 N. R. 20 E

B.M. "X" is located on top of fence post along shoreline on South Side of public access on West end of line.
Assumed Elevation= 100.00'
Water Elevation= 98.8'



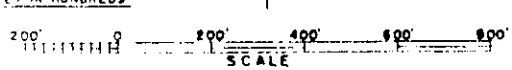
EQUIPMENT RECORDING SONAR MAPPED JULY 1974
MONTH YEAR

TOPOGRAPHIC SYMBOLS

Brush; Partially wooded; Wooded; Cleared; Pastured; 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; Si 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

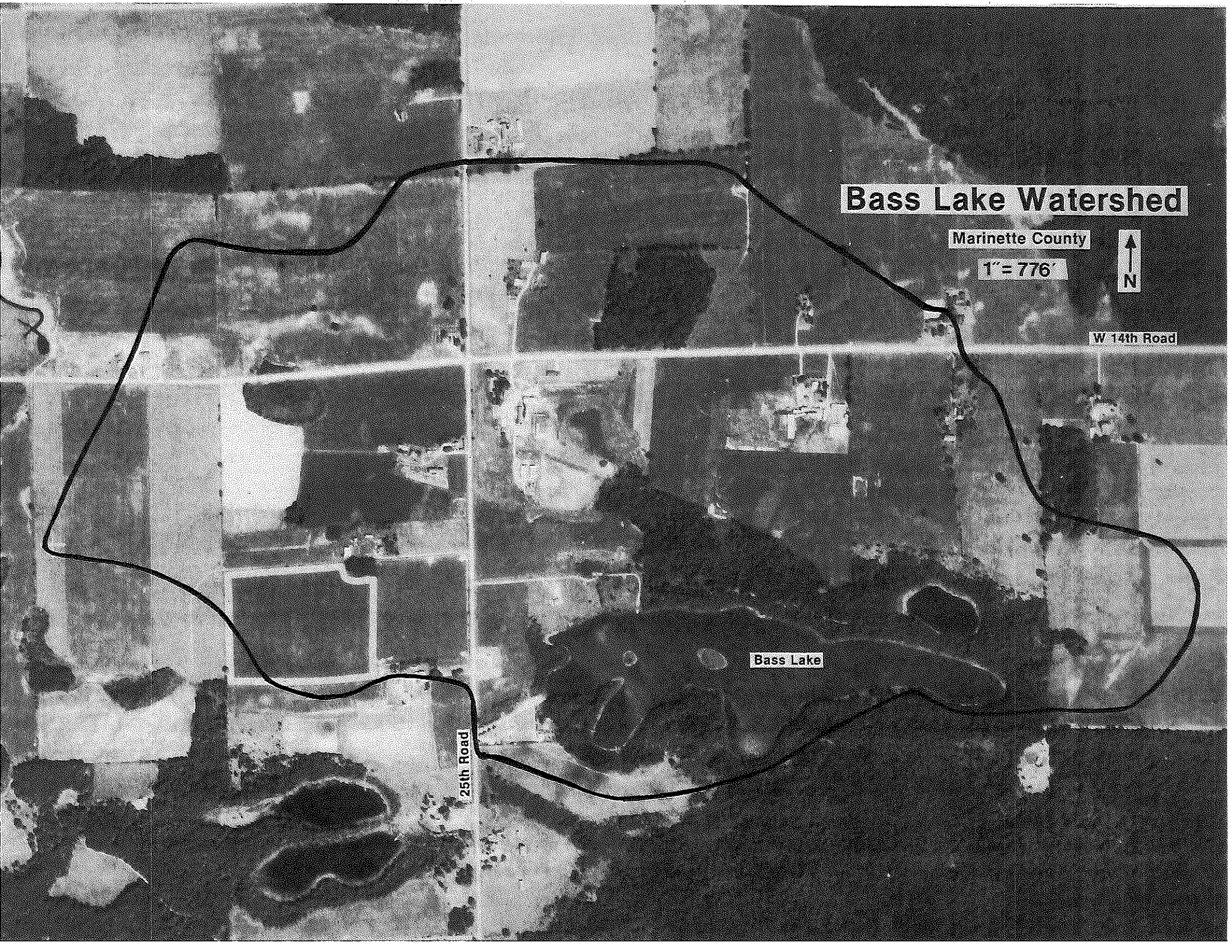
Drawn by G. Thuesen
Field work by D. Boone

SPECIES OF FISH

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

WATER AREA 37.4 ACRES
UNDER 3 FT. 6.25 %
OVER 20 FT. 66.47 %
MAX. DEPTH 85 FEET
TOTAL ALK. 120 PPM
VOLUME 1072.04 ACRE FT
MAIN SHORELINE 1.83 MI
ISLAND SHORELINE 0.15 MI

Figure 1. Bass Lake Map


Bass Lake Watershed
Marinette County
1″= 776′
N
W 14th Road
Bass Lake
25th Road

are undesirable to fish, ducks and people.

Phosphorus, the nutrient primarily supporting the algae, is similarly high. Samples taken from 1977 through 1984 at one meter of depth showed total phosphorus values of 95, 30, 143 and 220 ug/l (micrograms per liter). Phosphorus concentrations at 10 and 15 meters showed even higher values. Generally, 20 to 30 ug/l is considered as the division between mesotrophic (moderately rich lakes) and eutrophic lakes.

The dissolved oxygen in the bottom (hypolimnion) of the lake has greatly decreased due to decaying organic matter such as algae, manure and vegetative matter. As shown in figure 3, during July 1964, Bass Lake had dissolved oxygen levels of 7 parts per million (ppm.) at the surface; at least 6 ppm. from the surface to a depth of 8 meters (about 25 feet); and less than 1 ppm. below 9 meters (about 28 feet). In August 1984, as shown in Figure 4, the lake had dissolved oxygen levels of 9 ppm. at the surface; at least 6 ppm. from the surface to a depth of 5 meters (about 16 feet); and less than 1 ppm below 6 meters (about 19 feet). On April 15, 1986, the dissolved oxygen at the surface was 4.5 ppm. The levels decreased with depth to the point where the dissolved oxygen reached 0 ppm. at about 9 meters (about 30 feet). Appendix A contains additional dissolved oxygen information.

Since only a few years of water quality data exist for Bass Lake, the Department elected to reconstruct the history of the lake by analyzing lake sediments which were collected in the fall of 1985. Lake sediments record watershed activities, including natural events such as forest fires,and human activities, such as deforestation for agricultural use. Sediments also record changing levels of plant productivity within the lake ecosystem.

Preliminary results of the paleolimnological investigation indicate that the trophic status (or how productive the lake is) has changed considerably over time. (See Appendix C.) Concentrations of both phosphorus and plant pigment degradation products have increased since man settled in the Bass Lake watershed. Changes in the lake's productivity are the apparent result of influx of sediment and nutrients from the watershed.

The Dillon-Rigler (1975) model was used to further evaluate current conditions in the lake. Two situations were evaluated are are illustrated in Figure 5. Due to the physical characteristics of Bass Lake, the in-lake conditions may better reflect the watershed's land management of 3 to 9 years ago better than the conditions in the watershed today. Department of Natural Resources staff believe the land management improvements that were made during the last 2 to 5 years may have already reduced the amount of phosphorus entering Bass Lake. Before recent changes in the management of the watershed, it was estimated about 800 pounds of phosphorus per year entered Bass

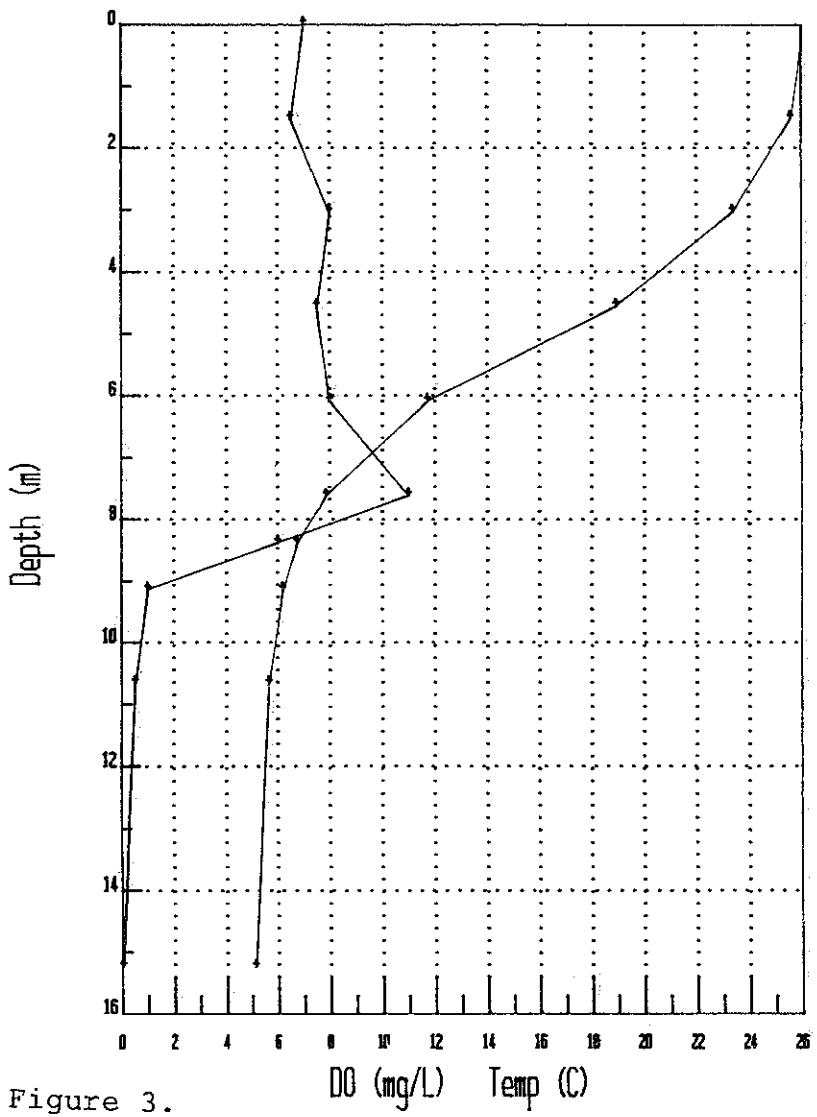


Figure 3.

1964 Dissolved Oxygen - Temperature Profile

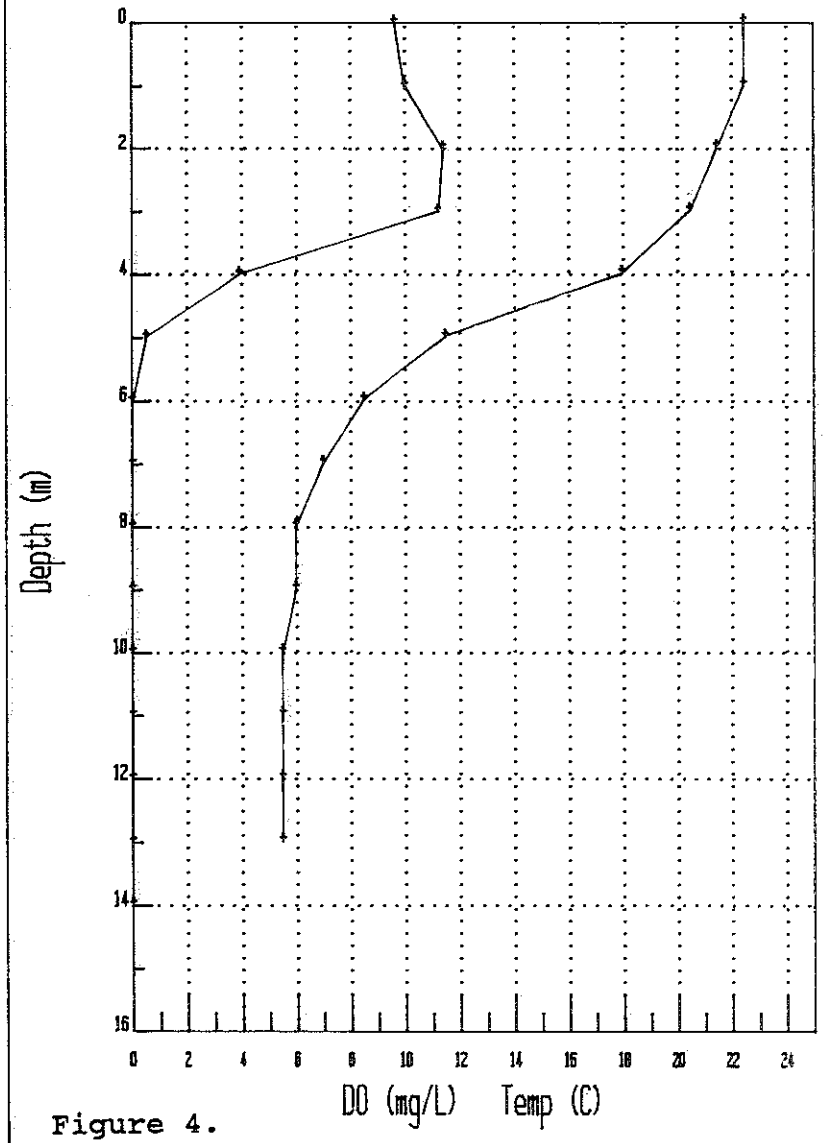


Figure 4.

1986 Dissolved Oxygen - Temperature Profile

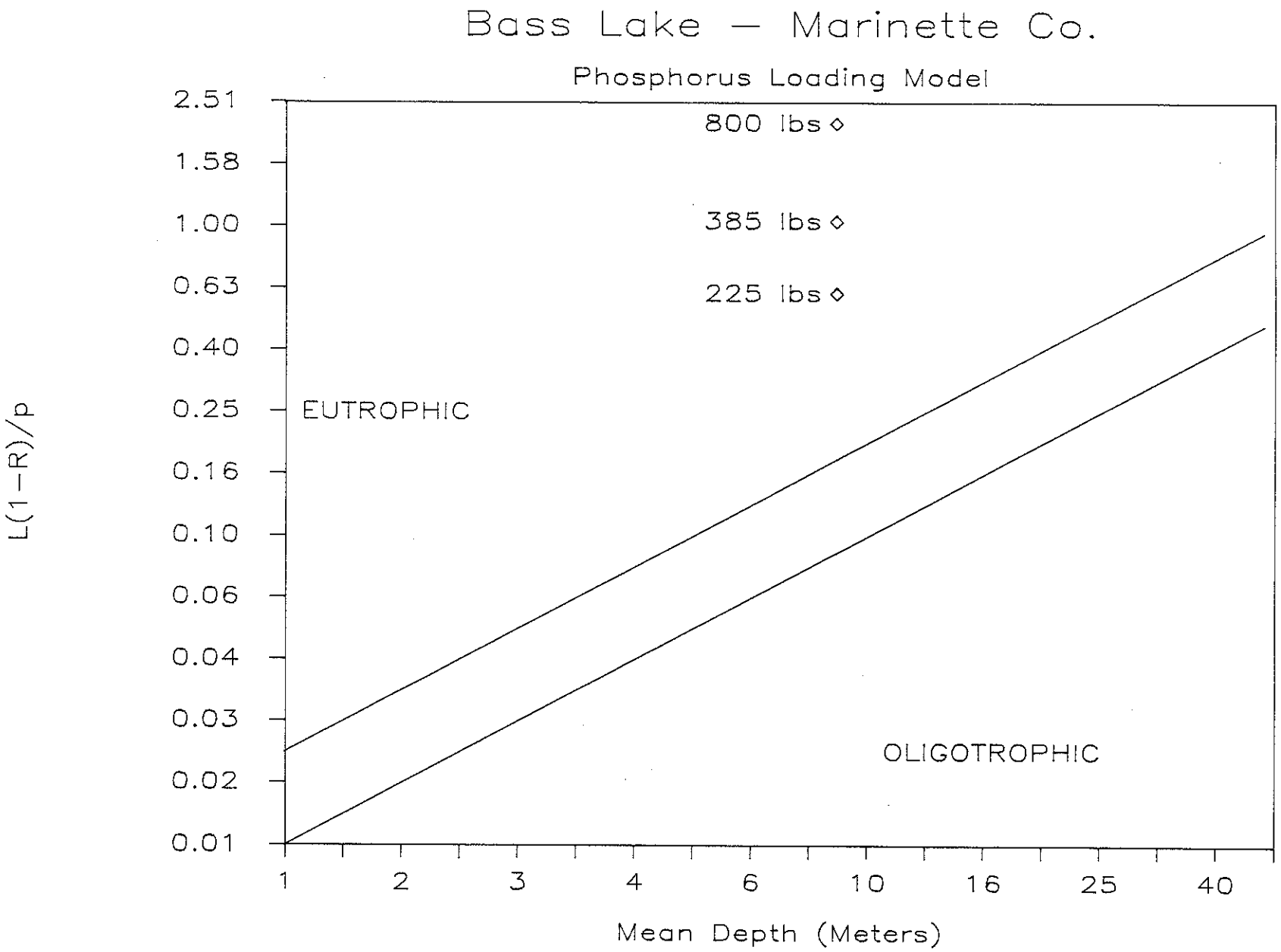


Figure 5. Trophic Status of Bass Lake

Lake. The model identifies the lake as hyper-eutrophic or excessively eutrophic.

The present phosphorus loading to the lake is estimated at about 385 pounds per year (see the section on assessment of nonpoint sources for loading estimates). Under this loading rate, the lake is still eutrophic.

C. Assessment of Nonpoint Sources

Phosphorus has been identified as the key pollutant causing the water resources problems in Bass Lake. It may reach the lake from a number of nonpoint sources. Phosphorus in manure is "readily available" to algae. Phosphorus from eroding croplands is generally attached to the sediment and is "less readily available" to algae in the lake. However, the phosphorus attached to the sediment can be released slowly to the water and ultimately also become "available" to the algae.

The Bass Lake watershed was assessed to:

1. estimate the phosphorus reaching Bass Lake from nonpoint sources;

2. determine the feasibility and cost effectiveness of different alternatives for controlling the nonpoint sources; and

3. estimate the phosphorus load reduction that is likely to be achieved if best management practices are installed to control the significant nonpoint sources.

Based on an onsite inspection of the watershed, manure sources such as barnyards and upland erosion sources such as eroding croplands were identified as likely nonpoint sources of phosphorus. No point sources exist in the watershed. No eroding stream banks or shorelines were observed. A few cottages exist near the west shore of the lake. An assessment of their septic systems is described later in this section.

C. 1. Assessment of Existing Conditions

<u>Animal Lot Runoff Sources</u>

There are two relatively large dairy operation with animal lots in the Bass Lake Watershed. Both were inventoried by Marinette County and Soil Conservation Service staff. The inventory data were analyzed by DNR using the Wisconsin version of the ARS barnyard runoff model. The model estimates the amount of phosphorus in the runoff for a 10-year, 24-hour storm.

The analysis estimates about 65 pounds of phosphorus for one operation and 18 pounds of phosphorus for the other operation. Most of the phosphorus from the operation with the larger load is from a portion of the yard with water flowing into the yard from buildings and fields. Since the conditions in Bass Lake are most likely related to the annual phosphorus load, estimates based on the 10-year, 24-hour storm must be adjusted. Adjustment multipliers of "1X", "1.5X" and "2X" were analyzed. The results of this analysis are summarized in Appendix B. For purposes of comparison to upland erosion sources, a multiplier of "1.5X" was selected corresponding to an estimated average annual phosphorus load of 125 pounds.

As illustrated in Figure 6, both of the operations must be considered significant sources of phosphorus to Bass Lake. To help put these estimates into perspective, they can be compared to animal lots in the Little River Watershed, a Wisconsin Nonpoint Source Water Pollution Abatement Program priority watershed project in Marinette and Oconto counties. The Bass Lake operation with the larger phosphorus load has a greater phosphorus load than the highest ranked yard in the Little River Watershed. The Bass Lake operation with the smaller phosphorus load would rank about 31 out of the 268 operations in the Little River Watershed.

While this analysis estimates phosphorus loads under existing conditions, phosphorus loads from manure sources were probably higher in the past. One of the operations has moved a substantial number of the cattle into a free stall barn. Thus the amount of manure on the yard has decreased substantially. Also, both operation store most of their manure in tanks so that the manure may be spread when it can be incorporated into the soil.

Upland Erosion Sources

Staff from the Marinette County Land Conservation Department and the Soil Conservation Service field office in Marinette County inventoried all cropland fields, pastures and other agricultural lands in the watershed. A soil loss was calculated for each field using the universal soil loss equation. The total number of tons of erosion was calculated by multiplying the soil loss rate (average tons per acre per year) by the number of acres in the field. Table 1 shows the soil loss rate and tons of erosion for each by landowner. The table also shows the estimated total erosion (average tons per year). The actual amount of sediment reaching Bass Lake is only a fraction of the amount of soil loss shown on Table 1.

TABLE 1. ANALYSIS OF UPLAND EROSION SOURCES

SOIL EROSION UNDER EXISTING MANAGEMENT

LAND-OWNER	FIELD NO.	ACRES	TOTAL ACRES	SLOPE %	CROP ROTATION	FACTORS K	FACTORS LS	FACTORS C	FACTORS P	EROSION T/A/Y	TONS/ YEAR	TOTAL TONS
A	1	38	38	7	3RO5H	0.20	0.82	0.10	1.0	1.6	62	62
B	10	2		2	CONT V	0.20	0.20	0.50	1.0	2.0	4	
	12	3		2	2R10H	0.37	0.20	0.07	1.0	0.5	2	
	3	48		5	5RO4H	0.20	0.66	0.18	1.0	2.4	114	
	6	30		6	5R4H	0.17	0.67	0.21	1.0	2.4	72	
	6A	19		8	5RO4H	0.17	1.80	0.21	1.0	6.4	122	
	9A	2.5		2	LOT	0.20	0.20	0.04	1.0	0.2	0	
	9B	4		6	LOT	0.20	0.67	0.20	1.0	2.7	11	
	9C,9D	4.5		3	LOT	0.20	0.29	0.45	1.0	2.6	12	
	13	9		6	3R4H	0.17	0.67	0.15	1.0	1.7	15	
	14	8		15	2R10H	0.17	2.50	0.07	1.0	3.0	24	
	FRMSTD	8									0	
	4,11,15	15	153		WILD						0	375
C	2,3	32		3	4R7H	0.20	0.32	0.14	1.0	0.9	29	
	5	9		4	4R7H	0.20	0.40	0.14	1.0	1.1	10	
	7,8	10		3	RRR	0.17	0.32	0.37	1.0	2.0	20	
	10	6		3	4R7H	0.17	0.35	0.14	1.0	0.8	5	
	11	14		4	4R7H	0.17	0.47	0.14	1.0	1.1	16	
	FRMSTD	13									0	
	6	23	107		WILD						0	80
D	1	6.5		16	2RO4H	0.17	3.48	0.11	1.0	6.5	42	
	2	23.5		3	2RO4H	0.17	0.40	0.11	1.0	0.7	18	
	3	5	35	10	2RO4H	0.17	1.53	0.11	1.0	2.9	14	74
E	2	24		6	3RO5H	0.20	0.75	0.10	1.0	1.5	36	
	3	14		3	2RO4H	0.20	0.33	0.10	1.0	0.7	9	
	4	20		3	3RO5H	0.20	0.35	0.10	1.0	0.7	14	
	FRMSTD	2	60								0	59
F	1	20		7	4R7H	0.17	1.31	0.14	1.0	3.1	62	
	2	19		6	4R7H	0.17	0.82	0.14	1.0	2.0	37	
	FRMSTD	4									0	
	3,4	49	92		WDS						0	100
G	1	3		3	3RO5H	0.17	0.33	0.10	1.0	0.6	2	
	3	3	6	4	3RO5H	0.17	0.47	0.10	1.0	0.8	2	4
H	3,7	17		8	WDS						0	
	5	10		10	4R7H	0.17	1.53	0.14	1.0	3.6	36	
	6	10		10	4R7H	0.17	1.53	0.14	1.0	3.6	36	
	8	10	47	4	4R7H	0.20	0.47	0.14	1.0	1.3	13	86
I	1	28		3	5R5H	0.20	0.37	0.14	1.0	1.0	29	
	3	3	31	7	5R5H	0.20	0.82	0.14	1.0	2.3	7	36
TOTALS			569								876	876

NOTE: THE INVENTORY OF UPLAND FIELDS INCLUDED ALL OF THE FIELD INCLUDING PORTIONS OUTSIDE OF THE WATERSHED. THEREFORE, THE TOTAL ACRES OF CROPLAND ON THIS TABLE EXCEEDS THE TOTAL ACRES OF CROPLAND IN THE WATERSHED.

ALTERNATIVE A: 5 TONS/ACRE/YEAR					ALTERNATIVE B: 3 TONS/ACRE/YEAR					ALTERNATIVE C: 2.5 TONS/ACRE/YEAR				
NEW C	NEW P	NEW EROSION T/A/Y	NEW TONS/ YEAR	NEW TOTAL TONS	NEW C	NEW P	NEW EROSION T/A/Y	NEW TONS/ YEAR	NEW TOTAL TONS	NEW C	NEW P	NEW EROSION T/A/Y	NEW TONS/ YEAR	NEW TOTAL TONS
			62	62				62	62				62	62
			4					4					4	
			2					2					2	
			114					114					114	
			72					72					72	
0.14	1.0	4.3	81		0.1	1.0	3.1	58		0.19	0.3	1.5	28	
			0					0					0	
			11					11					11	
			12					12					12	
			15					15					15	
			24					24		0.03	1.0	1.3	10	
			0					0					0	
			0	335				0	312				0	267
			29					29					29	
			10					10					10	
			20					20					20	
			5					5					5	
			16					16					16	
			0					0					0	
			0	80				0	80				0	80
0.08	1.0	4.7	31		0.05	1.0	3.0	19		0.04	1.0	2.4	15	
			18					18					18	
			14	63				14	51	0.16	0.3	1.2	6	39
			36					36					36	
			9					9					9	
			14					14					14	
			0	59				0	59				0	59
			62		0.12	1.0	2.7	53		0.09	1.0	2.0	40	
			37					37					37	
			0					0					0	
			0	100				0	91				0	77
			2					2					2	
			2	4				2	4				2	4
			0					0					0	
			36		0.1	1.0	2.6	26		0.08	1.0	2.2	22	
			36		0.14	0.6	2.2	22		0.14	0.6	2.2	22	
			13	92				13	61				13	57
			29					29					29	
			7	36				7	36				7	36
TOTAL TONS				830	TOTAL TONS				755	TOTAL TONS				682
% REDUCTION				5	% REDUCTION				14	% REDUCTION				22

REVISED: 3/14/86

Phosphorus loads from the upland erosion sites were estimated by Department of Natural Resources staff using monitoring information from sites elsewhere in Wisconsin and applying this information to the soil loss estimates. The monitoring information shows unit area loads (pounds per acre) for cropland ranging from 0.3 pounds of phosphorus per acre to over 1.0 pounds of phosphorus per acre. The higher values are generally associated with areas with high erosion rates or heavy soils. Given the relatively low soil loss and the texture of the soil, 0.4 pounds per acre was assumed for this analysis. Other unit area loads were assessed along with various phosphorus loads from animal lot runoff. This analysis of various unit loads is summarized in Appendix 2. Thus, it is estimated about 130 pounds of phosphorus may reach Bass Lake per year from the 327 acres of upland agricultural sources. In addition, a unit area load of 0.1 pounds of phosphorus per acre was used for the 161 acres of woods, wildlife lands, farmsteads, roads and small tracts of land. Thus it is estimated about 15 pounds of phosphorus may reach Bass Lake from woods, wildlife lands, farmsteads, roads and small tracts of land.

Septic Systems

Septic systems, although not legally defined as nonpoint sources, were also inventoried by Marinette County. Four year round residences on small tracts all reported their systems were working well. No failures were observed.

C.2. Alternatives for Reducing the Phosphorus to Bass Lake

Given the significance of the animal lot runoff ant the relative potential to control the various sources, the three alternatives described below consist of control of the two animal lots and various levels of cropland erosion control.

The phosphorus reaching Bass Lake from manure carried in runoff from the animal lots can be minimized by (1) diverting runoff away from the animal lots, (2) more frequent scraping of the lot and (3) filtering (infiltrating) the runoff from the animal lot. On both of the livestock operations it appears a variety of barnyard runoff management components can be installed. For example, there appears to be sufficient area to create filter strips downslope of the animal lots. Based on these site conditions, it is assumed at least 75% reduction in the phosphorus load from the animal lots can be achieved.[1] Thus,

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[1] Simulation of the barnyard runoff management components such as diversions and filter strips would estimate a reduction percentage of 90 to 100. However, due to the seasonal variation in the effectiveness of filter strips, a lower load reduction

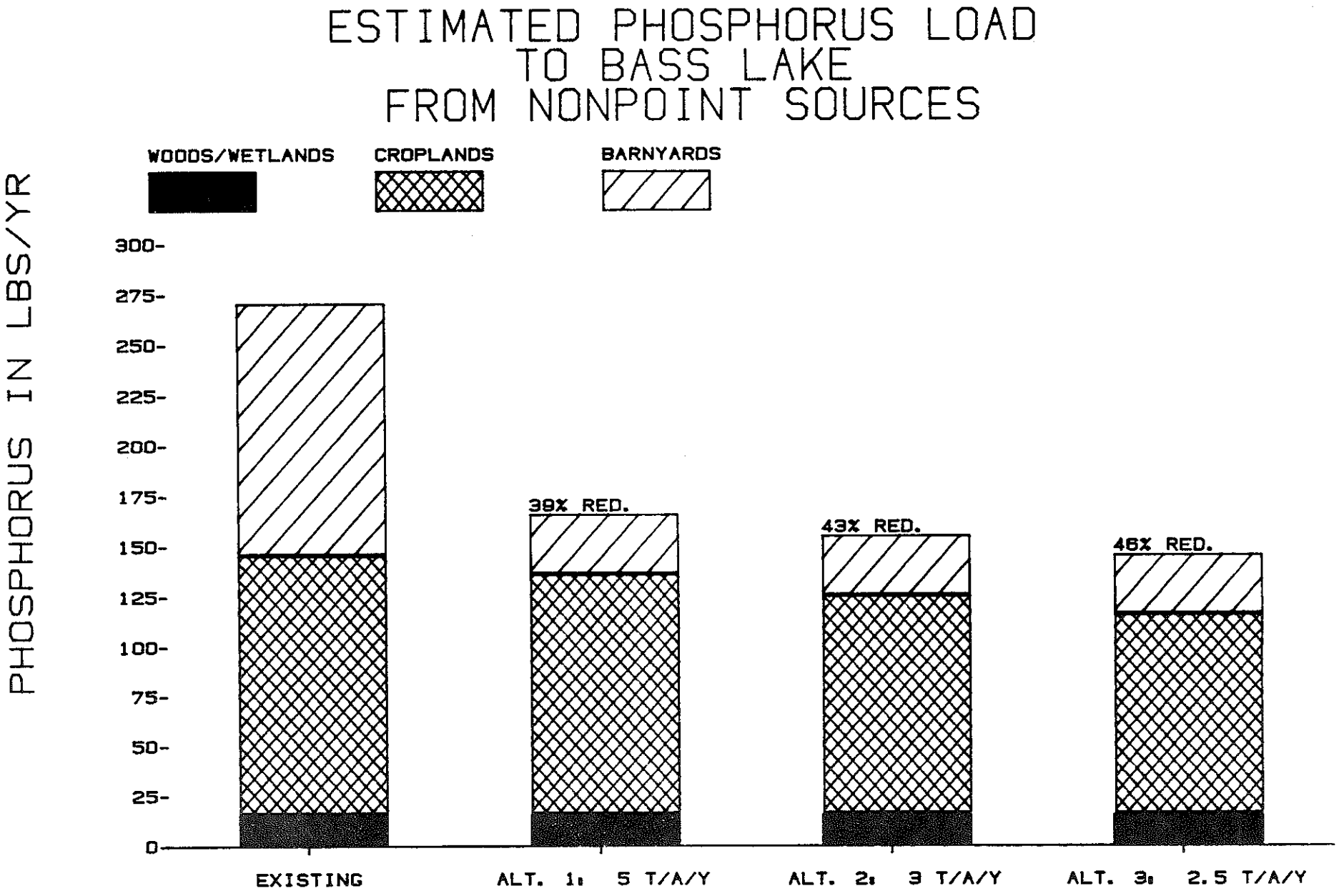

Figure 6. Existing Phosphorus Load and Alternatives for Reducing Phosphorus Load

the estimated annual phosphorus load from animal lots can be reduced from 125 pounds to 30 pounds.

Generally the phosphorus from upland erosion sources can be reduced by reducing the soil loss. (Management of fertilizer application rates and techniques is an exception to this statement.) Therefore, alternatives for reducing the phosphorus are based on different target levels of soil loss. Marinette County and DNR set-up three alternatives:

> Alternative A: Reduce soil loss on all cropland fields with erosion rates above 5 tons per acre per year to 5 or less tons per acre per year;
>
> Alternative B: Reduce soil loss on all cropland fields with erosion rates above 3 tons per acre per year to 3 or less tons per acre per year; and
>
> Alternative C: Reduce soil loss on all cropland fields with erosion rates above 2.5 tons per acre per year to 2.5 or less tons per acre per year.

The various practices used in each alternative were identified by Marinette County. DNR analyzed the information.

Table 1 also shows the soil loss and total tons for each field and landowner under the three alternatives. The overall reduction in tons of soil loss is as follows:

> Alternative A: 6% reduction
> Alternative B: 14% reduction
> Alternative C: 22% reduction.

The actual phosphorus reduction will be slightly less than the estimated soil loss reduction since the phosphorus is attached to the smaller sized soil particles which are harder to control than the larger soil particles.

Alternative A involves two landowners and one field on each farm. A total of 25.5 acres is included on those two fields. Alternative B involves four landowners and one or two fields on each farm. A total to 65.5 acres is included on those two fields. Alternative C involves the same four landowners as in Alternative B and one or two fields on each farm. A total to 78.5 acres is included on those two fields. In all cases, the three alternatives for croplands involve low or no cost best management practices such as changes in cropping rotations, reduced tillage or contour strip cropping.

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percentage is assumed.

Figure 6 also shows the phosphorus load reduction estimated by controlling the runoff from the two livestock operations along with the three alternatives for cropland erosion control. The overall estimated phosphorus load reduction are:

39% for barnyard runoff control and alternative A for cropland erosion control;

43% for barnyard runoff control and alternative B for cropland erosion control; and

46% for barnyard runoff control and alternative C for cropland erosion control.

D. Water Resources Objectives and Nonpoint Source Control Needs

D. 1. Water Resources Objectives for Bass Lake

The Department's evaluation of the lake concludes a substantial reduction in phosphorus load is necessary for the lake to support a stable fishery. The actual percent reduction still needed is very difficult to determine. Based on the results of the lake modeling and the assessment of the nonpoint sources, the phosphorus load reduction necessary to achieve a mesotrophic condition cannot be reached. However, improvements in the conditions in the lake can still be improved. Therefore, the water resources objective for Bass Lake is to bring Bass Lake back to a less eutrophic state. Bass Lake can probably return to conditions with substantial reductions in the amount and duration of the blue-green algal blooms and a stable warmwater fishery. Therefore, the maximum, practicable phosphorus load reduction is needed.

Even though the nutrient loading to the lake from the watershed can be reduced with a few years, Bass Lake will be slow to respond. Phosphorus already in the lake sediment is available to algae. Eventually much of the supply of phosphorus from the lake sediment will be depleted, but that may take decades. However, there are some actions that can be used to speed up the recovery time of the lake. The application of alum, a non-toxic chemical that is applied to the water column, is probably the most viable action.[2] When applied in water, alum forms a floc and settles to the lake bottom. Thus, the phosphorus in the sediments is no

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[2]. Alum treatments are not an eligible best management practice under the Wisconsin Nonpoint Source Water Pollution Abatement Program. Also, the Lake Management Program does not have funds to make grants for alum treatments. The Department of Natural Resources is exploring sources of funds for treating Bass Lake.

longer available to the algae.

D. 2. Nonpoint Source Controls Needed to Meet the Water Resources Objectives for Bass Lake

Based on the level of phosphorus needed to achieve the desired water quality in Bass Lake, the following nonpoint source controls are needed:

1. Barnyard runoff management for the animal lots on both of the livestock operations and

2. Cropland erosion control to reduce all cropland soil loss to 3 tons per acre per year (Alternate B).

As shown in Figure 7, together the barnyard runoff management and cropland erosion will reduce the phosphorus load to Bass Lake by 43 percent. This level represents the most reasonable approach in the opinion of the Department of Natural Resources and the Marinette County Land Conservation Committee.

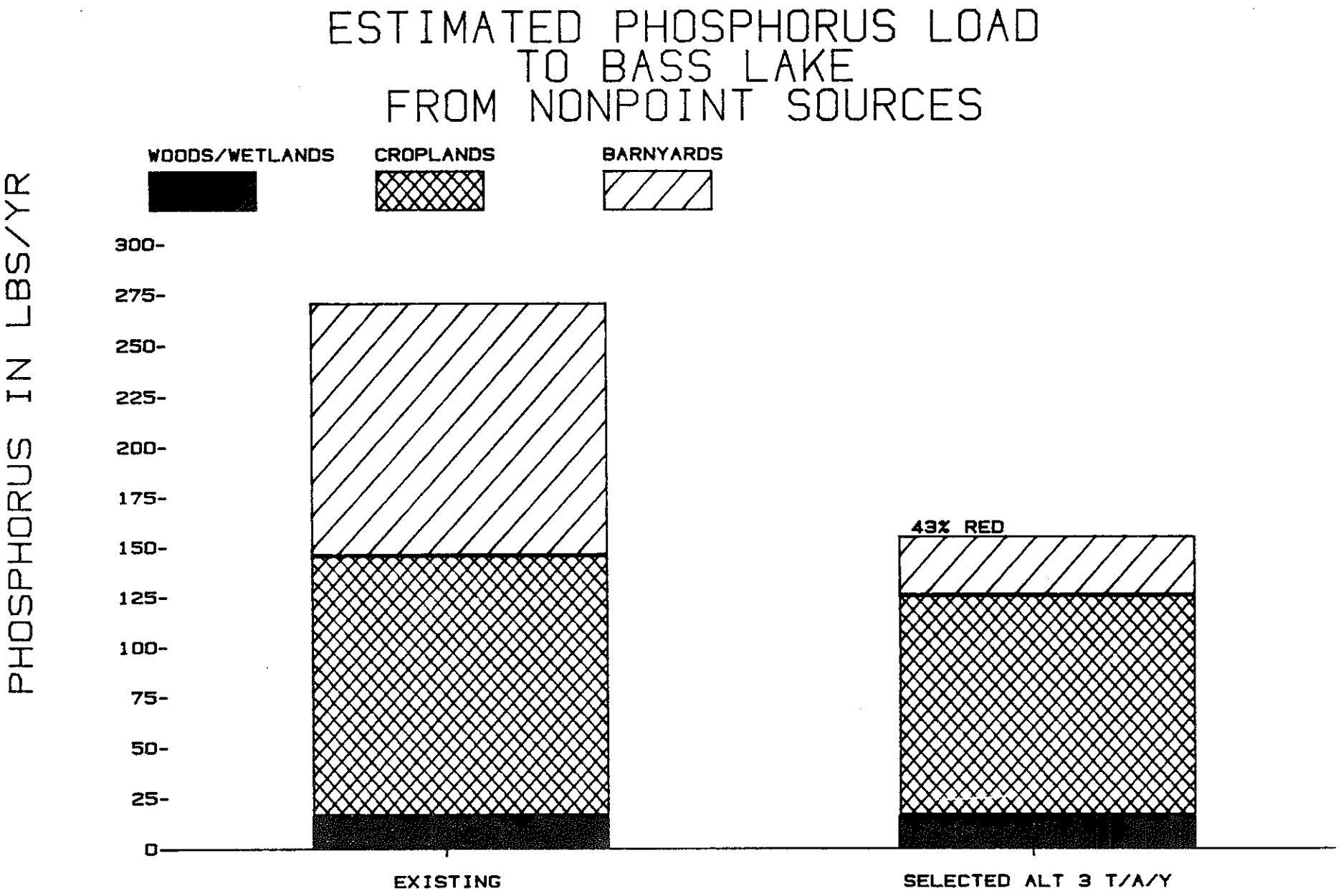


Figure 7. Existing Phosphorus Load and Selected Alternative

III. DETAILED PROGRAM FOR IMPLEMENTATION

A. Introduction

The purpose of the Detailed Program for Implementation portion of the plan is to outline the strategy Marinette County, acting through its Land Conservation Committee, will use to assist landowners and land operators in installing best management practices to control the critical nonpoint sources identified in the Watershed Assessment portion of this plan. This strategy includes:

1. a cost share budget based on the estimated cost of the best management practices;
2. a schedule for implementation activities;
3. a description of information and education activities;
4. a summary of fiscal management procedures; and
5. an estimate of staffing needs.

Marinette County, through the Wisconsin Statutes, is responsible for the local implementation of the Bass Lake Small-scale Watershed Project. Marinette County has assigned the lead role to its Land Conservation Committee and Land Conservation Department. The Soil Conservation Service staff assigned to the Marinette County field office will assist in implementing this project.

Marinette County Land Conservation Department will be implementing this project in compliance with section 144.25 of the Wisconsin Statutes, the Legislation establishing the Wisconsin Nonpoint Source Water Pollution Abatement Program; NR 120 of the Wisconsin Administrative Code, the administrative rules for the program; and all grant agreements between Marinette County and the Department of Natural Resources.

B. Best Management Practices and Estimated Budget

Table 2 contains an estimate of the types and units of best management practices needed to control the critical nonpoint sources to Bass Lake. All best management practices will be designed and installed to meet the cost share conditions identified in Chapter NR 120, Wisconsin Administrative Code, and the Soil Conservation Service Technical Guide standards and specifications cited in the code for each practice.

Table 2 also contains total cost and cost share amounts for the installation of the best management practices. The total cost are estimates based on current costs for eligible items as identified in Chapter NR 120, Wisconsin Administrative Code. The cost share rates are those identified in the administrative rules. The cost share rates are those identified in the administrative rules. The sum of the cost share amounts serves as the basis for the budget for the project. The actual amount available for cost sharing is the amount identified in the project's Nonpoint Source Grant Agreement. The grant agreement will be based on the amounts in Table 2 and may be amended to reflect more detailed estimates.

Table 2. Estimated Best Management Practices and Costs.

Practice	No. of Units	Total Cost	Cost Share Rate	Cost Share
Barnyard runoff manage.	2	$46,000	70%	$28,600
Grassed waterways	1650 ft.	2,100	70%	1,500
Reduced tillage	47 acres	1,400	50%	700
Contour Strips	19 acres	460	50%	230
Total		$49,960		$34,630

C. Schedule of Implementation Activities

Due to the small size of this watershed, many of the activities will be carried out during the first project year. Other activities such as practice installation will be scheduled when cost share agreements are signed. All activities will be carried out within the limits specified in Chapter NR 120, Wisconsin Administrative Code.

The following activities will be carried out or are anticipated during 1986:

landowner contacts	11	22 hours
information and education		12 hours
farm conservation planning	447 acres	112 hours
cost share agreement development	5	10 hours
practice design & installation		311 hours
		465 hours

It is anticipated some of the design and installation will carry over into 1987 or subsequent years. Annual status reviews will be conducted for each cost share agreement.

As required by Chapter NR 120, Wisconsin Administrative Code, all cost share agreements must be signed within three years of the signing of the project's Nonpoint Source Grant Agreement. Also, all best management practices must be installed within five years of the date the cost share agreement is signed.

D. Information and Education

All of the information and education activities directed towards landowners will be conducted on a one-on-one basis. Marinette County will use materials currently available from the Soil Conservation Service and University of Wisconsin - Extension as well as materials prepared for the Little River Watershed Project to assist landowners.

The Marinette County Land Conservation Department will keep interested citizens and members of interest groups appraised of progress in the Bass Lake Project through newspaper articles, letters and its annual reports. A tour of the watershed will be conducted after the best management practices are installed.

E. Staffing Needs

The estimated hours for various activities were identified in the scheduling section above. Marinette County will handle the project management and fiscal management activities with existing staff. A portion of the technical design and installation time may not be met with existing staff. Marinette County anticipates hiring an person to help meet the needs of the Little River Priority Watershed Project and the Wildlife Damage Program. The person may assist in the Bass Lake Project as well to meet the staffing needs.

Chapter NR 120 of the Wisconsin Administrative Code identifies additional staff time as eligible for reimbursement through and Nonpoint Source Program Local Assistance Grant Agreement. Marinette County will seek financial support for partial support of this additional position.

F. Fiscal Procedures

As required by Chapter NR 120, a cost share agreement must be signed before any best management practice is eligible for cost share assistance. The cost share agreements will be between Marinette County and the landowner or land operator. The Marinette County Land Conservation Committee will act on behalf of the County Board. The chairman of the Land Conservation

Committee will sign all cost share agreements. As required, all cost share agreements will use form 3400-68 or any forms superseding that form.

Marinette County will use the following cost containment procedures:

barnyard runoff management	average cost
grassed waterways	average cost
reduced tillage	flat rate
contour strips	flat rate

The cost share recipient, the landowner or land operator, is responsible for arranging the installation of the practice and paying the contractor. The Marinette County Land Conservation Department or the Soil Conservation Service Marinette County field office will inspect the installation and verify the practice has been properly installed.

Once the practice has been verified and the cost share recipient has submitted the required receipts, the Marinette County Land Conservation Committee will review the receipts. If everything is in order, the committee will approve the costs and direct that the cost share recipient be reimbursed through a Marinette County check.

Marinette County will set up a project account and bookkeeping system that complies with the requirements of Chapter NR 120, Wisconsin Administrative Code. As requests for reimbursement from the Department of Natural Resources will be on forms supplied by the state and follow procedures required by administrative rule.

IV. Project Evaluation

The Department of Natural Resources will track the progress of the Bass Lake Watershed Project through simulating the installation of best management practices and the monitoring of changes in the lake. The simulation of the practices will use the same nonpoint source analysis techniques as used in developing this plan.

Bass Lake will be monitored by Department of Natural Resources staff to track progress towards achieving the more desirable water quality described in the section on Water Resources Objectives. The lake will be monitored in 1986 to better describe the existing conditions in the lake. Since the lake has a residence time of about six years, the monitoring will be repeated about every five or six years to measure improvements.

If Bass Lake is treated with alum, the frequency of monitoring will be increased by monitoring the year before the alum is applied and for each of the two to three years following the application. After the period of more frequent monitoring, the lake will again be monitored every five to six years.

Water samples will be collected once each quarter of a year, as is standard ambient lake monitoring procedure, and analyzed for total phosphorus, total kjeldahl nitrogen, ammonia nitrogen, nitrite-nitrate nitrogen, total alkalinity, pH and chlorophyll a. In addition, temperature, dissolved oxygen and secchi transparency will be measured.

APPENDIX A: DISSOLVED OXYGEN AND TEMPERATURE INFORMATION

July 24, 1964

Depth (M)	Temp (C)	DO (mg/L)
0.0	26.1	7.0
1.5	25.6	6.5
3.1	23.3	8.0
4.6	18.9	7.5
6.1	11.7	8.0
7.6	7.8	11.0
8.4	6.7	6.0
9.1	6.1	1.0
10.7	5.6	0.5
15.2	5.0	0.0

	February 2, 1977		May 11, 1977		August 22, 1977		October 25, 1977	
Depth (M)	Temp (C)	DO (mg/L)	Temp (C)	DO (mg/L)	Temp (C)	DO (mg/L)	Temp (C)	DO (mg/L)
1	4	1.5	17	12.7	21	8.6	11	8.9
2	4.5	1.1	16	12.4	21	8.6	10.1	8.6
3	4.5	1.1	15	12.2	20	8.6	10	8.1
4	4.5	1	9	2.5	20	8.6	10	8
5	4.5	0.9	6	0.7	17	0.9	10	7.8
6	4.5	0.4	5	0.6	10	0.7	10	7.3
7	4.5	0.3	5	0.5	7	0.7	10	6.6
8	4.5	0.2	5	0.4	6	0.6	9	0.8
9	5	0.3	5	0.4	6	0.6	6	0.6
10	5	0.3	5	0.4	6	0.5	5	0.4
11	-	-	5	0.4	5	0.5	5	0.4
12	-	-	5	0.3	5	0.5	5	0.3
13	-	-	5	0.3	5	0.4	5	0.1
14	-	-	5	0.3	5	0.4	5	0.1
15	-	-	-	-	5	0.4	5	0.1

	February 20, 1984		August 28, 1984	
Depth (M)	Temp (C)	DO (mg/L)	Temp (C)	DO (mg/L)
1	1.5	3.9	22.5	9.6
2	3	2.2	22.5	10
3	3	1.7	21.5	11.4
4	3	1.1	18	11.2
5	3	0.8	11.5	3.9
6	3	0.4	8.5	0.5
7	3	0.2	7	0
8	3	0.1	6	0
9	3	0.1	6	0
10	3	0.1	5.5	0
11	3	0.4	5.5	0
12	3	0.1	5.5	0
13	3	0.1	5.5	0
14	3	0.1	-	-
15	3	0.1	-	-

APPENDIX B: ANALYSIS OF PHOSPHORUS LOAD REDUCTIONS FOR BASS LAKE

USING CROPLAND UNIT AREA LOADS OF 0.4 LB/ACRE AND 0.6 LB/ACRE AND BARNYARD LOADS OF 1X, 1.5X AND 2X THE 10 YR-24 HOUR STORM

USING 0.4 LBS/ACRE FOR CROPLAND

		ACRES	UNIT LOAD	LBS P	REDUCTIONS ALT. A	ALT. B	ALT. C
1 X	BARNYARDS	NA	85	85	20	20	20
10 YR	CROPLAND	327	0.4	130	120	110	100
24 HR	WDS/WETLDS	161	0.1	15	15	15	15
	TOTALS	488		230	155	145	135
	% REDUCTION				33	37	41
1.5 X	BARNYARDS	NA	125	125	30	30	30
10 YR	CROPLAND	327	0.4	130	120	110	100
24 HR	WDS/WETLDS	161	0.1	15	15	15	15
	TOTALS	488		270	165	155	145
	% REDUCTION				39	43	46
2 X	BARNYARDS	NA	170	170	40	40	40
10 YR	CROPLAND	327	0.4	130	120	110	100
24 HR	WDS/WETLDS	161	0.1	15	15	15	15
	TOTALS	488		315	175	165	155
	% REDUCTION				44	48	51

USING 0.6 LBS/ACRE FOR CROPLAND

		ACRES	UNIT LOAD	LBS P	REDUCTIONS ALT. A	ALT. B	ALT. C
1 X	BARNYARDS	NA	85	85	20	20	20
10 YR	CROPLAND	327	0.6	200	190	170	150
24 HR	WDS/WETLD	161	0.1	15	15	15	15
	TOTALS	488		300	225	205	185
	% REDUCTION				25	32	38
1.5 X	BARNYARDS	NA	125	125	30	30	30
10 YR	CROPLAND	327	0.6	200	190	170	150
24 HR	WDS/WETLD	161	0.1	15	15	15	15
	TOTALS	488		340	235	215	195
	% REDUCTION				31	37	43
2 X	BARNYARDS	NA	170	170	40	40	40
10 YR	CROPLAND	327	0.6	200	190	170	150
24 HR	WDS/WETLD	161	0.1	15	15	15	15
	TOTALS	488		385	245	225	205
	% REDUCTION				36	42	47

APPENDIX C: RECONSTRUCTING THE HISTORY OF BASS LAKE

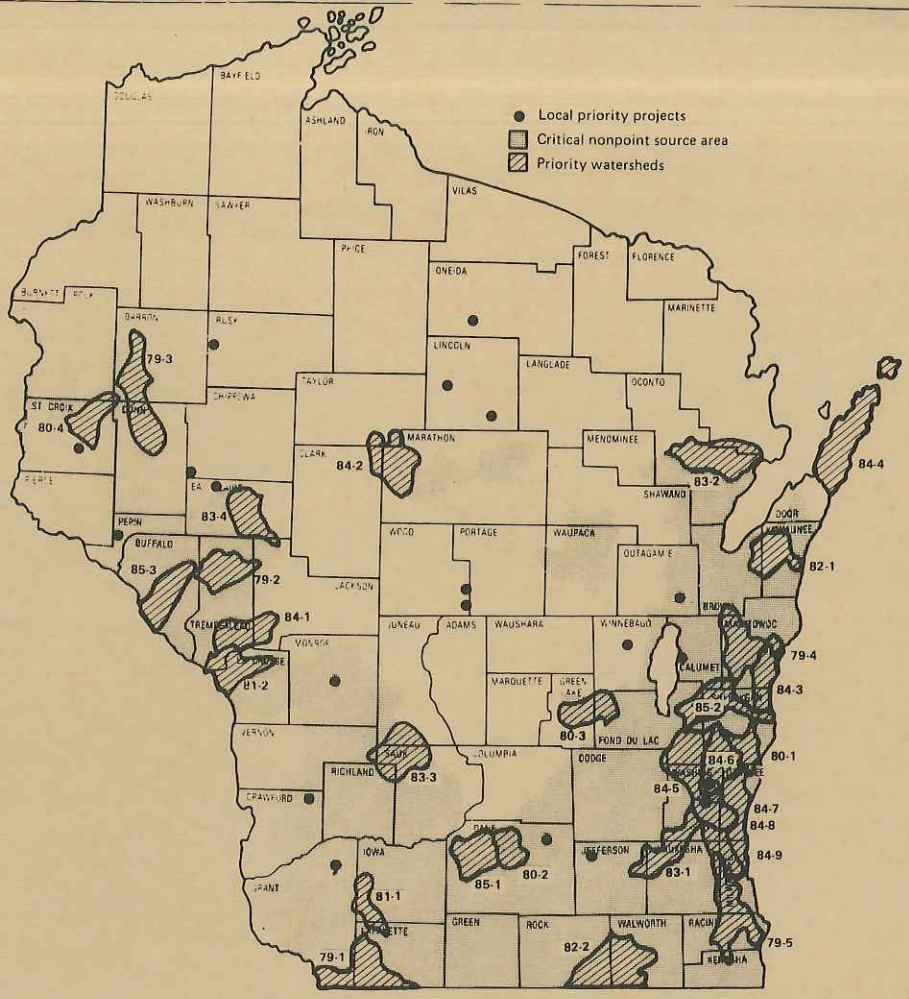
Implementation of effective and successful lake management plans are in part a reflection of a good understanding of the lake and its history. Historical data can provide insights on whether a lake is maintaining its current water quality condition, or if is has degraded or improved over time. Since long-term historical data are rare on any particilar lake, lake managers are often expected to make management decisions on the basis of one or two years of water quality data.

One way of obtaining historical data is through paleolimnology, or the use of the sediment record to reconstruct the history of a lake. Lake sediments record watershed activities, including natural events such as forest fires, and human activities, such as deforestation for agricultural use, the use of the lake for sewage effluent, or construction activities. Sediments also record changing levels of productivity within the lake ecosystem. The technique of paleolimnology is emerging as a useful tool to the Department of Natural Resources in making management decisions for many lakes.

A core was taken at Bass Lake on 25 October 1985 and is currently being analyzed by the Bureau of Research in Madison. Complete analysis of the sediments will include concentration of organic matter, phosphorus, chlorophyll degradation products, identification of diatoms, and sediment dating by pollen analysis and lead-210. Changes in each of these parameters at various depths represent different water quality conditions over time.

Bass Lake is an an ocassional winterkill lake with abundant algal blooms in the summer months, while ten years ago it supported a trout fishery. The changed trophic status of the lake is the apparant result of influx of sediment and nutrients from the watershed. By reconstructing the history of the lake through paleolimnology, we will be able to understand the water quality the lake is most realistically capable of supporting.

CURRENT PRIORITY WATERSHED PROJECTS IN WISCONSIN



Map Number	Project	County	Year Project Selected
79-1	Galena River	Grant, Lafayette	1979
79-2	Elk Creek	Trempealeau	1979
79-3	Hay River	Barron, Dunn	1979
79-4	Lower Manitowoc River	Manitowoc, Brown	1979
79-5	Root River	Racine, Milwaukee, Waukesha	1979
80-1	Onion River	Sheboygan, Ozaukee	1980
80-2	Sixmile-Pheasant Branch Creek	Dane	1980
80-3	Green Lake	Green Lake, Fond du Lac	1980
80-4	Upper Willow River	Polk, St. Croix	1980
81-1	Upper West Branch Pecatonica River	Iowa, Lafayette	1981
81-2	Lower Black River	La Crosse, Trempealeau	1981
82-1	Kewaunee River	Kewaunee, Brown	1982
82-2	Turtle Creek	Walworth, Rock	1982
83-1	Oconomowoc River	Waukesha, Washington, Jefferson	1983
83-2	Little River	Oconto	1983
83-3	Crossman Creek/Little Baraboo River	Sauk, Juneau, Richland	1983
83-4	Lower Eau Claire River	Eau Claire	1983
84-1	Beaver Creek	Trempealeau, Jackson	1984
84-2	Upper Big Eau Pleine River	Marathon, Taylor, Clark	1984
84-3	Seven Mile-Silver Creeks	Manitowoc, Sheboygan	1984
84-4	Upper Door Peninsula	Door	1984
84-5	East & West Branch Milwaukee River	Fond du Lac, Washington, Sheboygan, Dodge	1984
84-6	North Branch Milwaukee River	Sheboygan, Washington, Ozaukee	1984
84-7	Cedar Creek	Washington, Ozaukee	1984
84-8	Milwaukee River South	Ozaukee, Milwaukee	1984
84-9	Menomonee River	Milwaukee, Waukesha, Ozaukee, Washington	1984
85-1	Black Earth Creek	Dane	1985
85-2	Sheboygan River	Sheboygan, Fond du Lac, Manitowoc, Calumet	1985
85-3	Waumandee Creek	Buffalo	1985