Chute Lake Water Quality Study
Oconto County, Wisconsin

Prepared for:

Mel Plamann
Chute Lake Protection and Rehabilitation District No. 1
Mountain, Wisconsin

Prepared by:

MEAD & HUNT, Inc.

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UPL-454

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Oconto County, Wisconsin

1. Introduction

Chute Lake is a shallow water impoundment of the North Branch of the Oconto River in the town of Armstrong in Oconto County, Wisconsin. The lake is formed by the downstream dam with a 13-foot head maintained by Oconto County and has a surface area of 417 acres with a maximum depth of 18 feet. The lake contour map is shown in *Figure 1*, and photographs of the lake and dam are shown in *Figure 2*.

Table 1 lists the physical characteristics of Chute Lake.

Table 1 – Physical Characteristics of Chute Pond

Watershed area	185 square miles
Reservoir area (A)	417 acres
Average annual outflow	176 cfs*
Reservoir volume (V)	3,270 acre-feet
Hydraulic residence time (annual average)	10 days
Maximum depth	15 feet
Mean depth (V/A)	6 feet
Volume of soft sediment	1.1 million cubic yds

* *cubic feet per second*

The Chute Lake watershed is 121,000 acres and its land use is primarily forested, with little agricultural or residential use (see *Figure 3*[1])

In 1976, the Chute Lake Protection and Rehabilitation District (CLPRD) was formed to improve the lake's recreational uses. A feasibility study conducted by the DNR Office of Inland Lake Renewal was completed in 1980. This study collected and analyzed lake data, including aquatic

[1] Please note that references to *Chute Pond* are the same as *Chute Lake*. In this report, *Chute Lake* is used to be consistent with the name of the District.

LAKE Chute Pond
SECTION 25, 26, 35, 36, 31
RANGE 16, 17 E
TOWN Armstrong
TOWNSHIP 31 N

This is the only hydrographic m
produced from original charts
sources —

A U. S. Geological Survey Map
ing the area (approx. 12 square

To order specify Mountain

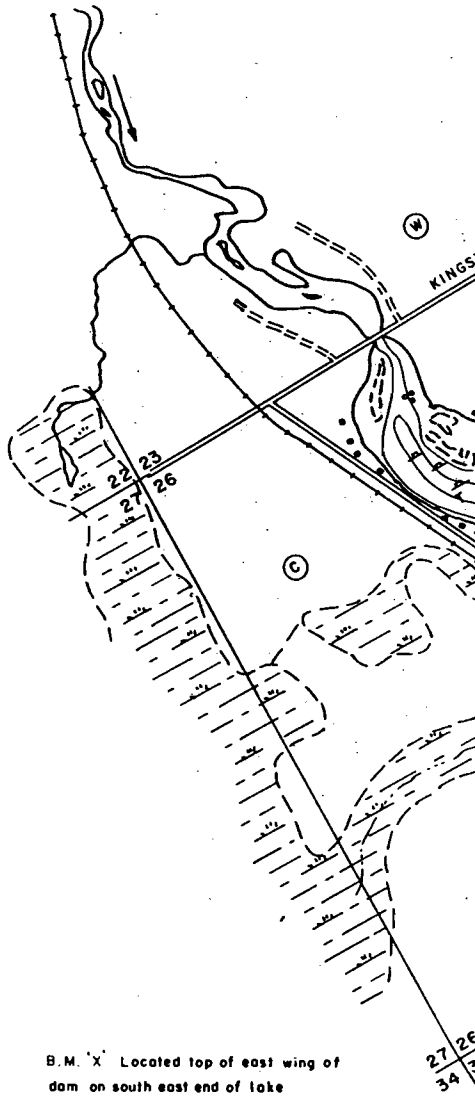
LEGEND

TOPOGRAPHIC SYMBOLS

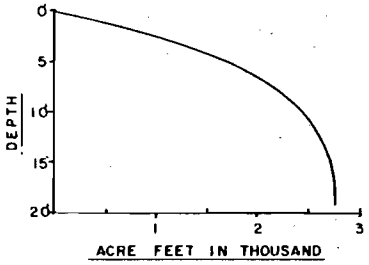
- BRUSH REFUGE
- SAPLING TANGLE
- SPAWNING BOX
- MINNOW SPAWNER
- WEED BED
- ROCKY SHOAL
- DWELLING
- ABANDONED DWELLING
- RESORT
- STEEP SLOPE
- SPRING
- INTERMITTENT INLET
- BRUSH
- WOODED (W)
- PASTURED (P)
- CULTIVATED (C)
- ENCROACH. SHORE
- PERMANENT INLET
- PERMANENT OUTLET
- MARSH
- PARTIALLY WOODED (PW)
- CLEARED (C)
- BENCH MARK B.M.

LAKE BOTTOM SYMBOLS

- PULPY PEAT P
- MUCK K
- CLAY C
- SAND S
- RUBBLE R
- EMERGENT VEGET. ⊥
- FIBROUS PEAT F
- DETRITUS D
- MARL M
- GRAVEL G
- BEDROCK Br.
- SUBMERGENT VEGET. T



B.M. 'X' Located top of east wing of dam on south east end of lake
Assumed Elevation 100.00'
Water Elevation 94.00'



ACRE FEET IN THOUSAND

800' 0' 800' 1,600'
SCALE

◇ Access ◇ Access with Parking

of this lake available,
Dept. of Natural Re-

available from us show-
es) adjacent to this lake.

nd Breed
Quadrangle

OCONTO COUNTY

Map No. 801

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

WATER AREA 421.6 ACRES
UNDER 3 FT. 17 %
OVER 20 FT. 0 %
MAX. DEPTH 19 FEET.
TOTAL ALK. 103 P.P.M.
VOLUME 2,759.1 ACRE FT.
MAIN SHORELINE 8.230 MI.
ISLAND SHORELINE 1.510 MI.

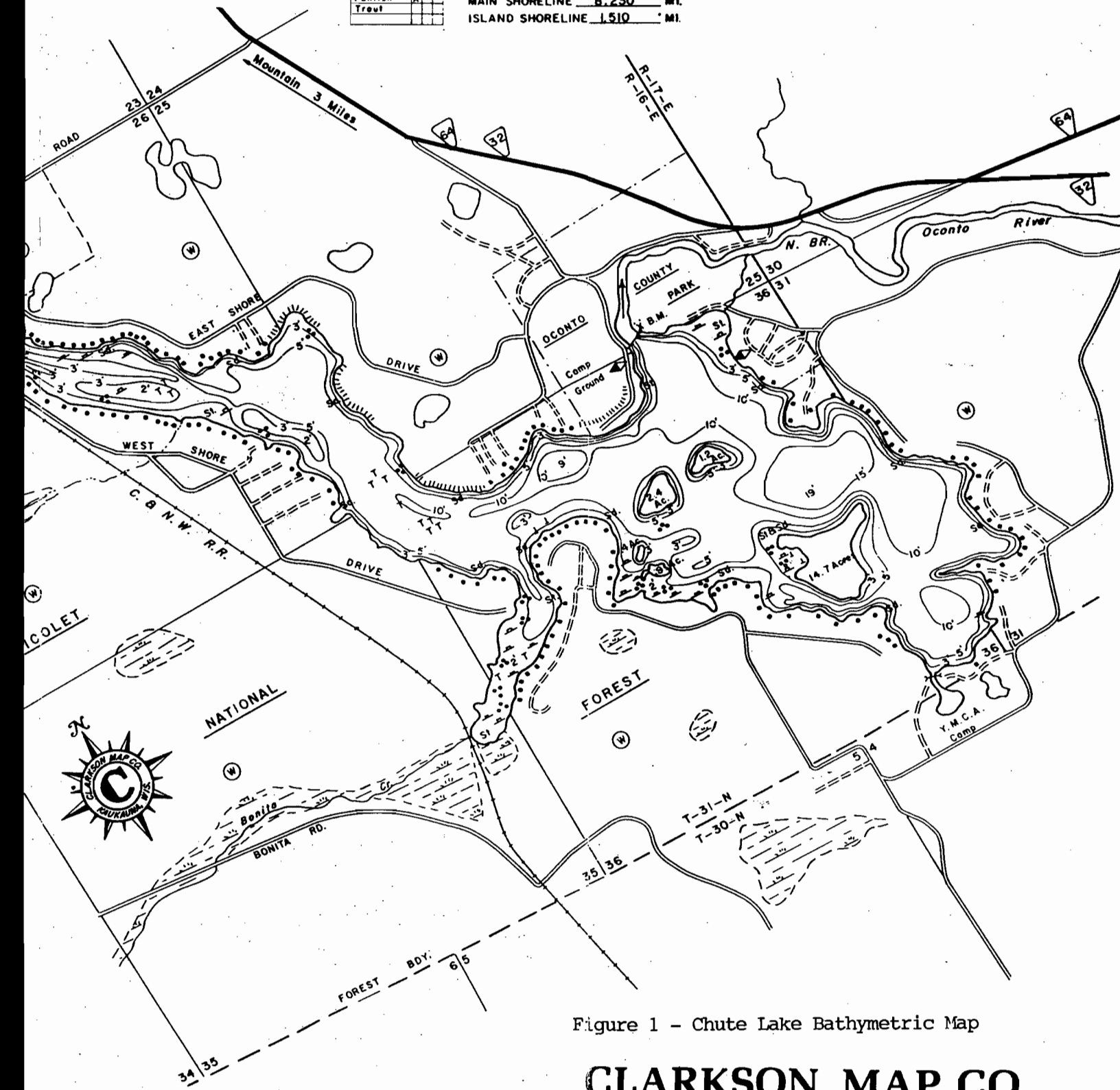


Figure 1 - Chute Lake Bathymetric Map

CLARKSON MAP CO.

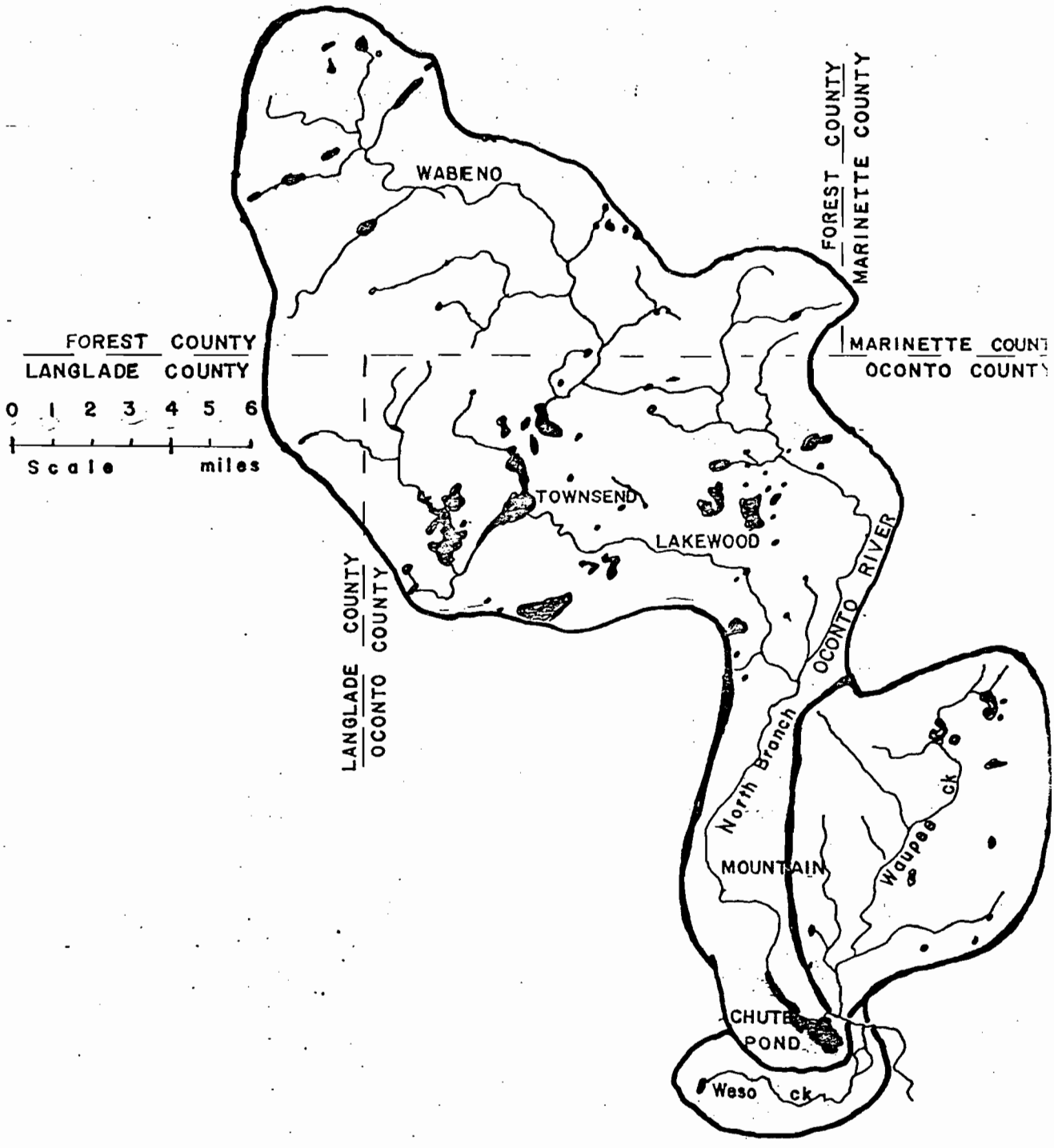
POST OFFICE BOX 208
Kaukauna, Wisconsin 54130

t Livery

CHUTE LAKE WATERSHED

121,000 ACRES

Figure 3 - Chute Lake Watershed



Prepared By OCONTO COUNTY UW—EXTENSION

plants, water quality, and sediment information to form preliminary recommendations for improvements to the lake. Since that time, very few lake water quality studies have been performed. However, district members have noted a worsening of aquatic plant growth, sedimentation, and fishery conditions in the lake.

On October 22, 1996, the CLPRD authorized Mead & Hunt to apply for a lake planning grant from the Department of Natural Resources (DNR) to collect lake data to update the earlier study. Specifically, the scope of the Mead & Hunt study was to:

- **Conduct Sampling** – Characterize the lake water quality during the spring or early summer of 1997 to obtain baseline information on available phosphorus – both in the water and in the sediment – algae content, and sediment content. This sampling will include lake stratification levels, lake bottom sediment survey, and aquatic plant survey.

  Collect water quality data at the deepest point of the pond on five separate dates next spring or early summer. These samples will be collected once in the winter, once after ice-out conditions, and once during June, July and August. The samples collected will be tested for: dissolved oxygen, temperature, dissolved phosphorus, total phosphorus, chlorophyll *a*, and suspended solids. Collect five lake bottom sediment core samples at points throughout the lake to characterize the phosphorus in the sediment.

- **Submit Questionnaire Survey** – Submit a questionnaire to lake owners to determine the adequacy of their septic system, their current assessment of lake conditions, and observed problems on the lake.

- **Define Water Quality Problems** – Based on the results of the sampling and the questionnaire, define water quality problems on Chute Lake. Prioritize the problems based on the extent of each and its perceived importance to CLPRD.

- **Preliminary Solutions** – Once the problems have been defined, establish several alternatives to solve them. Recommendations include future actions, cost estimates, and potential funding sources for improvement alternatives.

On April 1, 1997, CLPRD received the grant from the DNR to conduct this study. This report summarizes the methodology, work efforts and results of this study.

2. Data Collection

Mead & Hunt staff sampled Chute Pond monthly throughout the summer of 1997 to determine its water quality. In late August, the pond was sampled once to determine the phosphorus and organic content of bottom sediments.

A. Water Quality

Water quality samples were collected from the area where Chute Pond reaches its maximum depth. The sample location is shown on *Figure 4* and was found monthly through the use of this map and a Humminbird DM3-600 depth sonar. Water samples were collected from 1 meter below the water surface and 1 meter above the lake bottom sediment using a Wildco Kemmerer stainless steel, vertical sampler. The 2-liter sample containers were rinsed twice with sample water, filled, and placed in a cooler until they could be processed.

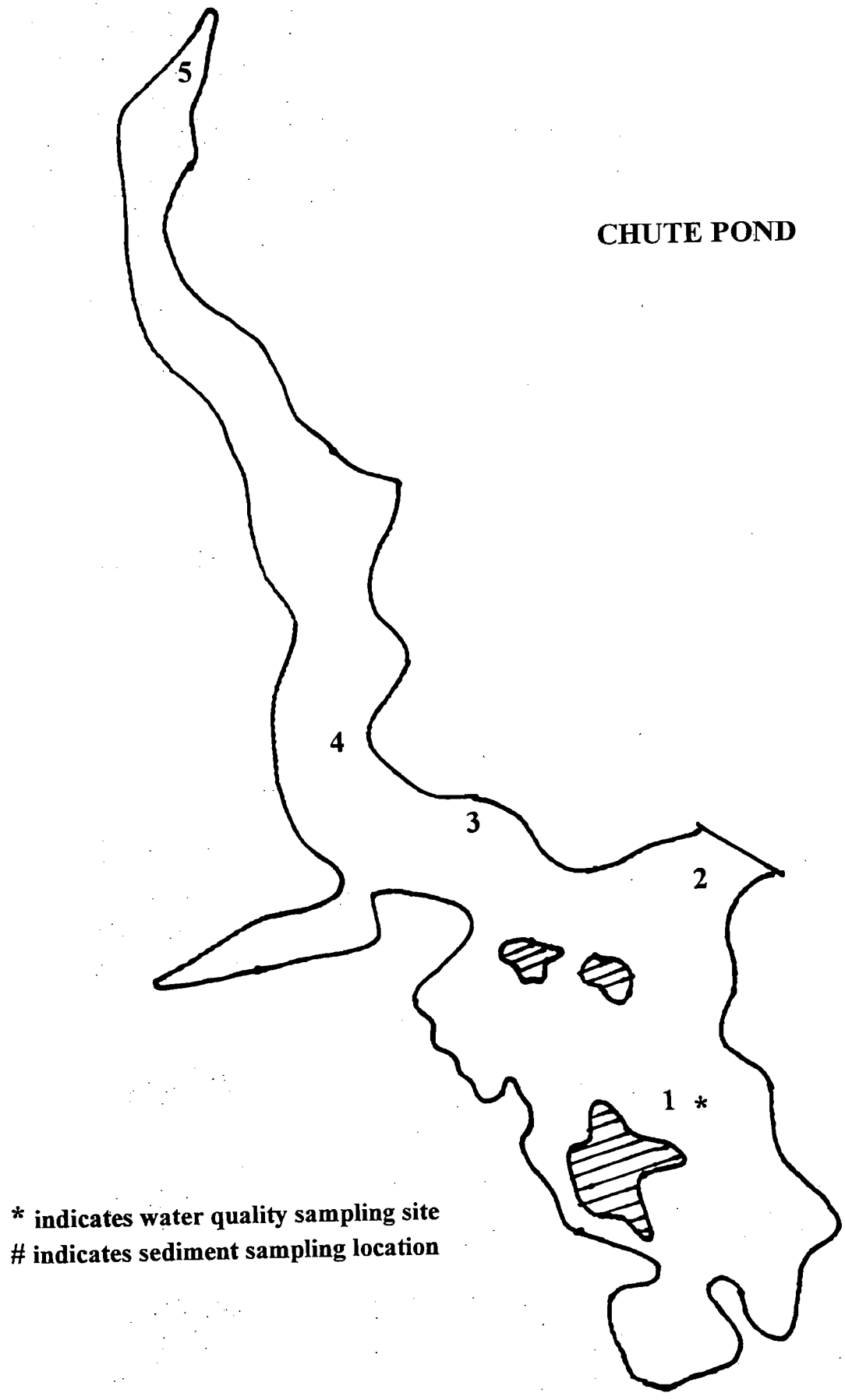
Measurements of the water oxygen and dissolved solids content, as well as temperature and pH, were taken from the same location as above using a Hydrolab DataSonde 3 with a depth sensor. Readings were recorded at 1-foot intervals and stored in a Hydrolab Surveyor 3 until they could be downloaded directly to a computer for compiling.

Water samples were processed for analysis in accordance with Wisconsin State Lab of Hygiene (WSLH) procedures. Samples to be analyzed for suspended solids were placed directly into 625-ml bottles. Samples for total phosphorus were poured into 250-ml bottles and H_2SO_4 (sulfuric acid) was added to bring the pH to <2. Five hundred ml of the sample was filtered for chlorophyll *a* content with a 0.45-micron glass fiber filter. The filter was then folded twice and wrapped in aluminum foil to block light penetration, sealed in a small plastic bag and frozen. Fifty ml of the filtrate was poured into a plastic bottle for reactive phosphorus analysis. All of the water samples were stored on ice until being shipped or delivered directly to the WSLH

B. Sediment

Five sediment sampling sites were selected prior to Mead & Hunt's August visit to Chute Pond. The sites were selected to represent sediment from the inlet and outlet areas, areas of minimum, middle, and maximum depths. These sites are indicated in *Figure 4*. Samples were collected using a Wildco Petite Ponar dredge with a 6-inch by 6-inch opening. Depending on the type of bottom sediment, the sampler generally retrieves a sample from the first 4 to 6 inches of the bottom layer. Three samples were composited from each site to maximize the data reliability by minimizing the sample variance. The samples were refrigerated until they could be delivered to the WSLH to analyze for total phosphorus and volatile solids.

Figure 4 - Sediment and Water Quality Sampling Sites



C. Fishery Survey

Results of a 2.5-hour pulsed DC electroshocking survey completed by the DNR) on September 18, 1997, were given to Mead & Hunt for our evaluation and recommendations. The DNR's survey is limited only to one type of sample method and focused on game fish and panfish longer than four inches.

3. Questionnaires

As shown in *Figure 5*, questionnaires were developed and sent to all 299 registered members of CLPRD. We received responses from 165 CLPRD members. Responses to the questionnaire are summarized in Table 2.

Table 2 - Chute Lake Questionnaire Results*

Years at Chute Lake		<10	10-20	>20	
		33	47	85	
Part-time	139				
Full-time	26				
Children/Grandchildren		Yes	No		
		138	26		
Worst Problem					
Noise	Weeds	Fish Decline	People	Pollution	Boats/Jet Ski
4	99	8	7	7	41
Most Important Aspect					
Quiet	Beauty	Boat/Fishing	Water Qual.	Wildlife	Weed Cntrl
46	36	41	36	37	4
Problems					
Fishing		Yes	No	Partial	
		100	26	8	
Weed Growth		Yes	No	Partial	
		127	17	4	
Sedimentation		Yes	No	Partial	
		60	32	10	
Wildlife		Yes	No	Partial	
		33	58	22	

Table 2 - Chute Lake Questionnaire Results*

Boating Safety					
Safety Issues			Yes	No	Partial
			93	47	1
Enough Boating Access			Yes	No	Partial
			135	10	1
Ever Had Access Problem			Yes	No	Partial
			9	143	4
Jet Skis			For	Against	Middle
			22	78	55
Septic System					
Year Installed	>90	90-80	80-70	70-60	<60
	83	18	1	2	4
Distance from Lake		>300	100-300	<100	
		26	70	16	
Problems with Drain field?		Yes	No		
			117		
Does Property Abut Chute Lake		Yes	No		
		121	39		

** Of 299 questionnaires sent, 165 were returned.*

Chute Lake Questionnaire

Figure 5

Life on Chute Lake

1. How long have you lived near Chute Lake?

2. Are you a part-time or full-time resident?

3. Do you have children/grandchildren using the lake?

4. What, in your opinion, is the worst problem with Chute Lake, and how would you suggest dealing with it?

5. What is the most important aspect of living on Chute Lake that you believe is worth preserving?

Problems

1. Since you've lived here, have you noted a worsening problem with the following issues? (If yes, explain location and extent of problem.)

    - Fishing (in terms of number and/or variety?)

    - Nuisance weed growth (algae blooms, floating weeds, new species?)

    - Sedimentation (loss of navigation, filling in of lake bottom?)

- Wildlife (an increase in nuisance or decrease of wildlife?)

Boating Safety

1. Do you feel there is a problem with boating safety issues ?

2. Do you feel enough boating access is provided?

3. Have you ever had a problem with boating access?

4. How do you feel about the use of personalized watercraft (jet skis) on the lake?

Septic System

1. Do you have a septic system? If yes, please respond to 1a., b. and c.

   1a. When was the septic system installed and last inspected or upgraded?

   1b. How far from the lake/river/creek is your septic field?

   1c. Have you had problems with your drain field? (i.e., standing water or well contamination)

2. Does your property directly abut Chute Lake?

The survey results are further summarized as follows:

Residential Information
- Over 10 years: 80%
- Part-time residents: 84%
- Bring children/grandchildren: 84%

Worst Problems
- Weeds: 60%
- Jet skis: 25%

Most Important Aspects
- Relatively equally balanced between tranquillity, beauty, fishing, water quality, and wildlife

Problems
- Felt fishing not as good: 76%
- Weeds had increased: 85%
- Sedimentation had increased: 60%
- Wildlife had decreased: 28%
- Felt some aspect of wildlife population had deteriorated (mainly muskrats): 20%

Boating Safety
- Felt there were problems/issues: 66%
- Felt there was enough access: 93%
- Never had an access problem: 91%
- Against jet skis on the lake: 50%
- Feel times/use should be regulated: 36%

Septic System
- Installed/inspected after 1990: 76%
- Problem with drain field: 0%
- Property abuts lake: 76%

The majority of district members are long-term residents living on the lake only in the summer. The major perceived problems are weeds and jet-skis. Tranquility, beauty, and fishing are perceived as important aspects of Chute Lake.

Boating access is not perceived as a problem. However, boating safety – primarily in the form of increasing no-wake zones and decreasing jet skis – is perceived as a problem. Although 50 percent are strongly against jet-ski use, 35 percent of members don't have strong feelings on this issue.

Most of the septic systems have been installed or inspected since 1990. No problems exist with drain fields.

4. Aquatic Plant Survey

On August 28, 1997, Perry Rossa of Mead & Hunt took a shoreline tour of Chute Lake to conduct an aquatic plant survey. The following is excerpted from his September 23, 1997, letter to Mel Plamann, Chairman of CLRPD, describing his findings:

> Besides the widespread growth of water celery, your lake was also noteworthy for the amount and variety of pondweeds, especially in Bonita Bay and other fringe areas not harvested. Especially important are Potamogeton amplifolius (bass weed), in the bays, and P. zosteriformis (flat-stemmed pondweed), which is widespread in shallow water. We found much of the flat-stemmed pondweed to have attached colonies of Gloeotrichia echinulata, a blue-green algae common in Wisconsin lakes. The pondweeds in Chute Lake also appear to have benefited from control of the competitive milfoil and coontail. They may also be more resistant to control by cutting because they have winter buds out of the range of the cutter near the lake bottom, and they are much less likely to develop thick mats that are easily cut.
>
> The plant that was of some concern to you because of its recent appearance in the lake and resistance to cutting is Potamogeton panormitanus, variety minor. It is a native species of pondweed, and although relatively unimportant as habitat, food, or cover compared to other pondweeds, it still contributes food and habitat to the community. Given its dense growth habit, it probably provides important cover for aquatic insects and other smaller life forms.

The CLPRD is using this aquatic plant survey to apply for funds from the DNR to upgrade the district's weed harvester.

5. Water Quality Data Analysis

A. Oxygen and Temperature

Figures 6 and 7 show the temperature and oxygen present in Chute Pond during the study months. In May, the water in Chute Pond was still in spring turnover, so both temperature and oxygen levels are the same from surface to bottom. As the summer progressed, however, the temperature and algal populations in Chute Pond increased. By July, the water at the surface of the reservoir maintained good oxygen levels, but due to increasing temperatures and the decomposition of dead phytoplankton, the oxygen content dropped below 5 mg/L at 12 feet and continues to zero near the bottom. Certain types of fish, such as walleye and trout, that seek out cooler, darker waters to live might not survive through the stress of such a condition. However, Chute Pond's fish population primarily comprises warm water species, such as northern pike, largemouth bass, and bluegill, that spend most of their lives in water closer to the surface and would not be endangered by such a drop in dissolved oxygen.

B. Phosphorus

In most lakes, phosphorus is the nutrient that is the greatest limiting factor to plant growth. Lakes that have high phosphorus contents tend to also have high algal populations and decreased water clarity. Phosphorus is measured in two different forms for limnological study:

- *Reactive* – Reactive phosphorus is considered to be the phosphorus available to algae or other plants for further growth.

- *Total* – Total phosphorus is all phosphorus regardless of form.

In the water column, total phosphorus is generally composed of reactive phosphorus tied up in both living and dead plant fiber and phosphorus attached to suspended sediment.

Table 3 shows the results of our sampling during the study month. Phosphorus levels found in Chute Pond are similar to those found in other small reservoirs; the watershed provides enough phosphorus to keep them fairly productive. From the 1980 DNR report, Chute Pond is said to have a turnover rate of 10 days, which indicates that there's probably a constant source of phosphorus upstream that will always maintain some elevated level. Otherwise, much of the phosphorus would flush downstream over time.

Figure 6. Ambient Water Temperature
Chute Pond, Wisconsin

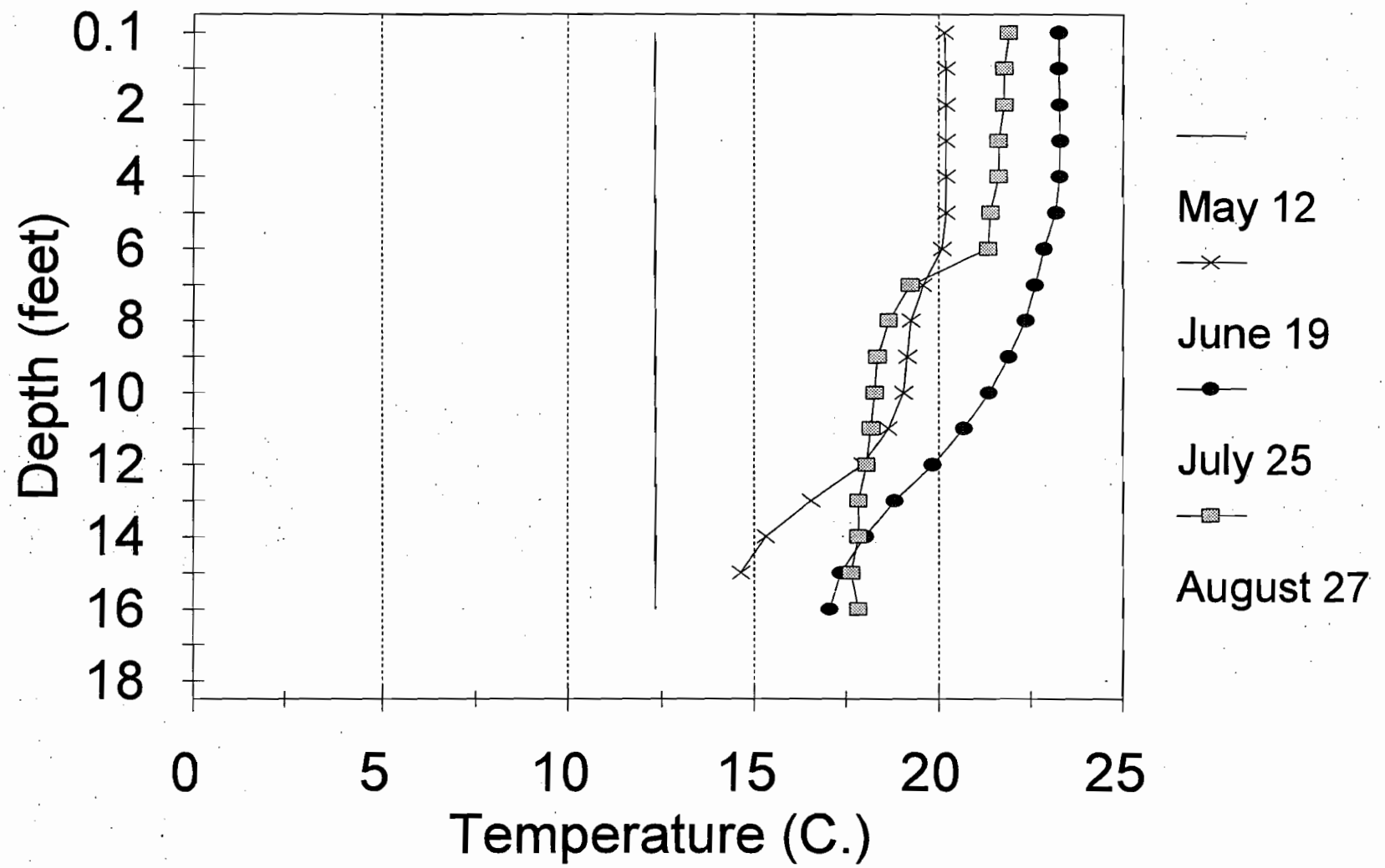


Figure 7. Dissolved Oxygen Content
Chute Pond, Wisconsin

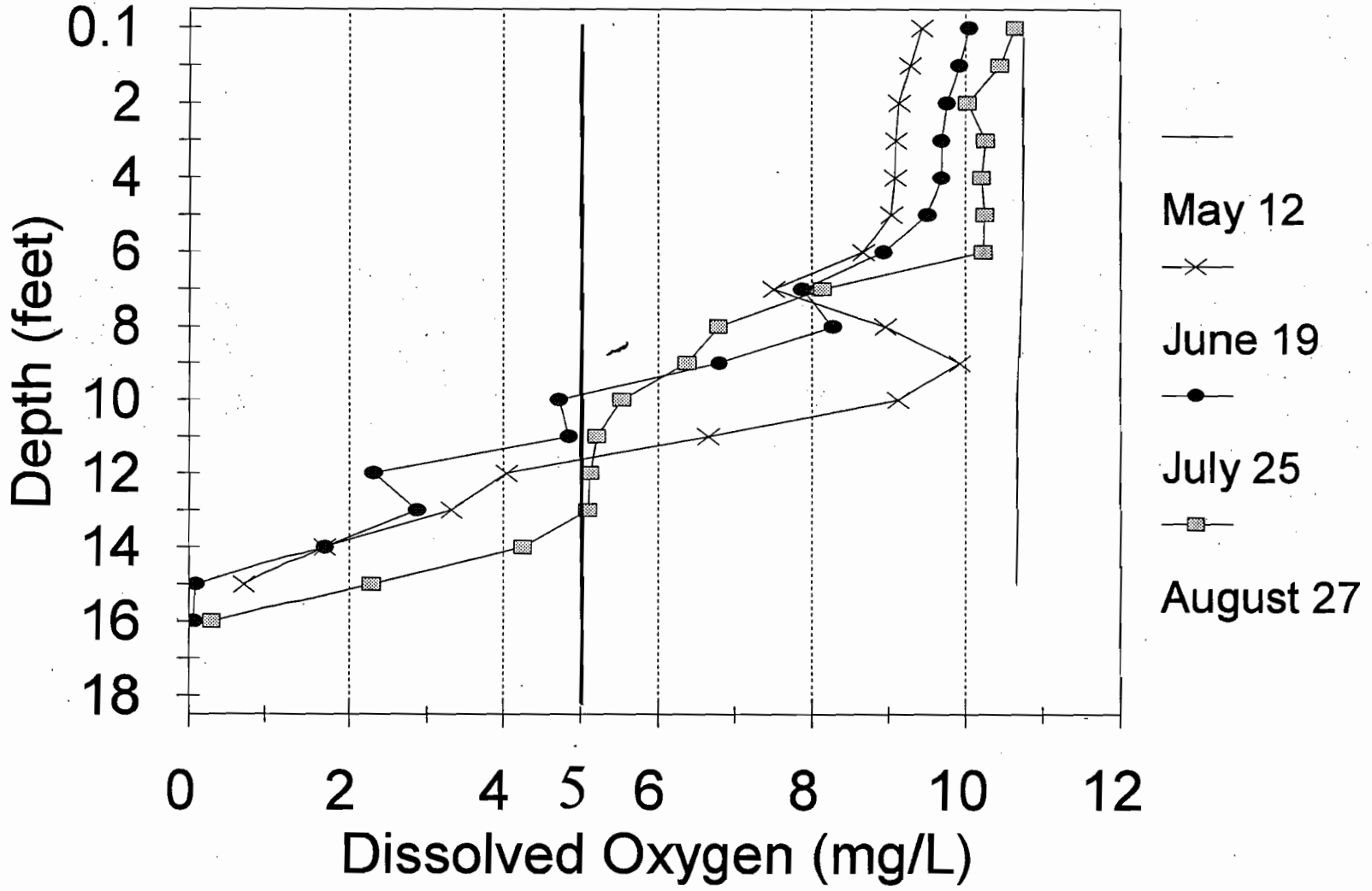


Table 3 – Water Quality Analysis Results
May through August, 1997

	Surface				Bottom			
Date	Chlorophyll a μg/L	Reactive Phosphorus μg/L	Total Phosphorus μg/L	Suspended Solids mg/L	Chlorophyll a μg/L	Reactive Phosphorus μg/L	Total Phosphorus μg/L	Suspended Solids mg/L
May 12	7.4	11	37	ND	7.4	11	37	ND
June 19	5	2	56	ND	2.13	7	63	ND
July 25	14	4	21	5	69	4	72	9
August 27	11	2	37	ND	3.8	9	51	ND
Average	**9.35**	**4.75**	**37.75**		**20.58**	**7.75**	**55.75**	

ND = Non-detectable below 4.88 mg/L

C. Chlorophyll *a*

In most lake systems, phytoplankton – or algae that lives in the water column – is the leading cause of deceased water clarity. Chlorophyll *a*, a pigment common to most phytoplankton, can be used to gauge the phytoplankton population. Typically, a phytoplankton population will gradually increase as the water temperature and daylight increase. In Wisconsin, phytoplankton populations are generally the highest in July and can often become very unstable from overpopulation, resulting in die offs.

In general, chlorophyll *a* contents of samples collected from Chute Pond were fairly low during most of the sampling season, as shown in Table 3. A lake needs some algae to provide food for zooplankton, which are in turn eaten by small fish. Samples collected in our July visit did indicate a much higher amount of chlorophyll *a* than any other month, which is to be expected. One unexpected result was the high chlorophyll *a* concentration in the deeper water, which was probably due to a high amount of chlorophyll *a* in dead algae that had sunk to that level. This also accounts for some of the reduced oxygen, which would be caused by the respiration of the bacteria decomposing the algae.

D. Suspended Solids

Suspended solids concentrations are shown in Table 4 for the sampled months. Suspended solids concentrations were below detectable limits in May, June, and August. During the July sampling, however, suspended solids in both samples reached measurable levels. Considering the amount of

chlorophyll *a* in both the July samples, an increase in phytoplankton population was responsible for these increased values.

Table 4 – Results of Sediment Samples from Five Sites

Site No.	Site Description	Sample Depth (ft)	Percent Moisture	Percent Organics	Total Phosphorus mg/kg
1	deep hole	17	92.2	36	2100
2	outlet	12	86.6	27	590
3	shallow	4	90.4	29	830
4	mid-depth	10	83.7	25	360
5	inlet	2 - 3	69.2	21	670
Average			**84.4**	**27.6**	**910**

E. Trophic State Index (TSI)

The TSI is a method of generating a number that's a general indicator of the trophic state of a lake by looking at water clarity (Secchi depths), amount of algae (chlorophyll *a*), and available nutrients (total phosphorus). To generate TSI numbers, the following formulas were used:

$$TSI(TP) = 60 - [33.2 \times (0.96 - 0.54 \log_{10} TP)]$$

$$TSI(CHL\ a) = 60 - [33.2 \times (0.76 - 0.52 \log_{10} CHL\ a)]$$

Table 5 shows that the average TSI value for Chute Pond was 53.5, a score that shows Chute Pond to be slightly eutrophic – meaning that the lake is probably rich in nutrients and very productive. This assessment is pretty accurate, considering the amount of vegetation growth during the summer of 1997.

Table 5 – Trophic State Index Calculation Results
May through August 1997

	Actual		TSI		Average TSI
Month	Chlorophyll a (μg/L)	Total (μg/L)	Chlorophyll a	Total P	
May	7.4	37	50	56	53
June	5	56	47	59	53
July	14	21	55	52	53.5
August	11	37	53	56	54.5
Average	**9.35**	**37.75**	**51.25**	**55.75**	
Overall Average					**53.5**

TSI Ranking	
Oligotrophic	39 or less
Mesotrophic	40 to 50
Eutrophic	50 or greater

Figures 8 and 9 show the results from monthly surveys of conductivity (a measure of dissolved solids) and pH. The conductivity of Chute Pond did not change significantly from month to month nor as it was measured vertically. Conductivity did increase slightly close to the bottom, which is probably due to dissolved solids generated by the decomposition of phytoplankton. Changes in pH were also only slight and reflect a change in oxygen content and the buildup of carbon dioxide-related biproducts associated with the decomposition process.

F. Reservoir Sediment

The results from the analysis of the sediment collected from Chute Pond in August of 1997 are consistent with the findings in the 1980 DNR report. The DNR document reported organic contents between 33 and 40 percent in the top 12 inches of soft sediment. Our results indicate that percentage may have dropped to between 25 and 36 percent in areas similar to those studied in 1980. This indicates that a significant portion of the sedimentation occurring at Chute Pond may be resulting from incomplete decay of dead vegetation. Given the current vegetation population at Chute Pond, this could be a significant amount over the next decade.

Figure 8. Water Conductivity by Depth
Chute Pond, Wisconsin

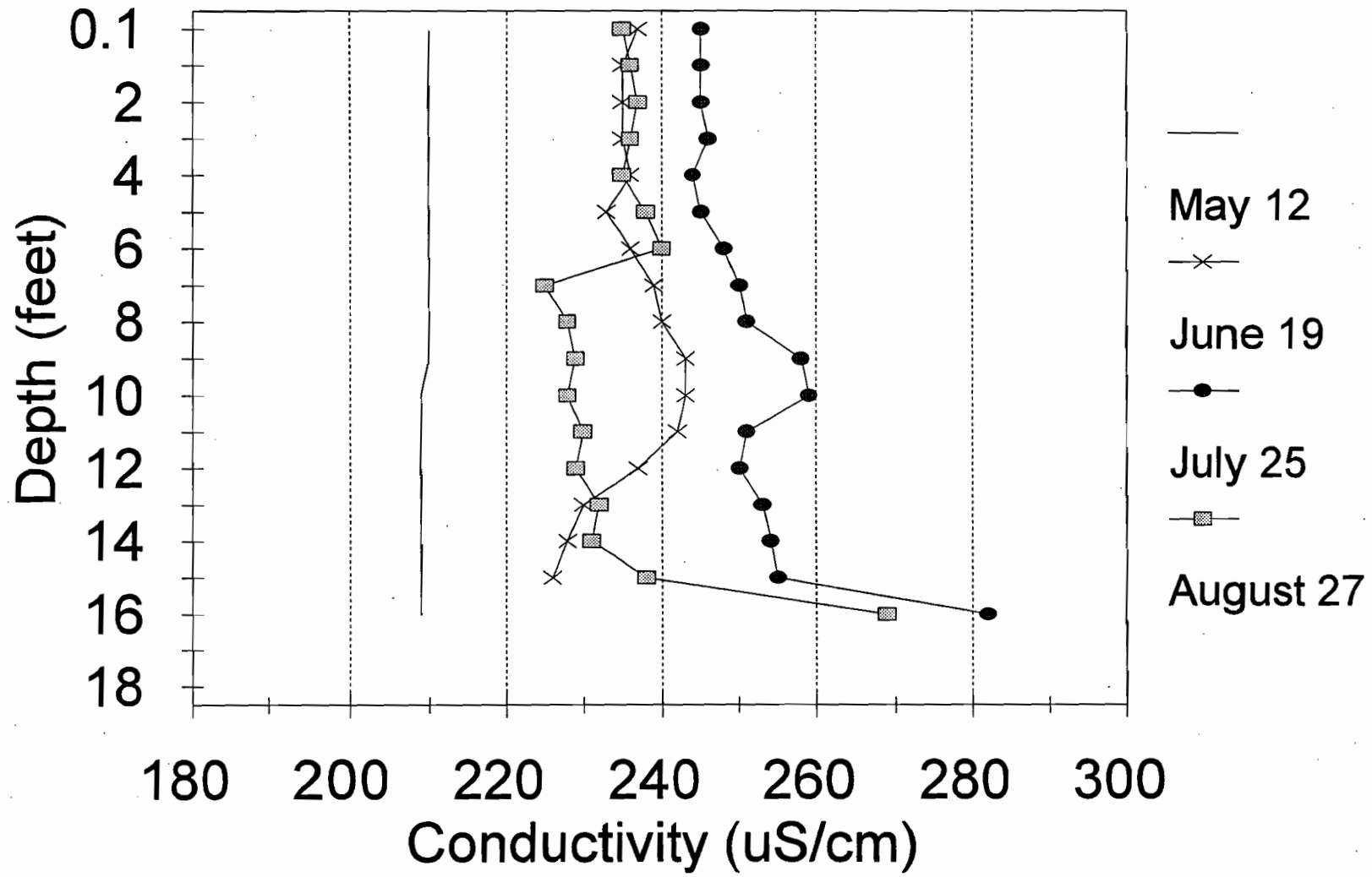
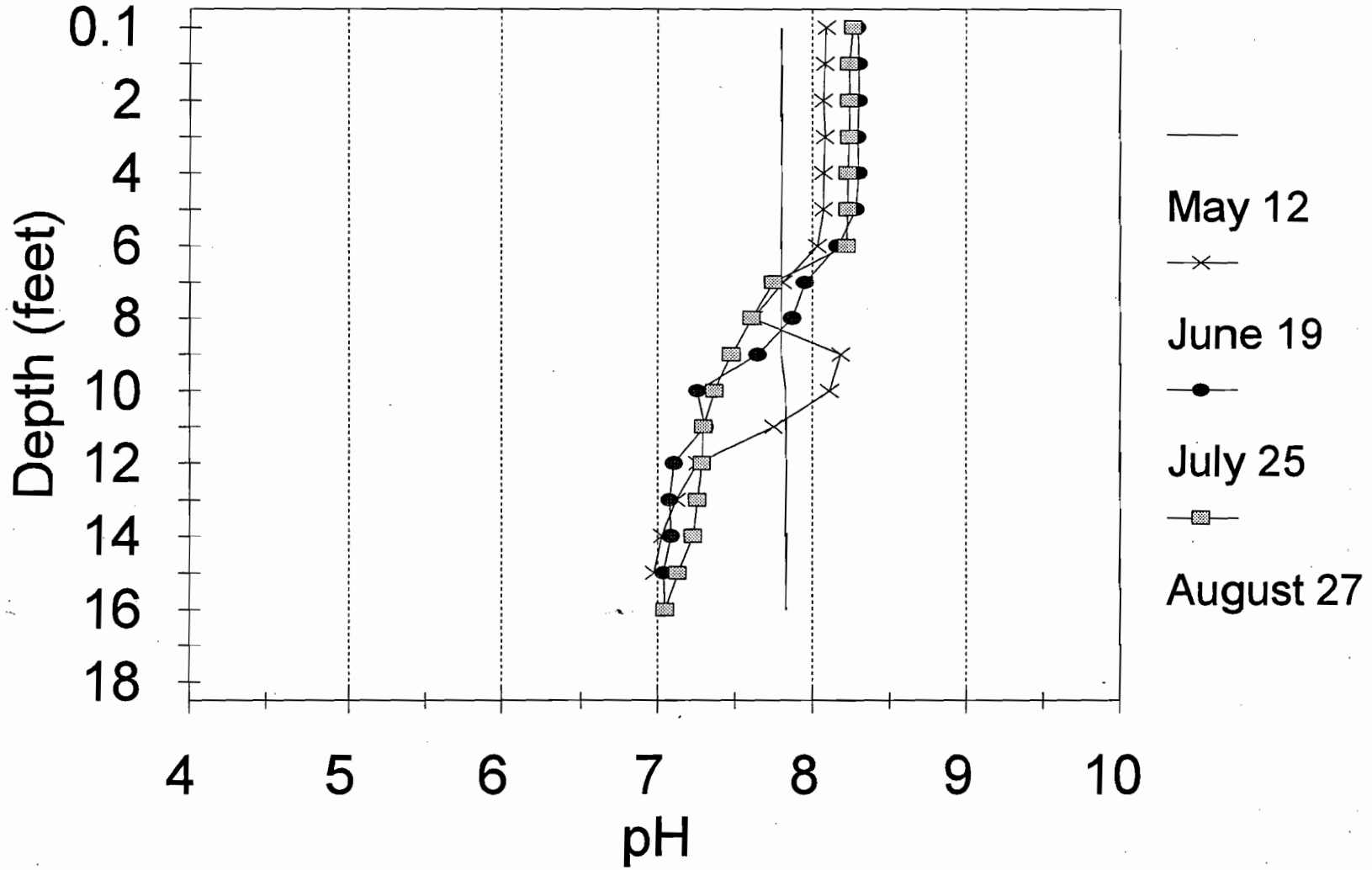


Figure 9. Changes in pH by Depth

Chute Pond, Wisconsin



The phosphorus content of the sediment is an important management consideration that the 1980 report did not discuss. Chute Pond's sediment is very phosphorus rich, especially in the deepest areas where none of it can be used by vascular (rooted) plants. This is to be expected for an impoundment lake, where fall leaf litter and other sources within the watershed can contribute very significant amounts of phosphorus annually. Unfortunately, although phosphorus in the sediment acts as the food source to support the extensive growth of vascular plants in Chute Pond, there are very few things that can be done to limit its accessibility in the sediment. However, shallow areas where sediment is stirred up by passing boats – which reintroduces phosphorus into the water column to be used as food by algae – can be addressed through the continuation and expansion of no-wake areas and times.

G. Fishery

The fishery data received by Mead & Hunt indicate that the population of largemouth bass, northern pike, and panfish are fairly healthy in Chute Pond. This study was limited, however, to only "catchable" size fish. The study only helps us understand the current population – it does not explain future year class strength. Because the study only examined data provided on fish greater than 4 inches, it provided a much more limited view of some smaller species. For example, while a 4-inch largemouth bass is a year-and-a-half-old fish, a 4-inch bluegill could be between 3 and 4 years old; therefore, any fish younger than this would not be surveyed. Since the smaller-sized fish are often both the food source for the older fish and the fish that will be caught in future years, information on their numbers is important to understanding how fishing will be in the future. From information that now exists, it appears as though the population of Chute Pond fishery is in fairly good shape.

6. Recommendations

Based on the data collected and analyzed, Mead & Hunt recommends the following improvements:

A. Continue Weed Harvesting Program

In his September 23 letter to CLPRD, Perry Rossa states:

> With visibility between 5 and 6 feet, Chute Lake is reasonably clear for an artificial drainage lake with stained water and potentially high nutrient loadings. From this perspective, your existing aquatic plant harvesting program provides an extremely important water quality benefit by annually removing phosphorous bound up with the aquatic plants. Based on an average phosphorous content of about 4 ounces per ton of wet weeds, your harvest removes about 450 pounds of phosphorous from the lake each year. This is based on the harvest rates we discussed during the field trip – 12 loads/week @ 6 tons/load for 16 weeks, for a total of 1,152 tons per year. Outside of the obvious recreational benefits, this aspect of the weed harvesting is probably most crucial for the long-term health of the Chute Lake ecosystem.
>
> Based on our assessment, stopping the weed harvest would have significant adverse effects on water quality and the existing aquatic plant community. Without harvesting, milfoil and coontail would probably quickly overtake much of the frequently used, shallow-water areas of the lake, out-competing the valuable pondweeds and water celery to the detriment of the structure, diversity, and wildlife value of the plant community. Phosphorous loadings would rise, leading to a significant excess of nutrients and algae blooms. Oxygen depletions during subsequent decay of the algae blooms could also be encouraged by the warm, stagnant water conditions caused by heavy mats of milfoil and coontail.
>
> While some native plants are certainly harvested in the existing program, the overall impact of the program is highly beneficial, and we strongly recommend that the Chute Lake Protection and Rehabilitation District make every effort to continue it.

B. Collect Oxygen Profiles

The CLPRD will want to implement a program to collect monthly oxygen profiles to assess the extent of the period where the deeper areas of Chute Pond have little to no oxygen. During our investigation, we determined there is a significant amount of water volume that fish and other aquatic life may avoid due to low oxygen levels. This should be investigated further to assess whether it also occurs at other times of the year. Ultimately, CLDRP may also want to investigate the prospect of installing aerators in some of the deep sections of Chute Pond. As previously discussed, the bacterial decomposition of organics in the deeper areas of Chute Pond are causing them to become anaerobic, reducing oxygen to below 5 mg/L under 12 feet. In addition, the lack of oxygen for bacterial action has allowed for the gradual accumulation of organics in the lake bottom sediment. Because the bottom sediment is currently between 25 and

40 percent organics by weight, an aerator would provide the oxygen necessary for the decomposition of this material, and could substantially curtail the rate at which these deeper areas of Chute Pond fill in.

Currently, a YSI brand oxygen/temperature meter can be purchased for about $1,000. Depending on the results of the oxygen survey, several companies that produce and market aerators would be very willing to assist the CLDRP in determining Chute Pond's needs. Before installation, however, the CLDRP will want to perform a much more extensive study of the bottom sediments so that effects of aeration can be adequately assessed.

C. Conduct Long-Term Water Quality Sampling

As part of the DNR's Self-Help Monitoring Program, the CLPRD should undertake annual sampling of chlorophyll *a* and total phosphorous concentrations, and measure secchi depths. The program is a statewide effort involving almost 700 lakes on which volunteers collect water quality data to identify long-term trends and emerging water quality problems. Besides serving to identify lake water quality problems at an early stage, the data helps the DNR formulate management options for different lake types throughout the state. Because the data collection does not require much time once on the water, much of it could be collected by the seasonal help the CLPRD already employs to run the weed cutter.

The basic structure of the sampling format is to sample chlorophyll *a* and total phosphorous during the ice-on and ice-off periods, and monthly from June to August, for a total of five samples. Water transparency is also measured with a secchi disk during these sample periods. Training is available through the DNR Green Bay office,[2] and most costs are borne by the DNR through joint funding with the U.S. Environmental Protection Agency.

D. Fisheries Survey

Past surveys of the fisheries population of Chute Pond appear to have been very sporadic and limited in scope. Although these shed some light on the health of the fishery, they are of little use in predicting future problems with the fishery, because there is no basis to assess the changes in population from year to year. The CLDRP should annually assess fish population to understand how changes to the management of Chute Pond have changed the fishery. The scope of this assessment should probably include investigating the same areas every year to assess changes, while other components could examine fish diets, forage populations, fishing pressure, and other areas of the lake.

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[2] Contact Scott Szymanski at (920) 492-5905.

E. Dredging

Due to prohibitive cost, dredging is not a recommended option for the CLPRD at this time. Depending on the amount dredged, the distance transported, and the costs of dewatering, dredging could cost from $5 to $15 per cubic yard. The principal benefit of dredging Chute Lake would be to achieve a water depth at which light is insufficient to sustain the growth of rooted aquatic plants. Because of the high flushing rate of the lake, no significant water quality benefits would be realized by dredging.

Because Chute Lake is an impoundment, however, the CLPRD should realize that ultimately the lake will fill with sediments, because all dams trap sediment that the rivers would otherwise transport downstream. Organic sediments produced by aquatic plants are another significant sediment source in small impoundments such as Chute Lake. The rate of sedimentation, however, can vary greatly. Based on our measurements, the deep hole of the lake has gained about one foot of sedimentation over the last 17 years. It's possible that within the next 50 to 100 years, dredging will be necessary to restore the benthic structure of the lake and remove at least part of its acreage from aquatic plant production. At that time, the target depth should be established at least one or two feet below the photic zone to prohibit plant life. The photic zone is generally considered to be twice the average secchi depth.

F. Winter Drawdowns

The CLPRD should further investigate the prospect of reducing the water level in Chute Pond during the winter. As stated in the 1980 DNR report, "(I)n Chute Pond the species affected would be the water milfoil Myriophyllum, a plant that grows to nuisance densities in the flowage." The exposure of shallower areas by drawdown may produce some control of vegetation in areas where the weed harvester cannot or should not go.

The CLPRD also considered, however, that during the drawdown period the area in which fish can live will be reduced. This will increase crowding of the fish population and may provide the unfortunate opportunity for increased fishing pressure. Prior to a drawdown attempt, it would be wise for the CLPRD to collect as much data on the fish population as necessary to accurately evaluate the effects that such a drawdown has made on the population. Ultimately, the CLPRD may need to approach the state to close fishing during drawdown periods if it is shown that increased fishing pressure is having a negative effect.

G. Watershed Protection

The CLDRP should implement a program to track development and forested areas that have a direct flow path to Chute Pond. The effects of sedimentation may be the most significant problem facing Chute Pond's future. Throughout Wisconsin, forestry practices and new construction have repeatedly caused more erosion of sediment to lakes and rivers than any other sources on a per acre basis. The CLDRP should form a focus group to regularly survey the watershed contributing to Chute Pond for construction activities, and inspect these areas to assess whether they are conforming to the erosion control Department of Work Force Development codes. Currently, there are very few regulations on erosion from forested land but it still would provide valuable information for the condition of the lake. Sediment from these sites will ultimately end up in Chute Pond and need to be dredged at the residents' expense.

H. Pursue Lake Management/Lake Protection grants

The DNR Lake Planning grants and Lake Protection grants provide an excellent funding source to obtain funds for lake studies. The deadline for application to the lake planning program is February 1 and October 1 each year. The deadline to apply for lake protection grants is July 1 of each year. Between $50,000 and $200,000 can be obtained through these programs from the DNR to finance lake quality improvements. Appendix A provides a more detailed explanation of these two programs.

Appendix A. Lake Planning Grants

LAKE PLANNING GRANTS

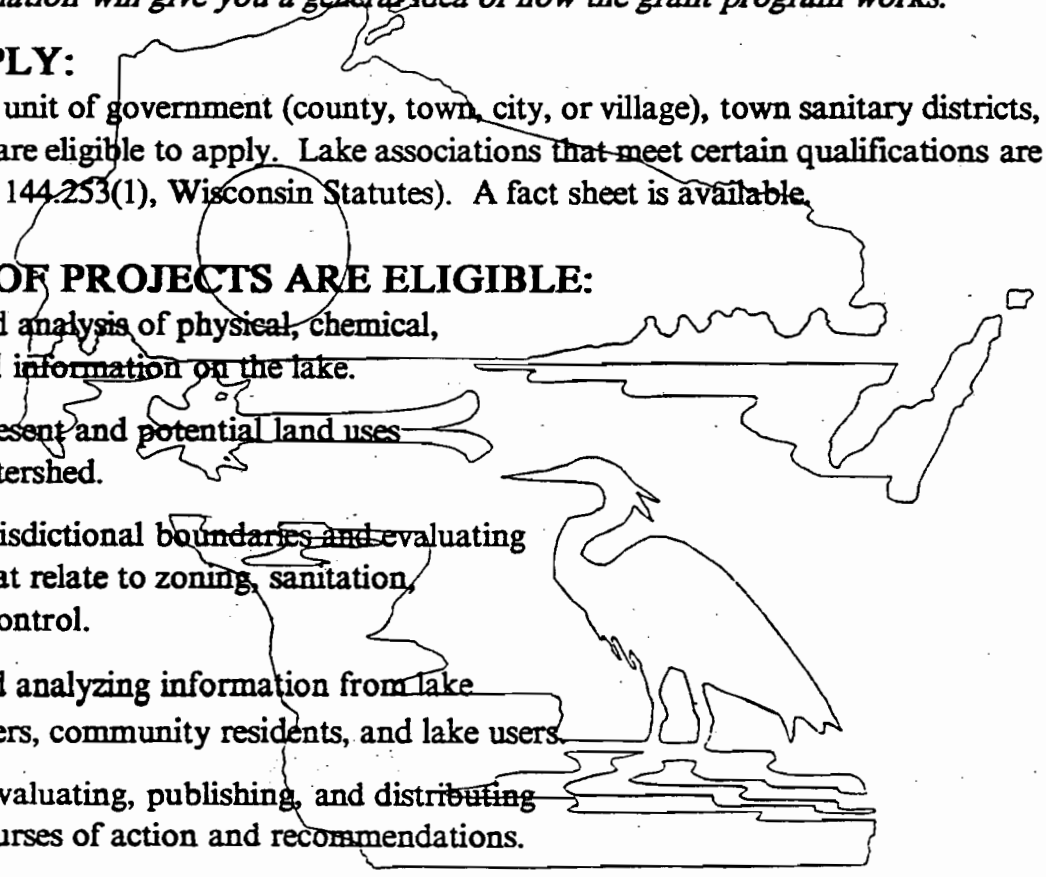
The United States has a treasure house of natural resources and Wisconsin holds the "Crown Jewels"--its 15,000 lakes. But Wisconsin's lakes are in jeopardy on numerous fronts and many lakes need help. Much of the management of lakes in Wisconsin is limited by a lack of information about the lake, the watershed, and the people who use it.

Under the Planning Grant Program, the Wisconsin Department of Natural Resources provides funding to local governments and lake management organizations for the collection and analysis of information needed to manage lakes. The program accomplishes this by encouraging local organizations to obtain basic water quality, water use and land use information that considers the broad range of factors that can affect the quality of inland lakes. Another goal of the program is to develop stronger state/local partnerships, leading to more effective watershed protection and lake management.

The following information will give you a general idea of how the grant program works.

WHO CAN APPLY:

Any general purpose unit of government (county, town, city, or village), town sanitary districts, and all lake districts are eligible to apply. Lake associations that meet certain qualifications are also eligible (Section 144.253(1), Wisconsin Statutes). A fact sheet is available.



WHAT TYPES OF PROJECTS ARE ELIGIBLE:

- Gathering and analysis of physical, chemical, and biological information on the lake.
- Describing present and potential land uses within the watershed.
- Reviewing jurisdictional boundaries and evaluating ordinances that relate to zoning, sanitation, or pollution control.
- Gathering and analyzing information from lake property owners, community residents, and lake users.
- Developing, evaluating, publishing, and distributing alternative courses of action and recommendations.

HOW MUCH MONEY IS AVAILABLE:

The state may pay for 75% of the cost of a planning project. The remaining 25% must be provided by the local organization from its own revenues or cash contributions from other non-state and non-federal sources. One or more grants may be made to your lake during each two-year state budget period. The total amount of state dollars cannot exceed $10,000 during each two-year period, or $30,000 during the life of the program.

The program has funded 74 grants totalling $650,000 since October of 1990. The budget for this program contains $450,000 per year. *Because grant requests have exceeded funds a ranking procedure has been needed.*

APPLICATIONS:

Applications are due by February 1 and August 1 of each year. The initial review is conducted by each DNR District Office where a decision on eligiblity is made and the project is ranked. A statewide priority list is assembled in Madison and grant agreements are processed. Decisions on each application are to be made within 60 days (April 1 and October 1).

Upon awarding the grant, the state provides 75% of its share based on estimated cost of the planning effort (75% of its 75% share). The remaining 25% is sent to the district after receipt of the final report. A final report is necessary at the conclusion of each grant. A summary of that document must be prepared for distribution to local property owners and interested citizens.

RANKING:

The following are some of the criteria:

- The degree to which the project provides a holistic set of alternatives to assist local decision-making in the formation of a strategy to enhance or maintain a lake's quality.
- The degree to which the project will enhance knowledge of a lake's water quality.
- The degree to which the project will enhance knowledge of a lake's watershed.
- How much the public uses the lake and the availability of public access.
- The extent and means by which information about the project will be distributed.
- The degree to which the project complements the use of other community funds for the project and other lake management efforts.
- The level of support for the project from other affected management units.

WHERE TO FIND MORE INFORMATION:

Application forms and more information are available from DNR District Offices or County Extension Offices. Some information can be gathered by your own members with the guidance of agency professionals. Private consultants are available to assist you in gathering other information. A list of consultants, without endorsements, can be obtained from UW-Extension, College of Natural Resources, University of Wisconsin, Stevens Point, WI 54481 (715/346-2116) or your DNR district lakes coordinator.

6/92
LKPLGR