PLANNING GRANT STUDY

GREATER BASS LAKE

LANGLADE COUNTY, WI

FEBRUARY 1992 TO NOVEMBER 1992

FINAL REPORT

PERFORMED BY NORTHERN LAKE SERVICE
400 NORTH LAKE AVENUE
CRANDON, WI

Introduction

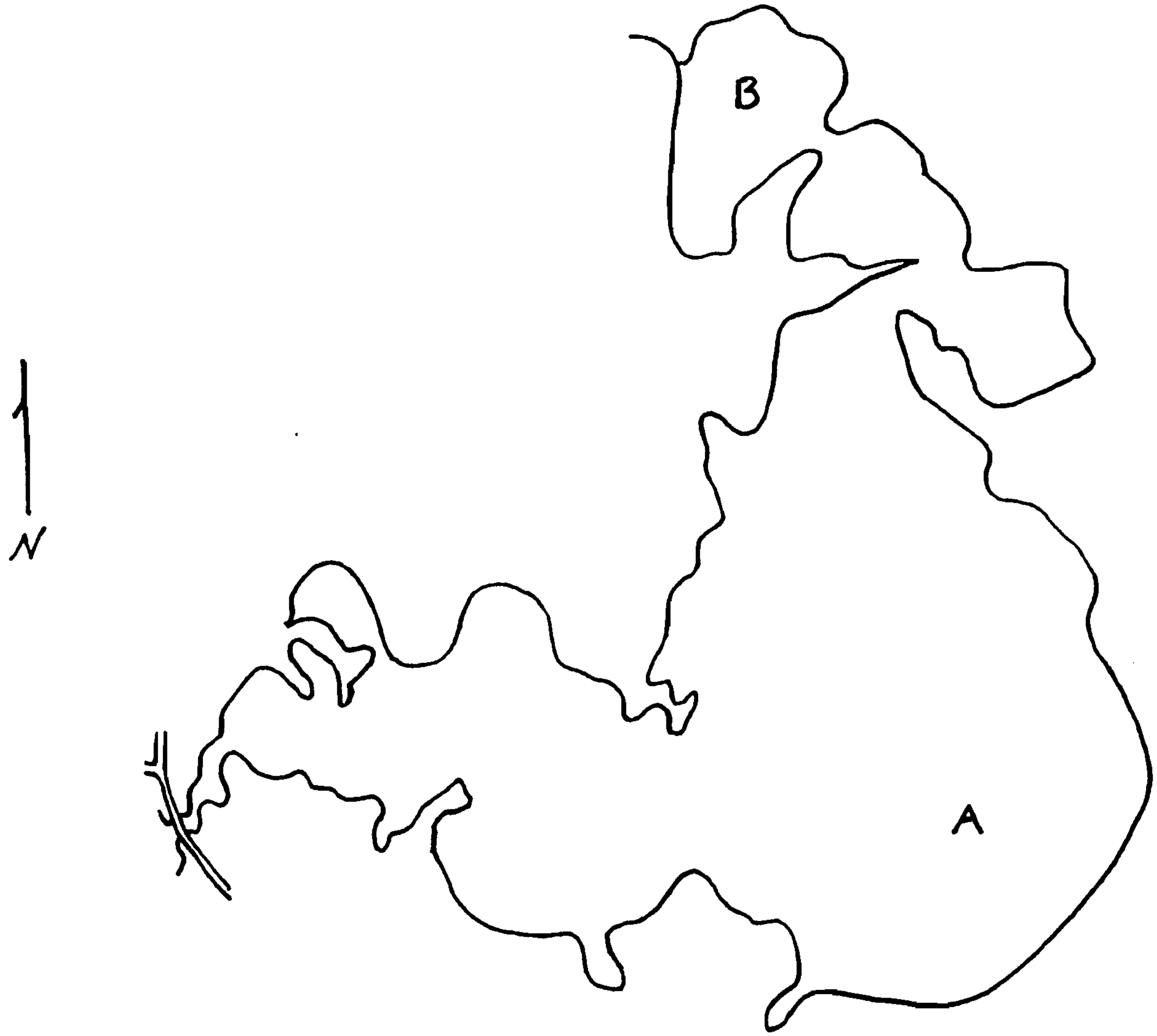
The following is a description of and results from the planning-grant study of Greater Bass Lake, performed by Northern Lake Service between February 1992 and November 1992. The purpose of this study was to determine current water quality for comparison to past and future data and provide a basis for recommending irnprovement/preservation strategies.

Greater Bass Lake is a 246 acre, drainage lake located in northern Langlade County (T33N, R10E, Section 12). It has a maximum depth of 27 feet, 6.9 miles of shoreline and watershed of 6.4 miles. The shoreline is approximately 95% uplands and 5% wetland and conifers. (From Surface Water Resources of Langlade County WDNR - 1977.) The shoreline is quite heavily developed.

Study

This study consisted of three visits to the lake. On each trip, water samples were collected at the deepest point in the lake. Here a sample was collected near the surface using a two-meter PVC sampler and approximately one foot off the bottom using a brass Kemmerer sample bottle. A third sample was collected in the northern lobe. Since this area is very shallow, only one sample was collected. It was taken as deep as possible without pushing the sampler into the sediment.

. The map on page two shows the sampling locations.


B
A
N

The samples were immediately dispensed into sample bottles with appropriate preservative and iced for transport to the laboratory. A portion of each sample was used for pH and conductivity determination, which was done on site. Dissolved oxygen/temperature profiles were also generated and secchi disc visibility measured at each sample site. These activities were done May 5, July 31, and November 11, 1992. During the July 31 sampling, a general macrophyte survey was performed. For a description of this survey see appendix B.

Samples were analyzed by Northern Lake Service for alkalinity, chloride, chlorophyll α, nitrogen (Kjeldahl, ammonia, and nitrate + nitrite) and phosphorus. These parameters are described on the following pages and all data can be found in appendix A.

Also included in this study were an assessment of current public access and a resident survey dealing with recreational use and waste systems.

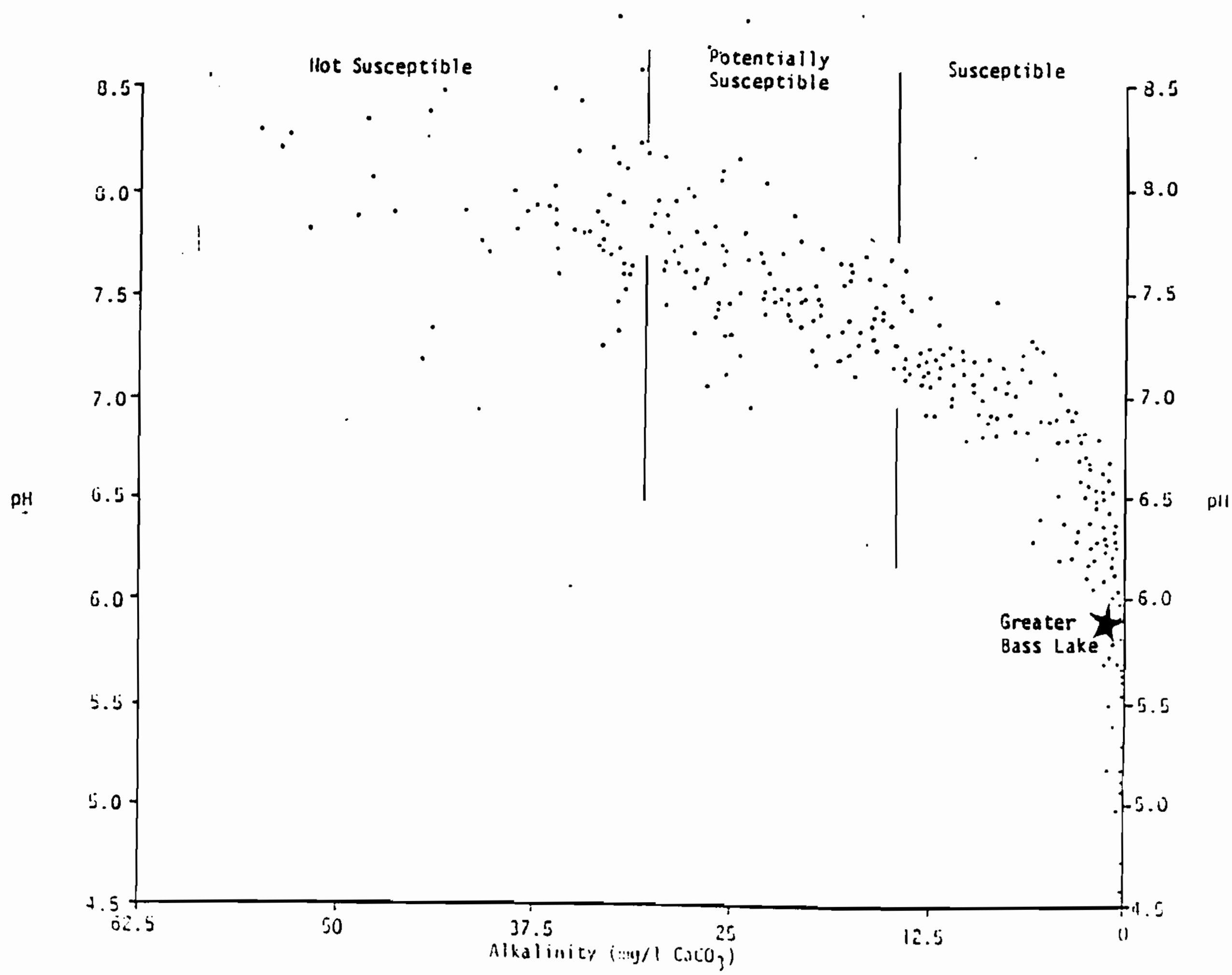
Survey Findings

pH and Buffering Capacity: pH and total alkalinity or acid neutralizing capacity (ANC) are indications of a lake's susceptibility to the effects of acid rain. pH is the measure of acidity on a logarithmic scale from 1 to 14. A pH factor of 1 is most acidic, 14 most basic and 7 neutral. Alkalinity measures the ability of water to neutralize substances on the upper and lower ends of the pH scale. This process, called buffering, is performed by salts, mainly calcium carbonate salts. The more of these salts present, the higher the alkalinity and the more resistant to pH changes the water is.

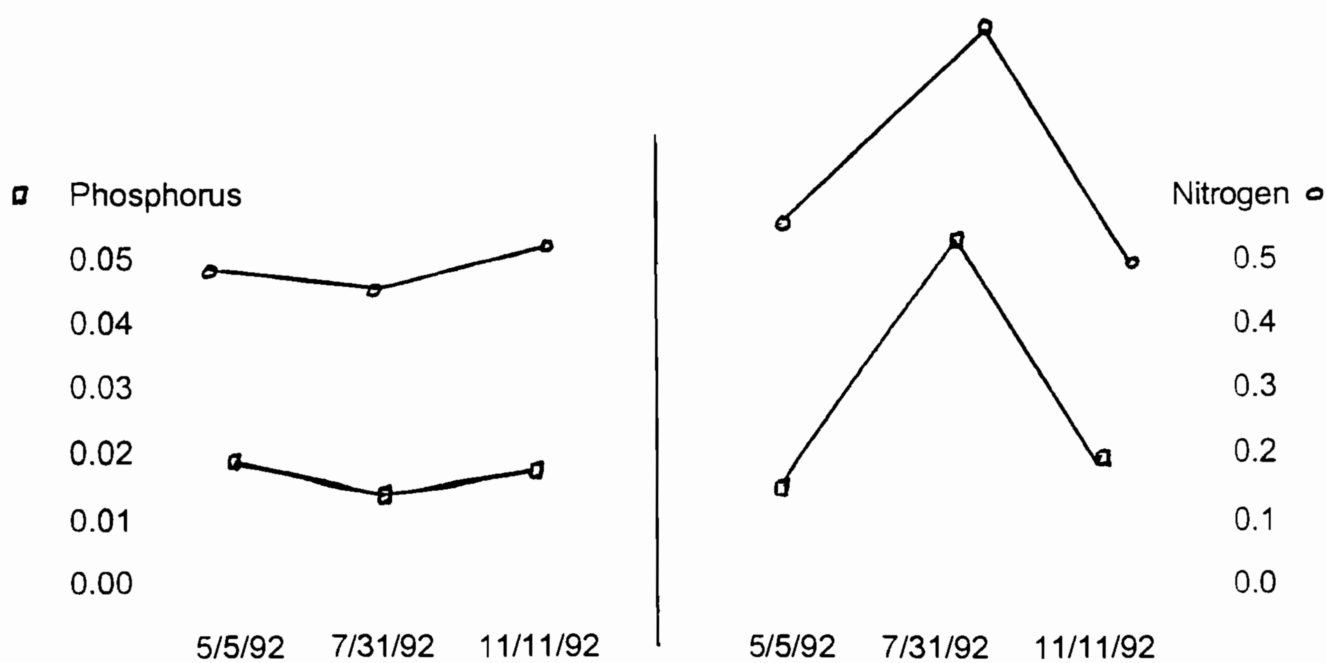
The pH on Greater Bass Lake ranged from 4.7 to 6.1. Alkalinity levels were very low, ranging from below detection limits to 6 mg/l. These levels were consistent with those reported in 1979-80. (pH - 4.7 to 6.0, alkalinity - <2 to 9 mg/l).

This range indicates relatively acidic conditions with poor buffering capacity. As the 1983 feasibility study report stated, this means Greater Bass Lake is highly susceptible to the effects of acid rain. According to Surface Water Resources of Langlade County (DNR 1977), the pH and alkalinity of Greater Bass were 6.8 and 5 mg/l respectively in 1932. If these values are correct, it means that, due to low alkalinity, the pH has been adversely affected by acid rain over the last 50+ years. Figure 1 is reproduced from that earlier feasibility study and shows the lake's susceptibility in relation to approximately 350 other Wisconsin lakes.

FIGURE 1

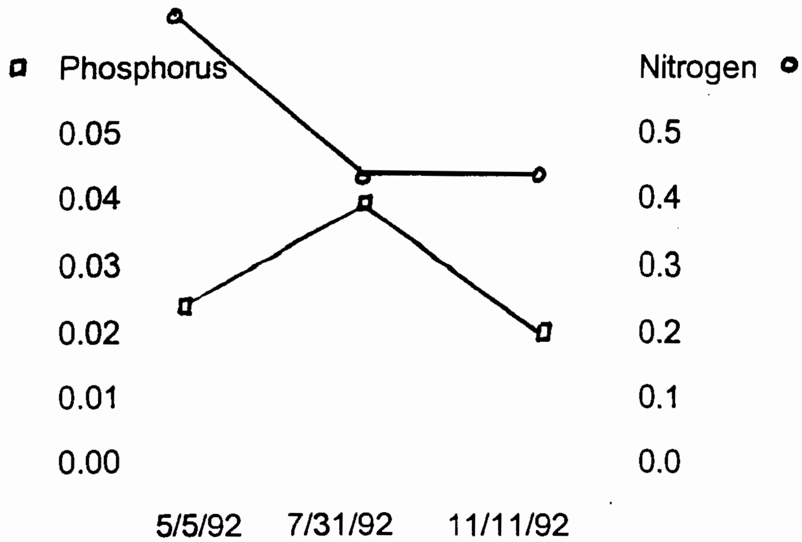


Nutrients: A nutrient is any element, ion or compound necessary for the growth and other life processes of an organism. Most nutrients are required in only trace amounts, but some, the macronutrients, are required in large enough amounts to dictate the productivity of a system. The macronutrients are carbon, nitrogen and phosphorus. Since carbon is so prevalent in a lake its levels do not get low enough to make it a limiting factor. (The limiting factor is the nutrient or energy source that exists in a quantity such that it dictates the extent of growth.) Therefore, nitrogen and phosphorus are considered the most important in terms of potential productivity of a lake. Generally a ratio of 13:1 nitrogen:phosphorus is considered the cutoff above which phosphorus is the limiting factor and below which nitrogen is. Throughout the study the ratio averaged approximately 24:1. The graphs below show nitrogen and phosphorus levels during the study. (Nitrogen levels are 10 times those of phosphorus on the graphs.)



Site A Top

Site A Bottom



Site B

High productivity characterized by nuisance weed or algae growth can be expected when total phosphorus levels exceed .015 mg/l. Phosphorus levels in Greater Bass Lake ranged from .015 to .051 mg/l during the study. Total nitrogen levels were between .34 and .76 mg/l. Both nitrogen and phosphorus levels were very similar to those determined in 1979 and 80. At that time total phosphorus ranged from .01 to .06 mg/l and total nitrogen from about .4 to 1 mg/l.

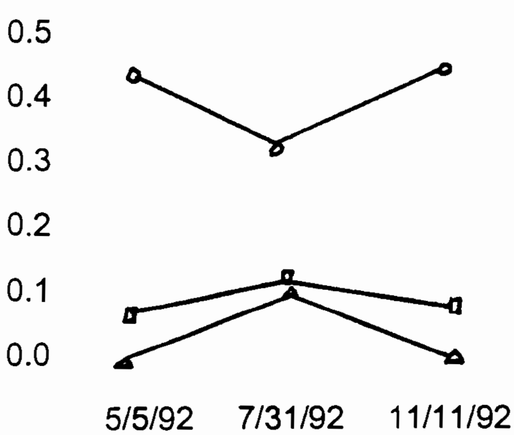
Total nitrogen consists of several components, which can be determined separately. Kjeldahl is the organic share. One component of organic nitrogen is ammonia, which can be an indicator of septic contamination. Ammonia levels remained below detection limits except in late July when they jumped a bit. This could indicate a slight septic problem since it occurred during the peak of vacation season but was probably due to natural production. The 1979-80 data did not show a similar peak but rather a fairly steady depletion over the course of the growing season.

Kjeldahl

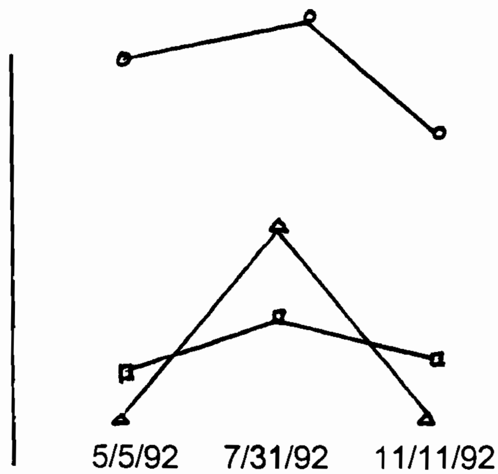
Nitrate+Nitrite

Ammonia

The inorganic portion of total nitrogen is made up of nitrate and nitrite. High levels of these compounds can indicate nutrient contamination from fertilizer or other man-made products. Nitrate + Nitrite levels were quite low, ranging from below detection limits to .14 mg/l. These levels were very consistent with those of the earlier study. The following graphs show the nitrogen component levels during the study.



Site A Top



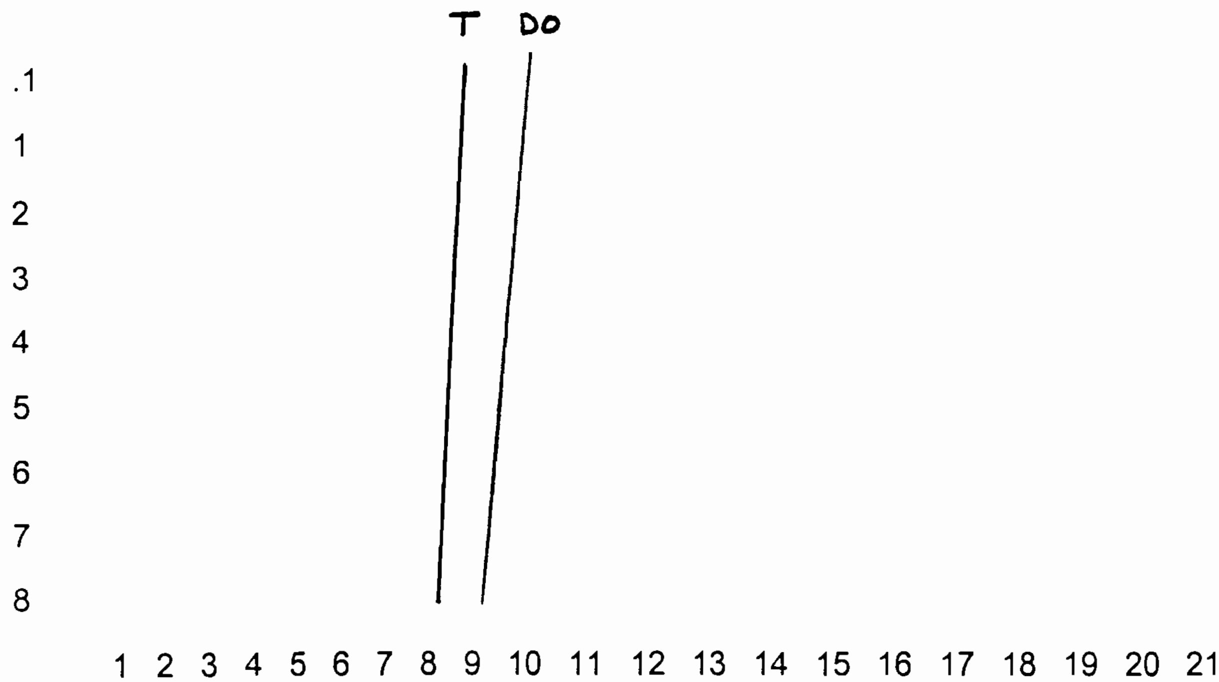
Site A Bottom

Site B

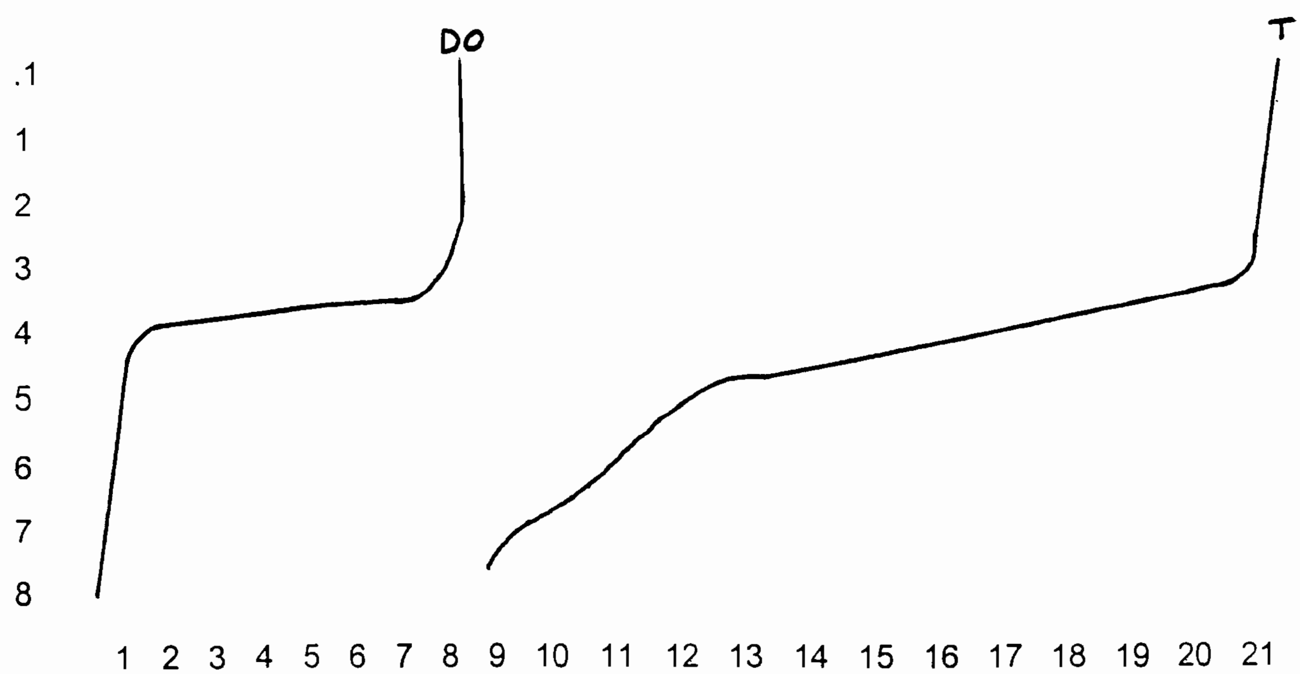
Dissolved Oxygen - Dissolved oxygen is critical to the survival of fish and other aquatic life. In the spring, when the ice melts and the lake turns over, dissolved oxygen levels will be at or near saturation throughout the water column. Over the course of the summer, if the lake stratifies, oxygen levels below the thermocline will begin to deplete. (Stratification is a function of water temperature and density in which the warmer surface water continues mixing and aerating while lower, cooler water is isolated from the surface and thus cut off from its oxygen source. The boundary between the upper (epilimnion) and lower (hypolimnion) layers is called the thermocline.) When the water cools again in the fall, the lake "turns over" and the water column is once again aerated. Under the ice the entire water volume is subject to depletion of oxygen when production (by plants and algae) ceases but consumption (by animals and bacteria) continues. If oxygen levels are depleted enough, fish may suffocate, causing a phenomenon called "winter kill".

On Greater Bass both summer and winter depletion do occur, but not to the extent to cause a serious problem. During the recent study, oxygen levels remained quite high down to 4 meters (≈ 13 ft.) and in 1980 study the water was well oxygenated to 4.5 meters (15 ft). In the early spring of 1980, oxygen levels remained high down to nearly three meters. No winter oxygen profiles were generated during the recent study.

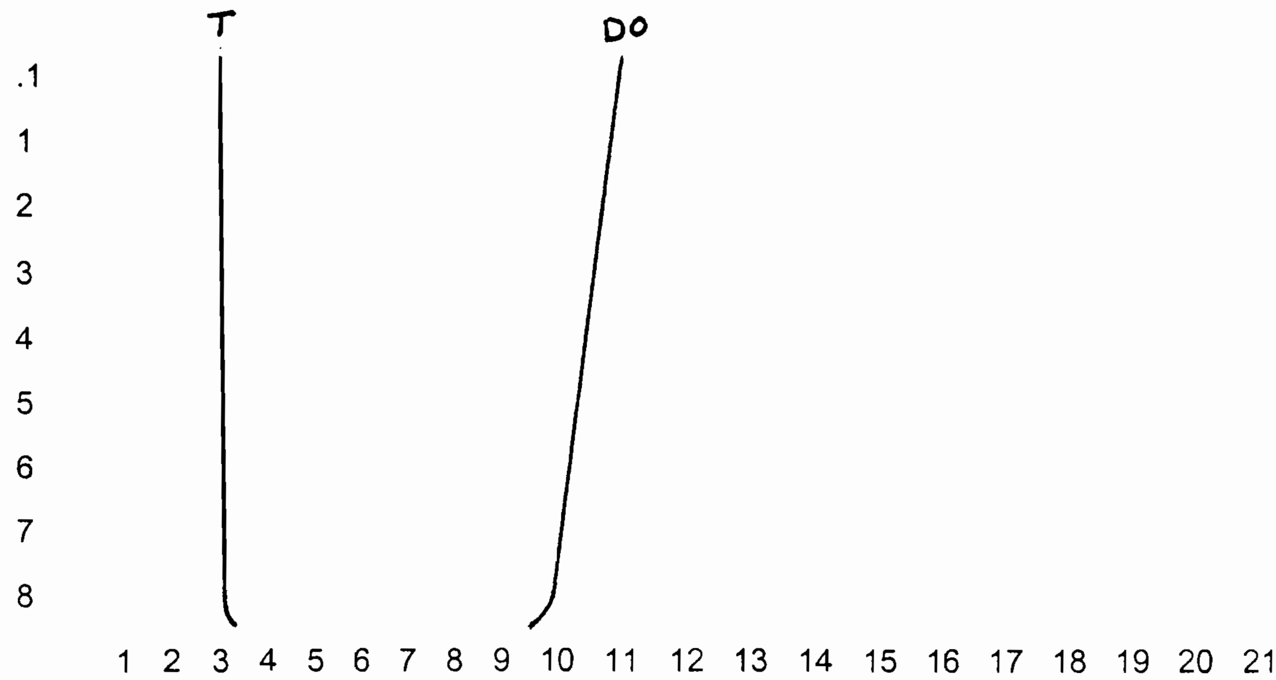
The following pages show oxygen / temperature profiles generated at site A during the 1992 study. Numbers on the vertical axis are depths in meters. Those on the horizontal axis represent both temperature in °C and mg/l or parts per million. Dissolved oxygen and temperature data is also included in appendix A.



Dissolved Oxygen / Temperature Profile Site A 5/5/92



Dissolved Oxygen / Temperature Profile Site A 7/31/92



Dissolved Oxygen / Temperature Profile Site A 11/11/92

Chlorophyll

Chlorophyll α, a pigment found in algae, is used as an indicator of algal growth. It is often closely associated with phosphorus levels and water clarity. Phosphorus is necessary for algal growth and the more algae the lower the visibility, thus the relationship. Unfortunately, the association is often not as clear on a naturally stained lake. This is the case on Greater Bass. The trophic-state models near the end of this report use this relationship.

Macrophytes

Macrophyte growth was quite widespread on Greater Bass, occurring throughout the lake to depths of nearly 15 feet. Growth was also quite diverse with 20 different species collected during the July 27 and 31 survey. These included 5 floating-leaf species, 2 emergents and 13 submergents. The dominant species was *Utricularia purpurea* or purple bladderwort. It was collected at nearly half of the stations and grew to nuisance proportions in many areas. *Fontinalis*, an aquatic moss, was also quite prevalent but since its growth is mostly low and in deep water it does not threaten recreation and aesthetics like *Utricularia* does. *Potamogeten confervoides* an endangered pondweed, was also collected during the survey. These three species, and several others collected, are characteristic of acidic lakes. The table below and continued on page 12 shows density and distribution information for macrophyte species collected.

GREATER BASS LAKE MACROPHYTE SPECIES LIST

Species (common name)	Relative Frequency (%)	Average Density	Depth of Growth (ft.)
Brasenia shreberi (water shield)	21.7	2.1	1 - 9
Eleocharis acicularis (needle rush)	40.6	1.5	1 - 9
Elodea canadensis (American elodea)	1.5	1	2
Elatine sp. (water wort)	13.0	2.1	1 - 5
Fontinalis (water moss)	30.4	3.5	2 - 15
Lobelia dortmanna (water lobelia)	2.9	2	1

GREATER BASS LAKE MACROPHYTE SPECIES LIST (cont.)

Species (common name)	Relative Frequency(%)	Average Density	Depth of Growth(ft.)
Myriophyllum farwelli (water milfoil)	36.2	2.0	1 - 10
M. humile (water milfoil)	2.9	2.5	5 - 8
Nitella (nitella)	8.7	2.7	2 - 12
Nuphar variegatum (yellow water lily)	5.8	1.5	2.5 - 6
Nymphaea sp. (white water lily)	17.4	1.7	1 - 9
Polygonum natans (water smartweed)	1.4	3	1
Potamogeten capillaceus	4.3	2.7	4 - 5.5
P. confervoides	4.3	2.0	1 - 2.5
P. epihydrus (ribbon leaf pondweed)	13.0	2.1	2 - 5.5
P. oakesianus	13.0	2.4	1 - 6
Sparganium sp. (bur-reed)	2.9	3.0	2 - 3
Utricularia purpurea (purple bladderwort)	43.4	3.0	2 - 11
Utricularia vulgaris (common bladderwort)	2.9	1	5.5 - 6

Note: p=present, but not found at any numbered station.

Public Access

Public access was assessed in terms of accessibility, size, available facilities and possible improvement. Public access, according to maps, consists of two boat launches and two walk in landings. The walk-ins were not assessed. Neither was marked and residents did not know where they were located.

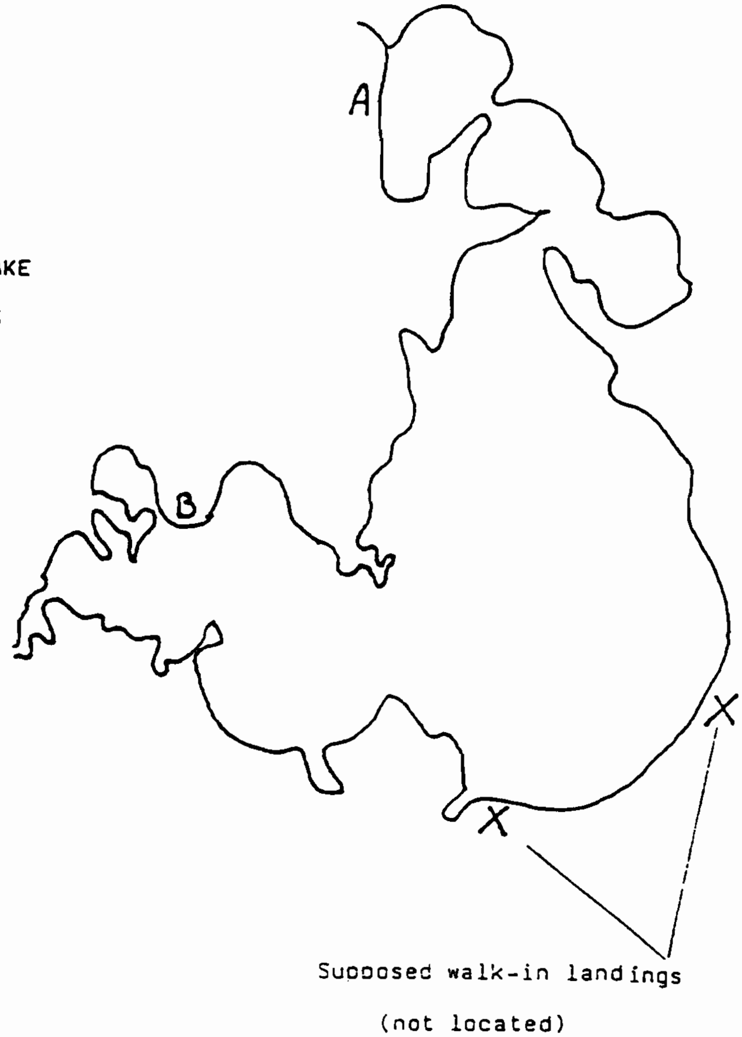
The first launch (A) is located on the northern-most lobe. It is a long, narrow gravel launch without a turn around. Backing must be done from the main road between two blind corners. Parking is limited to no more than five undesignated spaces. Currently, existing buildings along the launch would make improvement very difficult. Additional parking may be available across the road.

The other launch (B) is located on the western basin of the lake at the dead end of the road. This landing is also difficult to negotiate. The only turn around is a short private drive. Parking is extremely limited with little chance for improvement since the area is heavily developed. There are no piers, restrooms or any other facilities available at either launch.

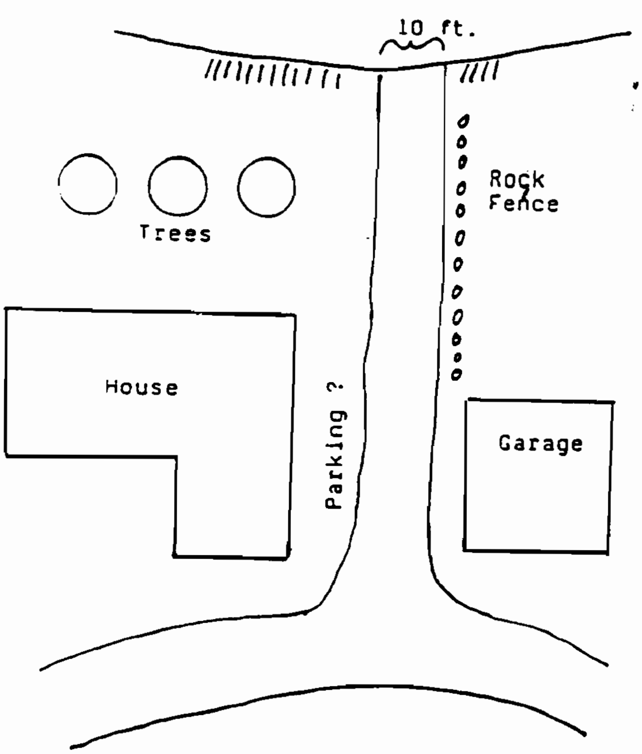
This issue should be considered further since access is currently so limited. Parking improvements should be attempted at existing sites, if at all possible. Also, land for potential new launches should be assessed. Funding is available for these types of projects. The following page shows the location of the sites and diagrams of the two currently used launches.

GREATER BASS LAKE

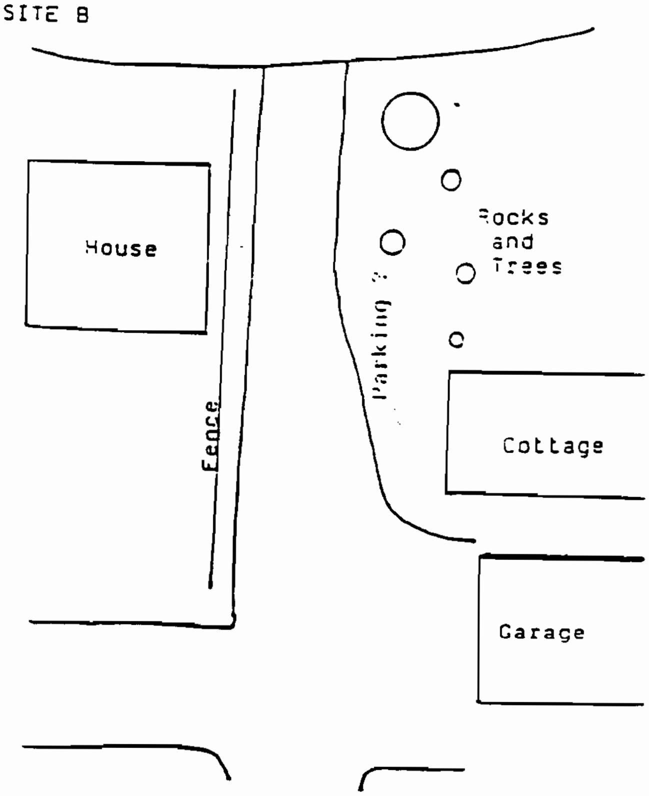
PUBLIC ACCESS



SITE A



SITE B



Resident Survey

The resident survey, a sample of which is included in this report as appendix C, was sent to the 249 members of the lake association. Several surveys could not be delivered and others were returned but had not been filled out. 158 surveys were returned in varying degrees of completeness. The survey consisted of questions concerning recreational use, restrictions and there enforcement, and waste treatment systems.

Recreational use: The most popular recreational use, according to this survey is swimming. This activity was ranked in the top five on 109 survey and number one on 27; the high in both categories. Small boating and fishing were second and third for top five activities, while aesthetics received the second most number one ratings. The question on the existence of use conflicts was a near deadlock with 73 respondents stating "no" and 69 "yes". Generally, those who said "no" preferred higher impact recreational activities such as motorboating and waterskiing, while those who thought conflicts **did** exist, preferred activities such as canoeing and aesthetics. It seems that those who enjoy the higher impact activities may not realize that they are infringing on the recreation of others.

Restrictions and enforcement: Residents responded negatively to the question of whether or not boating restrictions should be greater than state statutes by a vote of 87 to 41. Many people were unaware of what the state statutes are. In response to what type of boating hours are preferred, 34 residents indicated no wake before 10:00 a.m. and after 7:00 p.m. Several other combinations were suggested ranging from "no wake throughout" to "no restrictions whatsoever". None of these other combinations was agreed upon by more than 7 respondents. Forty-nine residents want restrictions enforced by the lake association while 37 would prefer a town ordinance. Only 28 respondents would be willing to pay higher taxes for enforcement while 99 said they would not.

Waste treatment systems: Of the 144 residents who responded to this section of the questionnaire, 80 reported having septic tanks with drain fields, 40 septic with dry well, 6 holding tanks, 3 privies, and 1 mound system. Fourteen reported having no system. The average age of the drain field systems is about 16 years and that of the dry well systems nearly 24. These systems, especially the approximately 1/3 that are 20 years old or older should be closely monitored to ensure they are not discharging to the lake. The association may want to consider dye-testing systems around the lake. According to the survey, system failure is extremely rare.

Summary & Recommendations

As a lake ages and nutrients accumulate, it becomes more productive or eutrophic. The rate of this process can be dramatically affected by the activities of man. The situation on Greater Bass Lake is one of moderately high productivity probably increased to an extent by man. Heavy development and areas of potentially high nutrient loading, such as the golf course, have certainly accelerated the process.

The following two models use phosphorus, chlorophyll α and Secchi depth to estimate water quality and trophic state (lake age). As the models show Greater Bass Lake is a bit eutrophic (productive), but water quality is still in the "good" range.

Trophic Level	Total Phosphorus	Secchi Disc	Chlorophyll
Eutrophic			
	20	2.0	8.5
Mesotrophic			
	10	4.0	2.3
Oligotrophic			

(Carlson, R.E., 1977, A trophic state index for lakes:
Limnology and Oceanography, March, v. 22(2), p. 361-369)

Water quality index	Total Phosphorus (mg/l)	Chlorophyll α (ug/l)	Secchi (ft)
Excellent	<0.001	<1	<19.7
very good	.001-.010	1-5	9.8-19.7
good	**.010-.030**	5-10	**6.6-9.8**
fair	.030-.050	**10-15**	4.9-6.6
poor	.050-.150	15-30	3.3-4.9
very poor	>.150	>30	>3.3

(Lillie, R.A., and J.W. Mason, 1983, Limnological characteristics of Wisconsin lakes: Wisconsin Dept. of Natural Resources Technical Bulletin No 138, 1116 p.)

The high level of productivity has lead to the current weed situation.

Table 2, on page 19, compares harvesting, chemical treatment and a number of other management tools.

While a classic approach to this problem may be considered, Greater Bass poses some unusual obstacles. U. purpurea usually does not root so it may make chemical treatment or harvesting much more difficult. Also, care should be taken to avoid any disturbance of areas where Potamogeten confervoides is growing. Management plans should be discussed with DNR representatives and individuals on the implementation end of the business.

Expensive, labor-intensive management plans are not the single remedy to "lake problems", but only a component. Proper "common sense" practices can be as important as high-tech rehabilitation efforts. These are low-tech, low-cost practices by lake residents and users to avoid accelerating the lake aging process. They include the following:

* Maintain naturally vegetated "buffer zones" along the shore,
* Carefully monitor septic system performance,
* Landscape to decrease erosion,
* Divert runoff from construction sites,
* Avoid the use of chemical fertilizers,
* Operate motorized watercraft slowly in shallow, heavily sedimented areas.

These efforts, while they do not exhibit the dramatic effects of high tech strategies, provide longer-lasting improvement or preservation of the system.

Also important, is keeping residents informed of what is happening on their lake. Regular newsletters updating regulations, suggesting "common sense" practices, and informing residents on on-going projects can help eliminate misunderstandings and disagreements. (Many survey respondents were unaware of the study, certain regulations, or even that the association had been resurrected.) Finally, we recommend a long-term, self-help monitoring program. A simple program which can be an extremely effective indicator of changes in aging trends is regular Secchi disc readings. It should be done at regular intervals of about 2 weeks and can be used with or without annual nutrient analysis to track water quality for a minimal cost. Information on establishing a self-help monitoring program is available through the Department of Natural Resources.

	Mechanical Harvesting	Aquatic Herbicides	Dredge	Rototill	SCUBA	Bottom Screens	Drawdown	Biological
Effect on Ecosystem	Remove plant material, some small fish	possible residual effects	removes littoral zone, disturbs sediments	disturbs sediments	removes aquatic vegetation	creates clear-cut	downstream water quality effects, possible fishery effects	needs research
Effective Large-scale	yes	yes - but possible residual effects	yes	yes	no - very labor intensive	no	yes	yes
Effective Small-scale	no - difficult to maneuver	yes	yes	no	yes	yes	no	no
Species Selective	no	yes - if applied properly	yes	no	yes	no	no	yes with fungi and insects
Removes Nutrients	yes	no	yes	no	yes	no	no	no
WDNR Acceptibility	high - minimul environmental impact	low - permit required	low - many environmental impacts	medium - prefer harvesting	high - proven effective in southern WI	high - for small areas, permit required	low - physical features of dam prevents drawdown	low - many unknowns
Public Acceptibility	high	medium - more public info needed	medium - many environmental impacts	medium - new technology	high - has been demonstrated to maintain channels up to 2 years	medium - effective but difficult to maintain	medium - depends on many factors, may have to coordinate with utility company	medium - more research and public info needed
Per acre cost	$200 to $600	$75 to $600	$15,000 to $20,000	$1500	varies depending on volunteers	$10,000 to $15,000	nominal	N/A

format taken from "Minnesota Aquatic Plant Control Draft Reconnaissance Report," August 1989

Appendix A. Greater Bass Lake Water Chemistry Results

Site A. Top

	5/5/92	7/31/92	11/11/92
Alkalinity (mg/L)	<2	2	2
Chloride (mg/L)	<1	<1	<1
Chlorophyll a	9.55	NA	NA
Conductivity (s.u.)	24.0	22.0	21
PH (s.u.)	5.9	5.3	6.1
Kjeldahl Nitrogen	0.41	0.32	0.44
Nitrate+Nitrite (mg/l)	0.07	0.11	0.07
Ammonia (mg/L)	<0.05	0.10	<0.05
Phosphorus (mg/L)	0.019	0.015	0.018
Secchi disc (ft.)	6.2	9.0	12.3

Site A Bottom

	5/5/92	7/31/92	11/11/92
Alkalinity	<2	6	2
Chloride	<1	<1	<1
Chlorophyll a	NA	NA	NA
Conductivity	26.0	38	20
PH	5.4	5.6	5.5
Kjeldahl Nitrogen	0.51	0.62	0.40
Nitrate+Nitrite	0.05	0.14	0.09
Ammonia	<0.05	0.26	<0.05
Phosphorus	0.017	0.051	0.018

Site B

	5/5/92	7/31/92	11/11/92
Alkalinity	<2	<2	2
Chloride	<1	<1	<1
Chlorophyll a	NA	NA	NA
Conductivity	24.0	22.0	22.0
PH	4.9	5.7	4.7
Kjeldahl Nitrogen	0.70	0.34	0.45
Nitrate+Nitrite	<0.05	<0.05	<0.05
Ammonia	<0.05	0.07	<0.05
Phosphorus	0.023	0.038	0.018
Secchi disc	6.0	6.4	6.0

Dissolved Oxygen / Temperature Profiles

5/5/92

Depth (meters)	Dissolved Oxygen (mg/L)	Temperature (deg. C)
.1	9.8	8.1
1	9.7	8.0
2	9.6	8.0
3	9.6	8.0
4	9.6	8.0
5	9.5	8.0
6	9.4	7.9
7	9.3	7.9
7.75	bottom	

7/31/92

Depth (meters)	Dissolved Oxygen (mg/L)	Temperature (deg. C)
.1	8.1	21.6
1	8.2	21.4
2	8.2	21.2
3	8.0	20.7
3.5	7.4	20.9
4	1.6	17.9
5	0.3	12.5
6	0.4	10.6
7	0.3	9.4
8	bottom	

11/11/92

Depth (meters)	Dissolved Oxygen (mg/L)	Temperature (deg. C)
.1	10.7	3.1
1	10.6	3.1
2	10.7	3.1
3	10.6	3.1
4	10.6	3.1
5	10.6	3.1
6	10.5	3.1
7	10.5	3.1
8	10.2	3.1
9	9.9	3.2
10	9.5	3.3
10.5	bottom	

APPENDIX B - MACROPHYTE SURVEY METHODOLOGY

A grid is drawn on a map of the lake so that intersection points give a good representation of the littoral zone (the area in which the bottom receives enough sunlight to support plant growth). These points will generally number between 30 and 80 depending on the size of the lake. Each point is numbered.

Once on the lake, a map, compass and visual estimations are used to locate the sampling stations. At each station an 8 to 10 foot circle is visualized and divided into 4 quadrants. Macrophytes are then collected, identified, and ranked as follows: 1 if present in 1 quadrant, 2 if present in 2 quadrants, etc... A ranking of 5 signifies complete or near complete dominance by one species, occupying a significant portion of the water column.

If a species is observed growing outside the circle, it is given a "p" for present. Species receiving only this designation are not considered when relative frequency, average density, and depth of growth are calculated, but are included on the species list. If a specimen cannot be identified to species it is referred to by the generic name followed by "sp" ("spp" indicates the presence of more than one unidentified species of the given genus.)

Water depth, depth to vegetation, percent open water, and bottom type (if depth permits) is also recorded at each station.

From the field sheet density and distribution values are determined. Relative frequency is determined by dividing the number of stations at which a species is collected by the total number of stations. Average density is determined by summing all density numbers for a species and dividing by the total number of stations where the species is present. Depth of growth is simply the shallowest and deepest point at which a species is collected.