Color

Steve McComas: *Lilies and Trees*, 1999

Lake Management Plan for the Pike Chain of Lakes Price and Vilas Counties, Wisconsin

[Pike Lake Chain includes Pike Lake, Round Lake, Amik Lake, and Turner Lake]

2003

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with significant contributions from the Pike Lake Chain of Lakes Association, and Wisconsin Department of Natural Resources

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for Pike Lake Chain of Lakes
Price and Vilas Counties, Wisconsin

Table of Contents

Technical Appendix

1. Lake Information
   1.1. Lake levels and rainfall
   1.2. Dissolved oxygen and temperature profiles
   1.3. Water clarity - Secchi disc data
   1.4. Water chemistry data
   1.5. Aquatic vegetation
      1.5.1. Survey results for four lakes in 2001
   1.6. Fisheries records (stocking, etc)

2. Lake and Watershed Assessment
   2.1. Entire questionnaire survey report

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1. Introduction and Project Setting

The Pike Chain of Lakes is located in Price and Vilas Counties, Wisconsin (Figure 1). Lake sizes and depths are shown in Table 1.

The objectives of this study were to characterize existing lake conditions and to make recommendations to protect and improve the lake environment where feasible.

Table 1. Lake statistics for the four principle lakes in this study.

	Pike	Round	Amik	Turner
Size (acres)	806	726	224	149
Mean depth (ft)	11	16	5	8
Maximum depth (ft)	17	24	8	12

Figure 1. Pike, Round, and Amik and Turner Lakes are located in Price County, Wisconsin.

2. Historical Highlights

2.1. Glaciers and Soils

The Pike Lake Chain of Lakes of lakes was formed approximately 10,000 years ago during the last glacial retreat of the Wisconsin Valley glacial lobe (Figure 2). The soils deposited by the Wisconsin Valley glacier were primarily sands and loamy-sands. Beneath these soils, at depths of about 50-350 feet, is Precambrian bedrock that is over one billion years old. The bedrock is referred to as the North American shield.

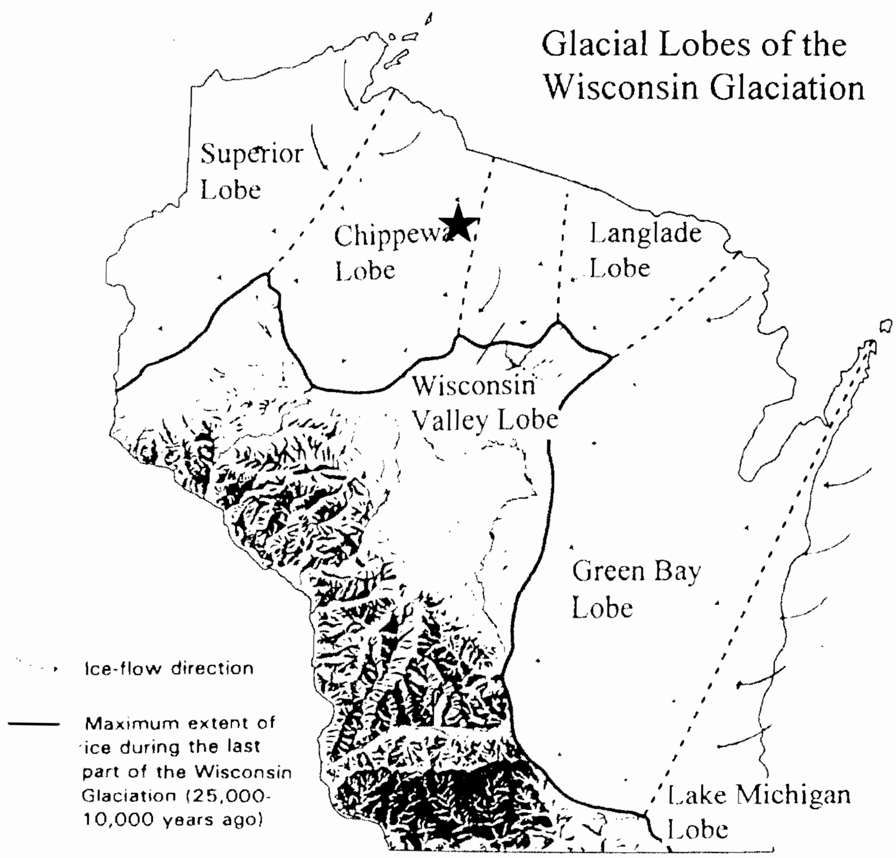


Figure 2. Glacial lobes of the Wisconsin glaciation. The Pike Lake Chain of Lakes of Lakes is located in the Chippewa lobe.

In glacial outwash areas, it is hard to predict what kind of material will be deposited. Apparently in Round Lake, a variety of rock sizes were left behind including some large size rocks. Many of these were of glacial origin (Figure 3).

These rocks are not to be confused with the rock pile used to anchor the log booms during the logging era.

Figure 3. Underwater view of Round Lake, July 2001.

The soils in the Pike Lake chain sit on top of glacial sands and are some of the most acid (pH 5.5) and have some of the highest available phosphorus (138 lbs/acre) of any soil in Wisconsin. The Pike Lake Chain of Lakes rests in Soils Group (21) referred to as the Vilas, Omega, Pence group. A soil regions map of Wisconsin is shown in Figure 4.

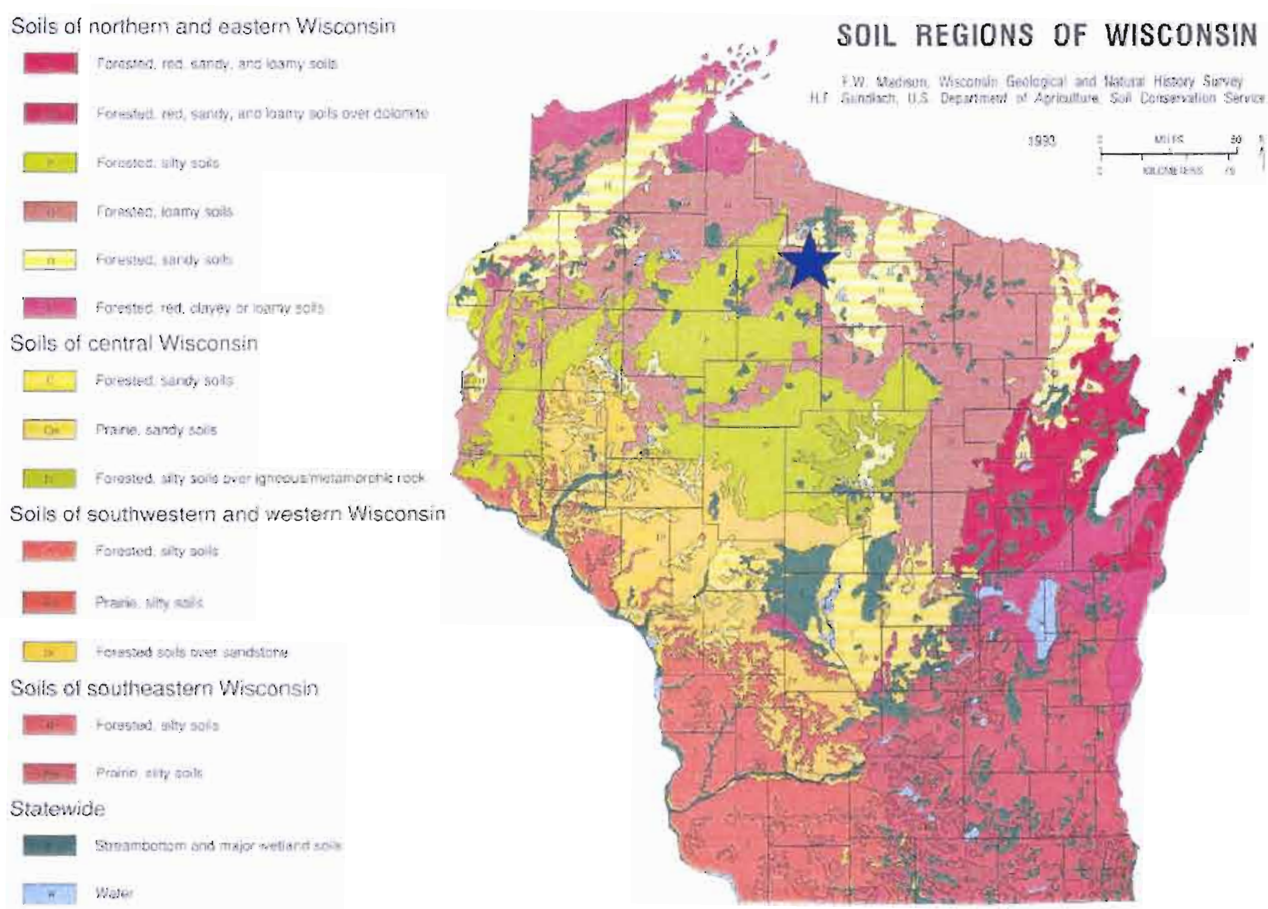


Figure 4. Pike Lake Chain of Lakes is located in a depression in soil groups that is categorized as forested loamy soils.

2.2. Recent Lake History

A comprehensive lake history report has been prepared by John Berg and is available as a stand alone book which was published in 2003 and is available from the Lake Association. John Berg's book will provide a definitive history of the Pike Lake Chain. A brief summary of the history of Pike Lake is summarized below.

?-1850s: land inhabited by native Americans.
1870s: logging begins in Price County
1876: log dam is in place at outlet of Round Lake. Army Corps of Engineers estimated a drainage area at Round Lake dam of 102 square miles (65,280 acres).
1884-85: Rock cribs are built and sunk in Pike and Round Lakes. They were used to anchor a steamboat as it winched a boom of logs from Pike Lake to the Round Lake outlet. The steamboat had several "stops" or mooring points and there were several rock cribs installed.
1921-28: Steam-powered sawmill processes all types of timber. Located in bay on the southwest shore of Pike Lake.
1930s-present: lakeshore construction of cabins and resorts picks up and continues to the present.

Figure 5. Pike Lake Club house in one form or another has been a fixture on Pike Lake since the early 1900s.

3. Watershed Features

3.1. Drainage Area to the Lakes

Drainage areas to individual lakes are listed in Table 2 and watershed-to-lake area ratios are shown in Table 3. The size of the direct drainage watersheds that drain to the lakes are typical for northern Wisconsin glacial lakes, however, there are large contributing watershed areas for Amik, Pike, and Round Lakes. This is not typical for glacial seepage lakes but is within reason for drainage lakes.

Table 2. Watershed areas for Pike, Round, and Amik and Turner (prepared by Blue Water Science).

	Lake Size (ac)	Direct Watershed (not including lake)(ac)	Contributing Watershed (ac)	Total Watershed Area (not including lake)(ac)	Total Watershed (including lake) (ac)
Turner	149	567	0	567	716
Amik	224	991	14,032	15,023	15,247
Pike	806	2,137	56,459	58,596	59,402
Round	726	1,872	59,402	61,274	62,000

Definitions:
Direct watershed: *land area that drains to the lake by runoff*
Contributing watershed: *land areas that drain to the lake by way of a defined channel or stream.*
Total watershed: *this is the direct drainage watershed area plus the contributing watershed area.*

Table 3. Watershed area to lake surface area ratios.

	Direct Drainage Watershed to Lake Ratio	Total Watershed (not included) to lake ratio	Comments
Turner	4	4	Only lake of the four with no contributing watershed.
Amik	4	67	Receives water from Tucker Lake and lakes to the north.
Pike	3	73	Receives water from Amik drainage, Turner Lake, and Squaw and Foulds Creeks.
Round	3	84	Main flow is from Pike Lake.

A breakdown of smaller drainage units to each lake is shown in Table 4 and a map showing watershed delineations is shown in Figure 6 and another map showing a stylized watershed is shown in Figure 7.

Table 4. Summary of watershed sizes (in acres).

Turner	
Direct drainage	567
Total watershed subtotal	567
Lake	149
TOTAL WATERSHED	716
Amik	
Pine Creek	13,408
Tucker Lake	624
Contributing watershed	14,032
Direct drainage	991
Total watershed subtotal	15,023
Lake	224
TOTAL WATERSHED	15,247
Pike	
Foulds Creek	10,704
Squaw Creek	29,792
Amik Lake	15,247
Turner lake	716
Contributing watershed	56,459
Direct drainage	2,137
Total watershed subtotal	58,596
Lake	806
TOTAL WATERSHED	59,402
Round Lake	
Pike Lake	59,402
Direct drainage	1,872
Total watershed subtotal	61,274
Lake	726
TOTAL WATERSHED	62,000

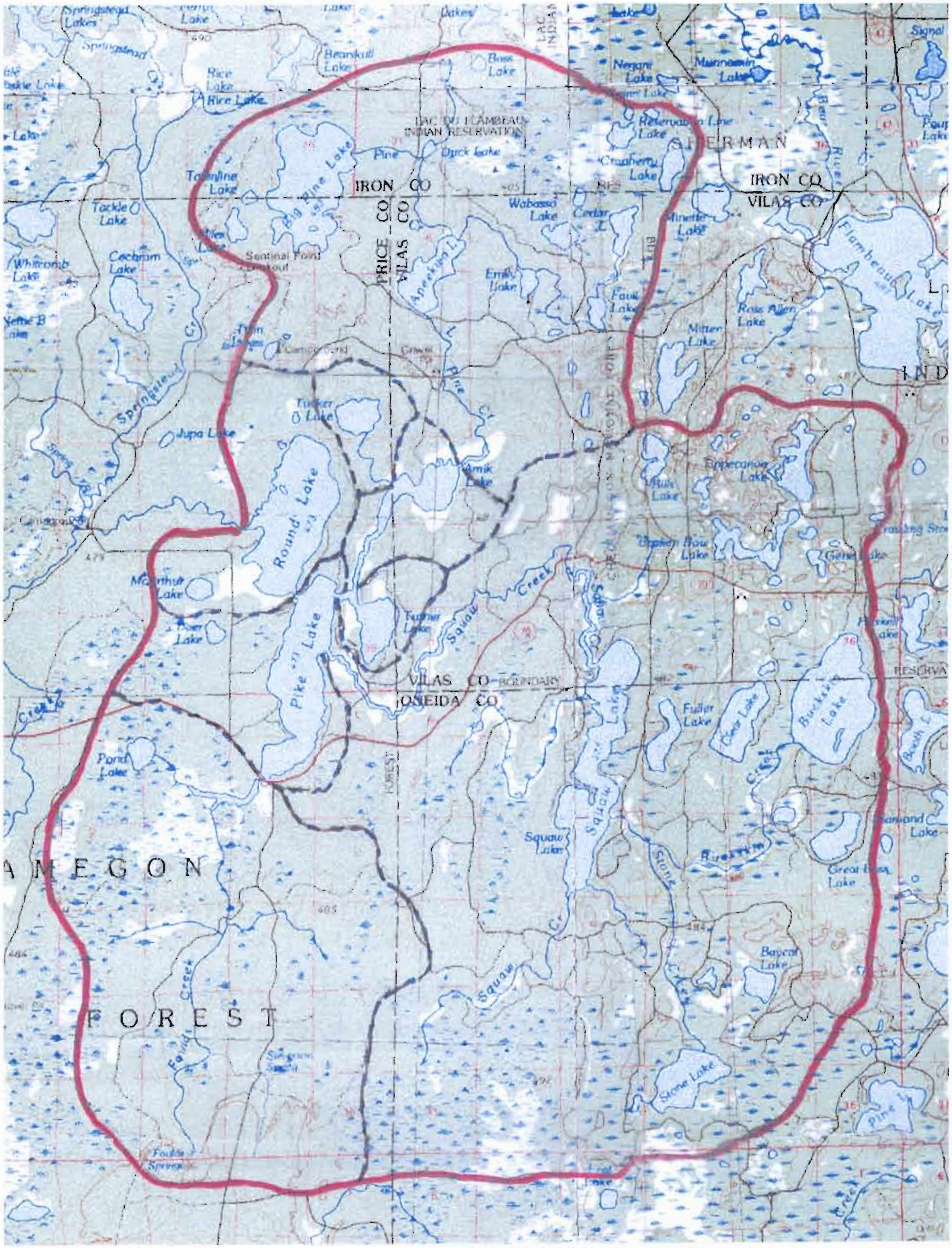


Figure 6. Watershed delineation for Pike, Round, Amik, and Turner Lakes.

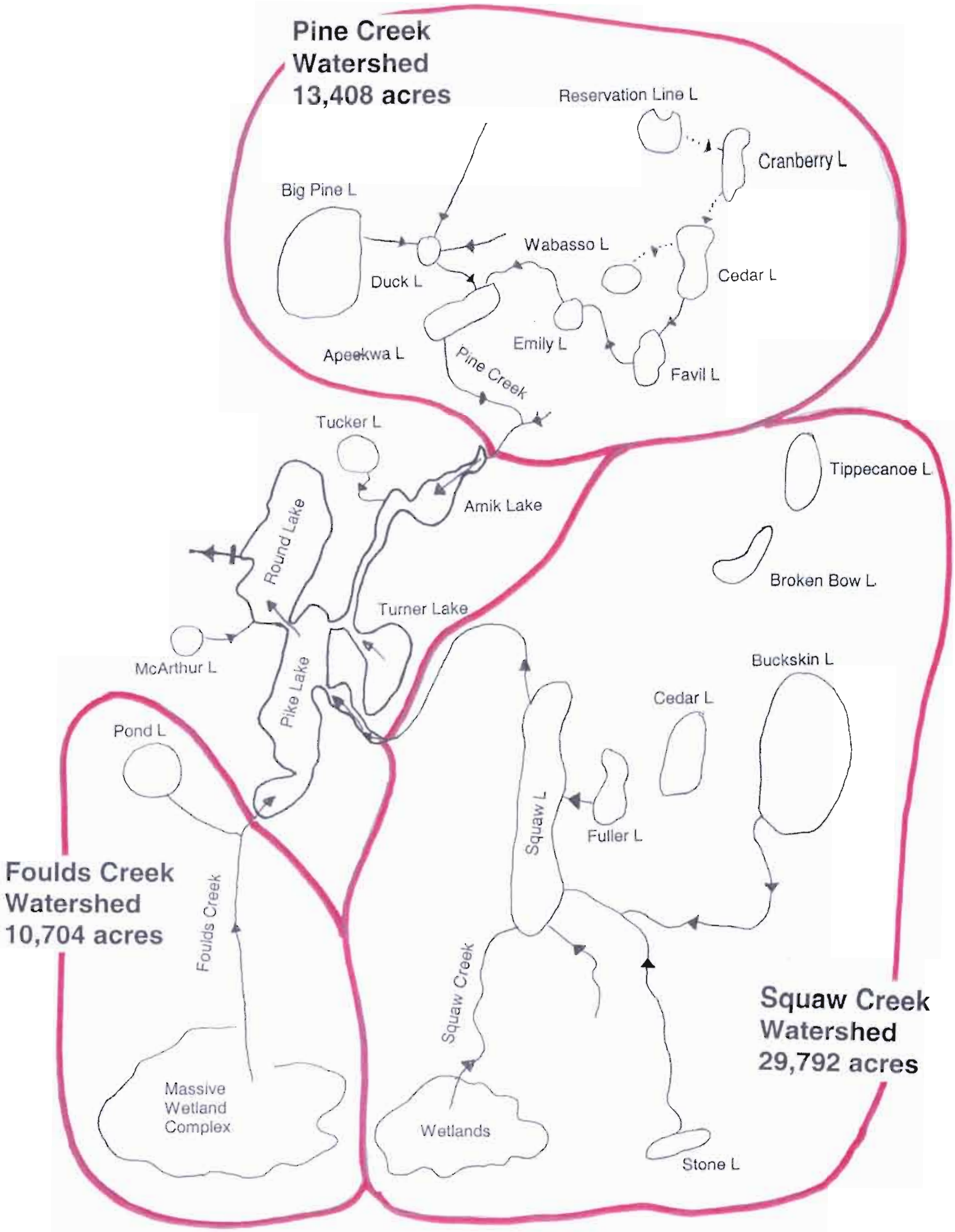


Figure 7. The three major subwatersheds draining to the Chain of Lakes and the direction of flow is shown above. There are at least 18 named lakes in the subwatershed.

3.2. Source of Water to the Lakes

Source of water to all four lakes is from rainfall, groundwater that seeps into the lakes from fringe wetlands, stream flows, and lake outlets. The amount of water flowing into and out of the lakes is substantial. Flows have been estimated for the major streams along with other water sources. The estimated flows from the three major subwatersheds are listed below in Table 5.

Table 5. Estimated flows of the three streams draining the three major subwatersheds.

	Pine Creek	Foulds Creek	Squaw Creek
watershed size (ac)	13,408	10,704	29,792
Average runoff (11 inches = 0.92 ft)	0.92	0.92	0.92
Amount of water (ac-ft)	12,290	9,848	27,408
Average flow rate over the year (cubic ft per second)	17 cfs	14 cfs	37 cfs
measured flow on April 25, 2001		30-40 cfs	40-60 cfs
measurement method		culvert 10' wide, 4 ft deep, flow = 1 ft per sec	culvert 10' wide, 3' deep, flow = 1.5 to 2 ft per sec.

It's a water rich watershed.

The estimated outflow at the dam at Round Lake is substantial and averages about 79 cubic feet per second. The total amount of water leaving Round Lake is calculated by assuming an average of 11 inches of rainfall per year makes its way off the land area of the 62,000 acre watershed. This is equal to 56,833 acre-feet of water.

This would be enough water to supply drinking water to a city with a population of 780,000 on a yearly basis (assuming 65 gallons per person per day).

Figure 8. Foulds Creek - April 2001. The creek flows north into Pike Lake with a relatively high flow in spring.

Figure 9. Fould's Creek - September 2001. In the fall, the flow in Foulds Creek is low. The average flow annual flow is estimated at 14 cubic feet per second.

3.3. Sources of Nutrients to the Lakes

The drainage areas to the chain of lakes are dominated by forests and wetlands. Although the forests have been clear cut at least once in the last 150 years, existing conditions are dominated by undeveloped land use. This condition allows the potential for good water quality to runoff the land and into the lakes.

Because of the extensive wetland areas that are undeveloped as well as a portion of the watershed within the national forest, nutrient levels in the incoming streams are close to natural background concentrations.

However, due to the "lay-of-the land" there is an exceptionally large drainage area to the lakes and an exceptional amount of water that runs into Amik, Pike, and Round Lakes. The result is a low phosphorus concentration but with a lot of flow that produces a large amount of phosphorus that enters the chain.

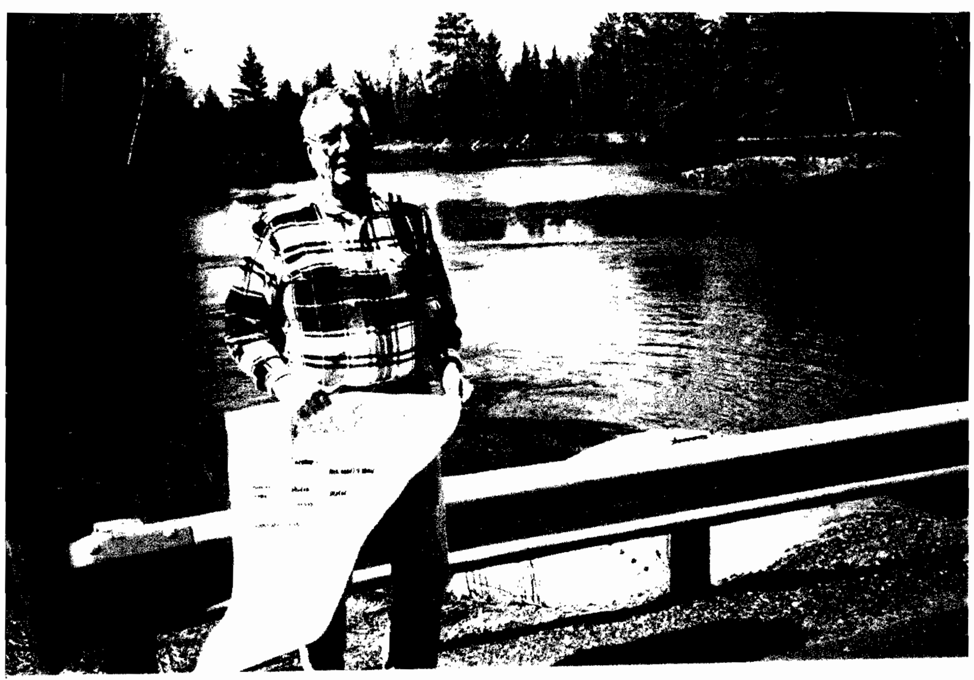


Figure 10. Squaw Creek is a major inflow to Pike Lake.

Phosphorus Loading from Major Subwatersheds: Phosphorus is a nutrient that is closely monitored in lake systems because it is the nutrient most likely to generate algae blooms. The amount of phosphorus entering the Chain of Lakes is estimated in Table 6 and is based on phosphorus stream sampling results from 2001. The stream flows represent the most important source of phosphorus to the lakes.

Table 6. Phosphorus concentrations and phosphorus loads for four major incoming surface flows to Pike, Amik, and Round Lakes. Turner Lake does not have a perennial surface inflow.

	Pine Creek (flows into Amik Lake) (phos in ppb)	Fould's Creek (flows into Pike Lake) (phos in ppb)	Squaw Creek (flows into Pike Lake (phos in ppb)	Pike Lake outlet (flows into Round Lake) (phos in ppb)
4.25.01*	--	15	24	--
5.30.01	38	16	24	--
6.25.01	29	30	35	--
7.11.01	31	29	43	--
8.20.01	35	25	34	--
9.18.01	33	28	58	--
May-Sept Average (phosphorus conc)	33	26	39	31
Watershed size (acres)	13,408	10,704	29,792	59,402
Average runoff per year (inches)	11" = 0.92 ft	11" = 0.92 ft	11" = 0.92 ft	11" = 0.92 ft
Amount of water (ac-ft)	12,290	9,848	27,408	54,650
Phosphorus load = p conc x amount of water = pounds of P	1,100 pounds (500 kg)	700 pounds (316 kg)	2,900 pounds (1,318 kg)	4,600 pounds (2,090 kg)

*DOC for Fould's Creek = <0.1 mg/l and for Squaw Creek = 14 mg/l

Summary of Phosphorus Loading to Lakes: There are other sources of phosphorus to the lakes. The estimated amounts of phosphorus carried into the lakes on an annual basis are shown in Table 7.

Table 7. Summary of phosphorus loading to lakes (in pounds).

	Phosphorus (pounds/year)	How the Phosphorus Load was Calculated
Turner		
Direct drainage	127	567 ac x 80 ppb-P
Rainfall	40	149 ac x 0.27 pounds/ac
Septic systems*	3	20 systems x 0.15 lbs/system
PHOSPHORUS LOAD	170	
Amik		
Pine Creek	1,100	13,408 ac x 33 ppb-P
Tucker Lake watershed	24	624 ac x 15 ppb-P
Direct drainage	157	991 ac x 70 ppb-P
Rainfall	61	224 ac x 0.27 lbs/ac
Septic systems	2	14 x 0.15 lbs/systems
PHOSPHORUS LOAD	1,344	
Pike		
Foulds Creek	700	10,704 ac x 26 ppb-P
Squaw Creek	2,900	29,792 ac x 39 ppb-P
Amik Lake watershed	1,000	15,247 ac x 26 ppb-P
Turner Lake watershed	48	716 ac x 27 ppb-P
Direct drainage	480	2,137 ac x 90 ppb-P
Rainfall	218	806 ac x 0.27 lbs/ac
Septic systems	26	170 x 0.15 lbs/system
PHOSPHORUS LOAD	5,372	
Round Lake		
Pike Lake watershed	4,600	59,402 ac x 31 ppb-P
Direct drainage	327	1,872 ac x 70 ppb-P
Rainfall	196	726 ac x 0.27 lbs/ac
Septic systems	12	80 x 0.15 lbs/system
PHOSPHORUS LOAD	5,135	

* Septic system loading was calculated as follows: Assume 1 system is used by 3 people for half the year. Phosphorus generated by 1 person/yr = 0.5 kg = 1 pound. An estimated 90% of the phosphorus is removed by the soil absorption field. Phosphorus from one system = 3 people x 0.5 yr x 1 pound/person x 0.10 that goes to lake = 0.15 pounds/system.

Phosphorus Inputs to Amik, Turner, Pike, and Round

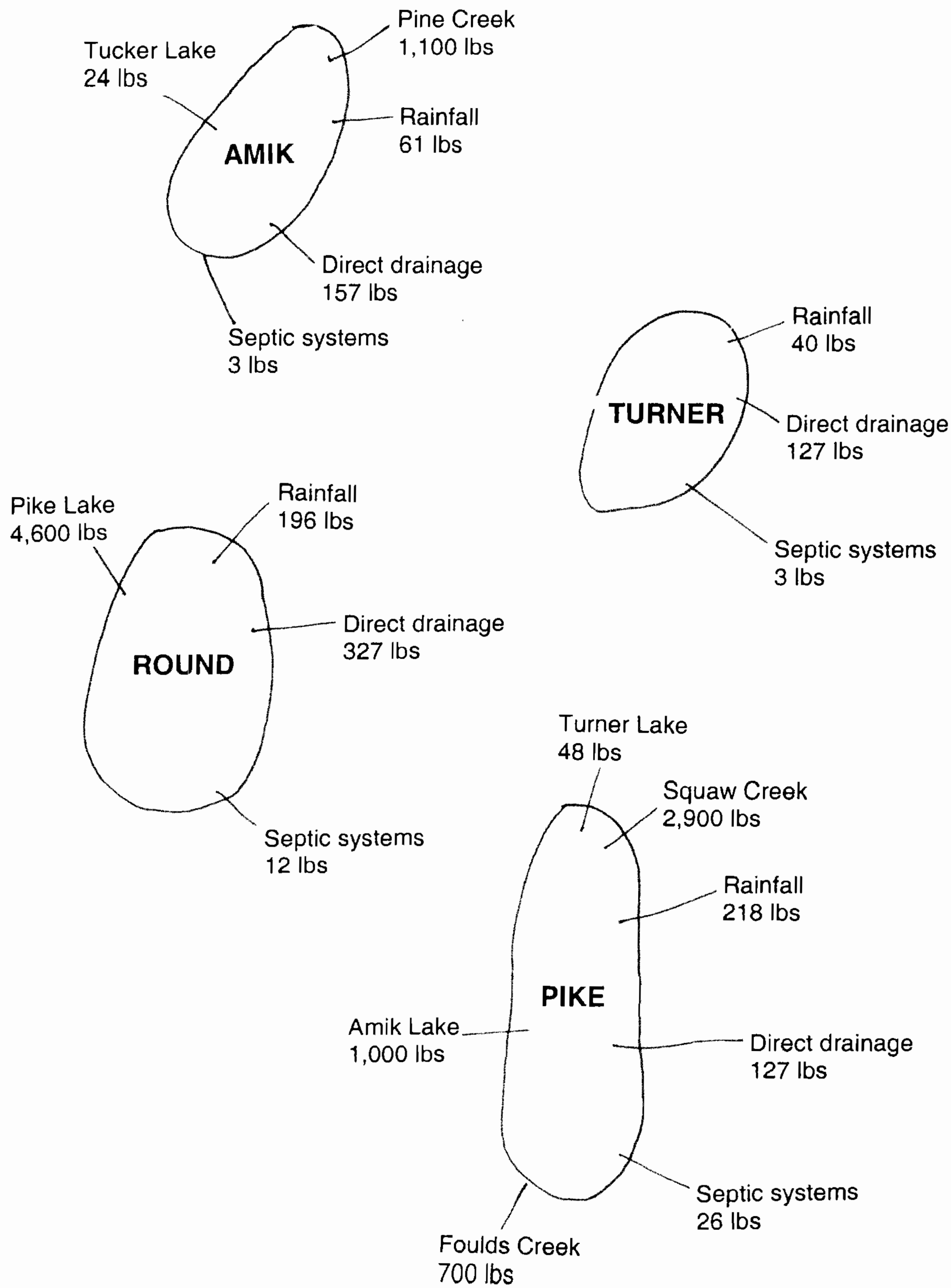


Figure 11.

3.4. Shoreland Status

The shoreland area encompasses three components: the upland fringe, the shoreline, and shallow water area by the shore. A photographic inventory of the Pike, Round, Amik, and Turner shorelines was conducted in 2001 with photographs taken by volunteers of the Pike Lake Association with analysis by Blue Water Science. The objective of the survey was to characterize existing shoreland conditions which will serve as a benchmark for future comparisons.

For each photograph we looked at the shoreline and the upland condition. Examples of shoreland conditions are shown in Figure 13. Our criteria for natural conditions were the presence of 50% native vegetation in the understory and at least 50% natural vegetation along the shoreline in a strip at least 15 feet deep. We evaluated shorelands at the 75% natural level as well.

A summary of the inventory results is shown in Table 7. Based on our subjective criteria over 95% of the parcels in the Round, Amik and Turner, Pike Lakes shoreland area meet the natural rankings for shorelines and upland areas. This is good for a lake in northern Wisconsin. However in the next 10 years there could be pressure to reduce natural conditions. Proactive volunteer native landscaping should maintain existing conditions and improve other parcels.

The full shoreland inventory is found in a separate report with copies at the WDNR-Rhinelander and at the lake association archives.

Table 7. Summary of buffer and upland conditions in the shoreland area of Pike, Round, Amik and Turner Lakes. Approximately 772 parcels were examined.

Pike Chain of Lakes	Natural Shoreline Condition		Natural Upland Condition		Undevel Photo Parcels	Shoreline Structure Present	
	>50%	>75%	>50%	>75%		riprap	wall
TOTALS (no. of parcels = 722)	95% (684)	91% (654)	92% (633)	87% (626)	53% (380)	5% (33)	0.1% (1)

Figure 12. [top] This parcel would rate as having a shoreline with a buffer greater than 50% of the lot width and an understory with greater than 50% natural cover.

[bottom] This parcel would not qualify as having a natural shoreline buffer greater than 50% of the lot width. Also understory in the upland area would be rated as having less than 50% natural cover.

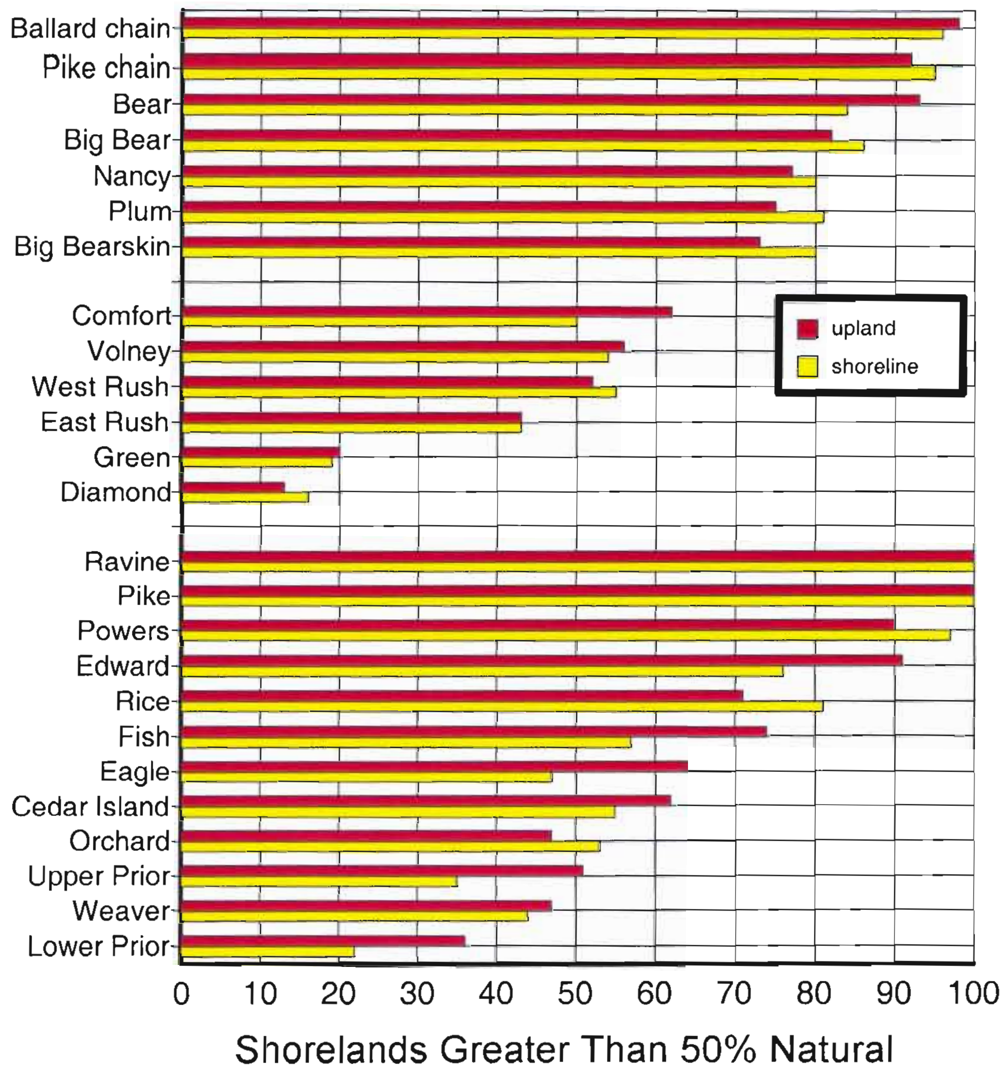


Figure 13. A summary of shoreland inventory results for lakes using an evaluation based on shoreland photographs. For each lake the percentage of shoreline and upland conditions with greater than 50% natural conditions is shown. The first tier of lakes are located in northern Wisconsin. The lower tier of lakes are in the Twin City Metropolitan area and are considered urban lakes. Although several lakes are "urban" lakes most of the shoreland is owned by the city and there is a high percentage of natural conditions. The middle tier of lakes are about an hour's drive from the Twin Cities, and are not considered to be urban lakes, they are "country" lakes.

Pike Chain of Lakes are northern Wisconsin lakes.

3.5. On-site Wastewater Treatment Systems Status

The status of on-site wastewater treatment systems in the watershed are rated as satisfactory. A typical on-site system is shown in Figure 14.

There may be some movement of septic effluent toward the chain of lakes, but this occurs in nearly all lake settings. The septic tanks are not polluting the lakes. This is based on several factors:

- soils have infiltration capacity so any overland septic flow would be rare.
- homes and drainfields are set back from the lake allowing adequate septic tank effluent treatment.
- there is a low density of residences around the lakes.

With new regulations in place for Price and Vilas Counties, water pollution problems from on-site systems are not anticipated in the future.

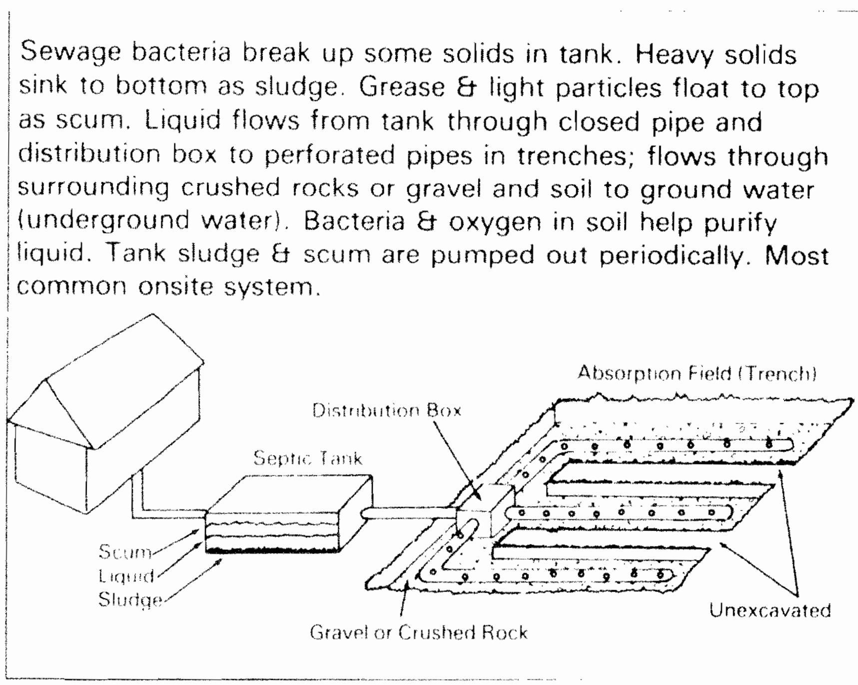


Figure 14. Typical septic tank/drainfield configuration (from McComas 1993. LakeSmarts).

3.6. Watershed Status Summary

The watershed area that drains to the chain of lakes is in exceptional natural state compared to watersheds in other areas of the state. The land in the watershed is dominated by wilderness areas and is composed primarily of forests and wetlands.

Because most of the watershed is composed of wetlands to the south and within a national forest to the west and north, there is the long term prospect for primarily a natural condition.

However, shorelands around the lake are privately owned and subject to alternations. Shoreland areas are critical to the lake environment. They are in a high natural state at this time (based on shoreline inventory results). The challenge will be to preserve those conditions which will benefit lake water quality in the long run.

4. Lake Features

4.1. Lake Maps and Lake Statistics

The chain of lakes is shown in Figure 15 and lake characteristics are shown in Table 8.

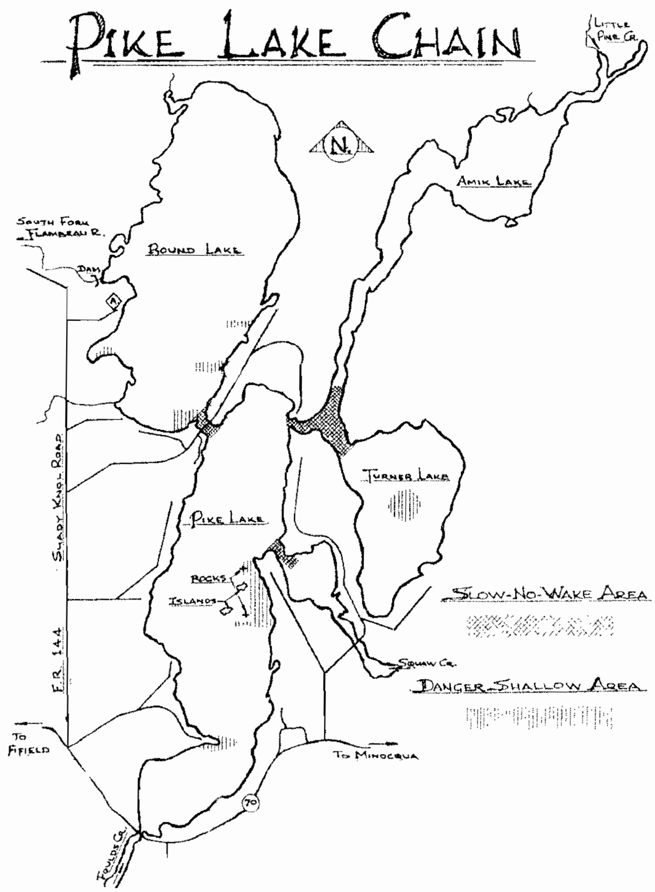


Figure 15. Lake maps of Pike, Round, and Amik and Turner Lakes.

Table 8. Lake and watershed characteristics for Pike, Round, and Amik and Turner Lakes.

	Round	Pike	Amik	Turner
Area (ac)	726	806	224	149
Mean depth (ft)	16	11	5	8
Maximum depth (ft)	24	17	8	12
Volume (ac-ft)	11,616	8,866	1,120	1,192
Watershed area (ac) (not including lake)	61,274	58,596	15,023	567
Watershed area:lake ratio	84	73	67	4
Estimated Average Water Residence Time (years)	0.2	0.2	0.1	2.4
Public Access	2	2	0	0
Inlets	3	3	1	1
Outlets	1	1	1	1

4.2. Temperature & Dissolved Oxygen in the Lakes

Dissolved oxygen and temperature measurements reveal several things about a lake. If oxygen is absent in the bottom of the lake, phosphorus can be released from the lake sediments. If the temperature is the same from the top to the bottom of the lake in the open water season, all the water will mix. If oxygen is depleted over the winter, winterkill can occur. Examples of dissolved oxygen and temperature profiles are shown in Figure 16.

Winter oxygen levels can be low in the bottom water of all four lakes, however oxygen is present in the upper water column. In summer, the lakes are well mixed and oxygen is present throughout the summer.

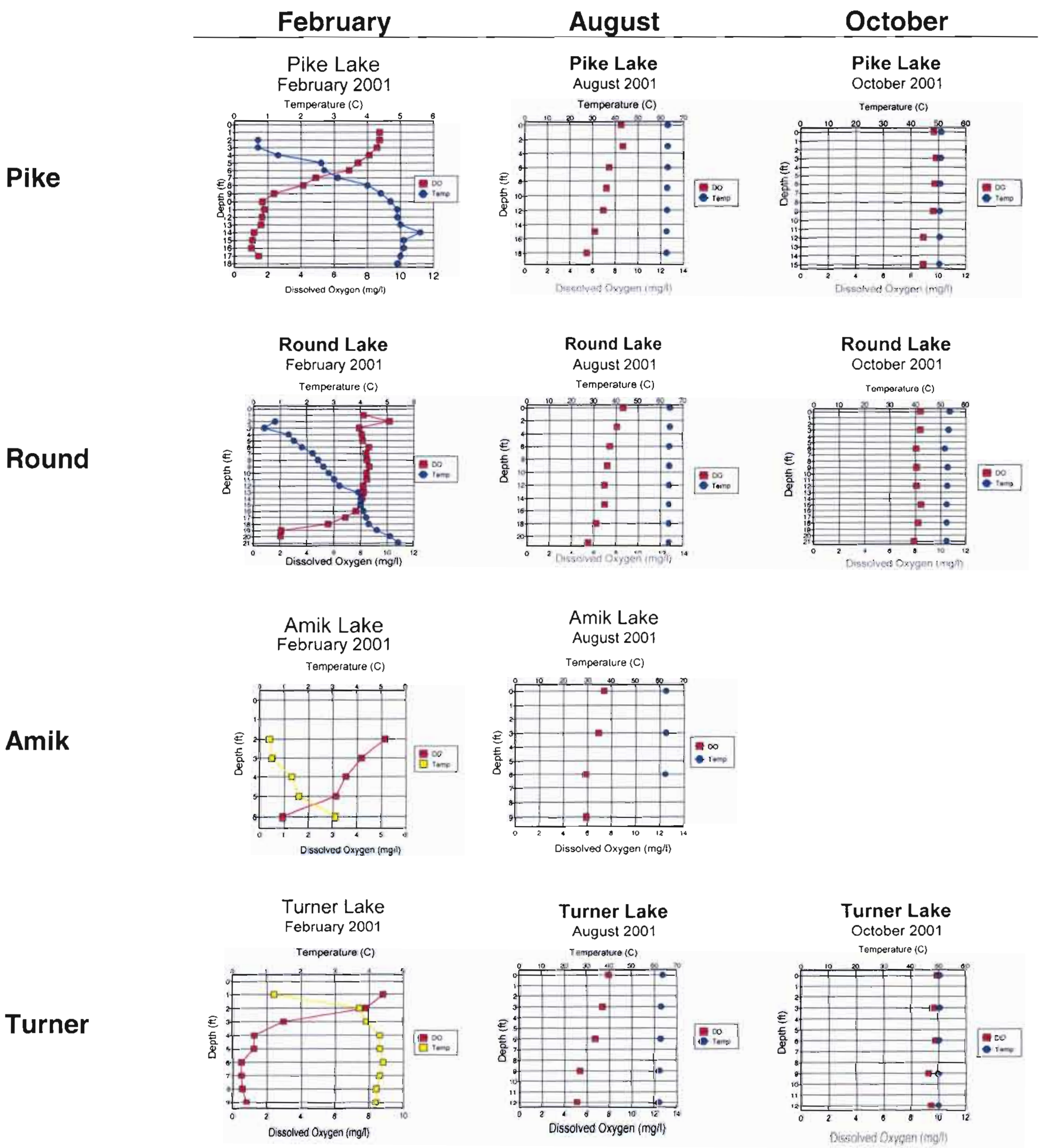


Figure 16. Dissolved oxygen/temperature profiles for Pike, Round, and Amik and Turner Lakes.

4.3. Water Quality Summary

Water testing was conducted by volunteers for the chain of lakes starting in the 1990s, with intensive efforts occurring from 1998 to the present. Lake monitoring has characterized lake water quality conditions and helped us to understand factors influencing water quality in all three lakes.

A summary of water chemistry data collected from 2000-2002 is shown in Table 9.

How does the water quality of the Chain compare to other lakes? The Chain of Lakes water quality parameters are compared to typical values for unimpacted lakes in the Northern Lakes and Forests Ecoregion in Table 9. For the three primary water quality parameters of Secchi disc, phosphorus, and chlorophyll, the Chain of Lakes have values that are outside the ranges of ecoregion lakes. The reasons for the water quality conditions of the Chain of Lakes appear to due to natural conditions and are related to the large watershed drainage area.

Figure 17. Water volunteer monitor Dallas Helm, one of several lake resident water quality monitoring volunteers.

For the most part, all four major lakes have similar water clarity and nutrient levels. When there is a thick growth of aquatic plants, Amik can be slightly clearer (as it was in 2000) compared to the other three lakes.

Table 9. Summary of water chemistry for the Pike Chain of Lakes.

Parameter	Northern Lakes & Forests	Pike			Round			Turner			Amik		
		2000	2001	2002	2000	2001	2002	2000	2001	2002	2000	2001	2002
Total phosphorus (ug/l) Epilimnion	14-27	26	31		30	33		23	30		16	36	
Chlorophyll (ug/l)	<10	--	21		--	17		--	13		--	13	
Chlorophyll - max (ug/l)	<15	--	38		--	24		--	18		--	23	
Secchi disc (ft)	8-15	3.7	3.8	3.5	5.1	3.9	4.6	3.5	4.9	3.5	6.8	5.1	4.1
Total kjeldahl nitrogen (mg/l)	<0.75	1.25	0.93		1.51	0.84		1.13	0.8		0.95	0.76	
TN:TP ratio	25:1-35:1	48:1	30:1		50:1	25:1		49:1	27:1		59:1	21:1	

A month by month water quality summary for 2001 is shown in Table 10. There was some differences between lakes on a month by month basis, but the summer averages for Secchi transparency and total phosphorus concentrations were similar.

What's interesting about the phosphorus results is that the top and bottom readings are similar. This indicates that there is not very much release of phosphorus from the lake sediments. If there was, the bottom phosphorus readings would be higher.

Table 10. Summer monthly water quality data for the Chain of Lakes in 2001.

Wisconsin State Laboratory of Hygiene	5.30.01				6.25.01				7.11.01				8.20.01				9.18.01			
	P	R	A	T	P	R	A	T	P	R	A	T	P	R	A	T	P	R	A	T
Total phosphorus (ppb) surface	28	26	33	25	27	26	32	27	25	22	35	29	37	39	34	37	37	52	47	33
bottom	33	25	33	31	29	29	33	35	23	32	28	35	32	33	34	45	39	47	45	31
Chlorophyll a (ppb)					8		9		11	11	11	4.9	38	17	10	17	26	24	23	18
Secchi disc (ft)	4	4.75	4.25	4.5	4.5	5	4.75	4	4.5	5.5	4	3.25	3	3	3.75	3.5	3.25	4.5	4.5	3.25
Kjeldahl N (mg/l)	0.78	0.7	0.77	0.7	0.7	0.59	0.65	0.67					1.2	1.04	0.8	0.85	1.04	1.02	0.8	0.98

In 1999 and 2000, lake water samples were sent to the University of Wisconsin-Stevens Point lab and a number of parameters were analyzed. Results showed alkalinity is low, but not dangerously low, and that the pH is slightly basic which is fine. An interesting result is the color results. All four lakes have relatively high color with Turner the lowest and Pike the highest. This color is a product of the inflowing streams bringing in dissolved substances from wetland drainage.

Table 11. Water chemistry data summary for the Chain of Lakes from the University of Wisconsin-Stevens Point results for 1999 and 2000 (P=Pike; R=Round; A=Amik; T=Turner).

Stevens Point Data	10.31.99				4.30.00				10.20.00			
	P	R	A	T	P	R	A	T	P	R	A	T
Total phosphorus (ppb)	29	32	24	32	27	27	29	31	26	30	16	23
Secchi disc (ft)	4.5	5.5	6.5	4.3	5	5.5	5.7	5.8	4.5	5.8	6.5	4.3
Color (SU)	93	83	48	49	107	79	59	39	100	71	66	33
Turbidity (NU)	2.2	1.6	2.2	2.4	1.7	1.9	1.9	2.4	0.6	0.9	0.4	0.6
Kjeldahl N (mg/l)	0.94	0.92	0.59	0.83	0.5	0.45	0.67	0.41	1.19	1.47	0.92	1.1
Nitrate/nitrite (mg/l)	<0.02	0	0.1	<0.02	0.1	0	<0.01	<0.01	0	0	0	0
Ammonia (mg/l)	<0.01	<0.01	0	<0.01	<0.01	<0.01	<0.01	<0.01	0.1	0	<0.01	0
pH	7.5	7.57	7.71	7.52	7.2	7.35	7.38	7.32	6.47	7.22	6.78	7.29
Alkalinity	33	32	44	32	28	31	38	34	24	32	34	36
Conductivity	73	72	89	70	59	67	70	63	77	69	82	69
Chloride (mg/l)	<0.5	<0.1	<0.5	<0.5	1.1	24.8	0.2	0.2	2	0.5	<0.5	<0.5
Sulfate (mg/l)	7.5	6	4	3.5	3.4	3.7	3.3	2.5	6.8	3	4.5	2.8
Sodium (mg/l)	1.9	1.8	1.7	1.5	1.8	1.7	1.4	1.4	1.8	1.7	1.6	1.4
Potassium (mg/l)	0.5	0.5	0.5	0.6	0.7	0.6	0.7	0.6	0.5	0.6	0.7	0.6
Magnesium (mg/l)	8	8	16	8	12	9.4	12.5	14.1	8.4	14.6	8.5	14
Calcium (mg/l)	24	24	28	24	20	22.6	25.5	21.9	23.6	21.4	27.5	22
Reactive phosphorus (ppb)	12	<2	10	<2	6	8	6	4	25	20	10	8
Total nitrogen (mg/l)	0.94	0.94	0.68	0.83	0.51	0.49	0.67	0.41	1.25	1.51	0.95	1.13
Total inorganic nitrogen		0	0.13		0	0			0.13	0.1	0	0.1
Total hardness (mg/l)	32	32	44	32	32	32	38	36	32	36	36	36
N/P ratio	32.4	29.4	28.3	25.9	18.9	18.1	23.1	13.2	48.1	50.3	59.4	49.1

Tucker Lake drains to Amik. It has a small watershed and good water quality. Notice it has a lower color content. That's because a relatively small wetland area drains to the lake.

Table 12. Snapshot of water quality conditions for Tucker Lake, a lake that drains to Amik Lake (shown in Figure 6, p. 3.3).

Tucker Lake (for comparison)	Lake size: 118 ac, Max. depth: 32 ft, Mean depth: 14 ft Watershed size (not including lake): 506 acres		
7/20/01	**3 feet**	**6 feet**	**Integrated Sample 0-6 ft**
Total phosphorus	11	15	15
Chlorophyll a	2	2	1.8
color (su)			10
Calcium (mg/l)			13
Alkalinity (mg/l)			47
Conductivity			106
pH			8.26
Magnesium (mg/l)			4.7
Nitrate-nitrogen			<0.01
Kjeldahl nitrogen			0.47
Turbidity			1.0

Table 13. Secchi disc transparency in feet.

	Pike				Round				Turner				Amik			
	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002
April 24		5														
30		5														
May 1										4.5						
5										4.5						
7							10	5/6								
8															3.25	
9													5.25			
14							5									
15		5								4.75						
16		5				6.5				4.75				6		
18															3.25	
20							5.5									
22		5	4							4.75					7	
25		5								4.75						
27				3.75/3.75				5/6				4/4	6.5			3.5/3.5
28							5									
29		5	4				4.5			5	4.75				4.25	
30			4/4				4.75				4.5				4.25/7	
31		5								5						
Jun 2	5								3							
3								5.5					6			
4							5									
5		5	4.25		6.5	5.75/5.75	4.75			5				6		
7										5		3.25/3.25				3.5/3.5
8		5	4.25	4.25/4.25							4.75			6		
9									3.5							
10								4.75/4.75					6			
11	5						5.25				4.25					
12		4.75/4.75	4.25		5.5	5.75/5.75	4.25			5/5				6/5.5		
14			4.25													
15												3/3				3.5/3.5
16													6			
17								4.75/4.75	3							
18	4						5.25							6		
19			4.5		5.25	5.75/5.75	4			4.25	6				4	
20				3.75/3.75												
21					6.5											
22			4.25								3.25				4	
23										4.25						
24	4.5			3.75/3.75				4.75/4.75	3				7			
25			4.5/4.5	3.75/3.75			5/5.25	4.25/4.25			4	4.5/4.5			4.75/4/4	4.25/4.25
26		4.4	4.5		5	5.75/5.75	3.25			3.75				7	4	
28					6.5					3.75						
29		4.5														
30								4.75/4.75						7		

	Pike				Round				Turner				Amik			
	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002
July 1	4.5												9			
2							5.25		3.5							
3		4.5	4.25			5.5/ 5.5	3			4				6	5	
4		4.5								4				6		
5					6.5											
6	5			3.75/ 3.75												
7			4.25								3	3.5/ 3.5			5	3/ 3
8								4.75/ 4.75								
9							5.25		3							
10		3	4.25			5.25/ 5.25	3.25			4	5.5		8		4	
11		3	4.25/ 4.5	3.25/ 3.25			5.5	3.75/ 3.75		4	3.25	3.25/ 3.25			4	3.25/ 3.25
12					5.5											
13	4															
15								4.5/ 4.5	3.5				7			
16							5.25									
17		3/ 3	4.75	3.75/ 3.75		5/ 5/ 4.5	3.5			3.75/ 3.75		3.75/ 3.75		7/ 6	4.25/	3.25/ 3.25
18											3.5			7		
19			4.75		5.25											
22	3.75							4.25/ 4.25							4	
23							5		3.75							
24			3.5			5/ 5	3.25			3	3			6		
25											3.25			6		
26				3.25/ 3.25	5							3.25/ 3.25				3.5/ 3.5
27			3.5													
28										3						
29	3						4.75	4.25/ 4.25	4				8			
31		3.25	3.25			4.75/ 4.75	3.5			3					4	

	Pike				Round				Turner				Amik			
	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002
Aug 1	2.75															
2	2.75			3/3	5							2.75/2.75				3.25/3.25
3		3.25	3.25								3.5				4	
5								4.25/4.25	3.25	3						
6							4						6.5			
7		2.75	3.25			4.5/4.75	4.5			2.5				6	3	
8		2.75	3	3/3							4.5					
9					5							3/3		6	3	4/4
11										2.5						
12	2.75							4.25/4.25								
13							3.75				2.75					
14		2.25	3			4.5/4.5	2.75		3	2.25	4.5				3	
15													6			
16				3/3.25/3.25	5							2.75/2.75				
17			3.25												3	5/5
19	3	2.25						4.25/4.25	3	2.25						
20			3/3				3/3.5				3.5		8		3.75	
21		2.75/2.75	2.75			4.25/4.25	3.5			2.5/2.25				4.75/4.75	5	
22				3.75/3.75												
23					5							2.5/2.5			5	5/5
24			2.75								3.5					
26	3			3.75/3.75/3.75				4.25/3.5/4.25/3.5				4/4				6.25/6.25
27							3.75		3.25				8			
28						4.25/4.25				2				9/9	6	
29										2						6/6
30					5							4.25/4.25				

	Pike				Round				Turner				Amik			
	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002	1999	2000	2001	2002
Sept 2	3.5							4.25/ 4.25	3.25							
3						4.25	3.75									
4		3				4.25				2.25				8		
5														8	6	
6		3			5					2.25						
7												3/ 3				5.5/ 5.5
8				3.5/ 3.5												
9								4.25/ 4.25								
10	3.5						4									
11			3.75			4.75/ 4.75				2						
13			3.75		5											
14										2		3/ 3				5/ 5
15								4.25/ 4.25								
16	3.5								3.75				8.25			
17							4.5									
18		3	3.25/ 3.25/ 3.25			5/ 5	2.75/ 4.5			2.25	3.25				8/ 4.5	
19										2.25						
20		3			5											
24	3.5							4.5/ 4.5	3		2.75	3.5/ 3.5				5/ 5
25			3.75			5.25/ 5.25	3.25/ 5			2.5/ 2.5						
27				2.75/ 2.75	5										8	
29	3.25															
30													8			
Oct 1			3.75	2.5/ 2.75/ 2.5			5.25	4.25/ 4.25				4.25/ 4.25				6.5/ 6.5
2						5.25/ 5.25	2.75		3	3						
3										3						
4					5						3.25					
6	4															
8							5.5									
9		4.5/ 4.5	5/ 5			5.5/ 5.5			3	4.75/ 4.75				8/ 8/ 6.25	8	
11					5						2.75	3.75/ 3.75			8	
14													8			
15	4															
16		4														
18					5											
20		4														
30														7		
31														7		
May-Sept Average	3.8	3.7	3.8	3.5	5.3	5.1	3.9	4.6	3.2	3.5	4.9	3.5	7.4	6.8	5.1	4.1
Number of Samples	19	30	38	34	19	36	41	43	16	42	21	34	16	23	32	34
Minimum	2.75	2.25	2.75	2.75	5	4.25	2.75	3.5	3	2	2.75	2.5	5.25	4.75	3	3
Maximum	5	5	4.75	4.25	6.5	6.5	10	6	4	5	6	4.5	9	9	8	6.25

4.3.2. Phosphorus

Phosphorus is a nutrient that is closely monitored in lakes because it is generally the nutrient that stimulates algae blooms. A graph of phosphorus concentrations for 1999, 2000, and 2001 for the four lakes is shown in Figure 19.

Lakes in the "Northern Lakes and Forests" Ecoregion typically have phosphorus concentrations less than 27 ppb. All four lakes hover around this concentration.

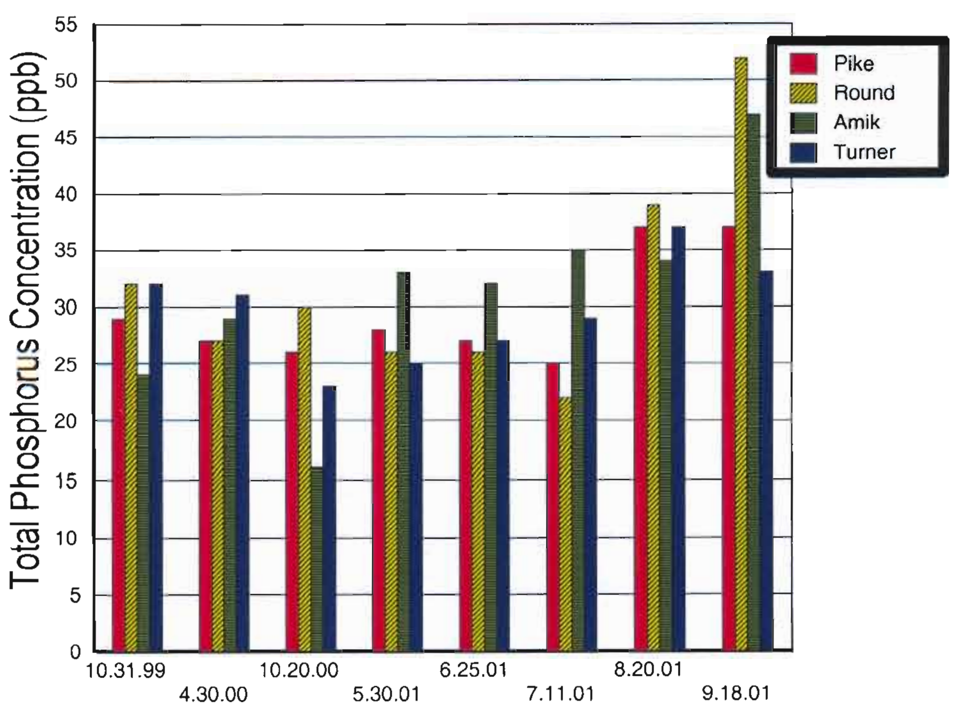


Figure 19. Pike, Round, Amik, and Turner Lakes total phosphorus concentrations for selected dates from October 1999 - September 2001.

Pike Lake Special Sample: The results of stream sampling and the deep water sampling indicated the main phosphorus source was from the stream inputs. The question was how does phosphorus vary from one end of the lake to the other. In August, Pike Lake was sampled in four locations (shown below). The results show Pike Lake is well mixed. The Musky Jack's sample was influenced by the Foulds Creek inflow, but the rest of the lake is influenced by Squaw Creek. A difference in 4 ppb is not much of a difference. For practical purposes, phosphorus levels are similar from the north end to the south end.

	8.3.01
	TP (ppb)
North Pike	24
South Pike	23
Squaw Lake	23
Musky Jacks Bay	20

4.3.3. Chlorophyll and Algae

The normal transition for algae in lakes over the summer months begins with diatoms which then die back while green algae become dominant. Next, the green algae die back and then blue-green algae become dominant. Typically, algae concentrations increase as the summer goes on. This is the pattern found in all four lakes over the summer of 2001. The amount of algae in a lake is often characterized by the chlorophyll content. So, analyzing for chlorophyll is a typical parameter to test for.

Results of chlorophyll testing over the summer of 2001 are shown in Figure 20. Turner and Amik Lakes have slightly lower chlorophyll results than Pike and Round.

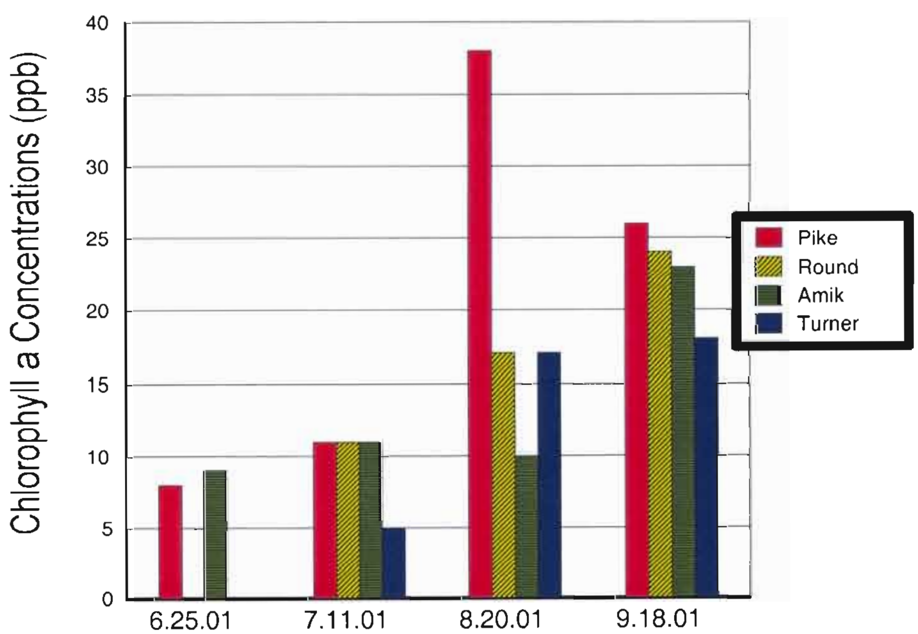


Figure 20. Chlorophyll levels for June, July, August, and September 2001.

Table 10. Chlorophyll a is a rough measurement of the amount of algae there is in a lake. Concentrations in 2001 are shown below.

Date	Pike	Round	Amik	Turner
6.25.01	8	--	9	--
7.11.01	11	11	11	5
8.20.01	38	17	10	17
9.18.01	26	24	23	18
Average	21	17	13	13

Algae bloom intensities can be assessed by the concentration of chlorophyll in a lake (Table 11). Pike had the highest algae levels of the four lakes.

Table 11. Chlorophyll a concentrations related to algae blooms for 2001 (MPCA 1994).

Chlorophyll a concentrations	Degree of algae bloom
0-9 μg/l	No bloom
10 - 20 μg/l	Mild bloom
21 - 29 μg/l	Nuisance bloom
30 μg/l and greater	Severe bloom

Water samples from Turner Lake were analyzed under the microscope for algae. By late summer, an important algae species was blue-green algae (Figure 21). The other lakes probably had the same situation.

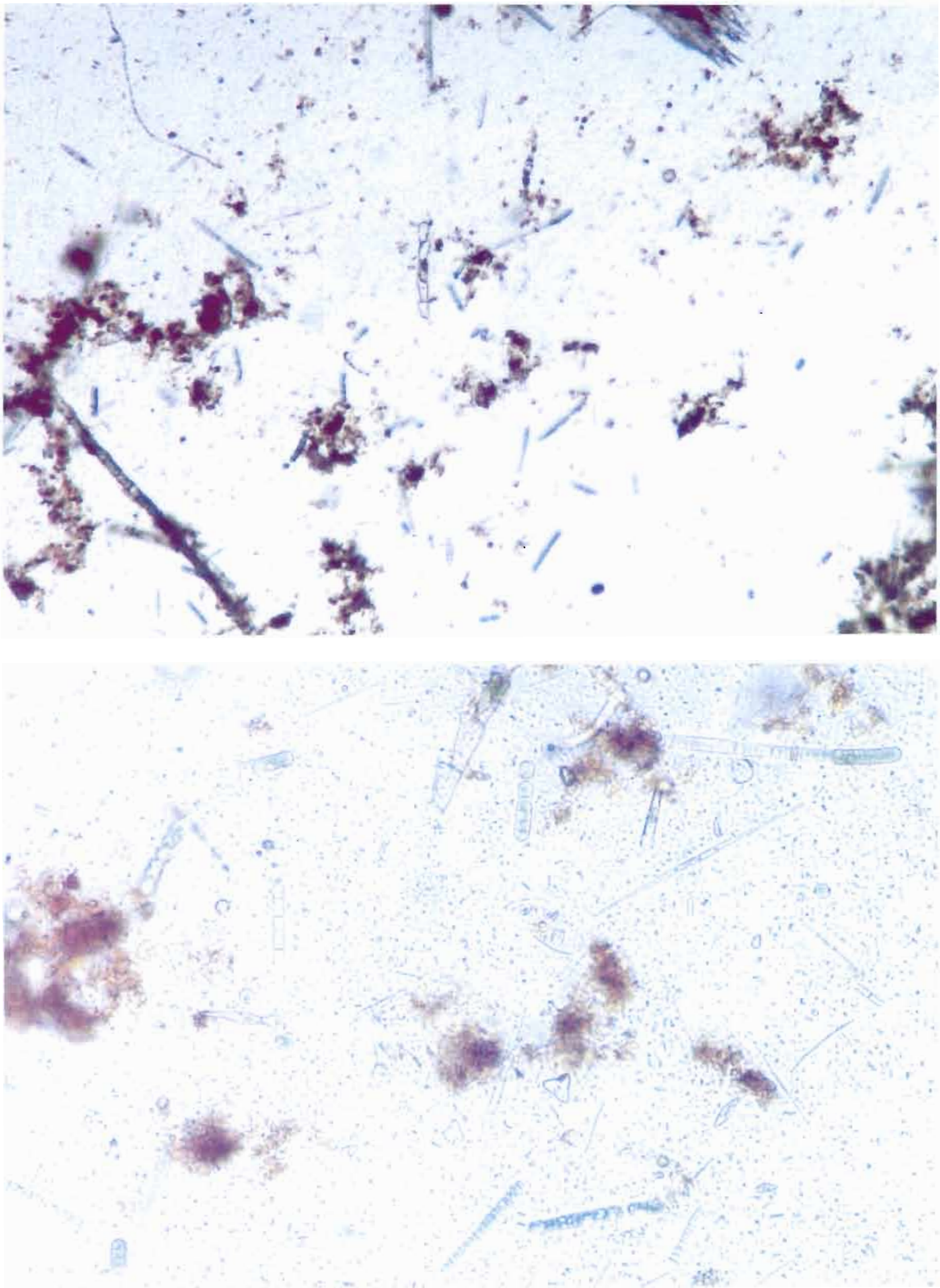


Figure 21. [top] An example of algae found in Turner Lake on August 4, 2001.
[bottom] The same sample from Turner Lake at a higher magnification.

4.4. Zooplankton and Other Invertebrates

Zooplankton are important in lakes. They graze on algae. If the algae population is composed of small algae cells, these are edible by zooplankton, and this grazing action can actually keep the lake relatively clear. The zooplankton community is composed of species of daphnia and copepods in the four lakes (Figures 22). The zooplankton communities are typical of lakes in this region.

However, there are a couple of invertebrates surprises. In Amik Lake, a colony of bryozoans is present. They are attached to tree branches and can grow to the size of a basketball, but a cantaloupe size is more common in Amik (Figure 23).

There is also a report of rusty crayfish in Round Lake. They are regional exotics and not desirable for a lake. They can decimate plant beds. They will be monitored in the future as one of the lake management recommendations.

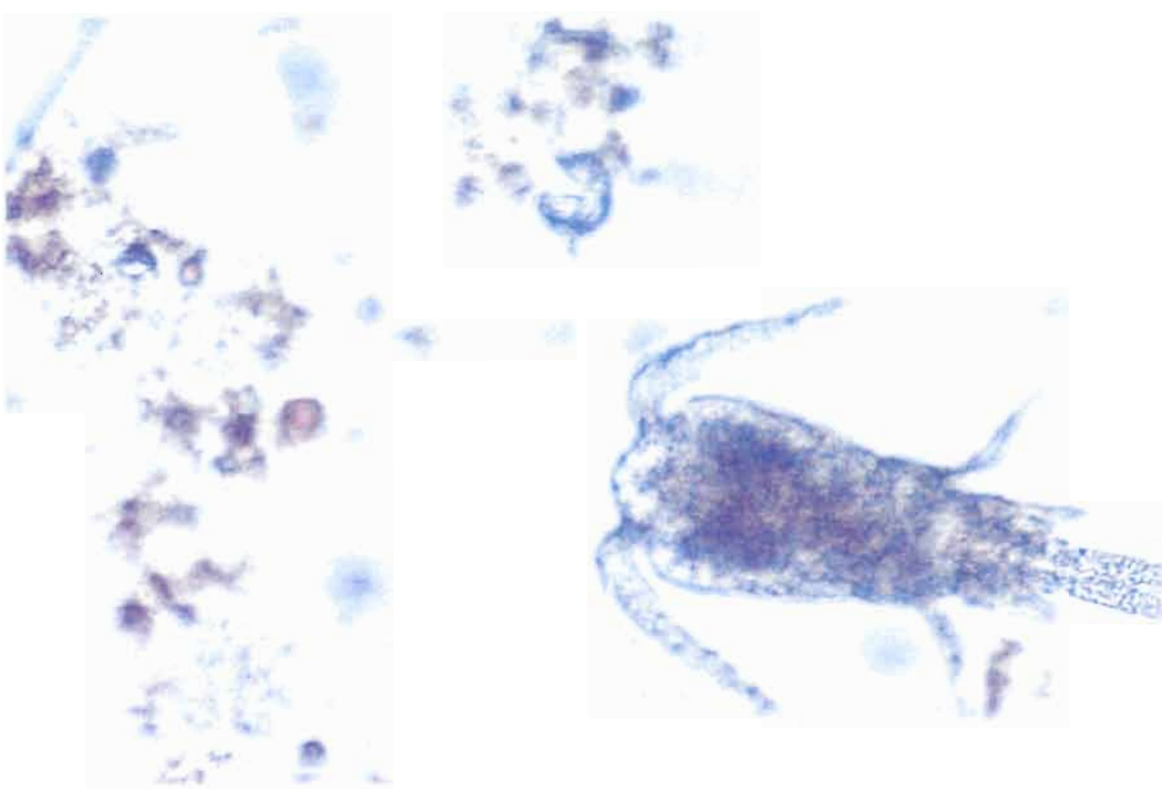


Figure 22. Example of a zooplankton species from Turner Lake, July 2001.

Figure 23. [top] Bryozoan colonies found in Amik Lake, August 4, 2001.
[bottom] Rusty crayfish like the one shown above have been found in Round Lake.

4.5. Aquatic Plant Status

Aquatic plants are very important to lakes. They act as nurseries for small fish, refuges for larger fish, and they help to keep the water clear. Currently Pike, Round, Amik and Turner Lakes have a wide diversity of aquatic plants, but coverage varies greatly among the four lakes..

The coverage and abundance of aquatic plants for Pike, Round, and Amik and Turner Lakes is summarized in Table 12 and is discussed for individual lakes in the next few pages. Specific details on aquatic plant surveys are available in the Appendix.

Of the submerged plants, water celery is the most common in the four lakes. Flatstem pondweed and claspingleaf pondweed also are found in all four lakes.

Pike Lake and Amik Lake has the highest number of submerged and floatingleaf plant species.

Figure 24. Coontail, a native, non-rooted plant was found in low densities in Pike Lake, June 2001, but found in high densities in Amik Lake.

Table 12. Summary for Pike Chain of Lakes aquatic plant occurrences for 2001.

	Percent Occurrence of Aquatic Plants			
	Pike (44 stations)	Round (44 stations)	Amik (22 stations)	Turner (24 stations)
Pickerel plant (*Pontederia cordata*)	11	--	14	17
Arrowhead (*Sagittaria sp*)	--	--	5	--
Three square (*Scirpus americanus*)	--	5	--	--
Bulrush - softstem (*Scirpus validus*)	7	9	5	13
Cattails (*Typha sp*)	--	5	5	--
Watershield (*Brasenia Schreberi*)	11	--	5	4
White waterlily (*Nuphar sp*)	9	--	45	13
Spatterdock (*Nuphar variegatum*)	16	7	18	8
Floatingleaf burreed (*Sparganium sp*)	18	--	5	--
Coontail (*Ceratophyllum demersum*)	7	--	64	33
Chara (*Chara sp*)	2	16	--	--
Elodea (*Elodea canadensis*)	2	--	--	38
Pipewort (*Eriocaulon septangulare*)	--	--	--	8
Northern watermilfoil (*Myriophyllum sibiricum*)	9	2	41	33
Naiads (*Najas sp*)	57	27	5	--
Nitella (*Nitella sp*)	--	7	--	--
Cabbage (*Potamogeton amplifolius*)	--	--	41	13
Ribbon-leaf pondweed (*P. epihydrus*)	--	--	36	13
Variable pondweed (*P. gramineus*)	9	25	--	--
Illinois pondweed (*P. illinoensis*)	--	--	18	--
Floatingleaf pondweed (*P. natans*)	5	--	9	--
Stringy pondweed (*P. pusillus*)	20	--	5	8
Claspingleaf pondweed (*P. richardsonii*)	23	25	23	17
Fern pondweed (*P. robbinsii*)	7	2	45	67
Flatstem pondweed (*P. zosteriformis*)	11	2	36	17
Bladderwort (*Utricularia sp*)	2	--	32	--
Water celery (*Vallisneria americana*)	59	50	23	46
Number of submerged and floatingleaf species	17	10	17	14

Pike Lake

Pike Lake has a lot of different aquatic plant species, its just that they only grow in shallow water (in water less than 6 feet deep). Water celery and naiads were the most common species (summarized in Table 12). Floatingleaf species were present and were pretty in the areas that they colonized.

A unique feature of Pike Lake is the bottom covering of wooden slabs in the north shore of the southern bay. They were discarded into the bay during the sawmill operation. No aquatic plants were found (Transect 10 on the map, Figure 27), but they offer some habitat for fish and invertebrates.

Figure 25. Discarded wooded slabs from the sawmill operation are still found in a southern bay of Pike Lake.

Figure 26. Examples of floatingleaf plants in Pike Lake consisting of watershield and Sparganium on July 26, 2001.

Pike Lake (806 acres)
(maximum rooted plant depth = 6 feet)

Figure 27. Pike Lake aquatic plant map based on the 2001 survey conducted by Blue Water Science.

Round Lake

Round Lake has the number of aquatic species of the four lakes with 10. Water celery (Figure 28) is the most common plant with naiads and claspingleaf also being common (summarized in Table 12).

Plants only grew out to a depth of six feet. Plant coverage is shown in Figure 29.

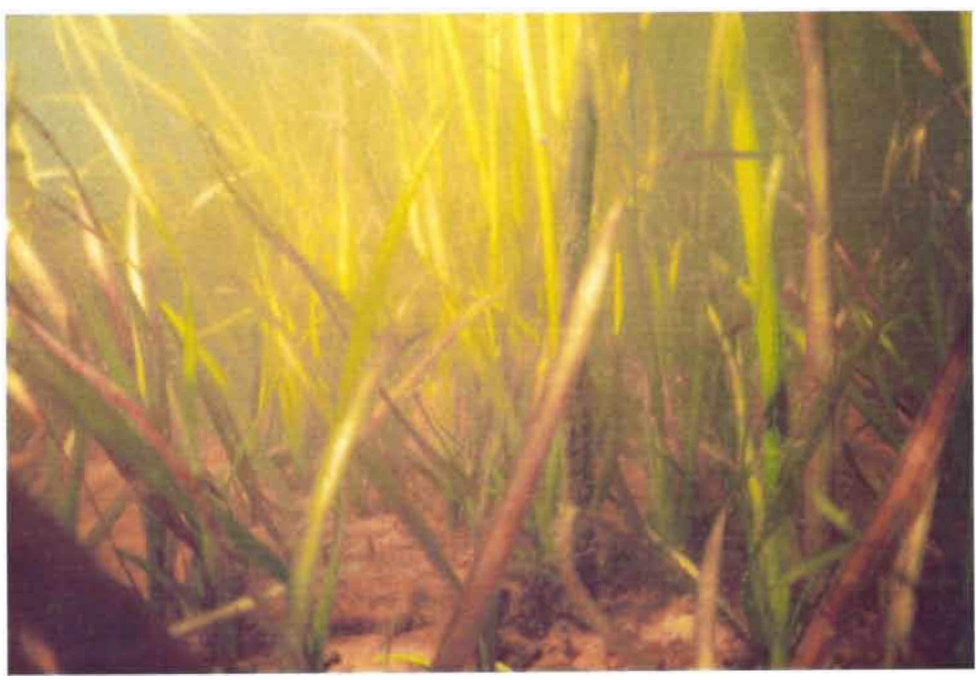


Figure 28. Underwater picture of water celery in Round Lake on July 26, 2001.

Round Lake (726 acres)
(maximum rooted plant depth = 6 feet)

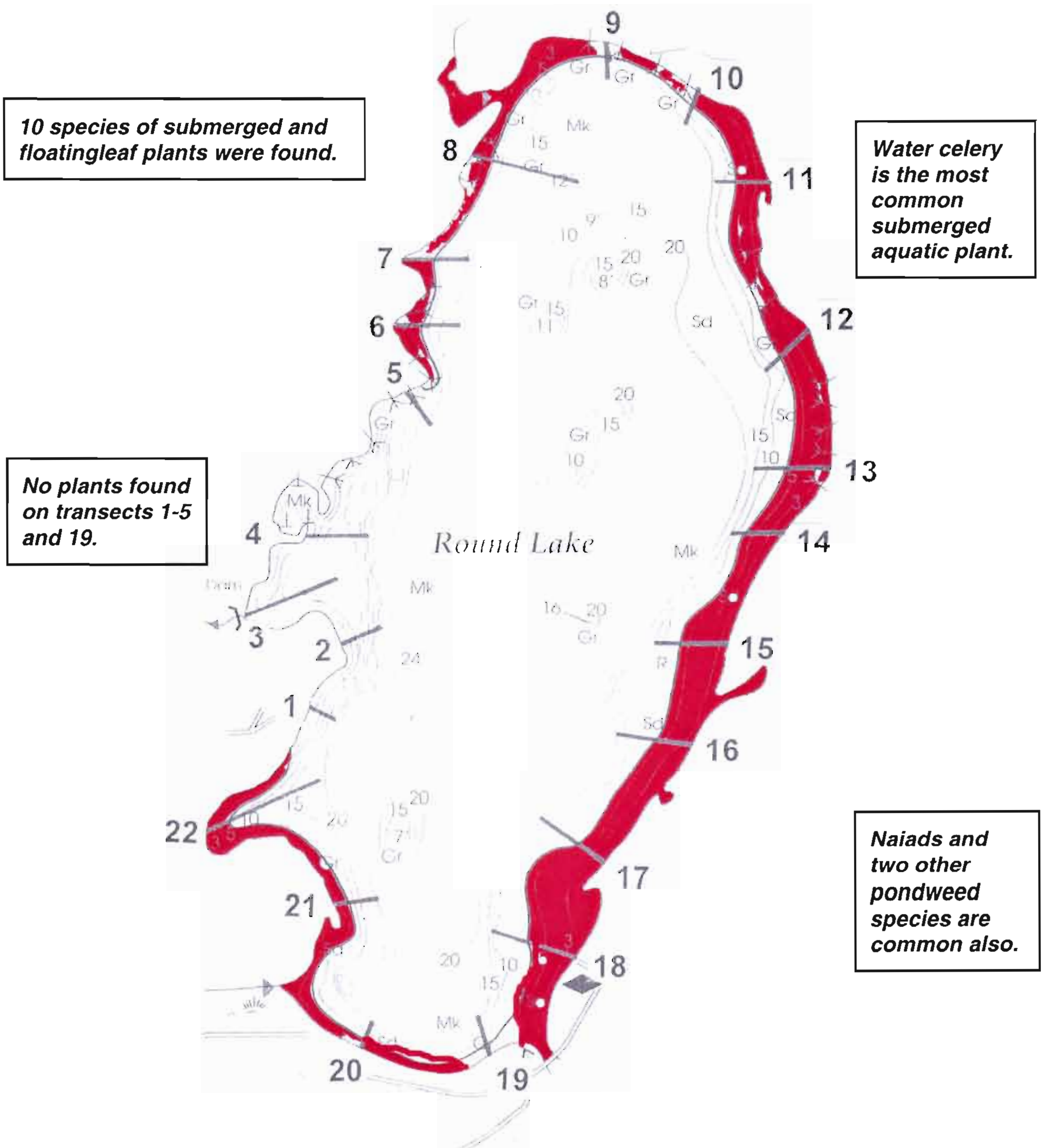


Figure 29. Round Lake aquatic plant map based on the 2001 survey conducted by Blue Water Science.

Amik Lake

Amik Lake has a rich plant community with over 17 species of floatingleaf and submerged plants. Coontail was the most common species followed by a half dozen other species. Amik Lake is shallow and plant growth can be found throughout the lake, but generally scattered. Plant growth is robust along the nearshore areas (Figure 30).

An interesting plant species in Amik Lake is cabbage (*Potamogeton amplifolius*). In 2000 it was reported to cover almost the entire lake basin. However, in 2001, cabbage was present, but scattered. It had the appearance of a die-back. Upon inspection of leaves and stems, we found that aquatic insect larvae were apparently feeding on the leaves and stems of the cabbage probably causing the die back. Its possible this insect could be responsible for controlling the excessive growth of cabbage (Figure 31).

It appears cabbage will not be a long-term problem in Amik. The good news is that the abundant vegetation will help keep water quality good. The only downside is a couple of residences have a slight problem getting to open water.

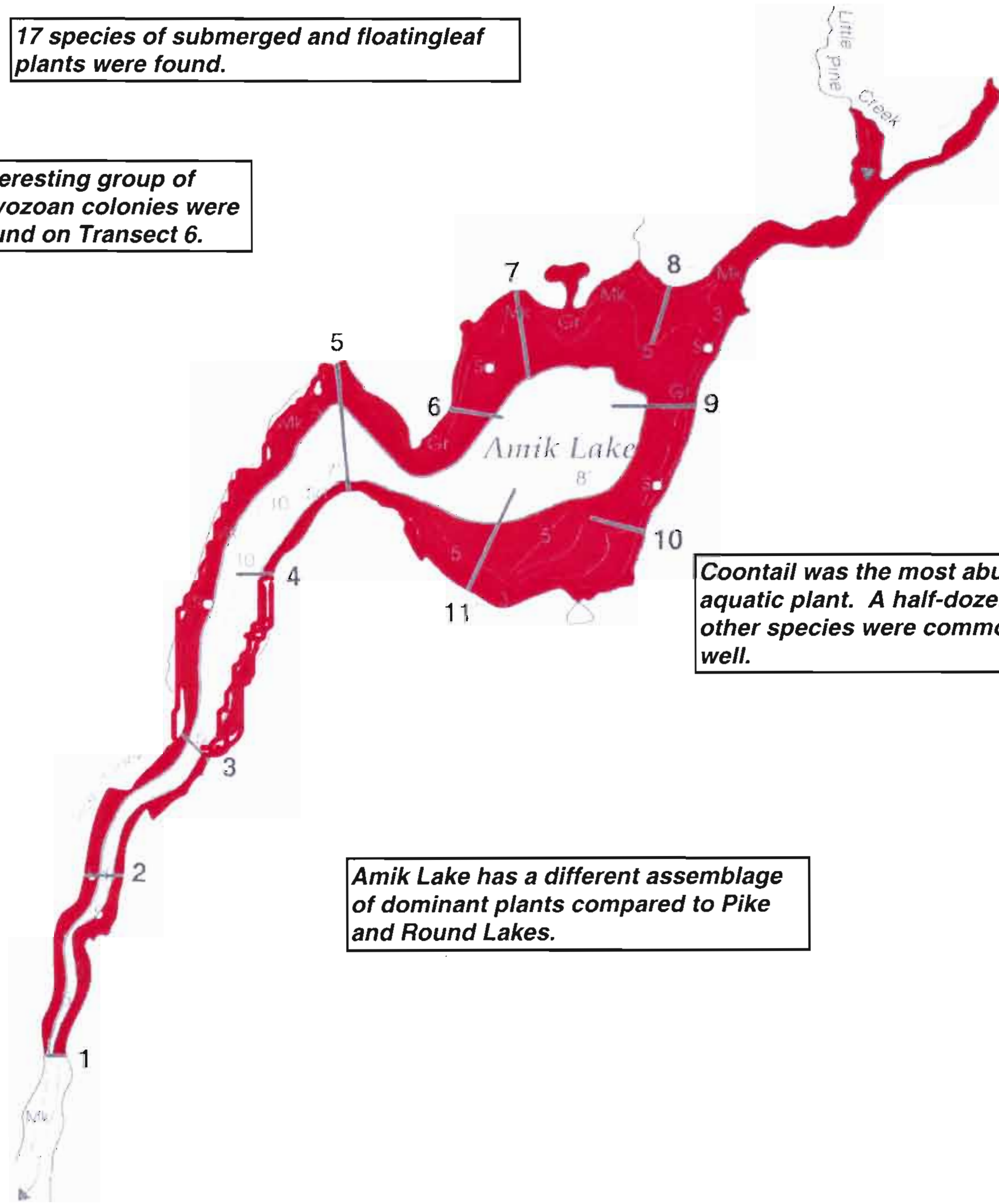
Figure 30. Nearshore growth of aquatic vegetation in Amik Lake, July 2001.

Figure 31. [top] This chironomid species was found on the underside of cabbage leaves in Amik Lake in 2001.
[bottom] At the time of the plant survey on July 26, 2001, much of the cabbage community was found scattered and not at nuisance densities.

Amik Lake (224 acres)
(maximum rooted plant depth = 6 feet)

17 species of submerged and floatingleaf plants were found.

Interesting group of bryozoan colonies were found on Transect 6.



Coontail was the most abundant aquatic plant. A half-dozen other species were common as well.

Amik Lake has a different assemblage of dominant plants compared to Pike and Round Lakes.

Figure 32. Amik Lake aquatic plant map based on the 2001 survey conducted by Blue Water Science.

Turner Lake

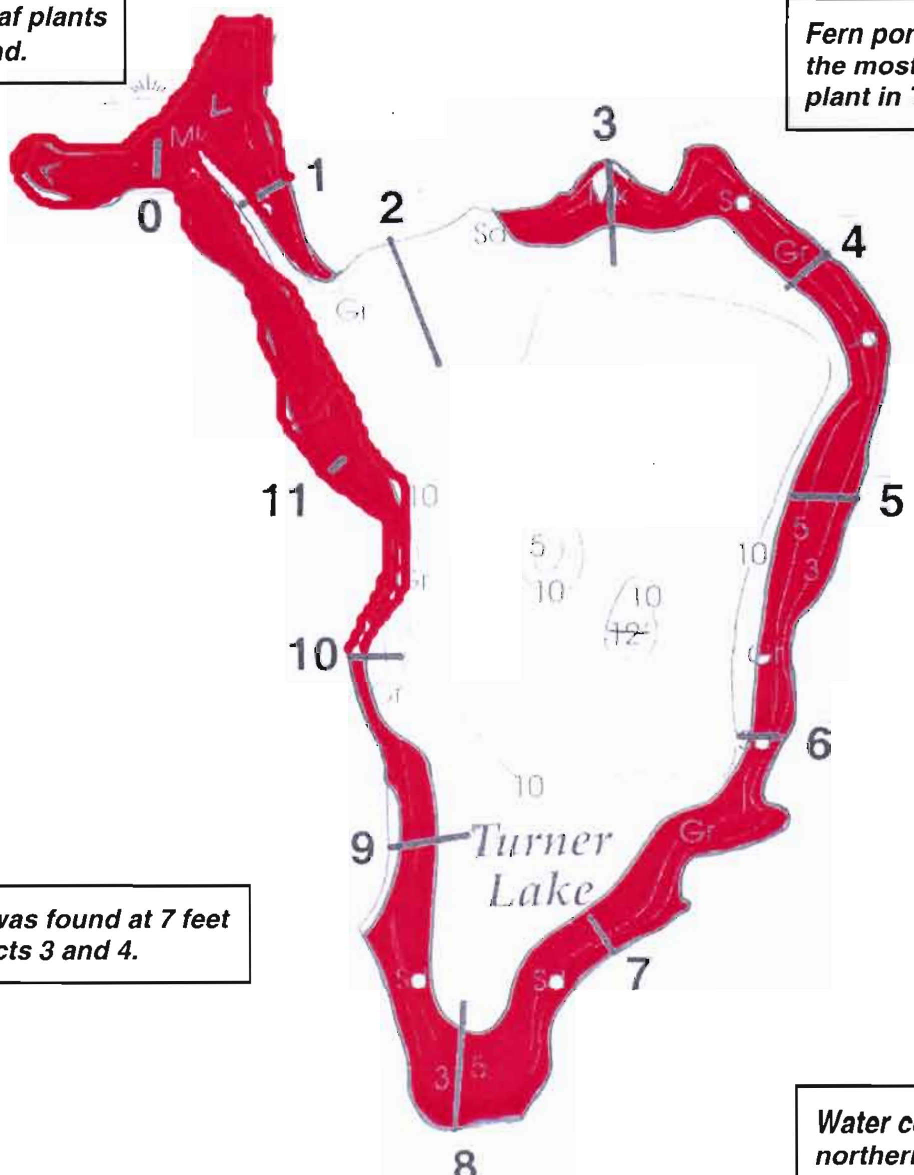
Turner Lake has a diverse aquatic plant community dominated by fern pondweed, followed by water celery, and several other species (Figure 33). Plant growth goes out to about 7 feet of water depth. Slightly better than Pike and Round Lakes. Plant coverage is shown in Figure 34.

Figure 33. [top] Nearshore vegetation in Turner, on August 4, 2001. [bottom] Water celery and elodea collected during the plant survey on Turner Lake in 2001.

Turner Lake (149 acres)
(maximum rooted plant depth = 7 feet)

14 species of submerged and floatingleaf plants were found.

Fern pondweed was the most common plant in Turner Lake.



Coontail was found at 7 feet on transects 3 and 4.

Water celery, elodea, northern watermilfoil, and coontail were common as well.

Figure 34. Plant map of Turner Lake.

Emergent Plants in the Pike Chain of Lakes

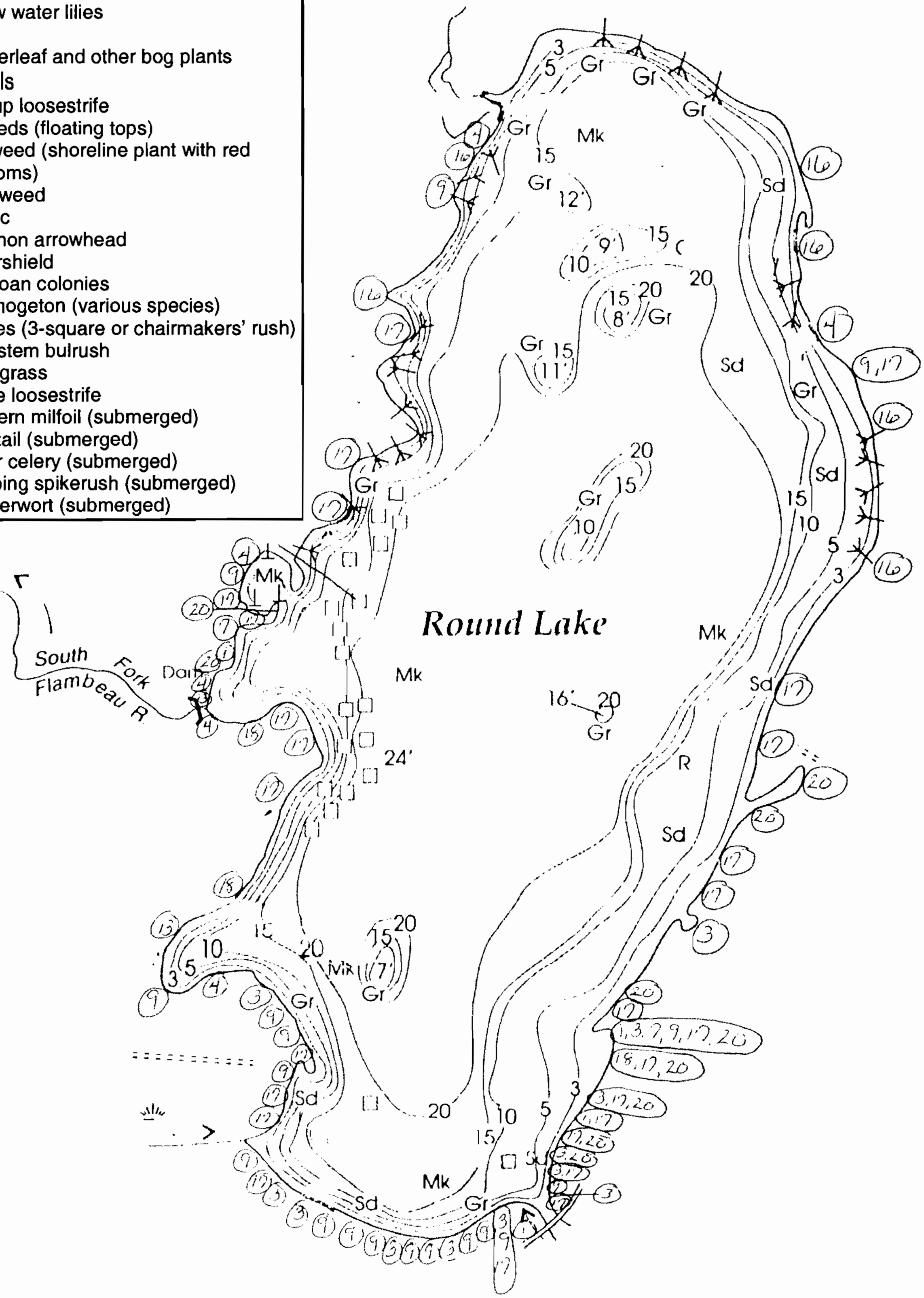
Emergent plants supply critical aquatic habitat and invaluable lake aesthetics as well as supplying water quality benefits.

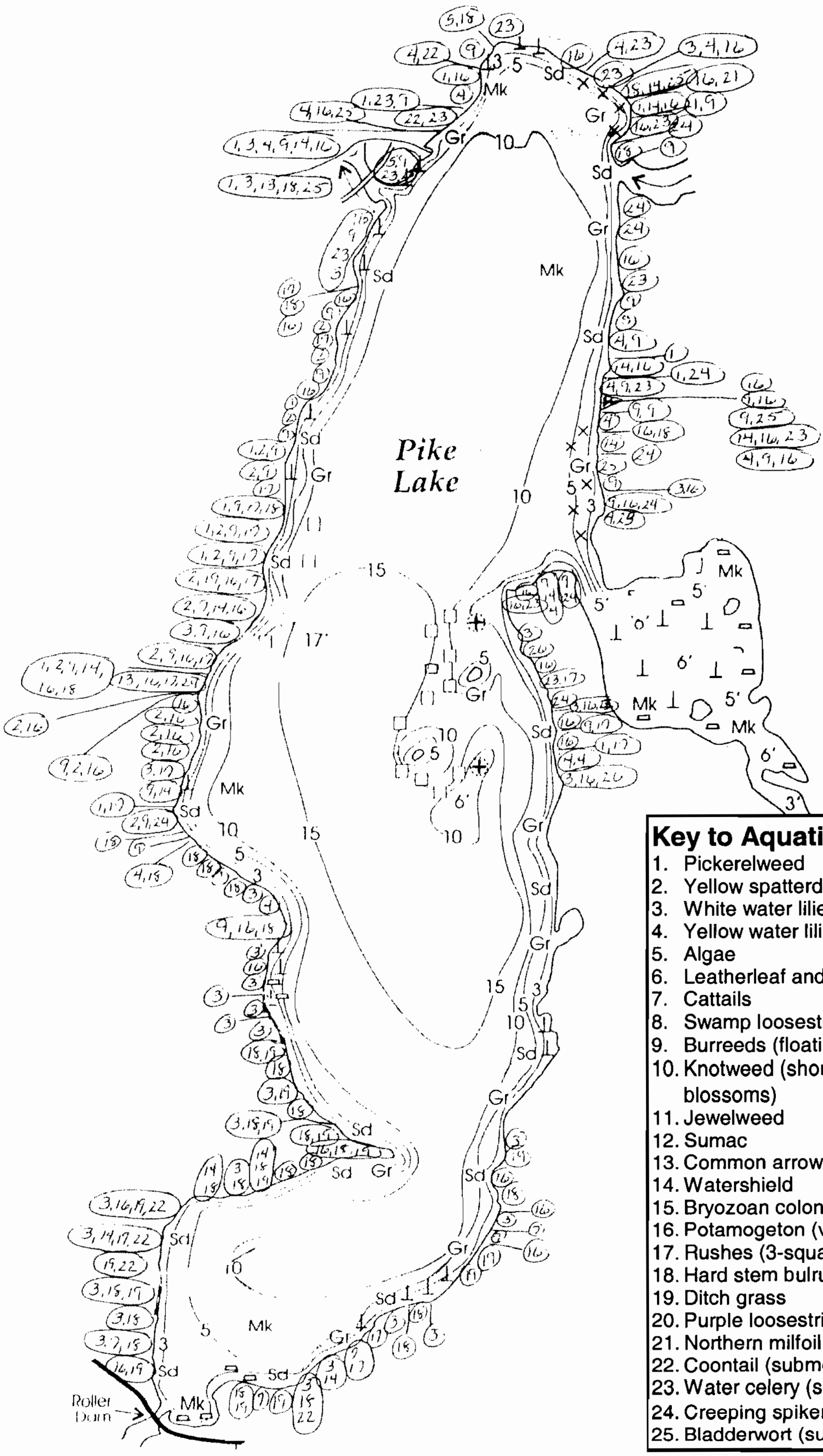
Lake residents organized into teams and surveyed nearly the entire shoreline of the Pike Chain of Lakes. Results of their survey efforts are shown on the next four pages.

Figure 35. Floatingleaf plants (mostly water lilies) and emergent vegetation along the shoreline somewhere on the Pike Chain.

Key to Aquatic Plants

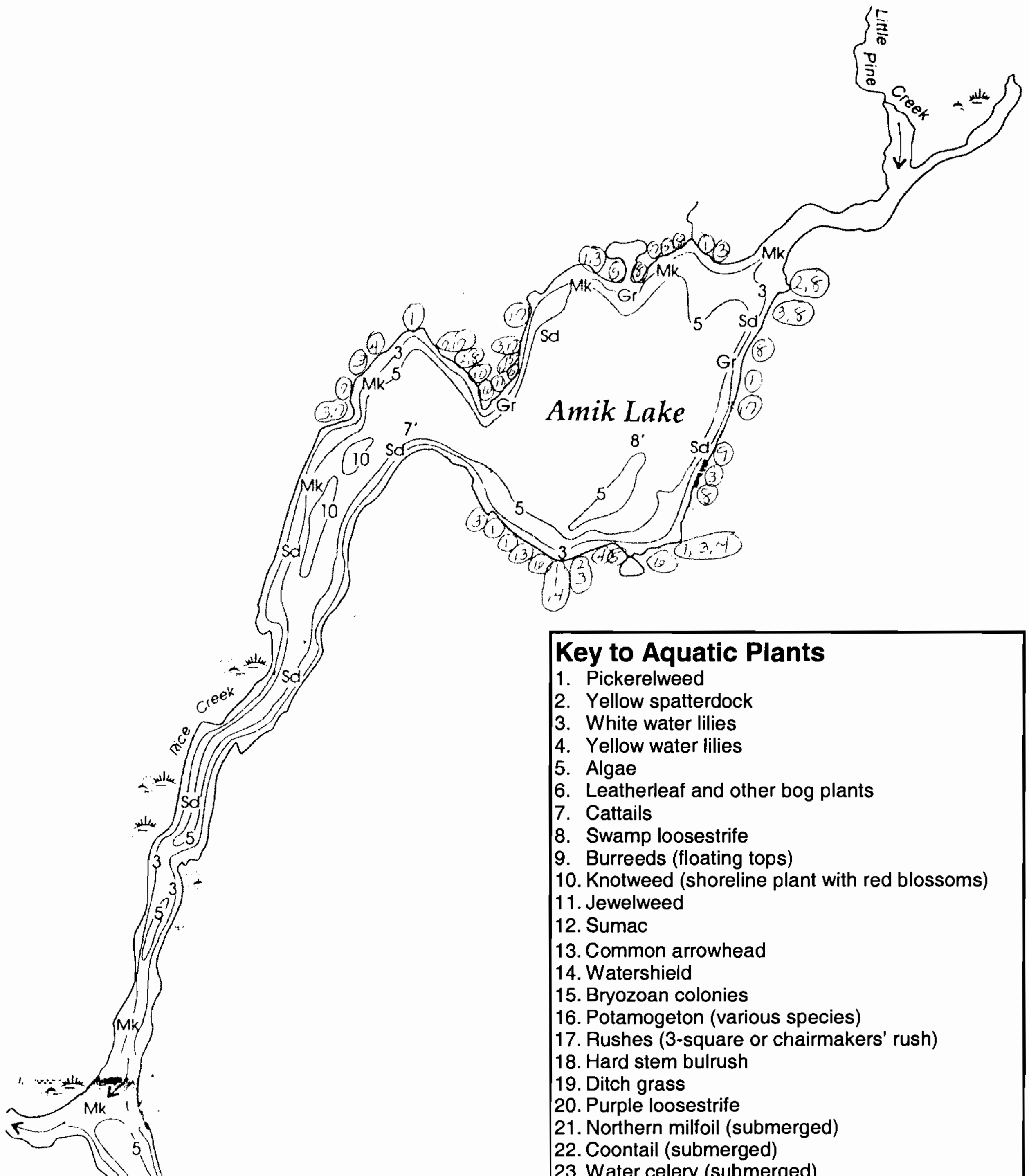
1. Pickerelweed
2. Yellow spatterdock
3. White water lilies
4. Yellow water lilies
5. Algae
6. Leatherleaf and other bog plants
7. Cattails
8. Swamp loosestrife
9. Burreeds (floating tops)
10. Knotweed (shoreline plant with red blossoms)
11. Jewelweed
12. Sumac
13. Common arrowhead
14. Watershield
15. Bryozoan colonies
16. Potamogeton (various species)
17. Rushes (3-square or chairmakers' rush)
18. Hard stem bulrush
19. Ditch grass
20. Purple loosestrife
21. Northern milfoil (submerged)
22. Coontail (submerged)
23. Water celery (submerged)
24. Creeping spikerush (submerged)
25. Bladderwort (submerged)





Key to Aquatic Plants

1. Pickerelweed
2. Yellow spatterdock
3. White water lilies
4. Yellow water lilies
5. Algae
6. Leatherleaf and other bog plants
7. Cattails
8. Swamp loosestrife
9. Burreeds (floating tops)
10. Knotweed (shoreline plant with red blossoms)
11. Jewelweed
12. Sumac
13. Common arrowhead
14. Watershield
15. Bryozoan colonies
16. Potamogeton (various species)
17. Rushes (3-square or chairmakers' rush)
18. Hard stem bulrush
19. Ditch grass
20. Purple loosestrife
21. Northern milfoil (submerged)
22. Coontail (submerged)
23. Water celery (submerged)
24. Creeping spikerush (submerged)
25. Bladderwort (submerged)



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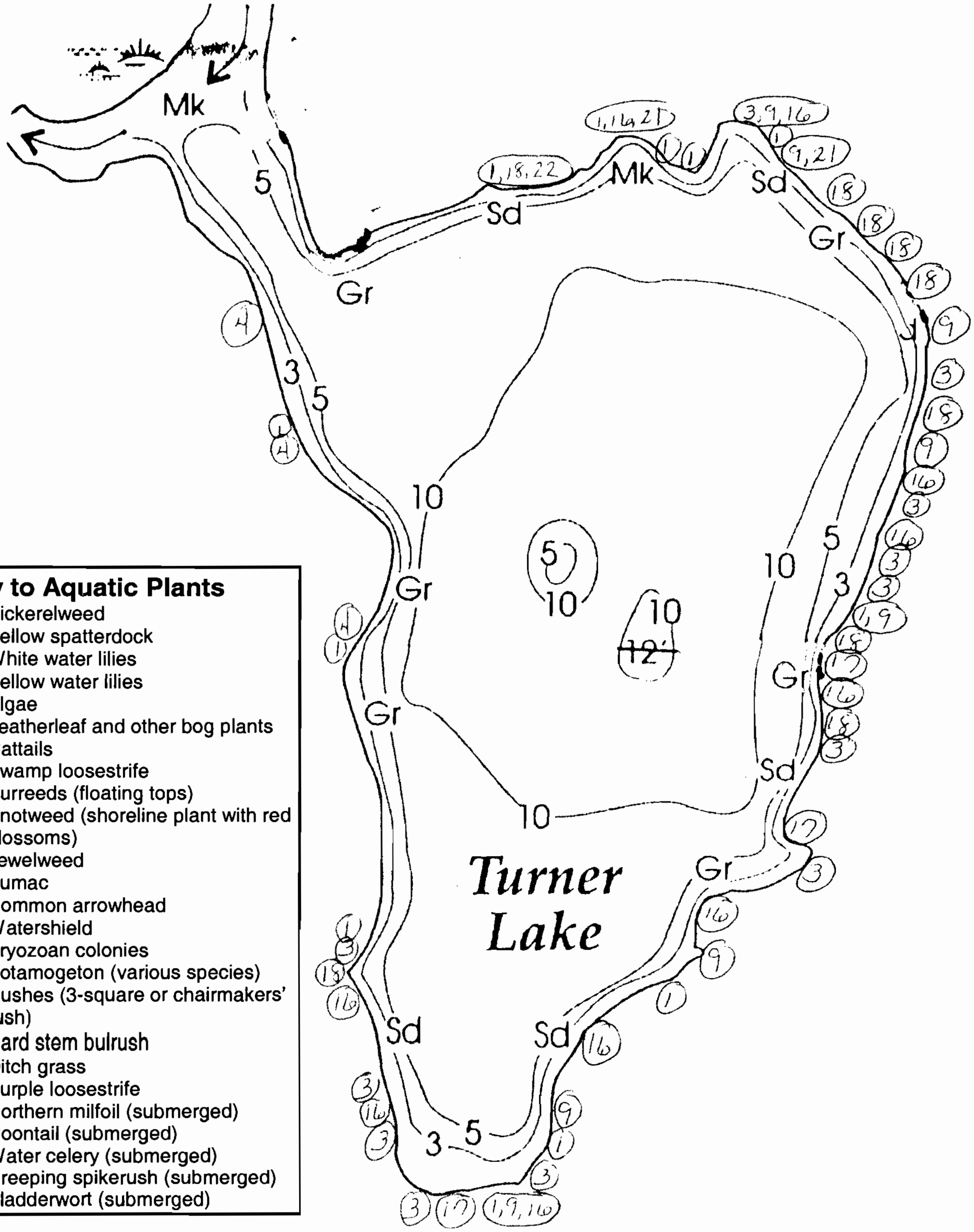

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4.6. Fishery Status

Fishing is an important recreational activity of the Pike Lake Chain. Within the sport fishery, muskies and walleyes are important species but crappies are important as well.

This type of information was collected by talking to anglers on the lake, Over an 18-month time span, the WDNR conducted a creel survey on the Pike Lake Chain. Interviews were conducted over summer and through winter. Results are shown in Figure 36 and 37 and in Table 13.

Some of the results included the following:

- Anglers spent the most time pursuing muskies and walleyes on Pike and Round Lakes (Figure 36).
- Panfish were the most frequently caught fish and Turner Lake produced the most panfish on a per acre basis (Figure 37).
- Muskies were the most difficult fish to catch, taking over 20 hours to catch a fish. Largemouth bass were easier to catch except in Pike Lake (Figure 37).

A number of other "fish facts" regarding fish lengths of species caught, how many fish caught and released, and hours of fishing are found in Table 13.

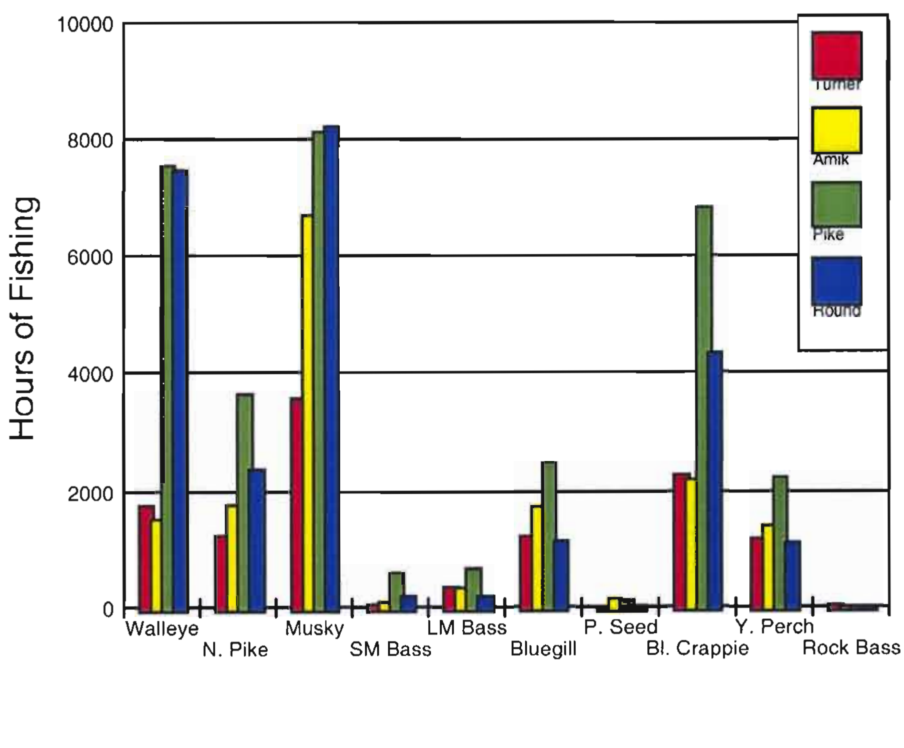
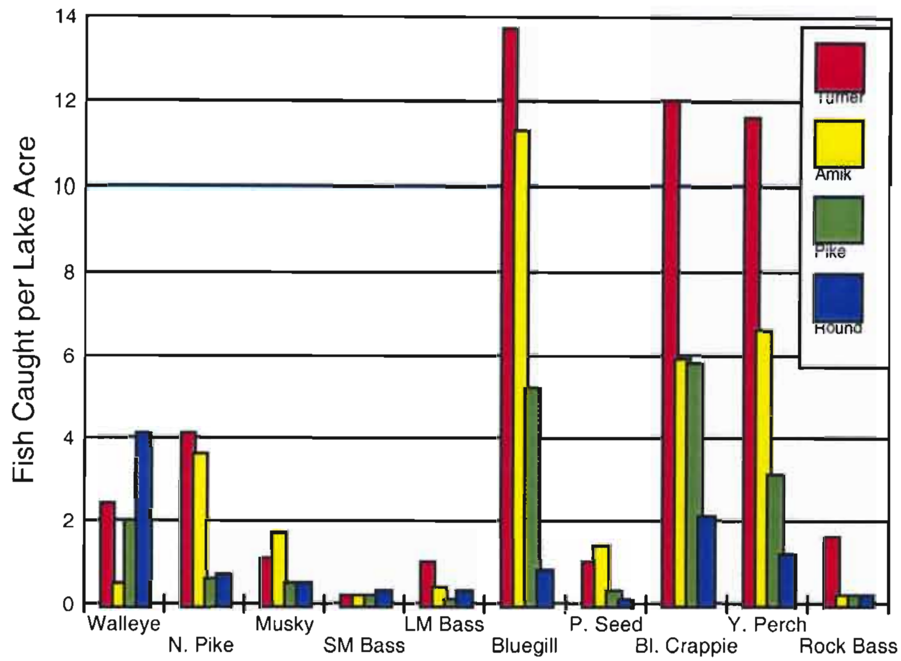


Figure 36. Hours of fishing for various species in the Chain based on creel survey results.



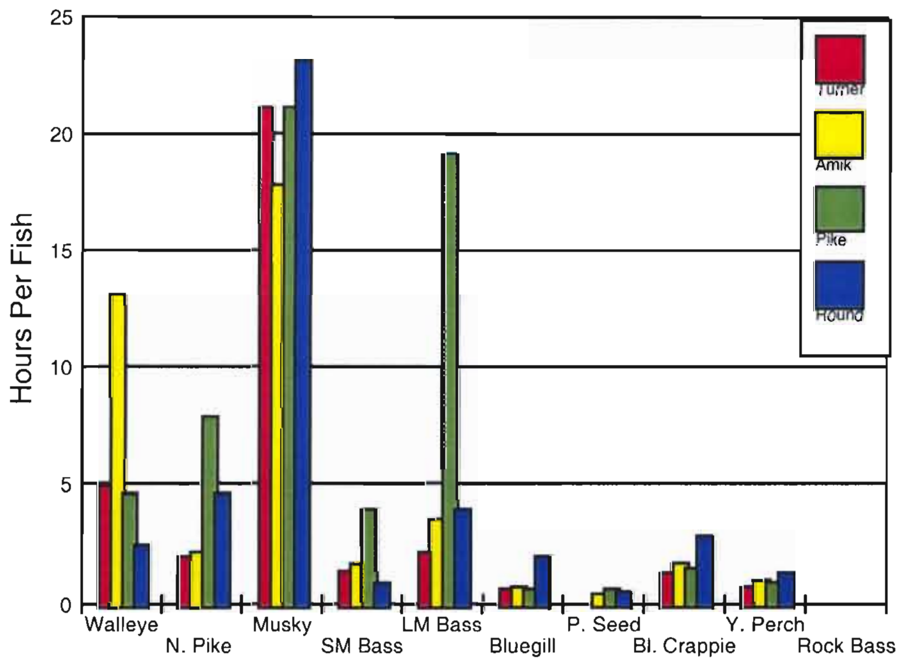


Figure 37. [top] Fish caught per acre based on the creel survey.
[bottom] The average number of hours it took to catch a fish of the targeted species that anglers were pursuing.

Table 13. Summary of creel census data collected on the Pike Chain over 1999 and 2000.

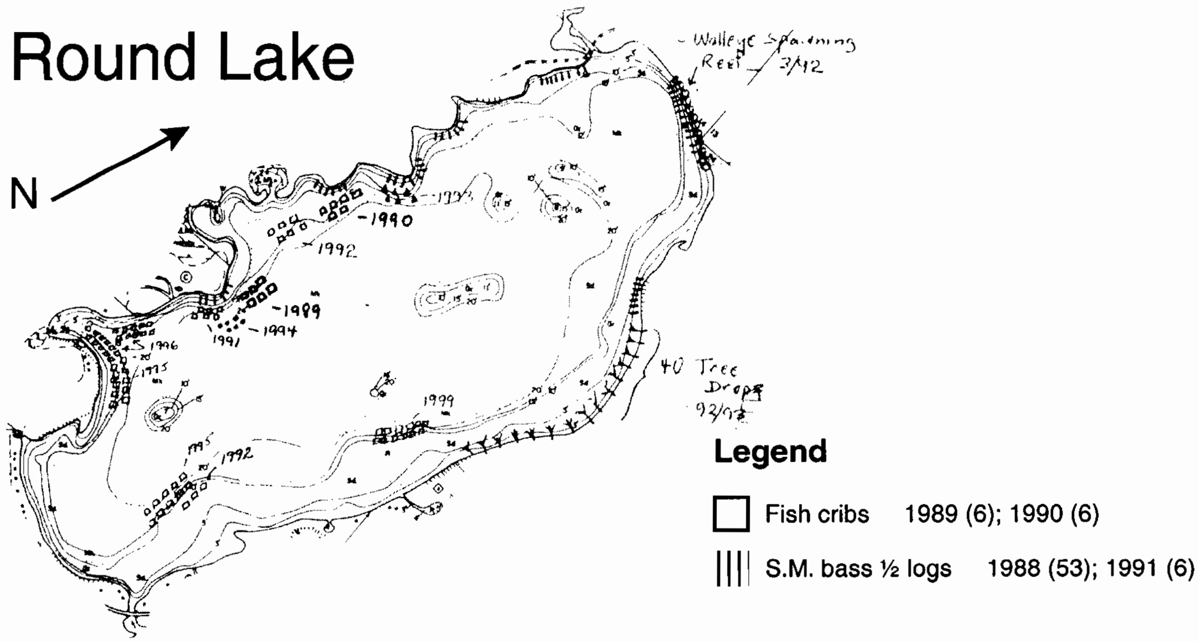
Species	Lake	Hours of Fishing	Percent Hours for that Species	Catch	Fish Caught per Acre	Hours Per Fish	Percent Harvested	Mean Length of Harvested Fish
Walleye	Turner	1766	15	358	2.4	4.9	36	14.8
	Amik	1520	10	116	0.5	13.1	66	11.9
	Pike	7530	23	1621	2	4.6	23	12.9
	Round	7459	30	2981	4.1	2.5	23	12.6
N. Pike	Turner	1239	11	610	4.1	2	10	20.7
	Amik	1770	11	801	3.6	2.2	7	21.4
	Pike	3625	11	465	0.6	7.8	20	22.9
	Round	2394	10	521	0.7	4.6	3	25.1
Musky	Turner	3561	31	169	1.1	21.1	0	--
	Amik	6678	42	375	1.7	17.8	0	--
	Pike	8111	25	384	0.5	21.1	0	--
	Round	8207	33	354	0.5	23.1	0	--
SM Bass	Turner	37	0.3	27	0.2	1.4	0	--
	Amik	85	0.5	50	0.2	1.7	0	16.6
	Pike	598	2	149	0.2	4	3	14.3
	Round	190	0.8	223	0.3	0.9	9	15
LM Bass	Turner	340	3	155	1	2.2	0	--
	Amik	326	2	90	0.4	3.6	0	--
	Pike	669	2	35	0.1	19.1	0	--
	Round	188	0.8	47	0.3	4	0	--
Bluegill	Turner	1223	11	2040	13.7	0.6	26	7.6
	Amik	1755	11	2542	11.3	0.7	39	7
	Pike	2515	8	4172	5.2	0.6	54	6.6
	Round	1141	5	580	0.8	2	42	7
P. Seed	Turner	0	0	152	1	BC	9	6
	Amik	138	1	318	1.4	0.4	40	6.1
	Pike	115	0.4	207	0.3	0.6	20	6.7
	Round	14	0.1	31	0.1	0.5	81	6.5
Bl. Crappie	Turner	2304	20	1790	12	1.3	50	10
	Amik	2212	14	1315	5.9	1.7	52	9.5
	Pike	6816	21	4698	5.8	1.5	70	9.6
	Round	4330	17	1510	2.1	2.9	48	10
Y. Perch	Turner	1179	10	1723	11.6	0.7	8	8.2
	Amik	1404	9	1469	6.6	1	27	7.3
	Pike	2250	7	2460	3.1	0.9	32	7.6
	Round	1111	4	837	1.2	1.3	24	7.9
Rock Bass	Turner	33	0.3	236	1.6	BC	6	6.1
	Amik	0	0	39	0.2	BC	0	--
	Pike	0	0	385	0.2	BC	13	7.4
	Round	0	0	131	0.2	BC	3	7.9

*Lake Sturgeon: 11 hours of fishing pressure in Round Lake, no catches.

** BC = By-catch

Fish Cribs in the Pike Chain

Because of a lack of aquatic plants in Round and Pike Lake, fish cribs and other artificial structures has been installed in an attempt to increase fish habitat. Fish crib locations are shown in Figure 38.



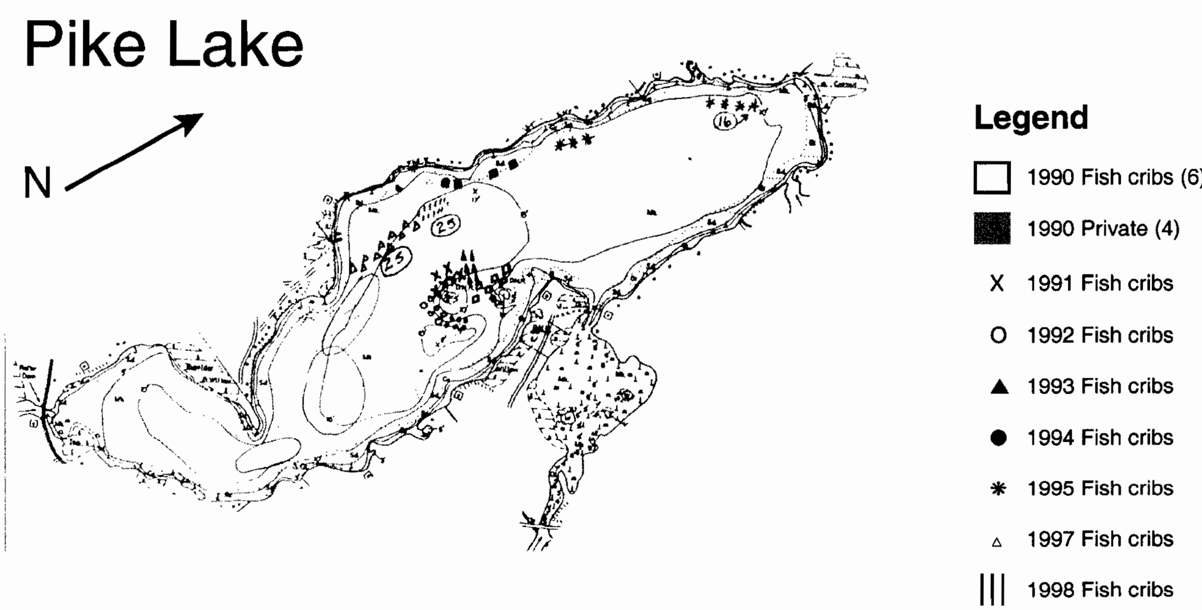


Figure 38. Fish crib placement as along with other structures in Round Lake (top) and Pike Lake (bottom).

The Status of Fish Cribs in Round Lake

In 2001, fish cribs were observed by SCUBA diving. The two cribs observed in Round Lake were mostly intact (Figure 39) and in fact, a bluegill was observed using the crib (Figure 39, bottom).

Because of the brownish water color due to the wetland or "bog" stain, cribs are hard to see, although fish will find them and use them for protection.

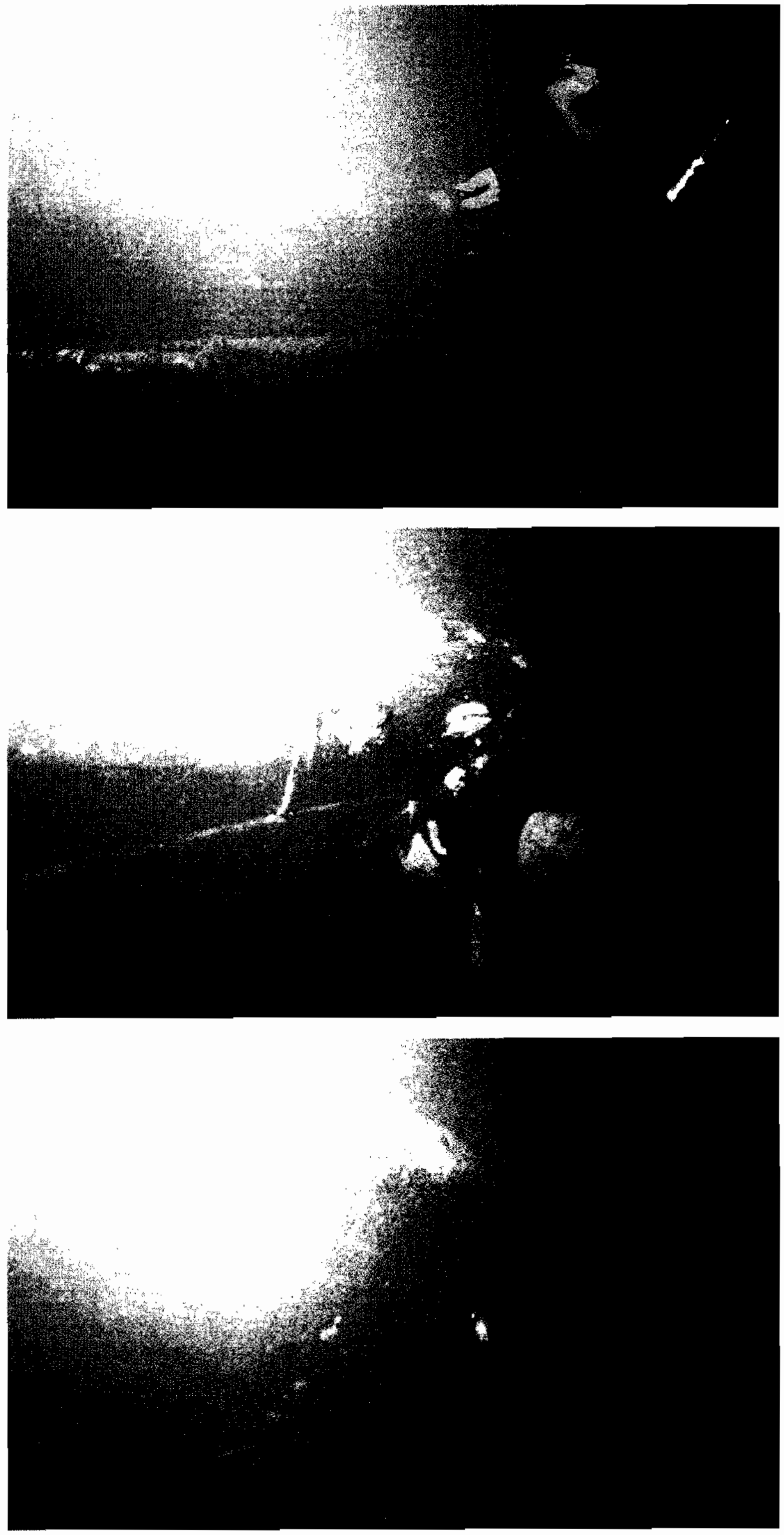


Figure 39. Underwater views of a fish crib in Round Lake in July, 2001.

5. Lake and Watershed Assessment

5.1. How Do the Lakes Rate?

One way to evaluate the conditions of the Pike Chain of Lakes is to compare their water quality to other lakes within the same ecoregion. An ecoregion is an area that has similar geology, plants, and soils. There are 84 ecoregions in the continental United States (see map on next page). The Pike Lake Chain is within the Northern Lakes and Forests Ecoregion (number 50).

The Pike Lake Chain water quality parameters are not quite within the water quality ranges for lakes in the Northern Lakes and Forests Ecoregion (Table 14). Although clarity, chlorophyll, and phosphorus levels are out of range for Pike, Round, Amik and Turner, there are several unique factors at play. One of the factors is the large watershed. It doesn't appear there are large sources of pollution to the lakes. In fact, this was reinforced with a historical lake analysis using lake sediments and conducted by Paul Garrison, WDNR.

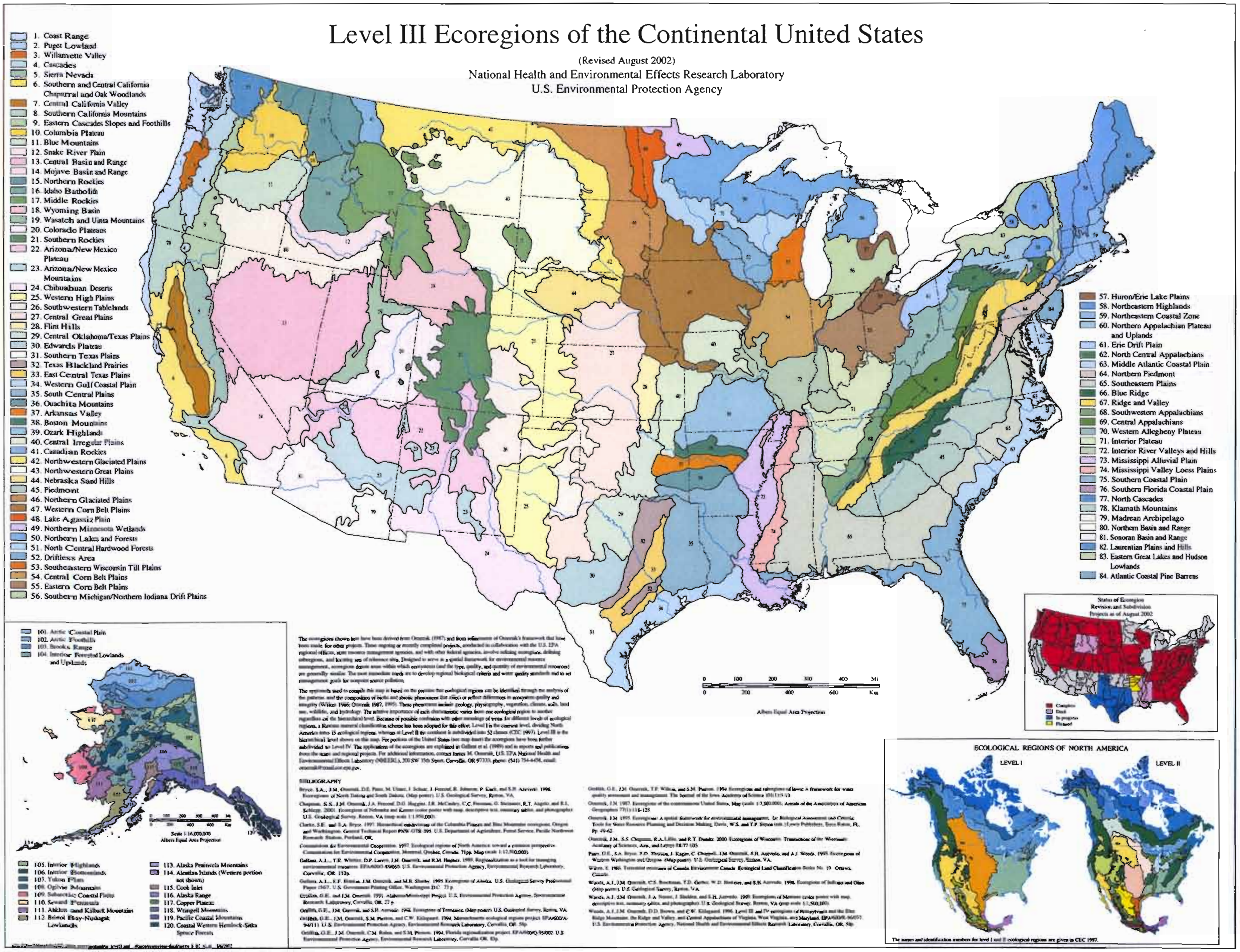
When the lake condition from 100 years ago was compared to today's condition, Paul Garrison concluded that the nutrients in Round Lake have probably increased slightly, and not dramatically. This was probably due to logging impacts as well as shoreline development.

Table 14. Range of summer water quality characteristics for lakes in the Northern Lakes and Forest ecoregion (from Descriptive Characteristics of the Seven Ecoregions in Minnesota, by G. Fandrei, S. Heiskary, and S. McCollar. 1988. Minnesota Pollution Control Agency).

Parameter	Northern Lakes & Forests	Pike Lake	Round Lake	Amik Lake	Turner Lake
Total Phosphorus (µg/l) (top water summer average)	14-27	31	33	36	30
Algae (chlorophyll mean (µg/l))	<10	21	17	13	13
Algae (chlorophyll maximum (µg/l))	<15	38	24	23	18
Secchi disc (feet)	8-15	3.8	3.9	5.1	4.9
Total Kjeldahl Nitrogen (µg/l)	<750	930	840	760	800
TN:TP Ratio	25:1-35:1	30:1	25:1	21:1	27:1

Level III Ecoregions of the Continental United States

(Revised August 2002)
National Health and Environmental Effects Research Laboratory
U.S. Environmental Protection Agency



5.2. What Impacts Water Quality?

Water quality in the Pike Chain of Lakes is good but different than many other glacial lakes in the Ecoregion. Water is not as clear in the Pike Chain as in other area lakes. However, there are special circumstances that account for the water quality conditions. The size of the watershed, land use, and the lake volume are all contributing factors.

One way to check the status of the Pike Lake Chain lakes was to insert existing data into equations to see if the answers matched what the observed water quality conditions are. These equations are referred to as lake models.

Lake models were run using watershed size and the known phosphorus concentrations in the incoming streams. Another lake model was run using an ecoregion stream phosphorus value of 52 ppb. Results are shown in Table 15. There is fair agreement between the predicted lake phosphorus concentration and the observed phosphorus concentration for Pike and Round Lakes. Amik and Turner lakes predictions were not very close to the observed values.

A factor for high phosphorus in Turner Lake may be due to boat traffic and sediment resuspension. There is also some wetland inflow and groundwater inflow as well.

The primary reasons for Pike and Round water clarity predictions being slightly off is due to the "bog stain" of the lakes and also the large watershed size.

Water clarity in Amik is influenced by aquatic plants. The greater the number of plants in Amik, the better the water quality.

Table 15. Observed lake water quality conditions and predicted lake water quality conditions based on measured stream phosphorus concentrations of around 30 ppb and Ecoregion phosphorus runoff of 52 ppb.

	Turner	Amik	Pike	Round
Water Clarity [in feet (meters)]				
Predicted lake values based on measured stream phosphorus concentration of around 30 ppb.	10.9 (3.3)	7.3 (2.2)	7.3 (2.2)	8.3 (2.5)
Predicted lake values based on theoretical stream concentration of 52 ppb.	8.6 (2.6)	5.3 (1.6)	5.6 (1.7)	5.6 (1.7)
Observed (2001)	4.3 (1.3)	5.9 (1.8)	4.0 (1.2)	5.0 (1.5)
Total Phosphorus (in ppb)				
Predicted lake values based on measured stream phosphorus concentration of around 30 ppb.	17	27	27	24
Predicted lake values based on theoretical stream concentration of 52 ppb.	23	41	38	37
Observed (2001)	27	26	29	32
Chlorophyll a (in ppb)				
Predicted lake values based on measured stream phosphorus concentration of around 30 ppb.	4	8	8	7
Predicted lake values based on theoretical stream concentration of 52 ppb.	7	15	14	13
Observed (2001)	13	13	21	17

5.3. Responses to 2001 Riparian Landowner Survey

(prepared by Pike Lake Chain of Lakes Association, 1/15/02)

Introduction
In 2001 the Pike Lake Chain Lakes Association, Inc. received a Lakes Planning Grant from the Wisconsin Department of Natural Resources. The planning grants primary goal was to establish, for the chain, a comprehensive set of base line data. This comprehensive data would allow the association to measure future changes to the chain of lakes. One of the specified requirements of the planning grant was to obtain a survey of riparian landowners, concerning their feelings on general areas of interest, fishing and boating activities, and activities of the association.

The survey was developed by the association board and mailed to 285 riparian landowners of the Pike Lake chain, as well as members of the association that did not own land on water. The survey was mailed in the summer of 2001. Responses were requested to be returned by September 15th of 2001. Of the 285 surveys mailed we had a return of 175 surveys, or a 61.4% response. With this high rate of return, we believe we have an excellent participation for surveys of this type, which shows an interest in the information requested. Where applicable the results of this survey will be compared to the survey that was made by the Land Conservation Department of Price County in 2000. We believe that the results of the survey also indicate that the riparian landowners of the chain have a real concern for the water quality and well being of our chain for today and the future.

The results of the survey will also be helpful in directing the board of the Pike Lake Chain, in addressing the feelings, perceptions and wishes of the riparian landowners. The survey results, along with all the other activities provided for by the grant, will help the association develop short and long range plans for the continued preservation of the quality of our lake chain.

Summary of Responses
Of the 175 survey results obtained, 97 or 55.3% were received from residents of Pike Lake. Of the remaining surveys 36 or 20.6% came from Round Lake, 19 or 10.6% from Turner Lake, 12 or 6.7% from Amik Lake, 7 or 4% from residents of creeks and rivers, and 4 or 2.3% from residents located off water. The results are consistent with the number of riparian properties owned on each lake in the chain.

Respondents indicated that the two top reasons for purchase of their property were for the appreciation, peace and tranquillity of the area and for hunting and fishing. These results are consistent with the data received in the Price County survey, as well as most other lakes and rivers in the state. The respondents of our survey differed slightly from the Price County survey in that they placed water sports and entertaining friends and relatives as their third and fourth reasons for property purchase. The Price County survey had observing wildlife as the third selection and entertaining friends and relatives along with holding property for appreciation in value as a tie for fourth choice. The choice of water sports was well down the list of choices in the Price County survey.

As was expected most respondents did not feel that, as of today, we were experiencing heavy use of the lake chain , or that we were experiencing major problems with conflicts of use. The respondents also feel that the present placement of "no wake" buoys are correct and adequate for our lake system. They also feel that our present "water skiing" hours are acceptable, and they would like to have a town ordinance established to require the use of PWC's (personal water craft) to conform to the same restrictions as water skiing.

Our respondents also feel our fish stocking activities, by the DNR, are adequate and that we should continue the placement of cribs in Pike and Round lakes. If there is no liability to the association they would like the placement of cribs to be extended to Turner and Amik lakes. Our respondents also do not favor the use of our chain by any major fishing tournaments. On the issue of local fishing tournaments the results indicate about a 50 - 50 split in the support of this tournament activity.

Results also indicate that the riparian landowners on the chain are only somewhat familiar with existing regulations relating to shoreland property ownership. This is also supported by a request of the majority of respondents to have the association provide timely information on water related issues. As to other association activities a majority of respondents want us to keep the association annual meeting as the Sunday in the Memorial Day weekend. There is about a 50 - 50 split on whether the annual meeting should also include a social gathering.

*(**Note:** Since not all questions were answered by all respondents, we have elected to use percentages in reporting results, rather than number totals.)*

Question IA. How do you rank these factors in order of importance as reasons for purchasing your property ?

A. Appreciating peace and quiet.
B. Hunting and fishing.
C. Entertaining friends and relations.
D. Holding property for appreciation.
E. Water sports.
F. Other.

1st Choice.

	Total Chain	Pike Lake	Round Lake	Turner Lake	Amik Lake	Other
A.	60.9%	61.3%	59.3%	65.0%	63.6%	55.6%
B.	25.4%	29.0%	19.5%	25.0%	27.3%	11.1%
C.	3.0%	2.2%	8.3%			
D.	2.4%	3.2%			9.1%	
E.	5.9%	4.3%	11.1%	10.0%		
F.	2.4%		2.8%			33.3%

Question IB. How would you rate boat traffic on your lake?

NORMAL USE.

Total chain.	
Light use	73.2%
Moderate use	26.8%
Heavy use	0.0%

Question ID - 1. Do you believe that Price County should require all septic systems to be pumped every three years regardless of age?

	Total chain	Pike Lake	Round Lake	Turner Lake	Amik Lake	Other
Yes	55.6%	61.4%	46.3%	47.4%	45.5%	70.0%
No	44.4%	38.6%	53.7%	52.6%	54.5%	30.0%

Comments: If used year round; If new every 5 years, if old every 3 years.

Question ID - 2. If the association could obtain a special price for septic tank pumping, through a formal bid process, would you subscribe to the service?

	Total Chain	Pike Lake	Round Lake	Turner Lake	Amik Lake	Other
Yes	75.2%	76.2%	79.3%	73.7%	63.6%	60.0%
No	24.8%	23.8%	20.7%	26.3%	36.4%	40.0%

Comments: If it was the most reasonable.

Question ID - 3. Are you aware of existing regulations relating to shoreland ownership?

A. Shoreland Zoning

	Total chain	Pike Lake	Round Lake	Turner Lake	Amik Lake	Other
Familiar	33.6%	29.7%	26.9%	47.4%	45.5%	50.0%
Somewhat	46.8%	50.5%	46.2%	42.1%	54.5%	10.0%
Not Familiar	19.6%	19.8%	26.9%	10.5%	0.0%	40.0%

B. Sanitary Ordinances

	Total chain	Pike Lake	Round Lake	Turner Lake	Amik Lake	Other
Familiar	36.4%	33.7%	25.0%	52.6%	63.6%	40.0%
Somewhat	46.9%	49.4%	59.4%	31.6%	27.3%	30.0%
Not Familiar	16.7%	16.9%	15.6%	15.8%	9.1%	

F. Boating Regulations and Ordinances.

	Total chain	Pike Lake	Round Lake	Turner Lake	Amik Lake	Other
Familiar	72.1%	72.6%	77.4%	84.2%	40.0%	60.0%
Somewhat	24.0%	25.0%	19.4%	15.8%	60.0%	10.0%
Not Familiar	3.9%	2.4%	3.2%	0.0%	0.0%	30.0%

SECTION II FISHING & BOATING

Question IIA. The DNR provides stocking of fish in our lake system with approximately 85,000 walleye fry being stocked on even years and approximately 2,000 musky fingerlings being stocked on odd years.

1. Do you believe this is an adequate stocking program ?

	Total chain.
Yes -	65.5%
No -	34.5%

	Pike lake.	Round lake.	Turner lake.	Amik lake.	Other.
Yes. -	59.3%	79.1%	20.0%	90.9%	80.0%
No. -	40.7%	20.9%	80.0%	9.1%	20.0%

2. Do you believe walleye stocking should ?

	Total chain.
Stay the same. -	45.4%
Increase. -	50.9%
Decrease. -	3.7%

3. Do you believe that musky stocking should?

	Total chain.
Stay the same. -	60.3%
Increase. -	21.7%
Decrease. -	18.0%

4. Do you believe that all stocking should stop and the system revert to natural reproduction?

	Total chain.
Yes. -	7.7%
No. -	92.3%

Question II B. Do you believe that the 34 in. limit on musky is adequate to manage the system?

	Total chain.
Yes. -	54.5%
No. -	7.3%
No opinion. -	24.7%
Go to Trophy Size. -	13.5%

Question II C. Fish cribs have been used by the DNR to improve fishing opportunities and to enhance deep water habitat. Fish cribs have been placed in Round and Pike lakes only.

1. Do you believe this should continue ?

	Total chain.
Yes. -	87.6%
No. -	12.4%

2. If there is no liability to the association, should cribs be placed in Turner & Amik lakes as well ?

	Total chain.
Yes. -	72.9%
No. -	27.1%

Question II D. Our lake chain has not been used very much for big fishing tournaments. In recent years we have had local fishing tournaments only.

1. Do you favor encouraging major fishing tournaments for the future ?

	Total chain.
Yes. -	5.9%
No. -	94.1%

2. Do you favor encouraging local fishing tournaments for the future ?

	Total chain.
Yes. -	52.0%
No. -	48.0%

	Pike lake.	Round lake.	Turner lake.	Amik lake.	Other.
Yes. -	52.7%	56.8%	45.0%	41.7%	50.0%
No. -	47.3%	43.2%	55.0%	58.3%	50.0%

Comments. As long as catch & release; Keep it no more than present.

Question II E. "No wake" zones have been established by town ordinance at the entrance to squaw creek, at the passage between Round & Pike lakes, and a portion of Rice creek as it enters Pike lake.

1. Do you believe these are adequate markings ?

	Total chain.
Yes. -	85.8%
No. -	14.2%

2. Do you believe these "no wake" zones should be expanded ?

	Total chain.
Yes. -	18.5%
No. -	81.5%

	Pike lake.	Round lake.	Tuner lake.	Amik lake.	Other.
Yes. -	11.6%	18.4%	28.6%	33.3%	40.0%
No. -	88.4%	81.6%	71.4%	66.7%	60.0%

2a. If you believe that "no wake" zones should be expanded, where should this expansion occur ?

All of Squaw creek.
More of Rice creek.
Further into Pike from Thorofare bridge.
Add more buoys.
Along all lake shores.
Sensitive lake front areas.
Boat landings.
All the way up Rice creek.
Further into lakes at all locations.
Major weed beds.
Further out from dam.
Wherever shoreline damaged.

Question II G. Do you believe that Personal Watercraft (PWC's) should be included in restricted hours, rather than as allowed by State regulations from sunrise to sunset?

	Total chain.
Yes. -	82.5%
No. -	17.5%

a. If you believe that restricted hours should be established, what should they be ?

Ban PWC's from the chain. 6.6%

Question II H. Do you believe that we have adequate enforcement of State and Town fishing and boating regulation and ordinances?

	Entire chain.
Very good. -	12.3%
Good. -	40.3%
Fair. -	16.4%
Poor. -	21.6%
Non existent. -	9.4%

SECTION III - EDUCATION

Question III A. I would like the association to provide timely information on state and county issues that may affect our lakes and streams?

	Entire chain.
Yes. -	92.4%
No. -	7.6%

Comment. I think you are doing a fine job; The county has always notified us in the past; Information perhaps once in awhile.

Question III B. I would like educational materials / information to be provided in the form of - (List in order of preference).

	1st. place vote.	2nd. place vote.	3rd. place vote.
Pamphlets. -	77.9%	11.1%	13.3%
Speakers. -	13.8%	62.2%	33.3%
Seminars. -	8.3%	26.7%	53.4%

Comment. Speakers or seminars are equal in value.

6. Lake Project Ideas for Protecting Water Quality and Wildlife

6.1. Ongoing Programs and New Project Ideas

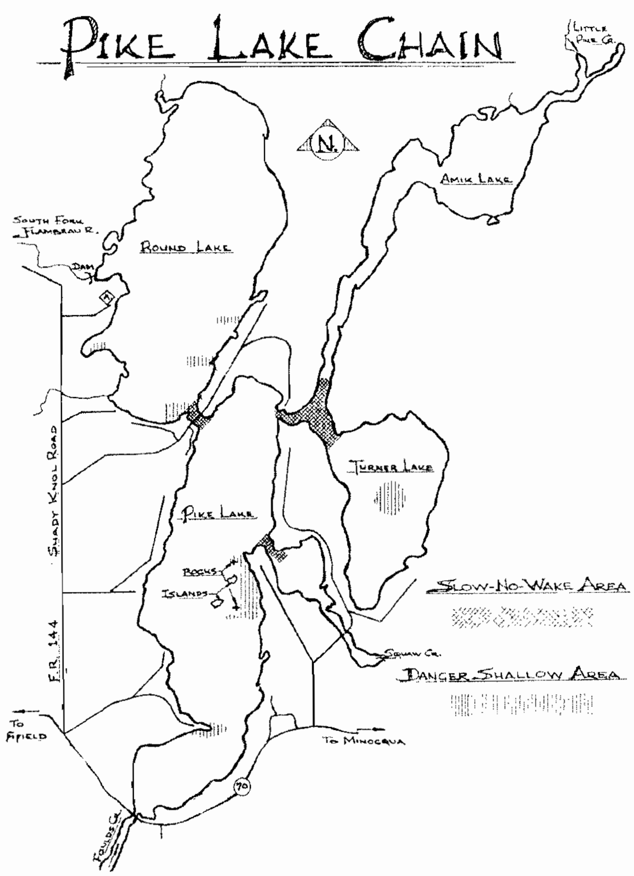
1. Ongoing watershed stewardship.
2. Purple loosestrife control projects.
3. Rusty crayfish management.
4. Aquatic plant management.
5. Fish management recommendations.
6. Water quality monitoring program.

6.1.1. Ongoing Watershed Stewardship

Protecting the natural character of the watershed helps maintain good runoff water quality and maintains the northwoods aesthetics.

Two important areas to address are:

1. Working with Price and Vilas Counties shoreland ordinances.
2. Educating new water front property owners on the value of shoreline habitat and good landscaping practice.



Map produced by a Lake Association board member showing no-wake and shallow areas.

Shoreland Development: Controls are in place at the county level to guide new shoreland development and redevelopment. Shoreland development guidelines are available from the county offices or even on-line. Price County has a progressive approach to protecting it's natural resource assets. Shown below is a summary of its Lake Classification program which will drive shoreland development activities in the future.

Existing shoreland ordinances if enforced, should project the lake environment in the future.

Pike, Round, and Turner Lakes are in Price County. Amik Lake is in Vilas County.

Price County Lake Classification is designed to assist lake users, lake communities and local governments as they undertake projects to protect and restore lakes and their ecosystems.

Classification
1. Objective setting for the classification system.
2. Preliminary investigation of appropriate management tools.
3. Investigation and selection of appropriate classification criteria.
4. Data collection & analysis to place waters in classes.

Management
1. Public information and education relating to impacts of development on water resources, alternative management options and expected consequences.
2. Objective setting for individual lake classes.
3. Ordinance development: zoning, watercraft regulation, construction site erosion control, public water access, piers and mornings, etc.
4. Implementation of alternative management tools: purchase of land or development rights, conservation easements, public information and education, continuing education for local government decision makers and staff, individual lakes and watershed plans, etc.
5. Adoption of policies, which encourage management of waters, based on specific needs of each waterbody

Implementation
1. Tracking and evaluating the enforcement and compliance with ordinances implementing the classification.
2. Developing forms, computer programs, and other procedures to improve and streamline administration.
3. Conduct training and education sessions on the classification system and the new regulations or develop and distribute printed materials or electronic media (web sites).
4. Support programs resulting from Lake Classification such as Shoreland restoration technical assistance.
5. Make revisions, amendments and "touch ups" to the classification system (maps, GIS databases) or the ordinances implementing them.

Shoreland Buffers: The Pike Lake Chain has a high degree of natural vegetative buffers along the shoreline already in place. The challenge ahead will be to maintain those and even improve low quality buffers.

A shoreland inventory consisting of photographs of the Pike Lake Chain shorelands was conducted by the Association in 2001. This serves of a reference for volunteers who may be interested in improving the natural conditions of their shoreland buffer. The shoreland inventory is available from the Lake Association secretary or president.

6.1.2. Purple Loosestrife Control Projects

Purple loosestrife (*Lythrum salicaria*) is native to Europe, first appearing in the U.S. in the early 1800s. Although it has a pretty purple flower, without natural controls in this country, the plant can take over marshy areas. And when it displaces native plants, wildlife that depend on them decline.

It's best to control the exotic purple loosestrife in the initial infestation stage. The following techniques work for small infestations of about 50 plants or less:

- Pull or dig out the plant before it flowers and produces seeds in August. Be sure to remove the plants from the site so they will not re-root.
- Spot treat with an herbicide.
  - Apply Rodeo (a glyphosate) with a backpack sprayer and spot treat, rather than broadcast spray. Rodeo a broad-spectrum herbicide, meaning it kills everything.
  - Apply a 2,4-D herbicide or Renovate, a triclopyr herbicide, which kill only broad-leaved plants (such as purple loosestrife). Many of the other wetland plants are in the grass family and are not affected.
- Torch the plants right before they bloom.

For stubborn, mature purple loosestrife plants, a fork or spade will ease out the root. (From Ontario Federation of Anglers and Hunters, Peterborough, Ontario, with support from several other organizations. With permission.)

These methods are not very effective for large infestations and established populations. One purple loosestrife plant can produce 2 million seeds in a year, so a substantial seed bank is often present.

Biological control is a long-term approach for managing large infestations of purple loosestrife. Several species of exotic leaf-eating and root-boring beetles were imported and tested. Research indicated that the exotic beetles stayed with loosestrife and did not damage native plant species. It can take up to 7 years to gain control using the beetles.

*The Wisconsin Department of Natural Resources and other groups sponsor starter kits for growing the loosestrife leaf-eating beetle (*Galerucella pusilla*). The beetles are raised in large quantities in controlled conditions on loosestrife plants under the netting and then are released into the problem loosestrife patch in the wild.*

Raising the loosestrife beetles under controlled conditions allows greater survival and a better chance that a sustaining population will become established in the wild purple loosestrife infested area.

In particular, research found a European leaf eating beetle (*Galerucella pusilla*), that fit the criteria for a biological control agent: it was host specific (fed and survived exclusively on purple loosestrife, as far as is known) and caused significant damage to purple loosestrife. In some areas starter kits are available to rear and then release these beetles. Hopefully, these beetles will not become a problem themselves.

6.1.3. Rusty Crayfish Management

The rusty crayfish situation has been evaluated from a number of angles. The most cost-effective management approach is to "let nature take its course." A variety of control measures have been tried over the last 15 years. None have produced satisfactory control. What seems to happen over time are two naturally occurring controls become important. First, the crayfish actually eat themselves out of house and home. With a decline of weed beds, their food source is diminished, and this will limit their population. Secondly, fish learn how to attack and eat the feisty crayfish. Once the fish community learns how to overcome the threatening posture and slightly oversized pinchers, they will be dining on crayfish.

You can tell when fish are starting to have an impact, because small crayfish will be eaten first, leaving only larger crayfish in the population. Pike Lake Chain is not at this stage yet.

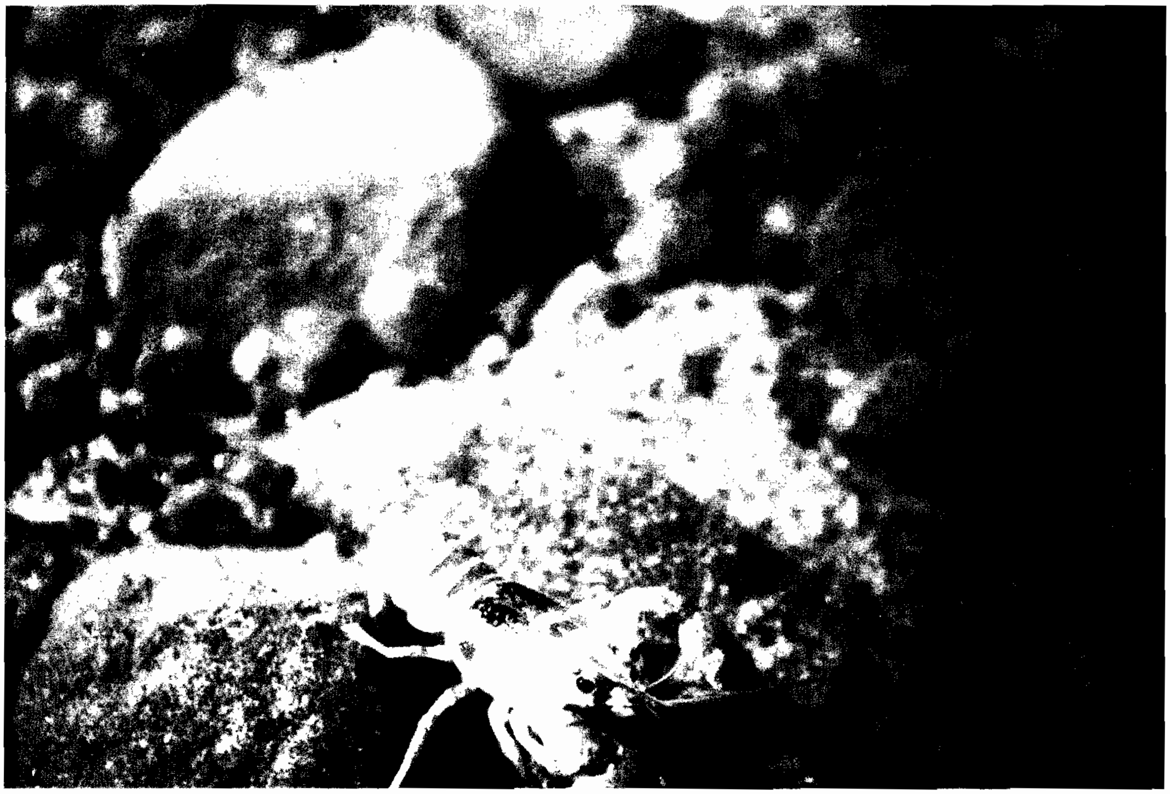
Rusty crayfish could be a problem in the Pike Chain for 5 to 10 years with the possibility their population would decline after that. Then their population probably would resemble a native crayfish population . . . they would be around but not much of a problem.

There are two crayfish projects the Pike Lake Chain Association could consider. The first is to use fish to control the smaller crayfish. Yellow perch can be good crayfish predators. Catch and release tactics would be helpful. Signs and information materials could be distributed to lake residents and at public landings to encourage catch and release fishing. The idea is to maximize the impact of fish predation on crayfish.

The second project area is to set traps and remove crayfish. An example of a trap is shown in Figure 28. It would take a substantial effort for several years to have a significant impact.

Big Bearskin Lake (Oneida Co) has been harvesting crayfish for a number of years. They should be contacted for harvesting techniques and ideas (Roger Soletski is the president)(Figure 29).

For Round Lake, initial trapping would indicate the severity of the problem. If it is a big problem, at least 200 traps should probably be set for 5 to 6 years. This may be a project area that Lake Association volunteers could participate in.



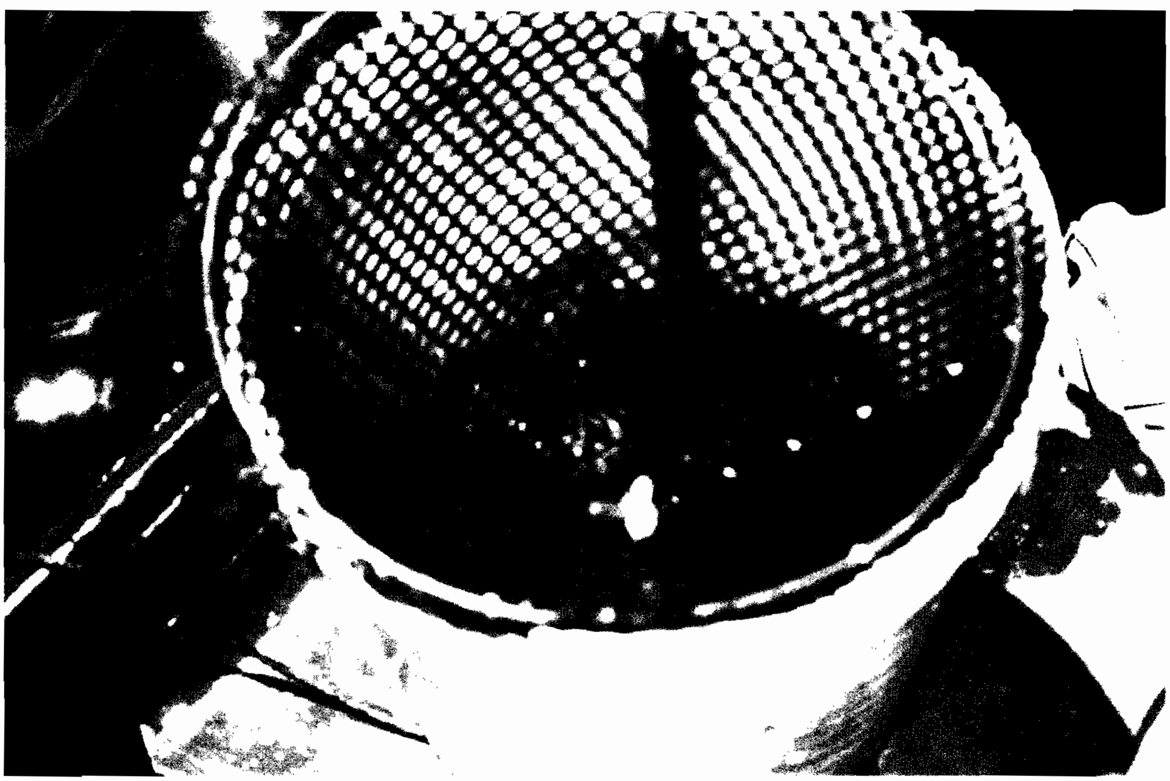


Figure 28. [top] Rusty crayfish can devastate plant beds. The Pike Lake Chain needs all the aquatic plants it can get.
[bottom] A funnel-shaped moth fitted over a bucket with bait is an effective crayfish trapping device and could be used in the Pike Lake Chain.

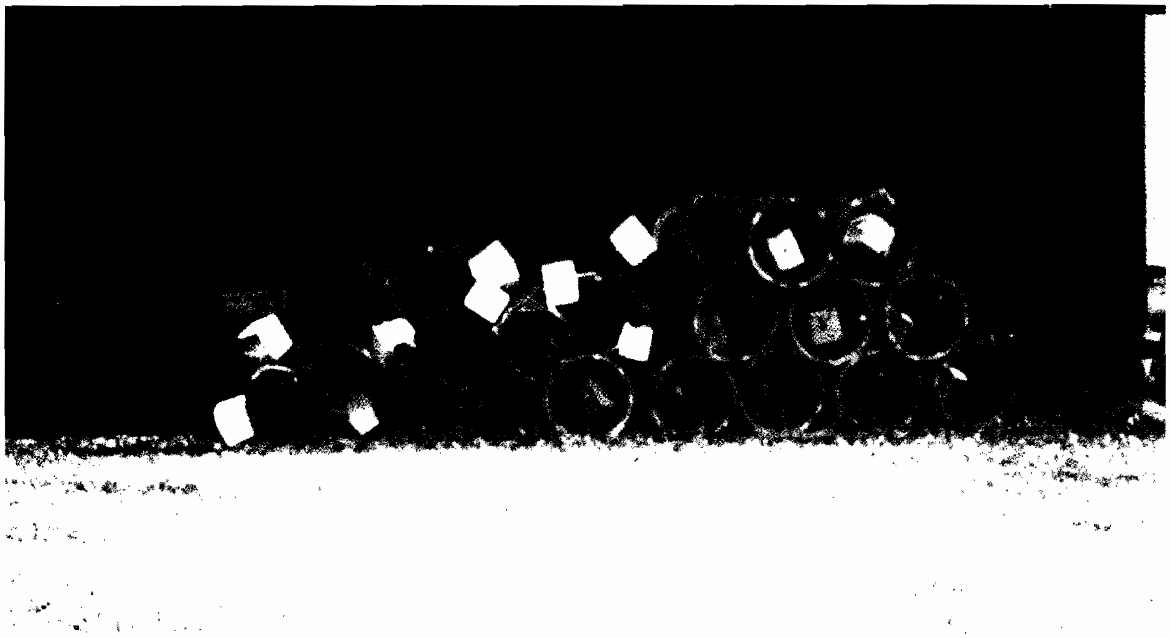


Figure 29. [top] Big Bearskin crayfish traps are ready to go into the lake. Pike Lake Chain volunteers could make and install traps as well. [bottom] Roger Soletski, Big Bearskin Lake, checks the crayfish holding cage at Big Bearskin. The larger crayfish can be sold.

6.1.4. Aquatic Plant Management

A high priority lake protection recommendation is to maintain healthy native aquatic plant communities in all four lakes and increase plants in Pike and Round, if possible. Currently, all four lakes have a variety of emergent aquatic plant growth but submerged plants are scattered in Pike and Round Lakes. In all four lakes, the aquatic plants are vital for helping sustain clear water conditions and contribute to fish habitat.

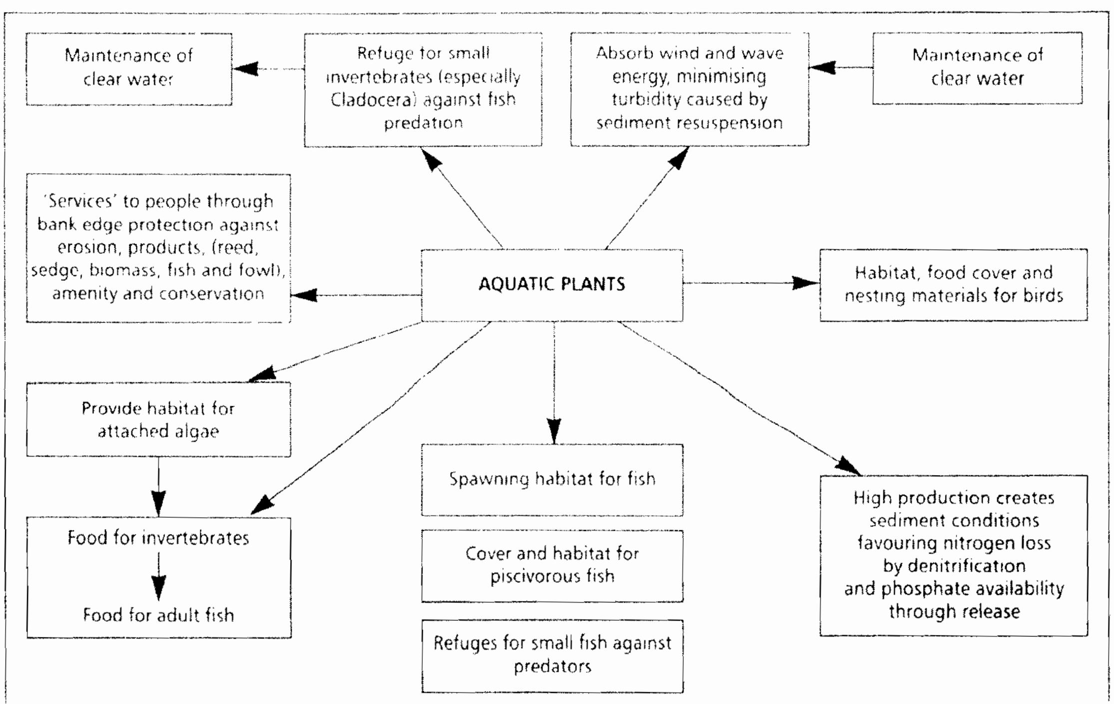


Figure 30. Links between aquatic plants and other organisms, including ourselves (source: Moss and others. 1996. A guide to the restoration of nutrient-enriched shallow lakes. Broads Authority Norwich, England).

Emergent plants in the Pike Lake Chain are fairly common and submerged plants in Amik are adequate. However, the challenge is to increase submerged aquatic plants in Round and Pike Lakes. Several plant improvement ideas are given below:

- determine if rusty crayfish are limiting aquatic plants.
- conduct a lake soil fertility survey to determine if soils can support plant growth. Sample areas with plants and areas without plants. If soil fertility is similar, then something other than nutrients are inhibiting plant growth.
- maintaining good shoreland conditions can promote improved plant distribution.

Round Lake has patches of aquatic plants but could use more.

6.1.5. Fish Management and Water Quality Recommendations

prepared by: Fisheries and Water Quality Committee, Dallas Helm, Chair, with comments in italics by Steve McComas

Planning program:

1. Continue Lake Programs as listed below for water quality sampling and analysis to increase the data base for the Pike Lake Chain. Program sampling as appropriate each year and implement using volunteers from the Pike Lake Chain.
    a. Continue Secchi disc clarity readings on all four lakes and incoming streams. This to include any satellite monitoring programs.
    b. Continue weekly lake level readings at the Thoroughfare Bridge.
    c. Expand monitoring programs to include creek mouths and checking for variations with in the lake system.
    d. Continue some program for checking dissolved oxygen, esp., winter months.
    e. Continue monthly temperature profile readings. (*this is optional and would be good if the labor is available*)
    f. Do phosphorus and chlorophyll readings as funding is available.
2. Continue working with the DNR and U.S. Forest Service to place fish cribs in the Price Co. lakes. Investigate the use of partial height cribs in Turner Lake as max. depth is 13'. My conversion with the DNR indicated we need 4' over the top of the crib after placement. Obtain crib materials as required to assist the U.S. Forest Service, i.e. blocks, brush, property permission for building cribs. Continue monitoring cribs for content, ie., brush, integrity, etc. (*cribs are not a high priority for Turner. Panfish catch rates are the highest on the Chain. Rather, work to improve aquatic plant conditions*)
3. Be on the lookout for studies on stirring and mixing of sediment by outboard motors or other watercraft. This relates to shallow water running of boats in lakes, channels, and weed beds (motor trollling) that might be detrimental. (*Information in Lake and Pond Management Guidebook indicates Turner is susceptible to sediment resuspension by boats*)
4. Keep abreast of DNR fish and forage stockings programs in area lakes, esp., our lake. Assist DNR with the scatter placement of stocked fish as agreeable with the DNR. Obtain fish surveys, stocking and shocking reports from the DNR. Record all data and send to file. Be aware of any fish tracking programs that are implemented.
5. Maintain and improve DNR and Forest Service relationships and continue sharing of information between us and the appropriate

departments. This includes sending copies of all data collected on our lake system. This is the responsibility of the Chair of the Committee.

6. Continue to shore committee obtained data with the membership of the Lake Association and put all data in central file for future reference. At the current time all data is given to the Secretary file.
7. Continue program of monitoring loon nesting and chick hatch for the Loon Watch Association in Ashland, Wisconsin. Investigate enhancing and implementing Loon nesting sights on all four lakes and incoming streams. Continue the protection of the osprey nest on Pike Lake, if applicable. Monitor all birds, sea gulls, ducks, geese, eagles, cormorants, etc., and notify appropriate DNR Dept's of any problems.
8. Keep abreast of local and professional fishing tournaments in the lakes.
9. Implement a program for monitoring incoming streams for beaver dams. Establish a procedure for compacting this information to appropriate local departments of DNR.
10. Investigate the replacement or restoration of roller dams on the Flambeau River. Not sure this falls within our committee responsibility, but put in for record.
11. We have a situation where decayed weeds is occurring on rock bars, mostly on Pike Lake. Why are the weeds dying? *It could be natural, aquatic plant beds expand and coontail depending on many factors including lake levels and water clarity. I am hoping its not rusty crayfish doing the damage. Generally, when water clarity improves for a year or two, aquatic plants respond with better growth.*
12. Keep abreast of DNR fish size and limits on the Pike Lake chain.
13. There use to be lots of schools of small catfish or willow cats in the shallow water and a large population of crabs in the lake system, both of these seem to have diminished, why? *Catfish year classes may not be as successful as they once were. These waters are marginal for catfish. Fortunately, it looks like other forage, as well as predators, are available.*

6.1.6. Water Quality Monitoring Program

A lake monitoring program is outlined in Table 16. It is designed to be flexible to accommodate the volunteer work force and a fluctuating budget.

Table 16. BIWB Water Quality Monitoring Program

Category	Level	Alternative	Labor Needed	Cost/Year
A. Dissolved oxygen	1	Check dissolved oxygen at Amik, Turner, Pike, and Round every two weeks in December, January, February, and March depending on winter conditions.	Moderate	$0
	2	Check dissolved oxygen at Amik and Turner outlet and Pike outlet every one to two weeks in December, January, February, and March, depending on winter conditions.	Moderate	$0
	3	Collect dissolved oxygen and temperature profiles in all three lakes, once or twice a month from May-September.	Moderate	$0
B. Water clarity	1	Secchi disc taken at spring and fall turnover.	Low	$0
	2	Secchi disc monitoring once per month May - October for all four lakes.	Low-moderate	$0
	3	Secchi disc monitoring twice per month, May - October for all four lakes.	Moderate	$0
C. Water chemistry	1	Spring and fall turnover samples from all four lakes are collected and sent to UW-Stevens Point.	Low	$250/lake
	2	Sample all four lakes for phosphorus and chlorophyll once per month from May - September (surface water only).	Low-moderate	$800
	3	Sample all four lakes for phosphorus and chlorophyll twice per month from May - October.	Moderate	$1,600
	4	Sample all four lakes for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N once per month (May-October)	Moderate	$960
	6	Sample all four lakes for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N twice per month (May-October).	Moderate	$1,920
D. Special samples	1	Special samples: suspended solids, BOD, chloride, turbidity, sampling bottom water, and other parameters as appropriate.	--	$50+

UW-Stevens Point Lab Analysis Costs:

Total phosphorus	$12.00	Total suspended solids	$8.00
Chlorophyll a	$20.00	Total volatile solids	$8.00
Kjeldahl-N	$12.00	Dissolved solids	$8.00
Nitrate/Nitrite-N	$10.00	Turbidity	$6.00
Ammonia-N	$10.00	BOD	$20.00

A recommended program consists of Levels A1, B3, and C2 or C3 depending on the available budget.