THE STATUS OF TEN FOREST COUNTY LAKES - 2003

A LIMNOLOGICAL SURVEY

Conducted by

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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) to study of the more heavily developed and utilized lakes in the county. The grant, the first given for a county wide project, was approved and work began in 1995. This project was completed in 1997. In 1998 FCAL applied for and received a lake planning grant to perform the same type of studies on ten additional lakes. This report contains the findings of those studies.

Following is a section from the original grant application stating the reason for these studies and the "goals" section from the current grant:

" 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 ten 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.
5. Map current macrophyte populations on the ten 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 ten lakes.
7. Collect water quality data on at least five of the ten 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 limnological projects, where available. Significantly less data is available for this group of lakes than was available for the twenty lakes previously studied. The following is a description of how the data included was gathered. All supporting information will be retained at Northern Lake Service, Inc (NLS) in Crandon.

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 - 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 a DNR publication called Water Quality of Selected Wisconsin Inland Lakes 1974-1975 and the Surface Water Resources of Forest County 1977. (Some of the data presented for Seven Mile Lake was taken from Surface Water Resources of Oneida County 1966) 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 outdated 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. Samples collected through the Department of Natural Resources Self-Help Lake Monitoring Program - These samples are collected by lake residents who also measure secchi disk depth. The samples are analyzed at the Wisconsin State Laboratory of Hygiene.

3. Samples collected and analyzed by Northern Lake Service, Inc. - Water quality data for several of the study group lakes was collected specifically for this project or as part of another county-wide project which was occurring at the same time.

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. Samples were preserved immediately after collection where applicable. All analysis was performed at Northern Lake Service (NLS). 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.

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 the DNR, 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 rain 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 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 a 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 both use phosphorus and Secchi depth as indicators. Chlorophyll a is often also used in this model, though it is not considered in this report.
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 (aquatic plant) surveys were completed by Northern Lake Service between 1998 and 2003. 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. 15 - 50 stations were sampled. 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 for each lake. A glossary of all the species and several pages of diagrams are avaiable as a supplement to this report, through Northern Lake Service, Inc..

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. 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 and is reported as d/m or "dwellings/mile".

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.

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.

In one case a narrative of lake use was provided.

Recreational use data was collected on 5 lakes.

RECOMMENDATIONS

Most planning grant studies are focused on an individual lake with specific concerns. 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 taken from the Surface Water Resources of Forest County and may be somewhat outdated on specific lakes.

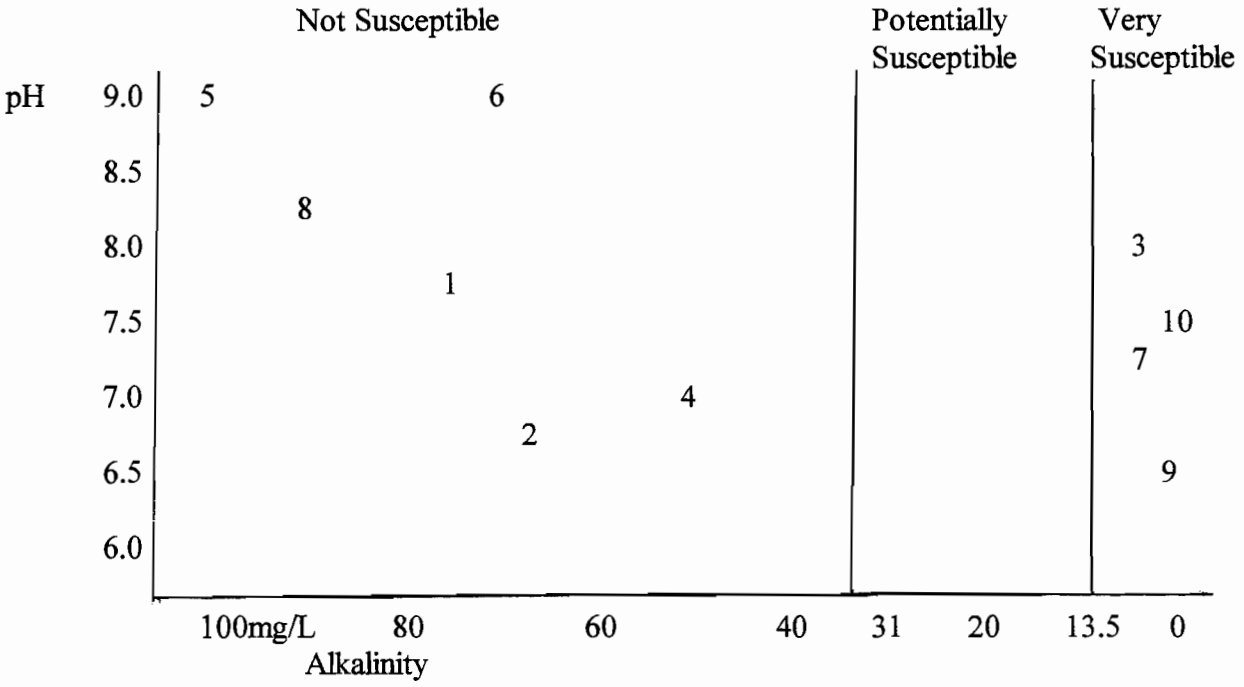
THE STUDY GROUP

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. The most heavily developed and utilized lakes in the county were included in the previous study, so this group represents a second tier based on these criteria. 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. (The information on Seven Mile Lake comes from The Surface Water Resources on Oneida County).

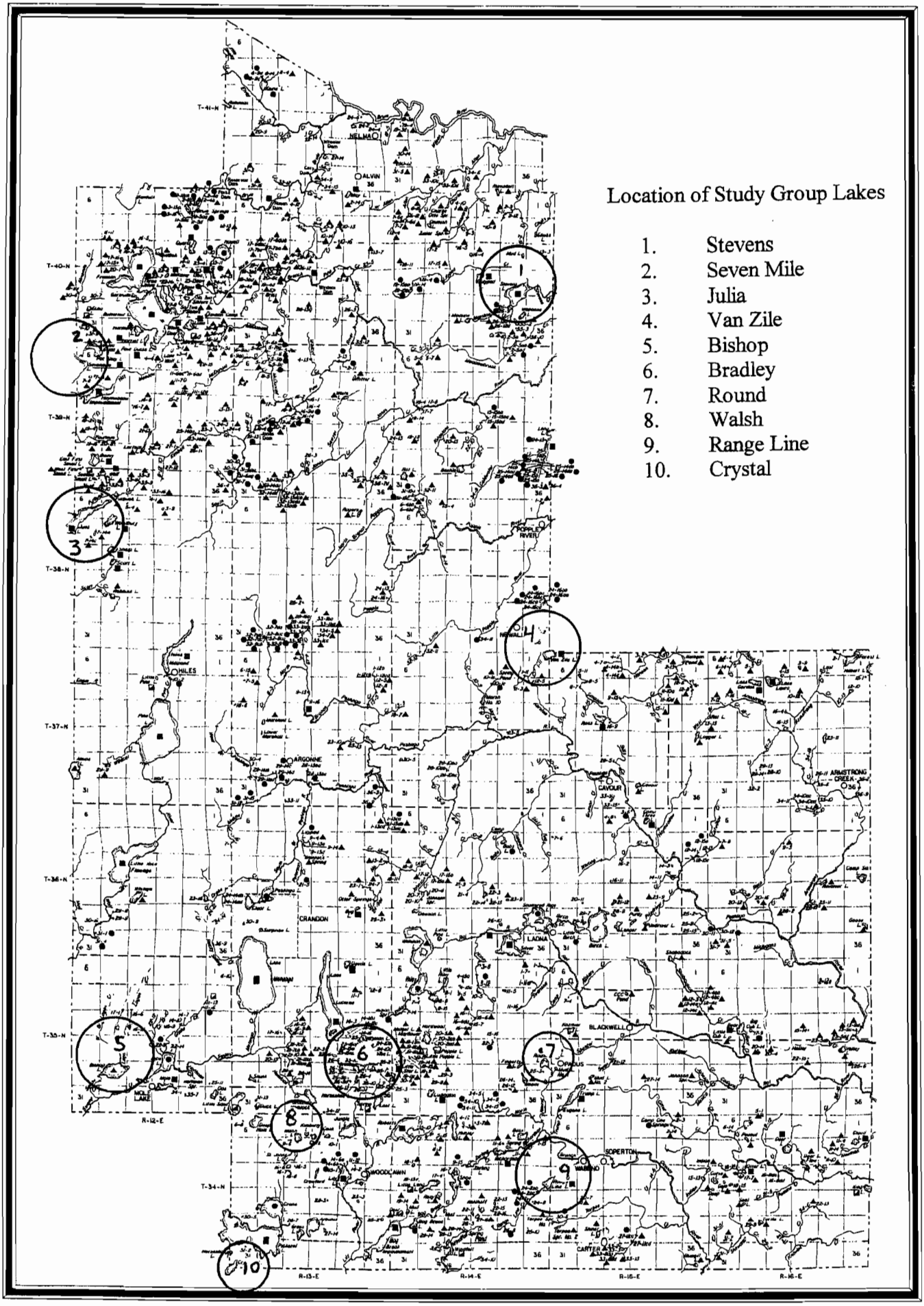
WATER QUALITY

Each lake section in this report contains water quality models for that specific lake. The only data that will be presented for all lakes in one table will be alkalinity levels which indicate susceptibility to acid rain. Four of the ten lakes in the study group fall into the area of high susceptibility to the effects of acid rain. This data is shown below.

Table 2. Acid Rain Susceptibility.



1. Bishop
2. Bradley
3. Crystal
4. Julia
5. Range Line
6. Round
7. Seven Mile
8. Stevens
9. Van Zile
10. Walsh



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APPENDIX I

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 F.	pH	Water Color†	Water-shed Area (sq.mi.)	Adjoin-ing Wetlands (acres)
Bishop	29	35	12	287	12	2.94	.83	1.2	55	D	72	209	7.6	LT.BR.	8.2	135
Bradley	26	35	13	49	26	1.60	.00	1.6	30	S	72	120	7.9	C	0.3	8
Crystal	31	34	13	63	43	1.73	.01	1.7	3	S	4	21	7.8	C	0.5	12
Julia	6	38	12	401	47	6.43	.96	2.3	25	D	39	122	6.8	C	4.5	0
Range Line	13	34	14	82	11	1.28	.35	1.1	30	D	92	165	8.3	C	4.6	35
Round	24	35	14	67	10	1.56	.76	1.4	45	SPR.	70	134	9.2	C	0.4	48
Stevens	23	40	14	295	10	3.01	.38	1.3	5	D	109	180	7.1	C	16.2	30
Van Zile	1	37	14	78	20	1.84	.04	1.5	60	S	2	20	6.0	C	0.5	57
Walsh	4	34	13	45	15	1.04	.00	1.2	15	S	8	29	6.1	C	1.1	8

Lake	S	T-N	R-E	Surface Acres	Max-imum Depth (ft.)	Miles of Shoreline	Miles of Public Shoreline	S.D.F.	Percent Muck Littoral Zone	Water* Source	M.P.A. (ppm)	Con-ductance 77° F.	pH	Water Color **	Watershed Area (sq. mi.)	Adjoining Wetlands (acres)
evenmile	3	39	11	240.2	36	5.6	2.10	2.58	10	D	36	78	6.7	LB	14.0	10

MACROPHYTES

Macrophyte communities of the study group were quite varied from excessive growth on Bishop Lake to very sparse growth on Range Line. The deepest growth noted was on Crystal where water moss was collected in 32 feet of water. Several of the lakes displayed communities characteristic of sandy-bottomed soft-water lakes, with very low-growing plants.

No exotic species were collected, but Eurasian water milfoil and other non-native plants do pose a real threat to several of the study lake, particularly those heavy-used public boat landing. No threatened or endangered aquatics were collected during the surveys

SHORELINE USE

The lakes in the study group provide a vast array of shoreline use and development examples. Several have been heavily developed for many years and show examples of environmentally unwise practices. On the opposite end of the spectrum several of the lakes, including Walsh, have been developed only recently and retain a very wild look.

Each lake in this study group 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 several lakes in the county and any area lake group should be aware of it. The concern is that some 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 our area 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 beginning 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.

Most of the lakes in this study group do not have the amount of high impact activities and potential user conflicts that were seen on a number of the lakes in the initial study group. However, several do receive heavy use. Stevens and Seven Mile have improved boat landings that are heavily utilized by fishermen. They each have large Forest Service Campgrounds also. Van Zile also has a small improved boat launch area with picnic grounds. Bishop, Bradley, Crystal, Julia, and Range Line all have unimproved boat landings. Round Lake has only an unmarked walk-in public access strip and Walsh Lake has no public access. Bradley has a "slow - no wake" ordinance in effect.

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, in southern Forest County, 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: Several lake sections in this report contain 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.

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. Lake 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.

BISHOP LAKE

Bishop Lake is a shallow 287 acre drainage lake in south eastern Forest county. It has one inlet and one outlet. It has a significant amount of undeveloped shoreline and a well-utilized public boat landing. The fishery consists of northern pike, perch, panfish and bullheads. Dense vegetation often surfaces early in the season significantly reducing accessability to much of the lake.

Water Quality

There is not a lot of water quality data available on Bishop Lake, but based on limited sampling, it can be said that it is a hard-water lake with relatively high nutrient levels and fair to good water quality.

The following data if from the SWRoFC and a sample collected and analyzed by NLS.

Table 3. Bishop Lake Water Quality Data

	70's	
Conductivity	209	150
pH	7.6	7.6
Alkalinity	72	78
Chloride		<5.0
Ammonia		.024
NO2+NO3		<.042
TKN, nit.		.78
Phosphorus		.026

The following secchi disk readings were taken in 1995 and 1996 through the state's Self-Help program:

9/15/95 = 8.0 feet
9/27/95 = 8.5

6/8/96 = 5.5
6/21/96 = 5.5
7/16/96 = 5.5
8/2/96 = 5.75
8/28/96 = 6.0

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

Lillie and Mason Water Quality Model			Carlson Trophic State Index
	Phosphorus	Secchi Depth	
Excellent	<0.001	>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

Plant growth on Bishop Lake is extensive. All 38 stations sampled supported some plant growth and most supported at least one species with a density of 4. Access to a large portion of the lake was difficult during the study due to surfacing or nearly-surfacing submerged vegetation. The most dominant species were *Elodea canadensis* (American waterweed) and *Ceratophyllum demursum* (coontail). These species had relative frequencies of 84% and 82% and demonstated very dense growth at most sample stations. *Myriophyllum exalbescens* (Northern water milfoil), *Potomogeton amplifolius* (large-leaf pondweed), *Potomogeton robbinsii* (Robbin's pondweed), and *Potomogeton zosteriformis* (flat-stem pondweed) were also very common and dense in many locations.

Floating-leaf vegetation was quite common and emergent vegetation (bulrushes) were present but not common.

A total of 22 species were collected during this survey.

Table 4: Bishop Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demursum	82	2.4	2.5 - 12.0
Chara vulgaris	8	1.7	2.5 - 7.0
Decodon verticillatus	3	1.0	2.5
Elodea canadensis	84	3.1	2.5 - 12.0
Lemna minor	8	1.0	NA
Lemna trisulca	10	1.0	NA
Megalodonta beckii	3	2.0	4.0
Myriophyllum exalbescens	68	2.4	2.5 - 8.5
Najas flexilis	24	1.8	4.0 - 8.0
Nuphar variegatum	10	1.8	2.5 - 5.0
Nymphea odorata	8	1.7	3.0 - 5.0
Potamogeton amplifolius	60	2.4	2.5 - 8.0
P. gramineus	3	1.0	5.5
P. illinoensis	5	1.5	4.5 - 8.0
P. natans	13	2.4	3.0 - 5.0
P. pectinatus	3	3.0	5.5
P. praelongus	32	1.8	4.0 - 12.0
P. robbinsii	60	2.8	2.5 - 8.0
P. zosteriformis	79	1.9	2.5 - 12.0
P. Sp.	34	1.8	2.5 - 8.0
Vallisneria americana	3	2.0	4.0

Figure 2a.
Bishop Lake Macrophyte Communities

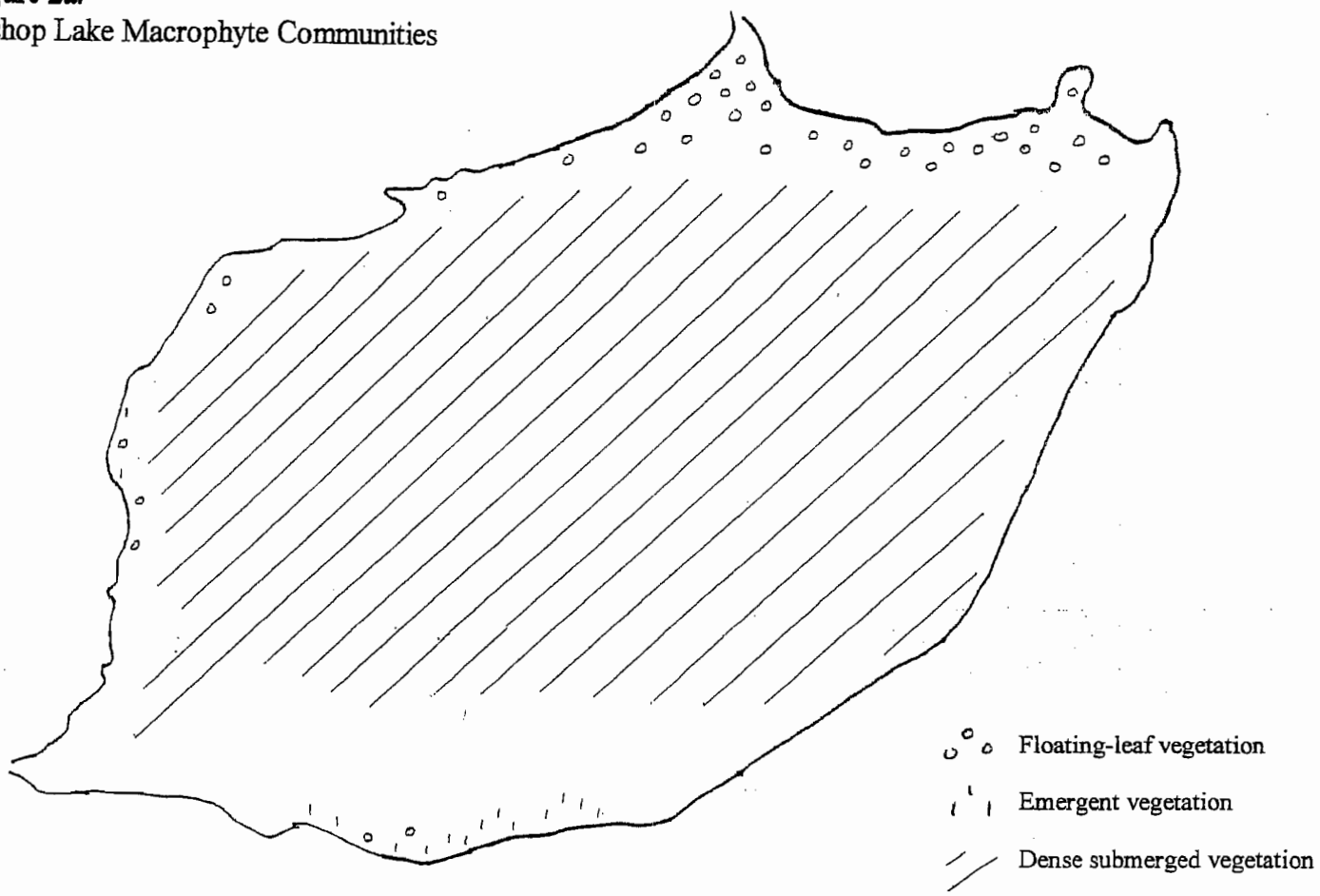
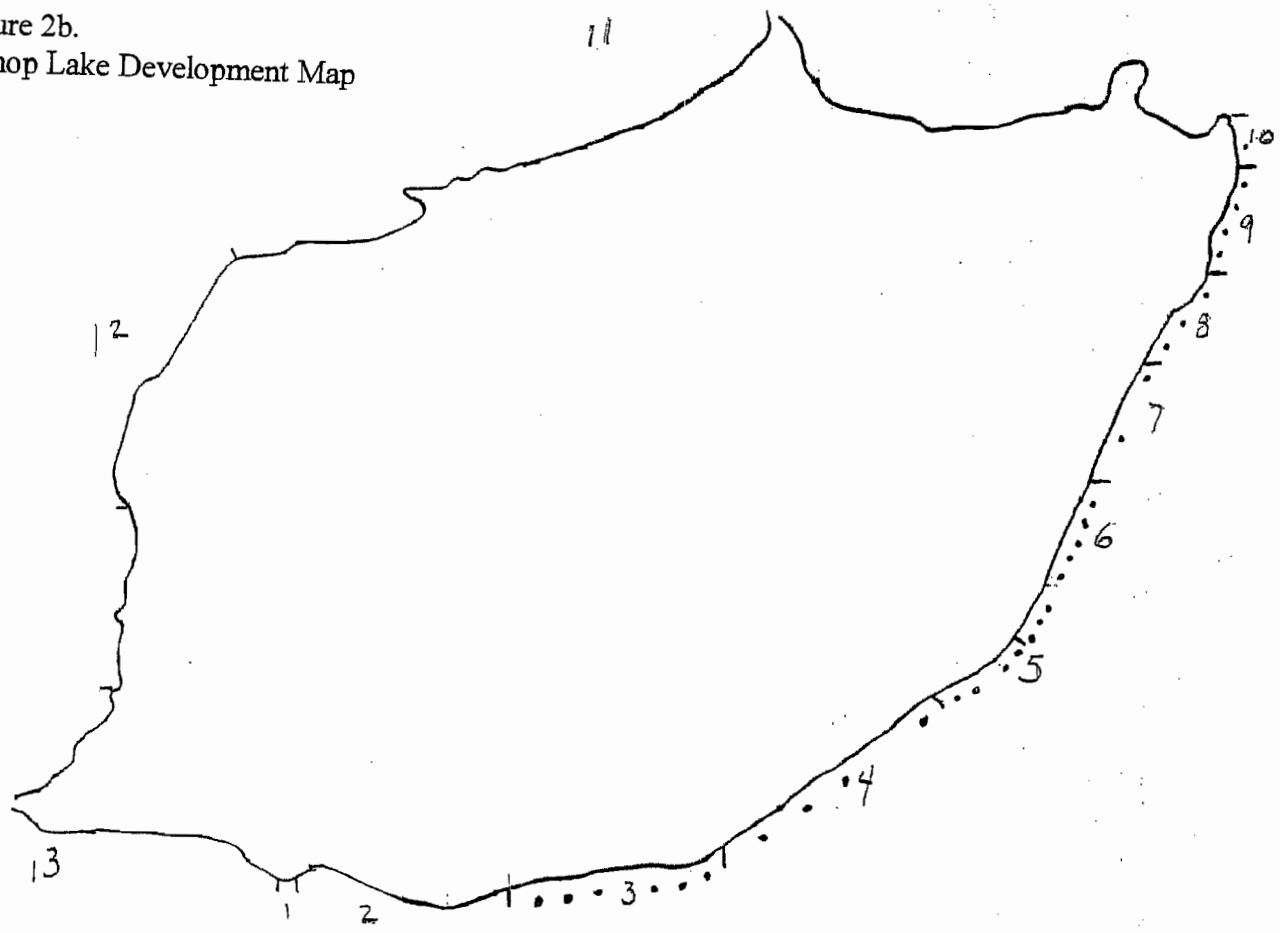


Figure 2b.
Bishop Lake Development Map



Shoreline Survey

According to SWRoFC Bishop Lake has 2.94 miles of shoreline of which .83 is publically owned. There are approximately 32 dwellings on the lake, giving a development factor of 10.9 d/m. However, if we take into account the amount of wetland shoreline that could not support development, this number would be significantly higher. SWRoFC states that only 20% of the shore is not wetland; if this figure is used, the development factor is 55 d/m. The SDF of Bishop Lake is 1.2.

Much of the natural shoreline is in tact on Bishop Lake, but other stretches have development patterns that can jeopardize water quality. Residents with lawn grass to the shoreline should be encouraged to allow buffer strips to grow near shore.

The following survey was performed on May 25, 2003. See development map for locations of shoreline segments.

1. Public boatlanding.

2. Swampy shoreline with tag alders. No development.

3. Six dwellings on moderate slope with short to moderate setbacks. Most natural vegetation has been removed; most with lawn grass to shoreline.

4. Four dwellings - first and fourth with deep setback, middle 2 with short setback. Some overstory, most understory gone, with lawn grass to shore.

5. Several dwellings with much more native vegetation in place. One wooden seawall.

6. Eight medium to large dwellings on moderate slope with medium setbacks. Much overstory, but very little understory - mostly lawn grass to shore. New construction site with probable erosion problems.

7. Steep slope with most native vegetation in place, pines - one lot with removal of much vegetation. Development (if present) is not noticeable from the lake.

8. Several hundred feet of native vegetation - hardwoods and pines - on very steep slope. 5 access points. Development well screened from the shoreline.

9. Four dwellings on very steep slope with short to moderate setbacks but well screened from the lake by native vegetation - birch and pines. Dwellings are very well spaced.

10. One dwelling and one access point with significant removal of natural vegetation on steep slope.

11. Native wetland shoreline of tag alders and cattails. Some short stretches where hardwoods come to near shore. No development.

12. Drier native shoreline - cedar, tag alder and sedges. No development. Single access point with pier.

13. Native wetland shoreland - tag alders and tamarack.

Recreational Information

No recreational use data was collected on Bishop Lake.

Recommendations

1. Monitor the area near the public boat landing for the introduction of Eurasian water milfoil and other exotic species

2. Encourage establishment of buffer strips in developed areas along the south and east shorelines.

3. Consider establishing a lake monitoring program to track water quality trends. Regular secchi disk readings are easy and can provide a very good baseline of data.

BRADLEY LAKE

Bradley lake is a 49-acre seepage lake with a maximum depth of 26 feet. It was chemically treated in 1957 and restocked with largemouth bass, muskellunge and forage species (SwoFC). It has an unimproved public landing on the northwest side.

Water Quality

Minimal water quality data has been collected on Bradley Lake, but based on the dat available, Bradley appears to be a fairly hard water lake with nutrient levels that are not particularly high, but could support nuisance plant growth.

The following data if from the SWRoFC and a sample collected and analyzed by NLS.

Table 5: Bradley Lake Water Quality Data

	70's	
Conductivity	120	170
pH	7.9	6.7
Alkalinity	72	72
Chloride		<5.0
Ammonia		<.024
NO2+NO3		<.042
TKN, nit.		.47
Phosphorus		.022

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

Lillie and Mason Water Quality Model

	Phosphorus		Secchi Depth
Excellent	<0.001		>19.7
Very Good	.001-.010		9.8 - 19.7
Good	.010-.030	•	6.6 - 9.8
Fair	.030-.050		4.9 - 6.6
Poor	.050-.150		3.3 - 4.9
Very Poor	>.150		<3.3

Carlson Trophic State Index

Oligotrophic

Mesotrophic

Eutrophic

Macrophytes

Bradley Lake supports a fairly healthy and diverse population of aquatic plants. 24 stations were sampled and all stations with a water depth less than 10 feet supported plant growth. Although plant growth is extensive it does not jeopardize recreational use since the most common species tend to grow near the lake bottom and seldom surface, except in very shallow areas. The most common submerged species is *Najas flexilis* (slender naiad). Plant growth occurred to 9 feet.

Floating-leaf vegetation was quite common, with *Nuphar variegatum* (yellow pond lily) present at 5 of the 24 sample sites and *Nymphaea odorata* (white pond lily) present at 8 sites. Small, scattered bulrush beds were also observed.

A total of 17 species were collected.

Table 6: Bradley Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	17	1.8	1.5 - 4.0
Chara vulgaris	29	2.6	1.5 - 10.0
Eleocharis sp	4	3.0	2.5
Elodea canadensis	8	1.5	1.5 - 6.0
Najas flexilis	42	2.9	2.5 - 9
Nuphar variegatum	21	1.8	2.5 - 4.0
Nymphea odorata	33	2.0	1.5 - 6.0
Polygonum natans	12	1.3	1.5 - 3.0
Potamogeton amplifolius	4	2.0	6.0
P. gramineus	4	1.0	5.0
P. natans	29	1.9	1.5 - 4.0
P. praelongus	4	2.0	8.5
P. zosteriformis	21	1.2	2.5 - 6.0
P. spp.	42	2.7	1.5 - 6.0
Sagittaria sp.	p		
Scirpus validus	8	1.5	1.5 - 3.0
Typha latifolia	p		

Shoreline Survey

According to SWRoFC, Bradley Lake has 1.60 miles of shoreline. There are 12 dwellings on the lake yielding a development factor of 7.5 d/m. The SDF is 1.6.

Most of the shoreline of Bradley Lake is in a natural state, however there are some short stretches where residents should be encouraged to allow native growth to reestablish.

The following survey was performed June 15, 2003. See development map for locations of shoreline segments.

1. Low, swampy native shoreline with tag alders. Public access (unimproved boatlanding) on western extreme.

2. Four dwellings with moderate to deep setback and most natural vegetation in place - well screened from the lake with narrow access strips. Development is well spaced with significant stretches of undisturbed shoreline between. Vegetation is mostly hemlocks with little native understory.

3. Gradual slope - maples, birches and more natural understory. Two well spaced dwellings with moderate to deep setbacks, most natural vegetation in place and well screened from the lake.

4. One larger dwelling on moderate to steep slope. This dwelling is visible from both sides of the point, but is fairly well screened, with most native vegetation in place. Narrow access point on the extreme tip of the point.

5. Two access points to (apparently) undeveloped lots. Second has a significant amount "weed whacking".

6. Two dwellings with medium to deep setbacks on a moderate slope. Very well masked from the lake by native vegetation consisting mostly of hemlock trees with little native understory. Development is separated by several 100 feet of undisturbed shoreline.

7. Native shoreline of red pines, white pines, maple and birch. No development.

8. One larger dwelling with very "suburban" look on steep slope. Most native vegetation is place at the shoreline, but no screening of the dwelling from the lake.

9. Gradual slope with taller shrubs and native grasses and sedges. Several access strips to (apparently) unimproved properties. Strip of uplands between the lake and wetland behind. Bulrushes and lily pads in front.

10. One dwelling on moderate slope with moderate to short setback. Well screened by overstory but much of the native understory has been removed behind a minimal buffer strip.

11. One dwelling on moderate to steep slope. Deep setback but lawn grass to very near shore Significant overstory in place but no understory.

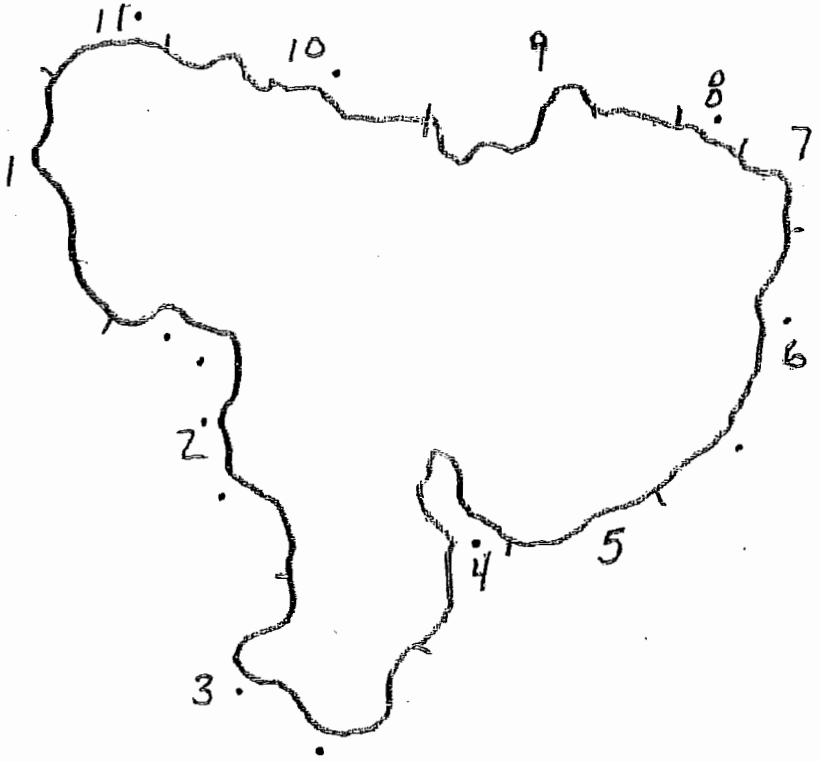
Figure 3a.
Bradley Lake Macrophyte Communities

Floating-leaf vegetation

Emergent vegetation

Dense submerged vegetation

Figure 3b.
Bradley Lake Development Map



Recreational Information

The following narrative was submitted by a Bradley Lake resident:

The heaviest use of the lake was the 4th of July weekend. Almost all of the cottage owners were up for the week. The use of the lake consisted mostly of paddle boats and swimmers. A few fishermen used the boat landing. The rest of the summer was quiet during the week and only a few paddle boats and fishermen on the weekends.

There were some problems on the lake in 1999 and the beginning of 2000 with boaters speeding and tubing. Bradley Lake has a no wake limit. The reason given as to why they were speeding and tubing, they did not know there was a no wake limit on the lake. After petitioning the town and pursuing it many times, the town finally put up a no wake sign in the middle of the summer of 2000. The no wake sign by the boat landing eliminated the problems.

The rest of the summer was pretty quiet and peaceful.

Recommendations

1. Encourage establishment of buffer strips in specific developed areas.

2. Maintain the "slow no-wake" ordinance as high impact activities on Bradley Lake may pose both a safety and environmental threat.

3. Consider establishing a lake monitoring program to track water quality trends. Regular secchi disk readings are easy and can provide a very good baseline of data.

CRYSTAL LAKE

Crystal Lake is a very soft water lake covering 63 acres, with a maximum depth 43 feet. It is located in southern Forest county and extends into Langlade county. It has an unimproved boat landing in the Langlade County portion. The fishery consists of largemouth bass, rainbow trout and bluegills.

Water Quality

Crystal is a very soft-water lake with low nutrient levels and very good water quality, but has been susceptible to fall algae blooms.

The following data if from the SWRoFC and a sample collected and analyzed by NLS.

Table 7: Crystal Lake Water Quality Data

	70's	
Conductivity	21	20
pH	7.8	8.0
Alkalinity	4.0	5.0
Chloride		<5.0
Ammonia		<.024
NO2+NO3		<.042
TKN, nit.		.31
Phosphorus		.009

The following data was collected through the state's Self-Help program

	Secchi depth ft	Chlorophyll ug/l	Phosphorus mg/l
7/27/96	21.25	1.31	
8/10/96	19.25		
8/25/96	22.5	0.91	.007
10/30/96	20.5	2.15	.011
5/26/97	20		
7/20/97	21.5	0.92	.011
8/9/97	19.5	1.47	
8/31/97	23.5		
5/16/98	25.0		
5/24/98	25.5		
7/3/98	23.0		
7/19/98	23.0	1.32	.005
9/6/98	19.5	1.29	
6/13/99	20.5		
7/4/99	18.75		
7/25/99	17.0	1.39	.008
8/1/99	9.0		
8/21/99	5.25 (algae)	9.0	.010
9/11/99	4.5		
10/17/99	9.0	4.31	.010
5/7/00	14.0		
5/29/00	26.5		

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

Lillie and Mason Water Quality Model				Carlson Trophic State Index
	Phosphorus		Secchi Depth	
Excellent	<0.001		>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

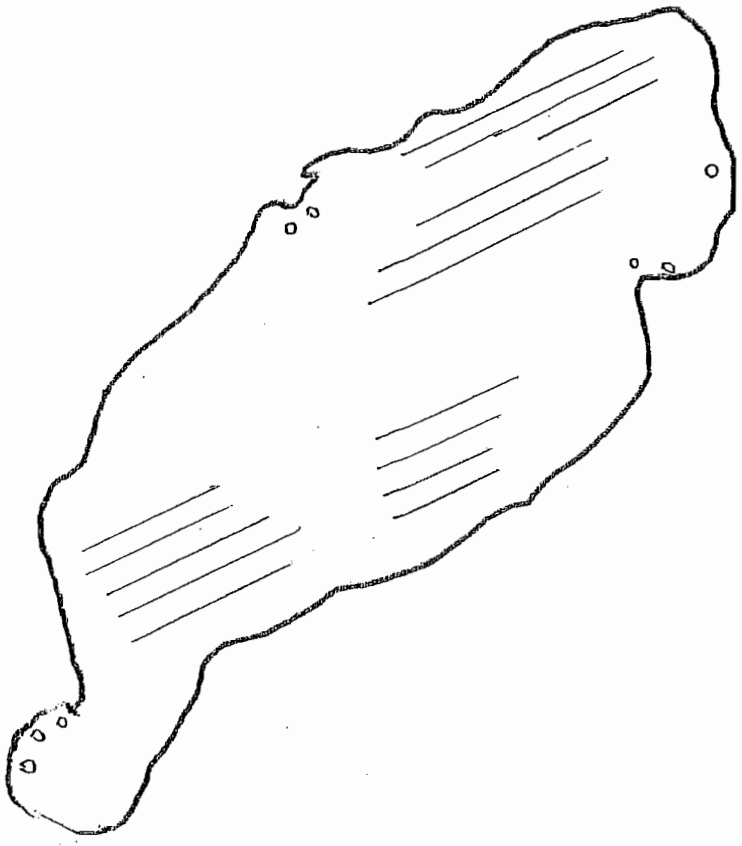
Crystal Lake supports a rather sparse plant population characteristic of a very soft-water lake. Two distinct communities are present. The shallower zone supports very small low-growing plants *Eleocarus acicularis* (water needles), *Juncus pelocarpus* (spike rush), and *Myriophyllum tenellum* (small water milfoil). These species occurred in relatively low frequencies.

Deeper water, from 15 to 32 feet, supported extensive growth of *Musci sp.* (Water moss) and Nitella, a colonial algae that resembles a green plant. Floating-leaf and emergent species were rare. Only 9 different species were collected or observed.

Table 8: Crystal Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Elatine minor	3	1.0	4.0
Eleocharis acicularis	12	1.8	3.0 - 10.0
Isoetes sp.	12	2.5	4.0 - 7.0
Juncus pelocarpus	9	2.7	3.0 - 6.0
Myriophyllum tenellum	6	3.5	3.0 - 4.0
Musci sp.	18	1.7	15.0 - 32.0
Nitella flexilis	21	3.1	15.0 - 28.0
Nuphar variegatum	p		
Sparganium eurycarpum	p		

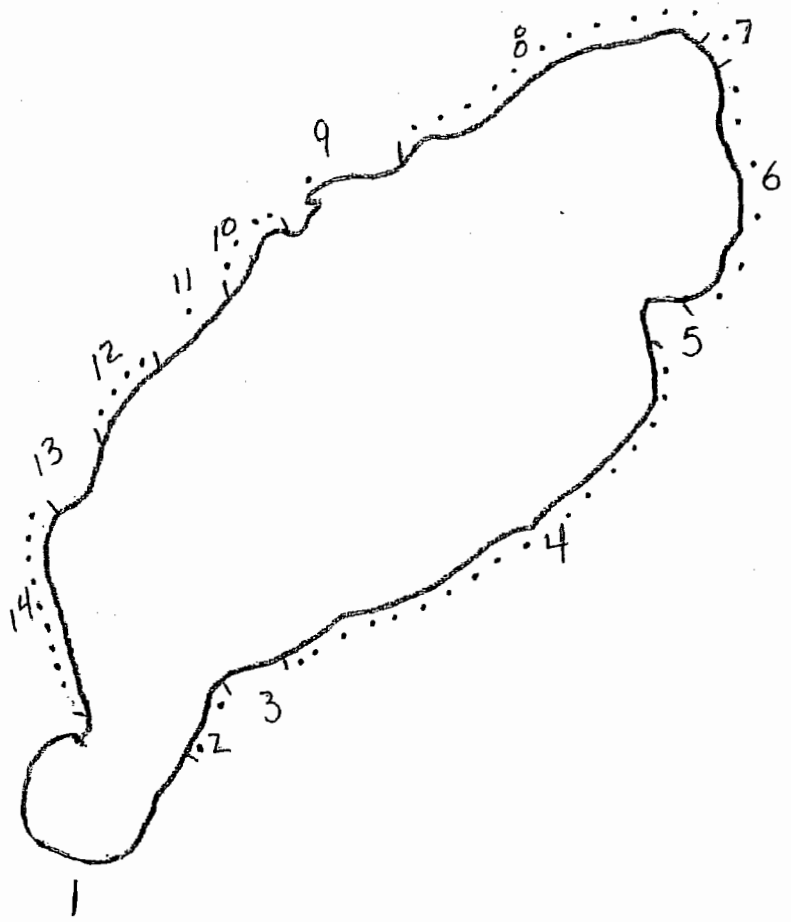
Figure 3a
Crystal Lake Macrophyte Communities



Floating-leaf vegetation

Dense submerged vegetation

Figure 3b
Crystal Lake Development Map



Shoreline Survey

According to SWRoFC, Crystal Lake has 1.73 miles of shoreline, of which .01 miles are publicly owned. There are approximately 56 dwellings on the lake, giving a development factor of 32.4 d/m. The SDF is 1.7.

Much of the shoreline of Crystal Lake has been cleared of the native vegetation. Residents should be encouraged to allow at least a minimal buffer strip near the shore where runoff from lawns could degrade water quality and lead to algae problems.

The following shoreline survey was performed on June 18, 2003. See development map for locations of shoreline segments.

1 Natural lowland shoreline with leatherleaf and conifer. One access point (small pier)

2 Two large dwellings on gradual slope with some overstory and minimal buffer strip in front of lawn grass

3 Wide strip of lawn grass running along shore behind minimal buffer strip - no development.

4 Seventeen dwellings, mostly small to medium in size with short setbacks, some overstory and most of the understory removed. Many with a very "suburban" look. The fourth is very large with a medium setback and rock landscaping. The sixth appears to be an older resort-type building with lawn grass and a short strip of beach. The last two also have a beach shoreline with lawn grass directly behind.

5 Natural vegetation - mostly birch.

6 Seven small dwellings with short to moderate setback, some overstory but most of the native vegetation removed.

7 One dwelling with a deep setback and more overstory than previous properties.

8 Eleven dwellings on a moderate slope with generally short setbacks. First three are very large "suburban" looking properties with grass to rock "ripwrap" shoreline. Fourth and ninth have significantly more natural vegetation in place. Properties have more natural vegetation between than on west side of lake. Slope grades to steep by the end of this segment.

9 Mostly native vegetation with one dwelling on the point. Property has moderate setback and some lawn grass but much of the native vegetation in tact on both sides.

10 Four dwellings. First two are small with moderate setback on a gradual slope, with lawn grass to the shore and natural vegetation on the edges of the properties. Second two are larger with more native vegetation in place.

11 Mostly undisturbed native shoreline of hemlocks and birch with one dwelling well hidden by native vegetation.

12 Four dwellings on gradual slope. First two large with moderate setback, some overstory and lawn grass to shore. Third is similar but smaller and fourth is small with a short setback but most of the native vegetation in place.

13 Undisturbed native shoreline.

14 Nine dwellings on gradual slope. First three have short setbacks but most of the native vegetation is in place and they are well screened from the lake. Next two have most of the understory removed. The sixth has a deeper setback with some overstory, but lawn grass to the shore. The last three are medium to small with short setbacks, very close to water level, and some overstory near shore.

Recreational Information

No recreational use data was collected on Crystal Lake.

Recommendations

1. Encourage establishment of buffer strips and regrowth of some native vegetation in developed areas along the south and east shorelines.

2. Encourage wise development strategies with minimal impact the native environment on new construction sites.

3. Continue active Self Help monitoring.

LAKE JULIA

Lake Julia is a long, narrow, soft water, drainage lake in northwestern Forest County. It covers 401 acres and has a maximum depth 47 feet. It has one inlet and one outlet. The lake supports a very diverse fishery including muskellunge, northern pike, largemouth bass, walleye, perch, panfish, white suckers, bullheads and other forage fish. There is an unimproved public boat landing on the southwest end of the lake.

Water Quality

Extensive water quality data has been collected through the state's Self Help program. It has not all been provided here but can be accessed on the Wisconsin DNR website. Based on that data and other samples, Julia appears to have phosphorus levels that are relatively low, but fluctuate near the level that can support nuisance plant growth. Secchi disk readings averaged 8.0 feet in 2002, 7.95 in 2001, 8.7 in 2000, 11.2 in 1999, and 9.4 in 1998, indicating good to very good water quality.

Table 9: Lake Julia Water Quality Data

The following is selected data from the state's Self Help lake monitoring program

	Secchi disk ft	chlorophyll ug/l	phosphorus mg/l
7/14/02	6.5	4.02	.015
8/11/02	7.75	4.32	.013
10/14/02	11.0	4.25	.016
6/11/01	10.0	4.0	.012
7/16/01	7.5	5.0	.012
8/8/01	6.3	2.5	.011
10/8/01	9.25	2.7	.012
6/6/00	11.0	2.0	.012
7/3/00	10.75	5.0	.013
8/9/00	5.5	8.0	.010
10/17/00	10.25	4.0	.010
6/8/99	10.5	1.52	.012
7/6/99	9.75	3.3	.011
8/10/99	10.25	1.89	.009
10/11/99	15.0	1.86	.009
6/16/98	8.0	4.01	.017
7/20/98	9.0	3.25	.009
8/18/98	9.75	4.03	.011
10/14/98	13.0	3.08	.005
7/15/97	6.0	4.09	.016
8/12/97	8.75	3.86	.008
10/20/97	10.5	3.98	.009

The following data if from the SWRoFC and a sample collected and analyzed by NLS.

	70's	
Conductivity	122	110
pH	6.8	7.0
Alkalinity	39	49
Chloride		<5.0
Ammonia		.046
NO2+NO3		<.042
TKN, nit.		.44
Phosphorus		.016

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

Lillie and Mason Water Quality Model

	Phosphorus	Secchi Depth
Excellent	<0.001	>19.7
Very Good	.001-.010	9.8 - 19.7
Good	.010-.030	6.6 - 9.8
Fair	.030-.050	4.9 - 6.6
Poor	.050-.150	3.3 - 4.9
Very Poor	>.150	<3.3

Carlson Trophic State Index

Oligotrophic

Mesotrophic

Eutrophic

Macrophytes

Lake Julia supports a healthy, diverse macrophyte population over much of its littoral zone. Fifty-six stations within the 20 contour line were sampled and 35 supported submerged plant growth. Several stations supported more than 10 different species and a single station in the north end of the lake supported 15 different species. A total of 29 species were collected or observed during the survey. Plant growth occurred to 12 feet.

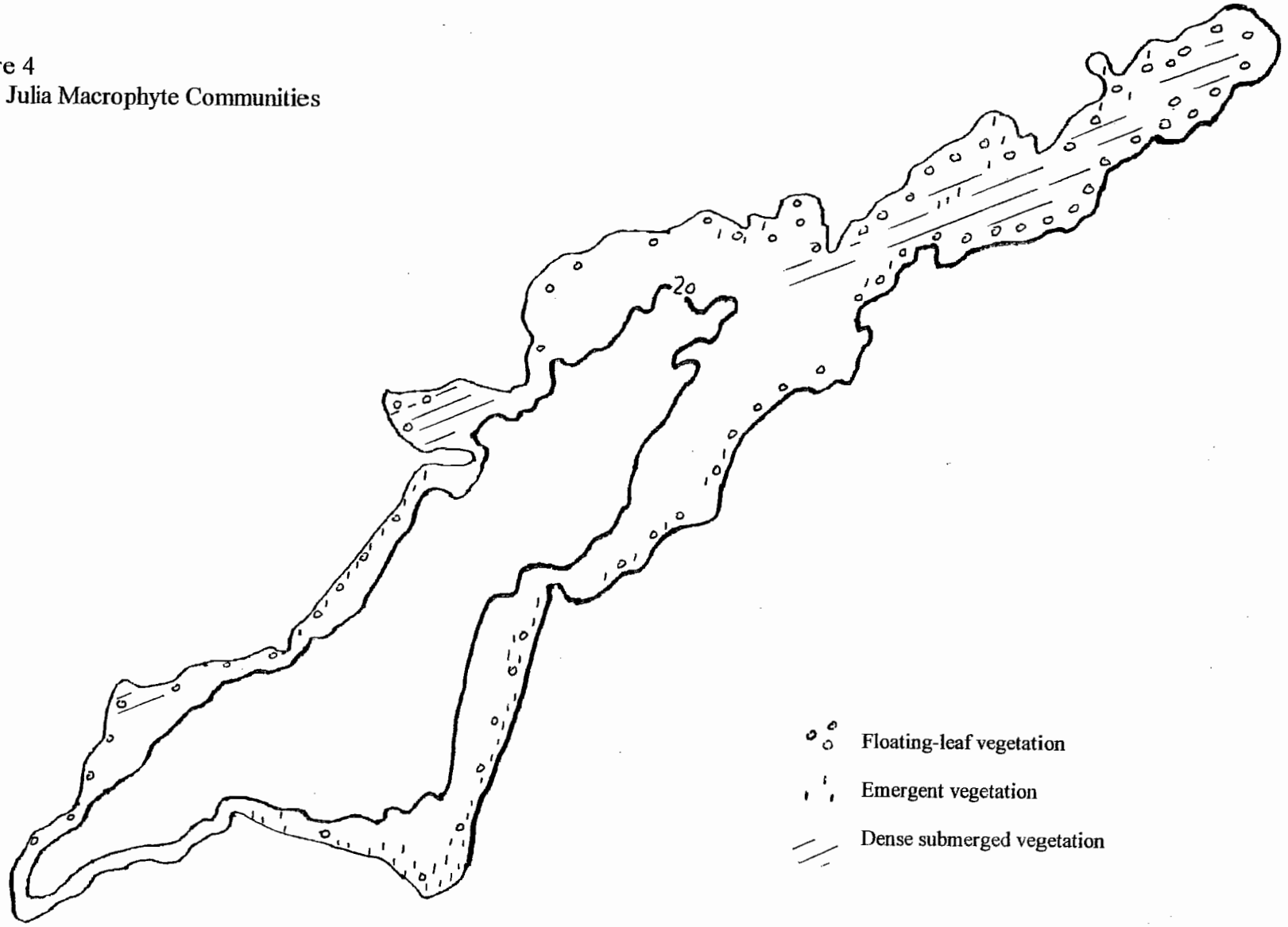
The most prevalent submerged species is *Valisnaria americana*, wild celery or tape grass, which was collected at 23 of 56 stations. *Myriophylum exalbescens*, Northern water milfoil (NOT eurasian), was the second most common submerged species. Emergent vegetation (bulrushes) and floating leaf vegetation (water lilies) are present along much of the shoreline. *Nuphar variegatum*, yellow pond lily, was collected or observed at 35 sampling stations.

In most areas the plant growth does not jeopardize recreational use of the lake since it occurs mostly in a narrow band near shore or in areas of the lake where high impact activities should be discouraged.

Table 10: Lake Julia Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	9	1.6	4.0 - 7.0
Ceratophyllum demursum	16	1.9	4.0 - 12.0
Chara vulgaris	2	1.0	6.0
Eleocharis acicularis	4	3.5	4.0 - 4.5
Eleocharis sp.	11	2.0	3.0 - 8.5
Elodea canadensis	9	2.4	3.5 - 6.0
Heteranthera dubia	2	1.0	3.0
Isoetes sp.	2	2.0	3.0
Megalodonta beckii	11	1.8	3.0 - 8.5
Myriophyllum exalbescens	29	2.4	3.0 - 8.5
M. sp.	2	2.0	4.0
Najas flexilis	12	2.0	3.5 - 6.0
Nuphar variegatum	32	1.2	1.5 - 7.0
Nymphea odorata	p		
Pontaderia cordata	p		
Polygonum natans	2	1.0	6.0
Potamogeton amplifolius	23	1.8	1.5 - 7.0
P. gramineus	21	1.6	3.0 - 8.5
P. natans	9	1.0	4.0 - 7.0
P. praelongus	11	1.5	3.5 - 8.0
P. richardsonii	21	1.9	3.0 - 8.0
P. robbinsii	9	2.0	4.0 - 7.0
P. zosteriformis	21	2.2	3.0 - 5.0
P. sp.	11	1.8	3.0 - 8.0
Ranunculus sp.	2	1.0	4.5
Scirpus validus	16	1.7	1.5 - 6.0
Sparganium eurycarpum	4	1.5	4.0 - 6.0
Typha latifolia	p		
Utricularia vulgaris	7	1.2	4.5 - 6.0
Vallisneria americana	41	2.2	3.0 - 8.5

Figure 4
Lake Julia Macrophyte Communities



Shoreline Survey

According to SWRoFC, Lake Julia has 6.43 miles of shoreline, of which .96 miles are publicly owned. There are approximately 38 dwellings on the lake, giving a development factor of 5.9 d/m. The SDF is 2.3.

Much of Lake Julia's shoreline is in a natural state, however development patterns in some locations could be detrimental to the water quality of the lake. Residents in areas where most of the native vegetation has been removed, should be encouraged to allow at least a buffer strip of vegetation to become established at the shoreline.

The following shoreline survey was performed on May 24, 2003. See development map for locations of shoreline segments.

1. Boat launch area. Most native vegetation in place. One larger dwelling with medium setback and most native vegetation in place. Gradual to moderate slope.

2. One dwelling with most native vegetation in place, followed by one dwelling on a moderate slope with a wide stretch of vegetation removed and grass to the shoreline. Some overstory in place.

3. Native vegetation - tag alders at shore and large white pines behind - on moderate slope grading into steeper slope.

4 Development with very deep setbacks (6 places according to the map) and most native vegetation in place. Slope grades down to gradual at the end of this segment.

5 Nine medium to small cottages on gradual slope. Most native vegetation in place especially between the properties. One with much of the overstory gone and one with much of the native vegetation gone and a wooden seawall at shore.

6. One dwelling with moderate setback and much native vegetation in place followed by a long stretch of undeveloped shoreline and 3 additional dwellings on a moderate to gradual slope well, spread out and with most native vegetation in place.

7 Mostly undisturbed native vegetation with one dwelling that has some lawn grass on a moderate slope. Shoreline occasionally drops to a gradual slope with tag alder shoreline.

8 Two dwellings spread far apart with most native vegetation between. Second has boathouse and a significant amount of the natural vegetation removed.

9. Lowland shoreline with tamaracks. One dwelling at extreme end of lake with much vegetation removed and a very old boathouse.

10. Two dwellings well spaced with medium setbacks on moderate slope. First has most vegetation in place. Second has much of understory removed by some screening from the lake by overstory. Long stretches of undisturbed shoreline between development.

11 Two dwellings on gradual slope with moderate setbacks. First has much of the native vegetation removed. Second has most vegetation in place.

12 Two large dwellings high on steep slope surrounded by large white pines.

13 Native wetland shoreline - no development.

14. Development with very short setback on gradual slope. Significant overstory, but most of the understory has been removed. Development is obvious from both sides of point.

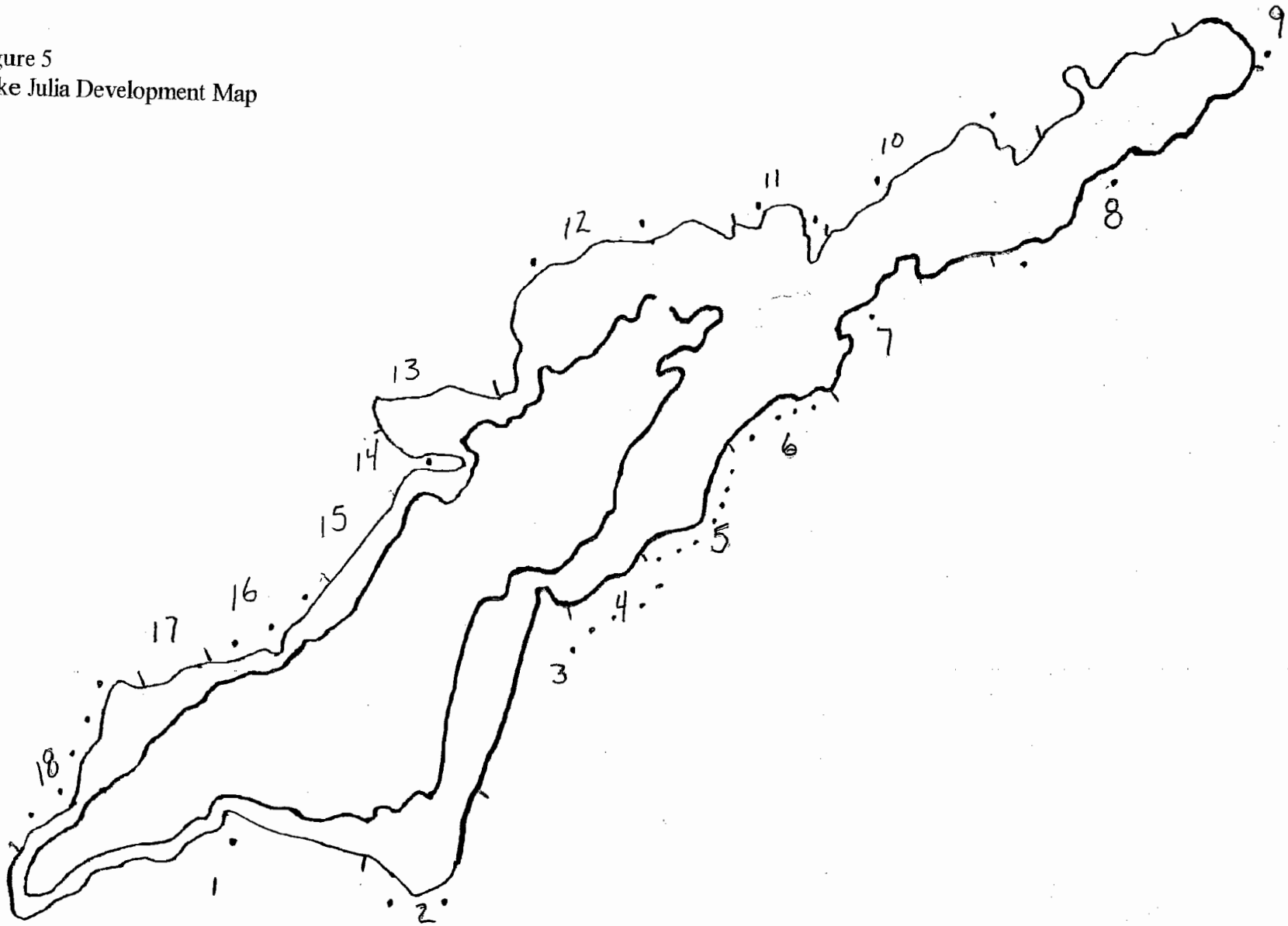
15. Native shoreline - no development

16. Three dwellings on moderate slope. First has most native vegetation removed. Second is very large with a very large boathouse but has retained most native vegetation. Third is large with a boathouse but maintains a reasonable buffer strip between lawn grass and the shoreline.

17 Undisturbed shoreline - no development

18 Five medium to large dwellings on moderate slope. First is medium-sized with a very short setback and a minimal buffer strip. Second is large with a short setback, minimal buffer strip and much of the overstory removed. Third is large with a deeper setback and more of the native vegetation in place. Fourth is medium-sized with moderate setback and most of the natural vegetation removed and a seawall at shore. Fifth is large on a more gradual slope with a minimal setback and most of the natural vegetation removed. It has lawn grass to a rock "ripwrap" shoreline.

Figure 5
Lake Julia Development Map



Recreational Use

Table 11: Lake Julia Recreational Use Data

	A	B	C	D	E
Fishing	2	3	2	1	2
Speed boating	0	1	3	1	5
Water skiing	3	4	1	1	1
Sailing	0	0	1	0	0
Canoeing/rowing	1	2	2	0	0
Jetskiing	0	0	0	0	0
Swimming/snorkling	0	7	2	0	0
Lounging	0	20	0	0	0
Pontoon boating	0	1	0	0	0

A - 7/3/00 2:15 pm 70 sunny
B - 7/4/00 2:00 pm "perfect weather"
C - 7/15/00 4:30 pm "good weather"
D - 7/15/00 7:00 pm
E - 8/23/00 3:30 pm

Recommendations

1. Encourage establishment of buffer strips and regrowth of native vegetation in developed areas.

2. Discourage high impact activities in ecologically sensitive areas i.e. the northern extreme of the lake and the bay on the northwest shore.

3. Encourage wise development strategies in areas yet to be developed.

4. Continue active Self Help monitoring.

RANGE LINE

Range Line Lake is a hard-water drainage lake covering 82 acres, with a maximum depth of 11 feet. Self Help water quality data indicate that water clarity is sometimes quite good, but more often it has very low transparency. The lake supports carp and a variety of other fish.

Water Quality

Range Line Lake is characterized by very hard, nutrient-rich water. The lake would probably support nuisance plant growth if not for the extremely low light penetration.

Table 12: Range Line Lake Water Quality Data

The following data if from the SWRoFC and a sample collected and analyzed by NLS.

	70's	2000
Conductivity	165	220
pH	8.3	8.9
Alkalinity	92	120
Chloride		5.2
Ammonia		<.024
NO2+NO3		<.042
TKN		1.7
Phosphorus		.087

The following secchi disk readings were collected through the state's Self-Help program:

6/13/95	1.25 feet
6/24/95	11.5 (bottom)
6/4/97	11.0 (bottom)
6/10/97	11.0 (bottom)
7/18/97	4.25
7/24/97	3.0
8/26/97	7.25
8/30/00	1.25
5/12/01	10.0 (bottom)

Macrophytes

Plant growth on Range Line Lake is very limited due to the very low water clarity. Only 12 of 30 stations supported any growth and most of these supported very sparse growth. No plants were collected below 4 ½ feet. Seven species were collected at one station in the outlet, but no single station within the lake itself supported more than two species. Nine species were collected during this survey.

Small, scattered bulrush beds were present along the east shore and floating-leaf vegetation occurred in the outlet.

Table 13: Range Line Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demursum	17	1.8	2.5 - 4.0
Elodea canadensis	17	1.6	2.0 - 4.0
Lemna minor	10	1.3	NA
Nuphar variegatum	3	1.0	2.0
Nymphea odorata	3	2.0	2.0
Potamogeton pectinatus	3	3.0	2.0
P. zosteriformis	3	2.0	2.0
Scirpus validus	p		
Typha latifolia	p		

Shoreline Survey

According to SWRoFC, Range Line Lake has 1.28 miles of shoreline, of which .35 are publically owned. There are six dwellings on the lake, giving a development factor of 4.7 d/m. The SDF is 1.1.

Much of the native shoreline of Range Line Lake is intact, however some development patterns exist that can be detrimental to both water quality and aesthetics. Current residents and future developers should be encouraged to leave native vegetation where it currently exists or allow it to reestablish where it has been removed.

The following shoreline survey was performed on June 15, 2003. See development map for locations of shoreline segments.

1. Native lowland shoreline dominated by tag alder and tamarack.

2. Undeveloped upland shoreline with moderate slope. Hardwoods, cedar, balsam with a rocky shoreline and one narrow access point.

3. One dwelling on a gradual slope with a very short setback and possible backlotted dwelling(s). Most of the native vegetation has been removed.

4. Undisturbed native shoreline of mixed hardwoods, cedar, and a thick understory on a very gradual slope with a rocky shoreline.

5. Undisturbed wetland shoreline of tamarack and tag alders. No development.

6. Moderate slope with mixed hardwoods and white pines. Unimproved boatlanding with removal of native vegetation for short stretch.

7. Three dwellings on a moderate slope with fairly deep setbacks. First has most of the native vegetation removed and lawn grass to a minimal bufferstrip. Second has more native vegetation in place and large grass-covered rock "pier extending into the lake. Third has better screening but most of the understory removed and lawn grass to a minimal bufferstrip. While there is no obvious evidence, there is good potential for erosion problems from a "straight-shot" driveway on this property.

8. Native shoreline of hardwoods and balsams on moderate slope becoming steeper to the north. Three narrow access points. The first two have no apparent development. The third is on a very steep slope and is very well screened from the lake by natural vegetation.

9. New construction site on gradual slope with all natural vegetation in place and a moderate setback.

Recreational Information

No recreational use data was collected on Range Line Lake.

Recommendations

1. Encourage establishment of buffer strips in developed areas.

2. Encourage wise development strategies in areas yet to be developed.

Figure 6b
Range Line Lake Development Map

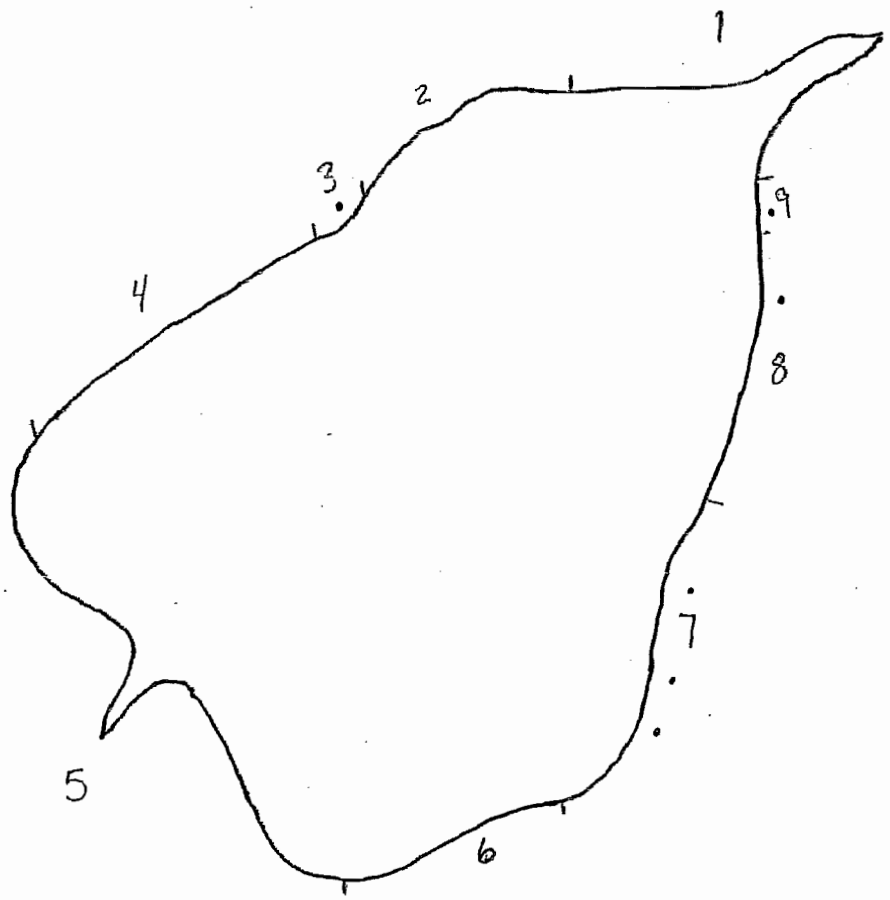
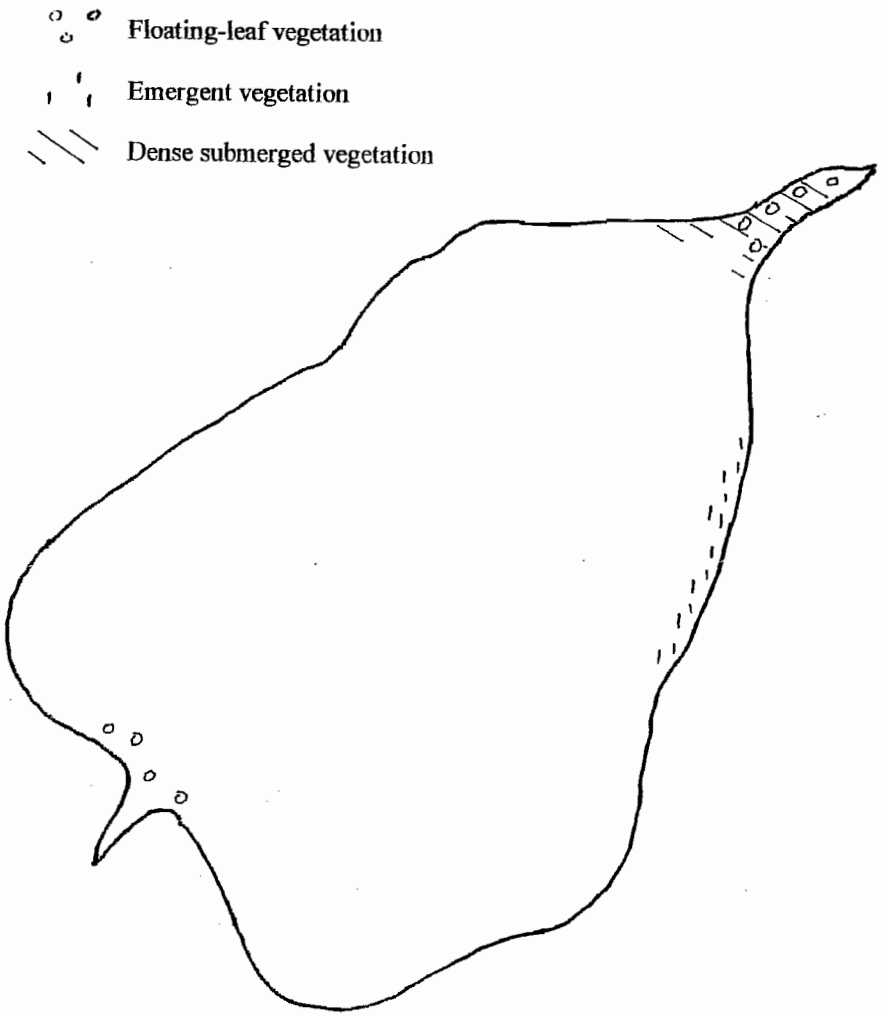


Figure 6a
Range Line Lake Macrophyte Communities



ROUND LAKE

Round Lake is a 67-acre spring lake with a maximum depth of 10 feet. It has one outlet. The fishery includes northern pike, largemouth bass and panfish. There is walk-in public access.

Water Quality

The following data if from the SWRoFC indicating that Round Lake has fairly hard water. No other water quality was found for Round Lake.

Conductivity = 134 pH = 9.2 Alkalinity = 70

Macrophytes

Plant growth on Round Lake was fairly sparse; though most sample stations did support some plant growth, only two species contributed the vast majority of total biomass. One or the other of these two species, *Najas flexilis*, slender naiad, and *Najas guadalupensis*, southern naiad, were collected at 13 of 17 sample stations. Densities of these two species were also significantly higher than other species present. Fortunately, these species tend to grow lower to the lake bottom and do not usually pose a threat to lake use. Plant growth occurs to at least 8 ½ feet - the deepest station sampled.

A total of 10 species were collected or observed during this survey. Floating-leaf and emergent vegetation (bulrushes) were found in small, scattered beds along the shoreline.

Table 14: Round Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Ceratophyllum demursum	6	1.0	1.0
Chara vulgaris	24	1.8	1.0 - 4.0
Najas flexilis	47	2.1	1.0 - 4.0
N. guadalupensis	35	3.3	3.0 - 8.5
Nuphar variegatum	6	1.0	3.0
Nymphea odorata	6	1.0	3.0
Potamogeton natans	12	1.5	3.0 - 4.0
P. sp	6	1.0	3.0
Typha latifolia	p		
Utricularia vulgaris	p		

Shoreline Survey

According to SWRoFC, Round Lake has 1.56 miles of shoreline, of which .76 miles are publicly owned. There are approximately 10 dwellings on the lake, giving a development factor of 6.4 d/m. The SDF is 1.4.

Much of the native shoreline vegetation is in place on Round Lake, and future development should be monitored to ensure this continues. Poor development of a relatively small lake like this can have a severe impact on water quality.

The following shoreline survey was performed on June 14, 2003. See development map for locations of shoreline segments.

1. Mostly undeveloped native shoreline. One larger dwelling on moderate slope with deep setback. Well screened from the lake, with most natural vegetation in place.

2. One undeveloped lot with a significant amount of vegetation removed.

3. One large dwelling on steep slope with most natural vegetation in place.

4. Native shoreline with two access points. No development.

5. Swampy native shoreline. No development.

6. Native upland shoreline with hardwoods and balsam. No development

7. Native wetland shoreline with tamaracks and tag alders. No development.

8. Two dwellings with deep setbacks on top of steep slope. Most native vegetation removed but buffer strip is present at shoreline.

9. Stretch of undeveloped native shoreline, followed by 1 dwelling with moderate setback and most natural vegetation in place, followed by more native shoreline with 2 access points, finally 1 additional dwelling with deep setback and most native vegetation in place.

10. One dwelling with moderate to short setback. Overstory screens it from lake but most of the understory has been removed - possible erosion problems.

11. Four dwellings with moderate to deep setbacks on steep slope with most natural vegetation in place - birch, maples and native sedges. Nicely screened from the lake.

12. Gradual slope. Two wider access points with significant vegetation removed - beach-type areas, but gradual slope means minimal erosion problems.

Figure 7a
Round Lake Macrophyte Communities

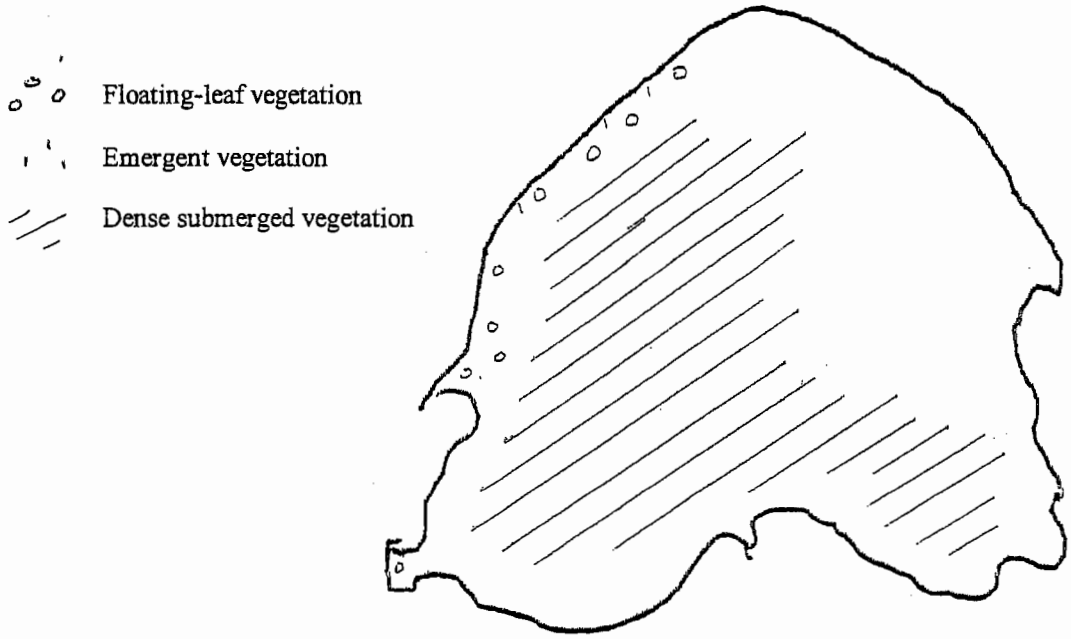
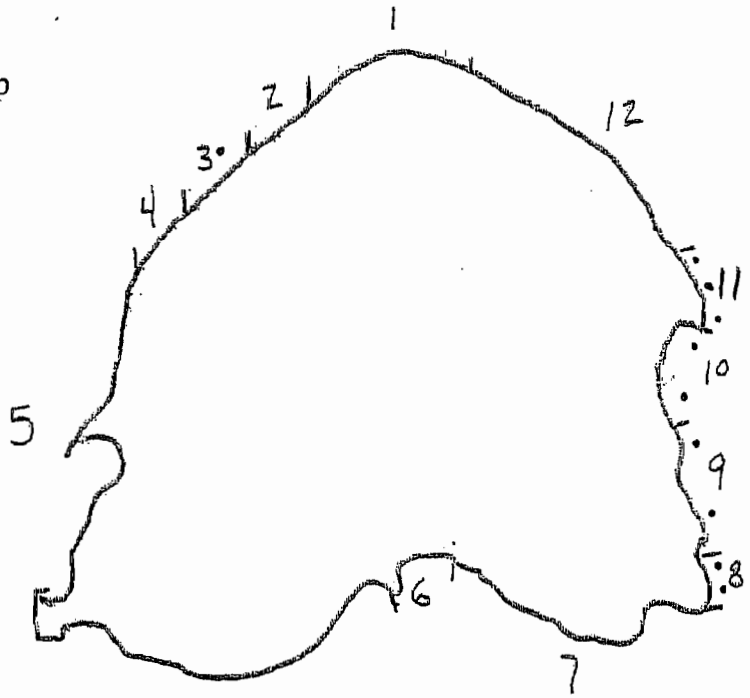


Figure 7b
Round Lake Development Map



Recreational Information

Table 15: Round Lake Recreational Use Data

	A	B	C	D*	E	F	G
Fishing	2	3	1		0	2	1
Canoeing/rowing	1	1	2		0	0	0
Swimming/snorkling	2	6	1		0	5	2
Lounging	7	11	4		2	7	4

A 7/2/00 10:00 am
B 7/2/00 2:00 pm
C 7/2/00 7:00 pm
D* Surveys performed at 10:00 am, 2:00 pm, and 7:00 pm - No activity reported
E 7/22/00 10:00 am
F 7/22/00 2:00 pm
G 7/22/00 7:00 pm

Recommendations

1. Wise development strategies with minimal impact to the native environment should be continue and be encouraged.

2. High impact recreational activities should be discouraged, due to potential safety issues and potential impact on the shoreline.

3. Consider establishing a lake monitoring program to track water quality trends. Regular secchi disk readings are easy and can provide a very good baseline of data.

SEVEN MILE LAKE

Seven Mile Lake is a soft-water drainage lake covering 240 acres, with a maximum depth of 36 feet. It is located in northwestern Forest County, with significant portion in Oneida County. It supports a very diverse fishery, including cisco (reported). A Forest Service campground with an improved boat landing is located on northeast shore.

Water Quality

Extensive water quality data has been collected on Seven Mile Lake through the state's Self Help

program. Following is secchi disk, chlorophyll and phosphorus data from 1996 to the present:

Table 16: Seven Mile Lake Water Quality Data

	secchi disk ft	chlorophyll ug/l	phosphorus mg/l
6/4/96	8.0	10.6	.014
7/8/96	9.0	4.15	.010
7/19/96	10.25	4.67	.010
8/26/96	10.5	5.06	.012
9/24/96	8.0	6.21	.017
5/20/97	6.5		
6/22/97	9.5	3.0	.017
7/21/97	8.25	3.31	.042
8/18/97	11.25	3.48	.021
10/1/97	9.5	4.51	.021
5/19/98	11.0		.014
6/16/98	10.75	3.54	.014
7/17/98	10.5	2.56	.010
8/17/98	9.25	2.77	.020
9/15/98	9.25	4.0	.016
5/1/99	6.0		
5/26/99	9.5		.016
7/6/99	8.25	6.42	.019
8/3/99	7.5	2.58	.019
9/7/99	11.0	2.35	.015
9/28/99	5.5	3.8	.015
6/13/00	9.25	2.4	.017
7/24/00	9.5	2.9	.018
8/28/00	9.75	6.0	.014
10/3/00	7.5	6.0	.018
5/5/01	5.25		
5/16/01	8.5		.015
6/19/01	10.25	3.0	.021
7/11/01	6.0		
7/25/01	9.0	3.6	.017
8/14/01	8.0	3.3	.018
10/9/01	9.25	1.8	.026
5/29/02	7.0		.024
7/23/02	11.0	2.18	.013
8/17/02	8.5		
10/14/02	5.0	5.16	.021

The following data is from the Surface Water Resources of Oneida County 1966

	60's
Conductivity	17
pH	7.2
Alkalinity	4

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

Lillie and Mason Water Quality Model

Carlson Trophic State Index

	Phosphorus		Secchi Depth	
Excellent	<0.001		>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 plant population on Seven Mile Lake is healthy and diverse. Most of the 44 stations sampled supported more than three species. Growth was not noted beyond 12 feet. The most common species were *Myriophylum exalbescens* (northern water milfoil) and *Potomogeton gramineus* (variable-leaf pondweed). Both of these species were collected at 20 of the 45 sample sites.

Floating-leaf and emergent vegetation was noted in smaller scattered beds but was not common.

A total of 19 species were collected.

Figure 8
Seven Mile Lake Macrophyte Communities

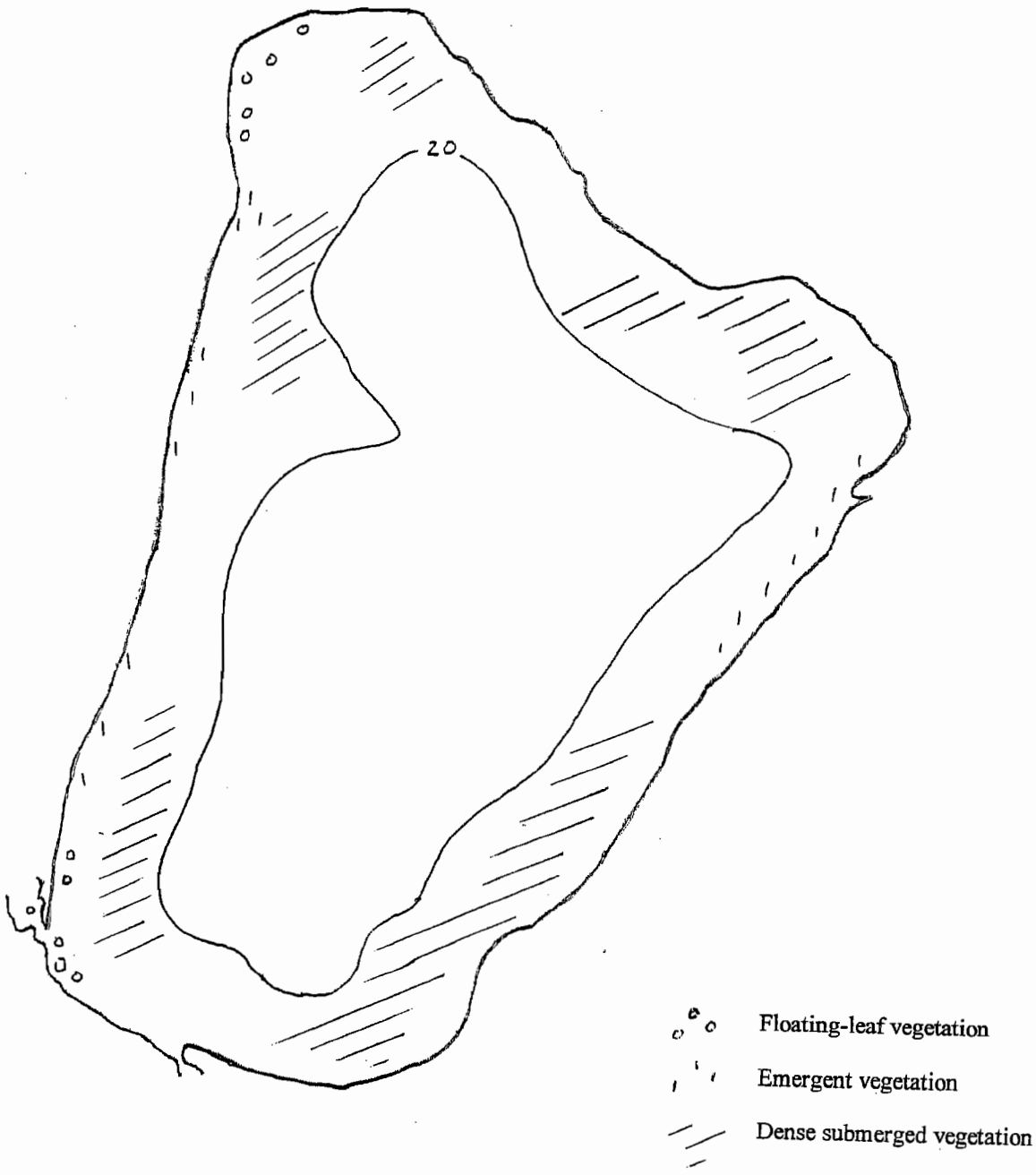


Table 17: Seven Mile Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Chara vulgaris	20	1.7	2.5 - 8.0
Eleocharis sp.	p		
Elodea canadensis	16	1.6	2.5 - 8.0
Isoetes sp.	4	1.5	3.0
Juncus pelocarpus	4	1.0	3.0
Myriophyllum exalbescens	44	2.0	1.5 - 12.0
M sp.	11	2.2	1.5 - 4.0
Najas flexilis	18	2.5	1.5 - 4.0
Nitella flexilis	9	1.5	4.5 - 12.0
Nuphar variegatum	9	1.2	2.5 - 6.0
Nymphea odorata	p		
Potamogeton amplifolius	31	1.6	2.5 - 8.0
P. gramineus	44	1.6	1.5 - 8.0
P. praelongus	18	2.1	4.0 - 8.0
P. richardsonii	40	1.5	2.0 - 8.0
P. robbinsii	2	2.0	3.0
P. zosteriformis	27	1.2	2.5 - 8.0
Ranunculus sp.	11	1.8	1.5 - 3.0

Shoreline Survey

According to Surface Water Resources of Oneida County, Seven Mile Lake has 5.6 miles of shoreline, of which 2.1 miles are publicly owned. There are approximately 83 dwellings on the lake yielding a development factor of 14.8. The SDF is 2.58.

Seven Mile Lake has several areas where unwise shoreline development may be adversely impacting water quality. Residents on properties where much of the native vegetation has been removed should be encouraged to establish buffer strips of native vegetation near the shoreline.

The following shoreline survey was performed on May 24, 2003. See development map for locations of shoreline segments.

1. Improved public boat landing. Native vegetation on very steep slope - large pines and birches with little natural understory. Forest Service campground.

2. Small beach area on more gradual slope, then natural tag alder shoreline gradually changing back to pines with natural a rocky shoreline. One long stretch of rock ripwrap at undeveloped lot.

3. Five dwellings with deep setbacks on gradual slope. First has most of the overstory removed but the understory intact. Next 4 have most of the native vegetation in place with narrow access strips.

4. Five medium to small dwellings with minimal setbacks on a very gradual slope. Much of overstory has been removed and there is not much native understory. Last place is new construction with a very minimal setback and most of the vegetation removed.

5. Hay meadow Creek

6. Three dwellings on moderate slope separated by stretches of native vegetation. First has minimal setback with some construction and a sediment barrier in place, next 2 moderate setbacks with most of the native vegetation in place.

7. Outlet to back-water area.

8. Native shoreline on gradual slope - sedges and small trees

9. Seven dwellings with short to moderate setbacks on moderate slope. First with good overstory but most of understory removed, second, third and seventh with most natural vegetation in place, and fourth, fifth, and sixth with most natural vegetation removed and lawn grass to a landscaped rock shoreline. Unimproved boat access at the end of this segment.

10. Seven dwellings on moderate slope. First three are very large with most vegetation removed and lawn grass to minimal buffer strips at the shoreline. Fourth and fifth have more natural vegetation in place with significant overstories. The sixth has most of the native vegetation in place. The last dwelling in this segment is very close to the lake with lawn grass to the shoreline.

11. Fourteen dwellings (one mobile home) on steep slope with moderate setbacks. Most have significant native vegetation in place providing good screening from the lake. The third, 13th and 14th dwellings in this stretch are landscaped and have less native vegetation intact than the others.

12. Native shoreline - no development.

13. Three dwellings high on very steep slope. Most of the native vegetation is in place; removal for narrow access strips

14. Shoreline drops back to very gradual slope. Approximately 10 dwellings with varying setbacks. The first, sixth and seventh have moderate setbacks but lawn grass to the shoreline. The second and third have deep setbacks and most of the natural vegetation in place. The rest have quite short setbacks, but most of the natural vegetation in place.

15. Tag alder lowland shoreline with one dwelling very deeply setback.

16. Approximately 7 dwellings on a moderate to steep slope. The first two have much of the understory gone, but significant screening from the lake by the overstory. The next two have a significant amount of rock and wood landscaping and very little natural vegetation in place to provide any screening or bufferstrip. Fifth has most native vegetation in place. Sixth has less natural vegetation and a wooden seawall.

17 One dwelling on gradual slope behind tag alder shoreline that extends to the inlet.

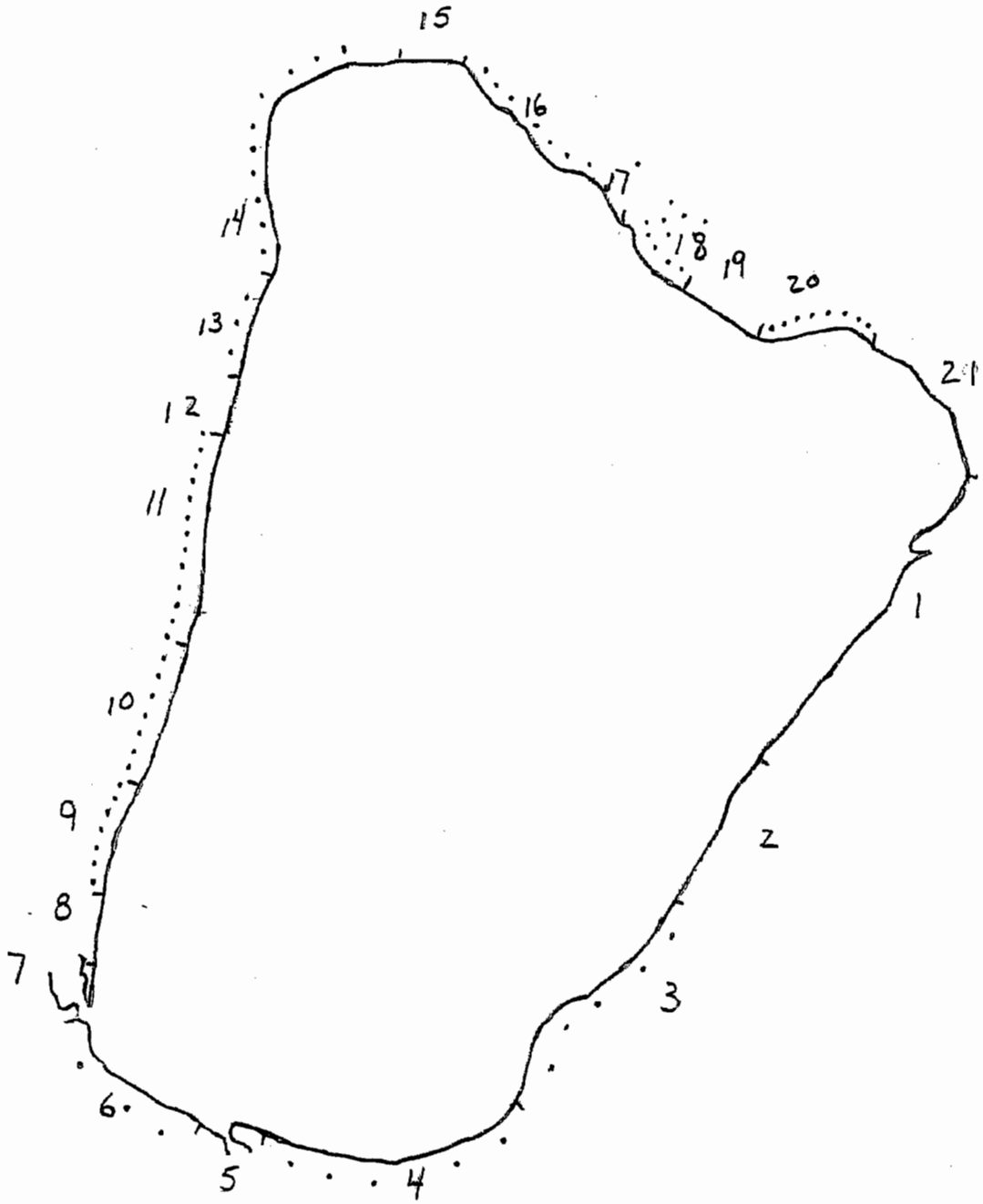
18 Natural vegetation to rocky shoreline for approximately 100 feet then opening into a large resort area. Most natural vegetation removed; beach with lawn grass and some small pines. Approximately 12 dwellings and several other outbuildings. Paved boat landing.

19 Natural vegetation on moderate slope.

20 Eight older small to medium dwellings with minimal setbacks and mostly lawn grass to the shoreline. One place near the end of this stretch is larger with a deeper setback and more native vegetation in place. One boathouse.

21. Native vegetation - cedar lowland sandy/grassy shoreline on very gradual slope. No development.

Figure 9
Seven Mile Lake Development Map



Recreational Information

Table 18: Seven Mile Lake Recreational Use Data

	A	B	C	D	E	F
Fishing	3	3	3	1	4	5
Speed boating	0	4	2	2	2	3
Water skiing	0	2	0	1	1	1
Canoeing/rowing	0	0	0	2	1	0
Jetskiing	0	1	0	1	1	0
Swimming/snorkling	0	6	0	0	0	0
Lounging	0	num.	4	0	4	15

A - 7/1/00 7:05 pm
B - 7/1/00 1:10 pm
C - 7/19/00 7:00 pm
D - 7/19/00 10:15 am
E - 7/24/00 10:00 am
F - 7/24/00 7:00 pm

Recommendations

1. Monitor the area near the public boat landing for the introduction of Eurasian water milfoil and other exotic species

2. Encourage establishment of buffer strips in developed areas along the south and east shorelines.

3. Continue active Self Help monitoring.

STEVENS LAKE

Stevens Lake is a shallow, 295-acre drainage lake with two inlets and one outlet. The fishery includes northern pike, walleye, perch, largemouth bass, and panfish. There is a Forest Service campground and an improved public boat landing on the west shore.

Water Quality

Stevens is a hard-water fairly nutrient-rich system. It was monitored regularly in the 1970's. A portion of that data is included here. The Rest can be found in Water Quality of Selected Inland Lakes 1974 and 1975 WDNR.

Table 19: Stevens Lake Water Quality Data

	8/30/73	5/21/75	7/10/01
Conductivity	162	163	190
pH	7.8	7.5	8.2
Alkalinity	84	73	90
Chloride	1.0	<1.0	<5.0
Ammonia	.08	.21	<.027
NO2+NO3	<.04	.62	<.075
TKN, nit.	.70	.58	.62
Phosphorus	.03	<.01	.029

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

Lillie and Mason Water Quality Model

	Phosphorus	Secchi Depth
Excellent	<0.001	>19.7
Very Good	.001-.010	9.8 - 19.7
Good	.010-.030	6.6 - 9.8
Fair	.030-.050	4.9 - 6.6
Poor	.050-.150	3.3 - 4.9
Very Poor	>.150	<3.3

Carlson Trophic State Index

Oligotrophic

Mesotrophic

Eutrophic

Macrophytes

Marcophyte growth on Stevens Lake is quite sparse. Thirty-eight stations were initially gridded, but only 20 were eventually sampled. Several stations between 7 and 11 feet were sampled but none supported any growth, therefore most stations over ten feet deep were not sampled. Three species occurred at 4 of the 20 stations - *Elodea canadensis* (waterweed), *Najas flexilis* (slender naiad) and Nitella, a colonial algae which resembles a green plant in growth form.

Floating-leaf and emergent vegetation were quite common along the shoreline.

Only eight species were collected.

Table 20: Stevens Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Chara vulgaris	5	1.0	6.5
Elodea canadensis	20	1.5	3.0 - 7.0
Najas flexilis	20	1.8	4.0 - 7.0
Nitella flexilis	20	3.2	4.5 - 7.0
Nuphar variegatum	10	2.5	3.0 - 4.5
Nymphea odorata	5	1.0	3.0
Potamogeton sp.	10	1.0	3.0 - 4.0
Scirpus americanus	15	2.3	3.5 - 4.5

Shoreline Survey

According to SWRoFC, Stevens Lake has 3.01 miles of shoreline, of which .38 miles are publicly owned. There are approximately 24 dwellings on the lake, giving a development factor of 8.0 d/m. The SDF is 1.3.

Much of the native vegetation is intact around Stevens Lake, however there are areas where development patterns may be adversely effecting the water quality of the lake. Residents on properties where most of the native vegetation has been removed, should be encouraged to establish buffer strips near the shoreline.

The following shoreline survey was performed on May 17, 2003. See development map for locations of shoreline segments.

1. Moderate slope, most natural vegetation in place; maples. Forest Service boat landing and campground.

2. Natural vegetation to intlet - no development - hardwoods and balsams moderate slope.

3. Natural vegetation similar to section 2 with some short stretches of wetlands.

4. Steeper slope with natural vegetation - no development

5. Development - short to medium setbacks, moderate to steep slope, most natural vegetation in place but possibility of some erosion problems on steeper slope.

6. Resort-type area with medium buildings and many outbuildings. Most natural vegetation removed. Moderate slope with lawn grass to narrow buffer strip. Very little overstory. Boat access.

7. Two dwellings moderate setback, most natural vegetation in place

8. Swampy lowlands with tag alder shoreline into outlet (Stevens Creek) and back out several 100 feet and past inlet (Lilypad Creek).

9. Mixed hardwoods, cedars and tag alders - no development.

10. Several dwellings, most with deeper setbacks. Some lawn grass but most have good buffer strips at the shoreline. One with most of the overstory removed. Dwellings well spread out, mostly with wider strips of native shoreline between. Last place with wider access point but still much natural vegetation in place.

11. Natural shoreline - balsams at shore, hardwoods behind. Single access point.

12. 10 - 12 larger dwellings possibly some backlotting in moderate slope. Many with grass behind buffer strips. Most understory has been removed, but reasonable overstory remains. One new construction site with sediment barrier in place. There is good potential for erosion and other impact to the lake if buffer strips and other nature vegetation is not retained and/or improved.

13. Gradual slope with tag alder wetland - no development.

Figure 10a
Stevens Lake Macrophyte Communities

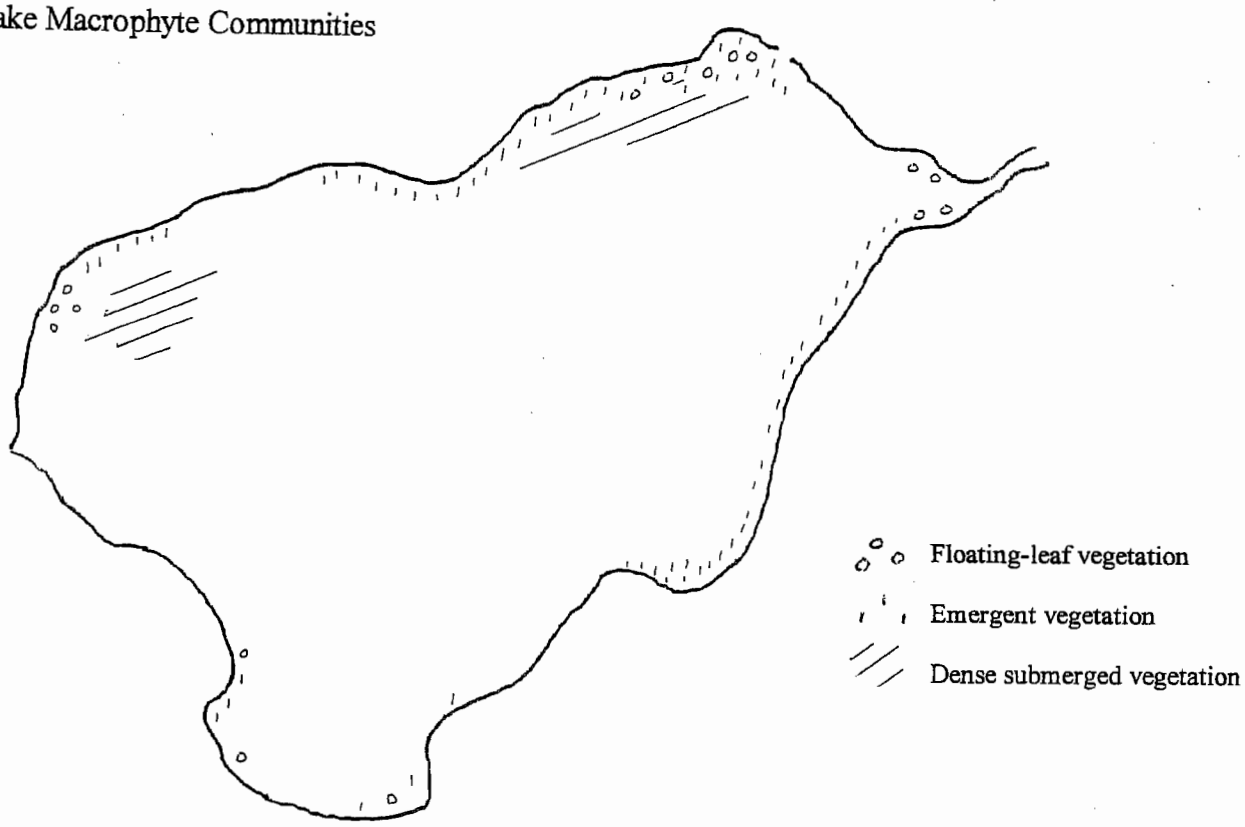
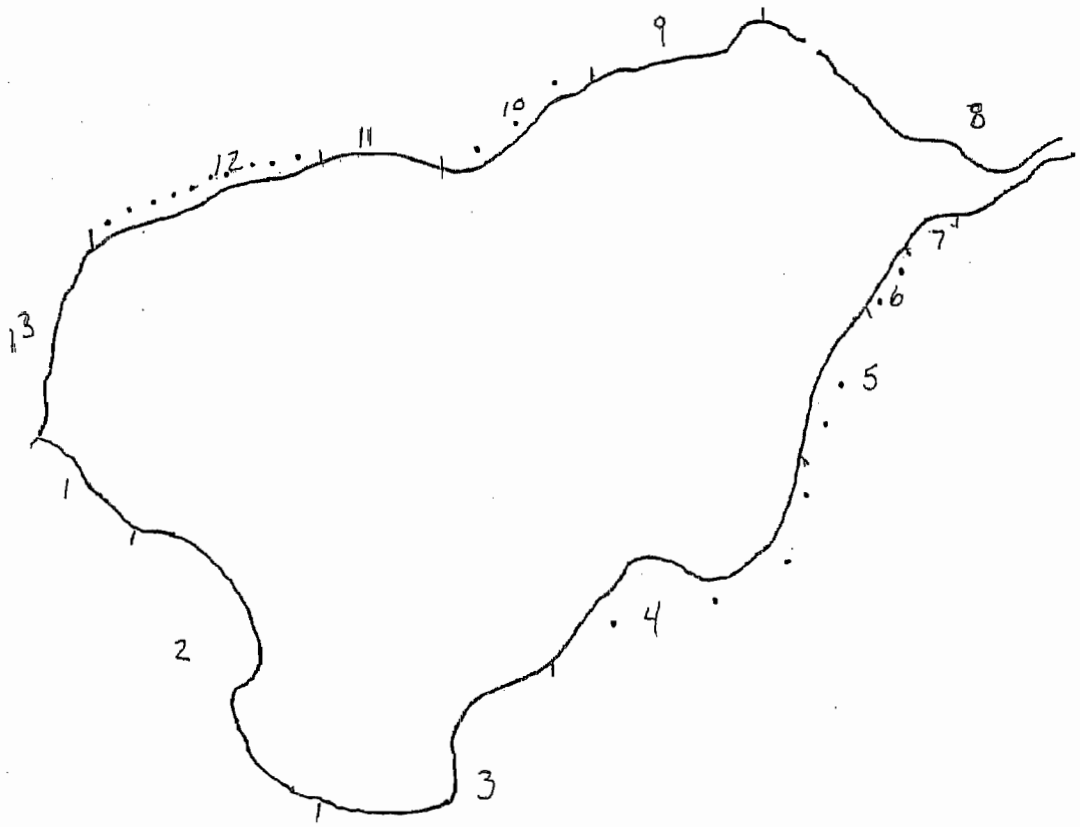


Figure 10b
Stevens Lake Development Map



Recreational Information

No recreational us data was collected for Stevens Lake.

Recommendations

1. Monitor the area near the public boat landing for the introduction of Eurasian water milfoil and other exotic species

2. Encourage establishment of buffer strips in developed areas.

3. Encourage wise development strategies in areas yet to be developed.

4. Consider establishing a lake monitoring program to track water quality trends. Regular secchi disk readings are easy and can provide a very good baseline of data.

VAN ZILE LAKE

Van Zile Lake is a very soft-water seepage lake covering 78 acres, with a maximum depth of 20 feet. The lake has a significant amount of undeveloped shoreline. It was chemically treated prior to 1975 and restocked with largemouth bass. There is a public beach and boat landing on the southwest shore.

Water Quality

The following data if from the SWRoFC and a sample collected and analyzed by NLS.

Table 21: Van Zile Lake Water Quality Data

	70's	
Conductivity	20	72
pH	6.0	6.4
Alkalinity	2.0	<2.3
Chloride		<5.0
Ammonia		<.024
NO2+NO3		<.042
TKN, nit.		.58
Phosphorus		.021

The following data was collected through the state's Self Help program:

Secchi disk readings in feet.

1996	1997	1998	1999
5/25 = 8.25	5/18 = 7.5	5/2 = 3.25	5/22 = 13.25
6/14 = 7.57	6/17 = 7.75	5/22 = 4.25	6/24 = 10.0
7/13 = 4.75	6/28 = 9.75	6/17 = 6.5	7/12 = 9.5
7/20 = 7.5	7/19 = 7.5	7/8 = 8.75	8/21 = 9.25
8/4 = 5.75	8/19 = 8.25	7/25 = 9.5	9/10 = 8.25
9/2 = 7.25	8/31 = 10.5	8/13 = 8.25	9/25 = 9.5
9/11 = 7.0	10/3 = 7.0	8/28 = 9.0	
9/21 = 7.0		10/2 = 10.5	
10/12 = 10.0			

2000	2001	2002	2003
5/9 = 5.75	5/8 = 5.0	6/1 = 4.25	5/4 = 7.75
5/20 = 9.5	5/26 = 5.0	6/16 = 5.25	5/13 = 10.0
6/18 = 8.0	6/16 = 5.25	6/22 = 5.0	
6/24 = 7.5	7/7 = 4.25	7/7 = 4.5	
7/3 = 10.0	7/21 = 6.0	7/22 = 4.0	
7/22 = 9.0	8/14 = 5.25	8/10 = 4.75	
8/8 = 9.25	9/2 = 8.25	8/17 = 4.5	
9/2 = 10.0	9/15 = 8.0	9/2 = 5.5	
9/9 = 8.5	10/14 = 5.75	9/15 = 6.75	
10/1 =9.5		9/29 = 7.0	
		10/11 = 7.5	

Van Zile Lake Water Quality Data Continued

	Chlorophyll a ug/l	Phosphorus mg/l
6/1/02	3.0	.021
7/22/02	32.6	.021
8/17/02	5.92	.023
10/11/02	4.65	.022
5/8/01		.020
6/16/01	13.0	.028
7/21/01	6.0	.017
8/14/01	16.0	.019
10/14/01	16.0	.016
6/3/00	3.0	.017
7/3/00	2.5	.018
8/8/00	4.0	.017
9/9/00	6.0	.021
5/22/99		.012
6/24/99	1.13	.012
7/12/99	4.45	.012
10/9/99	7.0	.013
5/2/98		.021
5/23/98		.016
7/8/98	4.83	.011
8/13/98	4.34	.013
10/2/98	18.5	
5/25/97		.043
6/17/97	6.86	.011
7/19/97	7.2	.014
8/19/97	5.98	.048
10/3/97	2.54	
6/14/96	2.74	.009
7/13/96	5.09	.015
8/4/96	12.9	.016
9/2/96	3.28	.011
10/12/96	5.51	.013

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

Lillie and Mason Water Quality Model				Carlson Trophic State Index
	Phosphorus		Secchi Depth	
Excellent	<0.001		>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

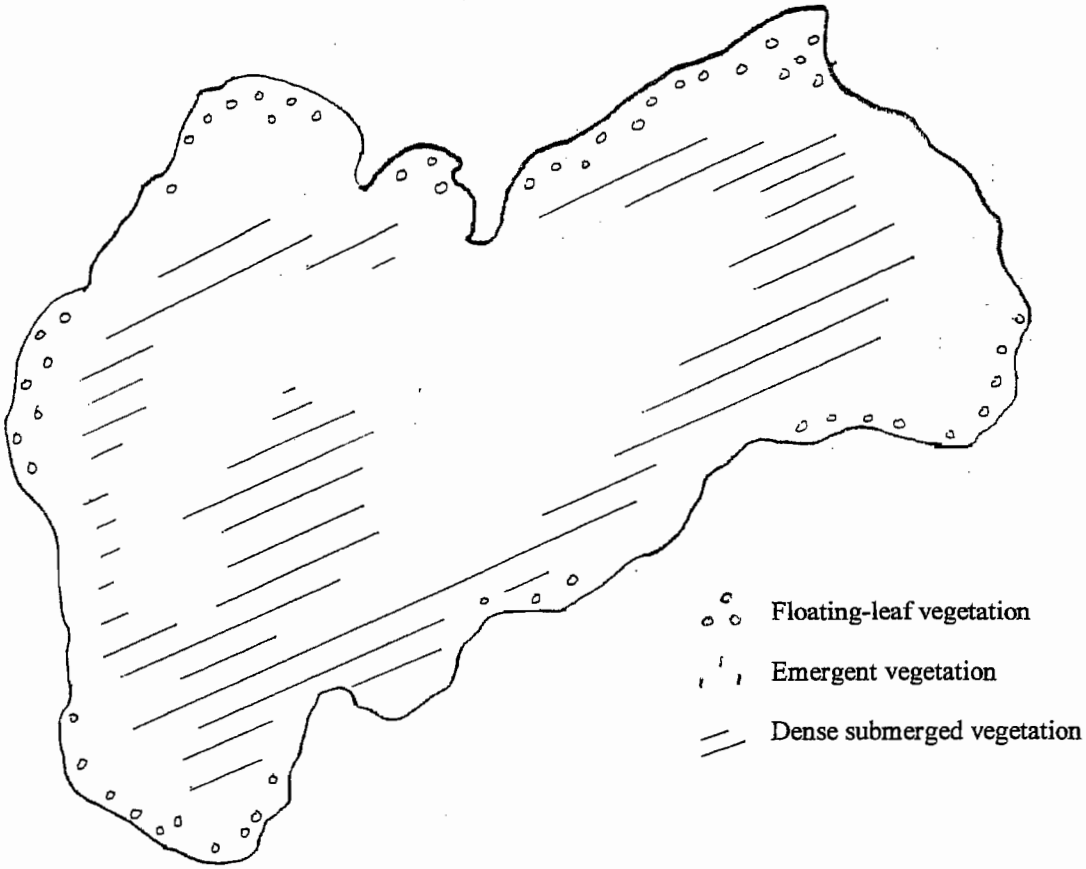
Van Zile Lake supports a variety of low-growing plants very characteristic of soft-water lakes. The most common were *Najas flexilis* (slender naiad), *Eleocharis acicularis* (water needles) and *Isoetes* (quillwort). Floating-leaf vegetation in the form of *Nuphar variegatum* (yellow pond lily) was common along much of the shoreline but growth was not thick in any areas. No emergent vegetation was observed. Plant growth occurred to 12 feet.

Only eight species were collected.

Table 22: Van Zile Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Elatine minor	9	1.7	1.5 - 2.0
Eleocharis acicularis	34	2.7	2.0 - 5.5
Isoetes sp.	29	2.4	1.5 - 4.5
Lobelia dortmanna	9	2.3	1.5 - 2.0
Myriophyllum tenellum	20	2.7	1.5 - 5.0
Najas flexilis	54	3.3	4.5 - 12.0
Nuphar variegatum	11	2.0	2.0 - 5.0
Utricularia sp.	3	1.0	4.0

Figure 11a
Van Zile Lake Macrophyte Communities



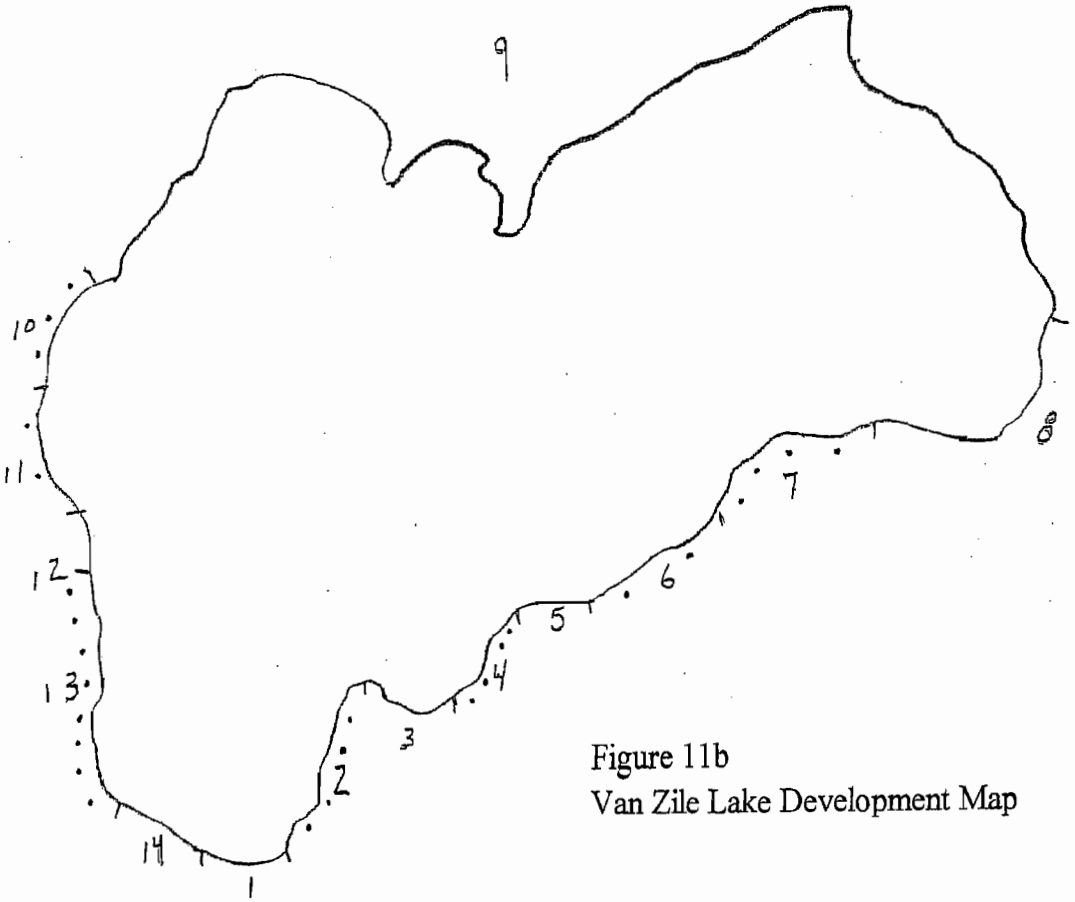


Figure 11b
Van Zile Lake Development Map

Shoreline Survey

According to SWRoFC, Van Zile Lake has 1.84 miles of shoreline, of which .04 are publicly owned. There are approximately 27 dwellings on the lake, giving a development factor of 14.7 d/m. The SDF is 1.5.

Much of the native vegetation is intact around Van Zile Lake, however there are areas where development patterns may be adversely effecting the water quality of the lake. Residents on properties where most of the native vegetation has been removed, should be encouraged to establish buffer strips near the shoreline.

The following shoreline survey was performed on May 24, 2003. See development map for locations of shoreline segments.

1. Public boat landing and small beach / picnic area. Most native vegetation removed. Very gradual slope.

2. Four dwellings on moderate to steep slope with moderate setback. First 3 with most natural vegetation in place and well masked from the lake. Fourth has much understory removed, but overstory in place.

3. Native shoreline.

4. Four dwellings with short setbacks, moderate overstory intact, minimal understory and lawn grass to minimal bufferstrips.

5. Native shoreline - hemlocks without much native understory. Moderate slope

6. Two dwellings, widely spaced with large stretches of native vegetation between. Most understory removed at second property.

7. Dwellings with good separation but some problems. One new construction site with minimal setback and obvious erosion problems. Area of lawn grass on moderate slope with minimal bufferstrip. Final place with minimal setback but most native vegetation in place and good masking from the water. One older boathouse.

8. Native lowland vegetation - pines, leatherleaf - no development.

9. Moderate slope, red pines and white pines, rocky shoreline - no development.

10. Three dwellings, well spaced on gradual slope with moderate setbacks. First has bufferstrip but most native vegetation removed, next two have much more natural vegetation in place and are well screened from the lake.

11. Two dwellings with very "suburban" look. Very little native vegetation in place and lawn grass to the shore.

12. Approximately 100 yards of natural shoreline.

13. Eight dwellings on moderate slope with minimal setback. Several with lawn grass to shore and no buffer strip. Some with significant natural vegetation in place. Two older boathouses.

14. Approximately 200 feet of native lowland vegetation.

Recreational Information

Table 23: Van Zile Lake Recreational Use Data

	7/11/00 2:00 pm	7/19/00 2:00 pm
Fishing	X	X
Canoeing/rowing	X	X
Swimming/snorkling	X	X
Lounging	X	X

Recommendations

1. Continue active Self Help monitoring.

2. Encourage establishment of bufferstrips in developed areas.

3. Encourage wise development strategies in areas yet to be developed.

WALSH LAKE

Walsh Lake is a very soft-water seepage lake covering 45 acres, with a maximum depth 15 feet. The fishery includes perch and panfish. There is no public access.

Water Quality

Walsh Lake is characterized by very soft water, but is not particularly acidic. The water quality is very good with high clarity and fairly low nutrient levels. Continued wise development practices may play an important role in maintaining the very good water quality on Walsh Lake.

Table 24: Walsh Lake Water Quality Data

The following data if from the SWRoFC and a sample collected and analyzed by NLS.

	70's	
Conductivity	29	25
pH	6.1	7.5
Alkalinity	8.0	<2.3
Chloride		<5.0
Ammonia		<.024
NO2+NO3		<.042
TKN, nit.		.40
Phosphorus		.013

The following secchi disk readings were collected through the state's Self Help program:

1999	2000	2001	2002
5/14 = 13.75	6/6 = 14.5	4/27 = 11.0	7/12 = 13.0
5/31 = 13.25	6/25 = 15.0	6/6 = 16.0	7/30 = 13.5
6/13 = 13.75	7/13 = 13.0	6/30 = 11.0	8/16 = 10.0
7/7 = 11.5	7/29 = 13.0	7/21 = 12.0	
8/1 = 10.5	9/15 = 10.0	8/12 = 12.0	
9/6 = 12.0			

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

Lillie and Mason Water Quality Model			Carlson Trophic State Index
	Phosphorus	Secchi Depth	
Excellent	<0.001	>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

Walsh Lake supports fairly sparse vegetation characteristic of very soft-water lakes. These plants tend to grow very low to the lake bottom. *Isoetes* (quillwort) was the most common species, present at 9 of 23 sample stations. No other species was collected at more than 5 stations. Floating-leaf vegetation was uncommon and emergent vegetation was no observed. Plant growth occurred to 13 feet.

A total of 11 species were collected.

Table 25: Walsh Lake Macrophyte Species List

Species	Relative Frequency	Average Density	Depth of Growth
Brasenia schreberi	9	2.5	3.0 - 4.0
Dulichium arundinaceum	p		
Eleocharis acicularis	22	2.0	3.0 - 9.5
Eriocaulon septangulare	4	1.0	3.0
Isoetes sp.	39	3.1	3.0 - 9.5
Nitella flexilis	4	3.0	13.0
Nuphar variegatum	9	1.0	4.0 - 9.5
Potamogeton epihydrus	17	1.5	4.0 - 8.0
P. sp.	17	3.0	8.0 - 11.0
Sparganium eurycarpum	4	1.0	4.0
Utricularia vulgaris	9	1.0	8.0 - 11.0

Figure 12a
Walsh Lake Macrophyte Communities

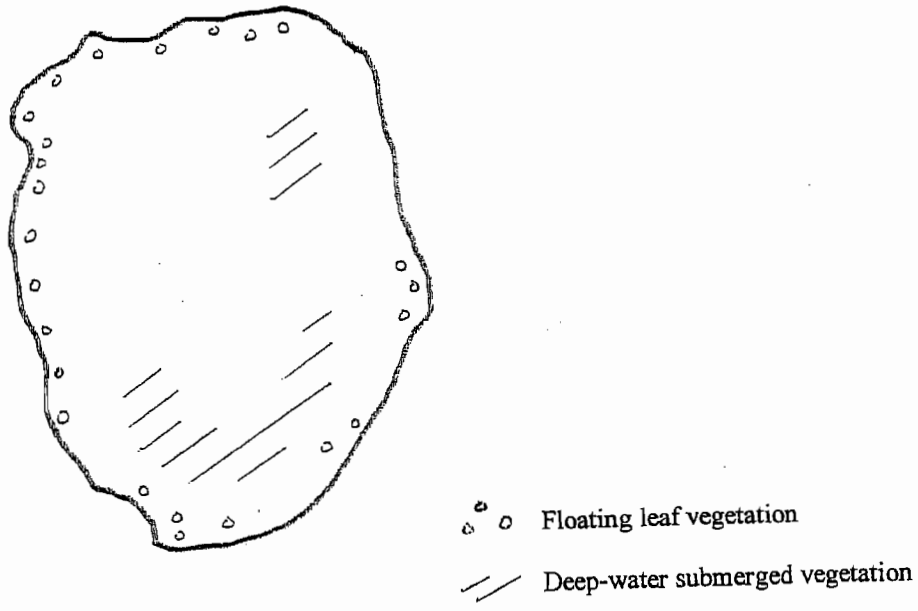
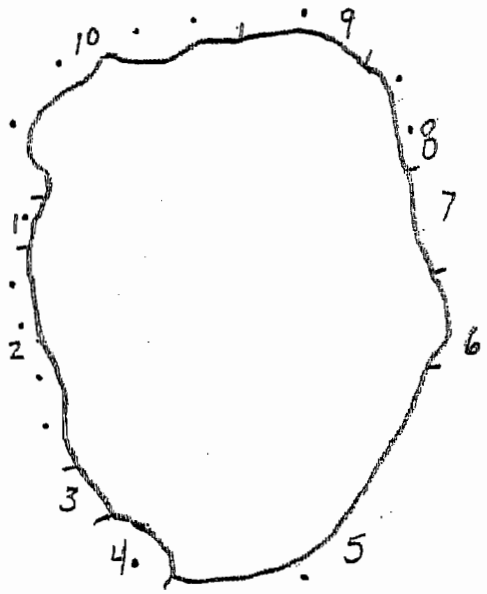


Figure 12b
Walsh Lake Development Map



Shoreline Survey

According to SWRoFC, Walsh Lake has 1.04 miles of shoreline. There are 14 dwellings on the lake, giving a development factor of 13.5 d/m. The SDF is 1.2.

Most of Walsh Lake has been wisely developed, with moderate to deep setbacks and retention of most of the native vegetation in place. Future development should be monitored to ensure that this continues. Poor development on a small lake can have very adverse effects on water quality.

The following shoreline survey was performed on June 15, 2003. See development map for locations of shoreline segments.

1. Mostly native shoreline hardwoods with diverse understory. One dwelling on gradual slope with minimal setback and total removal understory and most of overstory to the shoreline. Establishment of a buffer strip here should be encouraged.

2. Four well spaced dwellings with medium to deep setbacks on gradual to moderate slope and most native vegetation in place. Very good screening from the lake. Each access point is separated by significant stretches of native shoreline.

3. Unimproved lots with cleared "picnic area" near shore. Gradual slope.

4. One dwelling with good setback and most native vegetation in place.

5. Mostly undeveloped with pines, hemlocks and very little native understory. One dwelling on south shore with moderate setback. There is not much natural understory here but all overstory in place.

6. Wetland shoreline with tamarack and leatherleaf.

7. Two unimproved lots with removal of some vegetation at access points. This is a narrow strip of upland between the lake and wetland behind. Moderate slope with pines.

8. Two dwellings on gradual slope with moderate setback. Most natural vegetation in place at the first and a bit more removal of overstory at the second. Mostly hemlocks.

9. Birch, maple forest on gradual to moderate slope. Several undeveloped lots and one dwelling. Area with development has a significant amount of the natural vegetation removed - "weed whacked" look. Dwelling is very low to the water and somewhat hidden though.

10. Four dwellings with medium to deep setbacks much natural vegetation in place. Most overstory in present, but each has a fairly wide access strip where natural vegetation has been removed. These should consider allowing more vegetation to re-establish at least in the form of buffer strips.

Recreational Information

No recreational use data was collected for Walsh Lake.

Recommendations

1. Wise development strategies with minimal impact to the native environment should be continue and be encouraged.

2. Encourage establishment of buffer strips in noted developed areas.

3. Fishery issues seem to be a concern to residents. Consider establishing a formal committee to ask request assistance from the DNR with these issues.

4. High impact recreational activities should be discouraged, due to potential safety issues and potential impact on the shoreline.

5. Consider establishing a lake monitoring program to track water quality trends. Regular secchi disk readings are easy and can provide a very good baseline of data.