THE STATUS OF TWENTY FOREST COUNTY LAKES - 1997

A Limnological Survey

Conducted by

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Table of Contents

Table of Figures

Table Of Tables

INTRODUCTION

In 1993 the Forest County Association of Lakes (FCAL) was formed to serve as a forum for education and information exchange on lake issues. In 1994 the group applied for a lake planning grant through the Wisconsin Department of Natural Resources (WDNR). The grant, the first given for a county wide project, was approved and work began in 1995. Below is a portion of the grant application as it was submitted:

" REASON FOR STUDY

" FCAL is concerned about the effect of man's activities on area lakes. We feel it is necessary to begin collecting new data in order to develop plans for the protection of our lakes. This study will look at development, land use, recreational use and natural factors, specifically aquatic macrophytes and shoreline habitats and morphology , in order to establish a baseline for recommendations and comparison in the future. We feel a study of this nature will help to "put some teeth" into current zoning ordinances and provide a concrete starting point for the development of ordinances and other protective measures. This study provides meaningful information that would not otherwise be collected through general water quality projects. The information will be useful to the lake residents, municipal governments, the WDNR and other public and private groups.

"GOALS OF STUDY

1. Map current development on twenty of the more heavily developed Forest County lakes.
2. Map current shoreline use and habitat on those same lakes.
3. Estimate areas of possible future development - recommend areas for restricted development based on shoreline morphology, habitat and water quality considerations on the same lakes.
4. Compile current lake property values on at least ten of the twenty lakes.
5. Map current macrophyte populations on the twenty lakes in order to:
   A) Provide point-in-time data for future comparison.
   B) Identify areas for limited/restricted recreational use.
   C) Identify exotics for development of management strategies.
   D) Identify endangered/threatened species.
6. Compile data on current recreational use on at least five of the twenty lakes.
7. Collect water quality data on at least ten of the twenty lakes.
8. Make this information available to interested parties.

COLLECTION OF DATA

This study is a very broad collection of data meant to act as a baseline for the future or an indicator of the necessity for further testing. Because of the nature of the study and the fact that we are dealing with a large number of lakes, we have included data generated during other recent limnological projects, where available. The following is a description of how the data included was gathered. All supporting information will be retained at NLS. Copies will accompany the report to WDNR and a packet of information pertaining to each lake will go to that lake association or district.

WATER QUALITY

The water quality data included in this report falls into the following categories:
1. Samples collected and analyzed by the Wisconsin Department of Natural Resources over the past seventy years;
2. Samples collected and analyzed by Northern Lake Service;
3. Samples collected by lake volunteers and analyzed by NLS; and
4. samples collected and analyzed by other consultants and/or volunteers.

1. For many years the DNR has sampled Wisconsin lakes under several different programs. While they usually utilize state-of-the-art analytical methodology, state-of-the-art in 1934 was not what it is today. The older data is interesting, but direct comparison to numbers generated recently is not always practical. The DNR data included in this report comes from WDNR files in Rhinelander, WI, a WDNR publication called Water Quality of Selected Wisconsin Inland Lakes 1974-1975 and the Surface Water Resources of Forest County 1977. This second publication is an inventory of all Forest County water bodies and is an excellent source of information. Unfortunately, much of the information was already out dated when the book was published in 1977. This book will be referred to by the abbreviation SWRoFC in this report and will be referenced many times.

2. Water quality data from Crane, Ground Hemlock, Pickerel, Pine, and Roberts Lake was generated as portions of recent limnological studies. The scope of these studies is outlined in the opening narrative for each individual lake. The samples from Metonga and Silver Lakes were collected by NLS personnel specifically for this study.
The water samples were collected in a two meter PVC column sampler inserted vertically into the lake surface. The column is then allowed to mix in a large collection vessel from which final samples are drawn. In deeper lakes where samples were drawn at more than one depth, a brass Kemmerer bottle was used. Samples were preserved immediately after collection where applicable. Conductivity and pH were determined in the field.
All analysis was performed at Northern Lake Service in Crandon. NLS is a certified environmental laboratory. Although there is no certification for surface water monitoring in Wisconsin, the samples were analyzed using methodologies and quality assurance requirements from the state and federal groundwater and wastewater programs.

3. Samples from St. Johns, Windfall, and Lily Lake were collected by FCAL volunteers who were trained by NLS staff to follow the procedure above. Samples were iced and delivered to NLS within a few hours. In these cases pH was determined upon arrival at the lab.

4. Water quality data from Arbutus, Butternut, Franklin were collected and analyzed by sources other than DNR or NLS. It is assumed that care was taken in collection and that appropriate analytical methods were utilized, but the author is not in no way responsible for the data aside from including it in this report.

WATER QUALITY PARAMETERS: Water quality samples were analyzed for several different combinations of parameters. Below is a brief explanation of these parameters:

Alkalinity - This is a measure of certain dissolved compounds, mostly carbonates, which neutralize acid. The lower the alkalinity the greater the effect acid rain may have on the lake. According to WDNR, lakes with alkalinity levels below 13.5 mg/L are highly susceptible to adverse effects of acid deposition. Lakes with levels between 14 and 32 are susceptible, and those with levels above 32 are not susceptible. Table 2. shows alkalinity levels as they pertain to acid susceptibility for the lakes in the study group.

Chloride - This is a common ion which can be greatly influenced by the activities of man. High levels can indicate septic contamination, industrial pollution, heavy water softener use and road salt runoff. Chloride levels in our lakes are generally less than 5 mg/L.

Conductivity - This is a measure of water's ability to conduct electricity. Conductivity is directly related to dissolved compounds in the water. Pure water is unable to conduct electricity. This measurement is often used to "sniff out" septic leakage to a lake.

Nitrogen, Ammonia - This component of total nitrogen is often an indicator of septic contamination. It is also a naturally-occurring breakdown product of many natural processes and levels often fluctuate seasonally. High levels can be detrimental to many organisms. From a water quality standpoint, generally speaking for this parameter and the next three, the lower the better.

Nitrogen, NO2+NO3 - Nitrate and nitrite are inorganic components of total nitrogen. High levels can indicate industrial or agricultural contamination (or excessive lawn fertilization).

Nitrogen, Kjeldahl - This value minus the ammonia, is the organic nitrogen in the system. Kjeldahl plus NO2+NO3 represents the total nitrogen. Nitrogen is one of the major nutrients responsible for plant and algae growth in a lake. Kjeldahl levels may vary greatly from lake to lake and will commonly run between .2 and 1.1 mg/L

Phosphorus - This nutrient often determines the productivity of a lake system. Levels of .015 mg/L or greater are capable of supporting nuisance plant or algae growth. Very high levels are often attributed to severe agricultural contamination, but can also occur due to internal recycling in a highly productive system. A popular water quality model (Lillie and Mason, WDNR 1983) maintains that levels of .03 mg/L or less indicate good water quality.
NOTE: Generally if the ratio of nitrogen to phosphorus is greater than 13:1 then phosphorus levels determine the productivity in the system. If the ratio is less than 13:1 then nitrogen drives the system. This is called the *limiting factor*.

pH - This is the measurement of acidity on a logarithmic scale from 1 to 14. 1 being more acidic, 14 more basic and 7 neutral. The "soft water" lakes, those with and low alkalinity and often naturally acidic water are more susceptible to the effects of acid rain.

Secchi Depth - This is measure of water clarity and light penetration. A black and white disc is lowered into the water until it can no longer be seen from the surface. It is then lowered a few more feet and brought back up slowly until it reappears. The average of these two depths is the Secchi depth. Over a long period of time and with frequent readings, this is a very simple and inexpensive way to track trends and monitor the effects natural phenomena and man's activities have on water quality. The general assumption is as follows:

> Clarity is decreased with an increase in algae in the water column.
> The amount of algae increases with an increase in nutrients - usually phosphorus.
> Phosphorus levels generally indicate the trophic state/health/age of a lake.

So, GENERALLY, the greater the Secchi depth the better the water quality .

WATER QUALITY MODELS: In each water quality section there is table figure entitled "Lillie and Mason Water Quality Model / Carlson Trophic State Index". These are two commonly used water quality models superimposed on one another. They <u>both</u> use phosphorus and Secchi depth as indicators.
The terms used in the Carlson model refer to a lake's level of productivity. Eutrophic lakes are very nutrient rich and support extensive plant and/or algae growth. These are highly productive systems. Mesotrophic lakes have plenty of nutrients and may at times experience nuisance algae or plant growth. Oligotrophic lakes are nutrient poor systems. They are generally characterized by very clear water and sparse plant growth.

MACROPHYTES

All macrophyte surveys were completed by Northern Lake Service between 1991 and 1997. The following method was utilized on each lake:

A grid is drawn on a map of the lake so that the intersection points give a good representation of the littoral zone (the area in which light reaches the bottom). In most cases the area was assumed to be that which fell outside the twenty foot contour line. These intersection points represent the sample stations. Generally, 50 - 80 stations were sampled, though the actual number ranged from 32 on one of the smallest lakes to over 100 on Lake Lucerne where the shape of the lake both vertically and horizontally made a traditional grid difficult to use.
Several of the grids were modified slightly in the field.

Once on the lake, the map, a compass and visual estimates are used to locate the sample sites. GPS was not used on these surveys.

At each station a circle of approximately ten feet in diameter is visualized and divided into quadrants. Vegetation is then collected, identified and ranked as follows: 1 if present in one quadrant, 2 if present in two 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 determined, but they are included on the species list.

If a specimen is not identified to species it is referred to by the generic name followed by "sp" ("spp" is used to refer to more than one species within a given genus.)

Water depth and bottom type are also recorded at each station.

Included in this report is a community/density map, and a species list. Appendix A at the end of this report is a glossary of all the species and several pages of diagrams.

Each lake group will receive a sample site map and a copy of the field sheets completed during the survey.

SHORELINE SURVEY

The shoreline survey is simply a record of current shoreline use and condition. This includes shoreline development, vegetation, slope, and other factors that can effect water quality.
This report contains a summary of the survey. Each individual lake group will receive a transcript of the entire survey. A simple development factor, generated by dividing the number of dwellings by shoreline length in miles, is given in this section along with the shoreline development factor. The shoreline development factor, S.D.F., is a shoreline to surface area ratio. A perfectly circular lake would have a S.D.F. of one; the more shoreline, bays and points, per acre of water surface, the greater the S.D.F. S.D.F. values come from the SWRoFC.
This section contains also contains property value information. The information was gathered from both 1996 and 1997 roles, so inconsistencies may exist.

RECREATIONAL USE

Recreational use of a water body is usually at the heart of controversy and concern among lake residents, but it is seldom looked at objectively. While it may not be useful on its own, this information helps in making recommendations and prioritizing preservation/remediation strategies.
A "low tech" approach was used for gathering recreational data for this report. Lake volunteers were given a simple form and asked to complete it as many times as they wished. It was suggested that they choose several different times on several different days - including a "big" weekend day and quieter week day.

The volunteers simply cruised the lake and recorded a hash mark for each person or group of people engaged in a specific activity.

Recreational use data was collected on 9 lakes.

RECOMMENDATIONS

Most planning grant studies are focused on an individual lake with specific concerns. Some of the lakes we looked at in this study, Crane, Pickerel, Pine, Trump and Windfall, are currently addressing problem areas. Most of the others do not have serious problems. Therefore, these recommendations are mainly simple protection/preservation practices. The most important thing to keep in mind when it comes to lake management is that it is relatively easy to keep a lake in good shape and often nearly impossible to bring one back once it has been damaged. The adage "an ounce of prevention" has no better example than a lake.

NOTE: All fishery information was provided by Forest County DNR fish biologist Steve Avellelement in the fall of 1997.

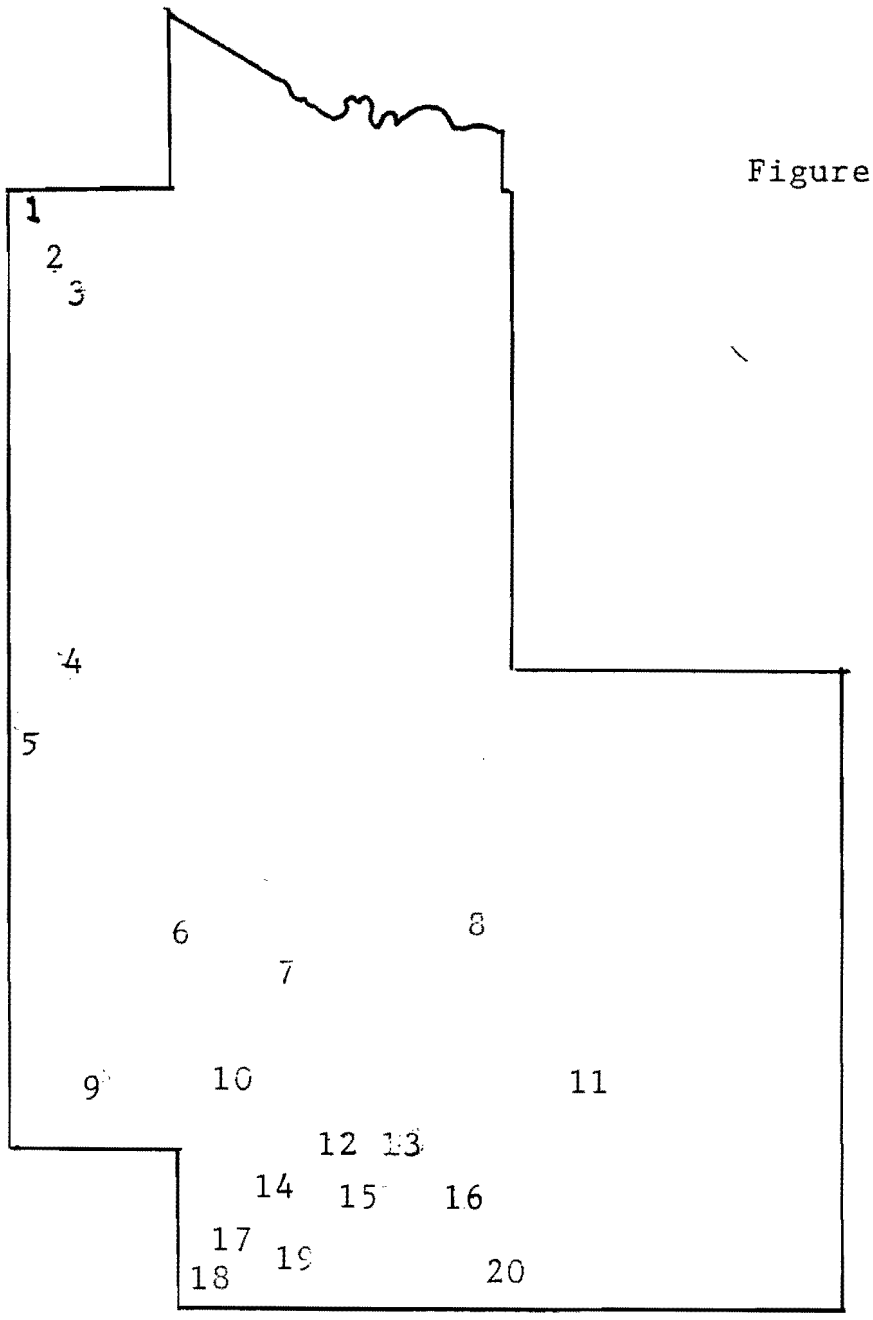


Figure 1. Study Lake Locations

1. Kentuck
2. Franklin
3. Butternut
4. Pine
5. Little Rice
6. Metonga
7. Lucerne
8. Silver
9. Mole
10. Ground Hemlock
11. Trump
12. Jungle
13. Roberts
14. St. Johns
15. Lily
16. Little Long
17. Crane
18. Pickerel
19. Arbutus
20. Windfall

TABULAR DATA OF FOREST COUNTY LAKES

Named Lakes	Location Sec.	T-N	R-E	Surface Acres	Max. Depth (ft.)	Miles of Shore-line	Miles of Public Shore-line	S.D.F.	% Muck Lit-toral Zone	Water Source*	M.P.A. (ppm)	Conductance 770 u.	pH	Water Color	Water-shed Area (sq.mi.)	Adjoin-ing Wetlands (acres)
Arbutus	27	34	13	161	35	2.53	.00	1.4	15	S	20	78	7.3	C	0.8	65
Bradley	26	35	13	49	26	1.60	.00	1.6	30	S	72	120	7.9	C	0.3	8
Buttermut	28	40	12	1,292	42	7.80	2.14	1.5	10	SPR.	45	101	7.4	C	11	35
Crane	20	34	13	341	26	3.83	.03	1.5	25	SPR.	110	191	7.9	C	3.9	35
Franklin	16	40	12	892	53	6.40	4.29	1.5	0	DR.	18	42	7.1	C	6.2	5
Ground Hemlock	33	35	13	88	42	1.81	.00	1.4	10	SPR.	110	196	8.5	C	0.9	8
Jungle	2	34	13	182	12	2.18	.00	1.2	20	D	49	103	8.0	C	2.5	28
Lily	14	34	13	211	25	2.88	.19	1.4	30	D	106	222	6.6	C	12.3	90
Little Long	17	34	14	102	28	2.40	.01	1.7	15	S	8	20	6.4	C	0.7	15
Little Rice	17	36	12	1,219	10	14.1	5.29	2.1	70	D	35	81	7.1	MD.BR.	45.0	130
Lost	36	35	13	75	10	1.80	.00	1.5	55	DR.	22	53	7.2	C	0.7	18
Lucerne	10	35	13	1,026	73	8.38	.01	1.8	2	DR.	22	61	6.9	C	11.3	11
Metonga	8	35	13	2,157	79	7.48	.28	1.1	5	D	80	192	7.2	C	7.0	0
Mole	34	35	12	73	17	1.95	.08	1.7	30	S	26	71	7.0	LT.BR.	0.9	18
Pickerel	30	34	13	1,299	14	8.14	.05	1.6	75	D	82	160	8.8	C	10.2	45
Pine	22	37	12	1,670	14	6.42	.46	1.1	25	D	35	90	7.6	C	14.0	147
Roberts	6	34	14	452	32	5.06	.06	1.7	15	SPR.	95	187	8.2	C	5.4	35
St. Johns	9	34	13	96	20	1.80	.00	1.3	10	S	13	20	6.3	C	0.9	18
Silver	35	36	14	320	20	4.06	.04	1.6	15	DR.	21	162	7.0	C	1.0	18
Trump	31	35	15	172	20	2.78	.08	1.5	35	DR.	21	51	8.0	D	1.3	10
Windfall	33	34	14	55	26	2.19	.01	2.1	75	D	120	234	8.2	C	1.6	15

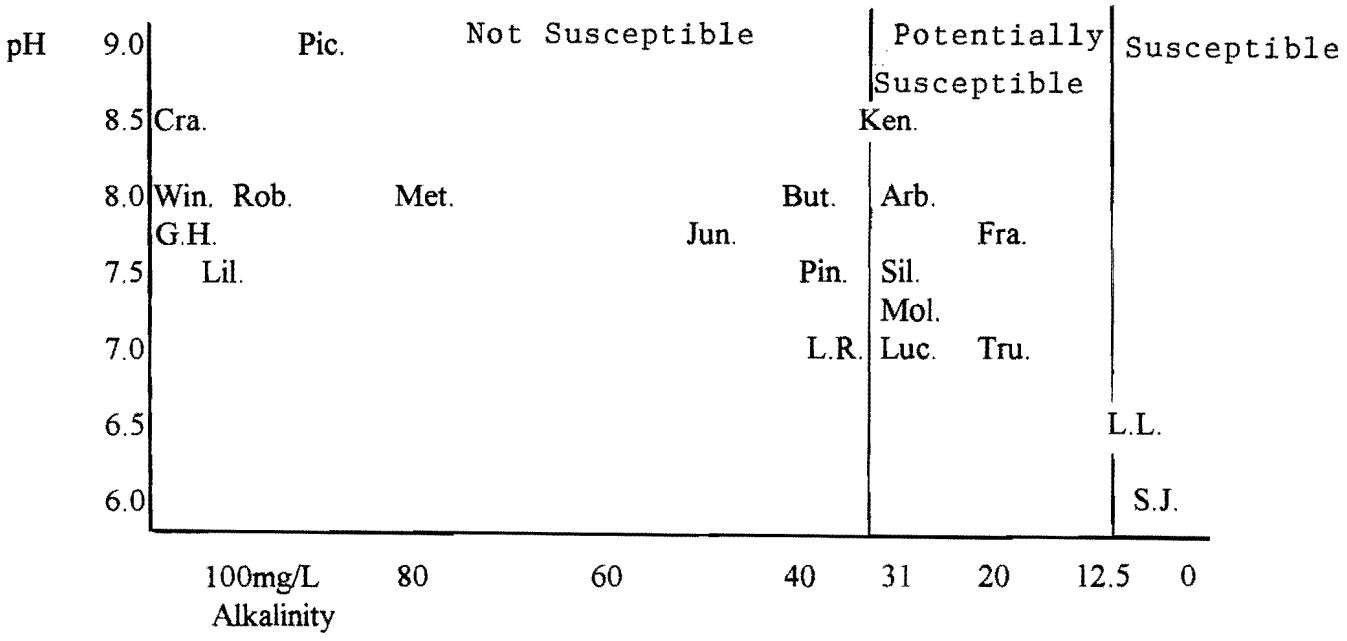
THE STUDY GROUP

The lakes in the study group were chosen based on several criteria: First the largest most heavily developed lakes were selected. Then development, susceptibility to development or other detrimental activity, and value as a recreational resource were considered. Figure 1. shows the general location of the lakes in the study group and Table 1. is general physical and water quality characteristics of those lakes chosen. This information is taken directly from SWRoFC.

WATER QUALITY

Each specific lake section in this report contains water quality models for that specific lake. The only data that will present all lakes in one table will be alkalinity levels which indicate susceptibility to acid rain. This data is shown below.

Table 2. Acid Rain Susceptibility.



MACROPHYTES

Fifty-four different taxa of aquatic plants were collected during the aquatic plants surveys. This probably represents 60 to 65 different species. Only species growing in truly aquatic habitats were recorded; semi-aquatics were not. *Potamogeton*, the pondweeds, a very common and diverse genus was represented by at least two members in all lakes except St. Johns. Each of these lakes had at least one large leaf and one narrow leaf pondweed. (Most of the narrow leafs were not keyed to species.) The single most common species was *Nymphaea odorata*, the white water-lily. It was present at 19 of the twenty lakes. (Also absent on St. Johns Lake.) *Chara vulgaris*, a colonial algae that resembles a green plant, was the most common submerged "plant." It was present on 17 lakes.

Exotic species were quite rare. *Myriophyllum spicatum*, Eurasian milfoil was only found in Lake Metonga and *Lythrum salicaria*, purple loosestrife was present in or near Kentuck, Metonga, and Lucerne. The purple loosestrife is still limited to very small isolated beds and could be eradicated from these areas with little effort. No other exotic species were collected.
No threatened or endangered aquatics were collected, but *Utricularia purpurea*, purple bladderwort, a "special concern" species was abundant in Little Long Lake.

SHORELINE USE

The lakes in the study group provide a vast array of shoreline use and development examples. Several have been heavily developed for over seventy years. Pine and Pickerel show the signs of years of poor shoreline management on large shallow lakes. Windfall demonstrates the effects of agricultural contamination.
On the opposite end of the spectrum are lakes like Jungle and Ground Hemlock which, although relatively heavily developed, have retained a very "wild" look. Ground Hemlock has recently had a number of residents who have decided to buck this trend and have built very close to shore and/or removed all of the natural vegetation.
Each lake has at least one example of wise development and one of not-so-wise development. Most of the lakes have areas that are still available for development. Some are still in the earlier stages of development. And development on most of the lakes, even those that were already heavily developed has increased dramatically over the last twenty-five years.

An off-lake development issue is causing concern on Little Long Lake and Arbutus Lake. These lakes are very close to small lakes that have recently been divided into several small lots. The concern is that these small lakes provide little recreational potential themselves and residents may want, or expect, to use the nearby larger lakes. Lake residents should explore the legality and likelihood of "Dockaminiums" or other lake use schemes which may be attempted on these lakes and others that may be subject to the same recreational pressures in the future.

Because of the relatively small watersheds of most of these lakes and the general lack of agricultural, industrial and urban influences, shoreline development is the main factor effecting the water quality of Forest County lakes. A faulty septic system could contribute the same amount of nutrients to a small seepage lake over a summer that would have taken Mother Nature years. A shallow bay that might take several hundred years to fill in naturally can undergo significant sedimentation over the course of a decade if it is subject to improper development. And a relatively clear lake can be turned to "pea soup" by overzealous lawn fertilization.

Wise shoreline use recommendations are often simple and inexpensive. Several are outlined on page 11.

RECREATIONAL USE

The number of lake users and variety of recreational activities has increased astoundingly over the past few decades. This has lead to an increasing number of user conflicts. Improper recreational use of a water body can also lead to a reduction in water quality.

Data was collected to establish point-in-time usage and help determine whether or not ordinances need to be adopted to lessen user conflict and protect sensitive areas.

Most of our lakes do not see the kind of over crowding common in other places, however nearly all of the lakes have at least one area that should be protected from high impact recreational activities. These are usually shallow bays with organic "muck" bottoms or areas of dense, diverse vegetation that support wildlife. These areas act as "nutrient sinks" and disturbing them can physically cloud the water and release large amounts of nitrogen and phosphorus. Protection can be attempted by passing ordinances, buoying the area or simply through education.

Little Long Lake has the most potential for recreational overload. During one of the survey times there were ten high impact activities occurring at once. That is one per ten acres of lake and would equate to about 60 waterskiers, 60 jetskis and 85 other speed boats on Lake Metonga - at once.

Ground Hemlock, Jungle and Windfall Lakes have motor/wake restrictions that limit these lakes to low impact activities.

RECOMMENDATIONS

As the shoreline section states, development and land use is the main factor effecting our lakes.

Several simple practices can dramatically reduce the effect we have on the water quality of our lakes:

Buffer strips: A buffer strip is a strip of sturdy vegetation near the shore that slows runoff from lawns, roofs and driveways. Unchecked runoff can lead to serious erosion problems and often carries significant amounts of sediment and nutrients to the water. A buffer strip will also help stabilize the shore and keep it from eroding. It is preferred over seawalls because it does not cause erosion problems on adjacent shoreline or destroy semi-aquatic habitat as seawalls can.
Lawn grass is a poor buffer as it tends to lie down and allow water to pass over it.
The easiest way to establish a buffer strip is to simply "let it go." Do not mow or remove vegetation growing within twenty or so feet of the shoreline.
Buffer strips are usually thought of as natural vegetation, but Roberts Lake has a nice example of a domestic floral buffer strip noted in the shoreline survey.
If a natural buffer strip does not seem to establish itself, there are native seed mixes available that could be tried.

Terracing: On very steep slopes it may be necessary to build terraces. It is very important to plan and construct these carefully so they do not intensify an erosion problem.

Septic Maintenance: This is particularly important at dwellings that are near the level of the lake. Learn the signs of septic failure, pooling or foul odors at the drainfield, a toilet that "won't flush", and thick, isolated algae or plant growth near shore.

If large scale septic failure is suspected a more direct may be taken. On Pickerel and Crane Lakes residents were surveyed to determine system's susceptibility to failure. The systems were then formally surveyed and prioritized for updating. Lake district status is necessary to have enforcement power for this type of program, but an association can initiate a survey of the systems on their lakes - age of system, setback, slope, usage, etc... - to help determine the necessity for such an effort.

Protection: Each lake section in this report contains identification of areas that should not be disturbed. These include shallow areas with flocculent (loose) sediment, which act as nutrient sinks; thick vegetation at inlets which acts as nutrient sponges and often provide valuable habitat to wildlife; and wetlands that are easily damaged and cannot properly support development.

Exotics: The threat of invasion by exotic species increases each year. Each lake group should be encouraged to form a committee to learn the few potential invaders and develop a plan of regular monitoring for them. Purple loosestrife and Eurasian milfoil are in the county and should be watched for very closely. Curly pondweed was not collected during this study but should also be paid some attention.

Near Lake Development: Lake groups should try to stay up to date on development projects near their lakes and what effect they might have on the lake. Situations sure to effect Little Long and Arbutus Lake have already been discussed and many other lakes are dealing with "back lot" issues.

Preserve Shore Cover: Maintaining a natural shoreline was the main recommendation from the county fish biologist. These areas act as nurseries for young fish.

Lake Philosophy: Do not take for granted that a general practice on a lake will be adhered to by new residents. Like groups should try to agree to a set of ideals that can be presented to new lake residents or potential residents. This may include development and recreational guidelines not addressed by ordinances. A lake philosophy can not be enforced.

The UW Extension and DNR have produced many helpful brochures on wise land use. So many however, that the mere volume of material may discourage readers. The best approach for lake groups to turn information into results is:

1. Customize: Weed out the information that is not applicable. The resident whose cottage sits a foot above the level of the lake needs information on septic maintenance and alternatives. The waterski enthusiast needs information on the protection of sensitive areas.
2. Deliver: The tendency seems to be for those who understand lake dynamics and protection to attend all the meetings and read all the literature. An effort needs to be made to get information into the hands of those who do not possess that understanding.
3. Teach: Although it does not always make a difference, it is important to teach residents why they should maintain a shoreline buffer strip, rather then informing them that they better maintain one. The first approach to preserving and protecting our lakes should be as non-confrontational as possible.

ARBUTUS LAKE

Arbutus Lake is a 161 acre, soft water lake located in southern Forest County. Though classified as a seepage lake, a lake which has no inlet or outlet and is fed by precipitation, runoff or ground water, Arbutus does receive some water from an adjacent tamarack and black spruce bog. During high-water periods the lake drains into Grass Lake via a culvert. Arbutus currently supports a strong, naturally reproducing bass population and a stocked population of walleyes along with panfish.

From 1994 to 1995 Northern Environmental Technologies performed a lake management study of Arbutus Lake. Much of the following information comes from that study, issued in April of 1996.

Water Quality

Table 3 is a copy of the water quality information included in the Northern Environmental study. The analysis was performed by the Wisconsin State Laboratory of Hygiene.

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model — Carlson Trophic State Index

	Phosphorus	ARBUTUS	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030	•	6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

Sixty-nine stations where sampled on a grid covering the entire lake except for a small portion on the north end which fell within the 20 foot contour on the map. All but seven stations supported plant growth to some extent. Twenty-six different taxa of aquatic plants were collected, including four floating-leaf species and two emergent species. The emergents were limited to the very southern end of the lake and to a lesser extent in the south eastern portion of the lake. These areas also displayed the most diversity. Nine different species were present near a sample site located in the southern bay. Since this area represents a relatively small portion of the surface of Arbutus, the plants here should probably be protected or at least tolerated as a refuge for wildlife.

While aquatic plants are plentiful throughout the rest of Arbutus Lake, the types of plants present seldom become a nuisance. Most are low-growing, "sand-loving" species that frequently do not even extend out of the substrate. The most common species was *Valisneria americana* or eel grass, which can become a nuisance, but at least at the time of this survey seldom surfaced. This species was collected at over half of the sample stations and grew from depths of two to 13 feet. *Chara*, a colonial algae which resembles a green plant, was the second most commonly collected macrophyte. It was collected at one forth of the sample stations to a depth of 22 feet - deeper than any other plant in Arbutus. As is quite common in soft water lakes, Arbutus lacks large "structural" plants, cabbage to fisherman, though the *Valisneria* and water lilies undoubtedly provide food and shelter for the fishery.

Table 4. Arbutus Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	7.3	2.4	2.5 - 4.0
Chara vulgaris	24.6	2.9	4.0 - 20.0
Elatine triandra	4.4	2.3	3.5 - 6.0
Eleocharis acicularis	23.2	2.5	2.0 - 11.0
Isoetes sp.	17.4	1.8	3.0 - 6.0
Juncus pelocarpus	14.5	2.0	3.0 - 6.0
Lobelia dortmanna	5.8	1.0	3.5 - 4.0
Musci sp.	5.8	1.0	16.0 - 22.0
Myriophyllum tenellum	2.9	2.0	3.0 - 4.0
Najas flexilis	17.4	2.0	3.0 - 20.0
Nitella flexilis	14.5	2.5	13.0 - 21.0
Nuphar variagatum	7.3	1.4	3.0 - 3.5
Nymphaea odorata	5.8	2.3	3.0 - 3.5
Polygonum natans	5.8	2.3	3.0 - 3.5
Potamogeten epihydrus	2.9	1.0	3.0 -3.5
P. gramineus	11.6	2.0	3.0 - 6.0
P. robbinsii	2.9	1.0	4.5 - 16.5
P. sp.	15.9	1.8	4.0 - 22.0
Sagittaria cristata	4.4	2.3	2.0 - 4.0
Sparganium sp.	4.4	1.3	3.0 - 4.0
Utricularia intermedia	1.5	3.0	3.0
U. vulgaris	1.5	1.0	3.0
Typha latifolia	p		
Vallisneria americana	56.5	2.6	2.0 - 13.0

Shoreline Survey

The natural shoreline of Arbutus consists mainly of upland hardwoods with a small portion in coniferous bog. According to SWRoFC there were 62 dwellings in the mid '70s. During the recent survey 95 dwellings were noted. This is an increase of 35%. Arbutus has 2.53 miles of shoreline, approximately 2.5 of which could be developed. So, dividing the shoreline by the existing dwellings yields a development factor of 38 d/m. The S.D.F. on Arbutus is 1.4. The assessed value of the properties is $1,273,030 and $3,083,630 on improvements for a total of $4,356,660.

The following is from a shoreline use survey conducted on August 8, 1995. The numbers refer to sections of shoreline shown on the development map.

1 - Four dwellings - first and second separated by narrow natural area - with short setbacks and grass to shoreline.
2 - Undeveloped. Spruce wetland.
3 - Several dwellings with short setbacks most with little natural vegetation and grass to the shoreline.
4 - Dense, diverse aquatic vegetation. One dwelling with grass to shore, other with good natural vegetation. North side of bay is wet area where fill was used to "make" small lots.
5 - Approximately 22 small dwellings. Shore juts up from water but levels off only a few feet up. Most dwellings are close to shore, with some large trees but little understory and often grass to the shoreline. Several concrete boat ramps.
6 - Approximately ten dwellings, most with a bit more natural vegetation. Rental cottages on one septic, but no obvious signs of septic overload in the lake.
7 - Natural vegetation. Lumber yard behind.
8 - Seven small dwellings, with minimal setbacks and little natural vegetation. Large pines remaining. Shoreline juts up about five feet and levels off.
9 - Several dwellingswith more natural vegetation remaining. Tan place very good example of buffer strip.
10 - Few large dwellings. Several with manicured lawns down to rocky shoreline.
11 - Small cottages with 100 foot setbacks and varying degrees of natural vegetation.
12 - Large dwellings but well separated with decent setbacks. Most have left several large trees and many have decent buffer strips at the shore, but some have lawn to the shore.
13 - Six places very close to the shore with very little vegetation - not even grass.
14 - Boat landing then approximately 15 dwellings most low to the water and close to shore. Most have few large trees - pine and birch - and grass to the shore. Some especially toward the south end have preserved more natural vegetation and have good buffer strips.
15 - Natural vegetation - tamarack wetland at interior of bay.
16 - Two dwellings with grass to shore.
17 - Two dwellings with good natural vegetation.

Recreational Use

Recreational use information was not collected on Arbutus.

Recommendations

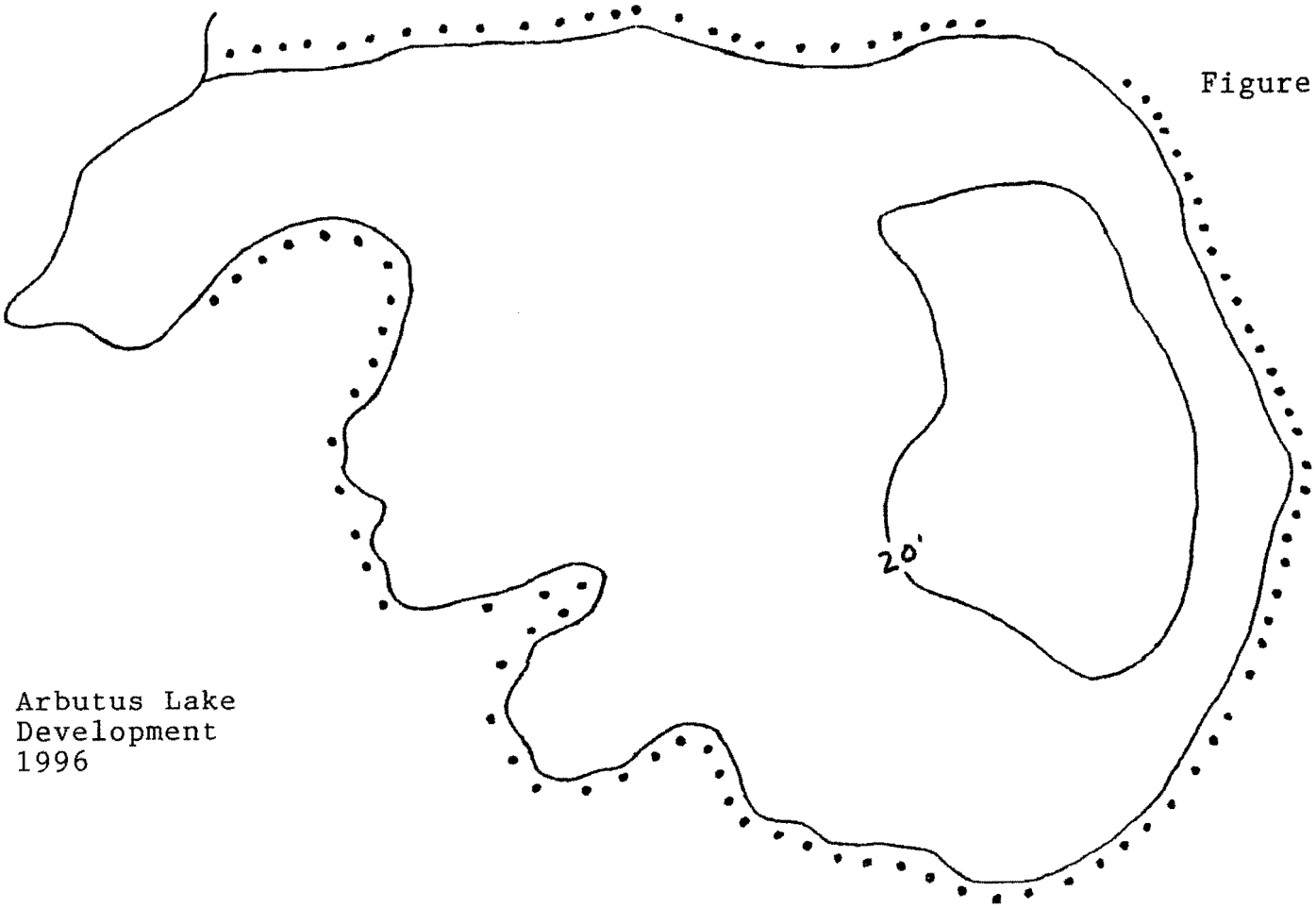
1. Much of the shoreline of Arbutus Lake supports development that is very close to lake level surrounded by very little natural vegetation. While the water quality is still quite good, there is no reason to ignore this situation. Shoreline buffer strips should be encouraged in these areas. A septic survey performed during the Northern Environmental study did not indicate any obvious areas of septic contamination to the lake, but a survey of age, usage, etc.. of systems which could be updated regularly (every five years perhaps), would certainly provide a valuable head start if this were to become a more obvious problem.

2. The Lake Association needs to assess the ramifications of the recent development of Grass Lake.

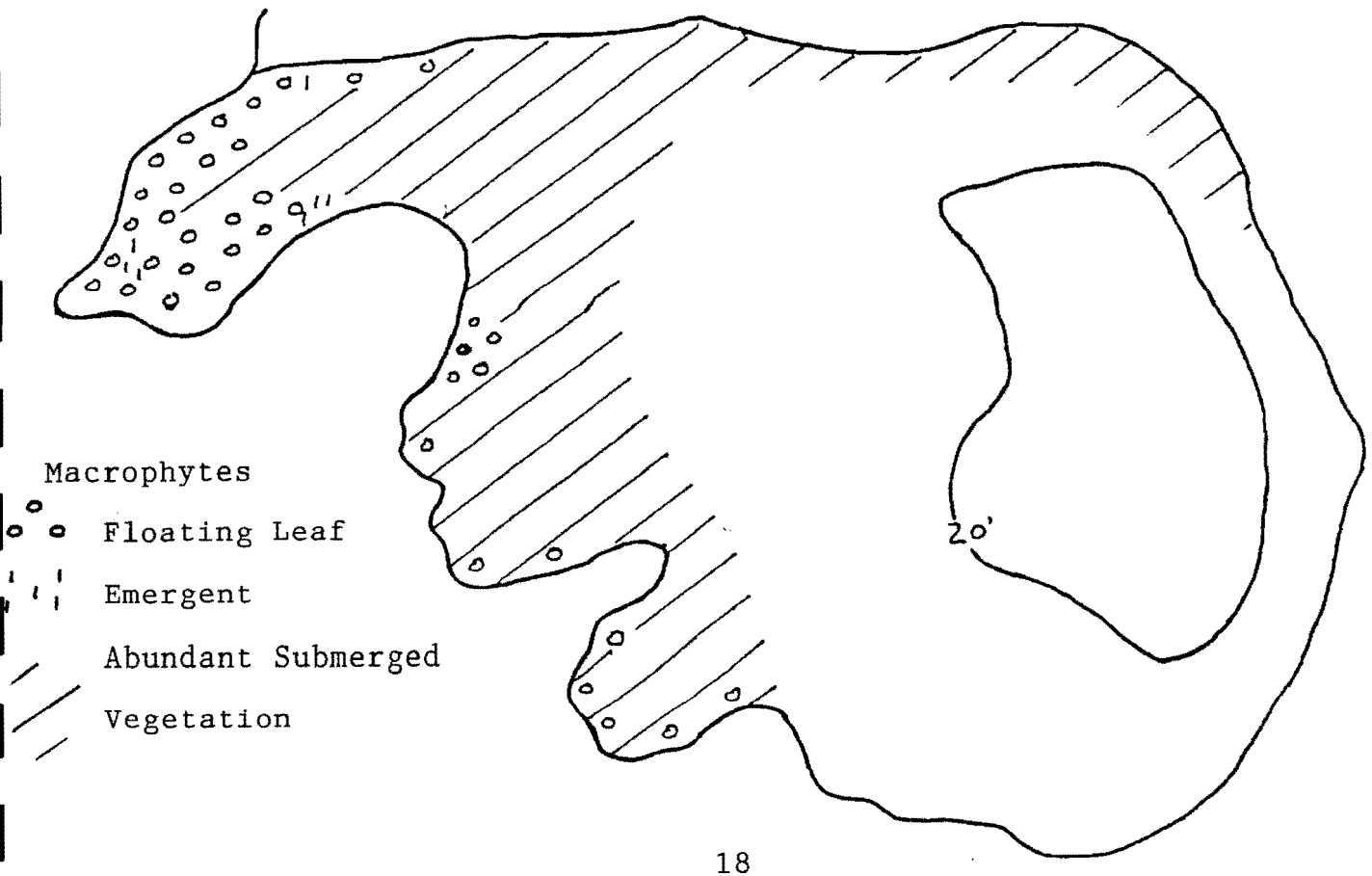
3. Along with the two areas near the lake that Northern Environmental suggested protecting, the southern bay should be protected from high impact activities and further development if possible. If development is to occur, stress the importance of protecting this area from additional sediment and nutrients. This area is valuable as wildlife habitat and as a nutrient sink.

4. Along with boatlanding improvements suggested by Northern Environmental, signs dealing with protection of sensitive areas on the lake, exotic species, and other lake issues should be posted.

Figure 2.



Arbutus Lake
Development
1996



BUTTERNUT LAKE

Butternut Lake is the largest of the cluster of lakes in northern Forest County. It covers 1,292 acres and reaches a maximum depth of 42 feet. It is a spring-fed lake with moderately-hard, slightly alkaline water. Nutrient levels are relatively low, producing clear water and little plant growth. More than half of the surface area lies within the 20 foot contour line. Water flowing out of Butternut becomes the North Branch of the Pine River. Butternut supports a strong population of large predator fish. Walleye are very common and northern pike, though less common, are quite large. It also supports a very strong population of naturally-reproducing small mouth bass. Whitefish may still be present but are now very rare.

Water Quality

Extensive water quality information has been collected on Butternut and Franklin Lakes in conjunction with work done by Dr. Nevin Grossnickle, Ph.D. from the university of Wisconsin - Marathon Center.
His work includes pH, dissolved oxygen, and fecal coliform testing throughout the lake. Nitrogen and phosphorus analysis was also analyzed over several years, unfortunately the phosphorus values seem erroneous - either raw data was misinterpreted, decimals were misplaced or inappropriate methodology was used. That data is not included in this report but is available from Northern Lake Service or the Butternut and Franklin Lakes association.

Table 5. Butternut Water Quality Data.

Secchi Depth Readings

	1986	1987	1988	1989	1990	1991	1992	1993
May			15.5	19.5	35.5	20.0	27.0	
June				27.0	24.0	22.0		21.0
				26.0				
July	16.0	15.5		19.5	20.0	19.0	14.5	22.0
		15.75						15.0
Aug				21.0		15.0	16.0	14.0
				11.0				
Sept							17.0	15.0
								17.0

These readings were taken from sample site five which is located in the "deep hole" near the east shore. Readings were taken at other sites but this is the most complete data set.
This data was collected through the WDNR Self Help program.

	Sept. 1, 1971	
	Surface	5 Meters
Alkalinity	42	42
Hardness	40	40
Phos. soluble	<.004	<.006
Phos. total	.034	.026
Organic nitrogen	.32	.32
Ammonia	.08	.12
Nitrites	<.002	<.002
Nitrates	<.04	<.04
pH	7.8	7.9
Dis. oxygen	8.5	8.2

	5/72	6/72	7/72	8/72	9/72	10/72	11/72	3/73
pH	7.8	8.2	8.1	8.0	7.6	7.7	7.5	6.5
Conductivity	86	83		89	89	76	73	171
Phos. total	.025	.035	.028	.044	.039	.060	.052	
Ammonia	.02	.02	.04	.02	.03	.05	.04	
Nit. total	.26	.26	.24	.15	.31	.21	.24	
Nitrite	.007	NF	.006	.002	.001	.004	<.001	
Nitrate	.02	.01	.12	.02	.04	.03	.03	
Iron	.72	.24	.10	.56	.47	.46	.12	

It is assumed that units are mg/L except pH = standard units and conductivity = umho@25C.

8/16/72

Depth(ft)	Temp	Conductivity	pH	D.O.	Alkalinity
0	20.5	128	7.7	9.3	42.4
5	20	130			
10	20	131			
15	20	132			
20	19.5	132	7.7	8.8	41.0
25	19	132			
30	17.5	133	7.1	3.5	44.7
35	15.5	140	6.8	0.0	59.4
40	13	153	6.8	0.0	72.2

Information from the preceding tables comes from WDNR files.

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model			Carlson Trophic State Index	
	Phosphorus	BTRNUT	Secchi Depth	
Excellent	< .001	•	> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030	•	6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

Aquatic plant growth in Butternut Lake is quite sparse. Seventy-three points falling outside the 20 foot contour line, were sampled, and of these only 22 supported macrophyte growth. This represents about one tenth of the lake's surface area.

The most common species collected was an emergent plant - *Scirpus validus* or bulrush. It was present at or near 14 of the sample stations and was the only species collected on the west side of the lake. Several stations along the eastern shore of the lake supported 6 or more species but they were usually present in low density. Most of the growth was small rosette and pin cushion-type plants. A few of the larger pondweeds or "cabbage" were observed but not in dense beds. *Potamogeton americana* was observed near site 15 in a very peculiar growth pattern. It appeared to have been "planted" in rows. The species was probably deposited by a boat launched near the site and was propagating in a very uniform pattern.

No floating-leaf species were noted during the survey.

Present macrophyte growth poses little threat to recreation and aesthetics, but also probably provides very little support for the fishery.
No exotic species were collected during the survey, but purple loosestrife was present in the area (Kentuck Lake), so residents should be aware of this weed and notify DNR if it is observed.

Table 6. Butternut Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Chara vulgaris	4	3.0	3.5 - 6.0
Eleocharis acicularis	5	2.2	3.5 - 6.0
Elodea canadensis	7	2.4	3.5 - 7.5
Juncus pelocarpus	1	1.0	1.0
Myriophyllum exalbescens	1	1.0	5.0
Najas flexilis	4	2.7	3.5 - 5.0
Nitella flexilis	1	2.0	3.5
Potamogeton americanus*	7	2.0	1.0 - 3.5
P. amplifolius	4	1.7	3.0 - 5.0
P. gramineus	1	2.0	3.5
P. illinoensis*	7	2.0	1.0 - 3.5
Sagittaria cristata	3	2.0	1.0 - 3.5
Scirpus validus	1	4.0	1.0
Typha latifolia	p		
Utricularia vulgaris	1	1.0	1.0
Vallisneria americana	8	1.8	2.5 - 6.0

* *Potamogeton americanus* was initially identified as *P. illinoensis*. All numbers apply to both the two species combined.

Shoreline Survey

According to SWRoFC, the shoreline of Butternut Lake is about 95% upland hardwoods and 5% wetlands. About twenty years ago there were 29 dwellings and 5 resorts along the shore. According to a recently developed map Butternut now supports approximately 62 dwellings. This is a 53% increase. The shoreline is 7.8 miles giving a development factor of 7.9 d/m, however if the 2.14 miles of publicly held shoreline is discounted the factor raises to 11d/m. The S.D.F. is 1.5. The properties on Butternut are valued at $3,124,800 and improvements at $3,256,000 for a total of $6,380,660.

The following is a condensed version of the shoreline survey conducted in October of 1996. The numbers refer to sections of shoreline shown on the development map.

1 - Undeveloped. White pines and birch behind alders. Bulrushes near shore. Larger trees decreasing and absent toward the point.
2 - Undeveloped. Tamarack wetland.

3 - Undeveloped. Alders at shoreline, birch and tamarack behind on gradual slope. Bulrushes.
4 - Still gradual slope but with red pines and oak.
5 - Appears to have been cleared. Small trees returning. Large public fishing dock.
6 - Undeveloped. Wetland at shore then steep slope with birch and oak.
7 - Same, but no longer wetland strip at shore.
8 - Approximately ten dwellings. 75 to 100 feet apart with good setbacks. Some with natural vegetation, some without.
9 - Natural vegetation and one large dwelling with some natural vegetation.
10 - Undeveloped. Oak, maple, birch and red pine - alders at shore.
11 - Approximately ten dwellings with short setbacks on steep slope. Most natural vegetation removed - no buffer strips. Probably some erosion problems.
12 - Six dwellings separated by strips of natural vegetation. Most 50 to 75 foot setbacks, some large trees, but grass to shoreline.
13 - Undeveloped. Hemlock, pine and birch.
14 - Large dwelling with much natural vegetation in place.
15 - Undeveloped. Same as 13.
16 - Two very large dwellings with several examples of unwise shore development. First has good setback but no natural vegetation at all between house and lake. Second is right at the shore.
17 - Natural shoreline.
18 - Several small dwellings very close together on gradual slope. Some natural vegetation in place but mostly grass to shore.
19 - Tag alder and bulrushes.
20 - Eight dwellings on medium slope most with some natural vegetation and buffer strips. Some erosion noticeable near barn-like building at the shore. Birch, maple and hemlock.
21 - Approximately six dwellings on steep slope with long setbacks. Most natural vegetation left. Several large cleared lots but with good buffer strips.

Recreational Use

Recreational use information was collected at 10:00 am, 2:00 pm and 7:00 on June 5, August 1, and August 17, 1996. Fishing was the most common activity during all nine survey times. High impact activities were observed but not particularly common. Below is a summary of observed activities.

Table 7. Butternut Lake Recreational Use.

	1	2	3	4	5	6	7	8	9
Fishing	12	13	17	11	8	7	10	6	6
Speed Boating			1			1		1	
Water skiing			1		2			2	
Sailing					1				
Canoeing/rowing				2					
Jetskiing	1	2					3		
Swimming/snorkeling			1	9	6	3		4	3
Lounging	16	7	14	3	5	2	3	8	8
Pontoon Boating		2							

1 = 6/5/96 7:00 pm - about 75 windy
2 = 6/6/96 10:00 am -70 overcast
3 = 6/6/96 2:00 pm - high 70's overcast
4 = 8/1/96 10:00 am
5 = 8/1/96 2:00 pm - 80's sunny
6 = 8/1/96 7:00 pm - warm, slight wind
7 = 8/17/96 10:00 am - warm, sunny
8 = 8/17/96 2:00 pm - warm, sunny
9 = 8/17/96 7:00 pm - warm, sunny

Recommendations

1. Butternut, though not heavily developed, has several areas where the shoreline should be improved. Specifically, the north west corner and the two very large places on the west shore. Efforts should be made to reduce runoff and erosion potential.

2. Be aware of what is occurring on large undeveloped areas. try to stress large lots and wise land use if these areas are to be developed.

3. Butternut is fairly close to several lakes with Eurasian milfoil and at least one patch of purple loosestrife (Kentuck Lake). The chemistry of Butternut would cause milfoil to spread very slowly but at the very least, prominent signs addressing these plants should be posted at the boat landing. The lake association may want to appoint a committee to monitor the lake for exotics.

Figure 3.

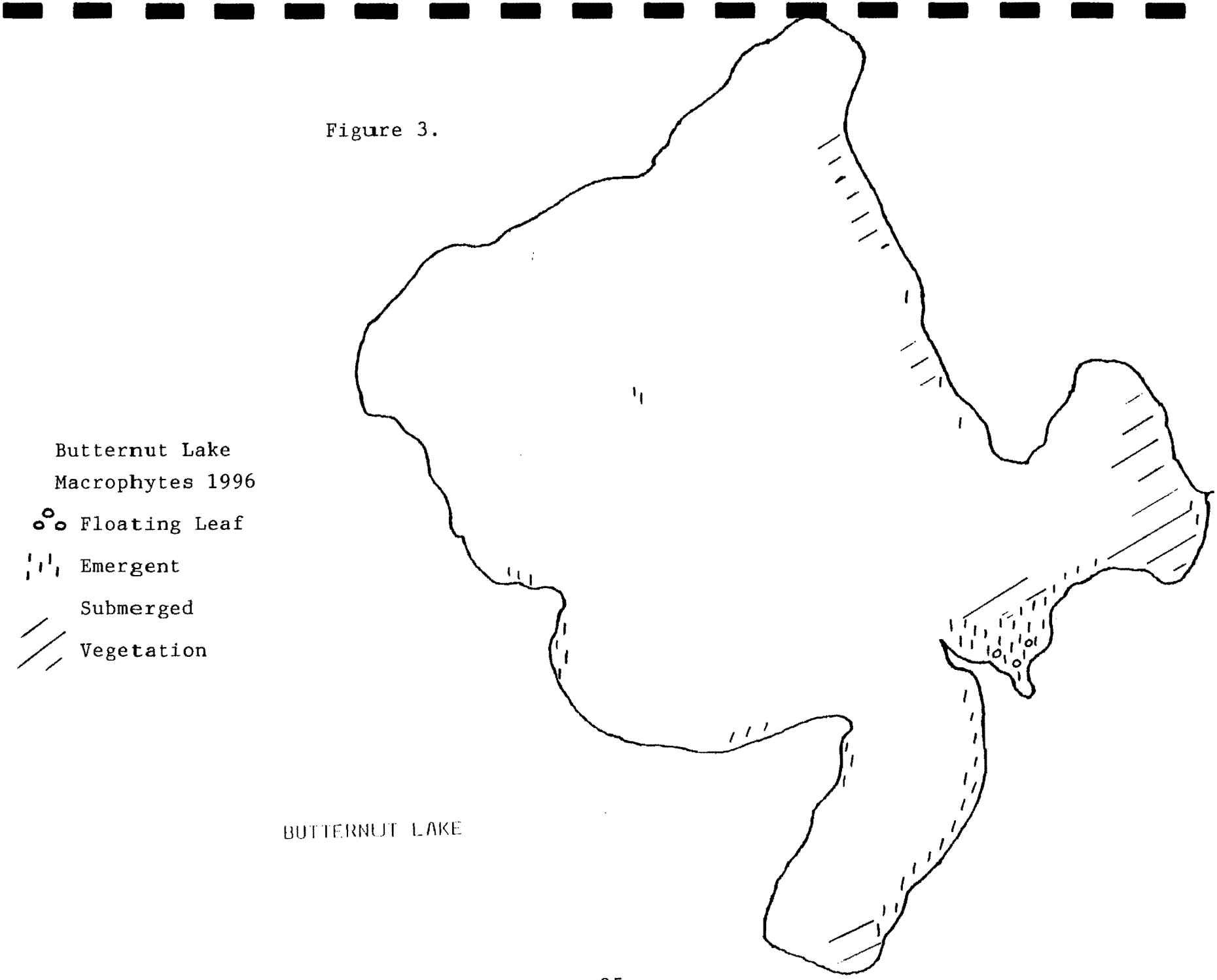
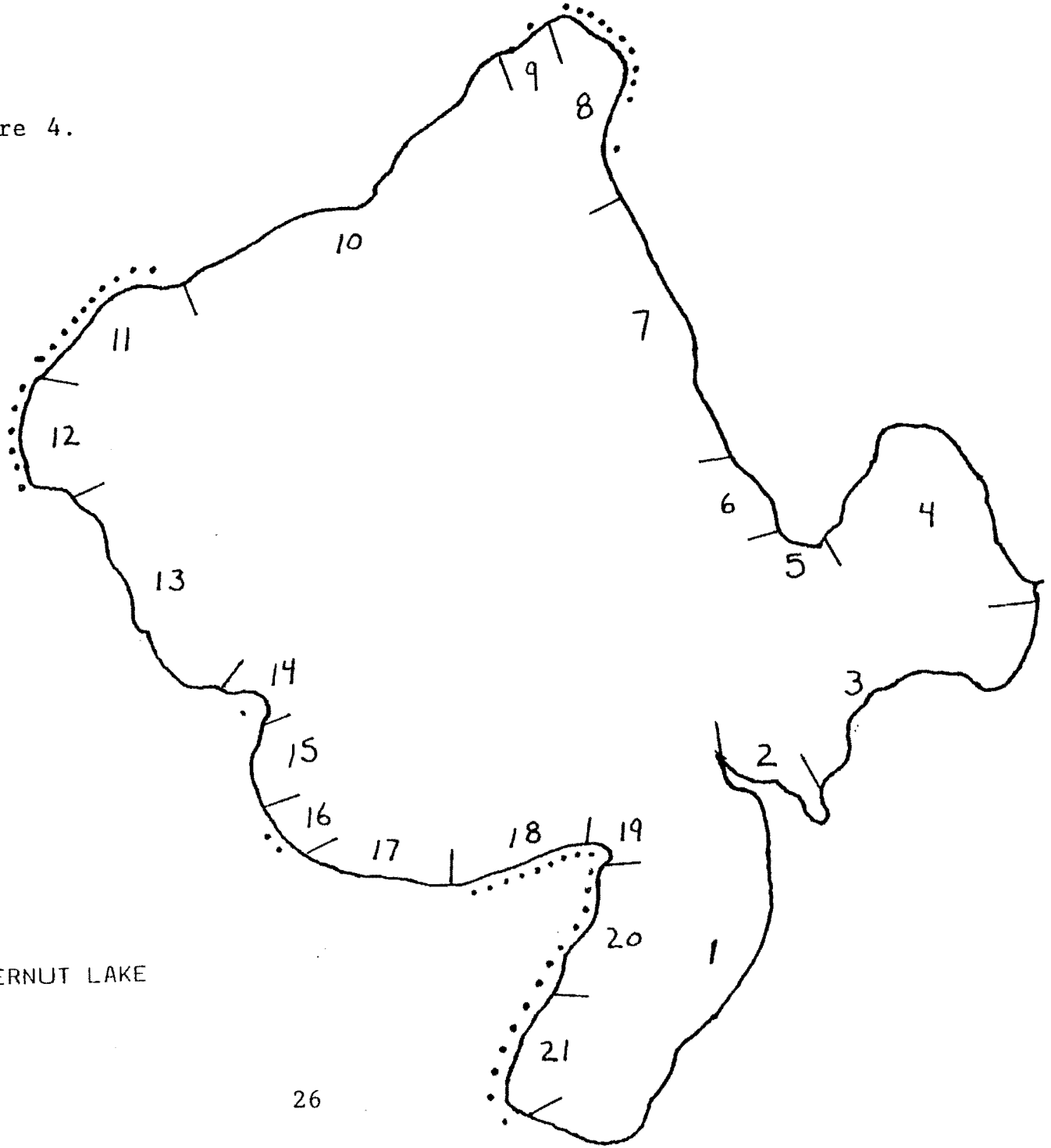

Butternut Lake
Macrophytes 1996
Floating Leaf
Emergent
Submerged
Vegetation
BUTTERNUT LAKE

Figure 4.



Butternut Lake
Development
1996

BUTTERNUT LAKE

CRANE LAKE

Crane Lake is a 340 acre, hard-water spring lake in southern Forest County. It is connected to Pickerel Lake via a navigable channel. During the early 1990's an extensive EPA feasibility study was performed on the two lakes. This study looked at water quality, macrophyte growth, zooplankton and phytoplankton populations, watershed use, groundwater influences, sediment deposition and other factors. The aim of the study was to help develop a management plan to combat nuisance weed growth, winterkills and other problems associated with a highly productive system. These problems are most prevalent in Pickerel Lake. Most of the following information was collected during that study.
Crane Lake supports a dense panfish population dominated by bluegills and pumpkinseeds. It also has a strong large mouth bass population and a few stocked walleyes.

Water Quality

The EPA study performed by E&S Environmental Chemistry, Inc and Northern Lake Service generated several hundred pieces of water quality data. A small portion of that data is included here to give the reader an idea of the general water quality of that lake. A copy of the full report is available at NLS. Table 9 is copy of Crane Lake water quality data generated in 1974 and 1975 by WDNR. The tables are copied directly from Water Quality of Selected Wisconsin Inland Lakes 1974 - 1975.

Table 8. Crane Water Quality.

9/14/91

	Surface	5.5 m.	7 m.
Conductivity	180	200	230
pH	8.7	8.9	7.4
Alkalinity	130	120	160
Chloride	<1		
Ammonia	<.05	.06	.40
NO2+NO3	<.05	<.05	<.05
TKN	.58	.53	.99
Phos, reactive	<.004		
Phos, total	.029	.031	.061
Silica	4.2	4.9	4.9
Secchi depth	2.4		

All values in mg/L except conductivity = uhmo@25C, pH = s.u. and Secchi depth = meters.

See water quality section on page 3 for an explanation of these tests and the following models.

Lake: Crane

Acres: [redacted]

Max. Depth: 25 feet

Other Conditions: 1-24-75 16" ice, 2" snow

Inlet(s): 1 Inlet at N. end of lake, sampled at lake frontage road, T-34N R-13E S-20
2

Table 9.

1					
DATE	8-22-74			INLET	INLET
DEPTH	0	20	25	1	2
NO2N	.005	.003	.006	.006	
NO3N	.22	.17	.16	.24	
NH3N	.14	.09	.11	.05	
ORGN	.86	.56	.54	1.12	
TOTN	1.222	.833	.811	1.421	
PO4P	.015	.052	.054	.037	
PTOT	.02		.05		
CA	45.	56.	55.	80.	
MG	44.	44.	44.	44.	
NA	3.	3.	3.	3.	
K	1.3	2.3	1.6	1.7	
COND	185.	198.	203.	256.	
SO4	5.	5.	5.	7.	
CL	<1.0	1.	<1.0	<1.0	
PH	8.6	7.8	7.8	7.9	
ALKA	94.	100.	130.	135.	
TURB	1.3	1.5	1.7	1.5	

Secchi 5.2 feet

2				
11-6-74			INLET	INLET
	0	23	1	2
NO2N	.022	.046	.044	
NO3N	.10	.09	.13	
NH3N	.24	.20	.19	
ORGN	.61	.67	.29	
TOTN	.972	1.008	.649	
PO4P	.054	.036	.089	
PTOT	.27	.10	.07	
CA	40.	33.	47.	
MG	18.	22.	58.	
NA	1.	2.	3.	
K	3.1	3.5	3.4	
COND	202.	201.	253.	
SO4	3.	5.	6.	
CL	<1.0	<1.0	<1.0	
PH	8.1	8.1	8.1	
ALKA	103.	101.	120.	
TURB	1.8	1.4	3.6	

Secchi 19.5 feet

3					
DATE	1-24-75			INLET	INLET
DEPTH	0	10	24	1	2
NO2N	.008	.021	.009	.014	
NO3N	.10	.10	.11	.09	
NH3N	.03	<.03	.09	<.03	
ORGN	.33	.29	.29	.15	
TOTN	.472	.431	.501	.239	
PO4P	.013	.010	<.005	.034	
PTOT	.03	<.01	<.01	.02	
CA	41.	48.	54.	44.	
MG	22.	25.	32.	27.	
NA	<1.0	<1.0	<1.0	<1.0	
K	.7	.6	1.6	.6	
COND	285.	273.	221.	301.	
SO4	6.	6.	6.	7.	
CL	1.	1.	1.	1.	
PH	7.8	7.8	7.8	7.9	
ALKA	119.	112.	116.	127.	
TURB	1.2	1.2	1.7	1.7	

4				
5-20-75			INLET	INLET
	0	24	1	2
NO2N	.004	.005	.005	
NO3N	<.04	.04	.12	
NH3N	<.03	.05	.04	
ORGN	.15	.13	.09	
TOTN	.14	.23	.25	
PO4P	<.005	<.005	<005	
PTOT	.02	.03	.09	
CA	8.	25.	7.	
MG	3.	27.	5.	
NA	<1.0	2.	<1.0	
K	.5	<.5	<.5	
COND	197.	195.	199.	
SO4	5.	8.	6.	
CL	1.	<1.0	<1.0	
PH	8.0	7.7	7.7	
ALKA	104.	110.	111.	
TURB	1.0	1.1	.9	

Secchi 9.0 feet

Lillie and Mason Water Quality Model

Carlson Trophic State Index

	Phosphorus	CRANE	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030		6.6 - 9.8	Mesotrophic
Fair	.030 - .050	•	4.9 - 6.6	----------
Poor	.050 - .150	•	3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

Crane Lake supports abundant growth over much of its area, but does not have the nuisance growth seen throughout Pickerel.
The species list and community map below were generated from a survey performed on July 29, 1991 as part of the Pickerel Crane Lakes Feasibility study. Thirty-six stations were surveyed. Floating-leaf vegetation was limited to small beds in protected areas. *Ceratophyllum demersum*, coontail, and *Vallisneria americana*, eelgrass, were the most commonly collected species.

Table 1 . Crane Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demersum	38.9	2.6	3.5 - 12.0
Chara vulgaris	22.2	3.0	2.0 - 10.0
Decodon verticillatus	p		
Elodea canadensis	16.7	1.8	2.5 - 7.0
Heteranthera dubia	5.6	3.5	2.5
Lemna trisulca	30.6	2.1	2.5 - 11.0
Myriophyllum exalbescens	47.2	2.1	2.5 - 11.0
Najas flexilis	27.8	2.6	2.0 - 10.0
Nuphar variegatum	p		
Nymphaea tuberosa	5.6	1.0	2.5
Polygonum natans	2.8	3.0	3.5
Potamogeten friesii	16.7	1.5	5.0 -11.0
P. illinoensis	2.8	2.0	6.0
P. pectinatus	13.9	1.6	2.5 - 5.0
P. richardsonii	30.9	1.8	2.5 - 7.5
P. robbinsii	p		
P. zosterformis	36.1	1.8	2.5 - 8.0
Vallisneria americana	38.9	2.9	2.5 - 10.0

Shoreline survey

The shoreline of Crane Lake is mostly upland hardwoods and pines with a small portion in wetlands. In the mid 1970's it supported about 62 dwellings. Crane now supports approximately 90 dwellings. If this is divided by the 3.83 miles of shoreline it yields a development factor of 16.2 dwellings/mile. Only .03 miles is in public ownership and very little is unfit for development. The S.D.F. for Crane Lake is 1.5. The following tax assessment values are for Pickerel and Crane Lakes combined. (Pickerel has approximately 264 dwellings or 80% of the total for the two Lakes.) Property values = $6,070,130; Improvements = $11,401,140; Total = $17,471,270.

The following is from a shoreline survey conducted in the summer of 1996. The numbers refer to sections of shoreline shown on the development map.

1 - Seven dwellings on moderate slope set back about 75 feet. Seawalls and two boathouses. Most natural vegetation removed, but narrow buffer strips at shore.
2 - Six dwellings with some natural vegetation, but little understory. Three boathouses.
3 - Five dwellings near lake level. Some with grass to shore.
4 - Four dwellings on moderate slope most with large trees and buffer strips. Two boathouses.
5 - Four dwellings with very little natural vegetation - lawns to shore. Two boathouses.
6 - One dwelling at the end of long undeveloped stretch.
7 - Low, wet area. Natural shoreline with tamarack and tag alder. Four dwellings. Third is new but very close to shore. Fourth is far from shore.
8 - Three dwellings on steep slope. First two set back approximately 100 feet, last one close to shore. Large birch and hemlocks but little natural vegetation.
9 - One dwelling - very "suburban" looking. Close to shore with boathouse a lots of lawn directly to shore.
10 - Six dwellings on steep slope, most with natural vegetation in tact - large hemlocks. Fifty to 75 foot setbacks. Five boathouses.
11 - One dwelling with very deep setback. Rest is natural hemlock shoreline with areas of tag alder.
12 - Three dwellings close to lake level, 50 - 60 feet off shore. One boathouse and blacktop ramp into lake.
13 - Three dwellings on very steep slope setback about 75 feet. Little understory at first two, most natural vegetation at third.
14 - Two dwellings set back about 75 feet in very low tag alder area.
15 - Only development is boathouse that does not appear to have development behind. Shoreline is mostly birch grading into tag alder and into cedar.
16 - One dwelling cleared to the shore then long stretch of natural shore into the channel to Pickerel Lake.
17 - Undeveloped wetland.
18 - Eight small, well spaced dwellings with 50 to 75 foot setbacks. Several with natural vegetation in tact. Seventh is on very steep slope with little vegetation. Eighth is very close to shore. Two boathouses.

19 - Undeveloped. Cedar and birch.
20 - Seven dwellings. Three close together, then natural shore, then one, natural shore and three more. Good natural vegetation on most, but decreasing to last one. On boathouse.
21 - Seven dwellings of varying size 30 to 70 feet off shore. Most with some large trees, but little understory. Three boathouses.
22 - Six dwellings. First three with decreasing natural vegetation. Then three well spaced, the last one with grass to shore.
23 - Undeveloped. Birch and cedar.
24 - Eight dwellings including three trailers on gradual to moderate slope. Set backs fifty feet and less. Several with good buffer strips, several with grass to shore.
25 - Boatlanding.

Recreational Use

No recreational use information was collected for Crane Lake.

Recommendations

1. Continue septic survey and updating initiated by the EPA study.

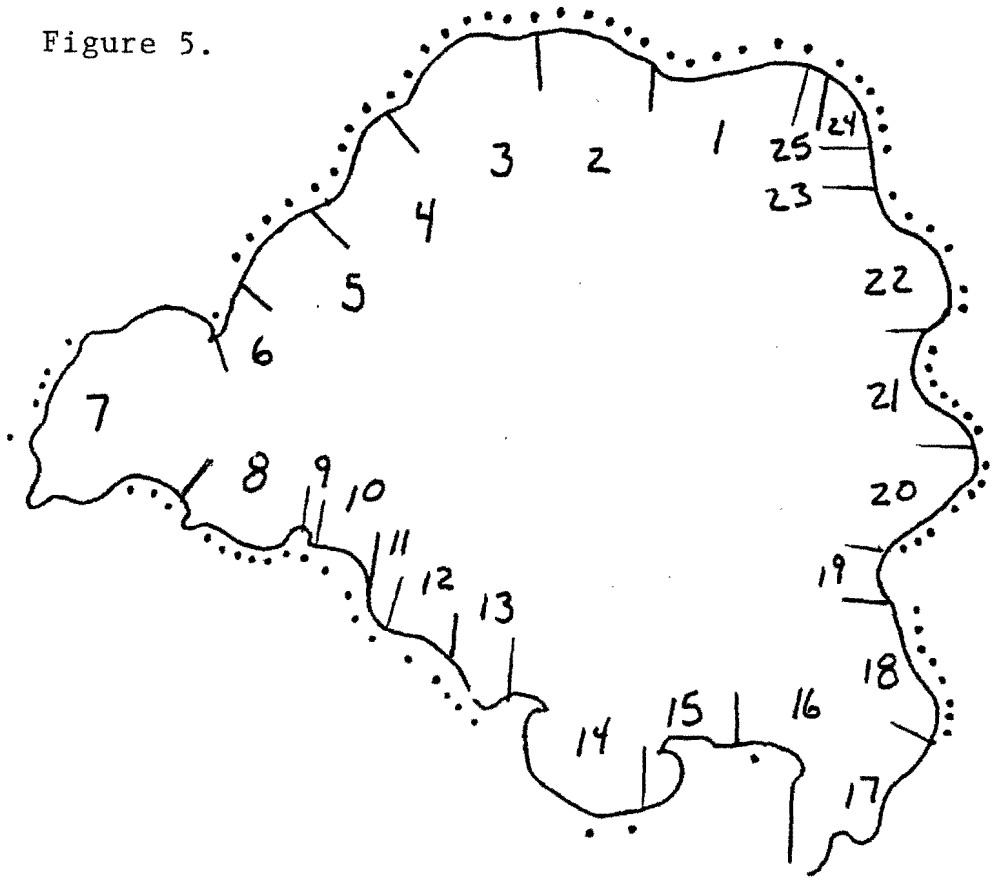
2. Improve shoreline where lawn extends to the water. Encourage residents to establish bufferstrips, especially in bay areas that already have heavy sediment accumulation.

3. Discourage high impact activities in shallow heavily sedimented areas, especially Bartz Bay.

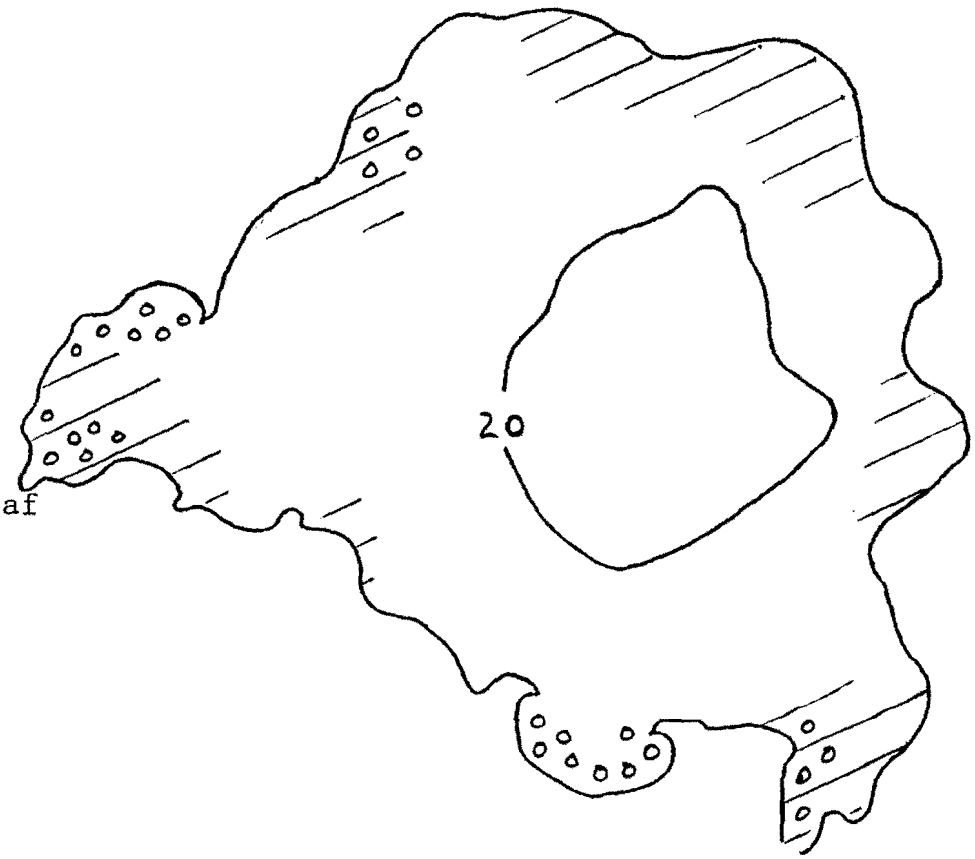
4. Improve boatlanding to include signs on exotic plant species. The chemistry of Crane and the fact that it is a popular recreational resource make it a good candidate for a milfoil invasion.

Figure 5.

Crane Lake
Development
1996



Macrophytes



Floating Leaf

Abundant

Submerged

Vegetation

FRANKLIN LAKE

Franklin Lake is very similar to its neighbor Butternut, though it is slightly more acidic with less buffering capacity. It is quite large - 892 acres - with a maximum depth of 53 or 46 feet, depending on the source, and is almost entirely sand bottom with very little organic sedimentation. The two lobes of the lake are quite different in form. The southern portion is nearly all less than 10 feet deep while the northern lobe is almost completely over 20 feet deep. Franklin Lake supports a strong preditor fish population of mostly northern pike and to a lesser extent walleyes. It also supports whitefish. Franklin has few panfish.

Water Quality

See Butternut Lake water quality section for additional information on water quality data collected on Franklin Lake.

Table 10. Franklin Water Quality Data.

Secchi Depth Readings

	1986	1987	1988	1989	1990	1991	1992	1993
May		22.0	34.0	16.0	23.0	15.0	13.0	15.0
						19.0	20.0	14.0
June		21.0	31.0	18.0	17.0	32.0	25.0	22.0
		21.0		14.0	15.0		14.0	19.0
July	13.25	13.25	19.0	22.0	17.0	20.0	18.0	19.0
		18.0	19.0	24.0	20.0	18.0	20.0	
Aug	14.0	21.0	19.0	23.0	18.0	20.0	16.0	19.0
	18.5	16.0	15.0			19.0		
Sept				18.0	17.0	18.0		
Oct						22.0	17.0	12.0

Data collected by volunteers through the WDNR self help program.

	8/23/72		Date unknown
	1 Meter	13 Meters	called "spring turnover"
Alkalinity	16	20	14
Hardness	40	40	17
Phos. soluble	.002	.002	<.005
Phos. total	.01	.04	.02
Organic nitrogen	.22	.56	.20
Ammonia	.02	.10	.02
Nitrites	.002	.002	.002
Nitrates	.02	.03	.06
pH	7.3	7.2	7.3

Data from WDNR files.

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model			Carlson Trophic State Index	
	Phosphorus	FRANKLIN	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030		6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

As these models show, the water quality is on Franklin Lake is very good.

Macrophytes

Forty-nine stations were sampled on Franklin Lake, yielding eighteen species of aquatic plants. Most of the plants present in Franklin, like those in Butternut, were small and inconspicuous. Franklin also supported a few small, but dense bed of larger "structural" plants. *Scirpus validus*, bulrush was not common throughout the lake but a very large dense bed extended along nearly the entire west shore of the north lobe of the lake. Three species of floating leaf species were present each was limited to only one or two sample sites. The north eastern shore of the lake displayed the most diversity. Several stations in this area each supported at least 5 species. No other station supported more than 4 species.

Table 12. Franklin Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	2	2.0	2.0 - 4.0
Eleocharis acicularis	14	2.4	3.0 - 6.5
E. sp.	4	2.0	1.0 - 3.0
Equisetum sp.	4	2.0	1.0 - 3.0
Isoetes sp.	4	1.5	3.5 - 6.0
Juncus pelocarpus	2	2.0	2.0 -4.5
Lobelia dortmanna	2	1.0	4.5
Myriophyllum tenellum	8	2.8	3.5 - 6.0
Najas flexilis	6	1.0	3.5 - 4.0
Nuphar variegatum	2	1.0	3.0
Nymphaea odorata	4	3.0	4.0 - 4.5
Potamogeten amplifolius	10	1.8	3.0 - 5.0

P. epihydrus	p		
P. gramineus	10	2.8	3.0 - 10.5
P. sp.	6	2.0	3.5 - 7.5
Sagittaria cristata	2	2.0	3.5
Scirpus validus	12	2.3	1.0 - 4.0
Vallisneria americana	8	2.5	3.0 - 6.0

Shoreline Survey

According to SWRoFC, the natural shoreline of Franklin Lake is mostly upland hardwoods with about 5% in shrub wetland. In the mid 70's the shoreline supported 23 dwellings and a large private camp - which still operates. More recent maps and shoreline work put the total at approximately 40 dwellings plus the camp and its cabins. The actual development factor for Franklin is about 6.4 dwellings/mile. However, two thirds of the 6.4 miles of shoreline is controlled by the US Forest Service and much of this is rustic campsites along the north east shore. If that 4.3 miles is discounted the factor increases to almost 19d/m. The S.D.F. for Franklin is 1.5.
Properties are valued at $1,807,100 and improvement at $2,004,700 for a total of $3,811,800.

The following is a condensed version of the shoreline survey performed on October 16, 1996. The numbers refer to sections of shoreline found on the development map.

1 - Undeveloped. Birch, white pine behind rocky shore.
2 - Tamarack and tag alder wetland.
3 - Huge new residence. No natural vegetation - grass to shoreline. No measures to control runoff/erosion.
4 - Mostly natural vegetation with two dwellings. Both with good setbacks and buffer strips.
5 - Approximately 15 medium to small dwellings 75 - 150 feet apart with 75+ foot setbacks. Shore slopes steeply then levels off five to ten feet up. Most places have buffer strips but some with grass to the shore. Possible erosion problem near boathouse,
6 - Undeveloped. Birch and large pines. West end of bay is wetland.
7 - Approximately 15 medium to small dwellings about 100 feet apart with 75 - 150 foot setback. Most of understory has been removed but many places have buffer strips. Slope is gradual, but some erosion problems are evident near several boathouses.
8 - Undeveloped.
9 - Two dwellings with long setback on steep slope. Most natural vegetation in place. Both with large boathouses.
10 - Undeveloped. Large pines.
11 - Undeveloped. Alders at shoreline, large pines behind, bulrushes extending into lake.
12 - Bulrushes extending several hundred feet into lake, Tamarack and birch behind. System of buoys (for waterskiing?)
13 - Large camp with horse stable setback about 200 feet, several small cottages and large lodge setback about 75 feet. Red pine and jack pine with no understory. Sandy beach.
14 - Approximately seven dwellings varying in size and setback. These do not match up with

development map.

15 - Campground. Long stretch of natural vegetation with narrow access points throughout. Slope is gradual near north end of section, then steepening at middle and returning to gradual at south end. Mostly pines and birch over cobble shore.

16 - Public beach. Gradual slope.

17 - Natural area with large, old pavilion which is not far from shore, but barely noticeable due to color and vegetation.

Recreational Use

Recreational activities were monitored at 10:00 am, 2:00 pm and 7:00 pm on July 6, Aug 1, and Aug 17, 1996. Franklin Lake supported a number of different activities during each of the monitoring periods, with no activity claiming a clear victory. Fishing and lounging received the most marked though they shared the lake with at least two high impact participants during each period. Table 13 contains a summary of all recreation data collected.

Table 13. Franklin Recreational Use.

	1	2	3	4	5	6	7	8	9
Fishing	10	6	14	6	4	4	14	5	6
Speed Boating	2	2	2		1	1	2	3	3
Water skiing		3		1	2			2	
Sailing		3		1					
Canoeing/rowing 2	2	3		1		1	3		
Jetskiing	2								
Swimming/snorkeling	4	11			7	2	4	7	
Lounging	9	10	2	10	4	2	7	15	4

1 = 7/6/96 10:00 am - 68 overcast, calm
2 = 7/6/96 2:45 pm - 75 overcast, calm
3 = 7/6/96 7:00 pm - 70 overcast
4 = 8/1/96 10:00 am - 67 sunny
5 = 8/1/96 2:00 pm - 74 sunny
6 = 8/1/96 7:00 pm - 71 sunny
7 = 8/17/96 7:00 pm - 70 sunny, calm
8 = 8/17/96 2:00 pm - 75 partly cloudy, breezy
9 = 8/17/96 10:00 am - 70 sunny, light breeze

Recommendations

1. The lake association needs to stay abreast of the status of large land holdings on the lake, specifically the camp at the north end. If it is ever to be lotted off, stress large lots and wise development. Perhaps a deed restriction could be agreed upon by the current owners.

2. Ask to inspect the horse stable area to make sure attempts are made to keep waste from reaching the lake.

3. Most of the residents on Franklin seem to have made an effort to keep development from adversely effecting the water quality. Others should be encouraged to establish buffer strips at shore. The place in the small bay on the south end of the lake needs to do something to control runoff. This is one of the few places on this lake that has some sediment accumulation already. This place should be used as an example of how not to develop a lot, especially in a tiny bay.

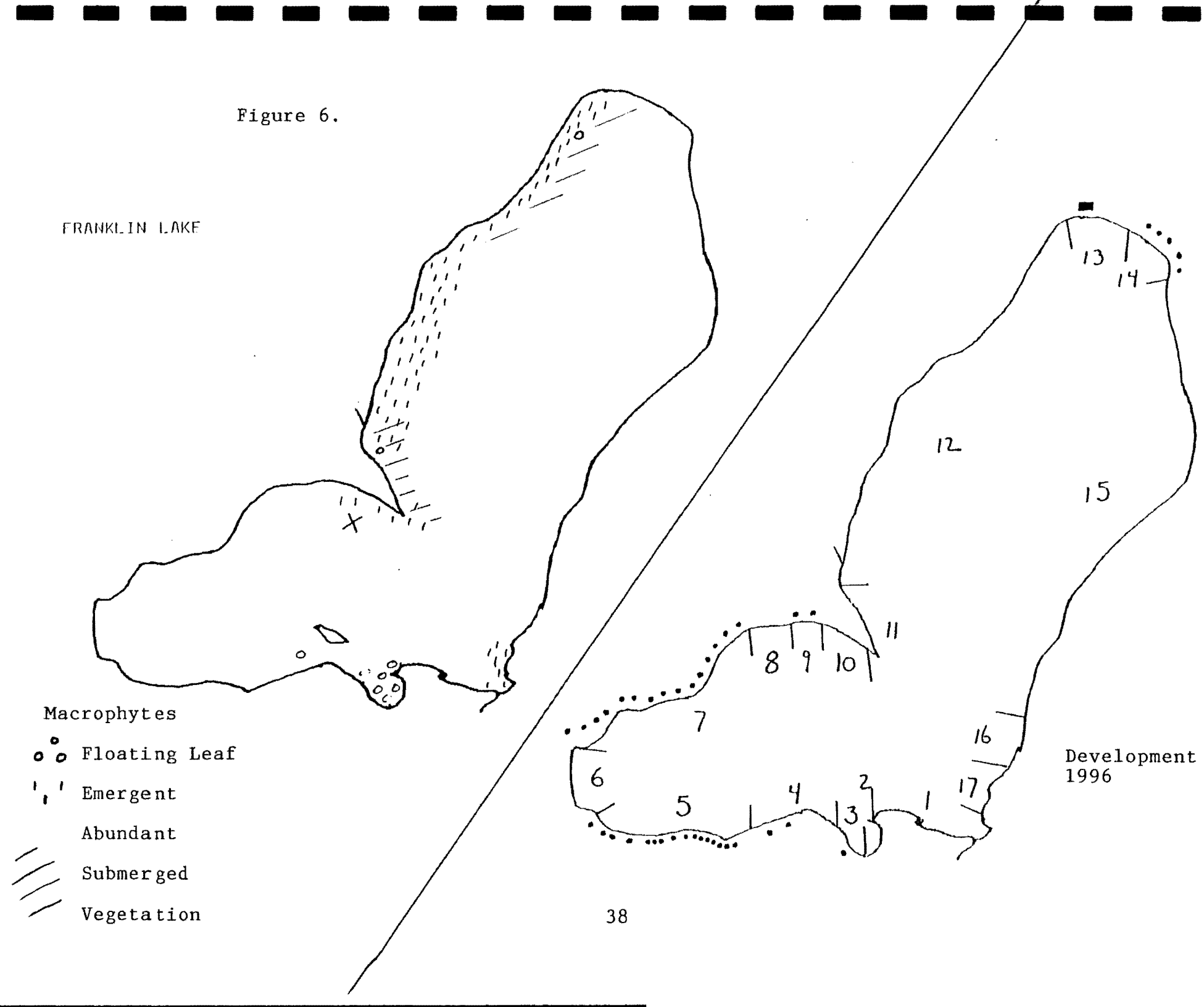
4. Protect this bay and the bulrush beds on the west shore from any high impact activities. These are important nursury areas for the lake.

5. The water quality of Franklin Lake would probably keep exotic species from spreading rapidly, but since the lake is a popular recreational resource, the association should develop a system for monitoring the lake for Eurasian milfoil. Also purple loosestrife is know to be in the area (Kentuck Lake). Awareness of this species is also important.

6. Post signs at the boatlanding and the campground educating the many nonresidents lake users on wise lake stewardship.

7. As Franklin is a slightly acidic, poorly buffered lake, pH and alkalinity should be regularly monitored to detect acid rain effects.

Figure 6.


FRANKLIN LAKE
Macrophytes
Floating Leaf
Emergent
Abundant
Submerged
Vegetation
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2
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17
Development
1996

GROUND HEMLOCK LAKE

Ground Hemlock is a deep (42 feet), hard water lake covering 88 acres in the south west corner of Forest County. It is the headwaters of Hemlock Creek a major tributary of Swamp Creek. The lake lies approximately 3/4 mile from the tailings management area proposed by Crandon Mining. Ground Hemlock supports a diverse fishery. The preditor population consists of northern pike and walleye. The panfish population consists of bluegills, perch, crappies and rock bass.

Water Quality

Ground Hemlock Lake is a very hard water lake with fairly high nutrient levels. The lake has been monitored irregularly over the last 25 years by the author and his father who is a resident of the lake.

The nitrogen to phosphorus ratio indicates that nitrogen is probably the limiting nutrient, unlike most lakes in the area. Table 14 shows water quality data collected over the past twenty years.

Table 14. Ground Hemlock Water Quality Data.

Fall	1973		1974		1993	
	surf.	bot.	surf.	bot.	surf.	bot.
Alkalinity	115	114	112	113	120	110
pH	7.8	7.8	8.3	8.2	7.9	7.8
Conductivity	212	213	222	223	220	220
Chloride	1	1	<1	<1	<1	<1
Nitrogen, total	.30	.36	1.11	1.16	.29	.46
Phosphorus, total	.04	.06	.11	.16	.05	.05

Spring	1974		1994		1995	
	surf.	bot.	surf.	bot.	surf.	bot.
Alkalinity	112	114	120	120	130	120
pH	8.2	7.7	8.3	8.1	8.1	8.2
Conductivity	186	197	240	240	230	230
Chloride	2	<1	<1	<1	1	1
Nitrogen, total	.35	.32	.44	.33	.20	.16
Phosphorus, total	.03	.04	.04	.05	.04	.05

Mid Summer 1996	Surface	6 Meters	12 Meters
Alkalinity	100	130	140
pH	8.8	8.9	7.5
Conductivity	210	260	140
Chloride	<1	1	<1
Nitrogen - ammonia	.1	<.1	.5
Nitrogen - NO2+NO3	<.1	<.1	.3
Nitrogen - TKN	.22	.32	.65
Phosphorus, total	.01	.1	.08

1970's data collected by WDNR, 1990's data collected by NLS.

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model

	Phosphorus	HEMLOCK
Excellent	< .001	
Very good	.001 - .010	
Good	.010 - .030	
Fair	.030 - .050	•
Poor	.050 - .150	
Very poor	> .150	

Carlson Trophic State Index

Secchi Depth	
> 19.7	Oligotrophic
9.8 - 19.7	----------
6.6 - 9.8	Mesotrophic
4.9 - 6.6	----------
3.3 - 4.9	Eutrophic
< 3.3	

Macrophytes

Ground Hemlock Lake supports extensive near-nuisance plant growth over most of its littoral zone (extending to a depth of about 15 feet).

The following species list and community map were generated from a survey performed on July 20, 1996. Forty-five stations were sampled. Of the thirty-seven samples stations that were 13 feet or shallower, only one had no vegetation present. Thirty-one sites had at least one species with a density rating of 3 or greater.

Twenty-one different species were collected. The most common species was *Chara* which is actually a colonial algae which resembles a green plant in its growth form. *Chara* was present at nearly half of the sample sites at an average density of 3.0. The second most common species, *Ceratophyllum demersum*, was present at one third of the stations. Both of these plants produce very thick vegetation. *Myriophyllum exalbescens, Potamogeton robbinsii*, and *P. zosteriformis* were also present at least 25 % of the sample stations.

Several floating leaf species were present in small scattered beds but none were common. A substantial bed of *Scirpus validus* was observed at the outlet of Hemlock Creek.

Table 15. Ground Hemlock Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demersum	32.6	2.1	1.5 - 16.0
Chara vulgaris	45.7	3.2	1.5 - 13.0
Elodea canadensis	2.2	2.0	1.5 - 13.0
Heteranthera dubia	4.3	1.0	1.5 - 4.0
Lemna minor	4.3	3.0	1.5
Myriophyllum exalbescens	23.9	1.3	1.5 - 13.0
Najas flexilis	13.0	1.3	1.5 - 5.0
Nymphaea odorata	6.5	1.0	1.5 - 2.5
Pontederia cordata	p		
Polygonum natans	p		
Potamogeten amplifolius	2.2	2.0	4.0
P. filiformis	2.2	1.0	1.5 - 12.5
P. illinoensis	15.2	1.9	2.5 - 4.5
P. natans	p		
P. pectinatus	4.3	2.0	1.5 - 2.5
P. richardsonii	10.9	1.6	2.5 - 6.5
P. robbinsii	21.7	2.5	1.5 - 14.0
P. zosteriformis	32.6	1.8	1.5 - 13.0
P. sp.	17.4	2.9	1.5 - 12.5
Ranunculus sp.	p		
Scirpus validus	2.2	4.0	1.5
Spirodella polyrhiza	2.2	2.0	1.5

Shoreline Survey

Although the shoreline of Ground Hemlock Lake is well developed, it remains largely undisturbed, as most residents have retained most of the natural vegetation between their dwellings and the lake. About 95% of the shore is upland hardwoods and conifers with a small area of adjacent wetland at the northern tip of the lake. Public access is via Hemlock Creek and there is no public frontage.

Ground Hemlock currently supports 51 dwellings. The development factor considering the shoreline length of 1.81 miles is 28 dwellings/mile. The S.D.F. is 1.4. Property on Ground Hemlock are valued at $2,801,375 and improvements at $1,218,565 for a total of $ 4,019,940.

The following is from a shoreline survey conducted in August of 1997. The numbers refer to sections of shoreline shown on the development map.

1 - Three dwellings on steep shore with deep setbacks. Most natural vegetation in tact. Cedars at shoreline.

2 - Approximately 200 feet of natural vegetation, then two dwellings close together about 75 feet from shore and near lake level. Many larger trees have been removed but smaller ones remain and each property has a buffer strip at shore. Third place in this section has all natural vegetation removed except a few trees at shore. Grass extends to shore - should establish a buffer strip.

3 - Four well spaced dwellings on increasingly step slope. Deep setbacks and most natural vegetation in tact.

4 - Undeveloped. Birch, cedar and hemlock on steep rocky shore.

5 - One dwelling with out buildings near lake level. Set back about 75. Most natural vegetation in place.

6 - Undeveloped. Very steep slope.

7 - Twelve well spaced dwellings. First few on very steep slope with most natural vegetation in place and very deep setbacks. Nearing the end of this section the slope decreases and dwellings are closer to shore, but still most natural vegetation in place. Some near this end have much vegetation removed.

8 - Undeveloped. Cedar and birch.

9 - Five dwellings - first few are very close to shore. Moderate slope but much vegetation removed with minimal buffer strips. Section is very uncharacteristic of this lake. Last few have most natural vegetation in tact.

10 - Undeveloped. Cedar, birch and balsam.

11 - One large dwelling near lake level with large trees but no understory. Slope is very gradual but buffer strip should be established.

12 - Hemlock Creek outlet.

13 - Ten small to medium dwellings an moderate to steep slope. Fifty to 75 feet back. Many have most natural vegetation in place but buffer strips could be improved. Very little natural understory here.

14 - Wetland with one dwelling 50 to 75 feet back almost below lake level. This should not have been developed.

15 - One older dwelling with many outbuildings on gradual slope. Large trees, no understory but good buffer strip.

16 - Eleven dwellings on steep to very steep slope. First two are former resort cabins which could improve vegetation between building and shore. All others with very deep setbacks and almost all natural vegetation in place. Many are not visible from the water. Shoreline is cedar, red pine aspen and maple.

Recreational Use

Recreational use was monitored at 8:00 am, 2:00 pm and 7:00 pm on July 6, 1996. Fishing was the most prevalent activity. A "slow - no wake" ordinance is in effect at all times so recreational conflicts are minimal.

Table 16. Ground Hemlock Recreational Use.

	1	2	3
Fishing	6	9	10
Sailing			1
Canoeing/rowing	3		
Swimming/snorkeling		2	
Lounging	1	8	2
Paddle boat	1	1	1

1 = 7/6/96 8:00 am 2 = 7/6/96 2:00 pm - warm, cloudy 3 = 7/6/96 7:00 pm

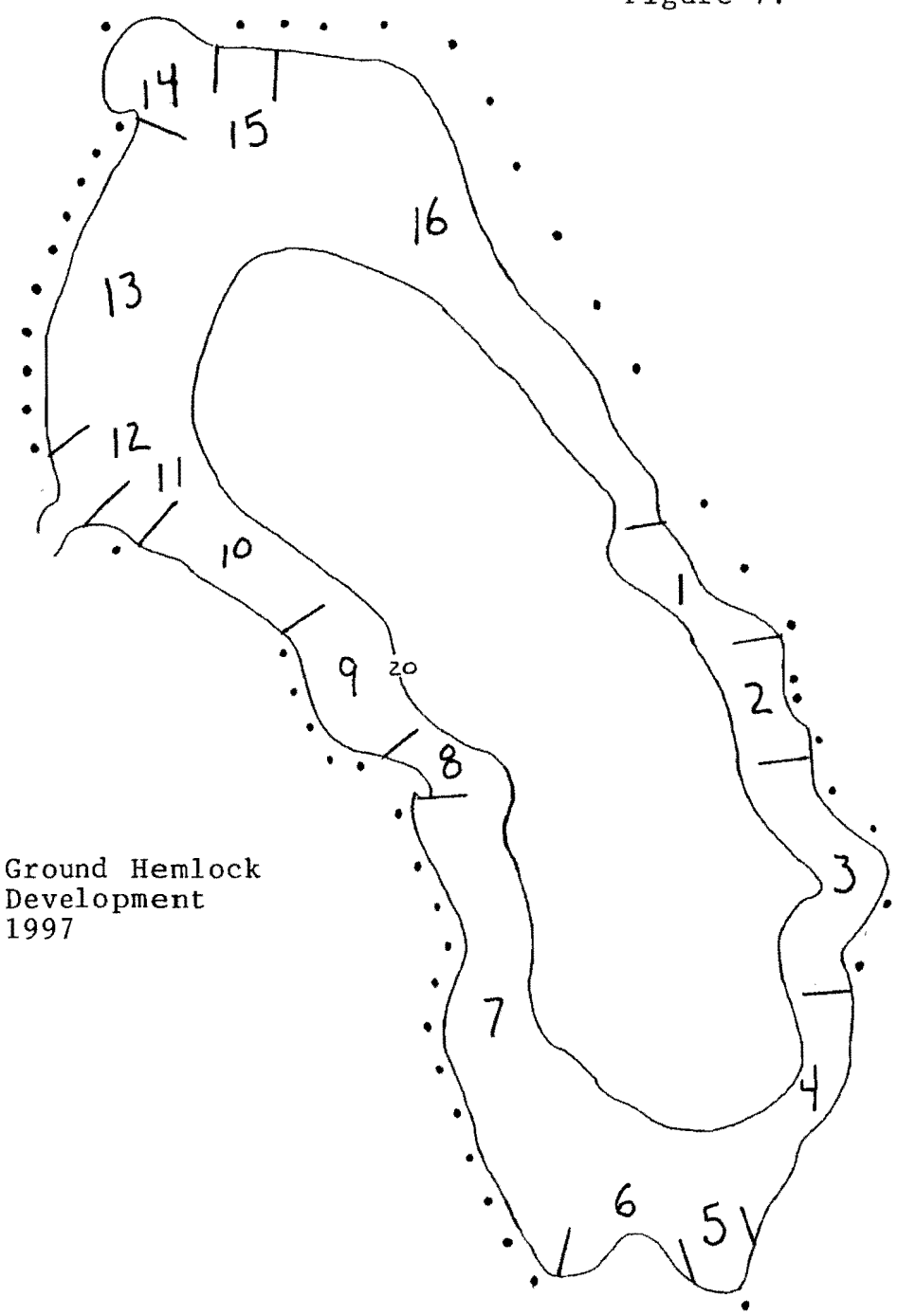
Recommendations

1. Residents who have not followed the trend to maintain a natural shoreline need to know the importance of keeping nutrients and sediment from being washed into the lake. They should be encouraged to allow natural vegetation to re-establish as soon as possilble.

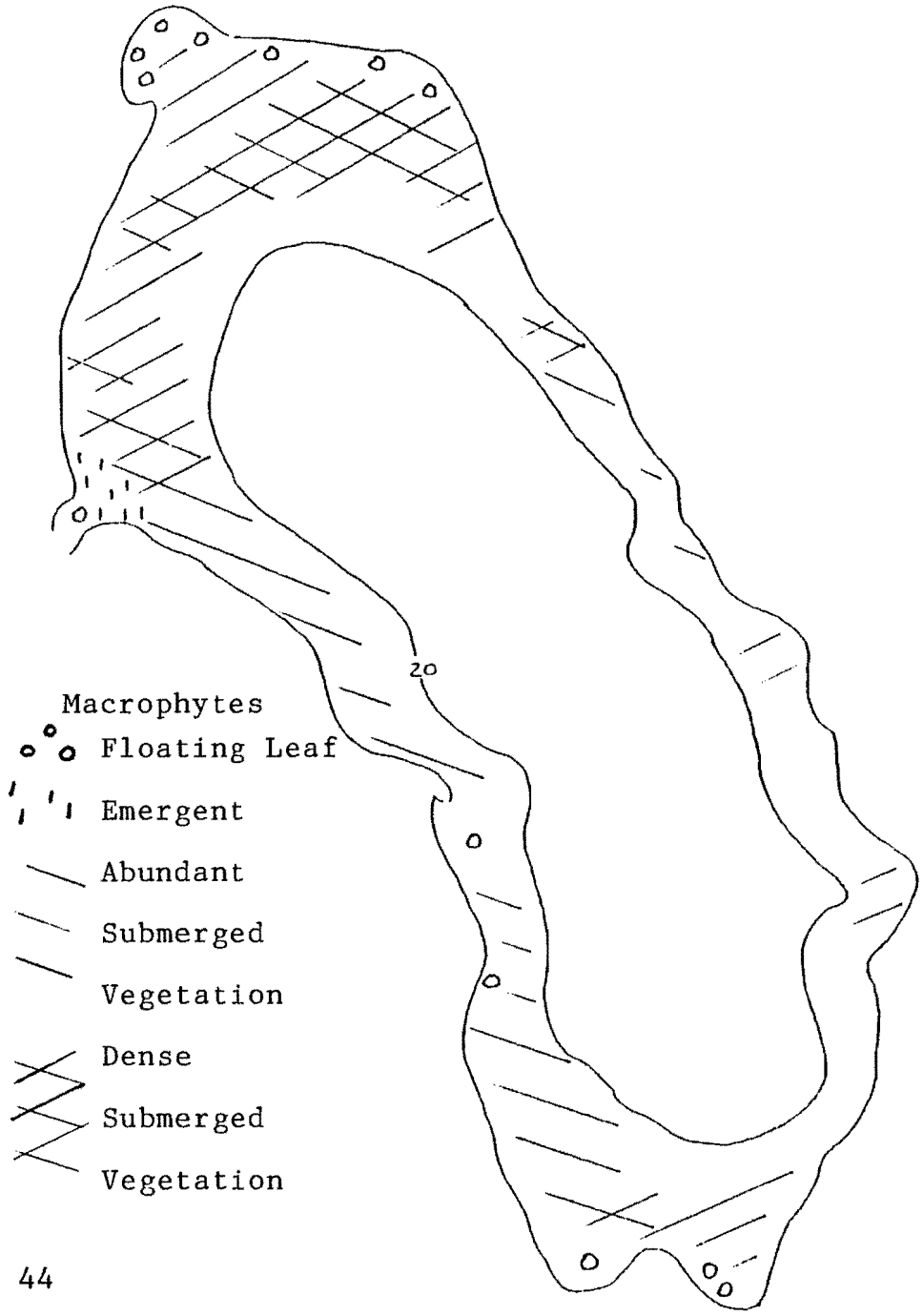
2. The lake association should stay abreast of the status of the long, undeveloped stretches on the south end of the lake. If these areas are ever to be lotted and sold, large lots and wise shoreline development should be encouraged. Perhaps a deed restriction agreement could be reached with the current owner.

3. Although the lack of a public boatlanding lessens the chance of exotics entering the lake, the water chemistry of Ground Hemlock would certainly speed its spread if one were to get in. A system of monitoring for exotics should be developed. Purple loosestrife is know to be within approximately six miles of the lake.

Figure 7.



Ground Hemlock
Development
1997



JUNGLE LAKE

Jungle Lake is a shallow 180 acre lake in south western Forest County. It has an unimproved public boat landing. Jungle is a fine exemple of a wisely developed lake.
The fishery on Jungle Lake consists of a very strong population of large mouth bass and walleyes and a panfish community dominated by perch and bluegills.

Water Quality

According to SWRoFC, the alkalinity, pH and conductivity are 53 mg/L, 7.8 s.u. and 130 uhmo@25C respectively.
Water quality samples on Jungle Lake were not collected and no other historical data was located.

Macrophytes

According to SWRoFC Jungle Lake was a sand-bottomed lake with sparse vegetation in the mid 70's. In July of 1996 Jungle was a muck bottomed lake with abundant vegetation. The entire lake was gridded as the maximum depth of 12 feet is well within the expected depth of growth. Of the 58 sample points, all but three supported vegetation. Thirty stations supported at least one species with a density of at least three. Approximately 25% of the surface of the lake contains either floating-leaf vegetation or surfacing submerged vegetation. The most common species was *Najas flexilis*, but the lake also supported extensive beds of large pondweeds, *Potamogeton*, or "cabbage."
Emergent vegetation was limited to a small area along the east shore.

Table 17. Jungle Macrophyte Specis List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	3.6	1.0	2.5 - 3.0
Chara vulgaris	27	1.9	4 - 8.5
Juncus pelocarpus	3.6	3.0	3.5 - 4.5
Myriophyllum tenellum	3.6	1.5	4.0 - 4.5
Najas flexilis	52	2.0	4.0 - 12.0
Nuphar variagatum	7.1	2.2	2.5 - 3.0
Nymphaea odorata	18	1.6	2.5 - 5.0
Potamogeten amplifolius	12	1.1	2.5 - 7.5
P. gramineus	11	1.3	2.5 - 8.5

P. natans	8.9	2.2	2.5 - 6.0
P. praelongus	43	2.2	4.5 - 12.0
P. robbinsii	16	1.6	2.5 - 10.5
P. zosteriformis	1.8	2.0	5.0
P. sp.	7.1	1.5	3.5 - 8.5
Scirpus validus	3.6	2.5	4.0 -4.5
Sparganium	p		

Shoreline Survey

When the information was gathered for SWRoFC, Jungle Lake had no development. Since 26 dwellings have been built. The development factor for the entire shoreline of 2.18 miles is 12 dwellings/mile. However nearly 15% of the shoreline is wetland. If this is taken into consideration the factor is 14/mile. The S.D.F. is 1.2.

The property on Jungle Lake is valued at $ 375,350 and improvements at $ 583,900 for a total value of $959,250.

The following is from a shoreline survey conducted fall 1997. The numbers refer to sections of shoreline on the development map.

1 - Undeveloped. Mostly pines and birch with other mixed hardwood. Narrow stretches of tag alder wetland at the far west end and into the small bay near the end of this section.
2 - One dwelling on steep slope about fifteen feet off the lake level and fifty feet back at the point. Most natural vegetation in tact. Several undeveloped lots with very narrow access points.
3 - Undeveloped. Birch, oak, maple and red pine.
4 - Four medium to small dwellings set back 50 to 75 feet near lake level. About 100 feet apart. Very natural look - log places with a lot of natural vegetation.
5 - One dwelling close to shore but much natural vegetation.
6 - Undeveloped. Tag alder wetland in narrow band along shore with birch and red pine behind. On east side wetland extends several hundred feet inland.
7 - Birch, maple and red pine. No development but some minimal clearing.
8 - Seven dwellings near lake level. First has very deep setback. Rest are 50 to 75 feet. Most with very good natural vegetation and narrow access strips. Sixth one has removed most of understory.
9 - Eleven medium to small dwellings on steeper slope. Some possible erosion problems. Most with short setbacks but wild shoreline with good buffer strips. Some undeveloped lots.
10 - Two dwellings with long undeveloped stretch of pine, maple and birch between. Shoreline very steep then leveling off at 10 to 12 feet. Second place with large cleared lot but natural vegetation at shore.

Recreational Use

Recreational use data was not collected for Jungle Lake.
A "slow, no wake" ordinance is in affect at all times.

Recommendations

1. Ensure that wise development practises are continued. Encourage the establishment of buffer strips at the few lots that have been cleared to shore.

2. Educate residents on the importance of monitoring septic performance. The plant population in Jungle indicates that it is a very productive system. Nutrient loading from uncontrolled surface runoff or failing septics could cause the healthy plant population to become a nuisance population.

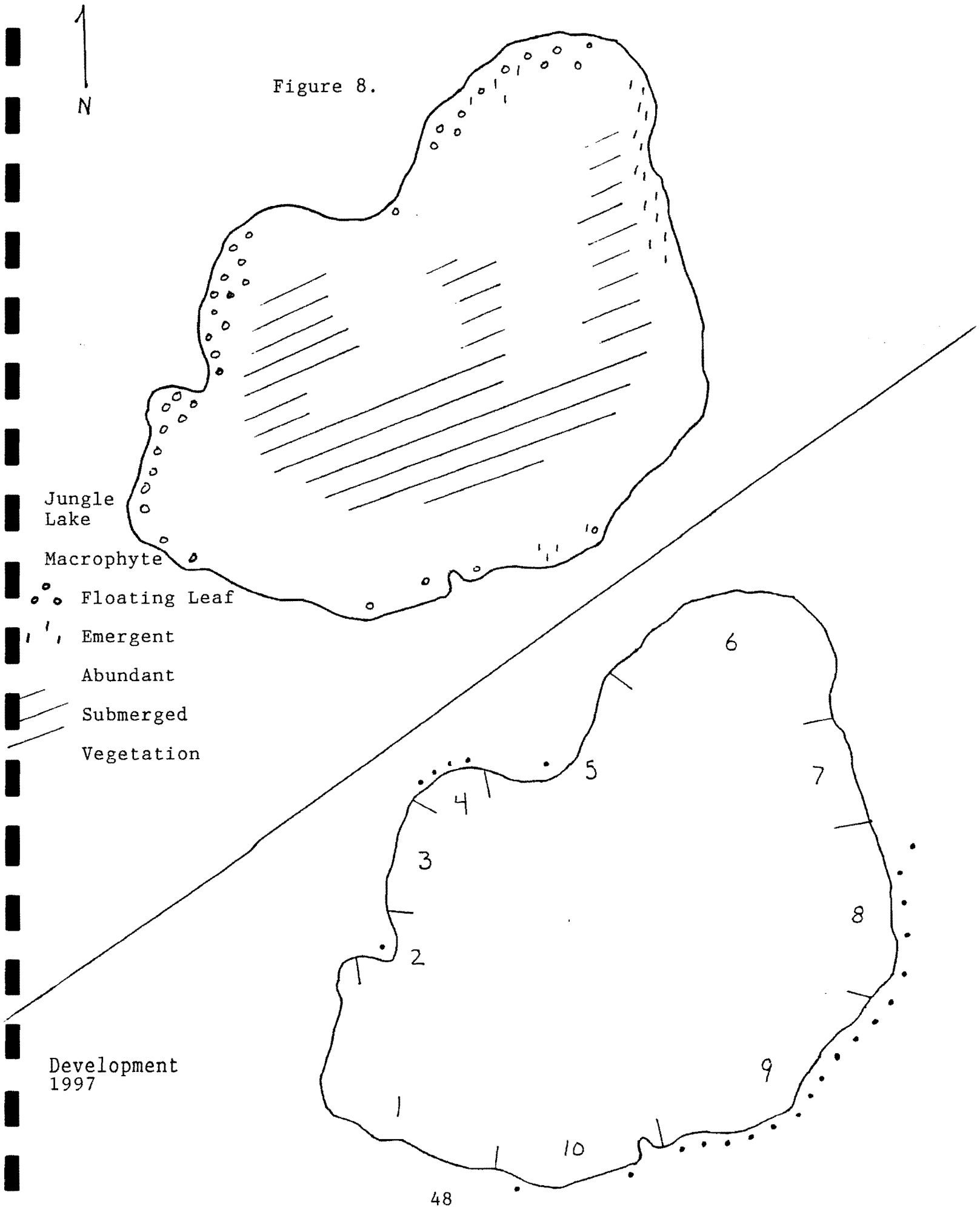
3. A baseline water quality sample should be collected.

4. Eurasian milfoil and curly pondweed (two noxious, exotic species) would probably do very well in Jungle Lake. The association should consider developing a system of monitoring for exotic species, especially near the boat landing.

5. The association should stay abreast of the status of large, undeveloped land holdings. If these are to be lotted and developed, encourage large lots and wise development. Perhaps a deed restriction agreement could be reached with the current owners

6. Protect the north end and southwest bay of the lake from development as they are not suited.

Figure 8.


N
Jungle
Lake
Macrophyte
Floating Leaf
Emergent
Abundant
Submerged
Vegetation
Development
1997
1
2
3
4
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9
10

KENTUCK LAKE

Kentuck Lake is a 957 acre drainage lake with a maximum depth of 40 feet. It is located in the far northwest corner of Forest County and a significant portion lies in Vilas County.
The fishery has undergone a dramatic change in the last few decades. In the early 1980's the crappie population begin to rise which lead to a rapid decline in the walleye population. Since this decline, the large and small mouth bass populations have increased to dominant status. According to the county fish biologist, there is significant data documenting this shift. Kentuck also supports a strong naturally-reproducing muskie population.

Water Quality

Kentuck is a very fertile lake but conditions seem to have improved quite dramatically over the last ten years.

Table 18. Kentuck Water Quality Data.

Selected Secchi Depths in feet (This table contains only average summer Secchi depths.)

1986	3.60	1990	9.43
1987	5.57	1993	8.9
1988	7.27	1994	10.1
1989	9.87	1995	9.2

Data collected by lake volunteers through the WDNR Self Help program.

Sample date	6/72	7/72	8/72	9/72	10/72	11/72	5/30/97*
pH	8.4	8.0	8.7	7.8	8.1	7.2	
Conductivity	71		83	69	60	56	
Alkalinity	1.8	21.9	31.3	33.3	31.8	31.7	
Phos. total	.074	.107	.088	.100	.125	.091	.045
Ammonia	.05	.08	.05	.10	.13	.10	
Nitrogen, total	.63	.53	.31	.63	.53	.48	
Nitrite	.012	.18	.001	.015	.016	.009	
Nitrate	.18	.050	.04	.02	.03	.17	
Iron	.43	.06	.28	.71	.96	.21	

This data is from WDNR files.

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model			Carlson Trophic State Index	
	Phosphorus	KENTUCK	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030	•	6.6 - 9.8	Mesotrophic
Fair	.030 - .050	•	4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

Fifty sites were sampled for aquatic vegetation on August 16, 1996. Nineteen species were collected, including one very small patch of purple loosestrife in the eastern bay of the lake. Emergent vegetation, consisting mostly of bulrushes, was present along much of the western shore, in smaller more scattered beds on the eastern shore and in a large, dense bed extended out several hundred feet along the northeast shore. Floating leaf plants were present but only in a few small, scattered beds. The most commonly encountered species were *Elodea canadensis* and *Najas flexilis*. The submerged species were present at 40% and 34% of the sample sites respectively. *Elodea* growth was quite dense at several sites in the southern half of the lake. This species has been a nuisance on Kentuck Lakes in certain years. Large leaf pondweeds beds were present in Kentuck but not common.

Table 19. Kentuck Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Chara vulgaris	8	2.0	4.0 - 4.5
Eleocharis sp.	2	1.0	2.5
Elodea canadensis	40	2.4	2.0 - 10.0
Equietum sp.	2	1.0	3.0
Isoetes sp.	2	2.0	2.5
Lythrum salicaria	p		
Myriophyllum exalbescens	6	1.7	2.5 - 10.0
M. tenellum	4	2.0	2.5
Najas flexilis	34	2.5	2.5 - 6.5
Nymphaea odorata	4	1.5	4.5
Potamogeten amplifolius	2	1.0	4.5
P. epihydrus	6	1.7	2.5 - 4.5

P. gramineus	2	3.0	2.5
P. richardsonii	10	2.0	1.5 - 9.0
P. sp.	26	2.4	2.5 - 10.0
Sagittaria sp.	p		
Scirpus validus	10	2.8	1.5 - 5.0
Sparganium sp.	p		
Typha latifolia	2	1.0	2.5
Vallisneria americana	2	4.0	4.0

Shoreline Survey

The following assessment values apply only to properties which lie in Forest County: Property = $2,727,000; Improvements = $2,936,800; Total = $5,663,800. The shoreline supports approximately 84 dwellings or 14 d/m. The S.D.F. is approximately 1.1.

The following is from a shoreline survey conducted on 10/16/96. The numbers refer to sections of shoreline shown on the development map.

1 - Undeveloped. Tamarack with bulrushes extending far into the lake.
2 - Five dwellings setback 75 to 100 feet near lake level, separated by approximately 100 feet of natural shoreline. Most have large trees and grass to shore.
3 - Six dwellings most with very deep setbacks and lots of natural vegetation. One shack right at shoreline.
4 - Four small dwellings closer to shore and most natural vegetation in place, but some areas of potential erosion problems.
5 - Nine large dwellings set back approximately 100 feet. Most with large trees, little understory and buffer strips at shore. Some potential erosion problems in this area also.
6 - Five dwellings - some backlotted with many outbuildings. This area has had all natural vegetation removed back several hundred feet. Grass to shore. Not as steep as previous sections.
7 - Ten medium to large dwellings on steeper slope, most with natural vegetation in tact. Setbacks 75 to 100 feet about 100 feet apart.
8 - Five dwellings near lake level with narrow cleared access strips. Very deep setbacks.
9 - Three dwellings widely separated on steeper slope. There are more places here than current development map shows.
10 - Undeveloped. Mostly birch and conifers.
11 - Seven widely spaced dwellings with deep setbacks. Couple with most vegetation removed - potential erosion/runoff problems. Others with most natural vegetation intact.
12 - Undeveloped. Mostly hemlocks.
13 - Thirteen medium to small, widely separated dwellings on steep slope. Several with natural vegetation in tact. Last few with less vegetation - potential erosion problems.

14 - Undeveloped.
15 - Two dwellings with boathouses, but most vegetation remaining.
16 - Four dwellings on west side of bay on steep slope - potential erosion problems.
East side undeveloped - alders and tamarack.
17 - Five dwellings an moderate slope. Most with buffer strips, some with grass to shore.
18 - Undeveloped. Wetland.
19 - Five dwellings (map shows many more) widely separated on steep slope all with deep setbacks. Most have maintained natural vegetation. One with grass to shore.
20 - Undeveloped. Birch, hemlock and cedar.

Recreational Use

Recreational use information was collected at 10:00 am, 2:00 pm and 7:00 pm on July 6, July 30, and Aug 17, 1996. Fishing was by far the most commonly noted activity. During four of the nine survey events more than thirty fishing parties were recorded. Lounging was also quite popular. Speed boating was occurring during almost all of the monitoring events. Below is a summary table of activities during the survey.

Table 20. Kentuck Recreational Use.

	1	2	3	4	5	6	7	8	9
Fishing	45	31	43	6	4	3	22	25	35
Speed Boating	7	9	9	2		1	5	6	3
Water skiing		3						2	
Sailing		1						1	1
Canoeing/rowing	3	2				2			
Jetskiing									
Swimming/snorkeling		4	6					3	
Lounging	32	25	29	7	3	3	17	19	18

1 = 7/6/96 10:00 am - overcast, light breeze
2 = 7/6/96 2:00 pm - 70 overcast, sprinkling
3 = 7/6/96 7:00 pm - overcast, calm; search for drowning victim
4 = 7/30/96 10:00 am - 55 cold, misty
5 = 7/30/96 2:00 pm - 58 misty, overcast; bald eagle and six loons
6 = 7/30/96 6:00 pm - overcast, cold, windy; six loons
7 = 8/17/96 10:30 am - 75 sunny
8 = 8/1/96 2:30 pm - 75 sunny; one loon
9 = 8/1/97 6:30 pm - sunny, calm; one osprey and seven loons

Recommendations

1. Restrict high impact activities in heavily sedimented areas specifically the south end, the northwest corner and the east bay. Educate residents and nonresident lake users on the effects disturbance of these areas can have on a fertile system.

2. Improve shoreline where natural vegetation has been completely removed, specifically the long stretch on the west side near the south corner.

3. Educate east shore residents on septic system monitoring. Perhaps send a survey to gather information on age, usage, etc... of these systems.

4. Educate west shore residents on importance of controlling runoff on steep slopes. At this time most of the development on this side has done so.

5. The purple loosestrife in the east bay should be removed. It looks nice, but it is an extremely aggresive non-native species.

6. Kentuck possesses several characteristics that make it a prime candidate for exploitation by other exotic plant species. It is a fertile system, it is popular with nonresidents and it is near lakes that have these pests. A systsem of monitoring for other exotics especially Eurasian milfoil and curly pondweed.

Figure 9

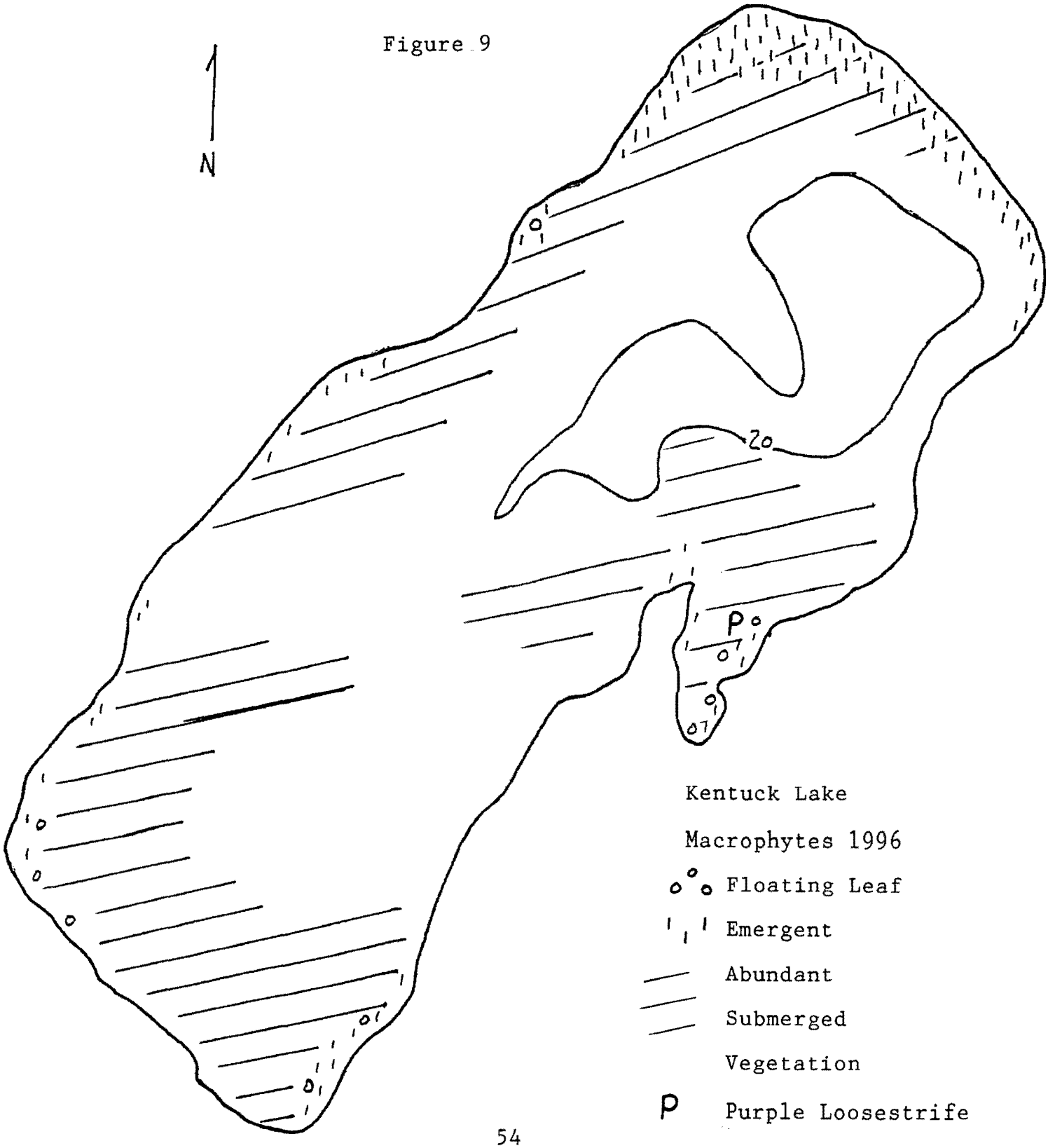
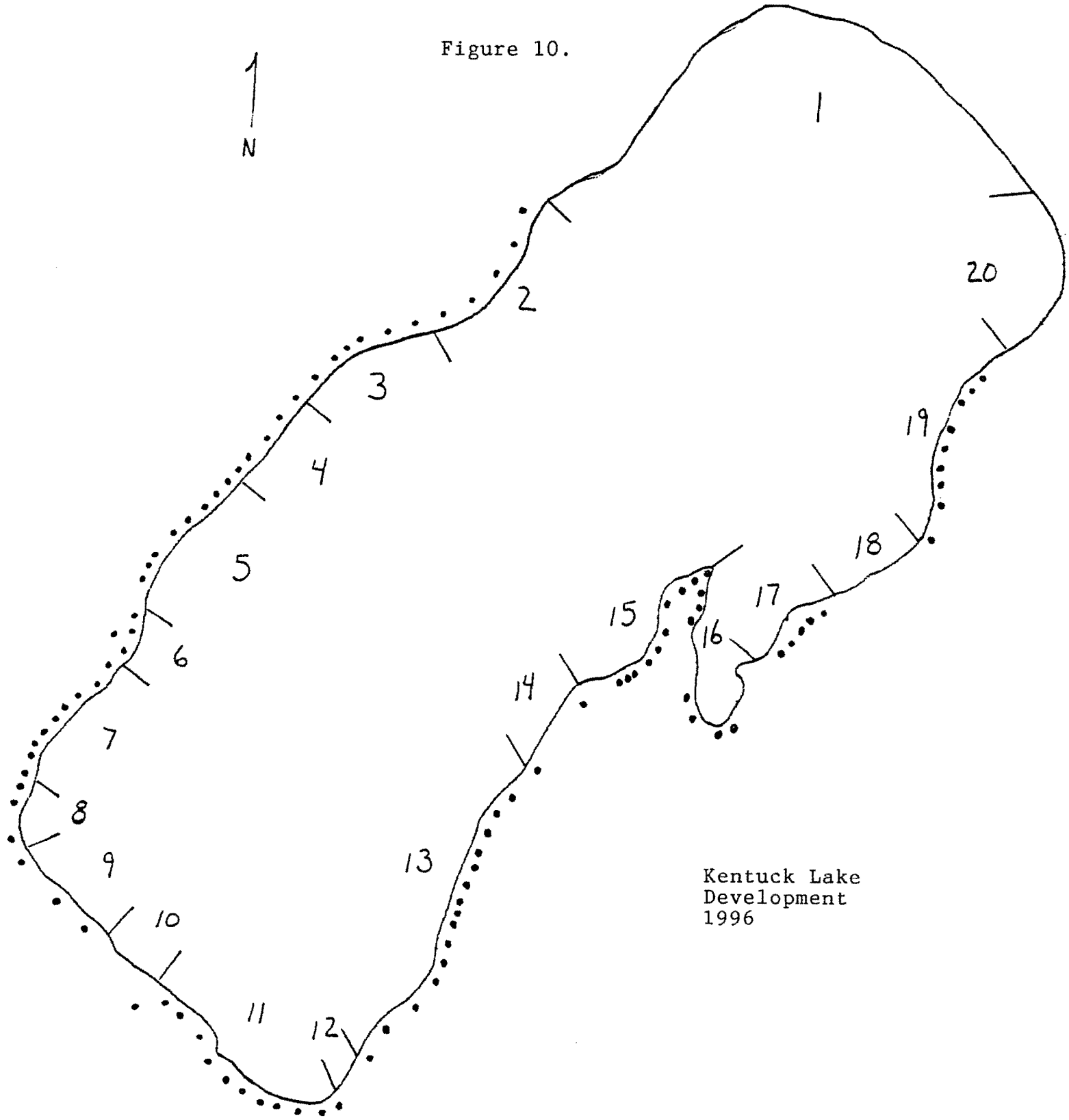

N
P
Kentuck Lake
Macrophytes 1996
Floating Leaf
Emergent
Abundant
Submerged
Vegetation
P
Purple Loosestrife

Figure 10.



Kentuck Lake
Development
1996

LILY

Lily Lake is a 211 acre, hard water lake located in southern Forest County. Twenty-three percent of the lake surface is over 20 feet deep. The Lily River flows into the east side of Lily Lake from Roberts Lake and out the south end. A severe infestation of rusty crayfish has altered the lake over the past few years but the population has recently shown signs of reaching an equilibrium. Although the crayfish infestation has probably had an adverse effect on large mouth bass numbers, the muskies and walleye populations seem quite strong.

Water quality

Water quality samples were collected in May of 1995 and 1996 by Lily Lake volunteers and analyzed by NLS. Below is a summary of data from those samplings along data from the SWRoFC presumably gathered in the mid 1970's.

Table 21. Lily Water Quality Data.

	1970's	1996	1997
Alkalinity	106	100	100
pH	6.6	7.3	7.8
Conductivity	222	-	209
Chloride	-	<1	-
Nitrogen - ammonia	-	.037	.115
Nitrogen - NO2+NO3	-	.090	.100
Nitrogen - TKN	-	.32	.57
Phosphorus, total	-	.03	.06

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model

	Phosphorus	LILY
Excellent	< .001	
Very good	.001 - .010	
Good	.010 - .030	
Fair	.030 - .050	•
Poor	.050 - .150	
Very poor	> .150	

Carlson Trophic State Index

Secchi Depth	
> 19.7	Oligotrophic
9.8 - 19.7	----------
6.6 - 9.8	Mesotrophic
4.9 - 6.6	----------
3.3 - 4.9	Eutrophic
< 3.3	

Macrophytes

The macrophyte growth within Lily Lake has been severely depleted by the rusty crayfish. Of the sixty stations sampled on August 5, 1995, only thirteen had any true macrophyte growth. Submerged vegetation was present at seven stations. Only floating leaf species were collected from the remaining six sites. Only five different species were collected - the fewest of the twenty lakes surveyed. Without large aquatic plants to utilize the available nutrients within Lily, algae has flourished. Thirty-nine stations had a thick mat of filamentous algae (*Spirogyra*) coating the bottom. The thickness of this mat ranged from less than an inch to probably over one foot.

The following factors make Lily Lake a good candidate for an invasion on Eurasian Water milfoil:
1. The current crayfish situation has weakened native plant populations.
2. The water quality and substrate are right for milfoil growth.
3. The newly renovated public boat landing invites "hitch-hiking" plant fragments.

The area near the boat landing should be monitored regularly for the presence of this species.

Table 22. Lily Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Lemna minor	1.5	1.0	4.5
Nuphar variagatum	9.0	1.8	3.0 - 4.5
Nymphaea odorata	1.5	1.0	4.5
Potamogeten amplifolius	7.5	2.4	2.5 - 5.0
P. epihydrus	1.5	1.0	4.0
Spirogyra spp.	61.2	2.6	2.5 - 22.0

Shoreline Survey

Lily has undergone limited development, most of which has occurred in the last twenty years. Only twenty-four dwellings were noted at the time of this survey. Approximately 50% of Lily's 2.88 mile shoreline is wetland. But even with that portion discounted the development factor is relatively low at 16.6 dwellings/mile. For the entire shoreline the factor is slightly over 8d/m. Much of the shoreline is publicly held and a significant tract is held by a private party who is not currently considering developing it.
Property is valued at $754,500 and improvements at $ 1,895,880 for a total of $ 2,650,380. These values include several properties on the Lily River.

The following is from a shoreline use survey conducted on August 2, 1995. The numbers refer to sections of shoreline shown on the development map.

1 - Developed but with good setbacks and most natural vegetation left in place. Large birch and alders. medium slope.
2 - Low wetland at shore with development behind. Most natural vegetation left.
3 - One large residence with vegetation removed - should be encouraged to let that come back.
4 - Four dwellings with most natural vegetation left. Good setbacks. Wetland at shore narrowing toward north end. Water lily beds.
5 - Undeveloped. Birch and other hardwoods grading into black spruce swamp which extends around entire north end of lake. Grading back into birch near point on east shore.
6 - Undeveloped. Birch, red pine, maple and balsam behind boulder shoreline.
7 - Areas cleared possibly for future development. Some signs of erosion near shore.
8 - Four dwellings. Very little natural vegetation in this area.
9 - Inlet.
10 - Development separated by wide natural strips, but with grass to shore.
11 - Undeveloped. Low wetland area with sedges, cattails and small black spruce.
12 - Outlet.
13 - New Development. Very steep slope at shoreline leveling off at about 15 feet. Five dwellings most with some natural vegetation and decent setbacks.
14 - Slope drops to low, wetland area.
15 - New development with obvious erosion problems.

Recreational Use

Recreational use on Lily Lake was dominated by fishing during all nine survey times. It outnumbered all other activities combined nearly two to one. Lily also has its share of high impact activities. Water skiers werenoted during six surveys and jetskiers on five surveys. The fact that only one crayfish trapper was observed may be an indication of a decrease in the crayfish population.

Table 23. Lily Recreational Use.

	1	2	3	4	5	6	7	8	9
Fishing	10	15	11	11	6	15	10	13	15
Speed Boating								2	
Water skiing	2	2		1	3		1	2	
Canoeing/rowing	1	1			1		1	1	
Jetskiing	1	1		2	2	1			
Swimming/snorkeling		4	2	2	3		3	7	4
Lounging		4	4					1	1
"Tending crab traps"	1								

1 = 7/6/96 10:00 am - 72 cloudy, calm
2 = 7/6/96 2:00 pm - 77 partly cloudy, calm
3 = 7/6/96 7:00 pm - 70 cloudy, calm
4 = 7/31/96 10:00 am
5 = 7/31/96 2:00 pm
6 = 7/31/96 7:00 pm
7 = 8/25/96 10:00 am
8 = 8/25/96 2:00 pm
9 = 8/25/96 7:00 pm

Recommendations

1. Continue wise development practices. Lily is a relatively fertile system. Heavy nutrient loading from unchecked runoff would be very detrimental to water quality.

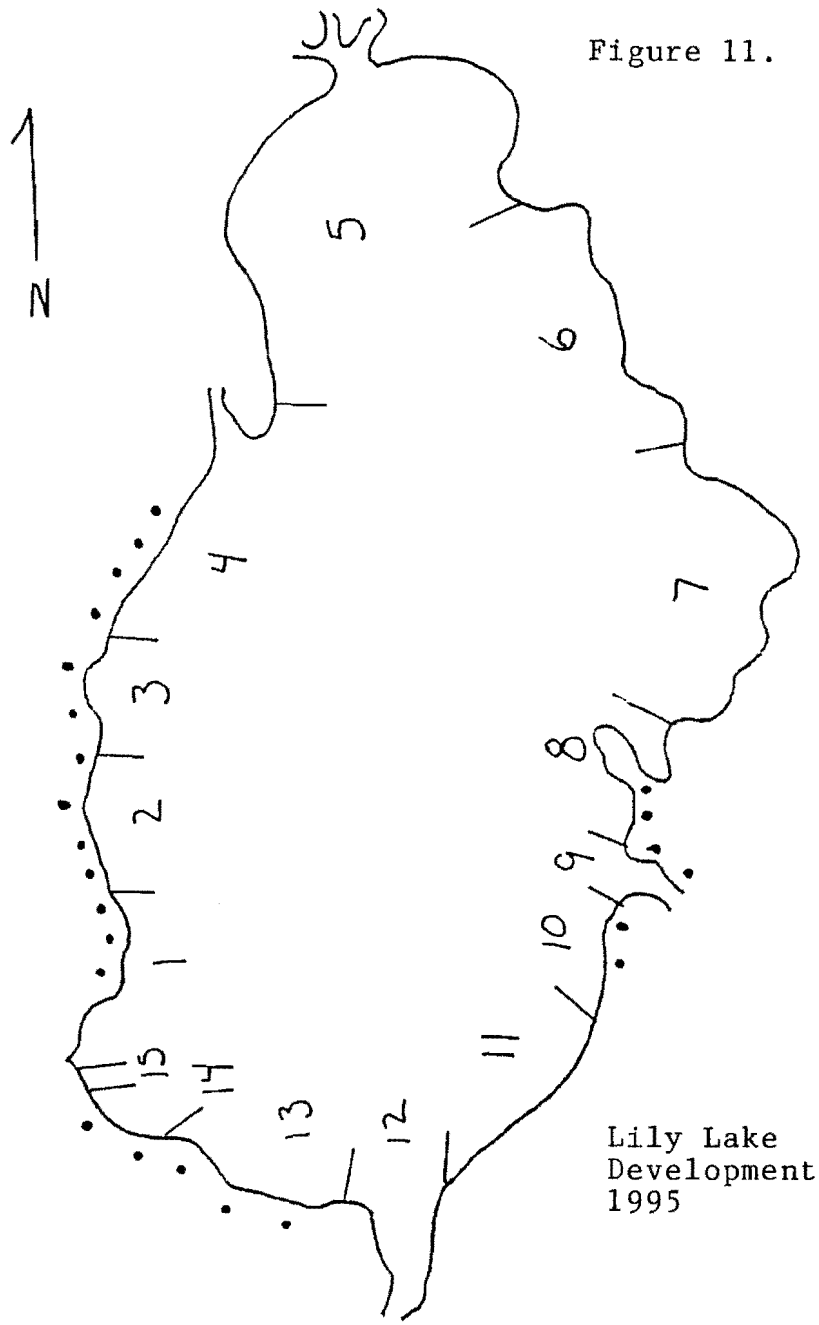
2. Monitor for exotic species. (See page 57.) Perhaps the lake association could appoint a committee to implement a monitoring program.

3. Place prominant signs on exotic plant species at the boat landing.

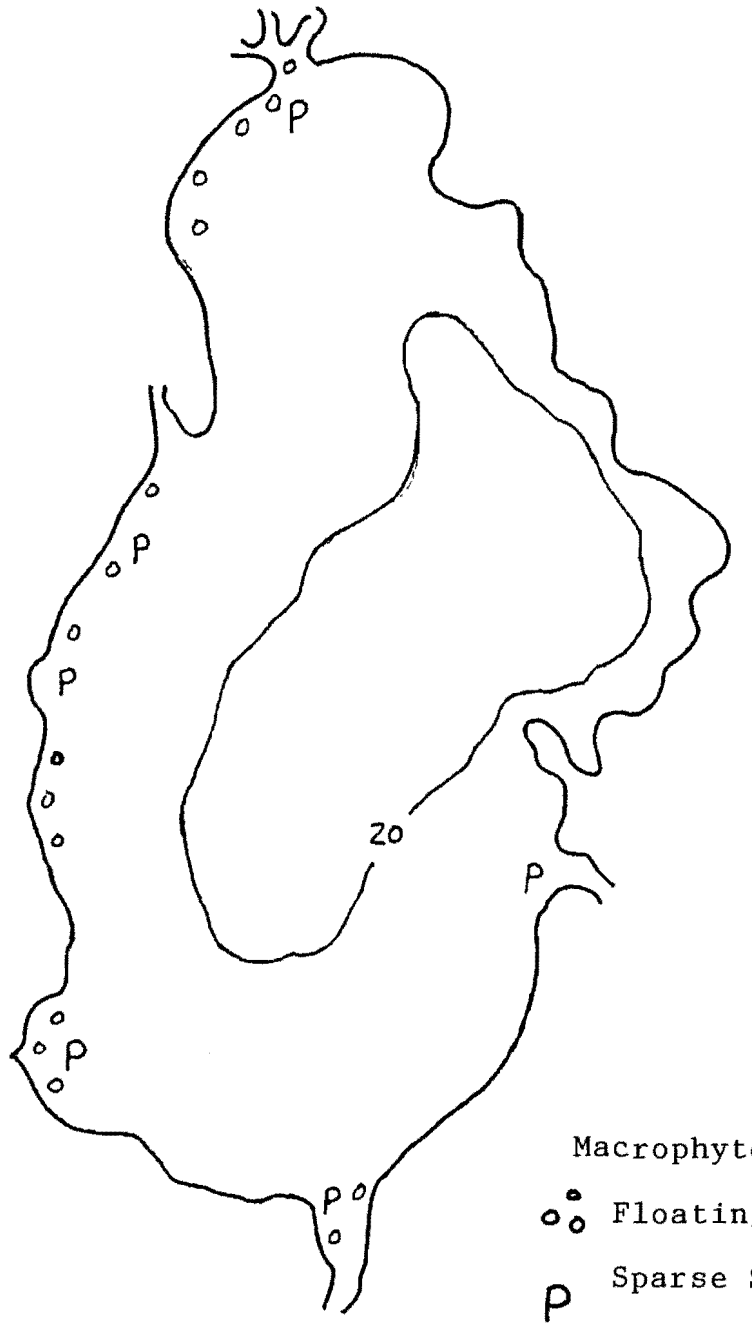
4. The lake association should stay abreast of the status of the large, privately held tract along the east shore. If this section is to be lotted and sold, encourage wide lots and wise development practices. Perhaps a deed restriction agreement could be reached with the current owner.

5. Protect sensitive, shallow, heavily sedimented areas, specifically the north end of the lake, from high impact recreational activities. Disruption of the sediment in these areas could release significant amounts of nutrients. Post information on these areas at the boatlanding for nonresident lake users.

Figure 11.



Lily Lake
Development
1995



Macrophytes 1995

Floating Leaf

P Sparse Submerged Vegetation

LITTLE LONG LAKE

Little Long Lake is a very soft-water, seepage lake in south central Forest County. It is 28 feet deep and covers 102 acres. A significant portion of the northern lobe lies within the twenty foot contour. The fishery on Little Long Lake is mainly largemouth bass and panfish, with some stocked walleyes.

Water Quality

Water quality data on Little Long Lake has been collected sporadically under several different programs. In the SWRoFC the pH, conductivity and alkalinity are listed at 6.4 s.u., 20 uhmo and 8 mg/l respectively. In 1980, concerns from residents prompted sampling for fecal coliform bacteria to determine whether or not failing septic systems were adversely effecting the lake. Fifteen samples were collected and analyzed, yielding results of 20 colonies or fewer per 100 mLs on all samples. This indicated that at those sites (chosen because of there proximity to the shore) there was no unusually high levels of bacteria. The following tables contain additional data gathered from DNR files.

Table 24. Little Long Water Quality Data.

Selected Secchi depths in feet (Many more readings were taken and are available through WDNR. The following data is provided to indicate general water quality.)

8/17/95	9/23/95	10/12/95	5/25/96	6/22/96
12.5	10.0	13.0	13.0	11.0
7/20/96	8/22/96	9/21/96	10/15/96	
15.0	20.0	8.0	8.0	

This information was collected by volunteers through the WDNR Self Help program.

9/25/85

Calcium	2	Nit. - Ammonia	<.02
Sulfate	3.7	Nit. - NO2+NO3	<.02
Conductivity	19	Nit. - TKN	.40
Alkalinity	61	Phos. total	.01
Chloride	.4		

All values in mg/L except conductivity = uhmo@25C and alkalinity = UEQ/L

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model			Carlson Trophic State Index	
	Phosphorus	L.L.LAKE	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010	• •	9.8 - 19.7	----------
Good	.010 - .030		6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

The macrophytes present are representative of a very soft water, slightly acidic system. Fifteen species were collected. Vegetation was collected at 30 of the thirty-three stations sampled, including one site over twenty feet deep. The two most commonly collected plants were *Utricularia purpurea* and *Nitella flexilis*, which while similar in appearance are really quite different. They are both very limp, almost translucent and lack differentiated roots and leaves. *Utricularia purpurea* or purple bladderwort is a true green plant which generally does not root. It is found only in acid water bodies. *Nitella* which is a bit more common is actually not a green plant but a colonial algae that resembles a plant. This macrophyte is capable of growing at great depths and was collected at one station 24.5 feet deep.

Nymphaea or White water lily was present though not particularly dense in the shallows around most of the lake. *Brasenia schreberi*, the other floating leaf plant, was limited to the southern portion of the lake. Truly aquatic emergent vegetation was rare, but much of the shoreline along the southern bay consisted of several different semi-aquatic species growing in aquatic habitats.

Most of the remaining vegetation consists of small, "sand-loving" species. Some of which barely penetrate out of the bottom. These include *M.. tenellum*, *E. acicularis*, and *J. pelocarpus*. Little Long Lake lacks large structural macrophytes.

Utricularia purpurea is currently listed on the Wisconsin Natural Heritage list as a "special concern" species mainly because of the vulnerability of the systems in which it thrives.

Table 25. Little Long Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	18	2.2	3.5 - 6.5
Calla palustris	p		
Eleocharis acicularis	15	3.0	3.5 - 5.0
Elatine triandra	9	1.0	4.0 - 6.5
Eriocaulon setangulare	3	3.0	2.0
Isoetes sp.	15	2.0	4.0 - 6.5
Juncus pelocarpus	15	2.0	4.0 - 6.5
Myriophyllum tenellum	12	1.8	4.0 - 6.5
Nitella flexilis	54	2.7	6.0 - 24.5
Nymphaea odorata	21	2.0	4.0 -.6.5
Potamogeton epihydrus	21	2.0	4.0 -10.0
P. sp.	9	2.0	4.0 -6.5
Potentilla palustris	p		
Sparganium sp.	12	1.5	4.0 - 6.5
Utricularia purpurea	39	2.2	3.5 - 19.0

Shoreline Survey

The shoreline of Little Long is 2.4 miles long and approximately 85% uplands. It currently supports 66 dwellings compared to 36 at the time the SWRoFC was compiled. If the .36 miles of wetland are discounted, Little Long has a development factor of over 32 d/m. The S.D.F. is 1.7.

Property values are currently listed at $1,670,000 for property, $2,228,000 for improvement, and $3,898,000 total.

The following is from a shoreline survey conducted on October 28, 1996. The numbers refer to sections of shoreline shown on the development map.

1 - Seven dwellings on moderate slope, set back 50 to 100 feet. Most have large trees, no understory and minimal buffer strips. Some with grass to shore. Two large boathouses.

2 - Four dwellings on steep slope separated by 100 to 200 feet of natural vegetation - birch and hemlock. More natural vegetation in place. Some have terraced to control erosion.

3 - One small dwelling with very large cleared lot. Grass to shore.
4 - Undeveloped. Black spruce and labrador tea wetland.
5 - Undeveloped. Upland, mostly birch and hemlock.
6 - Undeveloped. Mostly birch uplands with patches of floating bog.
7 - Nine dwellings, including two mobile homes, on moderate slope with areas of floating bog in front. Setbacks 50 to 100 feet. Some with natural vegetation, several with little natural vegetation and grass to shore. Some real and potential erosion problems. Two boathouses.
8 - Undeveloped. Floating bog at shore.
9 - Three dwellings close to lake level, with at least some natural vegetation or buffer strips.
10 - Undeveloped. Labrador tea wetland.
11 - Nine dwellings on increasing slope. Most have deep to very deep setbacks - one very close to shore. Some have left natural vegetation in tact, some have terraced. One large boathouse.
12 - Black spruce wetland with mobile home on each end.
13 - Eight small dwellings some very close to shore. Most with large white pines and birch, but little understory.
14 - Three dwellings with very deep setbacks.
15 - Four dwellings and one boathouse. Place before boathouse is good example of natural vegetation. Most with approximately 75 foot setbacks and sedge buffer strips.
16 - Five dwellings 50 to 100 feet back, most with little understory. Third one has left natural vegetation. Some with grass to shore.
17 - Undeveloped. Mostly oak, hemlock and birch.
18 - Eight large well spaced dwellings approximately 75 back. Many with most natural vegetation in tact.
19 - Seven dwellings on steep slope 50 to 100 feet apart and 50 to 75 feet back. Some terracing but not much natural understory. One large boathouse. Some sea walls.

Recreational Use

Recreational information was collected on Little Long Lake at 10:00 am, 2:00 pm and 7:00 pm on July 6, July 31 and August 4, 1996. Water skiing / speedboating are restricted to 10:00 am to 5:00 pm. On July 6 at 2:00, 4 speed boaters, 3 water skiers and 3 jetskiers were reported. At 2:00 on August 4, 3 speed boaters, 3 water skiers and 2 jet skiers were reported. This recreational load must push the capacity of a 100 acre lake. Even with the high frequency of high impact activities, the most commonly noted activity was "lounging." Below is a summary table of activities noted.

Table 26. Little Long Recreational Use.

	1	2	3	4	5	6	7	8	9
Fishing	2	1	5	2	1	3			2
Speed Boating		4						3	
Water skiing		3						3	
Canoeing/rowing	1		2	1	2		2		3
Jetskiing	3						2		
Swimming/snorkeling		12			5		4	8	
Lounging	6	21	10	4	9	7	8	20	5

1 = 7/6/96 10:00 am - Sunday
2 = 7/6/96 2:00 pm
3 = 7/6/96 7:00 pm
4 = 7/31/96 10:00 am - Wednesday
5 = 7/31/96 2:00 pm
6 = 7/31/96 7:00 pm
7 = 8/4/96 Sunday (no times) - very warm
8 = 8/4/96
9 = 8/4/96

Recommendations

1. The association should explore the potential for and legality of "dockaminiums" and other shoreline use schemes that may be attempted due to the situation on Roxy Lake.

2. Recreational use should be studied further to assess the effect this heavy use has on the lake.

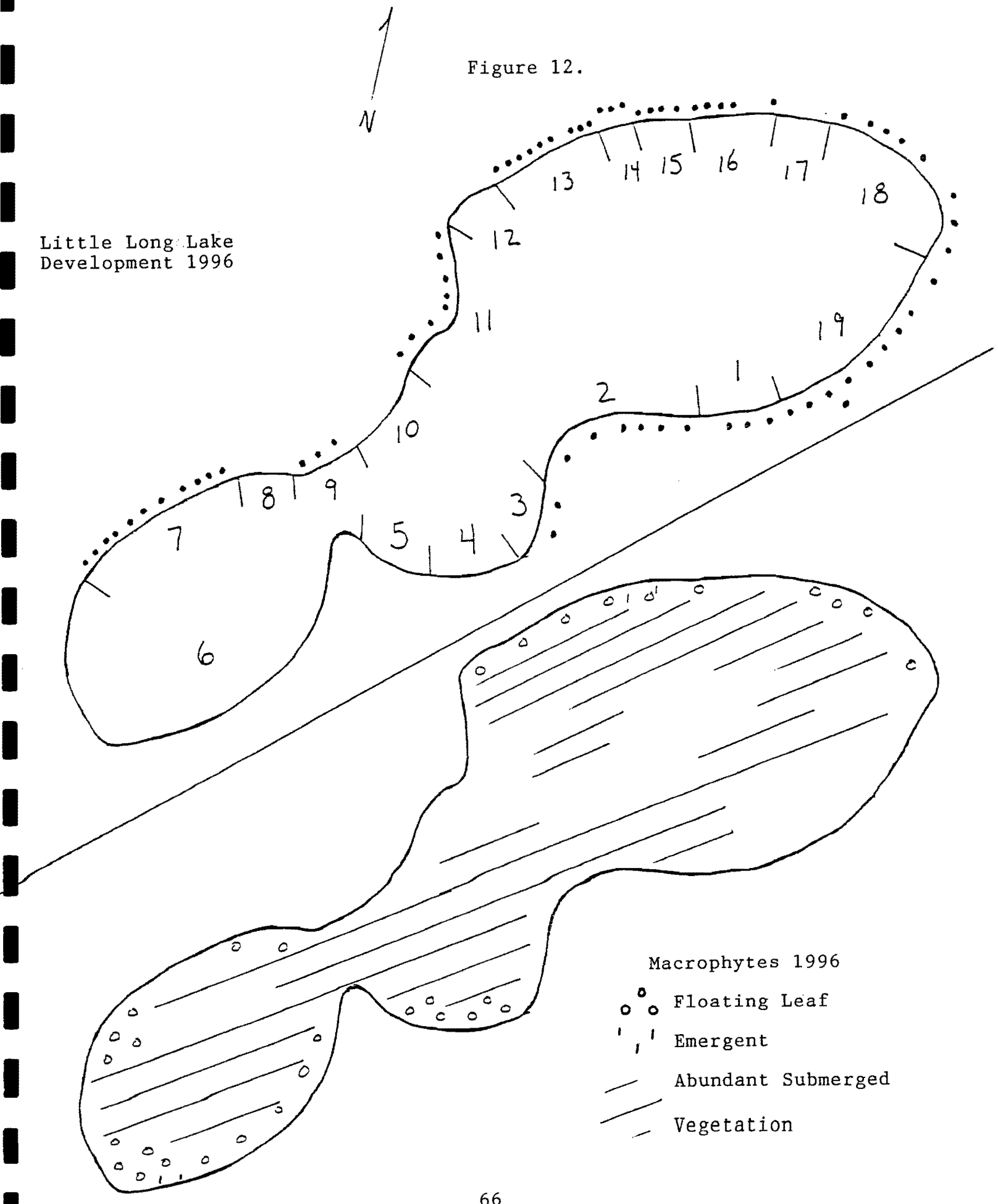
3. The south end of the lake should be protected from all high impact activities.

4. Residents should be encouraged to improve shoreline vegetation where necessary. Also erosion problems near boathouses and seawalls should be addressed. On a small lake where this is a common situation, shoreline improvement could be promoted as a lakewide co-operative effort. Maybe even consider a gimmick like a prize for "most improved."

5. The association should stay abreast of the status of long, undeveloped stretches and insist they be developed wisely if at all, especially with one of these areas very close to Roxy Lake.

6. Monitor alkalinity and pH for the effects of acid rain.

Figure 12.


N
Little Long Lake
Development 1996
1
2
3
4
5
6
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14
15
16
17
18
19
Macrophytes 1996
Floating Leaf
Emergent
Abundant Submerged
Vegetation

LITTLE RICE FLOWAGE

Little Rice is 1,219 acre flowage of the Wolf River which lies about five miles south of Pine Lake, the headwaters of the Wolf. It reaches a maximum depth of about 10 feet. Its level is maintained by a large dam, which is controlled by the DNR. The flowage is heavily used by migrating waterfowl and has extensive wild rice beds on the north end. The fishery is dominated by bullheads.

Water Quality

According to SWRoFC, the alkalinity, pH and conductivity of Little Rice are 35 mg/L, 7.1 s.u. and 81 uhmo@25C respectively. No other water quality data was located.

See the water quality section on page five for an explanation of these tests.

Macrophytes

The following species list and community map were generated from a survey performed in August of 1996 and 1997. Forty-two stations were sampled. Unfortunately the numbers below are not representative of this water body, as shallow water and thick vegetation prevented the sampling of many of the near shore sites and "backwater" areas. As is noted below, this specifically biased the frequency of wild rice.

Table 27. Little Rice Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demursum	16.7	1.3	2.5 - 7.5
Elodea canadensis	47.6	2.4	3.0 - 9.0
Lemna trisulca	2.4	3.0	3.5
Megalodonta beckii	33.3	1.7	2.0 - 5.0
Myriophyllum exalbescens	28.6	2.2	2.5 - 5.0
Najas flexilis	23.8	2.2	3.5 - 9.0
Nitella flexilis	52.4	2.8	3.0 - 9.0
Nuphar variegatum	26.2	1.2	2.0 - 7.5
Nymphaea odorata	2.4	2.0	2.0
Pontederia cordata	p		
Potamogeten amplifolius	14.3	1.5	3.5 - 5.0
P. epihydrus	p		

P. natans	p		
P. pectinatus	2.4	1.0	2.0
P. praelongus	26.2	1.4	4.0 -9.0
P. robbinsii	16.7	1.4	2.0 - 4.5
P. sp.	28.6	1.5	3.5 -8.5
Potentilla palustris	p		
Sagittaria sp.	2.4	1.0	2.0
Sparganium sp.	21.4	1.8	2.0 -5.0
Typha latifolia	p		
Vallisneria americana	57.1	2.8	2.5 - 8.0
Zizania aquatica	9.5 *	2.0	3.0 - 4.0

* This value is artificially low as many of the stations that were not sampled, supported thick rice (*Zizania*) growth.

Shoreline Survey

The 14.1 mile shore line of Little Rice is only moderately developed. 5.3 miles are in public ownership.
A shoreline survey was not performed on Little Rice due to thick vegetation and low water. It will be attempted in the spring of 1998.

Current property values of $1,806,210 include $503,100 for land and 1,303,110 for improvements.

Recreational Use

Recreational use data was not collected on Little Rice.

Recommendations

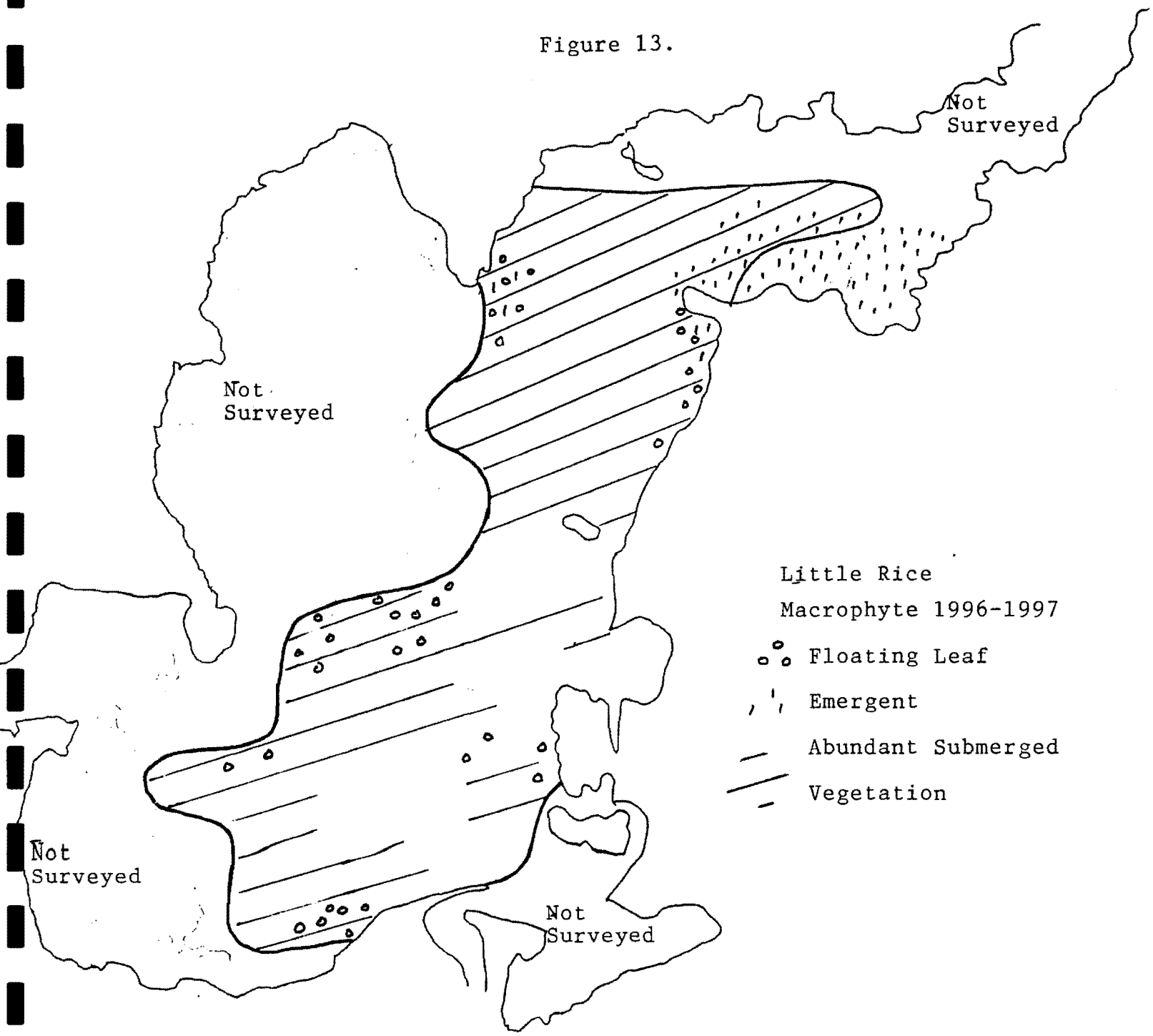
1. Ensure that future development is done wisely. Protect inappropriate areas from development.

2. Protect all sensitive "back water" areas from high impact activities.

3. Several locations on this flowage support extremely diverse aquatic and semi-aquatic communities that would make excellent educational areas. They are also much more easily accessible than these types of areas usually are.

4. A system of monitoring for exotic species should be developed and implemented.

Figure 13.


Not
Surveyed
Not
Surveyed
Not
Surveyed
Not
Surveyed
Little Rice
Macrophyte 1996-1997
Floating Leaf
Emergent
Abundant Submerged
Vegetation

LAKE LUCERNE

Lake Lucerne is a very long, narrow lake with a surface area of 1,026 acres and a maximum depth of 73 feet. It is know for its exceptional water clarity. It consists of two very different sections divided by a group of islands. The southern one forth is quite shallow and relatively fertile from an aquatic plant standpoint. The area to the north of the islands has very little surface area that is less than twenty-five feet deep. The bottom is predominantly large rocks and boulders with very little vegetation.

The shoreline is almost entirely upland hardwoods with scattered pines. Lucerne is the headwaters of Swamp Creek, an important tributary of the Wolf River. It supports a diverse fishery including stocked brown and lake trout and smelt. Whitefish, which were once present have not been noted in at least ten years.

Lucerne currently has "Outstanding Water Resource" status.

Water Quality

Water quality samples were collected in late fall in 1990, 1991, and 1992 by association members and analyzed by NLS. Table 15 is a summary of the data produced from those samplings along with data from the SWRoFC.

Table 28. Lucerne Water Quality Data.

	1938	1970's	1990	1991	1992
Alkalinity	23	22	38	32	36
pH	7.3	6.9	7.5	7.1	6.5
Conductivity		61	95	70	82
Chloride			2	<1	2
Nitrogen - ammonia			<.05	<.05	<.05
Nitrogen - NO2+NO3			<.05	<.05	.08
Nitrogen - TKN			.58	.70	.76
Phosphorus - total			.007	.009	.010

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model

	Phosphorus	LUCERNE
Excellent	< .001	
Very good	.001 - .010	•
Good	.010 - .030	
Fair	.030 - .050	
Poor	.050 - .150	
Very poor	> .150	

Carlson Trophic State Index

Secchi Depth	
> 19.7	Oligotrophic
9.8 - 19.7	----------
6.6 - 9.8	Mesotrophic
4.9 - 6.6	----------
3.3 - 4.9	Eutrophic
< 3.3	

Macrophytes

Lake Lucerne displayed the most diversity of the lakes surveyed, with 31 different taxa of aquatic plants collected. The shape and rapid dropoff along much of the shoreline made gridding this lake difficult. Eventually 142 sites were sampled. Of these, 101 supported at least some macrophyte growth. Floating-leaf vegetation, represented by five different species was present at 38 of the sample sites. Emergent vegetation was present at 24 stations. Most is encountered around the islands on the south end of the lake.

Lucerne supported many of the small rosette species associated with low-nutrient soft-water lakes and several species characteristic of more nutrient rich systems. The most commonly collected species was *Potamogeton gramineus*, a medium leafed pondweed which usually grows in shallow sandy areas. In Lucerne it was present at nearly 30% of the sample sites to depths of 15.5 feet. Many areas of the lake were characterized by distinct macrophyte communities. The small, sand-loving rosette species were very common along the south and east shores. Mixed beds of large, "cabbage" weeds, *Potamogeton richardsonii*, were present around and to the north of the island group, and *Nitella*, a large, limp, bright green, colonial algae was very common along the west shore. This "plant" was present in a thick mat at one station thirty-six feet deep. It was not determined what the maximum depth of grow of this species was.

A large patch of purple loosestrife has been present near the lake on the north end. The plant is very slowly approaching the lake. Since the study was done the lake association has removed plants near the lake but the main patch remains. No other exotics were collected.

Table 29. Lucerne Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	3.5	1.2	3.5 - 5.5
Carex sp.	.7	1.0	2.0
Chara vulgaris	14.1	2.0	2.5 - 19.5
Eleocharis acicularis	19.0	2.1	2.0 - 8.5
E. sp.	3.5	1.6	2.0 - 6.5
Elodea canadensis	.7	1.0	7.5
Eriocaulon septangulare	.7	1.0	3.0
Isoetes sp.	6.3	1.2	3.0 - 8.5
Juncus pelocarpus	17.6	2.2	2.0 - 8.5
Lobelia dortmanna	2.8	1.5	2.0 - 6.5
Lythrum salicaria	p		
Myriophyllum tenellum	4.9	1.7	4.5 - 7.5

Najas flexilis	19.0	1.9	2.0 - 12.5
Nitella flexilis	19.7	1.8	3.5 - 36.0
Nuphar variegatum	1.4	1.0	3.5 - 4.5
Nymphaea odorata	4.9	1.0	2.0 - 6.0
Polygonum natans	2.8	1.8	3.0 - 5.0
Potamogeten amplifolius	2.1	1.0	7.0 - 7.5
P. epihydrus	p		
P. gramineus	28.9	2.0	2.0 - 15.5
P. natans	2.1	2.3	4.5 - 6.0
P. praelongus	p		
P. richardsonii	9.2	1.5	5.0 - 19.5
P. robbinsii	14.8	2.0	5.0 -17.0
P. sp.	4.2	1.3	3.5 - 19.5
Sagittaria sp.	.7	2.0	5.0 - 5.5
Scirpus validus	3.5	1.2	2.0 - 6.5
Sparganium sp.	1.4	1.0	3.1
Typha latifolia	.7	1.0	2.0
Vallisneria americana	7.8	1.6	3.5 - 12.0

Shoreline Survey

Lake Lucerne's 8.4 miles of shoreline currently supports approximately 284 dwellings. This yields a development factor of nearly 34 d/m. The shoreline is nearly 100% uplands. The S.D.F. is 1.8.
Assessment values for Lucerne are as follows: Property = $18,456,605 ; Improvements = $8,154,380; Total = $ 26,210,985.

The following is from a shoreline survey conducted in 1995. The numbers correspond to sections of shoreline shown on the development map.

1 - Cleared area. Several small dwellings and resort with small cottages near lake level. No natural vegetation; lawn to narrow beach.
2 - Approximately forty-five dwellings on moderate slope about 50 feet back and 50 to 100 feet apart. Most with large trees, no understory or buffer strips - many with grass to shore. Several extremely large, new place with varying degrees of landscaping to control erosion. Some asphalt boat ramps. Rocky shore.
3 - Approximately thirteen dwellings more widely spaced on moderate slope. Most with some natural vegetation, though mostly just large trees. South side of both small bays are undeveloped. Shoreline slope is very gradual at south end.

4 - Approximately twelve dwellings on gradual slope, many with outbuildings and/or small bridges near shore. Many of these have much natural vegetation in place. Some have grass to shore.

5 - Approximately five dwellings on moderate to steep slope. Several with "manicured" lawns to shore. Last few with increasing natural vegetation and narrow access strips to rocky beach-like shore.

6 - Two former resorts with many cottages followed by an area of backlotted cottages. Approximately twenty dwellings. Second resort has asphalt boat ramp several hundred feet long, straight down moderate to steep slope and concrete seawall.

7 - Approximately fifteen dwellings, on gradual slope then moderate slope. Most with large trees and no understory or buffer strip. Several have grass extending to shore.

8 - Several very small resort-type cottages and some larger dwellings on moderate slope to rocky shoreline. Many cottages with very short setbacks and grass to shore.

9 - Approximately five larger dwellings including very large new place. Most near lake level, new place is built up on filled area. Many with grass to shore and very little natural vegetation.

10 - Steeper slope with fifteen to twenty dwellings including one resort with several small cottages. First few with many larger trees, resort has wide stretch grass to shore and last several places are separated by strips of natural vegetation but wide, cleared access strips. Slope is quite steep at north end of section and gradually decreases. Several older mobile homes in this area.

11 - Undeveloped. Mostly birch, hemlock and large pines. Much floating-leaf vegetation in this area.

12 - Several dwellings with minimal buffer strips. Erosion/runoff control is very important in this area, due to shallow water and natural sediment accumulation here.

13 - Undeveloped.

14 - Approximately twelve dwellings including resort with several small cottages. First few near lake level, then very high, steep slope, then last five on gradual slope. Most have much natural vegetation in place.

15 - Undeveloped with improved public boat landing.

The east shore was not formally surveyed. It supports approximately 85 dwellings.

16 - Widely spaced dwellings on moderate slope.

17 - Several small dwellings on very gradual slope. Close together and very near the shore

18 - Sparse development; approximately seven dwellings.

19 - Approximately 65 dwellings on extremely steep slope. Most have fairly wide natural strips between and much natural vegetation in tact. One very large place near the north end has a wide stretch of grass to shore on steep slope.

Recreational Use

Minimal recreational use data was collected on Lake Lucerne.

Table 30. Lucerne Recreational Use.

	7/6/96 1:30 p.m.
Fishing	13
Speed Boating	16
Water skiing	16
Sailing	6
Canoeing/rowing	
Jetskiing	13
Swimming/snorkeling	15
Lounging	37
Pontoon Boating	14
Paddle Boating	8

Recommendations

1. Improve shoreline. On most lakes older development is the main culprit when it comes to poor shoreline development. On Lucerne, many of the worst examples are brand new or still under construction. The water volume of Lucerne is massive enough to accept a large amount of sediment and nutrients before water quality is adversely effected, but that is no reason to completely ignore wise development practices.
There are several enormous new places along the north west shore that sit on completely cleared lots. Several new places including one on the far south end, were sedimentation is already heavy, showed severe erosion problems or potential erosion problems.
The lake association should insist that these situations be addressed by local zoning enforcers. Mass education of residents should be attempted. Residents need to know the effect this can have on a lake.

2. I would recommend protecting the entire south end from high impact recreation. If this is not practical then at least the southern bays should be kept completely free from these activities. Educate residents on the effects of continual disturbances of these areas.

3. Post the boatlanding with prominant signs on the protection of these areas and the threat of exotics.

4. Remove the purple loosestrife on the north end of the lake. It looks pretty but it really should be irraticated.

5. Other exotic plant species would probably not spread rapidly, but as a popular recreational resource, Lucerne is susceptible to invasion. The association should consider a monitoring program to address this concern.

Figure 14.

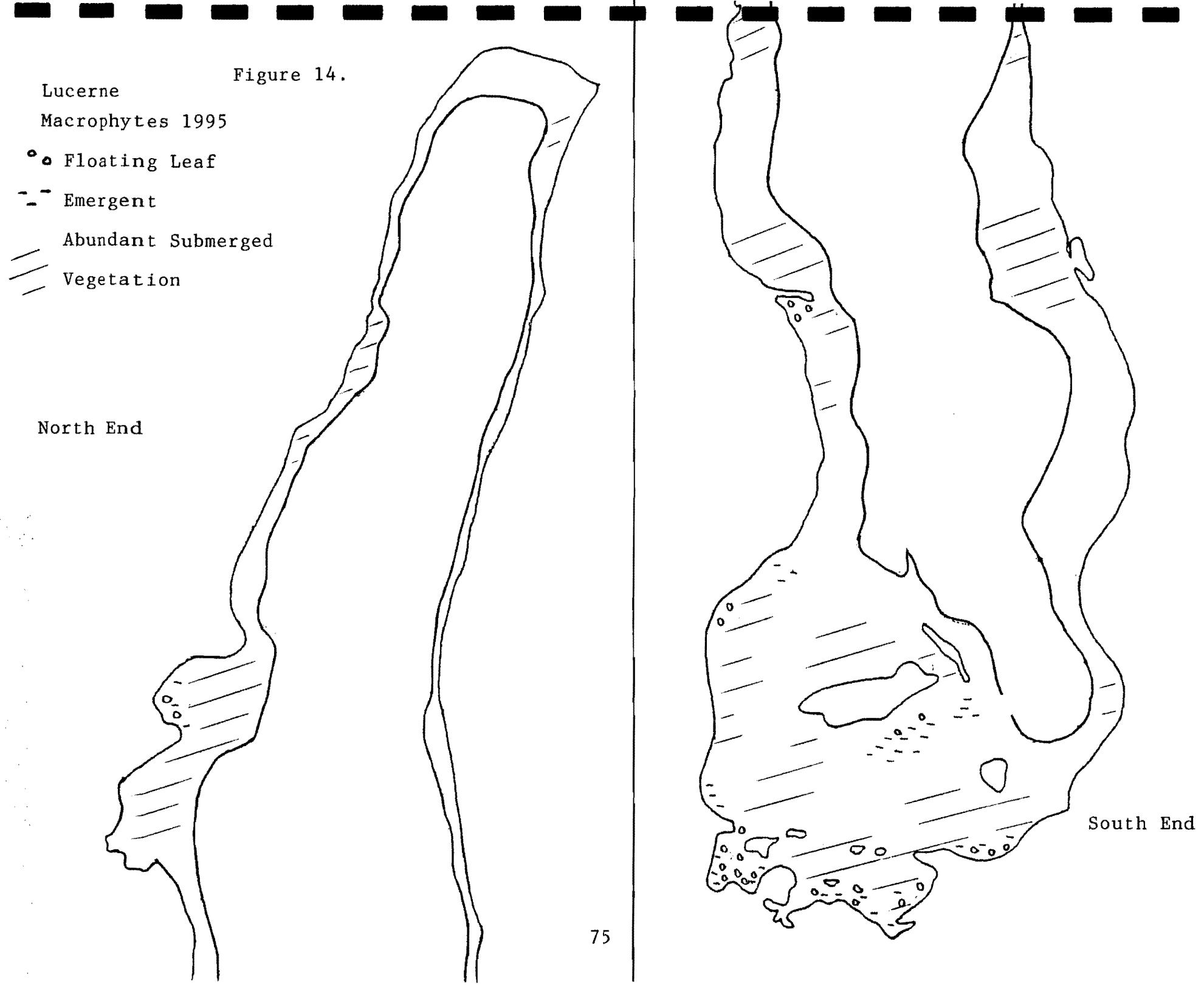
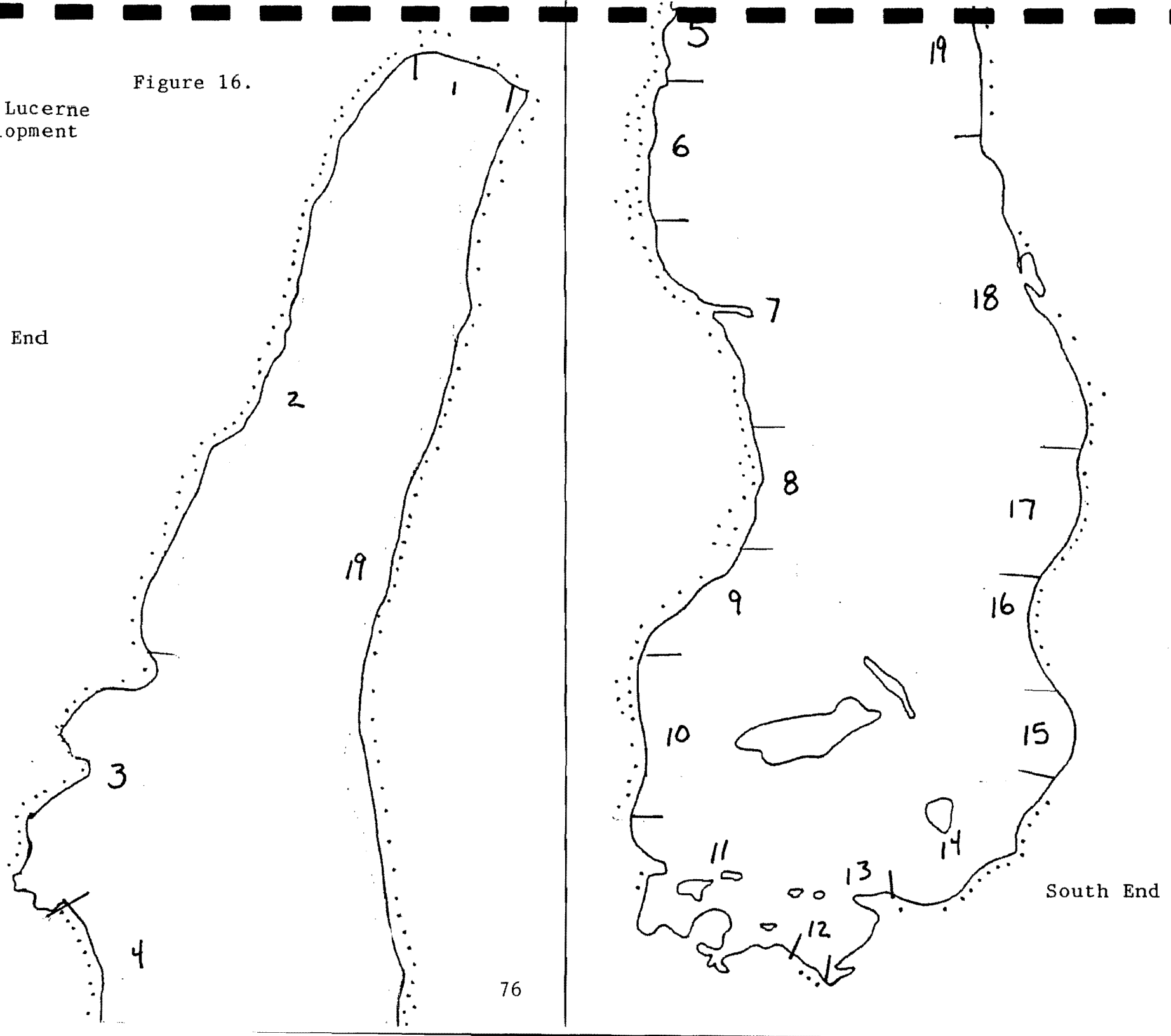

Lucerne
Macrophytes 1995
Floating Leaf
Emergent
Abundant Submerged
Vegetation
North End
South End

Figure 16.

Lake Lucerne
Development
1996



LAKE METONGA

At 2,157 acres, Metonga is the largest lake in Forest County. This fact along with its good water quality and close proximity to the largest city in the county make it an extremely valuable natural resource. It has also been the victim of more than its fair share of "scourges" over the years. Beginning no later than 1966, according to DNR files, swimmers itch was severe enough that most of the near-shore area was chemically treated. This continued at varying degrees until about 1980.

Around this time the rusty crayfish was introduced in the lake. An explosion in the population of this southern native severely depleted the vegetation in the lake. Through trapping, biological control and probably population dynamics of the crayfish itself, the population has decreased dramatically and stabilized. The fishery which was depleted by the crayfish infestation is once again strong, with a large natural and stocked walleye population and abundant perch and small mouth bass.

Recently, as aquatic plants have begin to re-establish, Eurasian milfoil was discovered. It was most likely introduced at the south boat landing, fragmented and drifted to the north end, where it is now making its way back to the south. This exotic plant is capable of tremendous growth. It will often occupy the entire water column of a lake it has invaded. Populations are probably currently at a level that focused management may keep it in check. At this point it is the only documented occurrance in the county. The milfoil issue will be discussed further in the "Recommendations" sections.

Water Quality

Table 31. Metonga Water Quality.

The data below is from SWRoFC, WDNR files (1977 sample) and a sample collected on June 26, 1997 and analyzed by NLS.

	4-23-63	1970's	11/16/77	6/26/97
Alkalinity	85	80	92	85
pH	8.2	7.2	8.0	7.7
Hardness			112	
Conductivity	185	192		-
Chloride	1.1			6.9
Nitrogen - ammonia		.11	<.02	<.06
Nitrogen - NO2+NO3		.002	.02	<.03
Nitrogen - TKN		.38	.20	.31
Nitrogen, total	.34	.40	.22	.31
Phosphorus, total		.024	.02	.012

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model | Carlson Trophic State Index

	Phosphorus	METONGA	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030	•	6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

The macrophyte community on Lake Metonga has received a dramatic stress over the past decade with the introduction of the rusty crayfish. Recently, aquatic plants have begun to return. On July 22, 1995 a general macrophyte survey was performed, during which ninety-nine stations were sampled. Bulrushes were present along most of the east shore. Floating leaf vegetation was limited to a few small beds in protected areas. The main issue generated from this survey is that of Eurasian Milfoil, *Myriophyllum spicatum*. This noxious exotic was one of the most commonly collected submerged plants though it's level of growth has not reached nuisance proportions. Purple loosestrife, another exotic is also present in small patches around Metonga. These species will be addressed in the recommendation section.

Table 32. Metonga Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demersum	6.1	1.2	3.0 - 13.0
Chara vulgaris	17.2	2.9	2.0 - 12.5
Eleocharis acicularis	6.1	2.5	1.5 - 13.0
Elodea canadensis	4.0	1.0	4.5 - 8.5
Isoetes sp.	1.0	1.0	2.0
Juncus pelocarpus	5.1	1.4	2.0 - 3.0
Lemna trisulca	p		
Myriophyllum exalbescens	8.1	1.9	1.5 -8.5
M. spicatum	10.1	2.6	2.0 -14.5

Najas flexilis	9.1	1.6	2.0 -7.5
Nitella flexilis	5.1	3.2	8.0 - 14.5
Nuphar variegatum	1.0	1.0	2.0
Nymphaea odorata	2.0	1.0	2.0 -3.5
Polygonum natans	p		
Potamogeten amplifolius	3.0	2.0	6.0 -8.5
P. gramineus	3.0	1.7	2.0 - 4.0
P. illinoensis	10.1	2.5	2.0 -8.5
P. pectinatus	3.0	1.3	2.0 - 8.5
P. zosteriformis	6.1	1.5	3.5 -8.5
P. spp.	3.0	1.5	6.5 - 8.5
Ranunculus	1.0	1.0	8.5
Sagittaria sp.	3.0	1.3	2.0 - 4.0
Scirpus validus	14.1	2.1	1.5 - 6.0
Typha latifolia	p		
Utricularia vulgaris	3.0	2.0	3.5 - 8.5
Vallisneria americana	16.2	1.8	1.5 - 7.5

Shoreline Survey

Of the 7.48 miles of shoreline, .28 is public. It is nearly all uplands. There are currently approximately 242 permanent dwellings and two mobile home courts. Fewer than 5 % of these could be considered backlots. For the sake of the development factor, the mobile home courts are counted as fifteen dwellings each, giving a total of 272. This yields a development factor of 36.4 d/m.

Total property values of $17,885,620, consist of $11,323,520 for land and $6,561,100 for improvements.

The following is from a shoreline survey conducted in fall 1997. The numbers refer to sections of shoreline shown on the development map.

1 - Undeveloped. Boulder shore with county road directly behind.
2 - Two dwellings with some natural vegetation in place.
3 - City park. Approximately 1000 feet narrow beach with grass behind. Moderate to gradual slope.
4 - Trailer court near level of lake with some medium trees.
5 - 20 dwellings. First few near lake level then shore steepens dramatically. Many with natural vegetation in place, some with terracing and one with grass to shore.
6 - Seventeen dwellings most at lake level, but some backlotted. Mostly grass to the shore and a few large trees.

7 - Five resort-type cottages and five backlotted dwellings. Area mostly wide open with grass or narrow beach at shore.
8 - Seventeen small to medium dwellings including four backlotted. Near lake level. Most have many large trees in front, but little understory. Last one with most natural vegetation in tact.
9 - Two dwellings widely separated by natural vegetation. Some cleared lots without dwellings.
10 - Three dwellings on very steep slope with deep setbacks and lots of natural vegetation.
11 - Six small to medium dwellings near lake level. Some natural vegetation some not.
12 - Six larger dwellings with deep setbacks and large trees but long strips of grass to shore. Buffer strips are important in bays.
13 - Undeveloped. Mostly pines and birch.
14 - One large dwelling on high, steep slope with deep setback and natural vegetation.
15 - Fourteen medium to small dwellings near lake level with 50 - 75 foot setbacks. Three have natural vegetation, most with some large trees.
16 - Five dwellings on moderate slope 50 foot setbacks. Some with natural vegetation, some without.
17 - Trailer court. Trailers back about 100 feet on moderate slope. Grass and some large trees to shore. Fifteen to twenty docks.
18 - Fourteen dwellings near lake level with 50 foot setbacks. Several undeveloped lots in this area. Fifth and eleventh places are good examples of natural vegetation. Others have little.
19 - Thirty-two small to medium dwellings on gradual slope with setbacks of about 50 feet. Some lots are separated by natural vegetation, many are not. Several with good buffer strips, some with large trees, many with grass to shore.
20 - Undeveloped. Alder wetland. This area should not be disturbed by development or high impact recreation.
21 - Moderate slope with one dwelling among natural vegetation, then several acres of grass extending to shore with three RV's. Seven more medium dwellings separated by natural vegetation. Also a large barn several hundred feet from shore.
22 - Twenty dwellings near lake level at about 50 foot setbacks. Most separated by natural vegetation. Many with grass to shore.
23 - County park. Approximately 1500 ft of beach with some large trees and campground behind near lake level.
24 - Thirty five small to medium dwellings and a supper club with 50 foot and shorter setbacks. The middle of this section where the supper club is located is on a gradual slope. Both ends are near lake level. Few places with natural vegetation, most with some large trees but no understory or buffer strip.
25 - Three dwellings with short setbacks but most natural vegetation in place.
26 - Undeveloped.
27 - Very steep slope with large pines and birch. One dwelling on each end of this section. Both have natural vegetation in front but short setbacks.
28 - Shore drops to lake level with county road just off the water. Four dwellings on steep slope on the other side of the road 50 to 75 feet from shore. First and last well masked, middle two not.

30 - Two dwellings near lake level, across road. First with buffer strip, second without.
31 - Fourteen medium to large dwellings on moderate slope. Many with good buffer strips. Last few are resort cottages and a large resort.
32 - Five small dwellings near the level of the lake. Two between the lake and road, three on the other side. Some grass extending to shore.
33 - Enormous new home very close to shore with varying shoreline - some buffered, some not.

Recreational Use

Recreational use data was not collected on Metonga, but it is a heavily used recreational resource, with two public beaches and two public boat landings.

Recommendations

1. Encourage shoreline buffer strips throughout the lake, but specifically at the trailer court on the west shore, the bay near the northwest corner of the lake, and "farmer's bay" on the south west corner of the bay. Stress the importance of keeping nutrients out of a lake and controlling sediment loads in bays.

2. Develop and implement a milfoil management plan, soon. Blitz residents on this species, educate them on the tendency for this plant to regenerate from fragments encourage them to remove any fragments and to avoid activities that might cause fragmentation. Appoint a committee to work with the DNR on a plan.

3. Remove purple loosestrife that is present in small scattered patches along the road on the north and east shore.

4. Post prominant signs at the boat landings that Eurasian milfoil is in the lake and that extreme care should be taken not to introduce it in another water body

5. Protect "farmer's bay " as much as possible from development. If that is not practical, stress wise development. This is an important wild area on the lake. It should also be protected from high impact recreational activities.

6. Educate residents in low areas, specifically the south east corner of the lake, on septic system maintenance and monitoring. Consider a survey of systems in this area or throughout the lake.

7. Establish schedule for regular collection of water quality samples.

Lake Metonga
Macrophyte 1995

Figure 16.

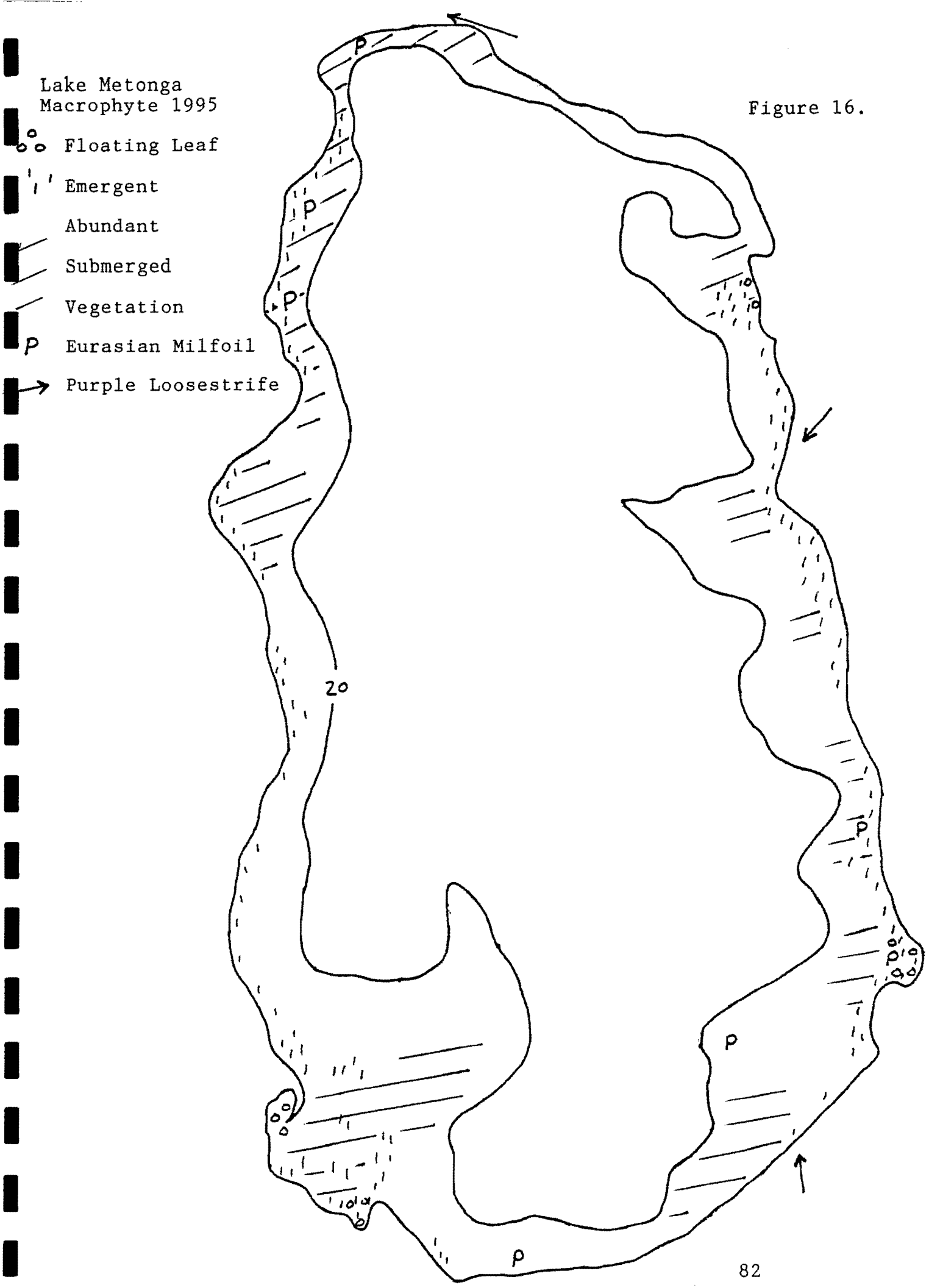
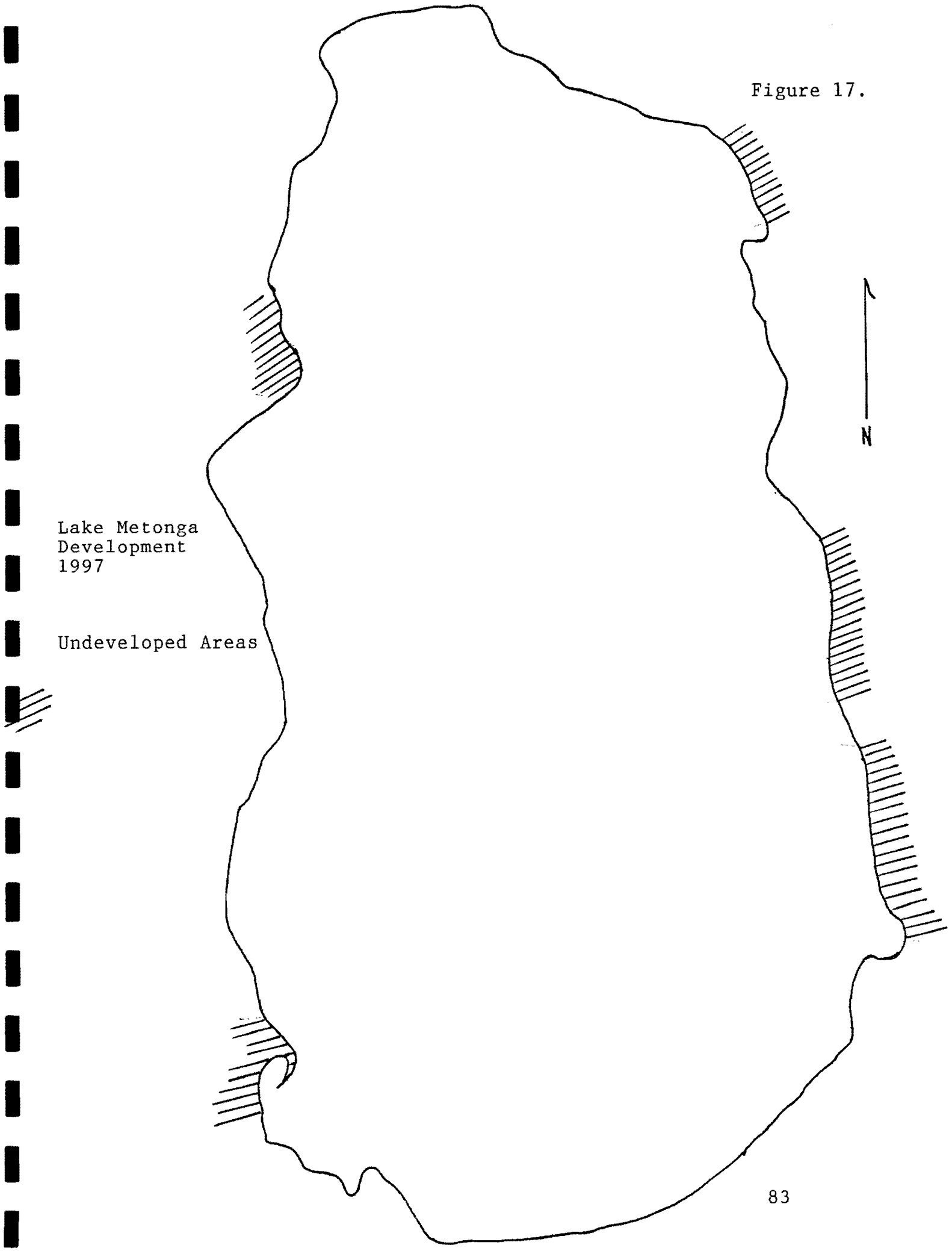


Figure 17.



MOLE LAKE

Mole Lake is a soft water, seepage lake with a surface area of 73 acres and a maximum depth of 17 feet. Much of its shoreline is wetland and it has probably had some agricultural influence in the past. It lies approximately three miles west of the proposed Crandon mine.

Water Quality

Table 34. is water quality data generated by WDNR for Mole Lake in 1974 and 1975. The tables are copied directly from Water Quality of Selected Wisconsin Inland Lakes 1974 - 1975.

See water quality section on page 3 for an explanation of those tests and the following models.

Lillie and Mason Water Quality Model

	Phosphorus	MOLE
Excellent	< .001	
Very good	.001 - .010	
Good	.010 - .030	•
Fair	.030 - .050	
Poor	.050 - .150	
Very poor	> .150	

Carlson Trophic State Index

Secchi Depth	
> 19.7	Oligotrophic
9.8 - 19.7	----------
6.6 - 9.8	Mesotrophic
4.9 - 6.6	----------
3.3 - 4.9	Eutrophic
< 3.3	

Macrophytes

Plant growth on Mole Lake was common though few plants were particularly abundant or dense. The most commonly collected plant was *Chara*, a large colonial algae that resembles a green plant in its growth form. Floating-leaf vegetation was also quite common, at one of the three floating-leaf species was present at 24 of the 47 sites sampled. Water moss was collected at two of the deeper sites to 16 feet. Wild rice, *Zizania aquatica*, was also present.

Table 33. Mole Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	19.1	2.2	1.5 - 10.0
Chara vulgaris	42.6	3.1	3.0 - 8.0
Dulichium arundinaceum	2.1	1.0	1.5 - 5.0
Elodea canadensis	12.8	1.5	4.5 - 10.0
Emergent *	12.8	2.7	2.0 - 7.5
Eriocaulon septangulare	12.8	1.5	1.5 - 6.0

Isoetes sp.	2.1	3.0	1.5
Megalodonta beckii	2.1	1.0	4.5
Myriophyllum exalbescens	2.1	2.0	4.5
M. tenellum	6.4	2.0	2.5 -6.0
Musci sp.	4.3	1.5	10.0 - 16.0
Najas flexilis	6.4	2.0	2.5 - 5.5
Nuphar variagatum	29.8	2.1	1.5 - 10.0
Nymphaea odorata	21.3	1.1	1.5 - 10.0
Polygonum natans	2.1	1.0	2.5
Pontederia cordata	p		
Potamogeten amplifolius	21.3	1.1	1.5 - 5.5
P. gramineus	10.6	3.2	1.5 - 5.5
P. praelongus	8.5	1.3	4.5 - 6.5
P. zosteriformis	6.4	1.0	4.5 - 5.5
P sp.	2.1	1.0	7.0
Sagittaria sp.	2.1	1.0	1.5
Sparganium sp.	4.3	1.5	1.5 -5.5
Utricularia intermedia	2.1	1.0	4.5
Vallisneria americana	14.9	2.7	1.5 - 7.0
Zizania aquatica	2.1	1.0	1.5

* This represents both *Eleocharis robbinsii* and *Scirpus subterminalis*, which were not recognized as two separate species in the field.

Shoreline Survey

The shoreline of Mole Lake is 1.95 mile long and supports approximately 48 dwellings, two of which are abandoned, giving a development factor of 24.6 d/m. An estimated 20% of the short is wetland. The S.D.F. is 1.7.

Current property values are $395,615 for land and 878,850 for improvements, giving a total of $1,274,465.

The following is from a shoreline survey conducted in the fall of 1997. The numbers refer to sections of shoreline shown on the development map.

1 - Natural shoreline. Mostly cattails with red pine, white pine and birch behind. Abandoned dwellings at each end of this section. Eyesores but probably not effecting water quality.

2 - Four small cottages near lake level close to shore with very large red pines but no understory. Grass to shore.

3 - Undeveloped. Pines grading into shrubby meadow back to tamarack wetland.
4 - Ten small cottages some with natural vegetation, some without. Several with very short setbacks.
5 - Undeveloped. Medium aspen trees.
6 - One dwelling near lake level with short setback but a lot of natural vegetation.
7 - Undeveloped. Wet meadow back several hundred feet to tamarack.
8 - Ten dwellings and a large barn. Most very near the level of the lake with long setbacks and good buffer strips.
9 - Five dwellings very close to shore with some large trees and grass to shore.
10 - Channel leading to store on the highway. Buffer strip along channel.
11 - Nine small dwellings close to lake level with setbacks varying from sub10 feet to 75 feet. First one is very good example of buffer strip. Several with grass to shore others with good natural vegetation.
12 - Six small to large dwellings with more natural vegetation in place. Also several undeveloped lots. Large pines and tall grass at shore.

Recreational use

Recreation information was not collected on Mole Lake.

Recommendations

1. Encourage establishment of buffer strips where they are lacking.

2. Inspect north end for possible agricultural impacts.

3. Remove abandoned buildings for safety and aesthetics.

4. Encourage continued wise development on south side.

5. Protect wetland margins from development.

Lake: Mole Table 34. Acres: 73 County: Forest Locatio
Max. Depth: 18 feet Other Conditions: 1-21-75 14" ice, 3-4" snow

Inlet(s): 1
2

1					
DATE	8-22-74			INLET	INLET
DEPTH	0	15	17	1	2
NO2N	.017	.009	.023		
NO3N	.15	.24	.15		
NH3N	/08	.25	.23		
ORGN	.69	.58	.76		
TOTN	.934	1.080	1.162		
PO4P	.035	.019	.021		
PTOT	.02	.02	.03		
CA	8.	11.	7.		
MG	8.	8.	7.		
NA	2.	<1.0	<1.0		
K	2.9	2.4	1.8		
COND	55.	57.	59.		
SO4	3.	5.	3.		
CL	1.	<1.0	<1.0		
PH	7.3	7.3	7.0		
ALKA	23.	23.	24.		
TURB	2.4	2.1	3.9		

Secchi 5.4 feet

2				
11-5-74			INLET	INLET
	0	17	1	2
NO2N	.009	.022		
NO3N	.14	.21		
NH3N	.27	.20		
ORGN	.99	.85		
TOTN	1.402	1.278		
PO4P	.145	.026		
PTOT	.09	.11		
CA	16.	13.		
MG	12.	11.		
NA	2.	2.		
K	3.2	4.0		
COND	57.	57.		
SO4	5.	5.		
CL	1.	1.		
PH	7.5	7.4		
ALKA	24.	23.		
TURB	1.8	2.0		

Secchi 8.2 feet

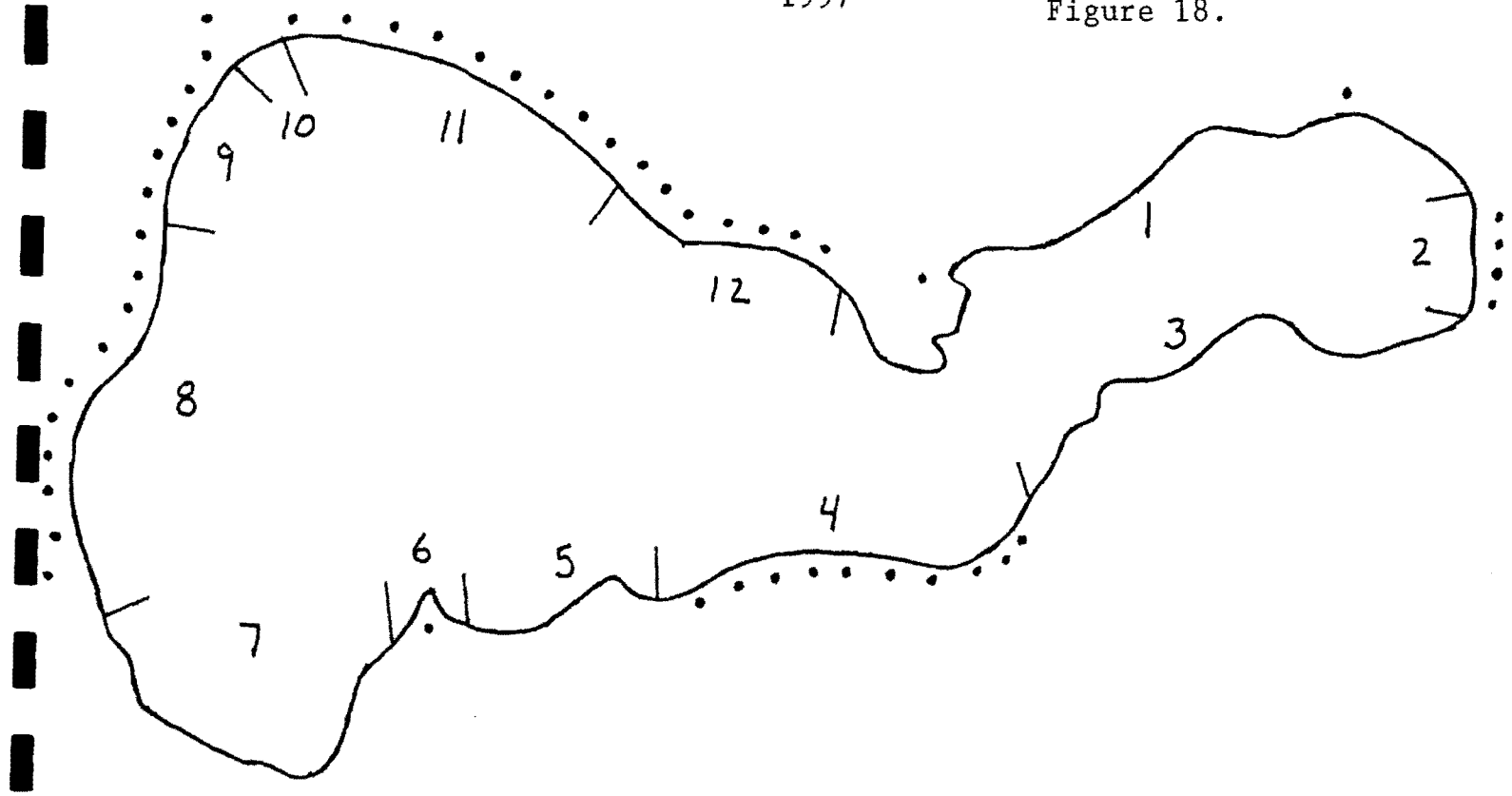
3					
DATE	1-21-75			INLET	INLET
DEPTH	0	10	16	1	2
NO2N	.009	.005	.004		
NO3N	.14	.17	.17		
NH3N	.24	.16	.11		
ORGN	.67	.51	.46		
TOTN	1.062	.837	.732		
PO4P	.027	.018	.012		
PTOT	.066	.02	.03		
CA	7.	7.	8.		
MG	5.	4.	4.		
NA	2.	2.	3.		
K	.9	1.5	1.5		
COND	68.	61.	66.		
SO4	5.	3.	5.		
CL	1.	3.	<1.0		
PH	7.1	9.2	7.3		
ALKA	30.	27.	26.		
TURB	2.1	1.8	2.1		

4				
5-20-75			INLET	INLET
	0'	17	1	2
NO2N	.033	.004		
NO3N	<.04	<.04		
NH3N	<.03	<.03		
ORGN	.53	.42		
TOTN	.55	.45		
PO4P	.048	.038		
PTOT	.07	.03		
CA	7.	8.		
MG	<2.0	8.		
NA	<1.0	2.		
K	3.2	1.5		
COND	57.	61.		
SO4	5.	7.		
CL	2.	<1.0		
PH	7.2	7.0		
ALKA	21.	26.		
TURB	2.0	1.6		

Depth-ft

Mole Lake
Development
1997

Figure 18.

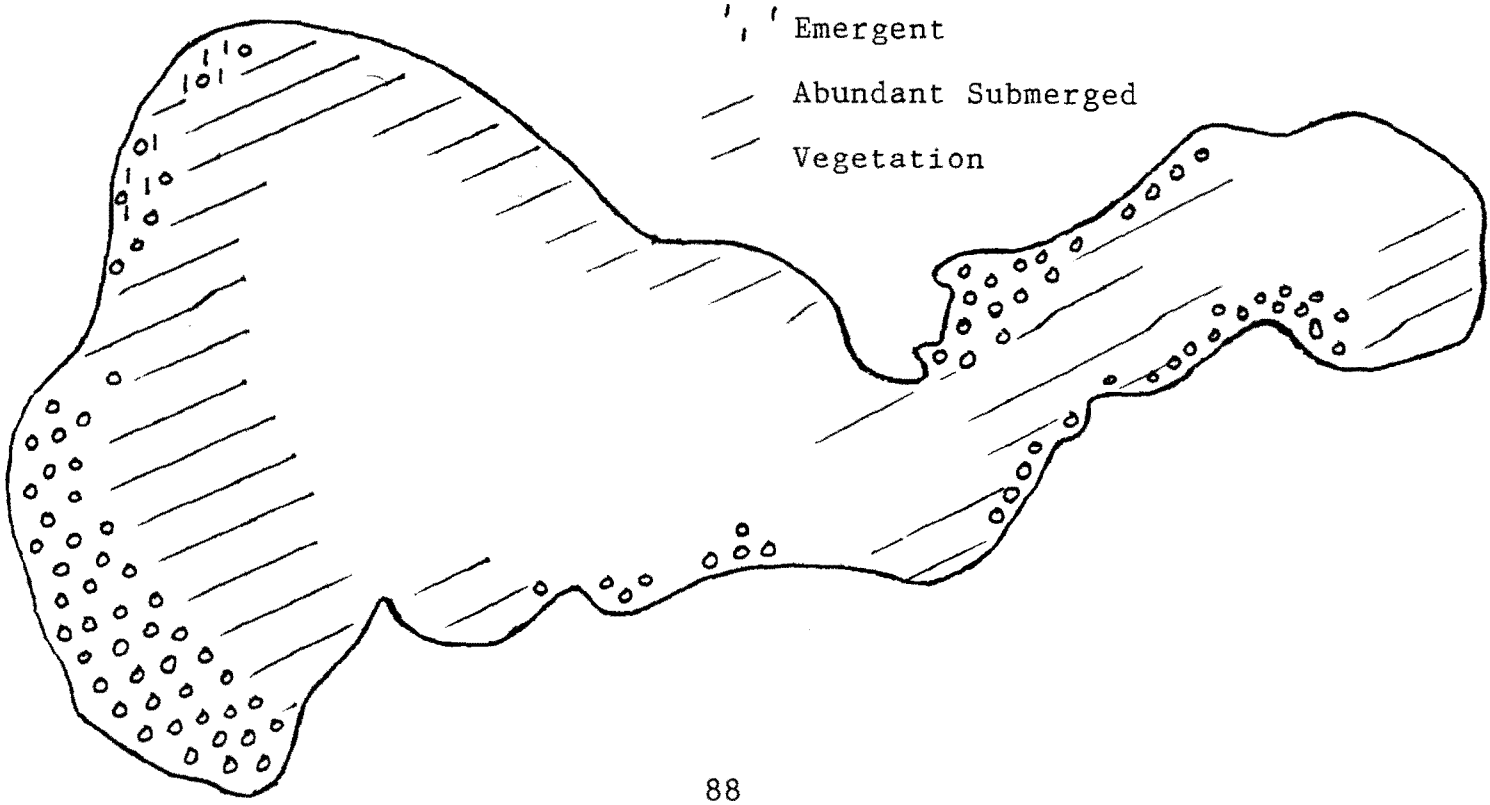


Macrophytes 1995

Floating Leaf

Emergent

Abundant Submerged Vegetation



PICKEREL LAKE

Pickerel Lake is a 1,299 acre drainage lake in southern Forest County. It consists of two distinct lobes similar in size and is connected to Crane Lake via a short navigable channel. The lake is heavily developed and suffers from excessive plant growth and winterkill. It supports northern pike, small mouth bass, walleyes and a diverse panfish population.
In 1990 and 1991 on extensive, cost-shared limnological study was performed on the two lakes. Data on water quality, sediment composition, zooplankton and phytoplankton populations, and other factors was generated during that study. Only a small portion of the data is included here to give the reader a general idea of water quality conditions at the time of the study.

Water Quality

Below is data generated for the feasibility study discussed above. Table 36 is data generated by WDNR in 1974 and 1975. The tables are copied directly from Water Quality of Selected Wisconsin Inland Lakes 1974 - 1975.

Table 35. Pickerel Water Quality Data.

9/14/91

	East Lobe		West Lobe	
	surface	3.5 m.	surface	3.5 meters
Conductivity	140	140	140	160
pH	9.1	9.2	8.7	8.7
Alkalinity	90	90	95	95
Chloride	<1		<1	
Ammonia	<.05	<.05	<.05	.07
NO2+NO3	.06	<.05	.06	<.05
TKN	.97	.62	.84	.99
Phos, reactive	<.004		<.004	
Phos, total	.025	.021	.025	.030
Silica	2.9	3.8	5.4	4.6
Secchi depth	3.4		3.2	

See water quality section on page 3 for an explanation of these tests and the following models.

Table 36.

Lake: Pickerel Acres: 1,299 County: Forest Locati
Max. Depth: 18 feet Other Conditions: 8-21-74 Heavy bluegreen algne b
1-24-75 15" ice, 1-3" snow

Inlet(s): 1 Crane Lake outlet, sampled at T-34N R-13E S-28
2 Rollingstone Lake outlet, sampled at T-34N R-12E S-24

1					
DATE	8-21-74			INLET	INLET
DEPTH	0	12	16	1	2
NO2N	.004	.004	.004	.007	
NO3N	.12	.09	.05	.16	
NH3N	.18	.86	.93	1.00	
ORGN	.85	1.71	1.69	2.24	
TOTN	1.156	2.661	2.682	3.403	
PO4P	.025	.028	.022	.039	
PTOT	.03	.03	.03	.11	
CA	7.	10.	7.	9.	
MG	15.	9.	9.	12.	
NA	<1.0	1.	2.	1.	
K	2.1	1.1	1.2	1.8	
COND	96.	124.	132.	128.	
SO4	9.	5.	5.	6.	
CL	<1.0	2.	1.	2.	
PH	8.7	9.0	8.8	8.8	
ALKA	54.	68.	69.	71.	
TURB	6.0	3.6	4.5	12.0	

Secchi 4.5 feet

2					
DATE	11-6-74			INLET	INLET
DEPTH	0	16		1	2
NO2N	.018	.015		.012	
NO3N	.14	.12		.09	
NH3N	.20	.31		.33	
ORGN	.76	.79		1.19	
TOTN	1.123	1.238		1.620	
PO4P	.174	.033		.082	
PTOT		.09		.16	
CA	17.	16.		17.	
MG	13.	13.		11.	
NA	2.	2.		1.	
K	3.4	3.4		3.8	
COND	149.	159.		190.	
SO4	3.	4.		5.	
CL	1.	<1.0		2.	
PH	8.6	8.5		8.0	
ALKA	76.	75.		95.	
TURB	1.5	1.5		2.0	

Secchi 17.0 feet

3					
DATE	1-24-75			INLET	INLET
DEPTH	0	10	17	1	2
NO2N	.010	.010	.007		
NO3N	.06	.12	.08		
NH3N	.12	.10	.10		
ORGN	.47	.48	.52		
TOTN	.650	.717	.703		
PO4P	.007	.009	.012		
PTOT	.01	<.01	.01		
CA	38.	35.	37.		
MG	17.	17.	18.		
NA	<1.0	<1.0	<1.0		
K	.7	1.0	1.0		
COND	222.	215.	217.		
SO4	6.	5.	5.		
CL	2.	1.	2.		
PH	7.9	7.8	8.0		
ALKA	114.	124.	113.		
TURB	1.6	1.9	2.3		

4					
DATE	5-20-75			INLET	INLET
DEPTH	0	16		1	2
NO2N	.016	.015			.004
NO3N	.05	.05			<.04
NH3N	.04	.04			.04
ORGN	.57	.27			.36
TOTN	.67	.37			.43
PO4P	<.005	<.005			<.005
PTOT	.01	.02			.02
CA	35.	38.			24.
MG	30.	33.			22.
NA	3.	3.			2.
K	.9	1.2			.7
COND	147.	169.			131.
SO4	6.	5.			10.
CL	<1.0	1.			<1.0
PH	8.4	8.1			7.5
ALKA	80.	88.			65.
TURB	1.	1.3			1.3

Depth-ft

Lillie and Mason Water Quality Model			Carlson Trophic State Index	
	Phosphorus	PICKEREL	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030	•	6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150	•	3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

Extensive plant growth has been a concern on Pickerel Lake for generations. Both chemical treatment and mechanical harvesting have been employed in an attempt to combat the problem. Recently efforts have been made to address the nutrient loading that is feeding the macrophytes. In 1991, 77 stations were sampled and 76 supported plant growth. The most commonly collected plant was *Elodea canadensis* or American waterweed, which was present at 80 % of the sample sites. Coontail and three of the pondweeds were also present at more than half of the sample sites. Emergent vegetation was present in one small bed near the soth end of the east bay. Floating-leaf vegetation was present near several sample sites, but not particularly common.

Table 37. Pickerel Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demersum	59.7	2.9	1.5 - 14.0
Chara vulgaris	2.6	2.0	4.5 - 6.5
Decodon vertcillatus	p		
Elodea canadensis	80.5	2.2	1.5 - 12.0
Lemna minor	p		
L. trisulca	6.5	1.2	1.5 - 6.0
Myriophyllum exalbescens	33.8	2.0	3.5 - 10.0
Najas flexilis	6.4	2.6	2.5 - 4.5
Nuphar variegatum	p		
Nymphaea tuberosa	p		
Potamogeten amplifolius	3.9	2.0	5.0
P. friesii	11.7	1.9	2.5 - 12.0
P. illinoensis	37.7	1.9	2.5 - 10.0
P. pectinatus	1.3	1.0	2.5
P. richardsonii	58.4	2.4	2.5 - 10.0

P. robbinsii	68.8	3.1	1.5 - 12
P. zosteriformis	67.5	2.0	1.5 - 14.0
Scirpus validus	p		
Typha latifolia	p		
Vallisneria americana	27.3	2.6	2.5 - 10

Shoreline Survey

Even though a significant portion of Pickerel's 8.14 miles of shoreline is wetland, it supports approximately 282 dwellings, including several resorts, and two mobile home parks. For the sake of calculating the development factor, these parks will be counted as ten dwellings, giving a total of approximately 302 dwellings. This yields a development factor of over 37 d/m. The S.D.F. for Pickerel is 1.6.

The following are current property tax assessment values for Pickerel Lake:
Land = $6,070,130; Property = $11,401,140; Total = $17,471,270.

NOTE: These values include Pickerel and Crane, but DID NOT include the 25 - 30 dwellings which lie in Langlade County.

The following is from a shoreline survey conducted in the summer of 1996. The numbers refer to sections of shoreline shown on the development map.

1 - Twenty-four dwellings consisting of two resorts with many small cottages, a few trailers and several small private cottages. Shore is very close to lake level and dwellings are very close to water. Much of this area was filled prior to developing.
2 - Twelve larger dwellings on a moderate slope with approximately 75 foot setbacks. Most have large trees but little or no understory. Many are separated by natural vegetation.
3 - Nineteen dwellings including several resort-type cottages and other small dwellings. Most near lake level, several very close to shore. Most have no understory. This area includes several undeveloped stretches. Two boathouses.
4 - Ten medium-sized dwellings on steep slope most with good setbacks and some natural vegetation. One very large place very close to shore.
5 - Seventeen small to medium dwellings on moderate slope at 50 to 100 foot setback. Most have maintained natural vegetation - white pine and oak; a few have not. Six boathouses.
6 - Two dwellings very close to lake level about 50 feet from shore.
7 - Six widely separated dwellings on moderate slope. Most have left natural vegetation in tact. Fifty to 75 foot setbacks. Three boathouses.
8 - Ten dwellings near lake level. Some with good vegetation but several with grass extending to short. Areas of tag alder separate properties.
9 - Undeveloped. Moderate slope.

10 - Seven dwellings about 100 feet apart and 75 back on moderate slope. Many with buffers strip but little understory. One wet boathouse, one dry.
11 - Three dwellings widely spaced; first with good natural vegetation, last with wide stretch of grass to shore. Two boathouses. Other decrepit shoreline development.
12 - Undeveloped. Tamarack and tag alder.
13 - Seven dwellings near lake level set back about 75 feet. No understory and grass to lake at point. Old seawall falling into lake.
14 - Eight medium to small dwellings with short setbacks and no understory. Fifth and sixth good examples of natural vegetation. Two boathouses.
15 - Undeveloped. Tag alder and tamarack.
16 - Seven dwellings setback about 75 feet with large trees, but no understory.
17 - Three small to medium dwellings with good natural vegetation to area of tag alder and tamarack.
18 - Resort area. Five small cottages setback about 75 feet with good coloration but no understory. Resort near point with grass and narrow beach to lake. Three more small small cottages. Trailer court - approximately 13 trailers several very close to shore with seawalls crumbling into lake.
19 - Two dwellings then into tamarack and tag alder wetland. Several cleared areas but no development.
20 - Undeveloped. Birch and hemlock with short stretches of tag alder.
21 - Undeveloped. Tamarack wetland. Several docks, but no development - probably shouldn't be developed.
22 - Five dwellings approximately 75 feet apart at lake level set back 50 to 75 feet. probably was wetland.
23 - Seven dwellings approximately 100 feet apart. Slope is low to water then steepens then back to lake level. Some obvious erosion problems.
24 - Twenty-two dwellings on steep slope. Some have maintained natural vegetation others have not. Includes resort with several small cottages, several very close to shore. Four boathouses.
25 - Two dwellings and long undeveloped stretches. Some erosion problems near dwellings.
26 - Four dwellings and a small mobile home court. Also a resort with several outbuildings. Very little natural vegetation.
27 - Eight dwellings on steep slope approximately 15 feet above lake level. Some with grass to shore. One boathouse.
28 - Nineteen widely spaced dwellings on very steep slope. Fourth has removed most natural vegetation, but most others have maintained it. Slope lessens toward sections end. Four boathouses including two wet.
29 - Twenty-seven dwellings including a cluster of seven small resort cottages. The two resorts in this section show obvious erosion problems. Five boathouses including two large wet ones. Some places have maintained natural vegetation, many have not.
30 - Mostly undeveloped - birch, cedar and maple. One enormous log dwelling that will have definite erosion/runoff problems unless properly landscaped/buffered.

31 - Two small dwellings and much natural shoreline.
32 - Four widely separated dwellings about fifteen feet above lake level with decent natural vegetation. Two boathouses.
33 - Twelve dwellings including a resort on steep slope. Many have grass to shoreline. Seven boathouses.
34 - Mostly natural shoreline Tag alder wetland, tamarack wetland and red pine stretches. One dwelling and other access points without development.
35 - Twelve well spaced dwellings on moderate to steep slope. Most with deep setbacks and much natural vegetation. Seven boathouses including bright red one.
36 - Cluster of four dwellings.
37 - Undeveloped.

Recreational Use

Recreational use data was not collected on Pickerel Lake.

Recommendations

1. Continue septic survey and updating.

2. Improve shoreline where most natural vegetation has been removed. Educate residents and encourage removal of seawalls where practical. Natural shoreline is much more beneficial biologically and provides nearly as much stability.

3. Protect wet shoreline areas from development. There are lots with no development on far west shore that should not be developed.

4. Protect west lobe from high impact activities. Stress importance of leaving heavily sedimented areas undisturbed, especially in a system that is already so nutrient-rich.

Figure 19. Pickerel Lake
Macrophytes 1990

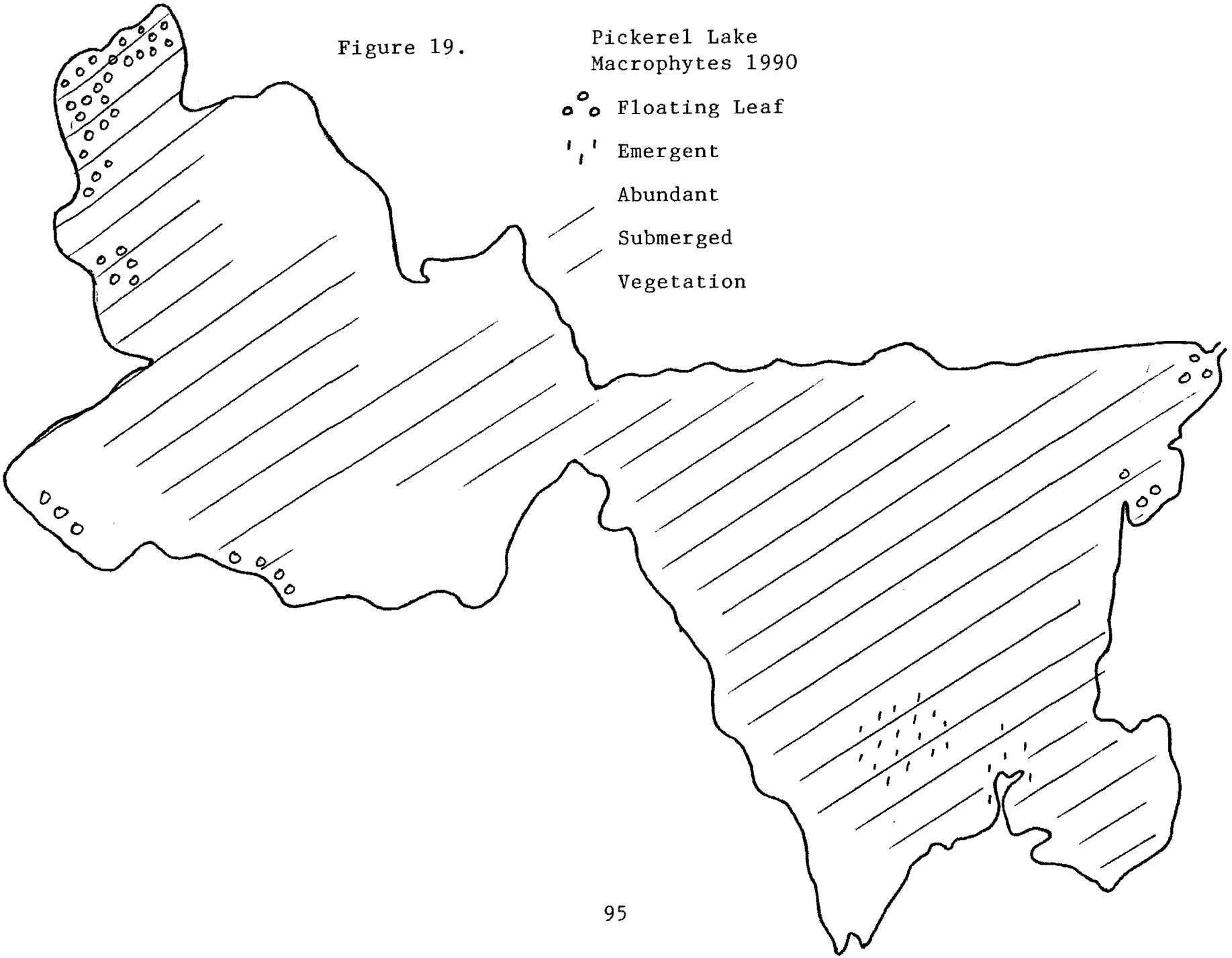
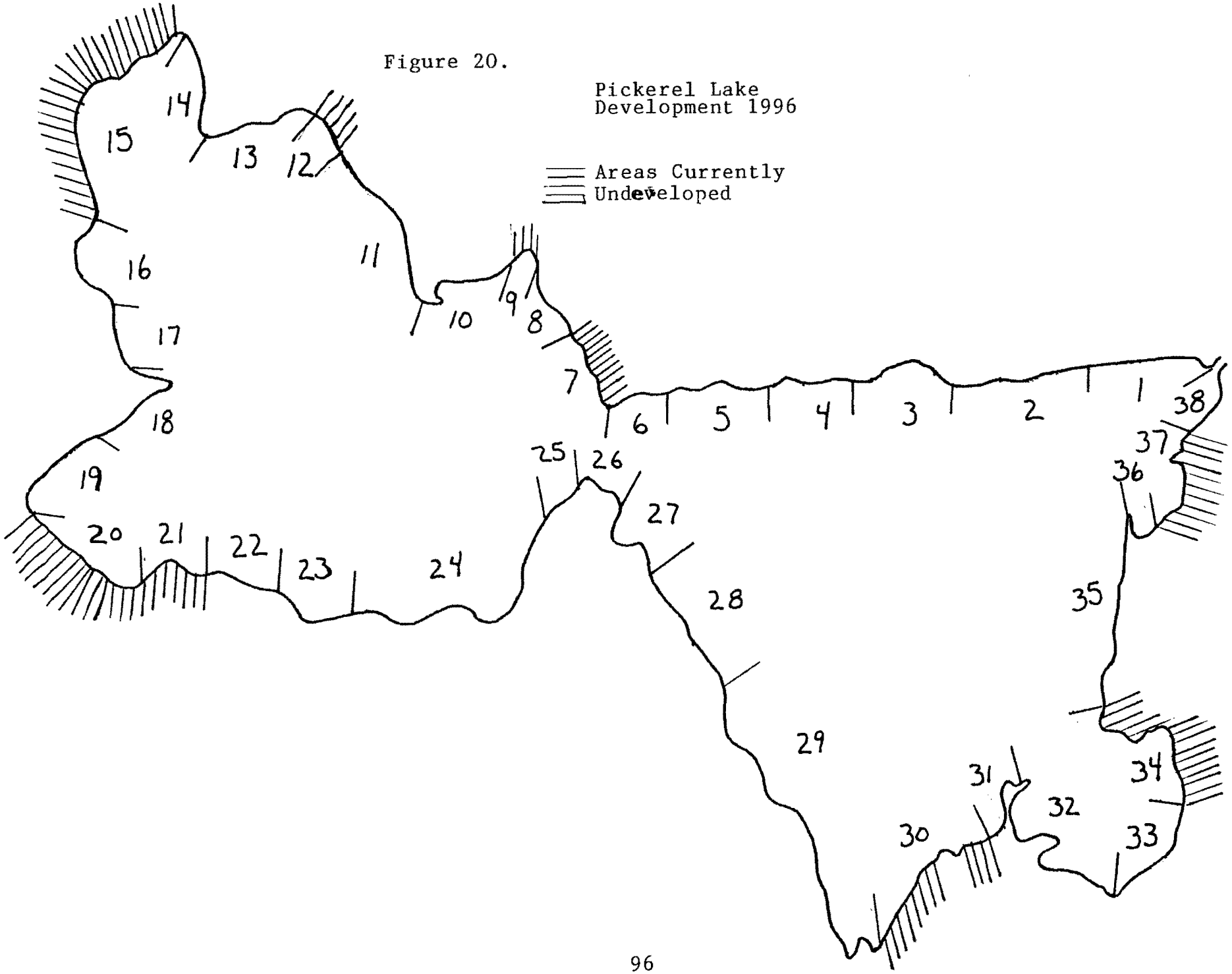


Figure 20.


Pickerel Lake
Development 1996
Areas Currently
Undeveloped
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PINE LAKE

Pine Lake is a very large (1,670 acre), shallow (14 feet) lake. Though it drain the Hiles Millpond and another small lake, it is considered the headwaters of the Wolf River. Pine Lake has battled nuisance weed growth for over 40 years and experiences regular winterkills but remains a very popular fishing lake. The lake district ownsand operates a mechanical weed harvester.
The lake level is controlled by a dam operated by the town of Hiles. Pine Lake supports a fishery consisting mainly of northern pike, large mouth bass, perch and bluegills.
In 1992, a planning grant study was performed on Pine Lake. Much of the followed information was gathered for that study.

Water Quality

The following water quality data comes from the SWRoFC and data produced by NLS as part of the 1992 lake planning grant study.

Table 38. Pine Water Quality Data.

Parameter	4/23/63	5/8/92	7/30/92	11/11/92
Alkalinity	37	34	38	36
Conductivity	87	85	90	87
Chloride	.7	<1	<1	3
Nitrogen - ammonia	.1	<.05	.08	<.05
Nitrogen - NO2+NO3	.18	<.05	.08	.11
Nitrogen - TKN	.25	.62	.46	.45
Phosphorus, total		.032	.022	.018

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model

	Phosphorus	PINE
Excellent	< .001	
Very good	.001 - .010	
Good	.010 - .030	•
Fair	.030 - .050	
Poor	.050 - .150	
Very poor	> .150	

Carlson Trophic State Index

Secchi Depth	
> 19.7	Oligotrophic
9.8 - 19.7	----------
6.6 - 9.8	Mesotrophic
4.9 - 6.6	----------
3.3 - 4.9	Eutrophic
< 3.3	

Macrophytes

Excessive aquatic plan growth has been a problem on Pine Lake for many years. The DNR file in Rhinelander contains many correspondences from the early 1950's requesting advice and assistance on dealing with the "weeds." In 1965, Gaylord Nelson was involved in trying to get emergency disaster funding to help dispose of the huge masses of plants and dead fish along shore following a particularly bad winterkill. In the early 1990's chemical treatment was used to try maintain a channel on the north end of the lake. An intensive weed harvesting program has been employed for the last few years.

Below is the species list and community map from a survey conducted on July 30, 1992 as part of Pine Lake's Planning Grant study. Of fifty-five stations sampled, 49 supported plant growth. Twenty-eight different species were collected. *Ceratophyllum demersum*, coontail was the most commonly collected species, present at 42 sample sites. *Elodea canadensis*, waterweed, was also quite abundant and very dense where present. Two small beds of emergent vegetation were located along the south and west shores.

Table 39. Pine Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	1.8	2.0	3.5
Ceratophyllum demersum	76.4	2.2	3.0 - 13.0
Chara vulgaris	3.6	2.0	2.5 - 5.0
Eleocharis acicularis	1.8	1.0	11.5
Elodea canadensis	44.0	2.0	2.5 - 11.0
Isoetes sp.	1.8	3.0	5.0
Lemna minor	p		
L. trisulca	5.5	2.3	3.0 - 4.0
Megalodonta beckii	1.8	3.0	3.0
Myriophyllum exalbescens	20.0	1.8	3.0 - 8.0
Najas flexilis	32.7	1.8	2.5 - 12.0
Nitella flexilis	1.8	4.0	7.0
Nuphar variegatum	5.5	2.7	3.0 - 3.5
Nymphaea odorata	3.6	3.0	3.0
Pontederia cordata	p		
Potamogeten amplifolius	12.7	1.7	5.0 - 8.5
P. berchtoldii	9.1	2.2	8.5 - 12.0
P. gramineus	10.9	2.0	3.0 - 6.5

P. foliosus	14.5	1.3	6.5 - 12.5
P. illinoensis	5.5	2.3	7.0 - 8.5
P. praelongus	40.0	1.8	3.0 - 12.0
P. richardsonii	25.5	1.6	2.5 - 12.0
P. robbinsii	29.1	3.2	3.0 - 12.0
P. zosteriformis	40.0	1.7	2.5 - 10.5
Scirpus heterochaetus	3.6	2.0	2.5 - 3.0
Typha latifolia	p		
Utricularia vulgaris	1.8	1.0	3.0
Vallisneria americana	p		

Shoreline Survey

The shoreline of Pine Lake is 6.42 miles long, about .6 miles are wetland. An additional small portion is occupied by a US Forest Service campground.

Property values on Pine Lake are currently $6,454,600 for land and $9,832,100 for improvements, for a total of $16,286,700.

The following is from a shoreline survey done on June 9, 1995 in conjunction with the lake planning grant study. The numbers refer to sections of shoreline shown on the development map.

1 - First 100 or so yards north from the boat landing is undeveloped with all natural vegetation.
2 - Next is a series of properties with beaches or lawns to the shorelines. These areas are separated by small areas of natural vegetation.
3 - Six small cottages, very low and very close together, most of them are very close to the shore. These have lawns with no buffer zones.
4 - Several large dwellings with greater setbacks and beach shoreline.
5 - Five small dwellings very close to shore with beach shoreline. Some minor erosion problems are evident in this area.
6 - Five dwellings with better set back and moderate buffer zones at the shoreline.
7 - Three dwellings close to the water with lawns to the shore. Also some back development behind them.
8 - Approximately 100 yards of beach and lawn with trailer park approximately 100 feet from shore.
9 - Three dwellings with lawn and natural vegetation - thick water lily growth could possibly be due to nutrient loading in this area.
10 - Several 100 yards of naturally vegetated, swampy shoreline with extensive macrophyte growth extending far into the lake. This area should be protected as a natural area for wildlife and a nutrient sink for the inlet.

11 - Steeper shore - some dwellings with buffer zones, some without.
12 - Several small dwellings close to the shore on a more gradual slope - some with buffer zones, some without.
13 - Two large dwellings close to shore with natural vegetation between.
14 - Slightly steeper slope; dwellings mostly close to the water but with buffer zones. More large trees were left in this area.
15 - Twenty-five small cottages low to the water and close to shore. Most have open lawns to the shoreline. Residents should be encouraged to protect the bulrushes by only using boats in the established paths. This area is broken up by a natural area approximately 200 feet long.
16 - Six dwellings on a much steeper slope with natural vegetation. Very nice aesthetically. One place appears to be a cottage built on top of a boat house.
17 - Twenty to 30 dwellings on a moderate slope, most with natural vegetation in front and between. Some without buffer zones.
18 - Six dwellings with natural strips of lawn to the shore and approximately 200 feet of natural vegetation between each.
19 - Four dwellings with lawn to the shore. Some apparent erosion problems.
20 - Four dwellings with a bit more natural vegetation - but more should be encouraged.
21 - Huge lawn extending to the shore.
22 - Five dwellings very close to the water and very low.
23 - Approximately 100 yards of natural vegetation.
24 - Ten to 12 dwellings with lawns but many more large trees.
25 - Six dwellings with mostly natural vegetation and good buffer zones where there are lawns.
26 - Several dwellings with boat houses and lawns without buffer zones.
27 - Four dwellings with good set backs and mostly natural vegetation.
28 - Beach.
29 - Several dwellings on steep rocky terrain with mostly natural vegetation.
30 - Six to 10 dwellings approximately 10 feet above the water, mostly with lawns extending to the shore.
31 - Six dwellings with some natural vegetation but buffer strips should be wider.
32 - Five dwellings with lawns to the water and many outbuildings. Also many large trees left in the yards.
33 - Seven dwellings very low to the water and close to the shore, mostly with open lawns to the shore.
34 - Outlet and then approximately 200 yards of swampy natural shoreline.
35 - Three large dwellings with lawns to the shore and a few trees.
36 - Many dwellings mostly with yards and some trees. This area is split in half by about 100 yards of natural vegetation.
37 - Six dwellings about 75 feet apart and close to the water on a relatively steep slope, but with good buffer zones at the shoreline.
38 - Seven dwellings (two mobile homes) low to the water with yards to the shore and very few trees.
39 - Several dwellings with a mixture of natural vegetation, buffer strips and yards.

40 - Approximately 100 yards of natural, undeveloped shoreline.
41 - Five dwellings very close together - some with buffer zones, some without.
42 - Five dwellings on a steep slope but set back farther and with mostly natural vegetation.
43 - Large dwelling very close to the water with a large patio which probably contributes a lot of runoff to the lake.
44 - Natural shoreline.
45 - Four or five dwellings with decent setbacks and mostly natural vegetation.

Recreational Use

Recreational use data was not collected for Pine Lake.

Recommendations

1. Consider program similar to Pickerel/Crane septic survey and update. I would recommend discussing their program with them. It is an aggressive and somewhat controversial program but it also probably the only hope for improving the situation on Pine Lake.

2. Encourage shoreline improvement where natural vegetation has been removed.

3. Pine Lake is popular with nonresident users and it is a very fertile system making it susceptable to invasion by non-native plant species. A system of monitoring for these species should be developed. The easiest would probably be to educate the harvester operators.

4. Protect the outlet from the millpond. This area acts to absorb nutrients and slow the water so sediment can settle out before reaching the lake. It is also probably very valuable to numerous species of wildlife.

5. Monitor the activities around the Millpond as these could have a fairly direct effect on the conditions on Pine Lake.


Abundant Submergent
Moderate Submergent
Sparce Submergent
Floating-leaf
Emergent
X No Vegetation observed
Macrophyte Communities 1992

Figure 21.

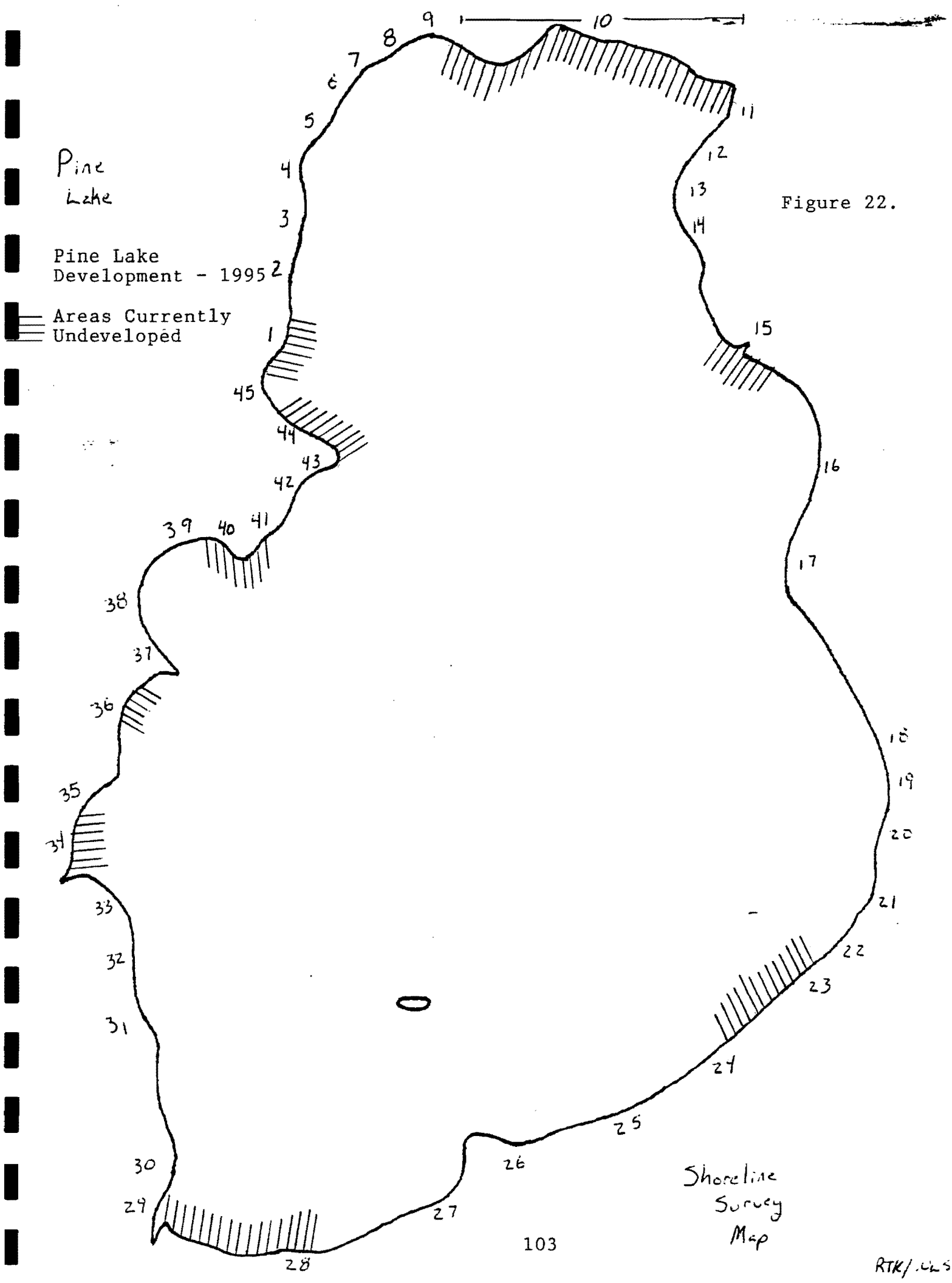


Figure 22.

RTK/...

ROBERTS LAKE

Roberts Lake is a hard water, spring fed lake. It is 452 acres and reaches a maximum depth of 32 feet. Roberts Lake is the headwaters of the Lily River. The dam at the outlet which controls the lake level, has been a recent point of contention. The structure may not have gone through the proper approval process at the time of construction and now that it is need of repair there is much argument over who will be responsible for the repair and for future control/maintenance. Further development of sensitive areas is also current concern.

The lake supports a strong preditor fish population including walleyes, northern pike and muskie. The panfish population is dominated by yellow perch.

In 1993/94, the Roberts Lake Association funded a limnological study of the lake. Most of the following information was generated during that study.

Water Quality

The following water quality data was taken from WDNR resources and the 1993 limnological study funded by the Roberts Lake Association. It is used here with their permission.

Table 40. Roberts Water Quality Data.

Surface Parameter	1970's	11/3/93	4/25/94	8/12/94	
Alkalinity	95	98	100		100
Conductivity	187	190	210		200
Chloride		8.0	1.0		1.0
Nitrogen - ammonia		<.05	<.05		.17
Nitrogen - NO2+NO3		<.05	.06		<.04
Nitrogen - TKN		.32	.21		.67
pH	8.2	8.0	7.7		8.1
Phosphorus, total		.019	.012		.008
Bottom					
Alkalinity		98	100		110
Conductivity		190	210		220
Chloride		2.0	1.0		2.0
Nitrogen - ammonia		<.05	<.05		<.03
Nitrogen - NO2+NO3		<.05	.05		<.04
Nitrogen - TKN		.27	1.1		.44
pH		8.0	7.7		7.7
Phosphorus, total		.017	.013		. 019

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model			Carlson Trophic State Index	
	Phosphorus	ROBERTS	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030	•	6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

Nuisance plant and algae growth has been a concern on Roberts Lake for several decades. In the early seventies significant portions of the littoral zone were chemically treated. The far northern bay was particularly bad. This was due at least in part to septic contamination from the resort cottages in that area. An area of "pooling" of black material was noted and a near shore water sample yielded a fecal coliform count of 1200 colonies/100 mLs. Generally, surface waters in this area will yield counts of 20 to <5 c/100, and 200 is considered unsafe for swimming.

Macrophyte growth is still abundant to dense in that area and much of the rest of the littoral zone but it was generally well below the water surface. Plant growth is quite sparse along the west and south shores. Of 84 stations sampled in 1994, 50 supported plant growth to some extent. Floating leaf vegetation was present at about 8% of the sample stations and small to medium beds of emergent vegetation were present throughout the lake. *Vallisneria americana* or eel grass was the most commonly collected submerged species.

During the shoreline survey in 1997, several large plants were noted in the inlet near the boatlanding. From a distance they resembled purple loosestrife but could not be inspected close-up. This area also supports dense native milfoil growth and should be carefully monitored for the presence of the Eurasian species.

Table 41. Roberts Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demersum	15	1.9	2.5 - 16.5
Chara vulgaris	26	2.4	2.0 - 15.5
Elodea canadensis	19	1.4	2.0 - 16.5
Lemna minor	5	1.5	4.0 - 13.5
Myriophyllum exalbescens	28	2.1	2.0 - 14.0
Najas flexilis	8	2.4	2.0 - 7.5
N. guadalupensis	1	2.0	14.5
Nuphar variagatum	5	1.3	2.0 - 4.0
Nymphaea odorata	5	2.0	2.5 - 4.0
Polygonum natans	1	1.0	4.0
Potamogeten amplifolius	13	1.8	2.0 - 7.5
P. illinoensis	7	1.3	2.0 -6.0
P. natans	2	2.5	3.0 -5.0
P. pectinatus	1	1.0	4.0
P. richardsonii	1	1.0	3.5
P. zosteriformis	26	2.0	2.0 - 16.5
P. sp.	4	1.3	2.0 - 5.0
Scirpus validus	7	1.3	3.0 - 5.0
Sparganium sp.	p		
Vallisneria americana	41	2.8	2.0 - 15.5

Shoreline Survey

The shoreline of Roberts Lake is approximately five miles long and almost 100% uplands. Development has increased by over 45% since the mid seventies to a current total of 158 dwellings. This yields a development factor of 31.6 d/m. The S.D.F. is 1.7. Current assessed property values are as follows: Land = $5,109,850; Improvements = $5,892,170; Total = $11,002,020.

The following is from a shoreline survey conducted in fall 1997. The numbers refer to sections of shoreline shown on the development map.

1 - Eight dwellings 50 to 75 feet back, about 10 feet of lake level on moderate slope. Much natural vegetation left in place. Fifth with lawn to shore.
2 - Six medium to large dwellings on very steep slope about 25 feet off lake level. Fourth and sixth with very little natural vegetation. Others most vegetation in place.
3 - Undeveloped - mostly maple and birch.
4 - Enormous home. Excellent example of improper development. Very steep slope with grass and some exposed soil to shore. No large trees, no understory and no buffer strip on most of lot.
5 - Undeveloped - same as 4.
6 - Large place on very steep slope with long (200+ foot) setback and all natural vegetation in front. Then two large new places about 60 feet back and 10 feet off the level of the lake. Good examples of wise lake development if you do not want to leave all vegetation in place i.e. Reasonable setback, neutral colors, many large trees and buffer strip at shore. One more dwelling with exposure to the lake and the bay. Pretty good natural vegetation.
7 - Undeveloped. Wetland
8 - Three dwellings. This area probably should not have been developed as the bay is already very shallow and full of flocculent (loose) sediment. Great care should be taken by these residents not to speeding the aging process here as it will be fast enough! This bay should be posted as no wake.
9 - One medium dwelling on steep slope with good natural vegetation.
10 - Outlet. Undeveloped. Mixed - mostly pines and birch with other hardwoods.
11 - Thirty-one dwellings on fairly steep slope, 10 to 25 feet off level of lake. Most have at least large trees, some with grass to shoreline others with very good buffer strips. Appears to be several undeveloped lots in this area. Five boathouses.
12 - Twenty dwellings. First two on slope in natural vegetation. Rest near lake level with very short setbacks and grass to rocky shoreline. Last few have more natural vegetation. Six boathouses.
13 - Five dwellings on steep slope with deep setbacks and natural vegetation but a lot of small "development" at the shore. One boathouse.
14 - Eleven dwellings including several very small resort-type cottages. Very short set backs. Most with grass to shoreline. Tenth lot has <u>all</u> natural vegetation in place - actually looks odd with nothing around it. Two boathouses.
15 - Four very small resort-type cottages with RV park behind. Cottages at lake level and very close to shore. Large supper club about 100 feet from shore.
16 - Twenty-three dwellings. Slope is moderate then gradual then very steep by the end of this section. Most are separated by strips of natural vegetation. Many with grass to shoreline and/or very short setbacks.
17 - Eight dwellings right at lake level. Screened to some extent by bulrushes, but most appear to have grass to the shore.
18 - Undeveloped. Tag alder wetland.

19 - Undeveloped. Very steep slope with mostly birches.
20 - Nine dwellings on moderate slope with 50 to 75 foot setbacks. Fifth and ninth have much natural vegetation. Others mostly large trees and grass to shore. Four boathouses.
21 - Eleven large dwellings on very steep slope. Fifth and sixth have removed much of the natural vegetation, but others have left most in tact. Places on long, steep slope as this should try to control erosion/runoff. One boathouse.
22 - Ten dwellings on very steep slope. Third has no "shore" only timber and trellis landscaping. Several have grass shore or rock and concrete. Seventh place is a good example of garden buffer strip for those who don't like "all natural" look. Slope tapers to lake level by the end of this section.
23 - Undeveloped. Tag alder and cattails.
24 - Three dwellings on moderate slope. Some natural vegetation but could easily improve without changing the look of the area too much. Two boathouses.
25 - Undeveloped. Birch tag alder wetland. Possibly purple loosestrife but not confirmed. should be verified.

Recreational Use

This survey indicates that Roberts Lake is a heavily used for recreation. Low impact recreational activities, fishing and "lounging", were most commonly noted on Roberts Lake, but it also supported many high impact activities. During two of the mid afternoon survey times these activities (waterskiing, jetskiing etc..) were occurring about one per 18 acres of lake. At the same time low impact activities were noted at about the frequency as during other survey times. This most likely leds to user conflicts and possibly forces high impact users into areas not suited for this use.

Table 41. Roberts Recreational Use.

	1	2	3	4	5	6	7	8	9
Fishing	21	13	23	14	6	17	21	10	11
Speed Boating		10	2		1			8	1
Water skiing		6						4	
Sailing		2	1					1	
Canoeing/rowing			2	1		1	2		
Jetskiing		4			2			7	
Swimming/snorkeling		6	6	3	22	3		32	5
Lounging		16	32	6	26	15	8	33	18
Pontoon boating	1	7	7		4	1			7
Tubing		4			2			6	
Paddle boating		4		2	1	1		6	
Pier fishing		5	6	3	4	3	2	5	12

1 = 7/5/96 9:30 a.m.	4 = 8/15/97 9:30 a.m. Thurs.	7 = 8/17/97 9:00 a.m. Sat.
2 = 7/5/96 1:00 p.m.	5 = 8/15/97 1:00 p.m.	8 = 8/17/97 1:00 p.m.
3 = 7/5/96 7:00 p.m.	6 = 8/15/97 7:00 p.m.	9 = 8/17/97 7:00 p.m.

Recommendations

1. Improve buffer strips where vegetation has been removed. Especially the small bay on the south shore. Stress the importance of keeping additional sediment out of this area. Residents in the north bay should also be aware of the effect unchecked runoff can have there area.

2. Protect shallow, heavily sedimented areas from high impact recreational activities. Especially, the two areas mentioned above.

3. Stress wise shoreline use throughout the lake. Educate residents on the effects poor development practices have on an already fertile system. Use huge, new place on east point as an example of what not to do.

4. Educate residents on septic monitoring. Perhaps distribute a survey to gather information on age, usage, etc of current systems.

5. If recreational conflicts are common as the survey indicates, try to resolve them before they get worse. Perhaps the association could appoint a committee with representatives of all activities to address issues like limiting the number of certain activities that can occur at once, determine how sensitive areas will be protected, and develop "use patterns" to facilitate safe use.

6. The water chemistry of Roberts Lake and the fact that it gets a fair amount of off-lake users makes it a good candidate for invasion by exotic plant species. An aggresssive program of monitoring for these, especially at the two boat launch areas, should be developed.

7. The association should stay abreast of the status of undeveloped areas, particularly the south east shore. If these are to be lotted and developed stress large lots and wise shoreline use. The dwelling at the south end of this stretch is an excellent example, the one on the north is not. If this area is held by a single owner, perhaps a deed restrict agreement could be met.

Figure 23.

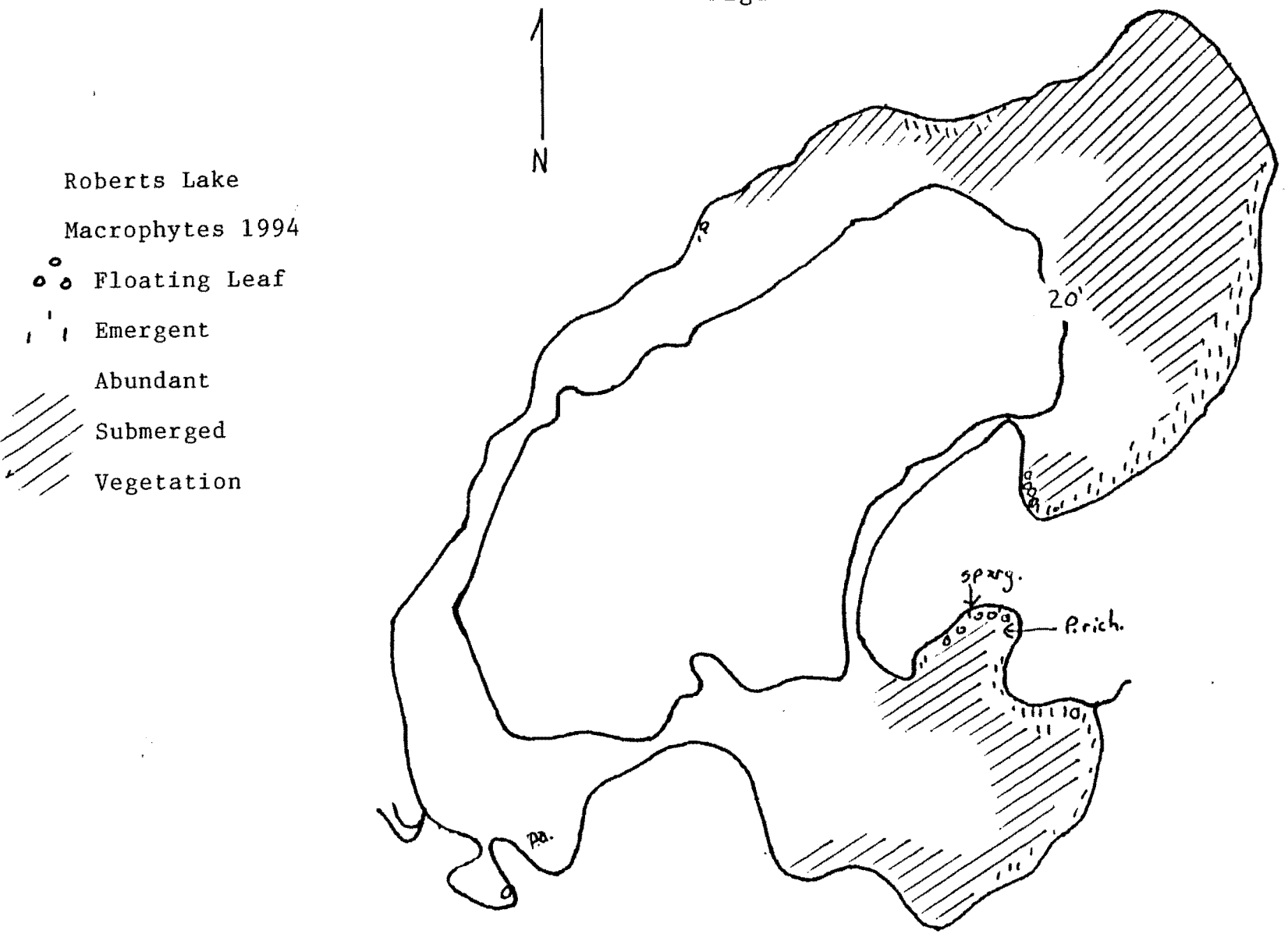
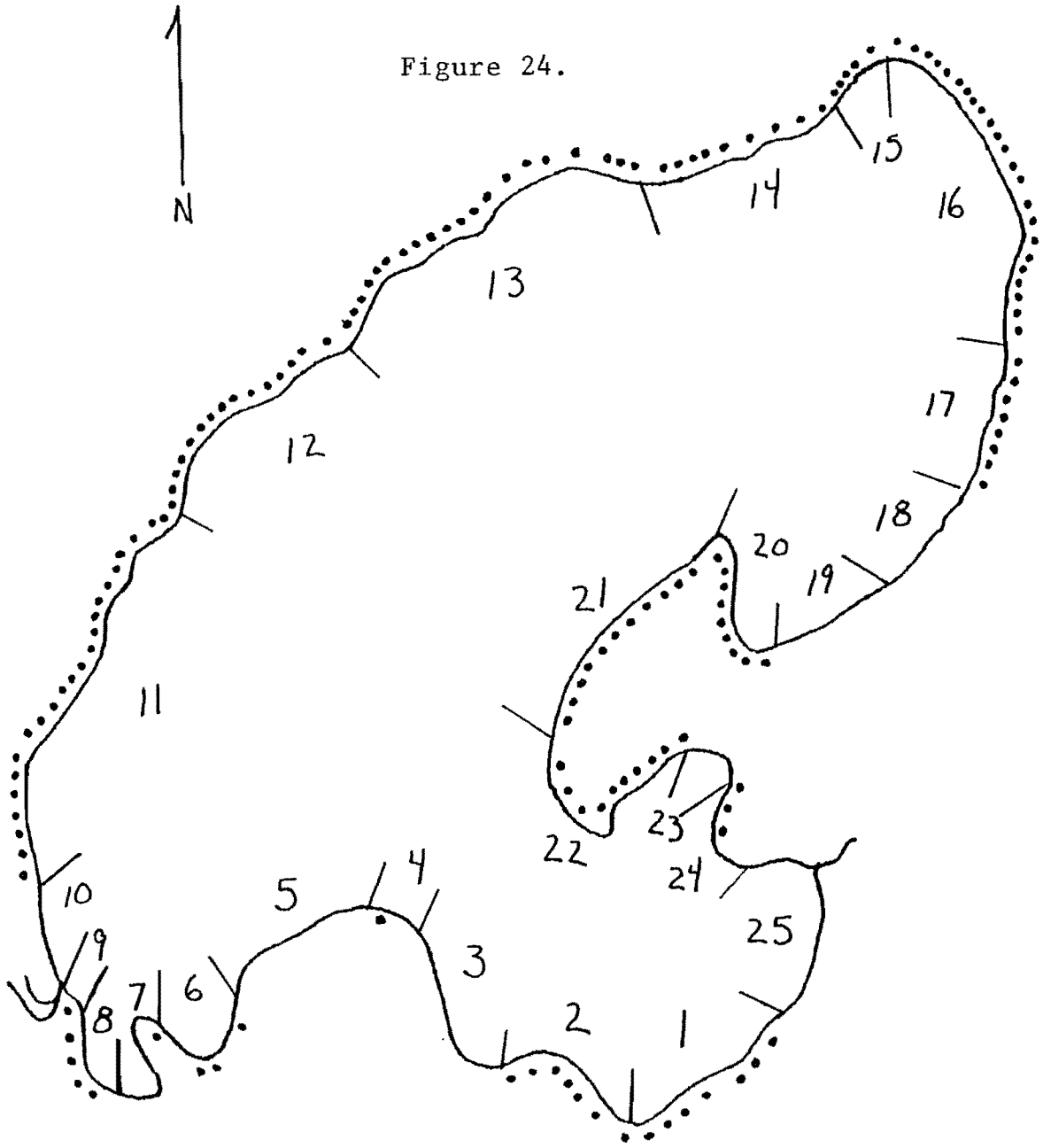

Roberts Lake
Macrophytes 1994
Floating Leaf
Emergent
Abundant
Submerged
Vegetation
N
20'
sparg.
P.rich.
pa.

Figure 24.

Roberts Lake
Development
1997



SILVER LAKE

Silver Lake is a 320 acre, soft water lake with a maximum depth of about 20 ft. Its outlet flows to the Rat River. The north end is heavily developed and has been for many years, while the south end is sparsely developed with long stretches of natural shoreline.
Silver Lake supports a strong population of both large and small mouth bass. Small northern pike are also very abundant.

Water Quality

Table 42 contains water quality data from SWRoFC (1935), WDNR files (1976) and data from a sample collected on 6-26-97 and analyzed by NLS.

Table 42. Silver Water Quality Data.

	7/11/35	7/15/76	6/26/97
Alkalinity	29	26	27
pH	7.0	7.2	7.8
Conductivity	61		
Chloride			1.5
Hardness		28	
Nitrogen - ammonia		.03	.14
Nitrogen - NO2+NO3		.02	<.03
Nitrogen - TKN		.56	.48
Phosphorus, total		.01	.015
Phosphorus, soluble		.003	

The following data is from two unlabeled tables found in WDNR files.

	4/23/74	8/14/75	9/9/75
Total Org. Nitrogen	.31	.87	.43
NO2 + NO3	.084		
Ammonia	.10	.06	.05
Total Phos.		.013	.015
Soluble Phos.		.013	.015

All value in mg/L except pH and conductivity in s.u. and uhmo@25C respectively.

7/15/75	0 feet	10 feet	19 feet
D.O.	8.2	8.0	8.0
pH	7.5	7.4	7.4
Alkalinity	23	22	25
Conductivity	58	71	69
Nitrite	.002	<.002	<.002
Nitrate	.10	.11	.19
Ammonia	<.03	<.03	<.03
Org. Nitrogen	.40	.34	.39
Total Nitrogen	.50	.45	.58
Dissolved Phos.	<.005	<.005	<.005
Soluble Phos.	.02	.05	<.01
Sulfate	8	6	8
Chloride	2	2	2

Phosphorus samples were collected at 3 and 17 feet below the surface on 6/8/94, 7/10/94, 8/10/94, and 10/3/94. All values were between .010 and .014 mg/L. Chlorophyll a was also analyzed on the 3 foot samples. The values 1.62, 3.68, 3,62, and 3.53.

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model

Carlson Trophic State Index

	Phosphorus	SILVER	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030	•	6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

Sixty-seven stations were sampled for aquatic plants on August 9, 1995. Of these, 59 supported macrophyte growth to some extent. The most common species was *Elodea canadensis* or water weed. This plant was present at nearly two thirds of the sample stations and grew to a depth of at least 19.5 feet - the deepest of any species collected. The Next two most common species were members of the pondweed genus which are generally regarded as beneficial to the fishery. These two species, *Potamogeton richardsonii* and *P. robbinsii* were present at 38.8% and 43.3% of the sample stations and usually occurred together. While macrophyte were quite abundant during this survey they do not seem to be adversely effecting recreational use, as the average depth to vegetation was seldom less than two feet.

Table 43. Silver Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	3.0	1.0	1.5
Chara vulgaris	17.9	1.9	6.5 - 11.0
Eleocharis acicularis	9.0	1.5	3.0 -5.0
Elodea canadensis	61.2	2.0	1.5 - 19.5
Isoetes sp.	1.5	1.0	1.5
Juncus pelocarpus	11.9	2.4	1.5 - 5.0
Lemna minor	1.5	1.0	1.5
Megalodonta beckii	7.5	1.4	1.5 -9.5
Najas flexilis	17.9	1.7	1.5 - 10.0
Nitella flexilis	13.4	2.1	4.0 - 17.0
Nuphar variegatum	3.0	1.0	1.5
Nymphaea odorata	4.5	1.7	1.5
Potamogeten amplifolius	3.0	1.5	6.5 - 7.5
P. gramineus	11.9	1.4	3.0 - 8.0
P. illinoensis	3.0	1.5	4.0 - 7.0
P. richardsonii	38.8	2.5	1.5 - 14.0
P. robbinsii	43.3	2.5	4.0 - 14.0
P. sp.	3.0	1.0	1.5 - 9.0
Sagittaria sp.	1.5	2.0	1.5
Scirpus validus	1.5	2.0	1.5
Sparganium sp.	1.5	1.0	1.5
Utricularia vulgaris	1.5	1.0	1.5 - 9.0
Vallisneria americana	29.9	1.9	1.5 - 14.0

Shoreline Survey

At the time data was gathered for the SWRoFC, Silver Lake supported approximately 80 dwellings. It now supports 118, an increase of 32%. The shoreline of Silver Lake is 4.06 miles long. A small portion is not appropriate for development due to its proximity to US Hwy 8. Development around the southwestern bay probably should probably be limited due its susceptibility to heavy sedimentation. If three tenths of a mile are discounted for these considerations the shoreline development factor of 31.4 d/m. The S.D.F. for Silver is listed at 1.6.

The total assessed value of Silver Lake properties is $7,346,570, with $3876,470 from land and $3,470,100 from improvements.

The following is from a shoreline survey performed in August of 1995. The numbers refer to sections of shoreline shown on the development map.

1 - Undeveloped. Shoreline is very close to highway. Shrubby vegetation with pines and birch.
2 - Approximately ten small dwellings. Short setbacks but some with good natural vegetation and some with at least large trees left. Shore levels off about five feet above waterline.
3 - Shoreline steeper. Six dwellings with less natural vegetation and more artificial shoreline stabilization efforts.
4 - Approximately ten dwellings very close together on steeper slope. Not much understory but some natural vegetation.
5 - Several dwellings with concrete breakwaters and lawn grass directly behind.
6 - Five dwellings with good natural vegetation.
7 - Public park with beach.
8 - Several dwellings some with long setbacks but most of understory gone, some with short setbacks but good buffer strips. Some with both.
9 - Very steep shoreline. Heavily developed. Most with good setbacks - two very close to shore. Many have attempted to control erosion. Several have breakwaters.
10 - Two dwellings with minimal natural vegetation - mostly grass, stone, and concrete.
11 - Approximately ten dwellings with good natural vegetation in place. Last few could improve buffer strip.
12 - Undeveloped. Wetland.
13 - Several dwellings with good setbacks and natural shoreline over sandy beach.
14 - Two dwellings with very little natural vegetation. Very susceptible to erosion/runoff. Should be encouraged to allow buffer strips to establish.
15 - Approximately 15 dwellings. Second close to shore, but others with deeper setbacks. Fairly steep slope with cattails near shore.
16 - Undeveloped.
17 - Large place built out over the water. Out of place on very natural-looking shore.
18 - Few dwellings spread apart, with good setbacks and natural vegetation. Rocky shoreline with thick pines, aspen, birch and hemlock.
19 - Several dwellings on very steep slope with little to control runoff. Should try to establish buffer strips though the usual buffer strip may not be adapted to this slope, perhaps taller, shrubby vegetation.
20 - Five small dwellings with large trees but no understory. Should consider some buffer strip.
21 - Naturally a wetland but has been filled in areas. This area probably should not have been developed and further development will only speed the degradation of this bay.
22 - Resort (?) with many small cottages and little natural vegetation. Approximately seven dwellings with wide cleared lots and wide strips of natural vegetation between.
23 - Several dwellings on very steep slope. Many attempts to minimize erosion/runoff - some have left much natural vegetation, some terracing, some breakwaters.

24 - Several cleared lots and dwellings with potential erosion problems. Should be addressed. Some "manicured lawns to shoreline.
25 - New development. Should be encouraged to allow natural vegetation to return. Would probably help shield him from highway noise.

Recreational Use

Recreational use data was not collected on Silver Lake.

Recommendations

1. Improve shoreline use. Encourage buffer strips where natural vegetation has been removed, especially in the southwestern bay where sediment is already heavy. This area must be wisely developed if it is to be developed at all. Educate redidents on the fact that seawalls often increase erosion at adjacent shoreline and destroys important semi-aquatic habitat. Natural shoreline provides nearly as much stabilization as concrete.

2. Protect southwest bay from any high impact activities. Educate lake users on the effects of disturbing these areas

3. The association should consider surveying residents on septic sytsyem status - age, usage, etc... Also educate them on monitoring system performance.

4. The association should stay abreast of the status of undeveloped areas, especially along the south shore. If these are to be lotted for development, stress wide lots and wise shoreline use. Perhaps deed restriction argeements could be reached with current owners.

5. As a popular recreational resource, Silver is susceptible to invasion by exotic plant species. A plan of monitoring for these, especially near the boat landing, should be developed and implemented.

Figure 25.

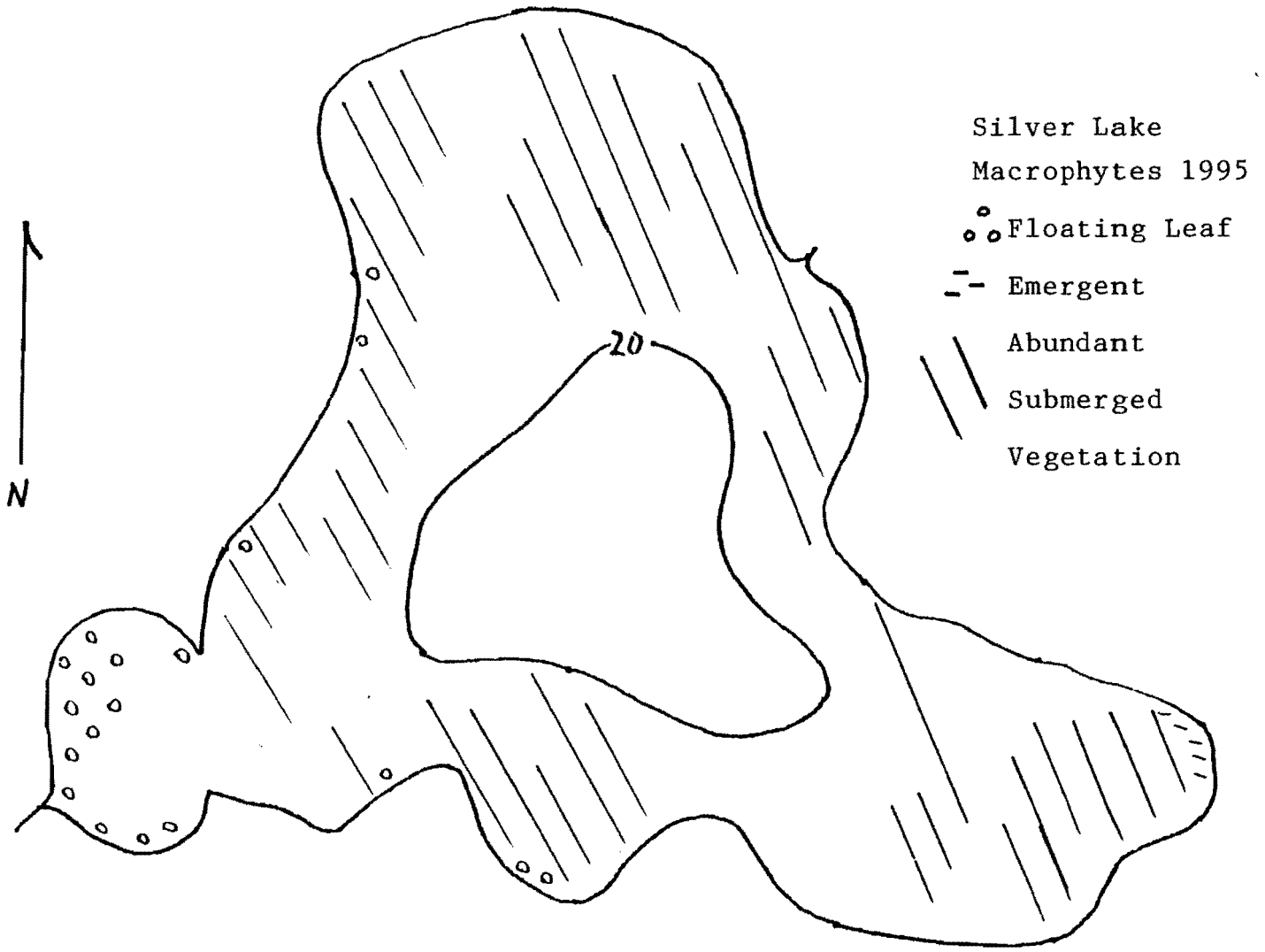
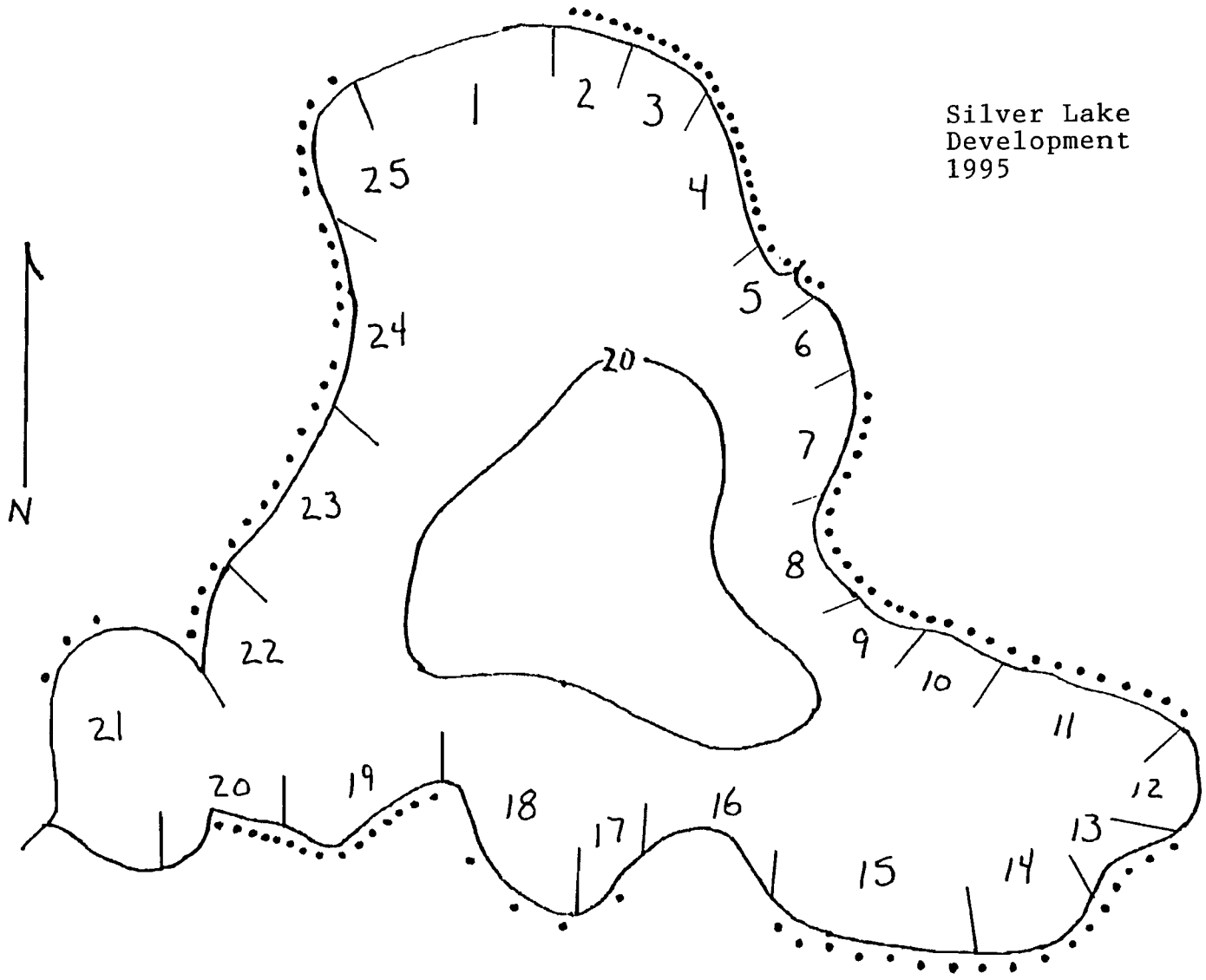

Silver Lake
Macrophytes 1995
Floating Leaf
Emergent
Abundant
Submerged
Vegetation
20
N

Figure 26.


Silver Lake
Development
1995
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ST. JOHNS LAKE

St. Johns Lake is a small (96 acre) seepage lake with very soft water. Development has occurred mainly in last twenty years. Extensive logging activity has occurred adjacent to the south bay of St. Johns Lake in recent years.

Water Quality

The follow table shows water quality data from SWRoFC and a sample collected on 5-13-96 and analyzed by NLS.

Table 44. St. Johns Water Quality Data.

	1970's	1996
Alkalinity	13	<2
pH	6.3	5.5
Conductivity	20	
Chloride		<.4
Nitrogen - ammonia		<.01
Nitrogen - NO2+NO3		<.02
Nitrogen - TKN		.25
Phosphorus		.01

All values in mg/L except pH=s.u. and Conductivity=uhmo@25C

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model

	Phosphorus	ST.JOHNS
Excellent	< .001	
Very good	.001 - .010	•
Good	.010 - .030	
Fair	.030 - .050	
Poor	.050 - .150	
Very poor	> .150	

Carlson Trophic State Index

Secchi Depth	
> 19.7	Oligotrophic
9.8 - 19.7	----------
6.6 - 9.8	Mesotrophic
4.9 - 6.6	----------
3.3 - 4.9	Eutrophic
< 3.3	

Macrophytes

Although aquatic plants were collected at 41 of fifty sample sites on St. Johns Lake, the predominant species were very small "sand-loving" plants that extend grow only a few inches out of the bottom. These include *E. triandra, E acicularis, J. pelocarpus,* and *M. tenellum*. St. Johns was the only lake in the study group that did not support a single representative of the genus *Potamogeton* or pondweeds, an extremely common and diverse group. Floating-leaf vegetation was present along the far western shore and in the southern back. This bay was entirely muck bottom and supported dense growth of *Utricularia vulgaris* or bladderwort, a species uncommon throughout the rest of the lake.

Table 45. St. Jons Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Chara vulgaris	4	3.0	5.0 -9.5
Carex sp.	p		
Dulichium arundinaceum	p		
Elatine triandra	14	1.7	3.5 - 5.5
Eleocharis acicularis	27	2.3	3.5 - 7.0
Isoetes sp.	27	2.3	2.5 - 7.0
Juncus pelocarpus	33	2.8	3.5 - 5.5
Lobelia dortmanna	14	1.6	3.5 - 5.0
Myriophyllum tenellum	20	2.0	3.5 - 7.0
Musci sp.	10	1.6	3.5 - 7.0
Nitella flexilis	27	3.6	5.5 - 17.0
Nuphar variagatum	4	1.0	6.5 - 7.0
Sagitaria cristata	8	3.2	2.5 - 3.5
Sparganium sp.	10	2.2	3.5
Utricularia vulgaris	18	2.4	3.0 - 8.5

Shoreline Survey

The total assessed property value on St. Johns Lake is $1,185,800, with $475,800 coming from land and $710,000 from improvements.

The following is from a shoreline survey conducted in the fall of 1997. The numbers refer to sections of shoreline shown on the development map.

1 - Several hundred feet of natural shoreline, then six dwellings each separated by 50 - 200 feet of natural vegetation. First is small mobile home. Second and third and fifth are small to medium with mostly natural vegetation. Fourth is open to the lake but has a very long setback. Last is a large place with most vegetation removed.
2 - Undeveloped.
3 - Three well spaced dwellings 75 to 100 feet back. Some terracing with grass to shore at first. Others with many lagre trees and little understory.
4 - Undeveloped. Bog.
5 - Four widely spaced dwellings on increasing slope, with 50 to 100 foot setbacks. Most with large trees and little understory. Third with boat ramp.
6 - Undeveloped.
7 - Fifteen dwellings on moderate to gradual slope. Most are widely seperated by natural shoreline. Several are very close to shore and/or very little natural vegetation. The second, fourth, tenth and eleventh are very good examples of natural vegetation for aesthetics and water quality preservation. Twelfth place has obvious erosion occurring near boathouse.
8 - Undeveloped. One slightly cleared lot.
9 - Two dwellings on gradual slope about 50 feet off lake. Both are very "suburban" looking. Very little natural vegetation - few trees and grass to narrow beach. Should try to establish buffer strips.

Recreational Use

Recreational use data was not collected on St. Johns Lake

Recommendations

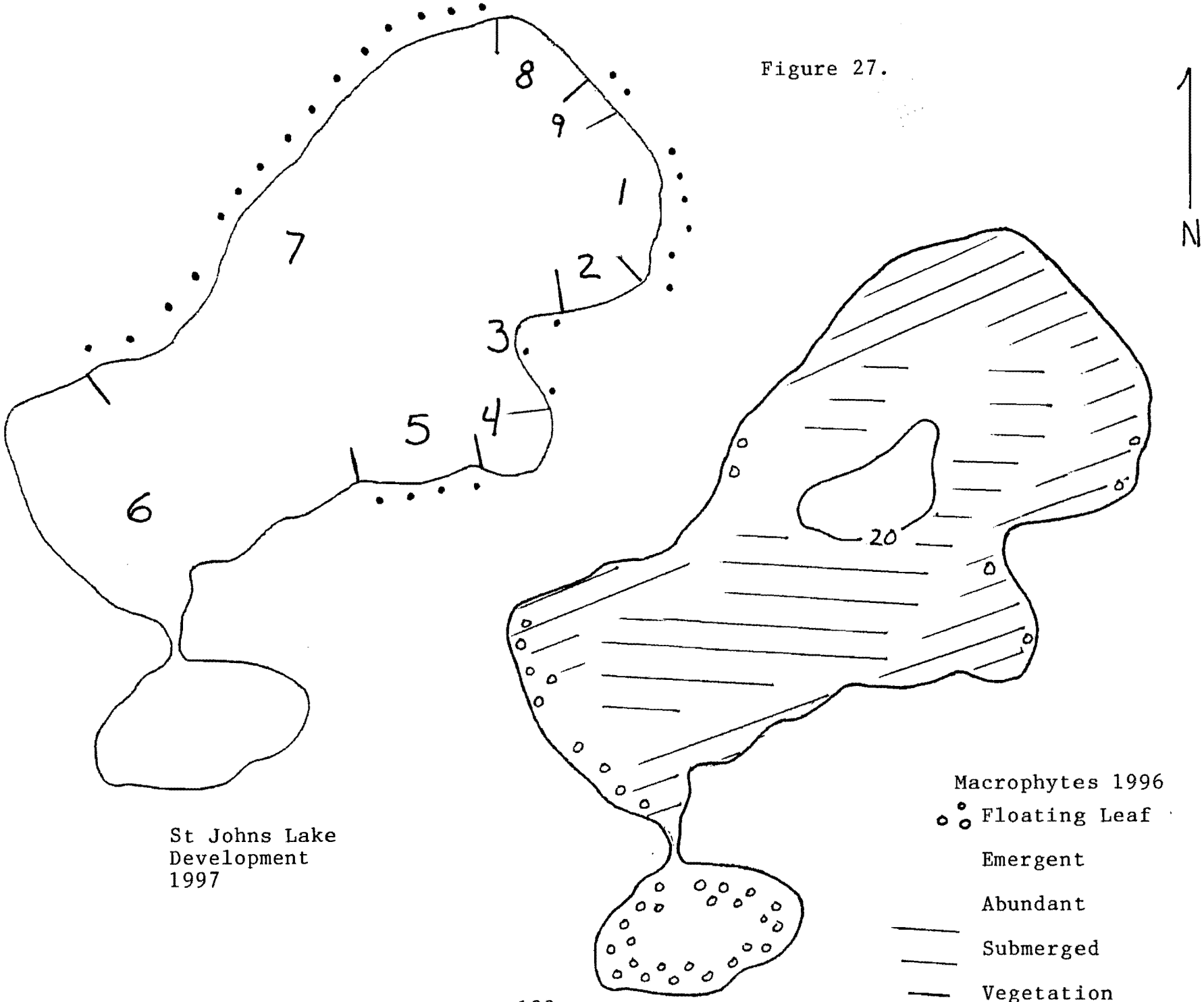
1. Monitor water quality for effects of acid rain, as St Johns is highly susceptible.

2. Improve shoreline use. Encourage buffer strips where natural vegetation has been removed. Encourage wise use for future development.

3. All residents should moniror septic system performance closely.

4. Protect south bay from disturbance.

Figure 27.



St Johns Lake
Development
1997

TRUMP LAKE

Trump Lake is a 172 acre, soft water, drained lake. It supports heavy development and is currently seeking grant money to study the need for and feasiblity of sanitary sewer service. The lake is quite heavily used for recreation. It supports Large mouth bass and northern pike and is stocked with walleye and muskies. Warmouth, an uncommon panfish is also present in Trump.

Water Quality

The following data was collected on August 17, 1972, in conjunction with a sanitary survey conducted by WDNR.

Table 46. Trump Water Quality.

	1 meter	6 Meters
Alkalinity	20	24
pH	7.4	7.3
Hardness	32	24
Nitrite	.002	.002
Nitrate	.05	.03
Ammonia	.04	.16
Org. Nitrogen	5.1*	.36
Total Phos.	.01	.01
Soluble Phos.	.001	.001

"All sample results expressed in mg/l (milligrams per liter) except pH which is in standard units"
* Probably should be ".51"

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model

	Phosphorus	TRUMP
Excellent	< .001	
Very good	.001 - .010	•
Good	.010 - .030	
Fair	.030 - .050	
Poor	.050 - .150	
Very poor	> .150	

Carlson Trophic State Index

Secchi Depth	
> 19.7	Oligotrophic
9.8 - 19.7	----------
6.6 - 9.8	Mesotrophic
4.9 - 6.6	----------
3.3 - 4.9	Eutrophic
< 3.3	

Macrophytes

Aquatic plants were common throughout most of Trump Lake. Thirty-six of 53 stations sampled supported vegetation. One of the most commonly collected submerged species was *Najas guadalupensis,* which was very dense but lies close to bottom so it does not effect recreational use. Floating-leaf vegetation was observed at over one third of the sample stations.

Table 47. Trump Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia shreberi	17	2.4	3.0 - 5.5
Chara vulgaris	7.5	1.2	5.5 - 6.5
Eleocharis acicularis	7.5	2.0	3.0 - 6.5
E. sp.	5.7	4.0	3.0 - 5.0
Elatine triandra	3.8	2.5	3.0
Isoetes sp.	1.9	1.0	3.5
Juncus pelocarpus	17	2.7	3.0 - 6.0
Myriophyllum tenellum	11	2.2	3.0 -6.0
Najas guadalupensis	32	2.4	3.0 -18.0
Nuphar variegatum	13	2.6	3.0 -5.5
Nymphaea odorata	9.4	1.8	3.0 -4.0
Potamogeten amplifolius	23	1.8	3.0 - 8.0
P. epihydrus	5.7	2.7	5.5 - 6.5
P. gramineus	19	1.8	3.0 -6.0
P. natans	5.7	2.0	3.0 - 4.0
P. robbinsii	25	2.8	6.0 - 18.0
P. sp.	38	2.0	6.5 - 8.5
Sagittaria sp.	5.7	1.0	5.5 - 6.0
Utricularia intermedia	5.7	1.7	3.0 -5.0
U. vulgaris	5.7	1.7	3.0 -5.0

Shoreline Survey

Property on Trump Lake is assessed at $3,799,000 and improvements at $ 3,802,866 for a total of $7,601,866

The following is from a shoreline survey conducted in 1996. The numbers refer to sections of shoreline shown on the development map.

1 - Thirty two dwellings. First seven approximately 50 feet apart with 50 foot setbacks. Some large trees and grass to the shoreline. Then four with most natural vegetation in place. Then eleven with mostly small trees and no understory. Setbacks about 40 to 70 feet on gradual slope to about ten feet above lake level. Four more dwellings; second is very good example of buffer strip. Lots of natural vegetation between these - mostly birch and maple. Large resort with two small cabins very close to shore with minimal natural vegetation. Three more small, old cottages. Total of thirty-two dwellings in the section.

2 - Three small, old dwellings approximately 50 feet back and 100 feet apart. Junkyard with approximately 10 - 12 vehicles +/- 75 feet of shore. From aesthetics and safety standpoint these should be removed. Sixteen medium places on moderate slope many with grass extending to the shore but most separated by strips of natural vegetation. Third place with much natural vegetation left and fourth is good example of buffer strip.

3 - Shoreline grades into lowlands then back to uplands with one dwelling and back into wetlands extending around south end of lake. Black spruce and tamarack with cattails, water lilies and spike rush extending out from shore.

4 - Four dwellings on moderate slope about 15 feet above level of water, set back 50 feet and 100 feet apart. Some natural vegetation - large hemlocks and at least some buffer strip.

5 - Fifteen dwellings near the level of the lake then grading into gradual slope. Most separated by some natural vegetation, but with grass to shoreline. Some have decent buffer strips. Signs of erosion near boat house at fourth place. Fifty to 100 feet apart and 50 to 75 feet off the shore.

6 - Seven dwellings including cluster of four small cottages on gradual slope. Two have wet boathouses. Some natural vegetation between but mostly grass to shoreline. North end of this section as small beach area.

7 - Seven dwellings mostly with large trees and no understory - third one has good natural vegetation. One very old wet boathouse. Fourth place has signs of erosion.

8 - Two dwellings on very steep shoreline. Some terracing, but not much natural vegetation.

9 - Six dwellings on moderate slope. Most with short setbacks and grass to shoreline. Fifth with natural vegetation.

10 - Undeveloped. Alder and leatherleaf wetland.

11 - Gradual slope grading into steep slope and back to gradual. Thirteen dwellings. Some very large new places with minimal setback and no understory. A few with longer (75 foot) setbacks but no understory or buffer strip. Second one is good example of natural vegetation with narrow access strip.

12 - Three dwellings with more natural vegetation.

13 - Park. 200-300 feet grass to shore but very gradual slope.

Recreational Use

Recreational use data was not collected on Trump Lake.

Recommendations

1. Continue to pursue septic survey work.

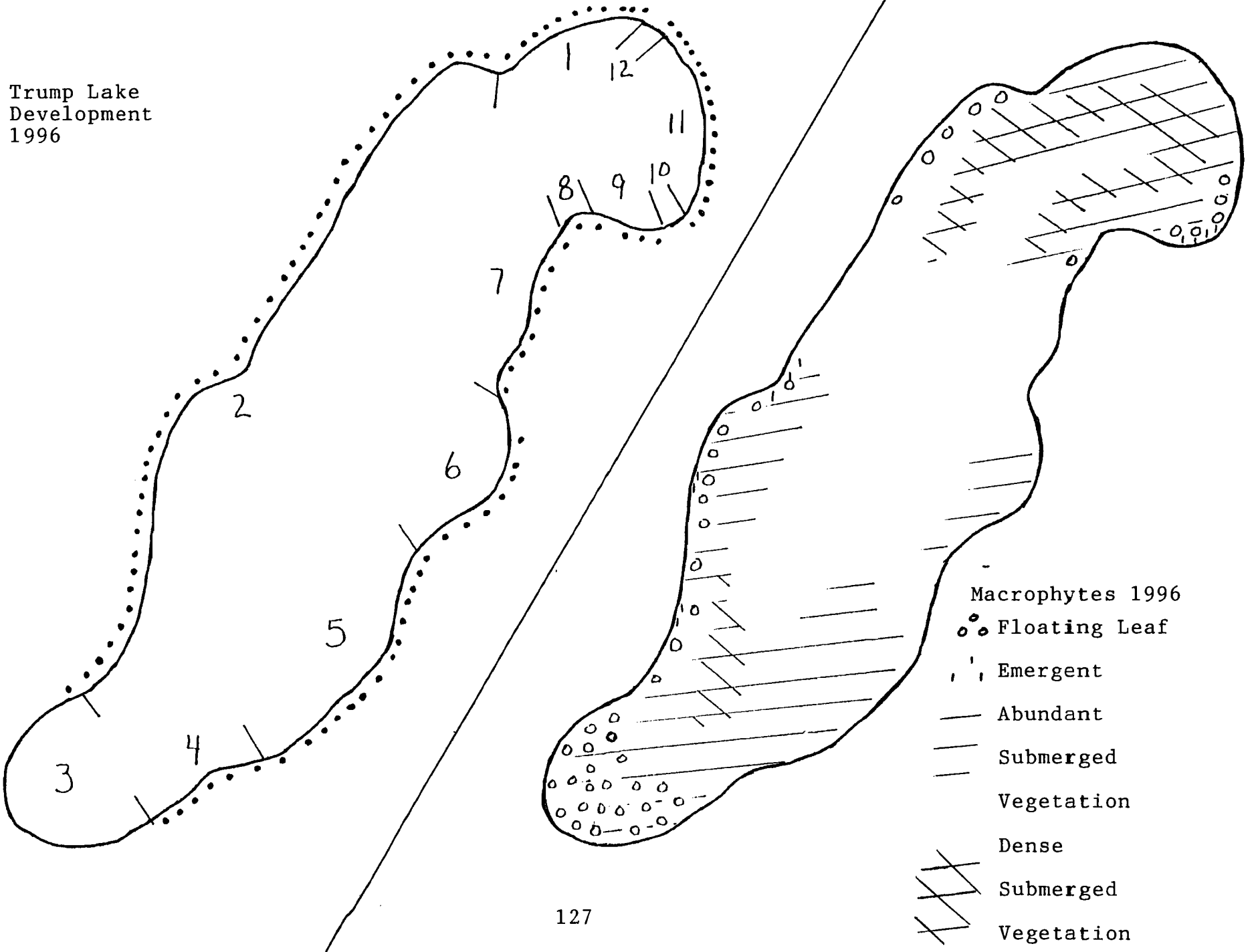
2. Encourage shoreline improvement. Including establishment of buffer strips and removal of old, nonconforming structures. Remove "junk yard" for safety and aesthetic purposes.

3. Protect south bay from development.

4. Protect south bay from any high impact recreational activities. It serves as a nutrient sink and is probably quite valuable as wildlife habitat. Educate residents on the importance of leaving this type of place undisturbed.

5. Develop and implement a plan of monitoring for exotic plant species, especially near the boat landing.

Figure 28.


Trump Lake
Development
1996
1
12
11
10
9
8
7
6
5
4
3
2
Macrophytes 1996
Floating Leaf
Emergent
Abundant
Submerged
Vegetation
Dense
Submerged
Vegetation

WINDFALL LAKE

Windfall Lake is a small, very fertile system. It has historically been impacted by agricultural runoff and may still be to a lesser extent. Residents have been battling nuisance weed and algae growth for several decades with little success. Chemicals have been applied for at least 28 years. Currently, barley straw is being used with some success, to combat algae growth. As the barley rots it releases an enzyme which inhibits algae growth. According to a DNR specialist, the treatment also seems to to be inhibiting other plant growth to a lesser extent and increasing the length of effectiveness of chemical treatment used along with the barley.
Windfall supports a fairly strong fishery, including large mouth bass, northern pike, crappies bluegills and stocked muskies.

Water Quality

The following contains water quality data from SWRoFC and a sample collected by association volunteers on May 19, 1996 and analyzed by NLS.

Table 48. Windfall Water Quality.

	1970's	1996
Alkalinity	120	110
pH	8.2	8.0
Conductivity	234	
Chloride		5.5
Nitrogen - ammonia		.078
Nitrogen - NO2+NO3		<.02
Nitrogen - TKN		.32
Phosphorus, total		.023

Values reported in mg/L except pH = s.u. and conductivity = uhmo@25C.

See water quality section on page 3 for an explanation of these tests and the following models.

Lillie and Mason Water Quality Model			Carlson Trophic State Index	
	Phosphorus	WNDFL	Secchi Depth	
Excellent	< .001		> 19.7	Oligotrophic
Very good	.001 - .010		9.8 - 19.7	----------
Good	.010 - .030	•	6.6 - 9.8	Mesotrophic
Fair	.030 - .050		4.9 - 6.6	----------
Poor	.050 - .150		3.3 - 4.9	Eutrophic
Very poor	> .150		< 3.3	

Macrophytes

Aquatic plant growth is abundant to dense over much of Windfall Lake. Thirty of 37 stations sampled on August 8, 1996, supported growth. In the narrow area between the two lobes of the lake and along the east shore of both lobes, growth was thick enough that pushing a boat through these areas was difficult. Six different species were present at more than one third of the sample stations. *Chara vulgaris*, a colonial algae that resembles a green plant was the most common submerged species and was extremely dense at most of the stations it was collected.

Table 49. Windfall Macrophyte Species List.

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia shreberi	57	2.4	2.0 - 13.0
Chara vulgaris	46	3.5	1.5 - 8.5
Elodea canadensis	14	2.0	1.5 - 4.0
Heteranthera dubia	8.1	2.0	2.0 - 4.0
Lemna minor	8.1	1.0	1.5 - 4.0
Megalodonta beckii	2.7	1.0	10.5
Myriophylum exalbescens	41	2.3	1.5 - 6.5
Najas flexilus	38	3.3	2.0 - 4.5
Nitella flexilis	5.4	3.0	4.0 - 8.5
Nuphar variegatum	27	1.2	2.0 -5.5
Nymphaea odorata	30	1.1	1.5 - 4.5
Polygonum natans	2.7	2.0	3.0
Potamogeten amplifolius	41	2.3	1.5 - 8.5
P. natans	5.4	1.0	2.5 - 4.0
P. pectinatus	11	2.0	1.5 - 3.0

P. richardsonii	35	1.6	1.5 - 10.5
P. zosterformes	38	1.6	1.5 - 10.5
P. sp.	14	3.0	1.5 - 11.5
Ranunculus sp.	2.7	1.0	1.5
Scirpus validus	p		
Spirodella polyrhiza	2.7	1.0	2.0
Typha latifolia	p		

Shoreline Survey

Property values on Windfall are $442,650 for land and $644,265 for improvements. This is a total of $1,086,915.

The following is from a shoreline survey conducted in the fall of 1997. The numbers refer to sections of shoreline shown on the development map.

1 - Natural vegetation; water willow, cedar, mixed hardwoods.
2 - Six small dwellings on medium slope. All natural vegetation removed at first three. Last three with some larger trees but no understory. Should be encouraged to establish buffer strips. One cleared lot with no improvements at the end of this section.
3 - Undeveloped. Mixed hardwoods and conifers. Thick understory and extensive semi aquatic growth at shore.
4 - Mostly natural vegetation, with scattered wide cleared areas of tall grass. Farm fields behind this section. The area should be inspected to ensure no agricultural runoff is entering the lake.
5 - Five dwellings. Slope starts medium but becomes very steep by last place. Set backs 50 to 75 feet - about 100 feet at last one. Mostly grass to shore; some large trees, landscaping, and some narrow natural separating strips.
6 - One trailer and one medium dwelling with short setbacks but very good natural vegetation. Second one is nearly invisible from shore.
7 - Two large dwellings. First on medium slope with some landscaping and narrow buffer strip. Second gradual slope with grass extending to shore for approximately 200 feet around point.
8 - Six dwellings on medium to steep slope, separated by good natural vegetation. First two with narrow strips of grass to shore, next two most natural vegetation left, fifth on steep slope with very wide strip of grass to shore - definitely should be encouraged to address runoff.

Recreational Use

Windfall has a "no gas motor" ordinance in effect at all times.

Table 50. Windfall Recreational Use.

	1	2	3	4	5	6	7	8	9
Fishing	1	3	4	1		1	7	13	15
Canoeing/rowing	1					12	5	8	
Swimming/snorkeling							12	7	1
Lounging		2					2	4	

1 = 8/17/96 10:00 am - warm, sunny
2 = 8/17/96 2:00 pm
3 = 8/17/96 7:00 pm
4 = 7/31/96 10:00 am - windy, rainy
5 = 7/31/96 2:00 pm
6 = 7/31/96 7:00 pm
7 = 7/6/96 10:00 am - partly cloudy, warm
8 = 7/6/96 2:00 pm
9 = 7/6/96 7:00 pm

Recommendations

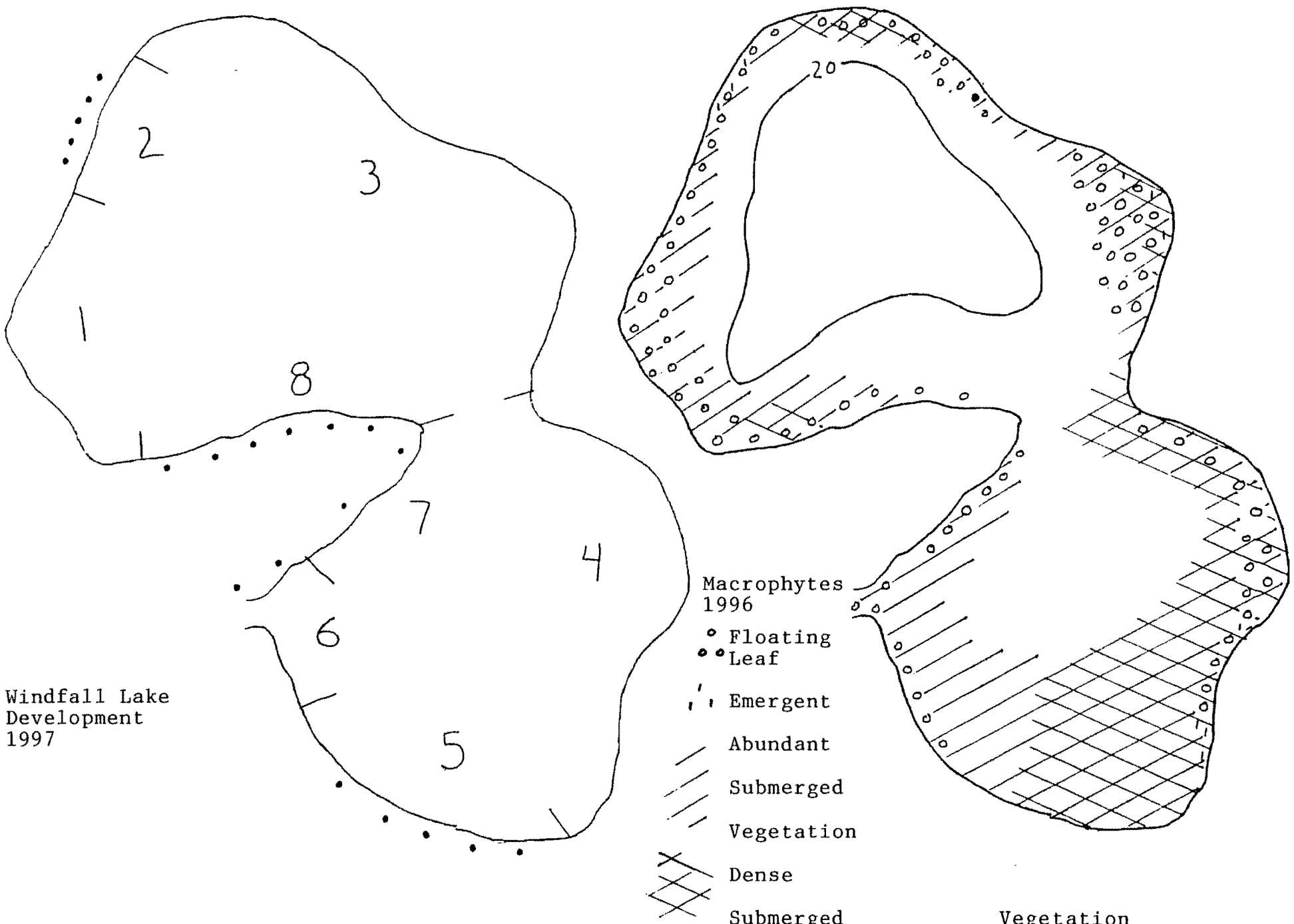
1. Every effort must be taken to keep additional sediments and nutrients from entering the lake. Residents should establish bufferstrips at the shore and closely monitor septic system performance.

2. Continue natural algae control with barley straw.

3. Inspect the adjacent farm to ensure it is no longer contributing to the nutrient load of the lake.

4. Development of low, wet areas must be discouraged.

Figure 29.


2
3
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20
Windfall Lake
Development
1997
Macrophytes
1996
Floating
Leaf
Emergent
Abundant
Submerged
Vegetation
Dense
Submerged
Vegetation