Turtle Lake at the Public Access

Comprehensive Lake Management Plan for Upper Turtle Lake, Barron County, Wisconsin

August 2003

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with contributions from Wisconsin Department of Natural Resources and the Upper Turtle Lake Association

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ACKNOWLEDGMENTS

Members of the Upper Turtle Lake Association and many others contributed in various ways to the work effort on the projects that formed the basis for this Management Plan. They include:

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SUMMARY

Upper Turtle Lake is a 438 acre lake located in Barron County, Wisconsin with an average depth of 13.8 feet and a maximum depth of 25 feet.

Goals

The goals of this project were:

* to examine existing lake conditions.
* to develop a lake management plan that protects, maintains, and enhances Upper Turtle Lake water quality.

Geology and Soils

Upper Turtle Lake is a glacial lake formed during the last retreat of the Superior glacial lobe starting about approximately 16,000 years ago. The soils deposited by the glacier are primarily sands and loamy sands.

Watershed Characteristics

The lake's watershed is approximately 1,732 acres (not including the lake). Land use is primarily cropland, with developed land (urban) accounting for only about 6% of the total.

Dissolved Oxygen and Temperature

Upper Turtle Lake does not strongly thermally stratify during the summer. Oxygen concentrations are found throughout the water column until the end of the summer.

Nutrients

Phosphorus concentrations are average compared to other lakes in the North Central Hardwood Forest ecoregion. Maintaining existing nutrient levels should be a primary goal for the Upper Turtle Lake Association.

Aquatic Plants

There are fair stands of emergent vegetation in shallow water near the shoreline which is beneficial as a filter for nutrients and as fish and wildlife habitat. Submerged plant distribution is good with 12 different species identified.

Lake Report Card

- Water chemistry results are comparable to and in some cases better than Ecoregion values.
- The data base does not go back far enough to examine trends, however Upper Turtle Lake is in good shape at this time in regard to transparency.

Recommended Lake Management Projects

1. Watershed projects: In conjunction with Barron County Soil and Water Conservation Department, develop and implement plans that promote the increased use of conservation tillage, grass waterways, and nutrient management techniques including managed land application of whey in the watershed.

2. On-site system maintenance: On-site wastewater treatment systems operate satisfactorily when they are properly installed and maintained. Several activities can be implemented to assist in proper operation of the system. These activities include workshops, septic tank pumping campaigns, and ordinance implementation.

3. Landscaping projects: Upper Turtle Lake has a relatively high percentage of natural shoreline conditions compared to other lakes in a rural setting. The challenge is to protect the existing natural conditions and to enhance shorelands that lack native vegetative buffers.

4. Aquatic plant projects: Aquatic plants are important in Upper Turtle Lake for fish habitat and for helping sustain good water quality. Minimal aquatic plant removal is recommended and only in areas where navigation is impeded. One exotic aquatic plant species, called curlyleaf pondweed, was found in Upper Turtle Lake. This species should be monitored in the future to see if it produces nuisance conditions.

5. Fish management options (including carp activities): Upper Turtle Lake has a well-balanced fish community based on WDNR records. Walleye stocking will continue on alternate years at 50 fingerlings/acre and will supplement natural reproduction. Walleye and northern pike spawning habitat should be protected.

6. Ongoing education program: Results from the lake questionnaire indicated lake residents rely heavily on getting lake information from the lake association newsletter. The newsletter should be an ongoing instrument to provide lake protection information. Abundant material is available that can inserted into newsletters.

7. Watershed and lake monitoring program: Ongoing testing should include: Secchi disk, total phosphorus, chlorophyll a, lake levels, rainfall, and fecal coliform levels in the lake. The level of effort depends on the availability of volunteers and funding levels.

1. Introduction and Project Setting

Upper Turtle Lake is located in Barron County, Wisconsin (Figure 1). Upper Turtle Lake characteristics 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.

	Upper Turtle Lake
Size (acres)	438
Mean depth (ft)	13.8
Maximum depth (ft)	25

Figure 1. Upper Turtle Lake is located in Barron County, Wisconsin.

2. Glaciers and Soils

Upper Turtle Lake was formed approximately 10,000 years ago during the last glacial retreat of the Superior Lobe (Figure 2). The soils deposited by the Superior Lobe 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. Upper Turtle Lake is located in the Superior lobe.

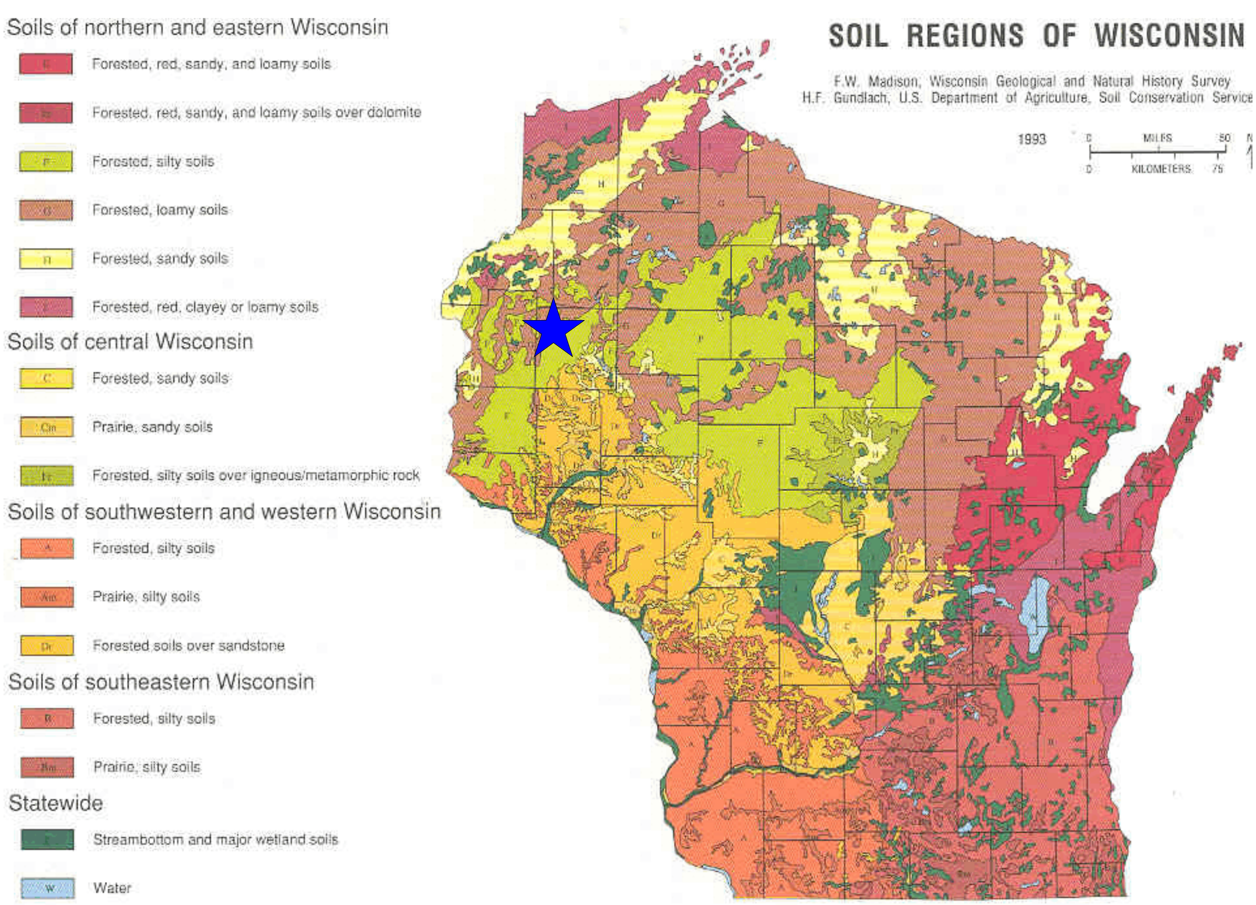


Figure 3. Upper Turtle Lake is located within a soils group characterized as forested loamy soils.

3. Watershed Features

3.1. Drainage Area and Land Use of Upper Turtle Lake

For this study, the Barron County Soil and Water Conservation Department prepared a watershed map and determined the land use breakdown for the watershed.

Drainage area to Upper Turtle Lake is 1,732 acres and the delineation is shown in Figure 4.

Upper Turtle Lake and its watershed are located within 8 sections of land in Almena Township of Barron County. Upper Turtle Lake as well as its watershed lies from northwest to southeast. That, combined with the shape of Upper Turtle Lake and its proximity to the terminal moraine, suggests that Upper Turtle Lake was formed by glacial melt water.

Land use within the watershed is shown in Table 2. Cropland is the dominant land use.

Table 2. Land use in Upper Turtle Lake watershed.

	Acres	Percent
Cropland	1,157	53%
Forested	300	14%
Wetland	95	5%
Residential	180	8%
Lake	438	20%
Total Watershed Area	2,170	100%

The watershed to lake ratio of Upper Turtle Lake is five to one. The watershed to lake ratio of Lower Turtle is seventeen to one. This undoubtedly accounts for the greater frequency and severity of algae blooms on Lower Turtle Lake. Upper Turtle Lake has enjoyed fairly good water quality and fishery, however, to ensure that is continues for years to come conservation measures in the watershed and on the lakeshore of Upper Turtle Lake should be considered.

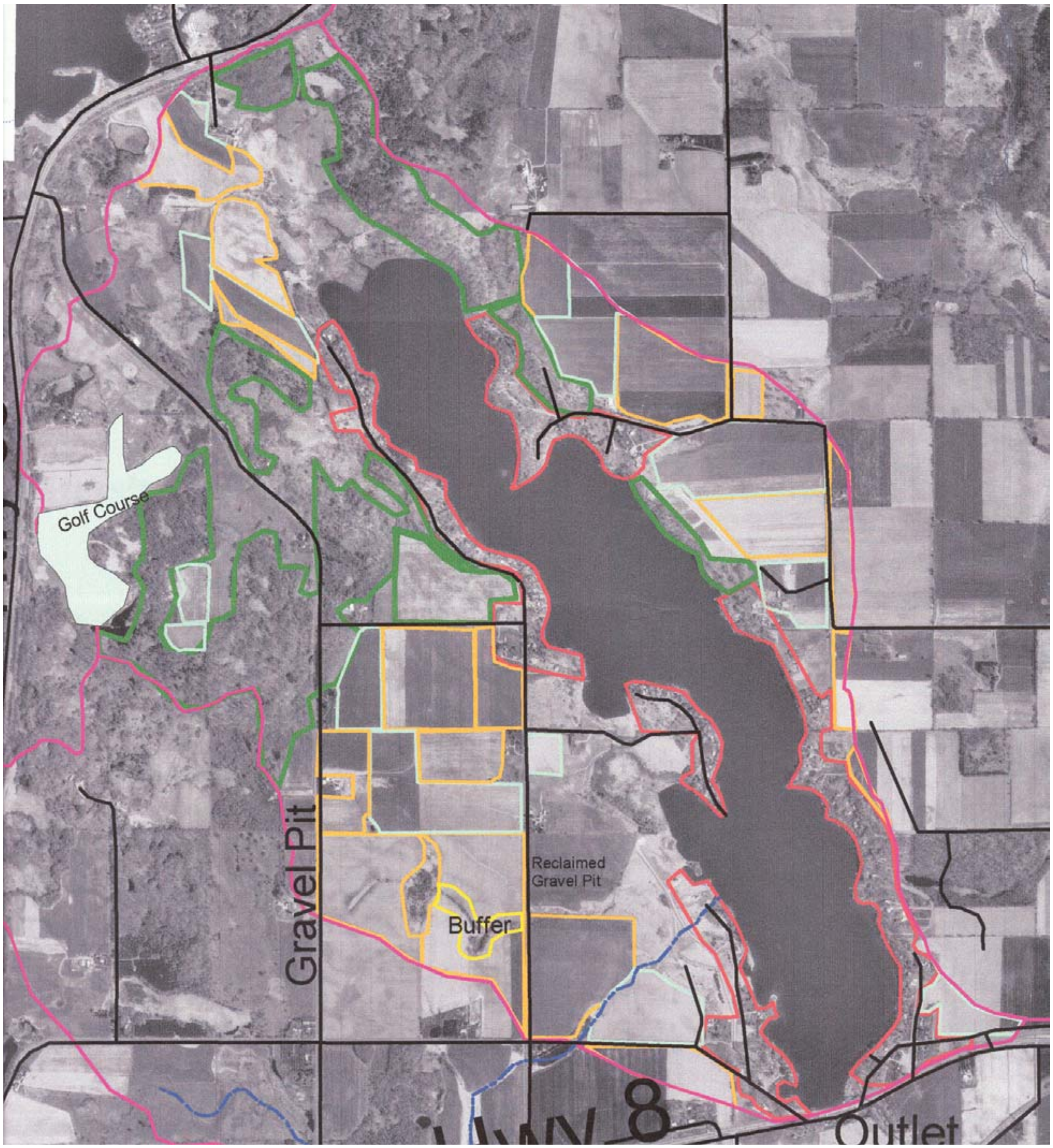


Figure 4. Watershed area for Upper Turtle Lake.

3.2. Source of Water and Nutrients to Upper Turtle

Water: Source of water to Upper Turtle Lake is from a combination of surface runoff, rainfall, and groundwater. The amount of water flowing into and out of Upper Turtle Lake is estimated to be about 2 cubic feet per second. Flows were estimated based on runoff amounts listed for Barron County in the Wisconsin Spreadsheet Lake Model (Table 3).

Table 3. Average annual water flow into Upper Turtle Lake.

Drainage area (acre)	1,732
Average yearly runoff for Barron County (feet)	0.81
Total water inflow (acre-feet)	1,403

***1,403 acre-feet would be enough water to fill a 1,400 foot deep swimming pool the size of a football field. It would also be enough drinking water to supply a town of 12,500 for a year.**

Although this is a lot of water coming into Upper Turtle Lake, the volume of Upper Turtle Lake is 6,044 acre-feet. If Upper Turtle Lake completely dried up, it would take 4 years to fill.

Nutrients (prepared by Dale Hanson, Barron Co): The primary source of phosphorus from the watershed of Upper Turtle Lake is agricultural runoff. As shown in Table 2 slightly over half of the watershed is cropland. In 2002, 60% of that cropland was row crops. We recommend that when farmers grow row crops, the following three practices be used: conservation tillage, including either no-till or reduced till, grass waterways, and nutrient management. Contour farming also is a valuable tool, however most of the topography of the Upper Turtle watershed does not lend itself to contour farming.

According to the Barron County Soil Erosion Transect Survey, in the area of Upper Turtle Lake, conservation tillage is used with some of the row crops, but there is definite room for improvement. According to the survey, 27% of the corn, 43% of the soybeans and 10% of the small grains are grown with conservation tillage. Given the runoff from cropland is the primary concern, the Soil & Water Conservation Department recommends that the Upper Turtle Lake Association promotes the increased use of reduced tilled and no-till, grass waterways and nutrient management in their watershed to protect and enhance the water quality of Upper Turtle Lake.

Nutrients Carried into the Lake with Streams: A major source of nutrients to Upper Turtle Lake is from inflowing streams that carry in phosphorus along with suspended sediments. Stream sample results for 2002 are listed in Table 4.

Turbid inflows to the cove in the southwest end of Upper Turtle Lake were observed in 2002.

Table 4. Stream monitoring results for Upper Turtle in 2002. Four watershed sites were monitored and site1, the heaviest flow, was sampled most frequently. Flows at the red dot stations move to Lower Turtle Lake.

		Total Phosphorus (ppb)	Total Suspended Solids (TSS)(mg/l)	Rainfall
May 9	Site 1 (Ken's Trib)	296	22	May 7 & 8: 3 in.
	Site 2 ($3^{3}/_{8}$ St Trib)	99	<5	
	Red dot (2nd St Trib)	200	12	
June 19	Site 3 (3rd St Cove)	275	--	Baseflow
	Red dot (2nd St Trib)	600	--	
July 22	Site 1 (Ken's Trib)	398	--	July 21: 0.5 in.
July 26	Site 1 (Ken's Trib)	24	--	July 25: 0.5 in.
July 2	Site 1 (Ken's Trib)	370	--	July 28: 1.5 in.
Aug 4	Site 1 (Ken's Trib)	980	--	Aug 3: 4.5 in., 30 cfs
Aug 17	Site 1 (Ken's Trib)	13,600	--	Aug 17: 1.5 in.
Aug 21	Site 1 (Ken's Trib)	4,200	--	Aug 21: 2.0 in.
Sept 6	Site 1 (Ken's Trib)	629	--	Sept 6:3.5 in.
	Site 4 (NW side)	63	--	

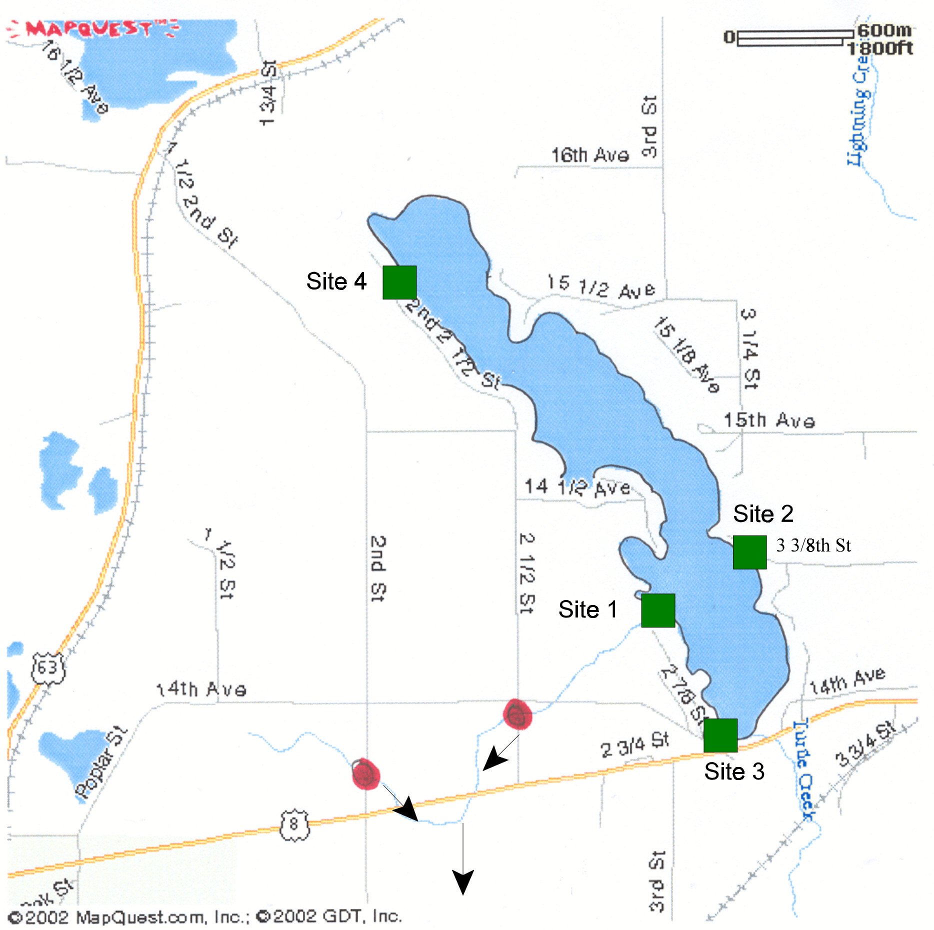


Figure 5. Site map of stream sample locations.

Figure 6. (top) Streams on the west side of Upper Turtle Lake carried high sediment loads during rainfall events in 2002.
(bottom) This is the color of the water collected from streams after a significant rainfall. The brownish/tannish color is from suspended sediments.

3.3. Shoreland Inventory

The shoreland area encompasses three components: the upland fringe, the shoreline, and shallow water area by the shore. A photographic inventory of the Upper Turtle Lake shoreline was conducted on July 23, 2002. The objectives of the survey were 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. 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 shorelines and uplands at the 75% natural level as well (Figure 7 illustrates the methodology).

A summary of the inventory results is shown in Table 5. Based on our subjective criteria about 58% of the total parcels in the Upper Turtle Lake shoreland area meet the minimum natural ranking criteria for shorelines and upland areas. This percent also includes 85 undeveloped parcels. This is about average for other lakes found outside the Metropolitan Twin City area. In the next 10 years proactive volunteer native landscaping could improve the natural aspects of a number of parcels.

The 1996 Barron County Lakes Inventory, found 134 homes on Upper Turtle Lake and found 53% (71 homes) of those homes maintained a lawn down to the lakeshore. In 2002, we found 214 developed parcels with 30% (64 homes) that had lawns going down to the lakeshore. It would be beneficial to the water quality and ecosystem of Upper Turtle Lake to encourage those homeowners to install lakeshore vegetative buffers (source: Barron County Soil and Water Conservation Department).

Table 5. Summary of shoreline buffer and upland conditions in the shoreland area of Upper Turtle Lake. Approximately 309 parcels were examined.

Upper Turtle Lake	Natural Shoreline Condition		Natural Upland Condition		Undevel. Photo Parcels	Shoreline Structure Present	
	>50%	>75%	>50%	>75%		riprap	wall
TOTALS (no. of parcels = 309)	76% (234)	68% (209)	72% (224)	58% (178)	28% (85)	18% (55)	3% (8)

A comparison of Upper Turtle Lake conditions to other lakes in Minnesota and Wisconsin is shown in Table 6 and in Figure 8.

Figure 7. [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.

Table 6. Summary of shoreland inventories from Upper Turtle Lake and 20 other lakes in Minnesota and Wisconsin.

Lake	Eco-region	Date of Survey	Total Number of Parcels (#)	Undevel. Parcels % (#)	Natural Upland Condition		Natural Shoreline Condition		Parcels with Erosion % (#)	Parcels with Shoreline Revetment % (#)
					> 50% % (#)	>75% % (#)	> 50% % (#)	>75% % (#)		
Upper Turtle Lake Baron Co, WI	CHF	7.23-24.02	309	28 (85)	72 (224)	58 (178)	76 (234)	68 (209)	0	20 (63)
Lake Volney Le Sueur Co, MN	CHF	9.21.02	79	25 (20)	54 (43)	42 (33)	56 (44)	47 (37)	0	30 (24)
Diamond Lake Kandiyohi Co, MN	CHF	8.13-14.02	344	2 (7)	13 (44)	11 (39)	16 (56)	12 (42)	1 (5)	49 (168)
Green Lake Kandiyohi Co, MN	CHF	9.19.01	721	1 (9)	20 (146)	12 (88)	19 (140)	14 (100)	0	62 (446)
Orchard Lake Dakota Co, MN	CHF	9.17.01	109	4 (4)	47 (51)	30 (33)	53 (58)	32 (35)	0	54 (59)
Ravine Lake Washington Co, MN	CHF	7.19.01	9	100 (9)	100 (9)	100 (9)	100 (9)	100 (9)	0	0
Rush Lake Chisago Co, MN	CHF	9.16.00	524	11 (58)	48 (253)	28 (147)	51 (267)	38 (201)	1 (3)	18 (92)
West Rush	CHF	9.16.00	332	12 (40)	52 (171)	31 (103)	55 (184)	43 (142)	1 (2)	15 (50)
East Rush	CHF	9.16.00	192	9 (18)	43 (82)	23 (44)	43 (83)	31 (59)	1 (1)	22 (42)
Maple Grove Lake Summary, MN	CHF	9.30 - 10.12.99	644	14 (89)	67 (431)	48 (312)	60 (385)	48 (310)	1 (3)	20 (129)
Cedar Island	CHF	9.30 - 10.12.99	93	5 (5)	62 (58)	35 (33)	55 (51)	39 (36)	0	22 (21)
Eagle	CHF	9.30 - 10.12.99	90	14 (13)	64 (58)	52 (47)	47 (42)	41 (37)	0	35 (32)
Edward	CHF	9.30 - 10.12.99	34	12 (4)	91 (31)	88 (30)	76 (26)	71 (24)	6 (2)	3 (1)
Fish	CHF	9.30 - 10.12.99	170	7 (12)	74 (126)	44 (75)	57 (97)	41 (70)	1 (1)	20 (34)
Pike	CHF	9.30 - 10.12.99	9	56 (5)	100 (9)	100 (9)	100(9)	100 (9)	0	0
Rice	CHF	9.30 - 10.12.99	137	33 (45)	71 (97)	64 (87)	81 (111)	74 (102)	0	19 (25)
Weaver	CHF	9.30 - 10.12.99	111	5 (5)	47 (52)	28 (31)	44 (49)	29 (32)	0	14 (16)
Powers City of Woodbury, MN	CHF		30	90 (27)	90 (27)	90 (27)	97 (29)	97 (29)	0	0
Upper Prior Scott Co, MN	CHF	9.30-10.12.99	366	10 (37)	51 (187)	36 (132)	35 (128)	31 (113)	4 (15)	46 (168)
Lower Prior Scott Co, MN	CHF	9.24-30.99	691	10 (66)	36 (249)	24 (166)	22 (152)	17 (117)	5 (35)	54 (373)
Comfort Chisago Co, MN	CHF	10.9-11.2.98	100	--	62 (62)	--	50 (50)	--	--	12 (12)
Big Bear Lake Burnett Co, WI	LF	9.11.02	87	13 (11)	82 (71)	62 (54)	86 (75)	76 (66)	0	9 (8)
Pike Chain Price & Vilas Co, WI			722	380	92 (633)	87 (626)	95 (684)	91 (654)	--	5 (34)
Plum Lake Vilas Co, WI	LF	7.26.01	225	13 (30)	75 (169)	58 (130)	81 (182)	708(158)	--	9(4)
Nancy Lake Washburn Co, WI	LF	9.21.00	217	19 (41)	77 (167)	65 (141)	80 (174)	72 (156)		5 (11)
Big Bearskin Oneida Co, WI	LF	8.10.99	130	--	73 (95)	63 (82)	80 (104)	67 (87)	--	0
Ballard chain Vilas Co, WI	LF	7.23.99	110	--	98 (108)	96 (106)	96 (106)	95 (105)	--	0
Bear Oneida Co, WI	LF	6.8.99	115	6 (7)	93 (107)	78 (90)	84 (97)	77 (89)	1 (1)	8 (9)

* CHF = Central Hardwood Forest Ecoregion
** LF = Lake and Forests Ecoregion

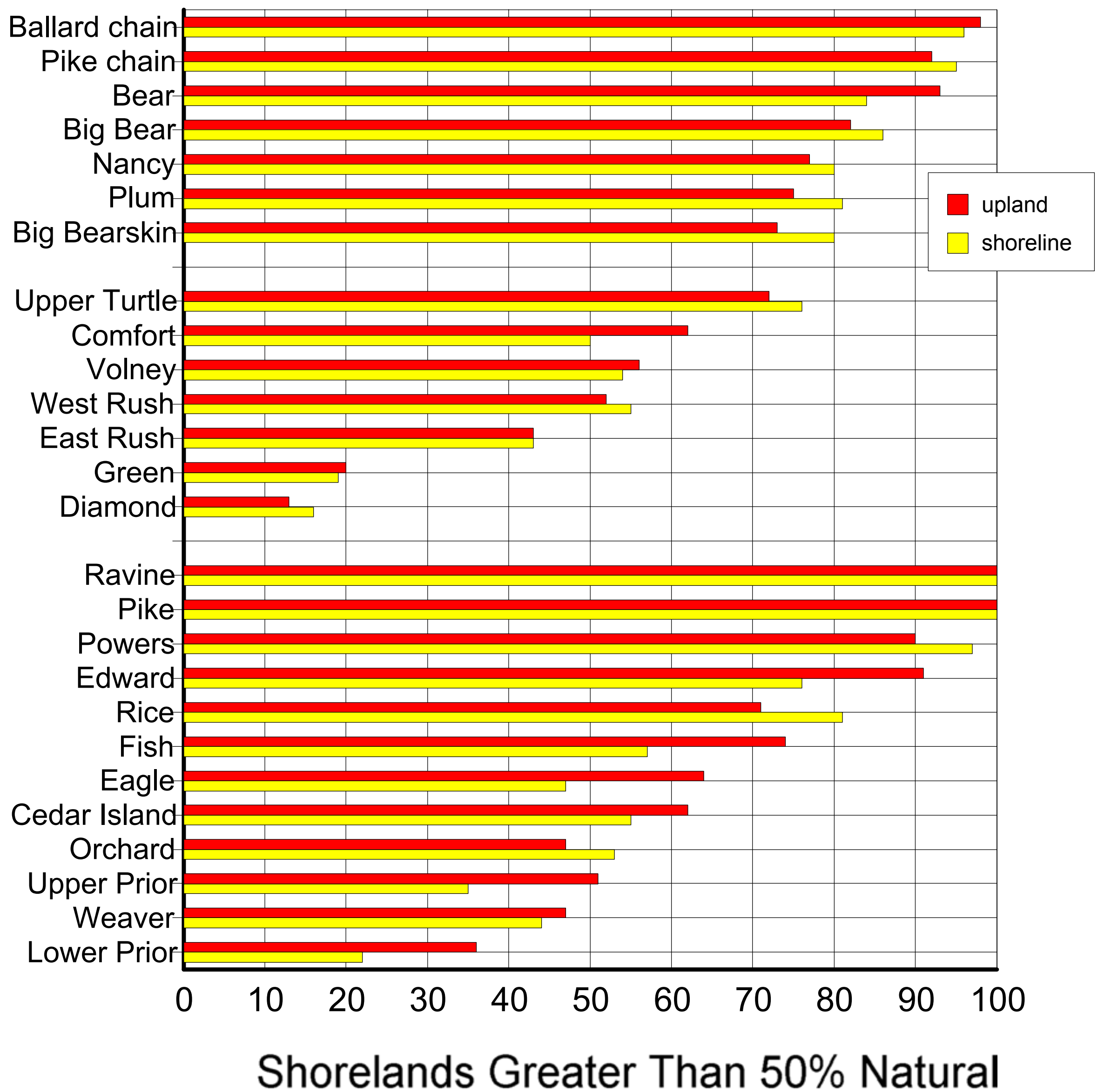


Figure 8. A summary of shoreland inventory results for lakes using an evaluation based on shoreland photographs. For each lake the percentage of shoreline and upland conditions with greater than 50% natural conditions is shown. The first tier of lakes are located in northern Wisconsin. The lower tier 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.

Upper Turtle Lake is a country lake. It's natural shoreland conditions are above average compared to the other country lakes in the middle tier.

3.4. Groundwater and On-site Wastewater Treatment Systems

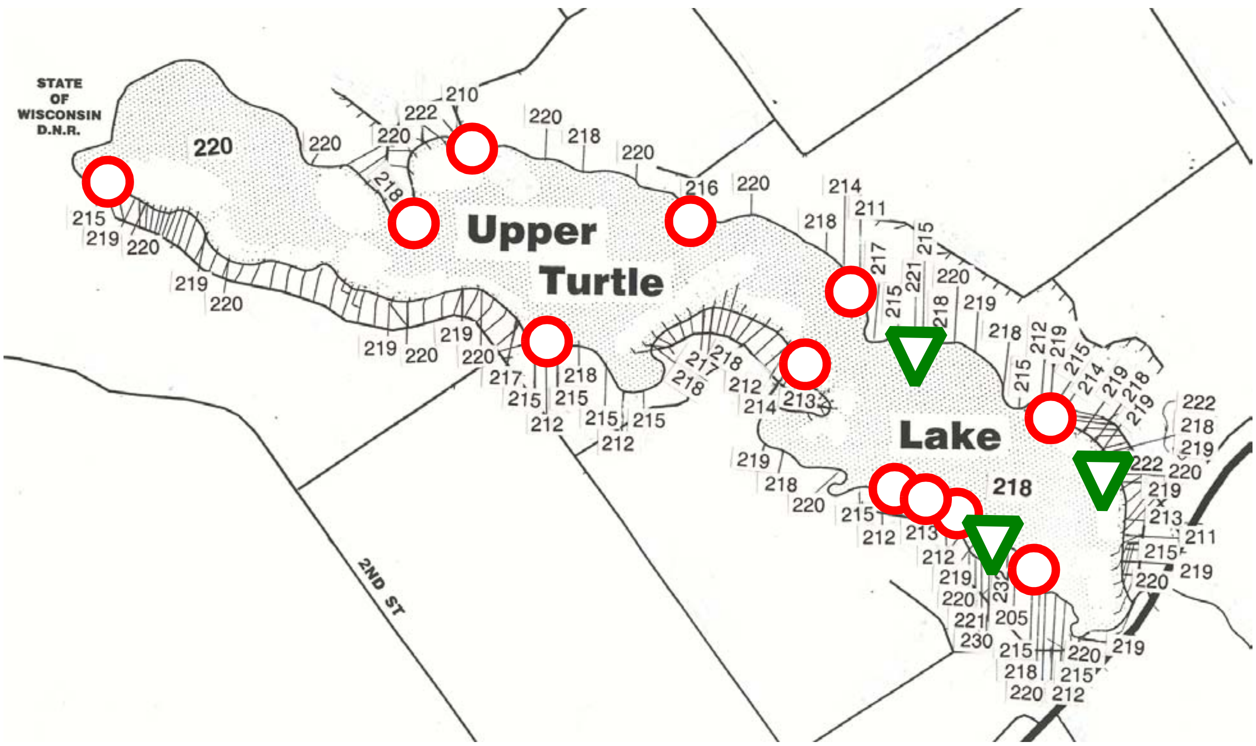
Groundwater inflow was evaluated indirectly by measuring lake water conductivity in the shallow nearshore area. The objective was to see if there was any change in conductivity. An increase or decrease in conductivity could indicate the inflow of groundwater. The groundwater could be coming from natural flows or from septic tank drainfields.

Specific conductance or conductivity is a measure of dissolved salts in the water. The unit of measurement is microSiemans/cm^2 or micro umhos/cm^2 . . . both are used. The saltier the water the higher the conductivity. For example oceans have higher conductivity than fresh water. For the conductivity survey on Upper Turtle Lake we used a YSI (Yellow Springs Instruments) probe attached to the end of an eight-foot pole (Figure 9). The survey used two people. One person held the probe under the surface of the water and recorded the reading off of a conductivity meter while the other person maneuvered the boat around the perimeter of Upper Turtle Lake.

Results are shown in Figure 10. The background or base conductivity was 218-220 umhos/cm. Several areas around Upper Turtle Lake had readings above background. The elevated conductivity readings could be an indicator of septic tank effluent inputs. However, just because a conductivity reading is elevated, it does not mean it is a phosphorus source. Additional testing is necessary. Results suggest that Upper Turtle Lake may be receiving groundwater inflows in several areas (Figure 10). It is not surprising that springs are found in Upper Turtle Lake. This was an active glacial area is the past and often leads to subsurface groundwater inflows.

Figure 9. The conductivity survey consisted of attaching a conductivity probe to the end of a pole and moving around the lake in the shallow shoreline area. The conductivity meter recorded changes in conductivity.

= spring inflows



= potential area of septic leachate inflow

Figure 10. Upper Turtle Lake conductivity survey, August 28, 2002.

Onsite Systems Status: Onsite systems appear to be in mostly good condition based on the conductivity survey results, the surrounding soils, and the setback of the cabins and homes. A conventional onsite system is shown in Figure 11. With proper maintenance (such as employing a proper pumping schedule) onsite systems are an excellent wastewater treatment option. The challenge is to maintain systems in good working condition.

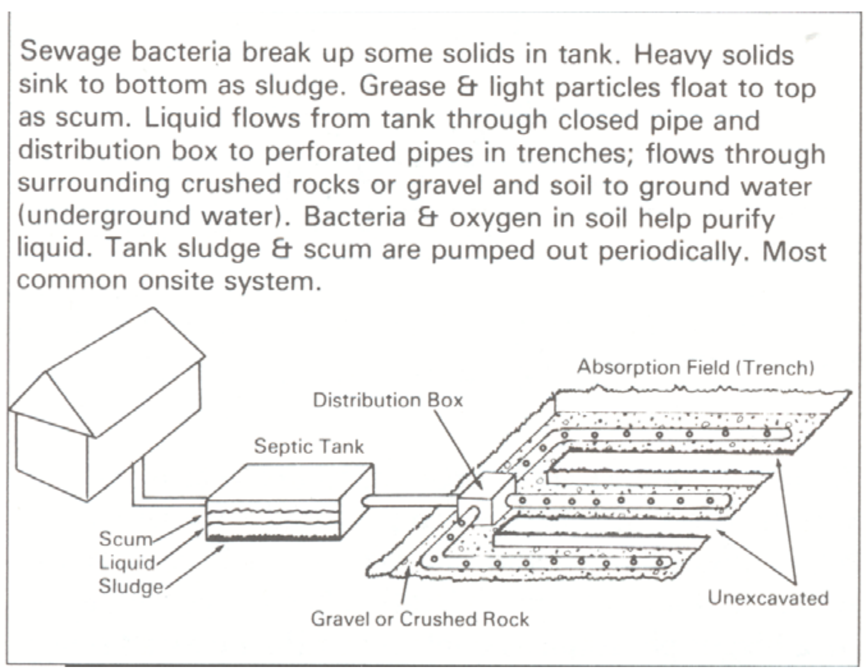


Figure 11. Typical onsite wastewater treatment system found in the Upper Turtle Lake watershed.

3.5. Wildlife Inventory

A wide variety of wildlife are present in the Upper Turtle Lake area. A summary of wildlife observations in 2002 by lake volunteers is shown in Table 7.

Table 7. Wildlife observations in the Upper Turtle Lake watershed recorded by Nancy Sanderson.

Birds Observed

Bird	Time Frame
Robin	3.31.02
Wood ducks (4)	4.13.02
Merganser	4.16.02
Loon (2)	4.19.02
Lesser scoup	4.20.02
Loon	4.21.02
Red poll	5.13.02
Chickadees	5.13.02
Grey herons	5.13.02
Bufflehead	5.13.02
Hummingbird	5.15.02
Bird	5.15.02
Pine grassheck	5.15.02
Indigo bunting	5.15.02
Sandhill crane	5.20.02
Bald eagle & baby eagle	5.20.02
Baby hummingbird	5.20.02
Cardinals	5.20.02
Sandhill crane	8.21.02
Golden eagle	8.22.02
Mallards	9.30.02
Kingfisher	10.2.02
Wood ducks	4.25.03
Mergansers	4.25.03
Pileated woodpecker	5.14.03
Catbird	6.17.03
Trumpeter swans (3)	
Canadian geese	
Wood ducks	
Northern shoveler	
Hawk	
Osprey	
Wild turtkey	
Ringnecked pheasants	
Morning doves	
Owl	
Swallows	
Blue jays	
Crows	
Robins	6.17.03
Cedar Waxwing	6.17.03
Grosbeak	6.17.03
Cardinals	6.17.03
Red wing blackbird	6.17.03
Orioles	6.17.03
Gold finch	6.17.03
Purple finch	6.17.03
Yellowheaded blackbird	6.17.03

Fish Observed

Animal	Time Frame
Carp	4.17.02

Animals Observed

Animal	Time Frame
Deer - 7	4.6.02
Otter	4.19.02
White squirrel	all winter long
Oppusum	8.13.02
Beaver - 2	4.25.03
Baby squirrel	4.25.03
Blond squirrel	4.25.03
Bear	6.17.03

3.6. Watershed Synopsis

The watershed area that drains to Upper Turtle Lake is dominated by agricultural acreage.

Questions have been raised by lake users about the water quality coming into Upper Turtle Lake. Special efforts were conducted by lake volunteers to explore the watershed of Upper Turtle Lake. Results of the water testing indicate water coming into Upper Turtle Lake is typical for the region and is not polluted although elevated levels of sedimens and nutrients were found in several storm event samples. It is uncertain if nutrient inputs were associated with erosion from Highway 8 construction and is construction related or if elevated nutrient inputs are a long-term problem.

Watershed phosphorus inputs have been estimated at 400 pounds of phosphorus per year based on a lake model that used the existing lake phosphorus concentration of 26 ppb and then back calculates to find how much phosphorus it would take to produce that lake concentration.

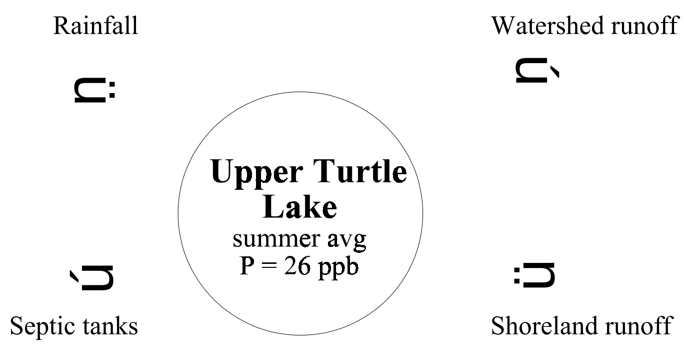


Figure 12. Sources of phosphorus (P) that feed into Upper Turtle Lake are shown above. It is estimated that approximately 400 pounds of phosphorus enter Turtle Lake on an annual basis.

4. Lake Features

4.1. Lake Map and Lake Statistics

Upper Turtle Lake is approximately 438 acres in size, with a watershed of 1,732 acres. The average depth of Upper Turtle Lake is 4.2 meters (13.8 feet) with a maximum depth of 7.6 meters (25 feet) (Table 8). A lake contour map is shown in Figure 13. Upper Turtle Lake is located in an area of Wisconsin that is dominated by forests.

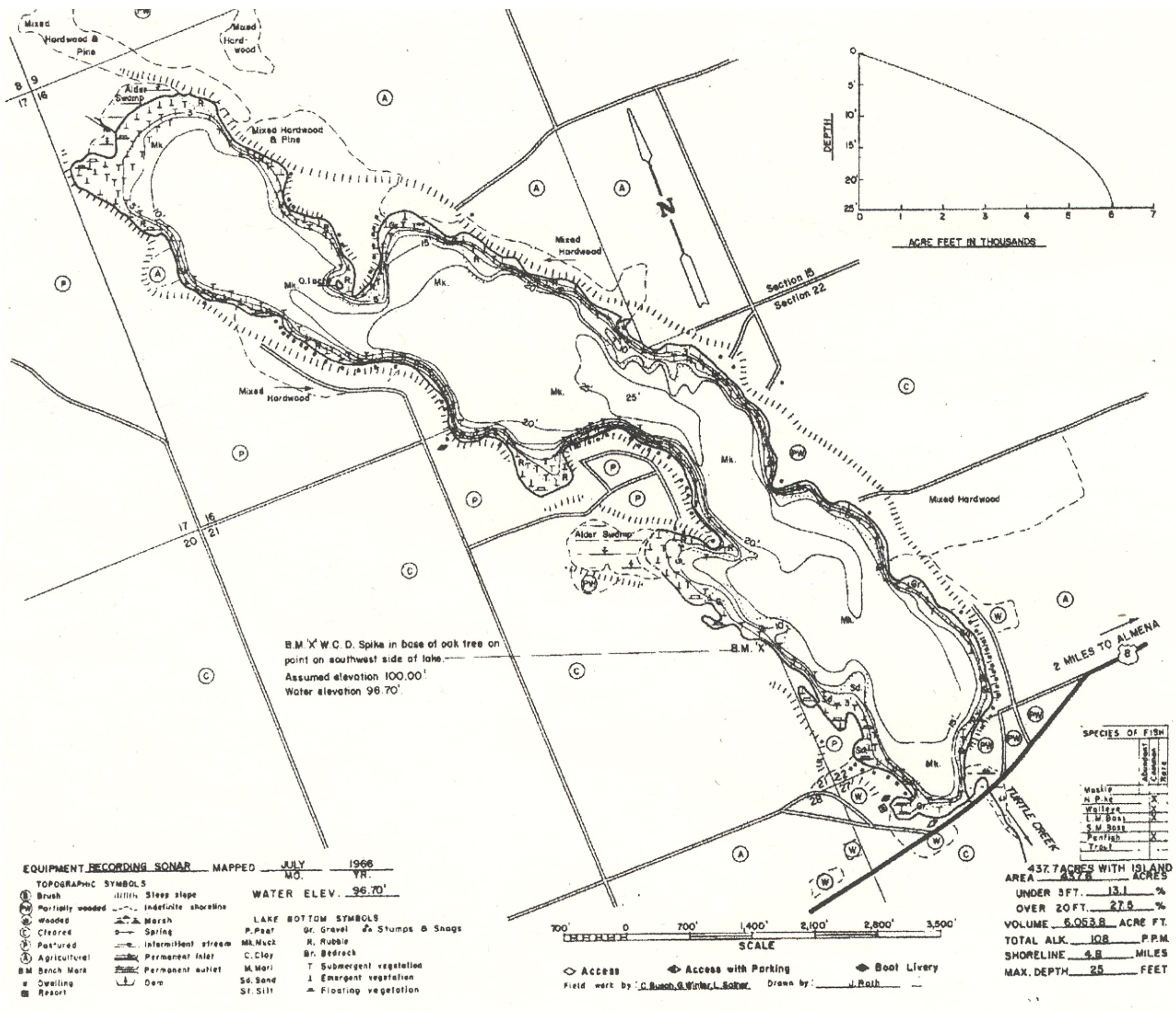


Figure 13.

Table 8. Upper Turtle Lake Characteristics

Area (Lake):	438 acres (177 ha)
Mean depth:	13.8 feet (4.2 m)
Maximum depth:	25 feet (7.6 m)
Volume:	6,044 acre-feet (743 Ha-M)
Fetch (longest open water distance):	1.3 mile (2.1 km)
Watershed area (not including lake area):	1,732 acres (701 ha)
Watershed: Lake surface ratio	4 :1
Public accesses (#):	1
Inlets: 4	Outlets: (Turtle Creek)

Aquatic plants were growing close to the lake surface in June on the west side of Upper Turtle Lake.

4.2. Dissolved Oxygen and Temperature

The summer dissolved oxygen and temperature profiles are shown in Figure 14.

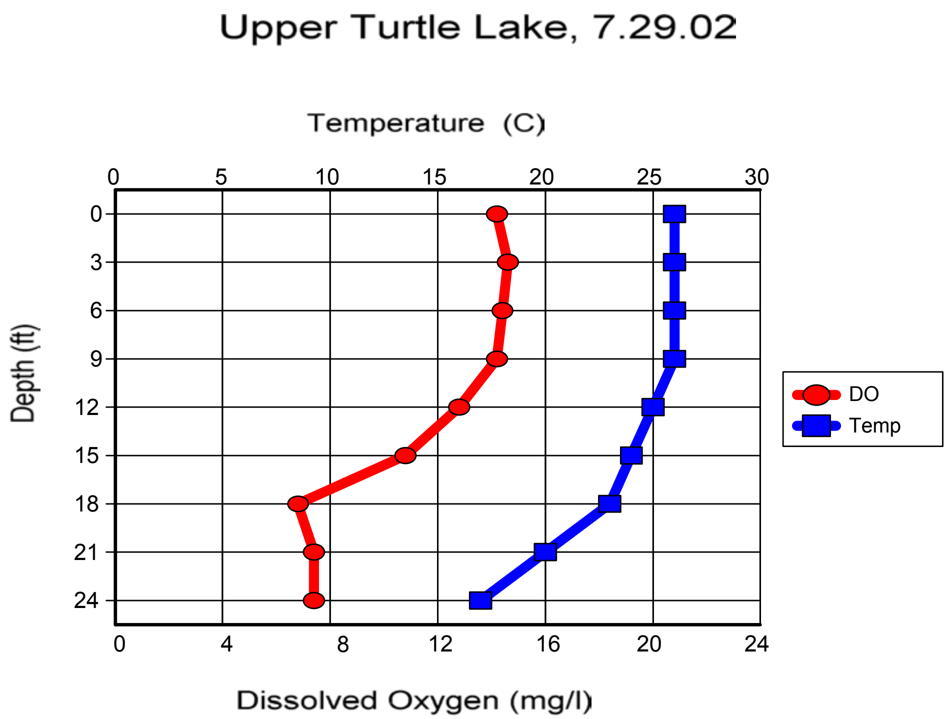
A profile was obtained each month from July and September, 2002. By examining the profiles, one can learn a great deal about the condition of a lake and the habitat that is available for aquatic life.

The July profile show that the lake was thermally stratified. **Thermally stratified** means that the water column of the lake is segregated into different layers of water based on their temperature. Just as hot air rises because it is less dense than cold air, water near the surface that is warmed by the sun is less dense than the cooler water below it and it "floats" forming a layer called the *epilimnion*, or *mixed layer*. The water in the epilimnion is frequently mixed by the wind, so it is usually the same temperature and is saturated with oxygen.

Below this layer of warm, oxygenated surface water is a region called the *metalimnion*, or *thermocline* where water temperatures decrease precipitously with depth. Water in this layer is isolated from gas exchange with the atmosphere. The oxygen content of this layer usually declines with depth in a manner similar to the decrease in water temperature.

Below the thermocline is the layer of cold, dense water called the *hypolimnion*. This layer is completely cut off from exchange with the atmosphere and light levels are very low. So, once the lake stratifies in the summer, oxygen concentrations in the hypolimnion progressively decline due to the decomposition of plant and animal matter and respiration of benthic (bottom-dwelling) organisms.

The July profile indicates that the epilimnion extended to a depth of about 18 ft, and that oxygen was present at all depths.



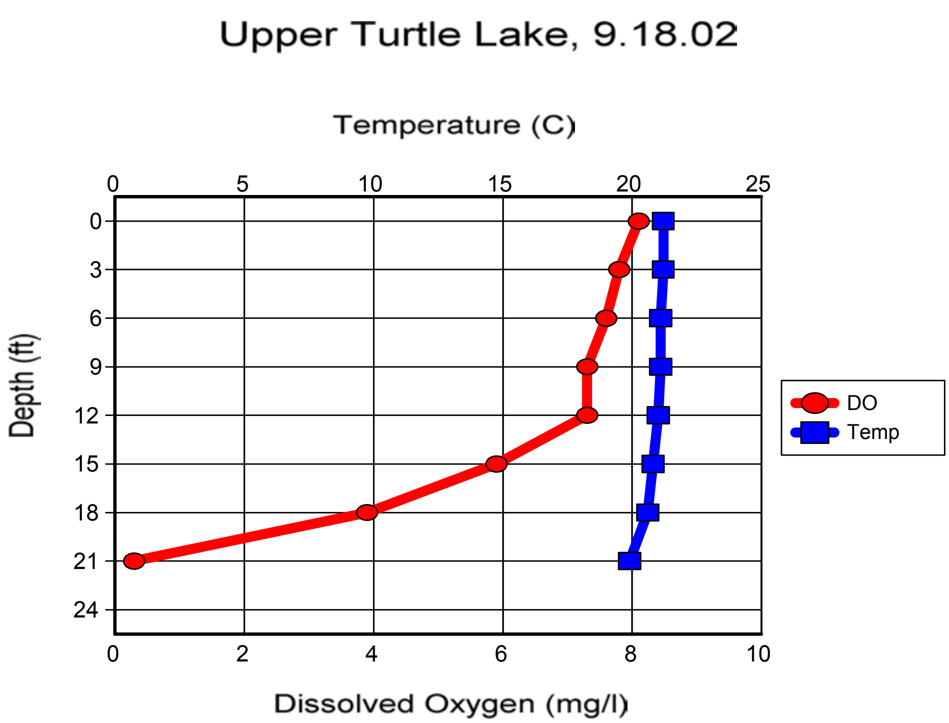


Figure 14. Dissolved oxygen (DO)/temperature profiles for July (top) and September (bottom) in 2002. Dissolved oxygen data are shown with circles and temperature with squares.

4.3. Lake Water Quality Summary

Summer water chemistry data collected during 2002 included secchi disc, total phosphorus (TP), and chlorophyll a (Chl a) (Table 9). Samples were collected at the surface and two feet off the bottom in the deepest area of Upper Turtle Lake. Total phosphorus was higher in the bottom water than the top water indicating some phosphorus release from the bottom material (sediments or plants) may be occurring, but it is minor. Overall, the three water quality indicators (Secchi disc, total phosphorus, and chlorophyll a) in 2002 indicate Upper Turtle is in fair shape.

Table 9. Summer monitoring results for Upper Turtle Lake in 2002.

		Secchi Disc (ft)	Total Phosphorus (ppb)	Chlorophyll a (ppb)
May 9	south	4.5	40	--
	north	4.5	39	19
Jun 25	south	11.5	14	--
	north	19	14	--
	bottom	--	63	--
Jul 29	south	10	18	--
	north	10.5	16	1
	bottom	--	160	--
Aug 28	north	5.4	26	13
	bottom	--	49	--
Sept 18	north	4.2	34	14
	bottom	--	34	--
Average	south	8.7 (3)	24 (3)	--
	north	8.7 (5)	26 (5)	12 (4)
	bottom	--	77 (4)	--

Special lake samples were collected during July and August and analyzed for fecal coliform. Results are shown in Table 10. Two readings were at 200 or over. These readings are slightly elevated. Additional sampling should probably occur in the future to determine if this area of the watershed is an ongoing source of fecal coliform.

Table 10. Fecal coliform lake samples. Results are shown in number/100 ml.

	1. Northeast pasture (farm)	2. Northeast pasture (farm)	3. 25 ft in middle of lake	4. 25 ft in middle of lake	5. Boat landing	6. Boat landing
7.22.02	200	280	30	10	20	<10
8.12.02	100	20	--	--	<10	<10

Viewing the results of Secchi disc summer averages from 1994 through 2002 indicates clarity is somewhat stable (Table 11 and Figure 14) from the perspective that there is no apparent trend for increasing or decreasing water clarity in Upper Turtle Lake.

Table 11. Historical seasonal (May - September) average lake monitoring results for Upper Turtle. The number in parenthesis is the number of data points used to calculate the seasonal average.

	Secchi Disc (ft)	Total Phosphorus (ppb) at 3 feet	Chl a (ppb) at 3 feet
1994	5.6 (7)	--	--
1995	7.1 (10)	--	--
1996	8.6 (9)	--	--
1997	9.1 (8)	--	--
1998	6.7 (10)	--	--
1999	5.1 (6)	--	--
2000	5.7 (16)	40 (2)	20 (2)
2001	6.8 (11)	43 (3)	18 (3)
2002	7.9 (14)	46 (3)	18 (1)

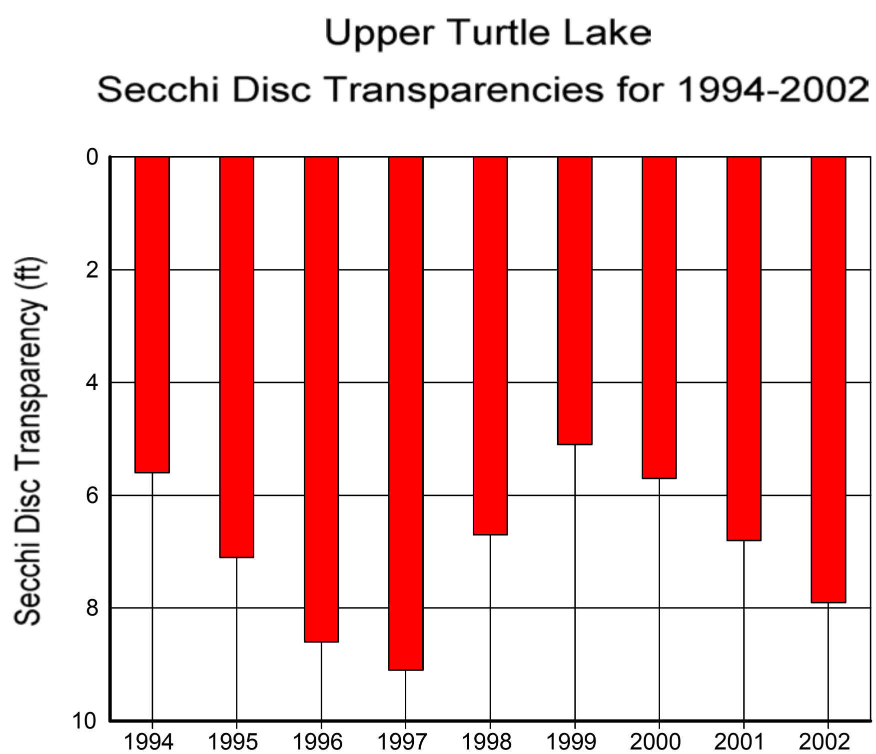


Figure 14. Annual summer Secchi disc averages for Upper Turtle Lake.

4.3.1. Secchi Disc Transparency

Water clarity is commonly measured with a Secchi disc. A typical seasonal pattern shows good clarity in May and June with a drop off in July, August, and September (Figure 15). This is a typical pattern for lakes like Turtle Lake.

Ken Klehr holding a Secchi disc which is used to measure water clarity.

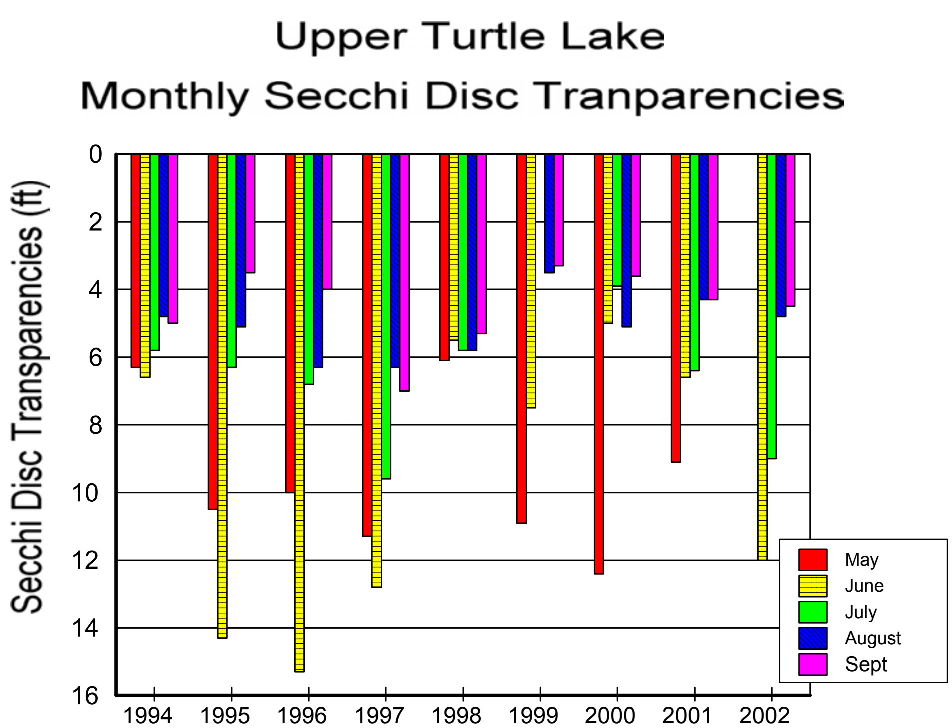
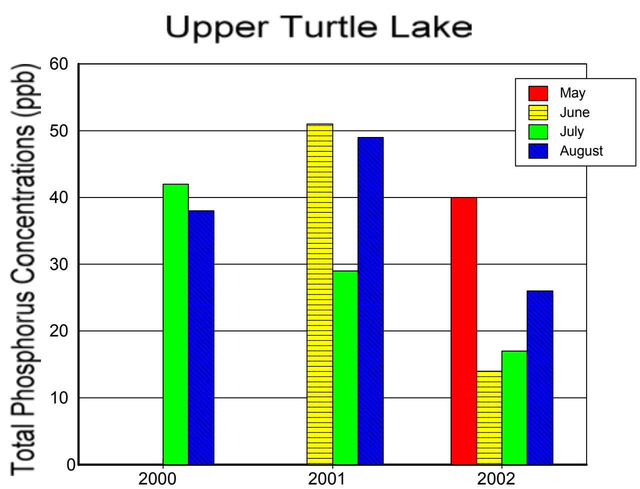


Figure 15. Monthly Secchi disc readings from 1994-2002.

4.3.2. Total Phosphorus

Phosphorus is the nutrient more often associated with stimulating nuisance algae growth. Lake phosphorus concentrations for 2000, 2001, and 2002 are shown in Figure 16. Phosphorus concentrations in Upper Turtle Lake are moderate. However, by the end of the summer they are high enough to produce moderate algae blooms.



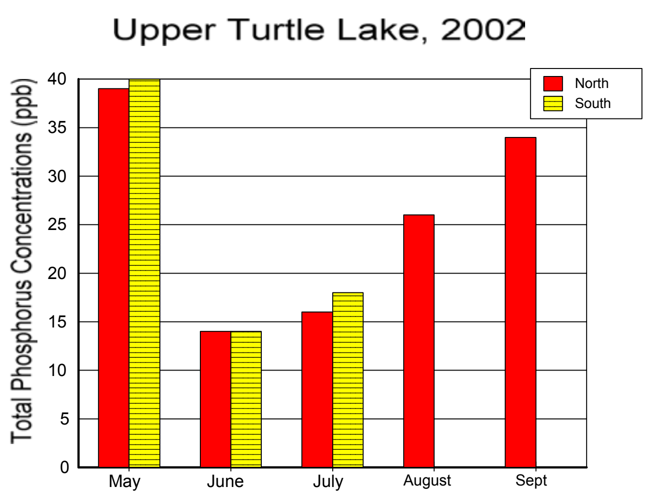


Figure 16. [top] Monthly phosphorus concentrations for 2000, 2001, and 2002. [bottom] Monthly phosphorus concentrations in Upper Turtle Lake for 2002. The north and south ends of the lake have similar concentrations.

4.3.3. Chlorophyll and Algae

Algae are small green plants, often consisting of single cells or grouped together in filaments (strings of cells). Algae blooms are patchy in Turtle Lake. Algae is commonly characterized by measuring the chlorophyll content in lake water. Chlorophyll results in 2002 are shown in Figure 17. In June and July chlorophyll was low and then increased in August and September. This is a common pattern for lakes like Upper Turtle Lake.

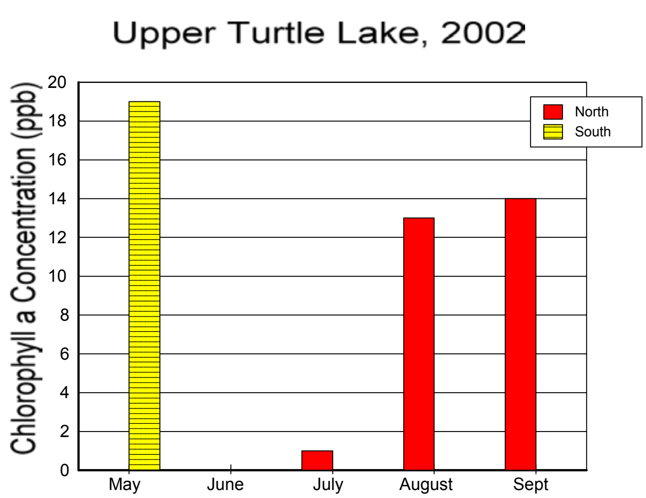


Figure 17. Monthly chlorophyll concentrations in Upper Turtle Lake for 2002.

4.4. Zooplankton and Other Invertebrates

Zooplankton are small crustacean-like animals that can feed on algae. Examples of algae and zooplankton from Upper Turtle Lake are shown in Figure 18. Algae are dominated by "good" algae, generally non-bloom forming species. The zooplankton community is typical for lakes in Northern Wisconsin. In the photos below, images are magnified 150 times.

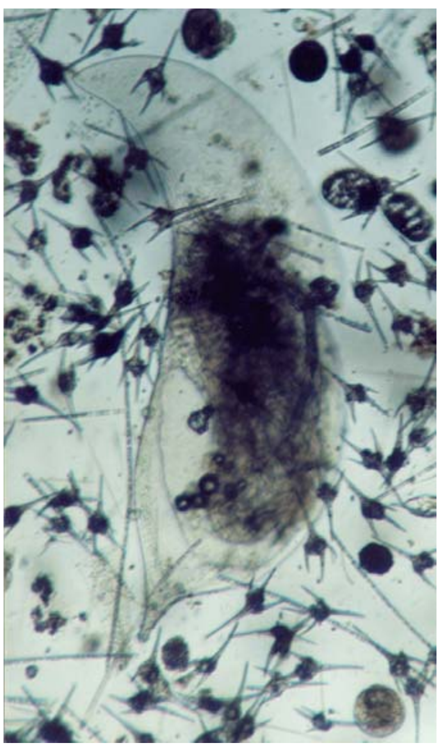


Figure 18. Two examples of zooplankton species from Upper Turtle Lake in 2002. The animal on the left is *Daphnia*, a relatively large zooplankton (1-2 mm in length) that feeds on algae. The animal on the right is a copepod

Zooplankton were sampled in 2002 results are shown in Table 12 and Figure 19.

Table 12. Zooplankton counts for 2002.

	5.9.02	6.25.02	7.29.02	8.28.02	9.18.02
Cladocerans	36	34	18	24	17
Big	25	23	5	8	2
Little	9	11	9	4	6
Ceriodaphnia	0	0	0	0	0
Bosmina	0	0	0	0	0
Chydorus	2	0	0	0	0
Retrocurva	0	0	4	12	9
Copepods	29	22	31	35	14
Calonoids	1	8	13	18	8
Cyclophoids	14	8	9	11	6
Nauplii	14	6	9	6	0
Rotifers	3	3	0	0	0
TOTAL	68	59	49	59	31

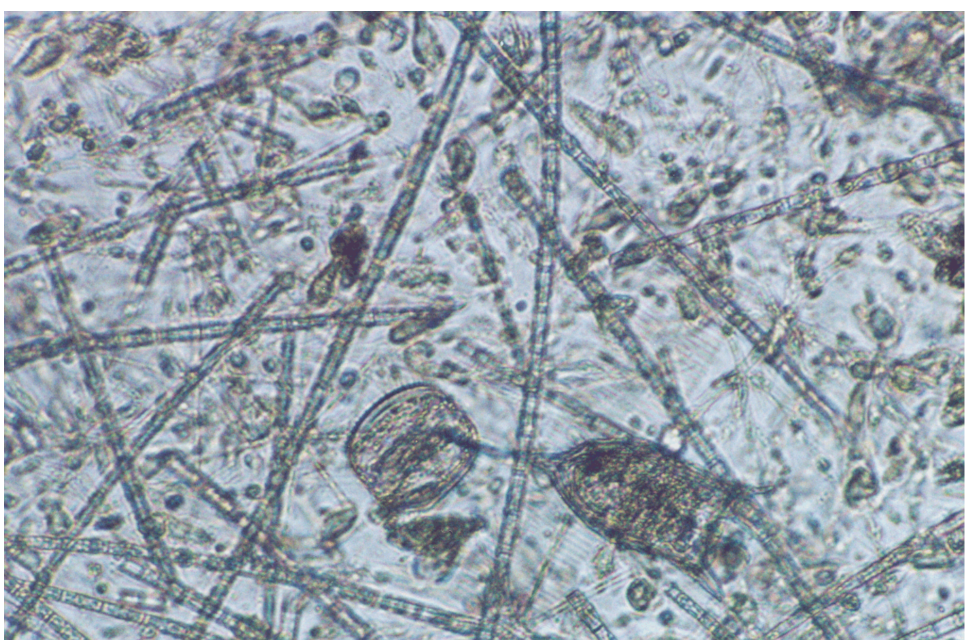


Figure 19. The zooplankton and algal conditions in Upper Turtle Lake on August 26, 2002 consisted of filamentous algae and diatoms (circular organisms) shown above.

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 Upper Turtle Lake has a wide diversity of aquatic plants.

The coverage of aquatic plants over the lake bottoms for Upper Turtle Lake is shown in Figure 21. Details for individual transects for the plant survey is found in Table 14 and summary statistics are listed in Table 14a.

Figure 20. Cathy Klehr, Upper Turtle Lake, assisted in the aquatic plant survey conducted on September 18, 2002.

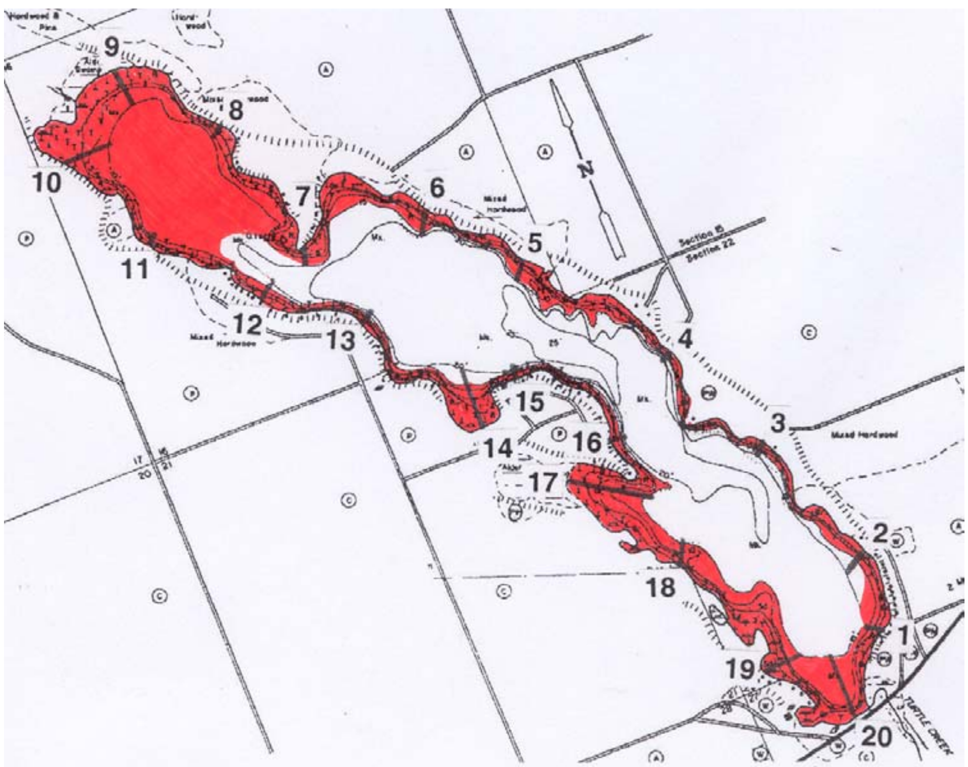


Figure 21. [top] Example of diversity of aquatic plants found in Upper Turtle Lake. [bottom] Upper Turtle Lake aquatic plant coverage based on the 2002 survey conducted by Blue Water Science.

Table 14. Aquatic plant occurrence and density for individual transects in Upper Turtle Lake, September 18, 2002.

	T1			T2			T3			T4			T5			T6			T7		
Depth (ft)	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15
Duckweed																					
Spatterdock																					
White waterlily																					
Coontail		2	1		3		4	3					1	0.5	1	3	1	1	1.5		1
Chara				4	2					0.5	1										
Elodea	1	0.5																			
Northern watermilfoil	1	1		1	1								0.5			2	2				
Naiads										2											
Curlyleaf pondweed																			1		
Illinois pondweed	3	1		2	2.5		2			1			2	0.5		2			1	1	
Claspingleaf pondweed																					
Flatstem pondweed	1													0.5							
Sago pondweed																				1	
Water celery	1									1	0.5		1	1					0.5		
Water stargrass		0.5												0.5							
Filamentous algae	1									2			1	0.5							

	T8			T9			T10			T11			T12			T13			T14		
Depth (ft)	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15
Duckweed							1														
Spatterdock																					
White waterlily										1									5		
Coontail	1	0.5	1	3	1	1	1.5		1	3	4	0.5						0.5	2	3	0.5
Chara													2	3					2		
Elodea				1						1.5									1		
Northern watermilfoil	2	1		1			0.5	0.5		1									1		
Naiads																					
Curlyleaf pondweed																					
Illinois pondweed	2			1									2	1		1	1		1		
Claspingleaf pondweed										1											
Flatstem pondweed							2	0.5		0.5	1								0.5		
Sago pondweed																					
Water celery	0.5	1								1						1					
Water stargrass				3																	
Filamentous algae							1		1							1	1				

	T15			T16			T17			T18			T19			T20		
Depth (ft)	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15	0-5	6-10	11-15
Duckweed							1.5											
Spatterdock							2											
White waterlily																		
Coontail		1		0.5	2		2	1.5	1	3	3	1	2	3	0.5	1	2	0.5
Chara																		
Elodea													1					
Northern watermilfoil													2			0.5		
Naiads																0.5		
Curlyleaf pondweed																		
Illinois pondweed	0.5			3				1		1	1		1	1		2	2	
Claspingleaf pondweed													1					
Flatstem pondweed								0.5					1			0.5		
Sago pondweed													1			0.5		
Water celery				2	0.5								1			1		
Water stargrass	0.5	1											2					
Filamentous algae	0.5			1				0.5	1		0.5							

Table 14a. Upper Turtle Lake aquatic plant occurrences and densities for the September 18, 2002 survey based on 20 transects and 3 depths (where possible), for a total of 60 stations. Density ratings are 1-5 with 1 being low and 5 being most dense.

	Depth 0-5 feet (n=20)			Depth 6-10 feet (n=20)			Depth 11-15 feet (n=20)			All Stations (n=60)		
	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density	Occur	% Occur	Density
Duckweed (*Lemna sp*)	2	10	1.3	--	--	--	--	--	--	2	3	1.3
Spatterdock (*Nuphar sp*)	1	5	2	--	--	--	--	--	--	1	2	2
White waterlily (*Nymphaea sp*)	2	10	3	--	--	--	--	--	--	2	3	3
Coontail (*Ceratophyllum demersum*)	14	70	2	15	75	2	14	70	0.8	43	72	1.6
Chara (*Chara sp.*)	4	20	2.1	3	15	2	--	--	--	7	12	2.1
Elodea (*Elodea canadensis*)	5	25	1.1	1	5	1	--	--	--	6	10	1
Northern watermilfoil (*Myriophyllum sibiricum*)	11	55	1.1	5	25	1.1	--	--	--	16	27	1.1
Naiads (*Najas sp*)	2	10	1.3	--	--	--	--	--	--	2	3	1.3
Curlyleaf pondweed (*Potamogeton. crispus*)	1	5	1	--	--	--	--	--	--	1	2	1
Illinois pondweed (*P. illinoensis*)	17	85	1.6	10	50	1.2	--	--	--	27	45	1.5
Claspingleaf pondweed (*P. richardsonii*)	2	10	1	--	--	--	--	--	--	2	3	1
Flatstem pondweed (*P. zosteriformis*)	6	30	0.9	4	20	0.6	--	--	--	10	17	0.8
Sago pondweed (*Stuckenia pectinata*)	2	10	0.8	1	5	1	--	--	--	3	5	0.8
Water celery (*Vallisneria americana*)	10	50	1	4	20	0.8	--	--	--	18	30	0.7
Water stargrass (*Zosterella dubia*)	3	15	1.8	3	15	0.7	--	--	--	6	10	1.3
Filamentous algae	7	35	1.1	4	20	0.6	2	10	1	13	22	0.9

A sonar with recording paper graph (Lowrance X16) was used to determine depth of plant growth and canopy characteristics. For this transect on Upper Turtle Lake, the deepest depth of plant growth is 15 feet (Figure 22).

A summary of aquatic plant statistics is shown in Table 13. The frequency of aquatic plant occurrence and their density is shown in Table 14.

Table 13. Aquatic plant survey summary.

	All Stations
Number of submerged aquatic plant species found	12
Most common plant	coontail
Rarest plant	curlyleaf pondweed (an exotic plant)
Maximum depth of plant growth	15 feet

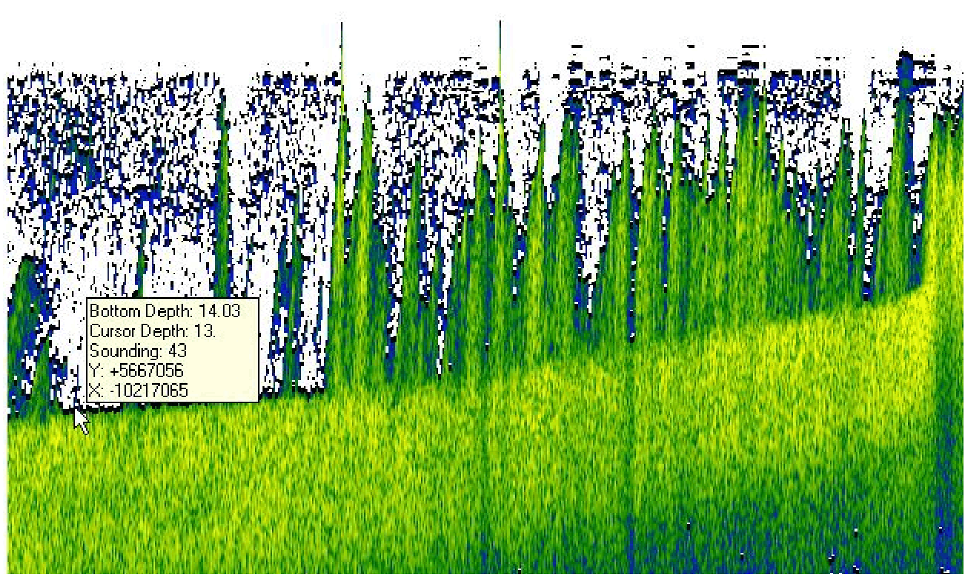


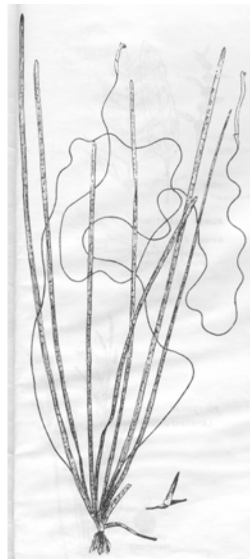
Figure 22. Sonar recording for Transect 20 on Upper Turtle Lake on September 18, 2002.

Common Plants in Upper Turtle Lake

Northern watermilfoil

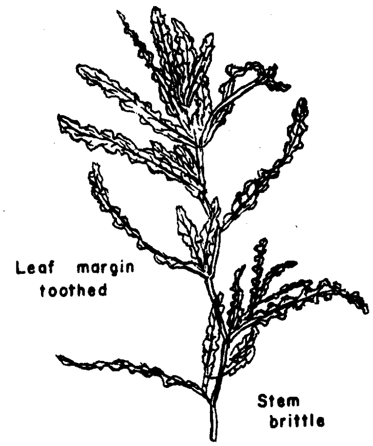
Northern watermilfoil (*Myriophyllum sibiricum*) is found in water depths to 10 feet.

Water celery



Water celery (*Vallisneria americana*) is found in water depths to 10 feet.

Curlyleaf pondweed



Curlyleaf pondweed (*Potamogeton crispus*) is an exotic plant found in Upper Turtle Lake.

Illinois pondweed

Illinois pondweed (*Potamogeton illinoensis*) is found in water depths to 10 feet.

Coontail

Coontail (*Ceratophyllum demersum*) is dominant in all water depths.

4.6. Fishery Status (prepared by WDNR)

The fishery status has been summarized by the WDNR.

The last fish survey of Upper Turtle Lake occurred in 1999, and the following information is primarily from this survey. The next fish survey is scheduled for 2004.

Walleye

1. Adult walleye population estimates:

Year	Number	Number per Acre
1992*	1,763	4.0
1999	1,503	3.4

*GLIFWC survey

2. Walleyes were first stocked into Upper Turtle Lake in 1933. Walleye fry or low numbers of fingerlings were stocked from 1933 through 1975. From 1976 to the present, walleye fingerlings have usually been stocked at the rate of 50 per acre (21,900 flg) on an alternate year basis. While surveys have indicated that stocking is contributing to the walleye population, natural reproduction is likely responsible for the majority of the walleye population.

3. The average size of walleyes captured during spawning was 17.0 inches, and the largest walleye was 29.4 inches. Fifty-three percent were in the 14.0 to 16.9 inch size range. Growth of walleyes is about average for northwest Wisconsin.

4. Tribal spearers have harvested from Upper Turtle Lake the last four years: 1997 - 28, 1998 - 28, 1999 - 26, 2000 - 69.

Northern Pike

1. The 1999 adult northern pike population was estimated at 2,178 or 5.0 per acre. Electrofishing catch per effort from past surveys indicate that the northern pike population in the 1990s is larger than in previous years.

2. The size distribution of the northern pike population was fair. Twenty-eight percent of the netted northerns were 20 inches or larger, and less than one percent were 30 inches or larger. The largest northern captured was 39.4 inches. Growth of northern pike was a little above average.

Largemouth Bass

1. The 1999 adult largemouth bass population was estimated at 1,760 or 4.0 per acre. Electrofishing CPEs show no clear trend in bass densities over time.

2. Many of the captured bass were "mid-sized", with 42% in the 14.0 to 15.4 inch size group. Forty-seven percent of the captured bass were 14 inches or larger, and the largest bass captured was 20.4 inches. Growth of bass is above average.

Smallmouth Bass

1. Electrofishing CPEs indicate the presence of a fairly low smallmouth bass population.

2. Smallmouth bass were captured up to 16.9 inches in length, and 28% were 14 inches or larger. Growth of smallmouth bass is above average.

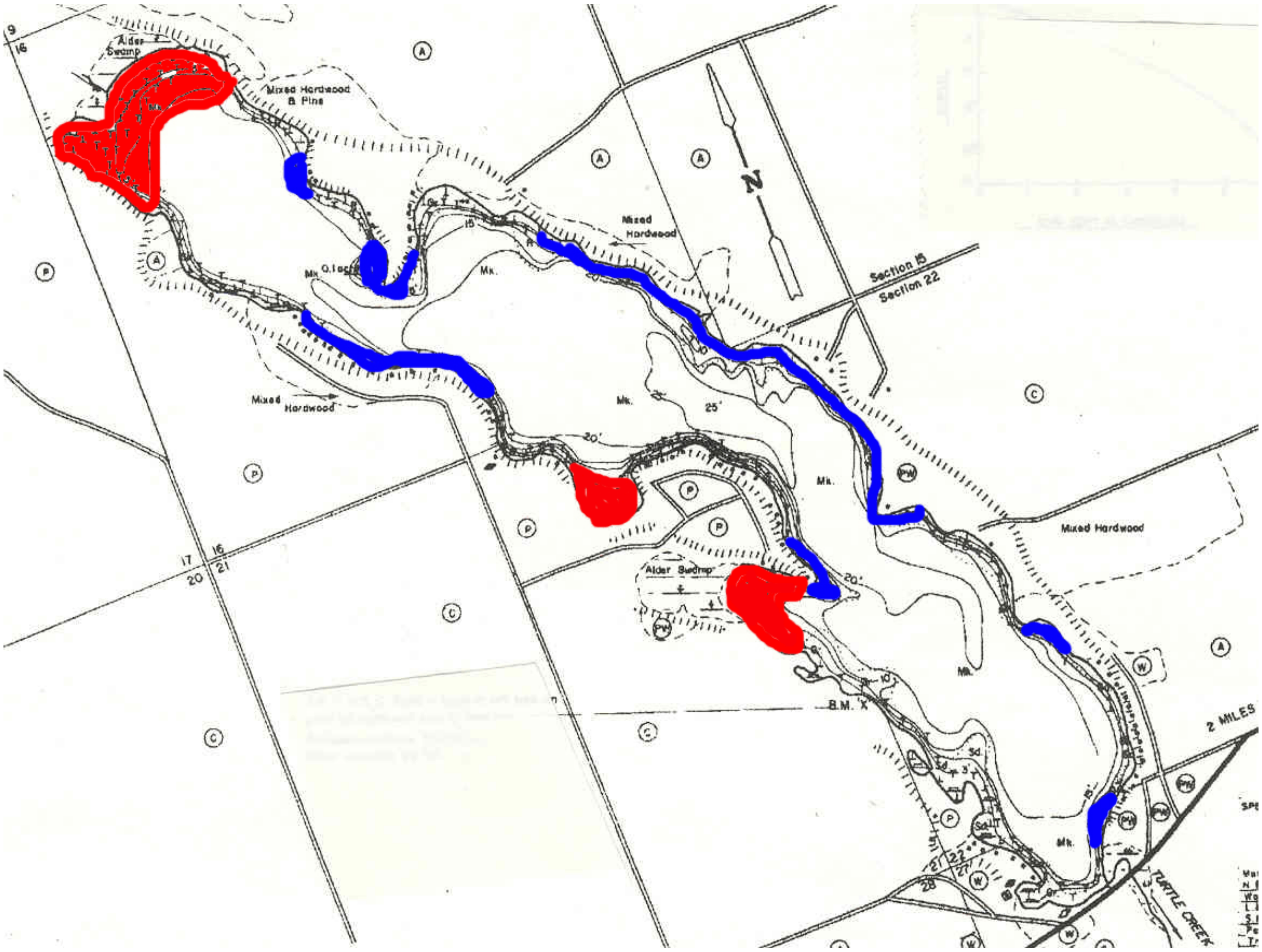
Management Recommendations

1. Upper Turtle Lake as a desirable, well balanced fish community, and current fishing regulations are appropriate.

2. Past surveys have indicated that walleye fingerling stocking is beneficial, so the current management scenario of stocking walleye fingerlings at the rate of 50 per acre on alternate years should continue.

3. Walleye natural reproduction is significant, and walleye spawning areas (see map) should not be altered or degraded in any way. Similarly, wetland areas and shallow, heavily vegetated bays where northern pike spawn should not be altered.

4. Carp are common in Upper Turtle Lake, as they have been for many years. The population appears stable and is composed mainly of large adults with limited natural reproduction. While carp are undoubtedly competing with more desirable species to some extent, carp have not caused serious habitat damage. Rooted aquatic vegetation is common, and the water is not turbid.



Legend

Northern pike spawning area.

Walleye spawning area.

5. Lake and Watershed Assessment

5.1. Lake Questionnaire Results

- The questionnaire was sent to approximately **144** Upper Turtle Lake property owners.
- 75 (52%) property owners responded to the Upper Turtle Lake questionnaire.
- Of those responding:
    - There was an average of **21.2** years of experience owning property on the lake.
    - What is enjoyed most on the lake: aesthetics.
    - Most critical issue: weeds.
    - 35% of respondents are willing to participate in a lake management program..
    - 42% get their information on lakes from the Lake Association newsletter.

Upper Turtle Lake Questionnaire

The Upper Turtle questionnaire was developed to better understand the concerns, goals, and attitudes of homeowners living around the lake. Their thoughts and ideas about the use and the quality of your lake are shown below.

1. What do you enjoy most about Upper Turtle Lake? Please rank 1 through 8 with 1 being the highest rank.

- 1 Aesthetics (viewing) (2.4)
- 2 Fishing (2.7)
- 3 Swimming (3.4)
- 4 Wildlife (3.6)
- 5 Motorized boating (waterskiing, jet skies, etc) (3.9)
- 6 Non-motorized boating (canoeing, kayaking, sailing, etc) (5.3)
- 7 Ice fishing (5.4)
- Other boat rides, convenience to city, solitude, constant lake level, right size

2. How would you rate the current water quality of Upper Turtle Lake? (Water quality indicators are things such as water clarity, algae, weeds or plants, swimming conditions, or fishing conditions.)

- 2 Excellent
- 33 Good
- 29 Fair
- 12 Poor

3. Since you have lived on or near Upper Turtle Lake, the quality has:

- 7 Improved
- 20 Remained the same
- 30 Degraded slightly
- 16 Degraded considerably
- 3 No opinion/can't tell
- 0 Other:

[I have been living on Upper Turtle Lake for 21.2 years.]

4. What do you see as the critical issues regarding the lake?
Please use a "1" for important, "2" for somewhat important, and a "3" for not important. Numbers can be used more than once.

- 1 Weeds (1.2)
- 2 Water quality (1.3)
- 3 Excessive algae (1.4)
- 4 Wildlife (1.4)
- 5 Poor fishing (1.6)
- 6 Lake crowding (1.8)
- 7 Water craft (1.9)
- 8 Development (2.0)
- 9 Lake water levels (2.1)
- 10 Rusty crayfish (2.6)

5. Who do you think is responsible for protecting and improving the lake. Enter the three most important groups or agencies by putting their letter in the spaces provided *(the highest score indicates the preference).*

1st	2nd	3rd	
4	0	1	A. Federal government
15	4	9	B. State government
9	14	12	C. County government (Barron County)
2	4	4	D. Local government
6	**20**	**16**	E. Upper Turtle Lake Association
21	16	9	F. Individual lake residents
7	10	12	G. The general public who use the lake
10	2	5	H. All equally
1	0	1	I. Other

6a. Are you familiar with the latest boating and shoreline regulations?
__47__ Yes __18__ No __21__ I would like more information

6b. Is stricter enforcement of boating and shoreline activities needed?
__30__ Yes __36__ No __1__ Maybe

7. What should be done to improve or protect the quality of the lake? (Examples of projects are watershed practices, buffer strips, wetland restoration, fish stocking, educational materials, etc).
Various answers were given. Examples include: evaluation of lakeshore owners; reduce weeds/algae; water levels.

8. You have variety of options for managing land practices on your lot. How is your yard maintained? (Please check all that apply)
__48__ No fertilizer applied
__21__ Fertilizer is applied: __20__ One; __1__ Two; __0__Three times per year
__3__ Use a commercial fertilizer service
__36__ Maintain natural landscaped area
__38__ Maintain a vegetative buffer between lake and mowed lawn

9. Where is your septic system located in relationship to the lake?

A. Low risk	**B. Medium risk**	**C. High risk**
Drainfield is at least 200 feet from the lake.	Drainfield is at least 100 feet from the lake.	Drainfield is less than 100 feet from the lake.

ANSWER:
A: 40
B: 22
C: 4

10. What is the age and capacity of your septic system?

A. Low risk	B. Medium risk	C. High risk	ANSWER:
System is five years old or less	System is between six and twenty years old	System is more than twenty years old	A: 20 B: 33 C: 14

11. Has your septic tank been pumped recently?

A. Low risk	B. Medium risk	C. High risk	ANSWER:
The septic tank is pumped on a regular basis as determined by annual inspection or about every 1-2 years.	The septic tank is pumped, but not regularly.	The septic tank is not pumped.	A: 50 B: 16 C: 1

12. Is your system exhibiting any signs of problems?

A. Low risk	B. Medium risk	C. High risk	ANSWER:
Household drains flow freely. There are no sewage odors inside or outside. Soil over drainfield is firm and dry.	Household drains run slowly. Soil over drainfield is sometimes wet.	Household drains back up. Sewage odors can be noticed in the house or yard. Soil is wet or spongy in the drainfield area.	A: 65 B: 3 C: 1

Holding tanks: 12 Outhouses: 1

13. Are you interested in participating in a Lake Management Program on a personal level? __50__ Yes __12__ No __13__ No Answer

Are you willing to do any of the following:

- __15__ Use soil test recommendations for fertilizer application?
- __32__ Plant native wildflowers, grasses, etc to attract wildlife?
- __30__ Leave as is or restore natural shoreland vegetation?
- __17__ Take water clarity readings using a secchi disc and send information to WDNR-Rhinelander?
- __6__ Other ideas

14. Where do you get your information on how lakes work?

- __61__ Lake Association newsletters
- __38__ Wisconsin DNR
- __26__ Newspapers
- __15__ Television
- __6__ Other: experience, Lake Detective, other newsletters & mailing, self-help program

5.2. Upper Turtle Lake Status

The status of Upper Turtle Lake is good and probably could be graded in the range of a C to B. Values for phosphorus, chlorophyll and secchi depth are within ecoregion values, which if turned into grades would be average.

An ecoregion is a geographic region in the State that has similar geology, soils, and land use. Upper Turtle Lake is on the border between two ecoregions. The two ecoregions are the North Central Hardwood Forest and the Northern Lakes and Forests ecoregions (Figure 23). Lakes in this area of the state have some of the best water quality values in the State. A range of ecoregion values for lakes in the two ecoregions along with actual Upper Turtle Lake data are shown in Table 15.

Table 15. Summer average quality characteristics for lakes in the Northern Lakes and Forest ecoregion, as noted in Description Characteristics of the Seven Ecoregions in Minnesota, by G. Fandrei, S. McCollar. 1988. Minnesota Pollution Control Agency.

Parameter	Northern Lakes & Forests	North Central Hardwood Forest	Upper Turtle (2002)
Total phosphorus (ug/l) - top	14-27	23-50	25
Chlorophyll (ug/l)	<10	5-22	14
Chlorophyll - max (ug/l)	<15	7-37	19
Secchi disc (ft)	8-15	4.9-10.5	8.7
Conductivity (umhos/cm)	50-250	300-400	219

These comparisons indicate that the water quality of Upper Turtle Lake is probably where it should be and is in a protection status rather than a restoration status. However, the challenge is to prevent excessive nutrients from entering Upper Turtle Lake – from both agricultural and shoreland sources.

An important component to watch and control is nutrient inputs -- especially phosphorus. If phosphorus concentrations increase to around 40 ppb or above, nuisance algae blooms could develop, and this could cause a cascade of problems.

Construction and lake resident activities can have significant impacts on phosphorus inputs. Studies in Maine show that clearing the trees off your property, even a partial clearing can increase phosphorus inputs to the lake from the runoff. Shoreland projects such as maintaining shoreline vegetative buffers to reduce nutrient inputs are important. Also, agricultural land use management practices will help to control excessive phosphorus inputs to Upper Turtle Lake.

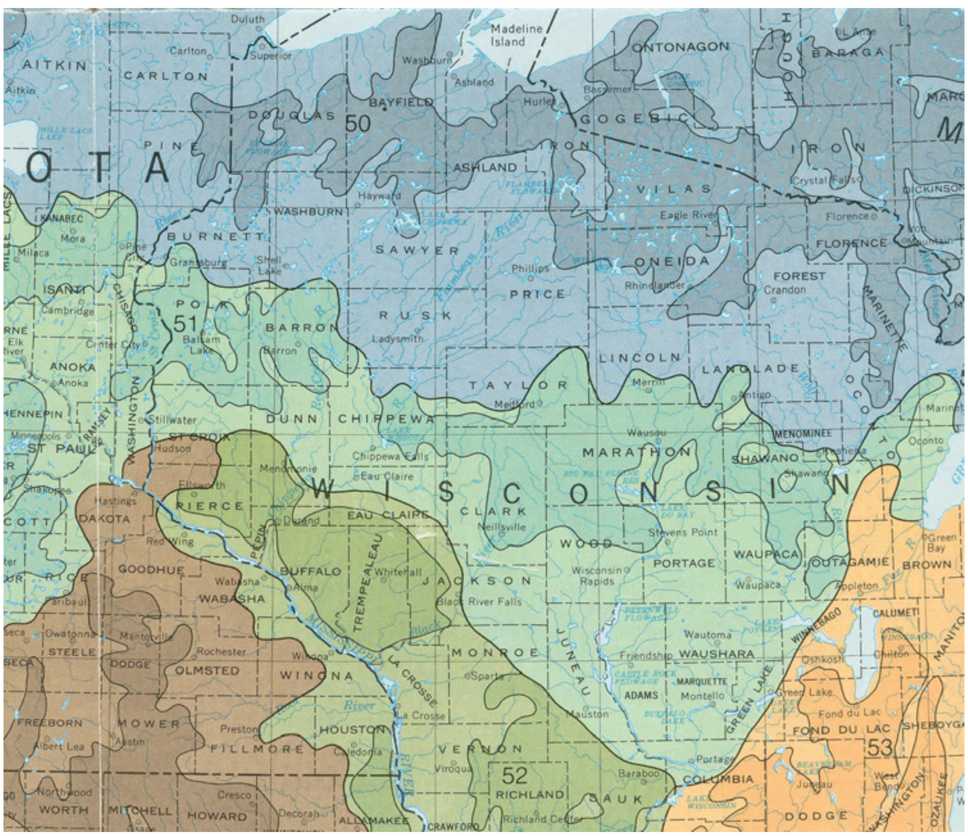
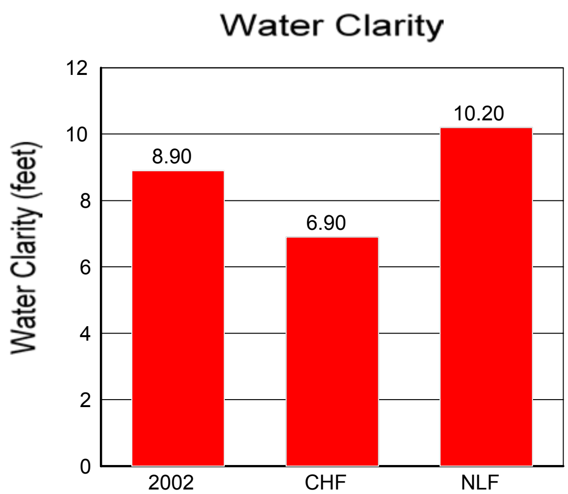


Figure 23. Ecoregion map for Wisconsin. Areas that are labeled with a "50" are bluish and are within the Northern Lakes and Forest Ecoregion. Areas labels with a "51" are blue-green and are in the Central Hardwood Forest Ecoregion. Upper Turtle Lake, located in northwestern Barron County is officially in the Central Hardwood Forest Ecoregion but close to the Northern Lakes and Forest Ecoregion.

5.3. Comparison to Ecoregion Values

Water quality in Upper Turtle Lake is average to above average compared with lakes located in agricultural settings, but it is not as good compared to some other reference lakes in the ecoregion. The small watershed, moderate soil fertility and natural land use cover, can account for the water quality observed in the lake. Lake phosphorus models were run using this information. It is estimated that about 400 pounds of phosphorus enters Turtle Lake on an annual basis. Results are summarized in Figure 24. There is close agreement between the predicted lake phosphorus concentration and the observed phosphorus concentration for Upper Turtle Lake.



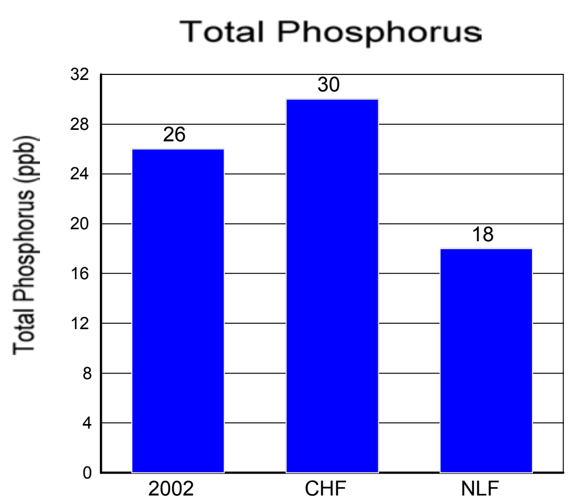


Figure 24. Comparison of water clarity and total phosphorus conditions for Upper Turtle Lake in 2002 to predicted conditions for a lake the size of Turtle Lake situated in the Central Hardwood Forest (CHF) or the Northern Lakes and Forest (NLF) ecoregion.

6. Lake Project Ideas for Protecting the Lake Environment (which includes water quality and wildlife)

Project ideas for Upper Turtle Lake are geared toward long-term protection of water quality.

A list of projects has seven main components:

1. Watershed projects.
2. On-site system maintenance.
3. Landscaping projects.
4. Aquatic plant projects.
5. Fish management options (including carp activities).
6. Ongoing education program.
7. Watershed and lake monitoring program.

Details for these projects areas are given in the next few pages.

Project 1. Watershed Projects

Two goals are:

- ! Protect the natural character of the watershed which helps maintain good runoff water quality.
- ! Educate waterfront property owners and agricultural producers on the value of good landscaping practices.

Barron County Soil and Water Conservation Department recommends that when farmers grow row crops, the following three practices be used: conservation tillage, including either no-till or reduced till, grass waterways, and nutrient management. Contour farming also is a valuable tool, however most of the topography of the Upper Turtle watershed does not lend itself to contour farming.

According to the Barron County Soil Erosion Transect Survey, in the area of Upper Turtle Lake, conservation tillage is used with some of the row crops, but there is definite room for improvement. According to the survey, 27% of the corn, 43% of the soybeans and 10% of the small grains are grown with conservation tillage. Given the runoff from cropland is the primary concern, the Soil & Water Conservation Department recommends that the Upper Turtle Lake Association promotes the increased use of reduced tilled and no-till, grass waterways and nutrient management in their watershed to protect and enhance the water quality of Upper Turtle Lake.

Project 2. On-site System Maintenance

The septic tank/soil absorption field has been one of the most popular forms of on-site wastewater treatment for years. When soil conditions are proper and the system is well maintained, this is a very good system for wastewater treatment. The on-site system is the dominant type of wastewater treatment found around Upper Turtle Lake today.

However, problems can develop if the on-site system has not been designed properly or well-maintained. Around Upper Turtle Lake there are probably some on-site systems that need maintenance and upgrades. At the same time, it is good practice to ensure that systems that are functioning adequately now will continue to do so in the future.

This project calls for an organized program to be developed that makes homeowners aware of all they can do to maintain their on-site systems.

A description of possible activities associated with the on-site maintenance program are described below:

! **Workshop**
A workshop should be scheduled for Upper Turtle Lake Watershed residents to demonstrate the installation of a conforming septic system and the proper care and maintenance of a septic tank and septic system.

! **Septic Tank Pumping Campaign**
Barron County could work with the Upper Turtle Lake Association in a coordinated campaign effort to get every septic tank associated with a permanent residence pumped 2-3 years and seasonal systems pumped 4-6 years in the shoreland area to help reduce phosphorous loading to the septic system drainfield.

! **Ordinance Implementation**
Work to implement and then get enforcement of a county ordinance, where septic systems must be "evaluated" at the time a property is transferred. The seller would obtain a septic system evaluation from Barron County at the time of property transfer. The evaluation would determine if the septic system was "failing", "non-conforming", or "conforming". A "failing" septic system includes septic systems that discharge onto the ground surface, discharges into tiles and surface waters, and systems found to be contaminating a well. The county would require a "failing" system to be brought into compliance with the Barron County ordinance within 90 days of property transfer. .

Through these county property transfer requirements a percentage of the septic systems that are not failing but are "non-conforming" would be upgraded to "conforming" if a prospective buyer was applying for a mortgage. This is because the potential buyer's lending institution in some cases will not approve the buyer's loan request because the property to be purchased does not have a conforming septic system. The county's evaluation report would state whether or not the evaluated septic system is "conforming" or "non-conforming".

Project 3. Landscaping Projects

Controls are in place at the county level to guide new shoreland development. However for existing properties, it is important to either maintain or to improve the natural vegetative buffer.

The shoreland area is valuable for promoting a natural lake environment and a natural lake experience for lake users. The shoreland is defined as the upland area about 300 to 1,000 feet back from the shoreline, and out into the lake to about the end of your dock (Figure 23). A shoreland with native vegetation offers more wildlife and water quality benefits than a lawn that extends to the lake's edge. A summary of attributes and functions of native plants in the shoreland area is shown in Table 16.

Figure 23. Cross section of the lake shoreland habitat.

Table 16. Attributes and functions of native plants in the shoreland area (Source: Henderson and others, 1999. Lakescaping for Wildlife and Water Quality. MnDNR)).

Important functions of plants in and around lakes
Submergent and emergent plants

- Plants produce leaves and stems (carbohydrates) that fuel an immense food web.
- Aquatic plants produce oxygen through photosynthesis. The oxygen is released into lake water.
- Submerged and emergent plants provide underwater cover for fish, amphibians, birds, insects, and many other organisms.
- Underwater plants provide a surface for algae and bacteria to adhere to. These important microorganisms break down polluting nutrients and chemicals in lake water and are an important source of food for organisms higher in the food chain.
- Emergent plants break the energy of waves with their multitude of flexible stems, lessening the water's impact on bank and thus preventing erosion.
- Plants stabilize bottom sediments, which otherwise can be resuspended by currents and wave action. This reduces turbidity and nutrient cycling in the lake.

Shoreline and upland plants

- Shoreline and upland plants provide food and cover for a variety of birds, amphibians, insects, and mammals above the water.
- The extensive root systems of shoreline plants stabilize lake-bank soils against pounding waves.
- Plants growing on upland slopes that reach down to lake hold soil in place against the eroding forces of water running over the ground, and help to keep lake water clean.
- Upland plants absorb nutrients, like phosphorus and nitrogen, found in fertilizers and animal waste, which in excessive concentrations are lake pollutants.

Improving Upland Native Landscape Conditions: In the glacial lake states, three broad vegetative groups occur: pine forests with a variety of ground cover species including shrubs and sedges: hardwood forests with a variety of understory species, including ferns: and tallgrass prairie with a variety of grasses as well as bur oaks and willow trees. Residences around Upper Turtle Lake are in the hardwood forest group.

Reestablishing native conditions in the shoreland area not only improves stormwater runoff quality, it also attracts a variety of wildlife and waterfowl to the shoreland area. Benefits multiply when other neighbors naturalize because the effects are cumulative and significant for water quality and wildlife habitat.

When installing native vegetation close to the shoreline residents are actually installing a buffer. A buffer is a strip of native vegetation wide-enough to produce water quality and wildlife improvements. Much of the natural vegetative buffer has been lost in shoreland areas with development where lawns have been extended right down to the shore.

Lawns are not necessarily bad for a lake. However they can be over fertilized and then runoff carries phosphorus to the lake. Also, lawns function as a low grade open prairie, with poor cover for wildlife and a food supply that is generally poor, except for geese who may find it attractive. Replacing lawn areas with native landscaping projects reduces the need for fertilizer, reduces the time it takes to mow, increases the natural beauty of a shoreland area, and attracts wildlife.

Lawns do not make very good upland buffers. With runoff, short grass blades bend and do not serve as a very effective filter. Tall grass that remains upright with runoff is a better filter. Kentucky bluegrass (which actually is an exotic grass) is shallow-rooted and does not protect soil near shorelines as well as deep-rooted native prairie grasses, shrubs, or other perennials. Grass up to the shoreline offers poor cover, so predators visit other hiding areas more frequently reducing the prey food base and limiting predator populations in the long run. Also with short ground cover, ground temperatures increase in summer, evapotranspiration increases and results in drying conditions, reducing habitat for frogs and shoreline dependent animals.

Buffer Strip Considerations: A functional upland buffer should be at least 15 feet deep. With this you start getting water quality and wildlife habitat benefits. But a 25 foot deep buffer is recommended. In the past, before lakeshore development, buffers ringed the entire lake. For lakeshore residents it is recommended the length of the buffer extend for 75% of the shoreline, although 50% would produce buffer benefits.

A buffer strip can address two problem areas right away. Geese are shy about walking through tall grass because of the threat of predators. There will always be a few who charge right through but it is a deterrent for most of them. Also, muskrats shouldn’t be a problem. They may burrow into the bank, but generally not more then 10 feet. With a buffer going back 15 to 25 feet, you won’t be mowing over their dens. An occasional den shouldn’t produce muskrat densities that limit desirable aquatic vegetation.

Several types of buffers can be installed or propagated that offer nutrient removal as well as wildlife benefits. Examples include:

Tall grass, sedge, flower buffer: Provides nesting cover for mallards, blue-winged teal and Canada geese. Provides above ground nesting habitat for sedge wrens, common yellow throat and others.

Shrub and brush buffer: Provides nesting habitat for lakeside songbirds such as yellow warblers, common yellowthroat, swamp sparrows, and flycatchers. It also provides significant cover during migration.
Forested buffers: Provides habitat for nesting warblers and yellow-throated vireo, Diamond herons, woodducks, hocked mergansers, and others. Upland birds such as red-winged blackbirds, orioles, and woodpeckers use the forest edge for nesting and feeding habitat.

Even standing dead trees, which are referred to as snags, have a critical role. When they are left standing they serve as perching sites for kingfishers and provide nesting sites for herons, egrets, eagles, and ospreys. In the midwest over 40 bird species and 25 mammal species use snags. To be useful, they should be at least 15 feet tall and 6-inches in diameter.

The initial step for lake residents to get started is to simply make a commitment to try something. Just what the final commitment is evolves as they go through a selection process. The next step in the process is to conduct a site inventory. On a map with lot boundaries, house and buildings, driveway, turf areas, trees, shrubs, and other features are drawn. If there is a chance, the property is checked during a rainstorm. Look for sources of runoff and even flag the routes. Find out where the water from the roof goes, and see if there are temporary ponding and infiltration areas. Are the paths down to the lake eroding? Then the next step is to consider a planting approach.

Native Landscaping for Buffers: Three Approaches: Native landscaping efforts can be put into three categories:

1. Naturalization
2. Accelerated Naturalization
3. Reconstruction

1. Naturalization: With this approach, the resident is going to allow an area to go natural. Whatever is present in the seedbank is what will grow. If they want to install a buffer along the shoreline, let a band of vegetation grow at least 15 feet deep from the shoreline back and preferably 25 feet or deeper. Just by not mowing will do the trick. Residents can check how it looks at the end of the summer. It will take up to three years for flowers and native grasses to grow up and be noticed. Residents can also select other spots on their property to “naturalize”.

2. Accelerated Naturalization: After developing a plant list of species from the area, residents may want to mimic some features right away. They can lay out a planting scheme and plant right into existing vegetation. Several Minnesota nurseries can supply native plant stock and seeds. The nurseries can also help select plants and offer planting tips. Wildflowers can be interspersed with wild grasses and sedges. Mulch around the new seedlings. With this approach lake residents can accelerate the naturalization process.

3. Reconstruction: To reestablish a native landscape with the resident's input and vision, another option is to reconstruct the site with all new plants. Again plant selection should be based on plants growing in the area. Site preparation is a key factor. Residents will want to eliminate invasive weeds and eliminate turf. This can be done with either herbicides or by laying down newsprint or other types of paper followed by 4 to 6 inches of hardwood mulch. Plantings are made through the mulch. This is the most expensive of the three native landscaping categories. Residents can do the reconstruction all at once, or phase it in over 3 to 5 years. This allows them to budget annually and continue evolving the plan as time goes by.

Also mixing and matching the level-of-effort categories allows planting flexibility. Maybe a homeowner employs naturalization along the sides of the lot and reconstruction for half of the shoreline and accelerated naturalization for the other half. Examples of the three approaches are shown in Figure 3.

A book that covers the shoreland improvements is "Lakescaping for Wildlife and Water Quality" by Carrol Henderson and others and is available from the Minnesota Department of Natural Resources for $21 (651.296.6157).

1. Naturalization: The easiest way to implement a natural shoreline setting is to select an area and leave it grow back naturally.

2. Accelerated Naturalization: To accelerate the naturalization, plant shrubs, wild flowers, or grasses into a shoreland area.

3. Restoration: This involves removing existing vegetation through the use of paper mats and/or mulching and planting a variety of native grasses, flowers, and shrubs into the shoreland area.

Examples of three shoreland management options.

Project 4. Aquatic Plant Projects

A high priority lake protection recommendation is to maintain healthy native aquatic plant communities in Upper Turtle Lake. Currently, Upper Turtle Lake has a variety of emergent and submergent aquatic plant growth. Aquatic plants are vital for helping sustain clear water conditions and contribute to fish habitat.

The challenge is to maintain and/or protect submerged aquatic plants in Upper Turtle Lake. Several plant improvement ideas are given below:

- 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.

- In the north end of Upper Turtle, some small-scale aquatic plant removal in the form of creating channels to open water could be implemented. Only the minimum amount of plants should be removed to improve navigation. Plants in this end of the lake are important fish habitat.

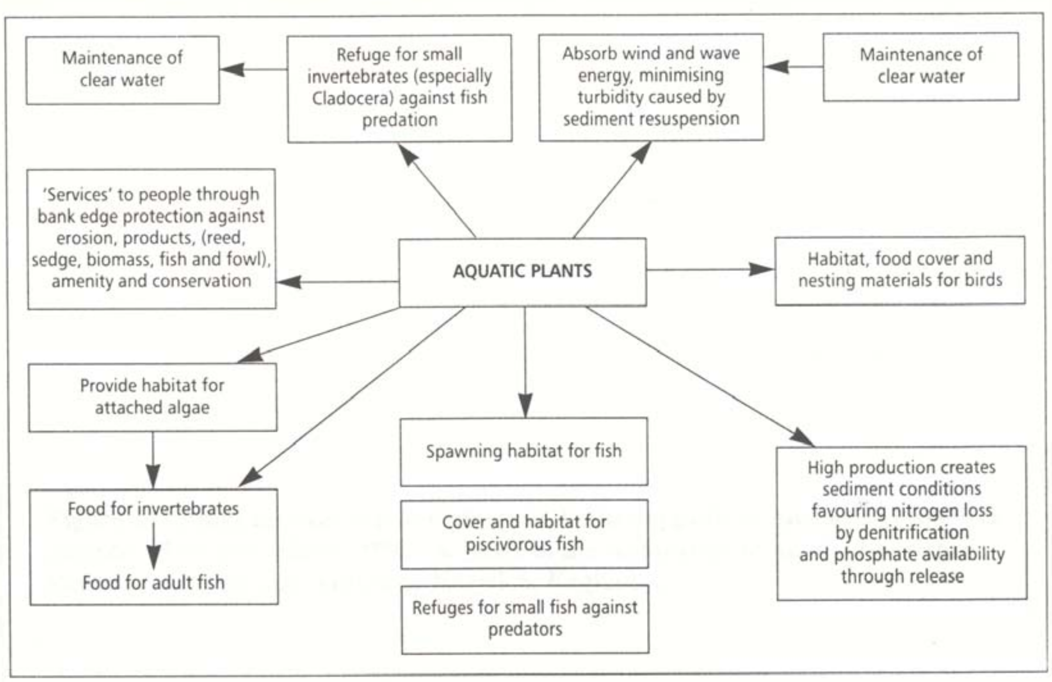


Figure 25. Links between aquatic plants and other organisms, including ourselves (source: Moss and others. 1996. A guide to the restoration of nutrient-enriched shallow lakes. Broads Authority Norwich, England).

Project 5. Fish Management Options

[Management recommendations are based on WDNR management plans]

1. Upper Turtle Lake as a desirable, well balanced fish community, and currently fishing regulations are appropriate.

2. Past surveys have indicated that walleye fingerling stocking is beneficial, so the current management scenario of stocking walleye fingerlings at the rate of 50 per acre on alternate years should continue.

3. Walleye natural reproduction is significant, and walleye spawning areas (see map) should not be altered or degraded in any way. Similarly, wetland areas and shallow, heavily vegetated bays where northern pike spawn should not be altered.

4. Carp are common in Upper Turtle Lake, as they have been for many years. The population appears stable and is composed mainly of large adults with limited natural reproduction. While carp are undoubtedly competing with more desirable species to some extent, carp have not caused serious habitat damage. Rooted aquatic vegetation is common, and the water is not turbid.

Project 6. Ongoing Education Program

Lake residents get an important amount of lake protection information from the lake newsletter. Each issue should offer tips on lake protection techniques. There is abundant material available. An example of an informational piece is shown below.

Reduce Waste *If not you, who?*

YOUR LAWN AND THE ENVIRONMENT

New phosphorus lawn fertilizer law aims to protect Minnesota lakes and rivers

Minnesota has recently passed a law that restricts the use of lawn fertilizers containing phosphorus, the primary nutrient that turns lakes green with algae.

New Phosphorus Law

Starting January 1, 2004, **fertilizers containing phosphorus cannot be used on lawns in the Twin Cities metro area** (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington counties). Greater Minnesota is restricted to lawn fertilizers with 3 percent or less phosphate content (with fertilizer, phosphorus is measured as *phosphate*). Look for the middle number on a bag of fertilizer. For the metro area, it should be zero (0) and in Greater Minnesota it should be three (3).

Keep fertilizer off paved surfaces: It's illegal to spread any fertilizer on hard surfaces such as streets, sidewalks, and driveways. Rain can wash the fertilizer into nearby storm drains or road ditches, eventually getting into a lake or river near you. If you accidentally spill or spread fertilizer on a hard surface, clean it up immediately.

Exemptions

Fertilizers containing phosphorus may be used on lawns if a soil test indicates that it is needed or if you are establishing a new lawn.

These restrictions do not apply to fertilizers used for agricultural crops, flower and vegetable gardening, or on golf courses by trained staff.

Do the green thing: fertilize responsibly Many garden centers and hardware stores now carry phosphorus-free lawn fertilizers.

Will phosphorus-free fertilizer keep my lawn healthy?

While phosphorus is necessary to grow healthy lawns, soils in many parts of Minnesota already have an adequate amount. In these instances, adding more phosphorus in fertilizer is not needed and will not benefit your lawn. Healthy lawns can be maintained with phosphorus-free fertilizers.

THE PROBLEM: TOO GREEN

Green and mucky Excess algae and weed growth is a major problem in many Minnesota lakes and waterways.

More phosphorus, less fish Too much algae lowers oxygen levels and darkens the water. This can have a devastating effect on fish populations.

What to look for

On any bag or box of fertilizer, there is a string of three numbers. The middle number indicates phosphorus content and should read "0" in the Twin Cities seven-county metropolitan area, and "3" or less in Greater Minnesota.

What can you do to protect water quality?

Fertilizers, leaves, grass clippings, eroded soil, and animal waste are all sources of phosphorus. When they are swept or washed into the nearest street or storm drain, they end up in your local lake or river. You can do your part to protect water quality by doing the following:

- Follow Minnesota's new phosphorus lawn fertilizer law.
- Keep leaves and lawn clippings out of your gutters, streets, and ditches.
- Clean lawn and garden equipment on the grass, not on hard surfaces. Never wash or blow soil or grass clippings into the street.
- Pick up pet waste promptly. Pet waste can contain harmful bacteria as well as nutrients. Never drop pet waste in the street or ditches.

- Control soil erosion around your house. When left bare, soil is easily washed away with rain, carrying phosphorus with it. Soil erosion can be prevented by keeping soil covered with vegetation or mulch.

Sweep it up Grass clippings and leaves left on streets and sidewalks are a major source of phosphorus.

Find out what you need: Test your soil

A soil test is a good idea, especially if you are concerned that your lawn may need phosphorus.

Instructions on soil testing are available through the University of Minnesota Extension Service's INFO-U by calling 612-624-2200 (metro) or 1-800-525-8636 and requesting message 468.

Soil testing information can also be obtained through the Internet by visiting **www.extension.umn.edu** and searching for "Lawn Soil Testing."

A list of laboratories certified for soil testing by the Minnesota Department of Agriculture can be found at **www.mda.state.mn.us/appd/soilabs.htm**.

Visit **www.reduce.org** for lots of ideas about reducing waste and toxic chemicals in your day-to-day life.

reduce.org

For more information on lawn care

- The **Yard & Garden Line** is the University of Minnesota Extension Service's one-stop telephone link to information about plants and insects in the home landscape. Call 612-624-4771, or (toll free) 1-888-624-4771 in Greater Minnesota.
- University of Minnesota **Extension Service's web site**: www.extension.umn.edu. From the home page click on "Garden" then on "Lawns."
- University of Minnesota Extension Service - **Sustainable Urban Landscape Information Series** (SULIS): www.sustland.umn.edu. From the home page, click on "Maintenance" then on "Lawn care."
- **Minnesota Department of Agriculture**: www.mda.state.mn.us. From the home page, click on "Water & Land," then on "Lawn Care & Water Quality."

To obtain additional copies of this fact sheet

contact Office of Environmental Assistance's **Education Clearinghouse** at 1-800-877-6300, 651-215-0232 or e-mail: clearinghouse@moea.state.mn.us.

Minnesota Department of Agriculture | Metro WaterShed Partners | University of Minnesota Extension Service | Minnesota Office of Environmental Assistance

Project 7. Watershed and Lake Monitoring Program

A lake monitoring program is outlined in Table 17. It is designed to be flexible to accommodate the volunteer work force and a fluctuating budget.

Table 17. Upper Turtle Lake Water Quality Monitoring Program

Category	Level	Alternative	Labor Needed	Cost/Year
A. Dissolved oxygen	1	Check dissolved oxygen in Upper Turtle Lake every two weeks in January, February, and March depending on winter conditions.	Moderate	$0
	2	Check dissolved oxygen in Upper Turtle Lake every one to two weeks in December, January, February, and March, depending on winter conditions and collect phosphorus samples.	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.	Low-moderate	$0
	3	Secchi disc monitoring twice per month, May - October.	Moderate	$0
C. Water chemistry	1	Spring and fall turnover samples are collected and sent to UW-Stevens Point. Selected parameters for analysis include: TP and chlorophyll.	Low	$200
	2	Spring and fall turnover samples are collected and sent to UW-Steven Point. Standard package of parameters is analyzed.	Low	$600
	3	Sample for phosphorus and chlorophyll once per month from May - September (surface water only).	Low-moderate	$300
	4	Sample for phosphorus and chlorophyll twice per month from May - October.	Moderate	$600
	5	Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N once per month (May-October)	Moderate	$960
	6	Sample for phosphorus, chlorophyll, Kjeldahl-N, nitrate-nitrite-N, and ammonia-N twice per month (May-October).	Moderate	$1,920
D. Special samples or surveys	1	Special samples: suspended solids, BOD, chloride, turbidity, sampling bottom water, and other parameters as appropriate. Aquatic plant surveys, etc.	--	$100-$3,000

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

For 2004, a recommended program consists of Level B2 and Level C3 annually. An aquatic plant survey (Level D1) should be conducted every three years.

Appendix