Introduction

This Aquatic Plant Management Plan is being developed for Rice Lake, Iron County Wisconsin. It presents data about the plant community, fisheries, watershed, and water quality of Rice Lake. Based on this data and public input, this plan provides goals as well as strategies for the sound management of aquatic plants in the lakes. The plan reviews public input, summarizes data, discusses management options and alternatives, and recommends action items. This plan will guide the Rice Lake Association, Iron County, and the Wisconsin Department of Natural Resources in aquatic plant management over the next five years (2012-2017). After 2017, this plan will be evaluated and revamped as needed

Rice Lake, Iron County Wisconsin (WBIC: 2300600) is a 125 acre drainage lake (from Turtle River). It is located at T43 R3E Section 26 in Iron County Wisconsin. The mean depth is 8.4 ft (maximum of 21 ft), a littoral depth of 12.7 ft and has a water volume of 1044 acre-feet. The lake has two inlet tributaries; Turtle River, which is the larger of the two, and Bear Creek.

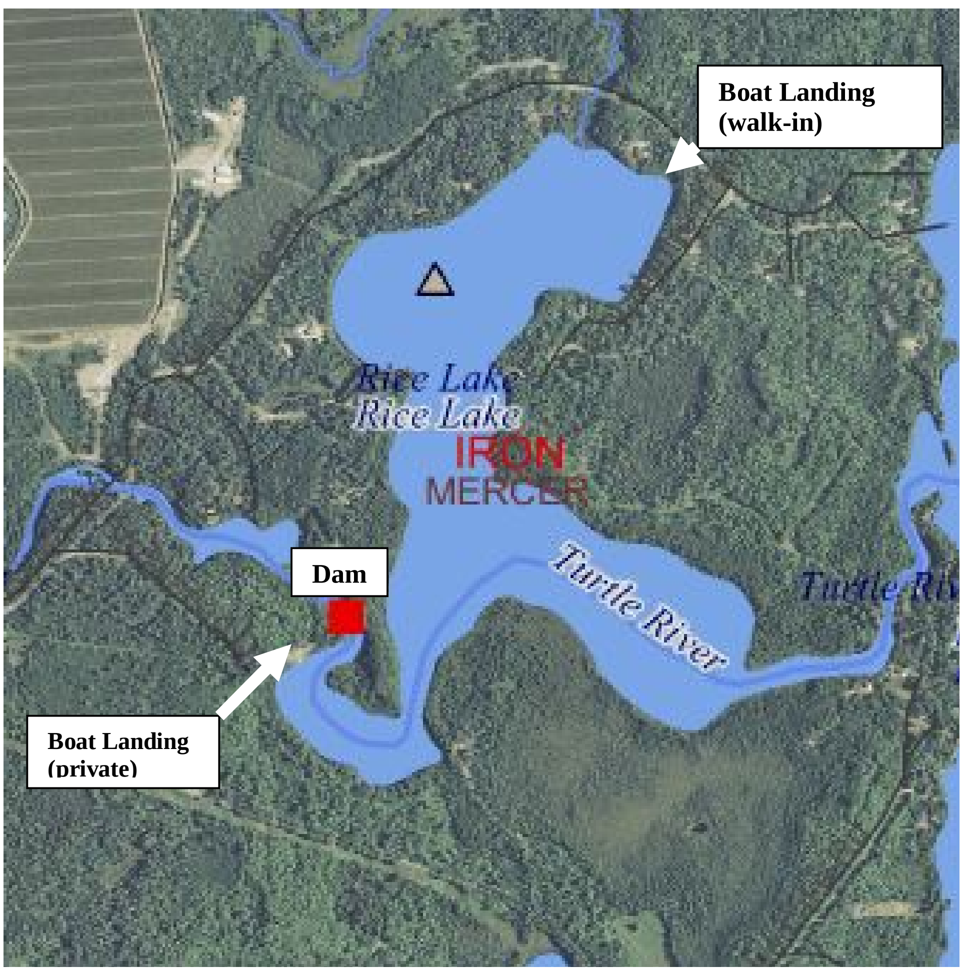


Figure 1: Aerial map of Rice Lake, Iron County indicating showing dam location and boat landing.

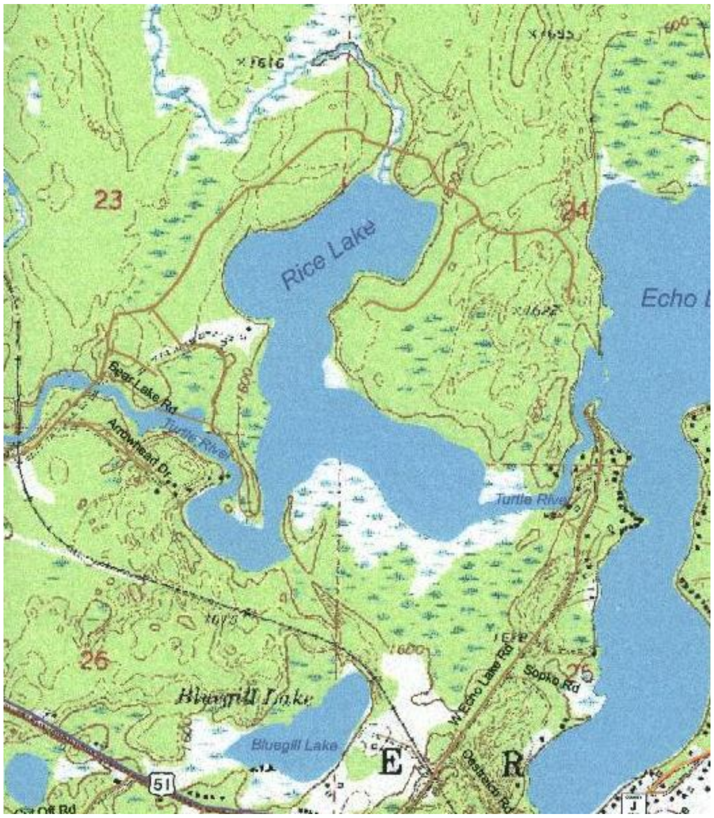


Figure 2: Topographical map showing Rice Lake, Iron County.

Public Involvement

During the fall of 2010, a plant a management committee was formed to give input for this management plan. The committee members are as follows:

Bonnie Banaszak
Jon Enslin
Gene Hickey
Greg Losiniecki
Sandy Losiniecki
Dave Ohlinger
Melodie Ohlinger
Harold Pott
Edie Pott
Nancy Werth
Scott Werth

In 2005, a survey of property owners on Rice Lake was conducted. Of the 24 surveys distributed, 14 were returned[1]. Seven of the respondents are (were) full-time residents, five were seasonal residents, one owned undeveloped property and

[1] As reported in Rice Lake Survey Results, by White Water Associates as part of Appendix in the Rice Lake and Echo Lake Environmental Information Review and Adaptive Management Plan. Dec 31, 2005.

one was undeclared. The questions and answers pertinent to aquatic plants and their management will be focused on.

- In terms of what people value most about their property, the following reponses were received:

  78.8% - Scenic beauty of the lake and shoreline
  57.1% - Undeveloped northwood's character/solitude
  50% - Natural environment of the watershed
  35.7% - Fishing
  28.6% - Recreational use of the lake
  21.4% - Property values as an investment
  7.1% - Other

- Of those surveyed, 66.9% stated they were satisfied with the lake at that time.
- As far as recreational use, the following breakdown of responses was received:

  92.3 % Canoeing, Kayaking, Rowing
  84.6 % Viewing lake from shore
  61.5% Fishing from boat
  46.2% Fishing from shore
  46.2% Pontoon boating
  38.5% Ice fishing
  38.5 Swimming
  23.1% Motor boating

- Of those Surveyed, 76.9% stated they would support efforts to improve fishing through use of fish cribs and/or stocking fish.

- 62.5% felt the lake was about the same in terms of quality, compared to the "last several years" and 84.6% felt water quality was "very important" while 15.4 % felt is was "somewhat important."

- 84.6% felt that the issue of exotic species was "very important" and 15.4% felt it was "somewhat important."

- In terms of noticing exotic species, 70% stated none were noticed while 30% state "yes a little bit." Two responded that they observed purple loosestrife and two responded having seen spiny water fleas.

- For future lake visions, 50% place high priority on protecting water quality and 50% want a balance between water quality and recreational use.

- The only aquatic plant questions were contained in a question regarding the management and educational activities they would support. The plant related responses were as follows:
  53.8% Harvesting aquatic plants as needed periodically.
  7.7% Chemically treat weeds and algae as needed periodically.
  69.2% Information at the public access sites regarding exotic species.

In December, 2010 a designated plant committee presented their concerns about aquatic plants and plant management. Some of the comments received included:

- "can't fish w/out catching weeds"
- "lake will be unusable if weeds continue as they have"
- navigation issues
- shore erosion ??
- concern over cranberry bog

The following is a map where interested parties indicated concerned areas on lake with too high of plant density:

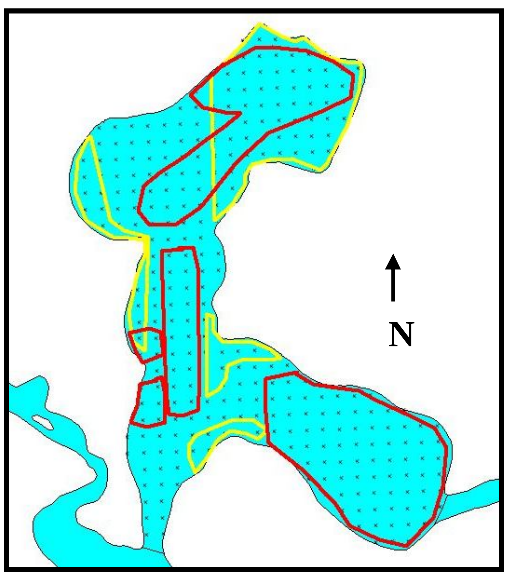


Figure 3: Map showing concerned for nuisance aquatic plant growth.

In addition, in December 2010, the plant management committee developed goals for Rice Lake and then in December 2011, developed objectives to reach these goals.

A draft plan was made available online (Iron County AIS site) and at the public library (in Mercer) for 15 days. A public meeting was held on August 11 2012 to present the plan and take public comments.

Importance of Aquatic Plants

The lake ecosystem relies extensively on the littoral zone, which is the area of the lake where the water is shallow enough to hold plants. As a result, the aquatic plant community plays a very important role in maintaining a healthy lake ecosystem.

Emergent plants (the ones sticking above the water surface) can help filter runoff that enters the lake from the watershed area. Their extensive root networks can stabilize sediments on the lake bottom. Wave energy can be reduced by emergent plants, thus reducing shoreline erosion. Many of these beds provide important fish habitat and spawning areas, as well as key wildlife habitat. Many birds, waterfowl, and some mammals rely on these plants for nesting materials as well as food.

Floating-leaf plants such as water lily provide shade and cover for invertebrates and fish. Although they appear thick on the surface, the underwater area beneath them is more open. This allows fish and other animals to move about hidden by the leaves above.

Submerged plants provide many benefits to the lake ecosystem. These plants are nature's aerators, producing the essential oxygen byproduct from photosynthesis. Submersed plants absorb nutrients through their roots and in some cases through their leaves, decreasing the nutrients that would otherwise be available for nuisance algae growth. Roots stabilize bottom sediments thus reducing re-suspended sediments. As a result, these plants help maintain water clarity. Since Rice Lake has had consistent phosphorus readings at or above the eutrophic threshold, aquatic plants can be a integral part of maintaining water quality in Rice Lake.

Aquatic plants take on many shapes and sizes and provide excellent habitat. Many of the plants, such as the milfoils or water marigold, have fine leaves that provide key invertebrate habitat. These invertebrates comprise a very important level in the food chain and result in excellent forage opportunities for fish. Other plants are adapted to grow in low nutrient substrates such as sand and gravel. These plants maintain important fish and wildlife cover for areas that would otherwise be devoid of plants.

Many fish rely on aquatic plants for reproduction. *Esox sp.* often spawn amongst submergent plants. The Northern Pike even has eggs that are adapted for attachment to the plants themselves. Once fish emerge from their eggs, the plants provide important cover and foraging areas. Muskellunge are present in Rice Lake and are stated to have natural reproduction occurring. This species relies on vegetation cover for successful reproduction.

Lake Information

This section of the Aquatic Plant Management Plan will give an overview of the various characteristics and information about Rice Lake that are important for plant management. These include: Fisheries, water quality data, watershed information, critical habitat and endangered/threatened species present.

Fisheries

The amount of fish data about Rice Lake is quite limited. The most recent survey was conducted in November 2001[2]. This data was provided by the Wisconsin Department of Natural Resources. The following game species were captured:

Species	Number captured	Size range (in)
Largemouth Bass	45	6.0-19.9
Walleye	14	11.5-16.4
Musky	12	10.0-37.4
Northern Pike	9	13.0

The following comments were presented based upon this survey:

- Largemouth bass are a major component in the gamefish population with indications of good abundance, growth, reproduction and size structure.
- Walleye are fairly common with good size structure but have limited natural reproduction (at least in 1999, 2000, and 2001).
- The musky population appears to be present in appropriate densities with good natural reproduction and recruitment in the absence of stocking.
- Northern pike are self-sustaining with average size structure.

Earlier historical reports indicate that the fish species in Rice Lake include walleye, largemouth bass, smallmouth bass, muskellunge, northern pike, yellow perch, rock bass, bluegill, black crappie, pumpkinseed, black bullhead, white sucker, redhorse, and burbot.

From 1951 to 1973 plantings of muskellunge and walleye occurred (14 plantings). In a 1972 electrofishing and fyke net survey, smallmouth bass were captured as well as the game species captured in the 2001 survey. Black crappie was the most abundant panfish in the 1972 survey. It was also stated in the 1972 survey that the

[2] Letter from Jeffery Roth, Wisconsin DNR Fisheries Biologist, to Rice Lake Association representative. Feb. 22, 2005.

smallmouth bass natural reproduction was limited, while walleye and muskellunge natural reproduction was good[3].

Since the 1970's, it appears the major change has been in the number of largemouth bass present and a decrease in black crappie.

Fish Species	Spawning Temp. (Degrees F)	Spawning Substrate / Location	Comments
Northern Pike	Upper 30s – mid 40s (right after ice-out)	Emergent vegetation 6-10 inches of water	Eggs are broadcast
Walleye	Low to upper 40s – (about one week after ice-out)	Rocky shorelines with rubble/gravel 0.5 – 3 feet of water	Eggs are broadcast
Black Crappie	Upper 50s to lower 60s	Nests are built in 1-6 feet of water.	Nest builders
Largemouth Bass Bluegills	Mid 60s to lower 70s	Nests are built in water less than 3 feet deep.	Build nests in gravel or hard bottom
Muskellunge	Mid 50's to near 60	Organic sediment, woody debris and submerged vegetation.	Eggs are broadcast

Table 1: Spawning information of various game fish present in Rice Lake.

Watershed

It does not appear as though the watershed of Rice Lake has been delineated professionally. There are rather "coarse" maps of landuse around the lake, but lack any area coverage or export data in relationship to nutrient contributions. However, nearly all of the land that appears to be in the watershed of Rice Lake is forested or wetland. In addition the topography is a gentle slope with only one area with a greater than 20% slope. There is very little impervious surface around Rice Lake with limited roads and development. The north end of Rice Lake contains the most amount of human development, which can increase the nutrient loading from the woodland that surrounds the lake.

Since Turtle Creek is an inlet, the greater watershed of Rice Lake is very large. The landuse practices around Turtle Creek could ultimately affect Rice Lake. Bear Creek further increases the watershed area. Within the Bear Creek watershed is a cranberry production operation. Cranberry production uses phosphorus and nitrogen in growing of cranberries. This water is then released during harvest and could cause nutrient loading into Bear Creek and then into Rice Lake.

[3] As reported by White Water Associates in the Rice Lake and Echo Lake Environmental Information Review and Adaptive Management Plan. Dec. 31, 2005.

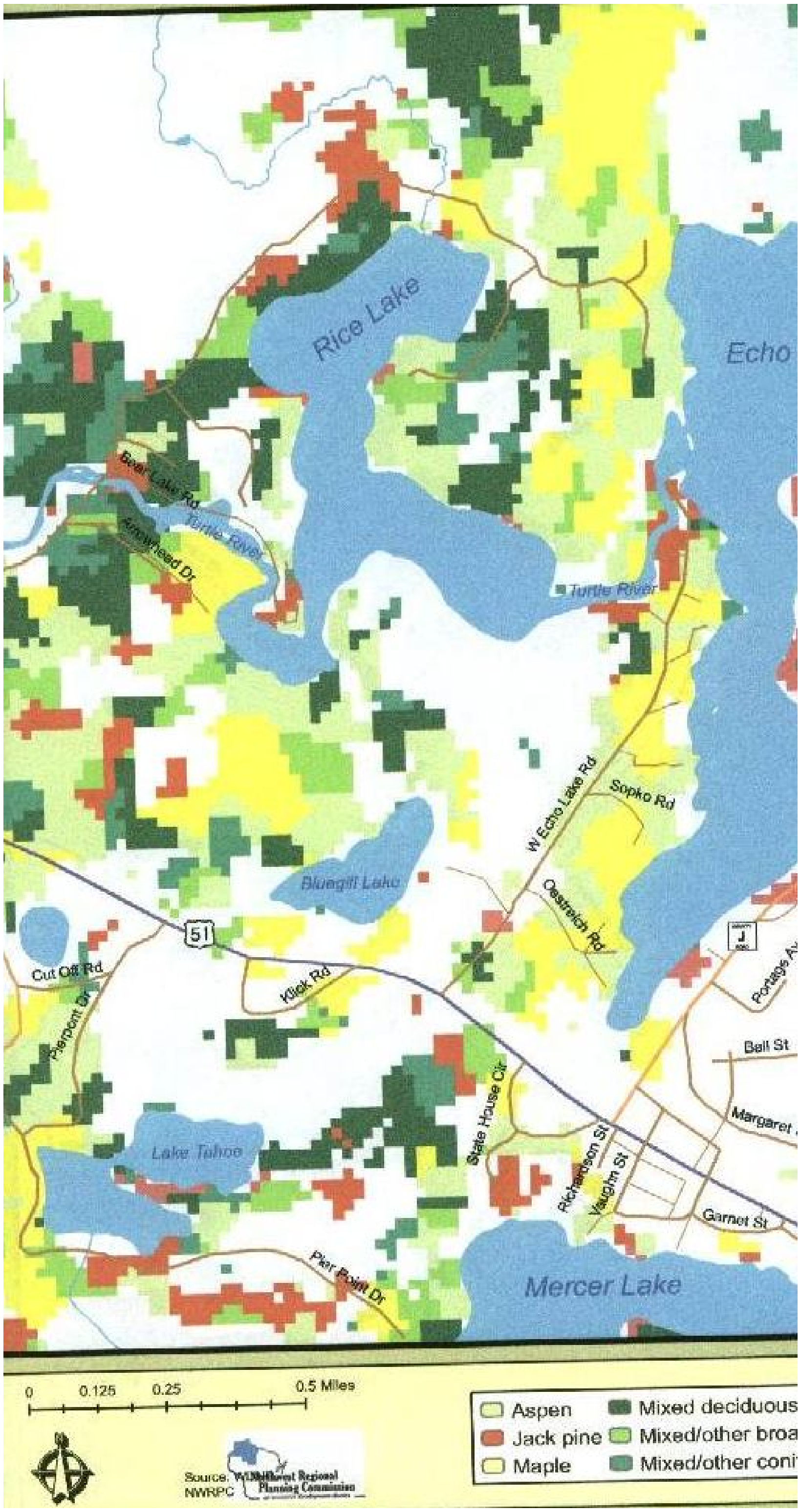


Figure 4: Forest cover type around Rice Lake

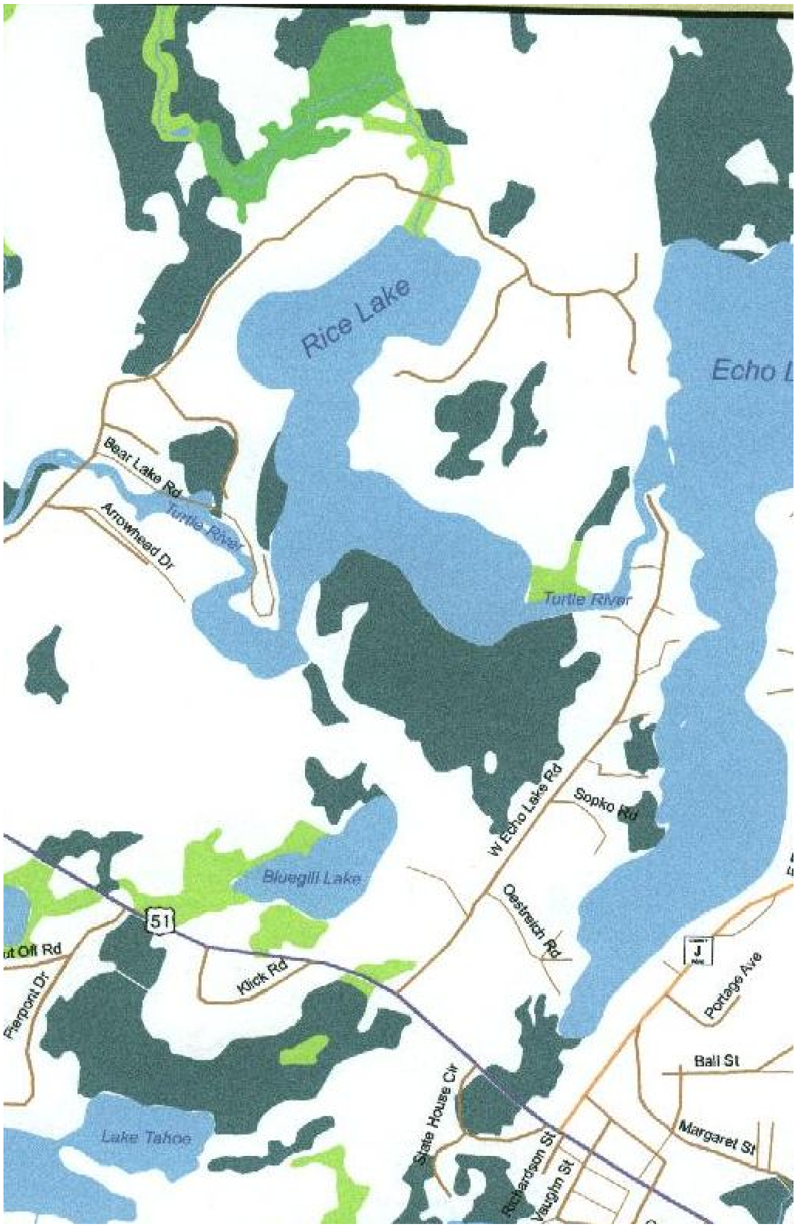


Figure 5: Wetland areas around Rice Lake

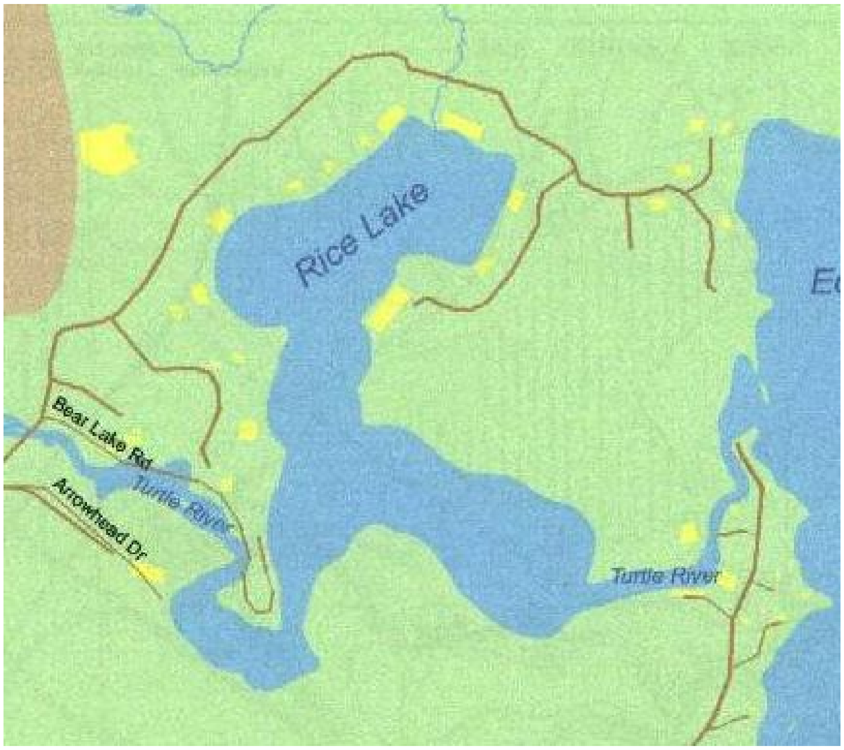
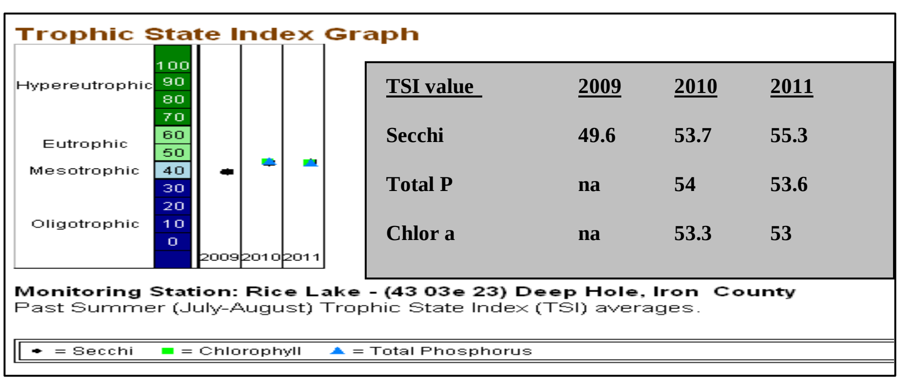


Figure 6: The yellow areas are residential/developed areas around Rice Lake.

Water quality

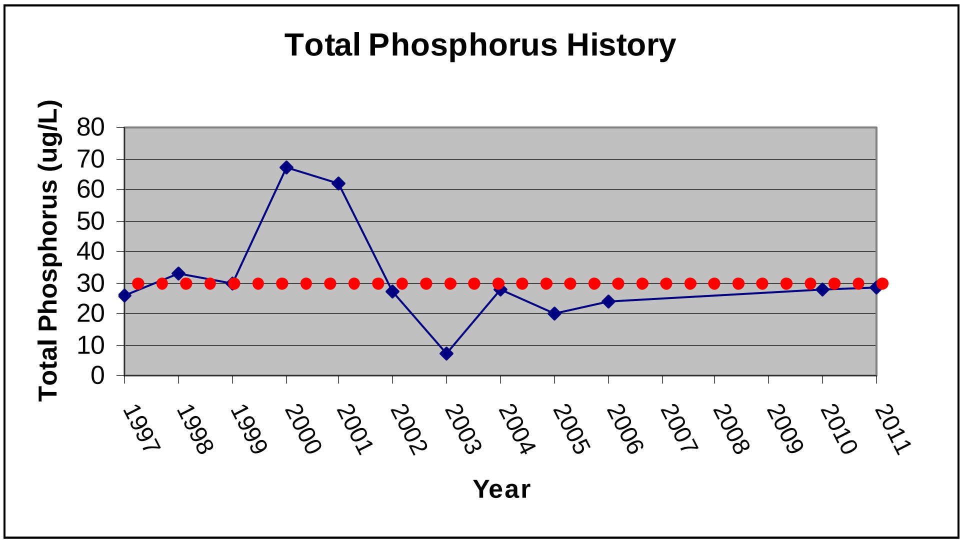
There is very limited data on water quality for Rice Lake. Since 1997, limited water samples have been analyzed. The sampling usually only occurred once annually and didn't always get sampled during the same time period. As a result, it is difficult to compare the nutrient history from year to year and is hard to establish any trends.

The graph below shows the phosphorus data available. The red dotted line is the threshold for accepted eutrophic levels of phosphorus from the Carlson Trophic Index. As can be observed, the phosphorus concentrations have been very near or above (2000 and 2001) the eutrophic level. This shows that in most years, it appears that Rice Lake has fairly large phosphorus concentrations, which can lead to nuisance algae growth.



TSI value	2009	2010	2011
Secchi	49.6	53.7	55.3
Total P	na	54	53.6
Chlor a	na	53.3	53

Figure 7 : Trophich Status Index (TSI) graph and data 2009-2011.



● ● ● ● ● ● ● ***Indicates TSI threshold for eutrophic (above this line).***

Figure 8: Phosphorus recording history (in ug/L or ppb) with TSI eutrophic threshold for comparison.

Rice Lake has brown tannic water (most likely from surrounding wetlands) that could reduce the secchi disk readings. However, secchi disk readings can still be effective indicators of water clarity through comparison (assuming the brown color remains relatively consistent). The table and graph below shows the secchi readings that were measured more extensively in 2010.

Date	Secchi reading (ft)	Chlorophyll a
5/7/2010	7	
5/20/2010	8	
6/28/2010	5.5	8.96 ug/L
7/14/2010	5	
7/26/2010	5.5	18.3 ug/L
8/03/2010	5.5	
8/29/2010	4.5	
9/21/2010	4.5	

Table 2: Secchi disc and chlorophyll a readings from Self Help Data 2010.

The measurement of chlorophyll a in the water column indicates the amount of the photosynthetic pigment in the water sample taken. This is a way to quantify the amount of suspended algae in the water. The 2010 data shows that the chlorophyll a amount increased significantly from June to July. This is typical in many lakes. However the chlorophyll-a concentrations for Rice Lake in July 2010, indicate eutrophic waters. This shows there is excess nutrients in the water, which is increasing algae production.

Rice Lake does appear to stratify and if the bottom sediment goes anoxic (void of oxygen), then phosphorus can be released. This is referred to as internal loading. Although internal loading has not been measured, data from 2005 indicates that there is some internal loading occurring. The near bottom phosphorus concentration in July 2005 was somewhat higher than the surface value . In September, 2005 the near bottom concentration was also higher than the surface. This shows that during the summer months, the phosphorus increased, most likely due to internal loading.

Without knowing depths of anoxic conditions and volume of key depths, internal loading cannot be calculated. However, it appears the internal loading is a potential contributing phosphorus source. Internal loading can contribute nutrients throughout the growing season if the lake does not stratify and mixing of the water column occurs. If the lake stratifies, mixing will not occur until the fall turnover, trapping the nutrients in the bottom and not available until the fall.

Further study of internal loading is encouraged by performing more frequent, annual dissolved oxygen/temperature profiles in Rice Lake.

Lake Trophic State

Water quality is frequently reported by the trophic state or nutrient level of the lake. Nutrient-rich lakes are classified as eutrophic. These lakes tend to have abundant aquatic plant growth and low water clarity due to algae blooms. At the high end of the eutrophic scale blue-green algae dominate and algal scums are present sometimes throughout the summer. Mesotrophic lakes have intermediate nutrient levels and only occasional algae blooms. Oligotrophic lakes are nutrient-poor with little growth of plants and algae.

Secchi depth readings are one way to assess the trophic state of a lake. The Secchi depth is the depth at which the black and white Secchi disk is no longer visible when it is lowered into the water. Greater Secchi depths occur with greater water clarity. Secchi depth readings, phosphorus concentrations, and chlorophyll measurements can each be used to calculate a Trophic State Index (TSI) for lakes. TSI values range from 0 – 110. Lakes with TSI values greater than 50 are considered eutrophic. Those with values in the 40 to 50 range are mesotrophic. Lakes with TSI values below 40 are considered oligotrophic.

Endangered, threathened and species of concern

According to the Wisconsin Natural History Inventory (NHI)[4], Township 43 North Range 3E (location of Rice Lake), have had the following species identified as observed in this range (not necessarily located in and immediately around Rice Lake):

Aeshna clepsydra Mottled darner (dragonfly)-species of special concern
Canis lupus Gray Wolf-species of special concern
Cygnus buccinator Trumpeter Swan-species of special concern
Falcipennis canadensis Spruce Grouse-threatened
Haliaeetus leucocephalus Bald Eagle-species of special concern
Martes Americana American marten-endangered

Although some very sensitive plants were sampled in the point intercept survey, no endangered, threatened, or species of special concern were sampled or observed. In an earlier lake management plan, the entity completing the study mentioned that *Potamogeton vaseyii* (Vasey's pondweed) ,which is a species of special concern, was observed. No details were provided other than stating no formal survey was conducted and that the plant was just "seen." This species was not sampled or viewed in the point intercept survey. Although it is possible this plant is in Rice Lake, it has never been vouchered (collected and preserved for verification).

A sensitive habitat survey has not been conducted on Rice Lake at this writing. This should be considered for future practices in Rice Lake.

Human use of aquatic resource

As of 2005, there were 23 residences, seven of which were full-time residences. Rice Lake is classified as a Class 2 lake, based upon its size. There is a possibility of old and possibly faulty (failing) septic systems which could affect water quality and lake health (as may the case with any lake). There is a commercial cranberry production operation along Bear Creek and effluent from that operation could enter Rice Lake by way of Bear Creek. Cranberry production operations may use large amounts of phosphorus for production, which could increase the nutrient loading into Rice Lake, thus adding to productivity in the form of more macrophyte growth.

[4] Natural Heritage data for Wisconsin is found at http://dnr.wi.gov/org/land/er/nhi. (data current as of 11/04/11)

Plant Community

In July, 2010 a point intercept survey was conducted on Rice Lake. The survey involved sample plants at each of 304 pre-determined sample points. Each species on the rake was given a density rating from 1-3.

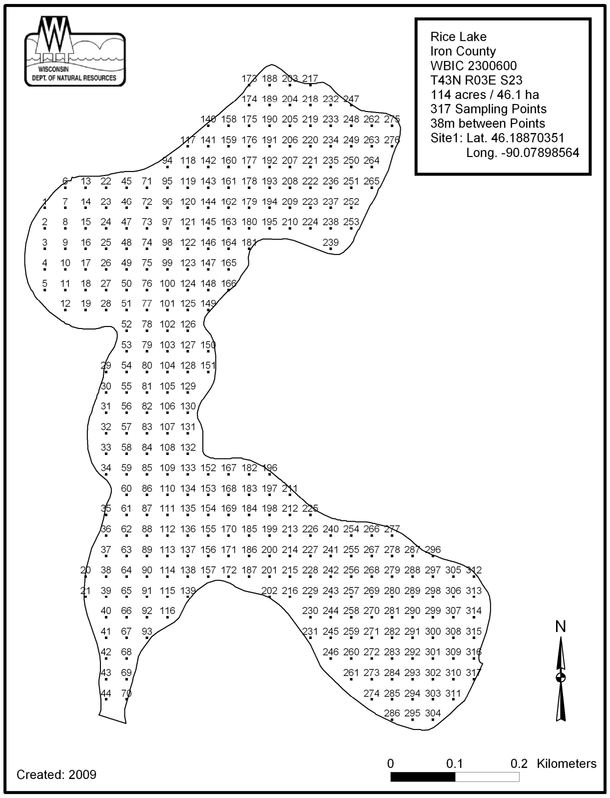
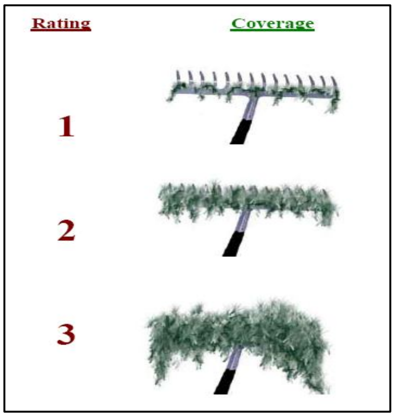


Figure 9: Map of point intercept sampling grid.

There were 304 sample points sampled for aquatic macrophytes in Rice Lake. There were 255 sites with vegetation sampled or 84%. The greatest depth plants were sampled was 12.7 feet. This is relatively shallow for the deepest growth of plants, but is probably due to the dark brown color of the water (from tannins). There were 280 sample sites with vegetation that were shallower than 12.7 feet, which calculates to 91% of the littoral zone (depth where plants can grow) with plant growth.

	Criteria for rake fullness rating
1	Plant present, occupies less than ½ of tine space
2	Plant present, occupies more than ½ tine space
3	Plant present, occupies all or more than tine space
v	Plant not sampled but observed within 6 feet of boat



SUMMARY STATS:	
Total number of sites visited	304
Total number of sites with vegetation	255
Total number of sites shallower than maximum depth of plants	280
Frequency of occurrence at sites shallower than maximum depth of plants	91.07
Simpson Diversity Index	0.94
Maximum depth of plants (ft)**	12.70
Number of sites sampled using rake on Rope (R)	60
Number of sites sampled using rake on Pole (P)	243
Average number of all species per site (shallower than max depth)	3.90
Average number of all species per site (veg. sites only)	4.29
Average number of native species per site (shallower than max depth)	3.90
Average number of native species per site (veg. sites only)	4.29
Species Richness	42
Species Richness (including visuals)	43
Species Richness (including boat survey)	48

Table 3: Point intercept survey statistics summary

The plant community is very diverse in Rice Lake, with the species richness being 42 plant species (43 if including viewed only (not sampled) and 48 if including boat survey). All species are native to Wisconsin lakes. The relative frequency (which is the frequency that particular plant compared to all plants sampled) is balanced, with the highest being 10%. This shows that no one plant is dominating the aquatic plant community. The Simpson's diversity index is very high at 0.94. This means that any two plants sampled have a 94% probability to be different. This also indicates a very high diversity in the plant community. Lastly, there was an average of 4.3 species sampled at each sample site. Again, this shows a highly diverse plant community.

Species	Freq	Freq littoral	Relative freq	sampled	mean density	visuals
Potamogeton robbinsii, Fern pondweed	45.49	41.43	10.63	116	1.53	2
Vallisneria americana, Wild celery	42.75	38.93	9.99	109	1.28	5
Ceratophyllum demersum, Coontail	40.78	37.14	9.50	104	1.40	4
Bidens beckii (formerly Megalodonta), Water marigold	32.55	29.64	7.61	83	1.20	26
Myriophyllum sibiricum, Northern water-milfoil	31.37	28.57	7.33	80	1.16	13
Elodea canadensis, Common waterweed	28.24	25.71	6.60	72	1.13	4
Potamogeton zosteriformis, Flat-stem pondweed	28.24	25.71	6.60	72	1.13	5
Potamogeton amplifolius, Large-leaf pondweed	27.06	24.64	6.30	69	1.23	17
Nymphaea odorata, White water lily	20.00	18.21	4.67	51	1.06	23
Potamogeton richardsonii, Clasping-leaf pondweed	16.86	15.36	3.94	43	1.07	18
Brasenia schreberi, Watershield	16.47	15.00	3.85	42	1.05	24
Heteranthera dubia, Water star-grass	12.55	11.43	2.93	32	1.09	9
Utricularia vulgaris, Common bladderwort	11.37	10.36	2.66	29	1.14	4
Potamogeton pusillus, Small pondweed	10.20	9.29	2.38	26	1.12	2
Elodea nuttallii, Slender waterweed	8.63	7.86	2.02	22	1.05	
Sparganium fluctuans, Floating-leaf bur-reed	8.63	7.86	2.02	22	1.27	7
Potamogeton praelongus, White-stem pondweed	5.88	5.36	1.40	15	1.07	5
Schoenoplectus acutus, Hardstem bulrush	5.10	4.64	1.19	13	1.00	3
Myriophyllum alterniflorum, Alternate-flowered water-milfoil	4.71	4.29	1.10	12	1.42	2
Pontederia cordata, Pickerelweed	3.92	3.57	0.92	10	1.00	8
Equisetum fluviatile, Water horsetail	3.14	2.86	0.73	8	1.00	3
Polygonum amphibium, Water smartweed	2.75	2.50	0.64	7	1.00	
Najas flexilis, Slender naiad	2.35	2.14	0.55	6	1.00	
Nuphar variegata, Spatterdock	1.96	1.79	0.46	5	1.00	6
Ranunculus aquatilis, White water crowfoot	1.96	1.79	0.46	5	1.00	
Eleocharis palustris, Creeping spikerush	1.57	1.43	0.37	4	1.00	
Sagittaria graminea, Grass-leaved arrowhead	1.57	1.43	0.37	4	1.00	
Sparganium eurycarpum, Common bur-reed	1.57	1.43	0.37	4	1.00	1
Carex comosa, Bottle brush sedge	1.18	1.07	0.27	3	1.00	
Chara sp., Muskgrasses	1.18	1.07	0.27	3	1.00	
Potamogeton epihydrus, Ribbon-leaf pondweed	1.18	1.07	0.27	3	1.00	2
Utricularia intermedia, Flat-leaf bladderwort	1.18	1.07	0.27	3	1.00	1
Eleocharis acicularis, Needle spikerush	0.78	0.71	0.18	2	1.00	
Isoetes sp., Quillwort	0.78	0.71	0.18	2	1.00	
Myriophyllum verticilatum, Whorled water milfoil	0.78	0.71	0.18	2	1.00	2
Schoenoplectus tabernaemontani, Softstem bulrush	0.78	0.71	0.20	2	1.00	1
Nitella sp., Nitella	0.39	0.36	0.09	1	1.00	
Potamogeton gramineus, Variable pondweed	0.39	0.36	0.09	1	1.00	1
Potamogeton spirillus, Spiral-fruited pondweed	0.39	0.36	0.09	1	1.00	
Sagittaria cuneata., (rosette) –Sessile fruited arrowhead.	0.39	0.36	0.09	1	1.00	1
Sparganium sp., Bur-reed	0.39	0.36	0.09	1	1.00	
Typha latifolia, Broad-leaved cattail	0.39	0.36	0.09	1	1.00	
Carex Sp-Sedge	na	na	na	na	na	4

Table 4: Point intercept survey species list with statistics.

Species viewed in boat survey
Sagittaria latifolia, Common arrowhead
Sparganium sp., Bur-reed
Typha latifolia, Broad-leaved cattail
Carex sp.
Carum palustre, Marsh cinquefoil
Dulichium arundinaceum, Three-way sedge
Rumex hydrolapathum, Water dock

Table 5: Point intercept survey species list from boat survey.

The most abundant aquatic plants sampled were *Potamogeton robbinsii* (fern pondweed), *Vallisneria Americana* (wild celery) and *Ceratophyllum demersum* (coontail) respectively. All three of these plants are common native aquatic plants in Wisconsin. These plants serve important roles in the lake ecosystem and are desirable to have present the lake ecosystem.

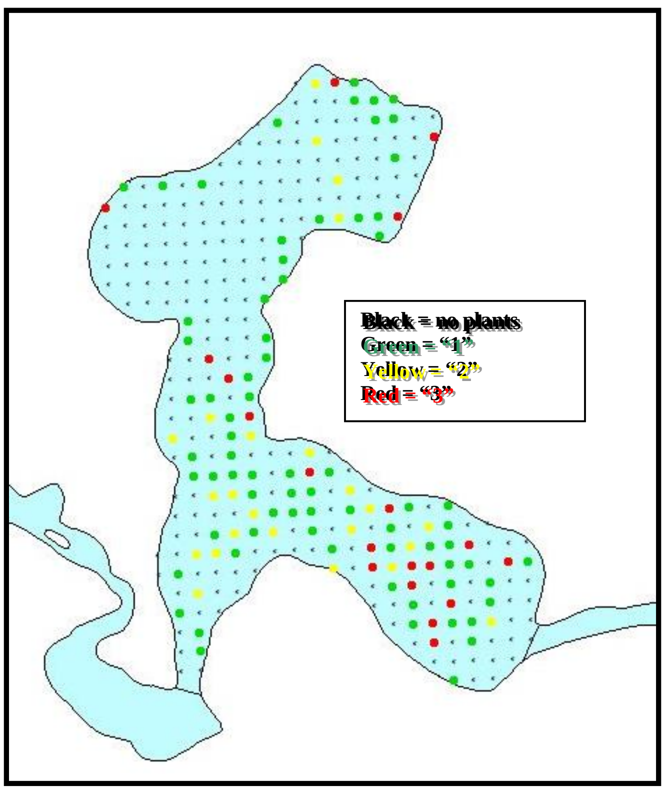


Figure 10: Distribution map of Robbins pondweed (*Potamogeton robbinsii*)-Most abundant.

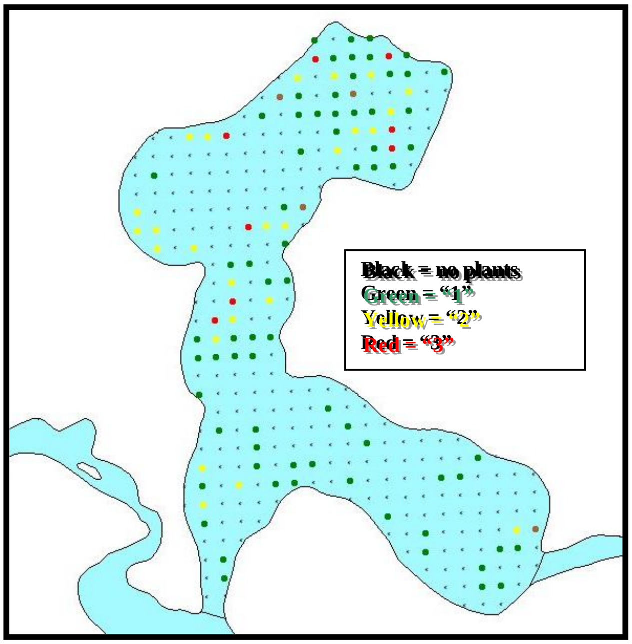


Figure 11: Distribution map of Coontail *(Ceratophyllum demersum)*-Second most abundant.

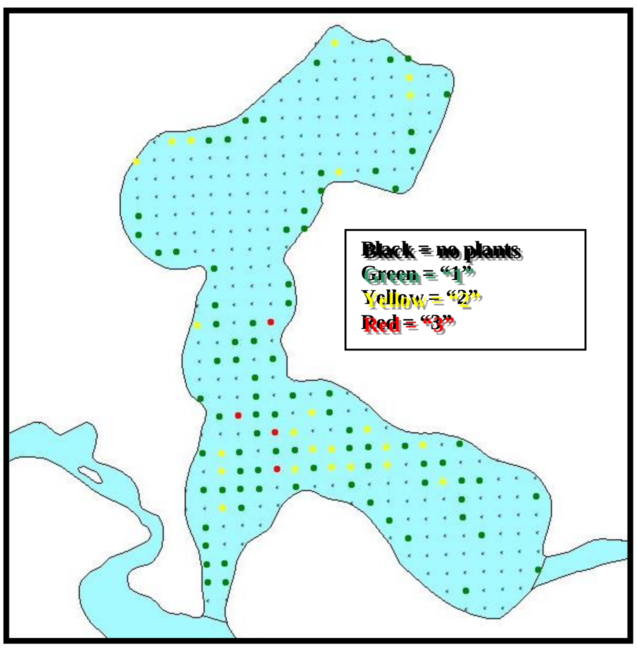


Figure 12: Distribtuion map of Wild celery (*Vallisneia americana*)-Third most abundant.

The coverage of aquatic plants in Rice Lake is extensive. Of the sample points that were at depths conducive for plant growth (less than 12.7 ft), 91% had plants. The density of plants is also quite extensive were plants were growing. There were several sample points where the total rake fullness was a "2" or higher, with an average rake fullness (where plants were sampled) of 2.28. In the more shallow areas, the plants are dense enough to potentially reduce navigation.

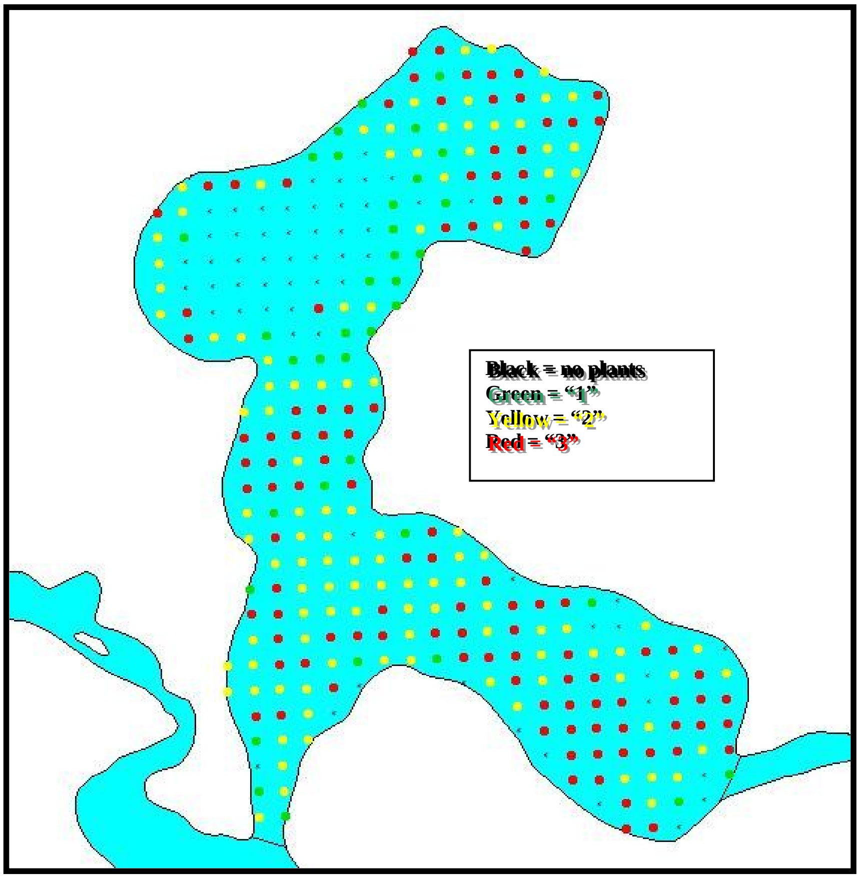


Figure 13: Rake density map for Rice Lake, 2010.

Floristic Quality

The plant community can indicate changes in habitat and water quality from human development by using a tool known as the Floristic Quality Index (FQI). This index uses the number of species sampled on the rake and a value given to certain plants known as conservatism. The greater the conservatism value (ranges from 1-10), the less tolerant the plant is to changes in habitat disturbances. The habitat changes are compared to pre-development characteristics in the lake. Table 6 summarizes the FQI information.

N	41
Mean Conservatism value	6.56
FQI	**42.01**

Table 6: FQI statistical summary

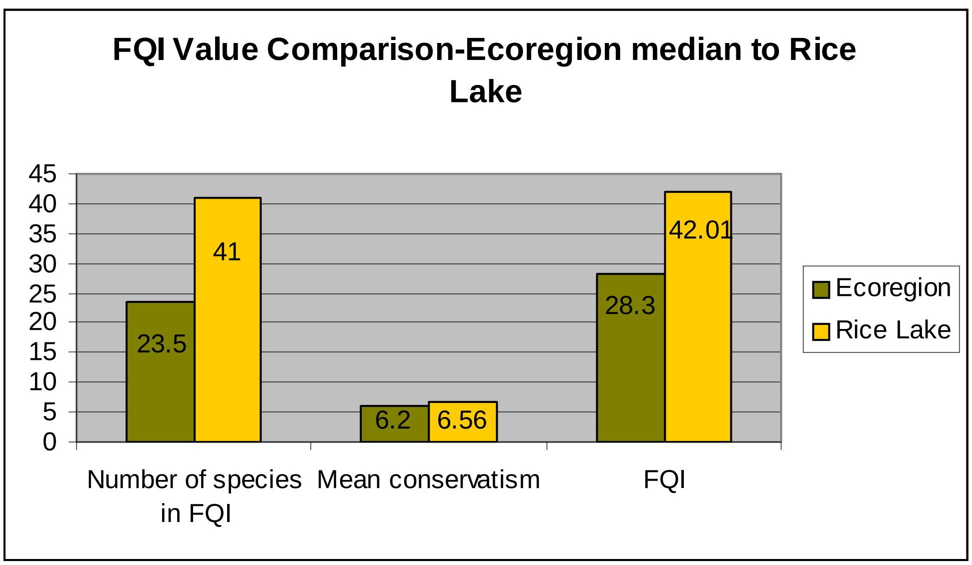


Figure 14: Comparison of FQI median value for the ecoregion (Northern Lakes and Forests-Flowages) to the Rice Lake FQI values.

FQI Species	Common name	Conservatism value
Bidens beckii	Water marigold	8
Brasenia schreberi	Watershield	6
Carex comosa	Bottle brush sedge	5
Ceratophyllum demersum	Coontail	3
Chara	Muskgrasses	7
Eleocharis acicularis	Needle spikerush	5
Eleocharis palustris	Creeping spikerush	6
Elodea canadensis	Common waterweed	3
Elodea nuttallii	Slender waterweed	7
Equisetum fluviatile	Water horsetail	7
Heteranthera dubia	Water star-grass	6
Isoetes sp.	Quillwort	8
Myriophyllum alterniflorum	Alternate-flowered water-milfoil	10
Myriophyllum sibiricum	Northern water-milfoil	6
Myriophyllum verticillatum	Whorled water-milfoil	8
Najas flexilis	Slender naiad	6
Nitella	Nitella	7
Nuphar variegata	Spatterdock	6
Nymphaea odorata	White water lily	6
Polygonum amphibium	Water smartweed	5
Pontederia cordata	Pickerelweed	8
Potamogeton amplifolius	Large-leaf pondweed	7
Potamogeton epihydrus	Ribbon-leaf pondweed	8
Potamogeton gramineus	Variable pondweed	7
Potamogeton praelongus	White-stem pondweed	8
Potamogeton pusillus	Small pondweed	7
Potamogeton richardsonii	Clasping-leaf pondweed	5
Potamogeton robbinsii	Fern pondweed	8
Potamogeton spirillus	Spiral-fruited pondweed	8
Potamogeton zosteriformis	Flat-stem pondweed	6
Ranunculus aquatilis	White water crowfoot	8
Sagittaria graminea	Grass-leaved arrowhead	9
Schoenoplectus acutus	Hardstem bulrush	6
Schoenoplectus tabernaemontani	Softstem bulrush	4
Sparganium eurycarpum	Common bur-reed	5
Sparganium fluctuans	Floating-leaf bur-reed	10
Typha latifolia	Broad-leaved cattail	1
Utricularia intermedia	Flat-leaf bladderwort	9
Utricularia vulgaris	Common bladderwort	7
Vallisneria americana	Wild celery	6

Table 7: FQI species list and C values.

The FQI for Rice Lake is very high. This shows that the plant community has several intolerant plant species. These are plants that do not respond well to habitat changes and/or water quality degradation in the lake. The mean conservatism for the Rice Lake FQI is 6.55, which is also high and supports the presumption that Rice Lake's plant community appears unaffected by human development.

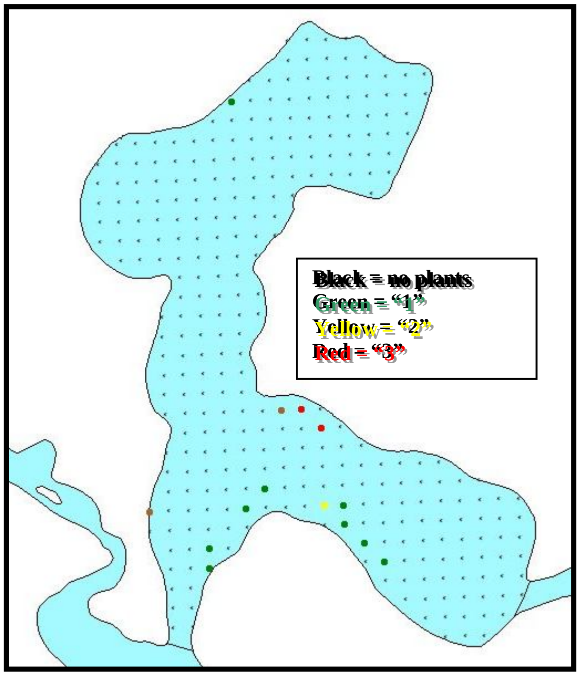


Figure 15: Distribution map of *Myriophyllum alterniflorum*-Alternate flowered water milfoil (C=10)

Two of the most sensitive plants sampled (with high conservatism value) was *Myriophyllum alterniflorum* (alternate flowered water milfoil) and *Sparganium fluctuans* (floating leaf bur-reed). Both of these plants have the highest conservatism value of "10". Two other plants, *Sagittaria graminea* (grass leaved arrowhead) and *Utricularia intermedia* (flat-leaf bladderwort), with conservatism values of "9' were sampled.

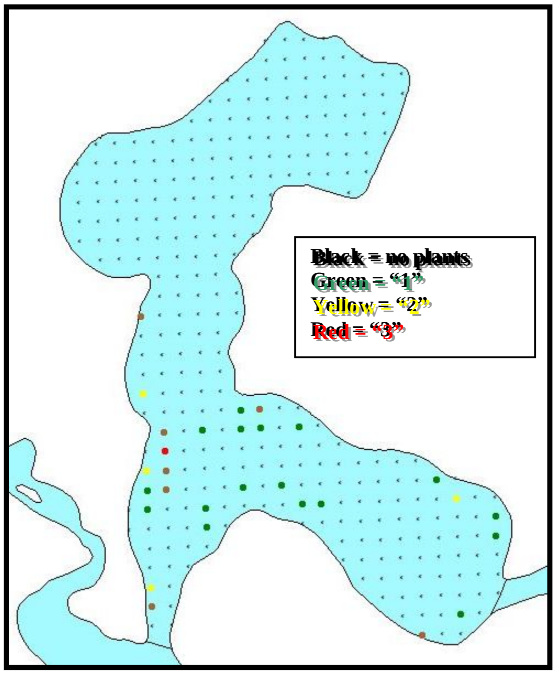


Figure 16: Distribution map of *Sparganium fluctuans*-Floating bur-reed (C=10)

> ***Shallow lakes typically have two alternative stable states—phytoplankton (algae)-dominated or macrophyte (plant)-dominated (Newton and Jarrell, 1999). In moderate densities, macrophytes are beneficial in these lakes. Macrophytes keep sediment from being resuspended by the wind and, therefore, help keep the water less turbid. Macrophytes also provide a place for attached algae to grow and remove phosphorus from the water column. If the macrophytes are removed or if external phosphorus inputs increase, the lake can shift from a macrophyte-dominated state to an algal-dominated state. Once a lake is in the algal-dominated state, macrophytes have a difficult time re-establishing themselves because algae reduce the penetration of light. Of these two conditions, it is commonly believed that the macrophyte-dominated state, which is present in Mercer Lake, is more desirable for human and biological use than the algal-dominated state (Newton and Jarrell, 1999). It is believed that Mercer Lake now has more macrophytes than it once had, but macrophytes may have always been common in the lake.***
>
> -USGS, 2012 from nutrient analysis of Mercer Lake, Iron County.

The quote in the box above is taken from the Mercer Lake nutrient analysis conducted by the USGS. This outlines the importance of aquatic macrophytes in the nutrient balance in a lake. Since Rice Lake has large amounts of aquatic plant growth and is near the eutrophic threshold (similar to Mercer Lake), consideration of the role of aquatic plants in nutrient management is important. Large reductions in aquatic plants could cause Rice Lake to become algae dominant rather than macrophyte dominant.

Aquatic Invasive Species

In the point intercept survey and boat survey, no non-native plants or aquatic invasive species (AIS) were sampled or surveyed. Although none were sampled or observed does not mean there are no invasive species present. However, if there are, they probably would not be in dense amounts. Diligence should be used to continue monitoring for such species.

There are lakes in the vicinity of Rice Lake that contain AIS. The Gile Flowage contains spiny water flew (*Bythotrephes cederstroemi*), which was discovered in 2003.

There are some lakes in Iron County that have Eurasian water milfoil (EWM) infestations. These lakes include: Long Lake, Long Lake Creek, and Wilson Lake.

Management Options

Biological control[5]

Biological control is the purposeful introduction of parasites, predators, and/or pathogenic microorganisms to reduce or suppress populations of plant or animal pests. Biological control counteracts the problems that occur when a species is introduced into a new region of the world without a complex or assemblage of organisms that feed directly upon it, attack its seeds or progeny through predation or parasitism, or cause severe or debilitating diseases (i.e., pathogenic microorganisms). With the introduction of native pests to the target invasive organism, the exotic invasive species may be maintained at lower densities.

While this theory has worked in application for control of some non-native aquatic plants, results have been varied (Madsen, 2000). Beetles (*Galerucella* spp) are commonly used to control purple loosestrife populations in Wisconsin with good success. Weevils (*Euhrychiopsis lecontei*),are used as an experimental control for Eurasian watermilfoil once the plant is established. Tilapia and carp are used to control the growth of filamentous algae in ponds. Grass carp, and herbivorous fish are sometimes used to feed on pest plant populations. Grass carp introduction is not allowed in Wisconsin.

There are advantages and disadvantages to the use of biological control as part of an overall aquatic plant management program. Advantages include longer-term control relative to other technologies, lower overall costs, as well as plant-specific control. On the other hand, there are several disadvantages to consider, including control times of years instead of weeks, lack of available agents for particular target species, and relatively strict environmental conditions for success.

Biological control is not without risks; new non-native species introduced to control a pest population may cause problem of its own.

Re-vegetation with native plants

Another aspect to biological control is native plant restoration. The rationale for re-vegetation is that restoring a native plant community should be the end goal of most aquatic plant management programs (Nichols, 1991; Smart and Doyle, 1995). However, in communities that have only recently been invaded by non-native species, a propagule bank probably exists that will restore the community after non-native plants are controlled (Madsen, Getsinger, and Turner, 1994). Re-vegetation following plant management implementation should not be necessary as Rice Lake has extensive native populations and any management will involve selection for target species only.

[5] Information from APIS(Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

Physical control[6]

In physical management, the environment of the plant is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, draw down, benthic (lake bottom) barriers, and shading or light attenuation. Because they involve placing a structure on the bed of a lake and/or affect lake water level, a Chapter 30 or 31 DNR permit is required.

Dredging removes accumulated bottom sediments that support plant growth. Dredging is usually not performed solely for aquatic plant management but to restore lakes that have been filled in with sediments, have excess nutrients, need deepening, or require removal of toxic substances (Peterson, 1982). Dredging is not a viable option for Rice Lake since this isn't recognized as an aquatic plant management tool alone and is not regarded as an effective tool for these lakes.

Drawdown, or significantly decreasing lake water levels can be used to control nuisance plant populations. Essentially, the water body has all of the water removed to a given depth. It is best if this depth includes the entire depth range of the target species. Drawdowns, to be effective, need to be at least 1 month long to ensure thorough drying (Cooke 1980a). In northern areas, a draw down in the winter that will ensure freezing of sediments is also effective. Although draw down may be effective for control of hydrilla for 1 to 2 years (Ludlow 1995), it is most commonly applied to Eurasian watermilfoil (Geiger 1983; Siver et al. 1986) and other milfoils or submersed evergreen perennials (Tarver 1980). Drawdown requires that there be a mechanism to lower water levels.

Although it is inexpensive and has long-term effects (2 or more years), it also has significant environmental effects and may interfere with use and intended function (e.g., power generation or drinking water supply) of the water body during the drawdown period. Lastly, species respond in very different manners to draw down and often not in a consistent fashion (Cooke 1980a). Drawdowns may provide an opportunity for the spread of highly weedy or adventive species, particularly annuals.

There is a simple rock dam below Rice Lake which cannot be used to adjust the level of Rice Lake. Also, this is a very dramatic management tool to use in a lake that has such a large diversity of aquatic plants. Drawdown would likely adversely affect this diversity and as a result would not be a desirable tool.

Benthic barriers or other bottom-covering approaches are another physical management technique. The basic idea is that the plants are covered over with a layer of a growth-inhibiting substance. Many materials have been used, including

[6] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

sheets or screens of organic, inorganic and synthetic materials, sediments such as dredge sediment, sand, silt or clay, fly ash, and combinations of the above (Cooke 1980b; Nichols 1974; Perkins 1984; Truelson 1984). The problem with using sediments is that new plants establish on top of the added layer (Engel and Nichols 1984). The problem with synthetic sheeting is that the gasses evolved from decomposition of plants and sediment decomposition collects under and lifts the barrier (Gunnison and Barko 1992). Benthic barriers will typically kill plants under them within 1 to 2 months, after which they maybe removed (Engel 1984). Sheet color is relatively unimportant; opaque (particularly black) barriers work best, but even clear plastic barriers will work effectively (Carter et al. 1994). Sites from which barriers are removed will be rapidly re-colonized (Eichler et al. 1995). In addition, synthetic barriers may be left in place for multi-year control but will eventually become sediment-covered and will allow colonization by plants. Benthic barriers, effective and fairly low-cost control techniques for limited areas (e.g., <1 acre), may be best suited to high-intensity use areas such as docks, boat launch areas, and swimming areas. However, they are too expensive to use over widespread areas, and heavily affect benthic communities by removing fish and invertebrate habitat. A Department of Natural Resources permit would be required.

Although a benthic barrier may be a potential option for riparian owners, there is no plan to use this as a management tool for Rice Lake. Since the main use of management tool would most likely to open up navigation for the lake, benthic barriers are not prudent as the coverage is too extensive and would be too labor intensive. Also benthic barriers involve a very expensive permit process.

Shading or light attenuation reduces the light plants need to grow. Shading has been achieved by fertilization to produce algal growth, by application of natural or synthetic dyes, shading fabric, or covers, and by establishing shade trees (Dawson 1981, 1986; Dawson and Hallows 1983; Dawson and Kern-Hansen 1978; Jorga et al. 1982; Martin and Martin 1992; Nichols 1974). During natural or cultural eutrophication, algae growth alone can shade aquatic plants (Jones et al. 1983). Although light manipulation techniques may be useful for narrow streams or small ponds, in general these techniques are of only limited applicability. As a result, management of Rice Lake will not use this management tool.

Manual removal[7]

Manual removal involving hand pulling, cutting, or raking plants will remove plants from small areas. It is likely that plant removal will need to be repeated during the growing season. Best timing for hand removal of herbaceous plant species is after flowering but before seed head production. For plants that possess rhizomatous (underground stem) growth, pulling roots is not generally recommended since it may stimulate new shoot production. Hand pulling is a strategy recommended for

[7] Information from APIS (Aquatic Plant Information System) U.S. Army Corps of Engineers. 2005.

rapid response to a Eurasian water milfoil infestation. If curly leaf pondweed or Eurasian watermilfoil is present at near shore locations in low density, hand pulling by residents may be effective. Caution needs to be exercised in removing the entire plant and any fragments to reduce spreading through fragmentation.

Mechanical control

Larger-scale control efforts require more mechanization. Mechanical cutting, mechanical harvesting, diver-operated suction harvesting, and rotovating (tilling) are the most common forms available. Department of Natural Resources permits under Chapter NR 109 are required for mechanical plant removal.

Aquatic plant harvesters are floating machines that cut and remove vegetation from the water. The cutter head uses sickles similar to those found on farm equipment, and generally cuts from one to six feet deep. A conveyor belt on the cutter head is always in motion, bringing the clippings onboard the machine for storage. Once full, the harvester travels to shore to discharge the load of weeds off of the vessel.

Harvesters come in a variety of sizes, with cutting swaths ranging from four to twelve feet in width. The onboard storage capacity varies as well, and is measured in both volume and weight. Harvester storage capacities generally range from 100 to 1000 cubic feet of vegetation by volume, or from one to eight tons. They are usually propelled by two paddle wheels that provide excellent maneuverability and will not foul in dense plant growth.

Mechanical harvesting of aquatic plants presents both positive and negative consequences to any lake. Its results—open water and accessible boat lanes—are immediate, and can be enjoyed without the restrictions on lake use which follow herbicide treatments. In addition to the human use benefits, the clearing of thick aquatic plant beds may also increase the growth and survival of some fish. By eliminating the upper canopy, harvesting reduces the shading caused by aquatic plants. The nutrients stored in the plants are also removed from the lake, and the sedimentation that would normally occur as a result of the decaying of this plant matter is prevented. Additionally, repeated treatments may result in thinner, more scattered growth.

Aside from the obvious effort and expense of harvesting aquatic plants, there are many environmentally-detrimental consequences to consider. The removal of aquatic species during harvesting is non-selective. Native and invasive species alike are removed from the target area. This loss of plants results in a subsequent loss of the functions they perform, including sediment stabilization and wave absorption. Shoreline erosion may therefore increase. Other organisms such as fish, reptiles, and insects are often displaced or removed from the lake in the harvesting process. This may have adverse effects on these organisms' populations as well as the lake ecosystem as a whole.

While the results of harvesting aquatic plants may be short term, the negative consequences are not so short lived. Much like mowing a lawn, harvesting must be conducted numerous times throughout the growing season. Although the harvester collects most of the plants that it cuts, some plant fragments inevitably persist in the water. This may allow the invasive plant species to propagate and colonize in new, previously unaffected areas of the lake. Harvesting may also result in re-suspension of contaminated sediments and the excess nutrients they contain.

Disposal sites are a key component when considering the mechanical harvesting of aquatic plants. The sites must be on shore and upland to make sure the plants and their reproductive structures don't make their way back into the lake or to other lakes. The number of available disposal sites and their distance from the targeted harvesting areas will determine the efficiency of the operation, in terms of time as well as cost.

Timing is also important. The ideal time to harvest, in order to maximize the efficiency of the harvester, is just before the aquatic plants break the surface of the lake. For curly leaf pondweed, it should also be before the plants form turions (reproductive structures) to avoid spreading the turions within the lake. If the harvesting is conducted too early, the plants will not be close enough to the surface, and the cutting will not do much damage to them. If too late, turions may have formed and may be spread, and there may be too much plant matter on the surface of the lake for the harvester to cut effectively.

If the harvesting work is contracted, the equipment should be inspected before and after it enters the lake. Since these machines travel from lake to lake, they may carry plant fragments with them, and facilitate the spread of aquatic invasive species from one body of water to another. Harvesting contractors are not readily available in northern Wisconsin, so harvesting contracts are likely to be very expensive. One must also consider prevailing winds, since cut vegetation can be blown into open areas of the lake or along shorelines.

Since the reduction of nuisance native plants would be the main management goal, mechanical harvesting may be a viable option. This tool would allow the opening of channels to enhance recreation opportunities. Also, this would allow for a "use as needed" management option. Spreading of AIS is a concern with this method and careful precautions would have to be followed.

Diver Plant Siphoning operations use pump systems to collect plant and root biomass. The pumps are mounted on a barge or pontoon boat. The dredge hoses are from 3 to 5 inches in diameter and are handled by one diver. The hoses normally extend about 50 feet in front of the vessel. Diver dredging is especially effective against pioneering infestations of submersed invasive plant species. When a weed is discovered in a pioneering state, this methodology should be considered. To be effective, the entire plant, including the subsurface portions, should be removed.

Plant fragments can be formed from this type of operation. Fragmentation is not as great a problem when infestations are small. Diver dredging operations can be an ongoing mission. When applied toward a pioneering infestation, control can be complete. However, periodic inspections of the lake should be performed to ensure that all the plants have been found and collected.

Lake substrates can play an important part in the effectiveness of the operation. Soft substrates are very easy to work in. Divers can remove the plant and root crowns with little problem. Hard substrates, however, pose more of a problem. Divers may need hand tools to help dig the root crowns out of hardened sediment. Diver removal in small areas could be viable option for Rice Lake. However, the area would have to be very small and would have to be hand removal and not use dredging divices.

Rotovation involves using large underwater rototillers to remove plant roots and other plant tissue. Rotovators can reach bottom sediments to depths of 20 feet. Rotovating may significantly affect non-target organisms and water quality as bottom sediments are disturbed. However, the suspended sediments and resulting turbidity produced by rotovation settles fairly rapidly once the tiller has passed. Tilling sediments that are contaminated could possibly release toxins to the water column. If there is any potential of contaminated sediments in the area, further investigation should be performed to determine potential impacts from this type of treatment. Tillers do not operate effectively in areas with many underwater obstructions such as trees and stumps. There may be a need to collect the plant material that is tilled from the bottom. If operations are releasing large amounts of plant material, harvesting equipment should be on hand to collect this material and transport it to shore for disposal.

Rotovation would release too much sediment and too many plant fragments and therefore would not be a good method for Rice Lake. Also, potential treatment of non-native plants by rotovation is not a good option as it could increase spreading of non-native plants while not selecting the target species. There have been no invasive species observed in Rice Lake thus far, but this could still be a concern. Rotovation is not likely to get permitted by the Wisconsin DNR.

Herbicide and algaecide treatments

Herbicides are chemicals used to kill plant tissue. Currently, no product can be labeled for aquatic use if it poses more than a one in a million chance of causing significant damage to human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification, bioavailability, or persistence in the environment (Joyce, 1991). Thus, there are a limited number of active ingredients that are assured to be safe for aquatic use (when used according to the label) (Madsen, 2000).

An important caveat is that these products are safe when used according to the label. The U.S. Environmental Protection Agency (EPA)-approved label gives guidelines protecting the health of the environment, the humans using that environment, and the applicators of the herbicide. In most states, additional permitting or regulatory restrictions on the use of these herbicides also apply. Most states require these herbicides be applied only by licensed applicators. Wisconsin Department of Natural Resources permits under Chapter NR 107 are required for herbicide application.

Herbicide use is a possible management tool for Rice Lake. Depending on the size of a management area and other parameters, herbicide use may or may not be the best option. For example, if there is a rather large area treated later in the summer and it is assumed the plant biomass would be high, a sudden decomposition of large amount of herbicide killed plants could cause a nutrient release and/or deplete oxygen in the lake. If areas are small or treatment occurs earlier in the spring, then these issues would not be as much of a concern.

~General descriptions of chemical control are included below~

Contact Herbicides

Contact herbicides act quickly and are generally lethal to all plant cells that they contact. Because of this rapid action, or other physiological reasons, they do not move extensively within the plant and are effective only where they contact plants. For this reason, they are generally more effective on annuals (plants that complete their life cycle in a single year). Perennial plants (plants that persist from year to year) can be defoliated by contact herbicides but they quickly resprout from unaffected plant parts. Submersed aquatic plants that are in contact with sufficient concentrations of the herbicide in the water for long enough periods of time are affected, but regrowth occurs from unaffected plant parts, especially plant parts that are protected beneath the sediment. Because the entire plant is not killed by contact herbicides, retreatment is necessary, sometimes two or three times per year. **Endothall, diquat** and **copper** are contact aquatic herbicides.

Systemic Herbicides

Systemic herbicides are absorbed into the living portion of the plant and move within the plant. Different systemic herbicides are absorbed to varying degrees by different plant parts. Systemic herbicides that are absorbed by plant roots are referred to as soil active herbicides and those that are absorbed by leaves are referred to as foliar active herbicides. Some soil active herbicides are absorbed only by plant roots. Other systemic herbicides, such as glyphosate, are only active when applied to and absorbed by the foliage. **2,4-D, dichlobenil, fluridone, and glyphosate** are systemic aquatic herbicides. When applied correctly, systemic herbicides act slowly in comparison to contact herbicides. They must move to the part of the plant where their site of action is. Systemic herbicides are generally more effective for controlling perennial and woody plants than contact herbicides. Systemic herbicides also generally have more selectivity than contact herbicides. A combination approach for CLP with contact and systemic may be considered.

Broad spectrum herbicides

Broad spectrum (sometimes referred to as nonselective) herbicides are those that are used to control all or most vegetation. This type of herbicide is often used for total vegetation control in areas such as equipment yards and substations where bare ground is preferred. **Glyphosate** is an example of a broad spectrum aquatic herbicide. **Diquat, Endothall, and fluridone** are used as broad spectrum aquatic herbicides, but can also be used selectively under certain circumstances. While glyphosate, diquat and endothall are considered broad spectrum herbicides, they can also be considered selective in that they only kill the plants that they contact. Thus, you can use them to selectively kill an individual plant or plants in a limited area such as a swimming zone. If used for CLP, an early season broad spectrum herbicide can target the CLP as most other plants are dormant.

Selective herbicides

Selective herbicides are those that are used to control certain plants, but not others. A good example of selective aquatic herbicide is 2,4-D, which can be used to control water hyacinth with minimum impact on eel grass. Herbicide selectivity is based upon the relative susceptibility or response of a plant to an herbicide. Many related physical and biological factors can contribute to a plant's susceptibility to an herbicide. Physical factors that contribute to selectivity include herbicide placement, formulation, and rate of application. Biological factors that affect herbicide selectivity include physiological factors, morphological factors, and stage of plant growth.

Environmental Considerations

Aquatic communities consist of aquatic plants including macrophytes (large plants) and phytoplankton (free floating algae), invertebrate animals (such as insects and clams), fish, birds, and mammals (such as muskrats, otters, and manatees). All of these organisms are interrelated in the community. Organisms in the community require a certain set of physical and chemical conditions to exist such as nutrient requirements, oxygen, light, and space. Aquatic weed control operations can affect one or more of the organisms in the community that can in turn affect other organisms or it can affect water chemistry that in turn affects organisms. The effects of aquatic plant control on the aquatic community can be separated into direct effects of the herbicides or indirect effects.

General descriptions of the breakdown of commonly used aquatic herbicides are included below.[8]

Copper compounds

Copper is a naturally occurring element that is essential at low concentrations for plant growth. It does not break down in the environment, but it forms insoluble compounds with other elements and is bound to charged particles in the water. It rapidly disappears from water after application as an herbicide. Because it is not broken down, it can accumulate in bottom sediments after repeated high application rates. Accumulation rarely reaches levels that are toxic to organisms or significantly above background concentrations in the sediment.

2,4-D

2,4-D photodegrades on leaf surfaces after applied to leaves and is broken down by microbial degradation in water and sediments. Complete decomposition usually takes about 3 weeks in water and can be as short as 1 week. 2,4-D breaks down into naturally occurring compounds.

Diquat

When applied to enclosed ponds for submersed weed control, diquat is rarely found longer than 10 days after application and is often below detection 3 days after application. The most important reason for the rapid disappearance of diquat from water is that it is rapidly taken up by aquatic vegetation and binds tightly to particles in the water and bottom sediments. When bound to certain types of clay particles diquat is not biologically available. When it is bound to organic matter, it can be slowly degraded by microorganisms. When diquat is applied foliarly it is degraded to some extent on the leaf surfaces by photodegradation, and because it is bound in the plant tissue a proportion is probably degraded by microorganisms as the plant tissue decays.

Endothall

Like 2,4-D, endothall is rapidly and completely broken down into naturally occurring compounds by microorganisms. The by-products of endothall dissipation are carbon dioxide and water. Complete breakdown usually occurs in about 2 weeks in water, and 1 week in bottom sediments. This will be the chemical of choice for early season CLP treatments.

Fluridone

Dissipation of fluridone from water occurs mainly by photodegradation. Metabolism by tolerant organisms and microbial breakdown also occurs, and microbial breakdown is probably the most important method of breakdown in bottom sediments. The rate of breakdown of fluridone is variable and may be related to time of application. Applications made in the fall or winter when the sun's rays are

[8]These descriptions are taken from Hoyer/Canfield: Aquatic Plant Management. North American Lake Management Society. 1997.

less direct and days are shorter result in longer half-lives. Fluridone usually disappears from pond water after about 3 months but can remain up to 9 months. It may remain in bottom sediment between 4 months and 1 year.

Glyphosate

Glyphosate is not applied directly to water for weed control, but when it does enter the water it is bound tightly to dissolved and suspended particles and to bottom sediments and becomes inactive. Glyphosate is broken down into carbon dioxide, water, nitrogen, and phosphorus over a period of several months.

Algaecide treatments for filamentous algae

Copper-based compounds are generally used to treat filamentous algae. Common chemicals used are copper sulfate and Cutrine Plus, a chelated copper algaecide.

Brand Name(s)	Chemical	Target Plants
Cutrine Plus, $CuSO_4$, Captain, Navigate, Komeen	Copper compounds	Filamentous algae, coontail, wild celery, elodea, and pondweeds
Reward	Diquat	Coontail, duckweed, elodea, water milfoil, and pondweeds
Aquathol, Aquathol K, Aquathol Super K, Hydrothol 191	Endothall	Coontail, water milfoil, pondweeds, and wild celery as well as other submersed weeds and algae
Rodeo	Glyphosate	Cattails, grasses, bulrushes, purple loosestrife, and water lilies
Navigate, Aqua-Kleen, DMA 4 IVM, Weed-Rhap	2, 4-D	Water milfoils, water lilies, and bladderwort

Table 8: Summary of chemical herbicide names and uses.

Historical Plant Management

Aquatic plants were managed through mechanical harvesting in the years 2004 and 2005. In 2004, approximately 10 tons of vegetation were removed. In 2005, approximately 5 tons of vegetation was removed. Access lanes 35 feet by 100-150 feet were cut to designated piers and a general use navigation lane (14 to 28 feet wide) which led to approximate harvesting total of 3.85 acres. Figures XX and XX show maps outlining the harvesting locations.

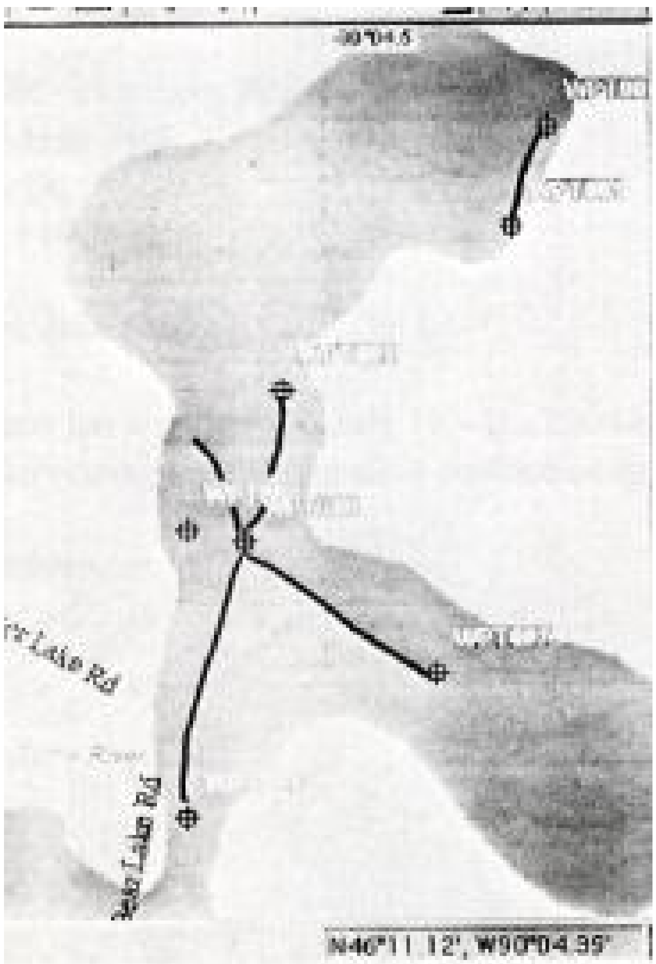


Figure 17: Harvesting locations on Rice Lake in 2004.

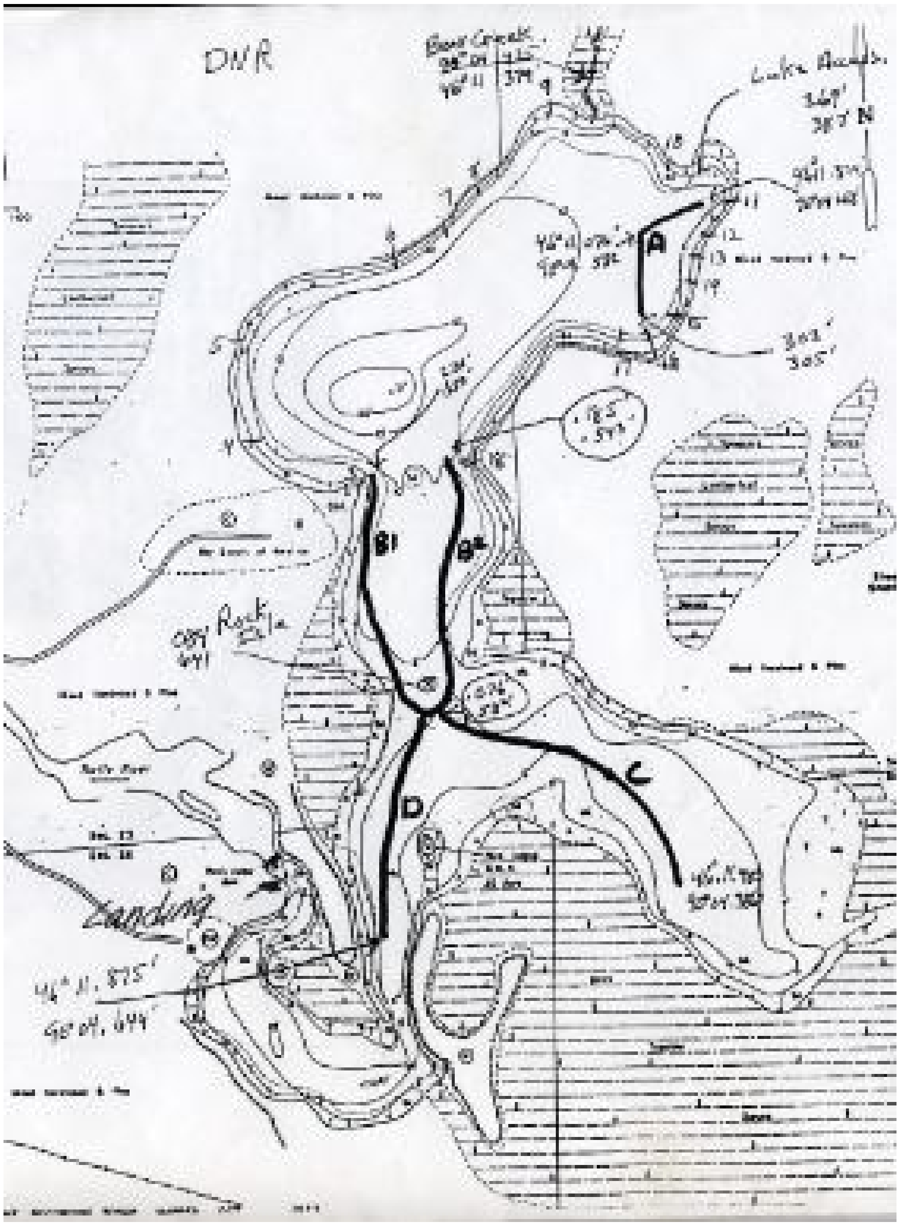


Figure 18: Harvesting locations on Rice Lake in 2005.

It was noted by the harvesting company that the landing was very poor and that future harvesting would not be possible without improvements to the landing. Also, it was observed that a great deal of sediment was disturbed during harvesting due to shallow conditions[9].

[9]This information was provided by Clifford Schmidt of Schmidt's Aquatic Plant Control who did the harvesting.

The DNR Northern Region released an Aquatic Plant Management Strategy (Appendix B) in the summer of 2007 to protect the important functions of aquatic plants in lakes. As part of this strategy, the DNR prohibited management of native aquatic plants in front of individual lake properties after 2008 unless management is designated in an approved aquatic plant management plan.[5] Because of the importance of the native plant population for habitat, protection against erosion, and as a guard against invasive species infestation, plant removal with herbicides as an option for individual property owners must be carefully reviewed before permits are issued. The DNR will not allow removal after January 1, 2009 unless the "impairment of navigation" and/or "nuisance" conditions are clearly documented.

Individual Corridor Access

The only time a permit is not required to control aquatic plants is when a waterfront property owner manually removes (i.e., hand-pulls or hand rakes), or gives permission to someone to manually remove, plants (except wild rice) from his/her shoreline in an area that is 30 feet or less in width along the shore and is not within a Designated Sensitive Area. The non-native invasive plants (Eurasian water milfoil, curly-leaf pondweed, and purple loosestrife) may be manually removed beyond 30 feet without a permit, as long as native plants are not harmed. Wild rice removal always requires a permit.

Permitting requirements

The Wisconsin Department of Natural Resources regulates the removal of aquatic plants when chemical and mechanical methods are used or when plants are removed manually from an area greater than thirty feet in width along the shore. The requirements for chemical plant removal are described in Administrative Rule NR 107-Aquatic Plant Management. A permit is required for any aquatic chemical application in Wisconsin.

The requirements for manual and mechanical plant removal are described in NR 109-Aquatic Plants: Introduction, Manual Removal & Mechanical Control Regulations. A permit is required for manual and mechanical removal except when a riparian (waterfront) landowner manually removes or gives permission to someone to manually remove plants, (with the exception of wild rice) from his/her shoreline limited to a 30-foot corridor. A riparian landowner may also manually remove the invasive plants Eurasian water milfoil, curly leaf pondweed, and purple loosestrife along his or her shoreline without a permit. Manual removal means the

[5] Aquatic Plant Management Strategy. DNR Northern Region. Summer 2007.

control of aquatic plants by hand or hand-held devices without the use or aid of external or auxiliary power.
The Northern Region of the Wisconsin DNR has established a management strategy for future plant management and can affect permitting for management. Their approach is as follows:[6]

1. After January 1, 2009, no individual permits for control of native aquatic plants will be issued. Treatment of native species may be allowed under the auspices of an approved lake management plan, and only if the plan clearly documents "impairment of navigation" and/or "nuisance conditions." Until January 1, 2009, individual permits will be issued to previous permit holders, only with adequate documentation of "impairment of navigation" and/or "nuisance conditions." No new individual permits will be issued during the interim.

2. Control of aquatic plants (if allowed) in documented sensitive areas will follow the conditions specified in the report. (Note: Minocqua Lake has several documented sensitive areas)

3. Invasive species must be controlled under an approved lake management plan, with two exceptions:
   a. Newly discovered infestations: If found on a lake with an approved plan, the invasives can be controlled via an amendment to the approved plan. Without an approved plan, they can be controlled under the WDNR' Rapid Response protocol.

   b. Individuals holding past permits for control of invasive aquatic plants and/or "mixed stands" of native and invasive species will be allowed to treat via individual Permit until January 1, 2009, if "impairment of navigation," and/or "nuisance conditions" is (are) adequately documented.

4. Control of invasive stands or "mixed stands" of invasive and native plants will follow current best management practices approved by the Department and contain an explanation of the strategy to be used. Established stands of invasive plants will generally use a control strategy based on spring treatment (water temperatures of less than 60 degrees F).

5. Manual removal (by definition) is allowed. However, wild rice may not be removed.

[6] Aquatic Plant Management Strategy. Northern Region of Wisconsin DNR. 2007.

Plan Goals and Strategies

This section of the plan lists goals and objectives for aquatic plant management for Mercer Lake. It also presents a strategy of actions that will be used to reach aquatic plant management plan goals.

Goals are broad statements of direction.
Objectives are measurable steps toward the goal.
Actions are actions to take to accomplish objectives.
The **Implementation Plan** outlines timeline, resources needed, partners, and funding sources for each action item.

Goals for Rice Lake's Aquatic Plant Management Plan

1. ***Preserve the native plants and protect the sensitive areas of the lake.***
2. ***Monitor and control any introduction of invasive species.***
3. ***Control growth of native plants in a responsible manner to enhance recreational activities on the lake (fishing, boating, swimming, etc.)***
4. ***Educate Rice Lake residents on the value of aquatic plants and the potential outcomes of an unbalanced environment.***
5. ***Evaluate and preserve water quality in Rice Lake to limit increase in macrophyte density.***

Figure 19: Management goals for Rice Lake APMP.

Goal 1: Preserve native plants and protect sensitive areas of Rice Lake.

Objective 1.1- Evaluate sensitive and critical habitat areas in and around Rice Lake. Once established, these areas will be preserved and any adverse effects of management will be avoided.

[redacted]

[redacted]

A sensitive/critical habitat assessment will evaluate and map regions that have sensitive plants, plants that have high importance for fish and wildlife habitat and areas that will enhance fish recruitment and rearing.

A full lake PI survey conducted in 2016 will allow for the evaluation of any changes in the native plant community that could have possibly been the result of the navigation channels.

Goal 2: Monitor for and control any introduction of invasive species.

Objective 2.1-Enhance the Clean Boats/Clean Waters program.

The Clean Boats/Clean Waters program is an excellent way to reduce the chance of AIS being introduced into a lake. The program typically involves having volunteers/hired personnel making contact with boaters using the landing. Since Rice Lake lacks a public landing other than a carry-in site, this is not possible. As a result, they will implement a modified version.

[redacted]

This modified version will involve signs at the public walk-in landing and talk to the private landing owner about putting signs there too. They will also make contact with boaters on the water from the channel leading from the private landing to the lake. Although this contact could occur after the boat launched with AIS, it is hopeful that the education of boaters will heighten awareness with Rice Lake boaters/recreation users.

[7] If chemical herbicides are used as a control method, a critical habitat assessment may be required prior to application of herbicides.

[redacted]

[redacted]

Objective 2.2- Monitor Rice Lake for AIS throughout the summer months each year.

[redacted]

The rapid response protocol in Appendix B will be followed should a potential AIS is observed at anytime.

The entire lake will be monitored as best as possible. However, since nearly the entire lake is littoral zone, a map with key areas has been created to identify key areas. These areas are based upon inflowing water and incoming boat traffic, which would be the most probable areas for AIS to come into Rice Lake. These areas should be monitored first, then if time permits, survey the entire lake.

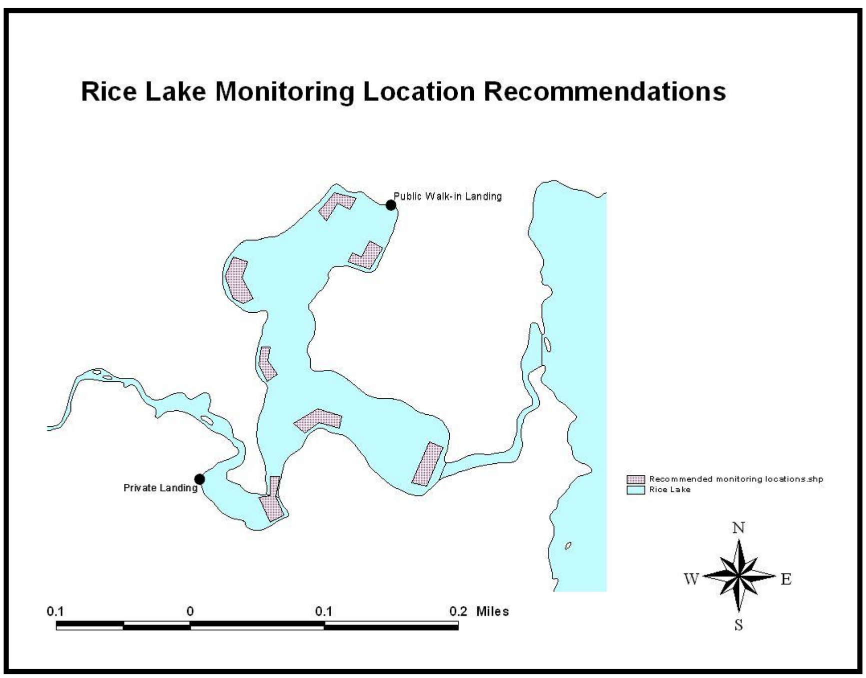


Figure 20: Recommended AIS monitoring location map

A monitoring kit will be created for the monitors. This kit will include: rake on a rope, AIS identification of biggest concern species, bags for vouchering concerned species, GPS and map of monitoring areas.

Goal 3: Control growth of native plants in a responsible manner to enhance recreational activities on the lake (fishing, boating, swimming, etc.)

Objective 3.1- Reduce plant density in high traffic areas where nuisance native plants are impeding navigation with boats.

Nuisance native plant growth threshold will be define as: An area where the mean density is 2.5 or greater throughout the plant bed (meaning the majority of sample points would be a 3; the plant growth height at or near surface (common motor depth) up to the surface throughout the plant bed; the plant bed is a minimum of 30 feet in length and too wide to easily pass around (approximately 50 feet).

[redacted]

*Note: The plant committee feels that mechanical harvesting is the best method for Rice Lake. However, the landing is too small to accommodate the harvester available for hire. Other harvesting options have been evaluated and at this point, no alternative has been found. The options evaluated have included purchase of a small harvester (too expensive to justify) and hiring a company with a smaller harvester to complete the work. One entity that sells small harvesters also lists their services for hire, however they have indicated not being available. As a result, herbicide use (which is less desired) appears to be the only option at this time.

The plant committee will continue to explore harvest options in the future in the hope that they can use that method.

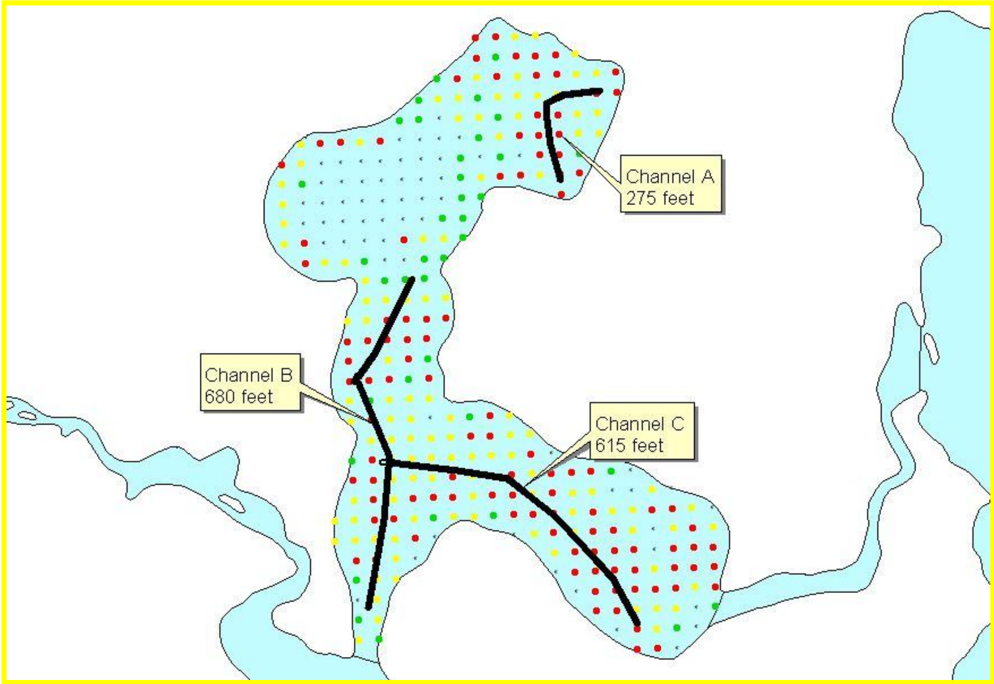


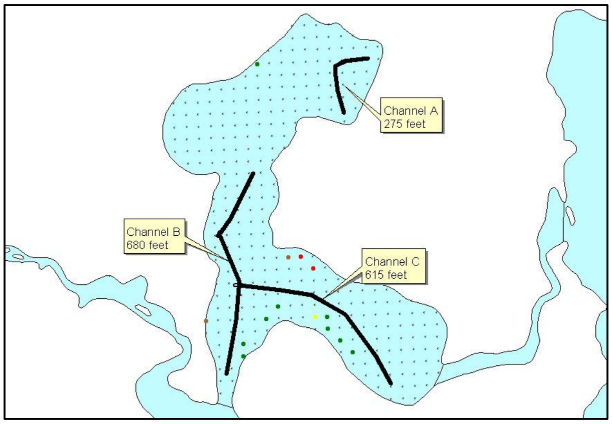
Figure 21: navigation channels location map with distances.

Note: The navigation channels in figure 21 are maximum proposals only and represent areas to be evaluated for high density issues. The areas the meet the nuisance requirements would be the only areas treated (or harvested). Any areas that are under the threshold will not be treated or harvested.

In addition to the main channel mapped, there may be small (narrow) feeder channels 10 feet wide that connect riparian owners to a low-density area or to the main channel, whichever is the shortest distance. These will be based on meeting the threshold requirements and a willingness to fund the narrow channel.

The navigation channels have been located to avoid highly sensitive plants. There are two plants that have a conservatism value of "10" than have been sampled in Rice Lake. The navigation channel avoids these areas. These plants will be monitored closely along with other plants[8]. Also, the critical habitat assessment may reveal areas that need to be avoided during reduction practices.

[8] These are proposed channels. The density of the plants will be checked before final channels are delineated and part of a permit application.



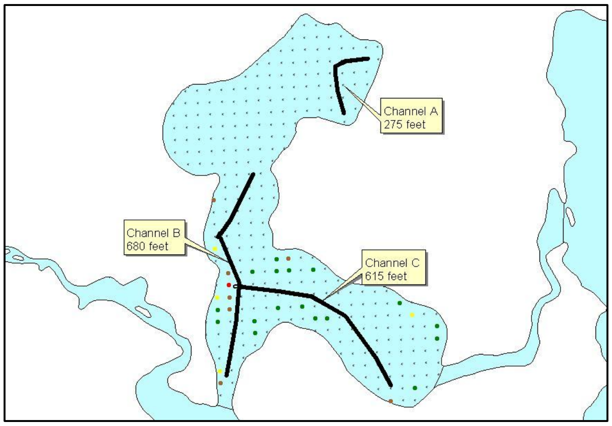


Figure 22: Navigation channel showing avoidance of sensitive plants.

Since these corridors involve the reduction in native plants, it is paramount to do a minimum amount of reduction. The reduction at individual riparian owners needs to be monitored and limited based upon objective criteria. The procedure for individual corridors is outlined as follows:

Procedure for Individual Corridor Permitting and Monitoring[9]

Verify/refute nuisance conditions and/or navigation impairment

- Landowners will document conditions with photographs and submit request for review by the APM Lead or designee.
- Landowner requests LLPRD APM Lead review of their property prior to submitting a permit application to DNR.
- The APM Lead visits site, reviews documentation and provides a written opinion of navigation impairment i.e., is herbicide treatment or harvesting warranted?
- Describe practical alternatives to herbicide use or harvesting that were considered. These might include:
  - -Hand removal/hand raking of aquatic plants
  - -Extending dock to greater depth
  - -Altering the route to and from the dock
  - -Use of another type of watercraft or motor, i.e., is the type of watercraft used common to other sites with similar conditions on this lake?
- Landowner/applicator applies for permit to WDNR including photographic documentation, identification of plants causing navigation problems, and LLPRD evaluation.
- WDNR will contact herbicide applicator and owner with a notice to proceed with treatment or denial of treatment application.

[9] Landowner can clear 30 foot wide corridor by hand without a permit from the Wisconsin DNR.

[redacted]

The navigation corridors will be evaluated during mid- July of each year to determine the density and aerial coverage within the corridors. A decision will be made to retreat based upon reaching the threshold within the treatable area. It is understood that only portions of the established corridors may need treatment in any given year after the initial year of treatment. Photographic verification may be required.

Objective 3.2- Evaluate fisheries in regard to weed density and if reduction could help recruitment and growth. There is concern among anglers in Rice Lake that the weed growth may be so dense, that it is adversely affecting the fisheries. There is some evidence in fishery literature that supports this concern. However, this would need to be evaluated by a fisheries biologist.

[redacted]

It is the desire of the stakeholders to get this evaluation completed to determine if the concern is warranted. At some point in history, it was communicated to the Rice Lake Association that very high density aquatic plant cover could adversely affect fish foraging success. This is a concern of the Rice Lake Association and would like to have and evaluation done and have education provided about this issue.

Goal 4: Evaluate and preserve water quality in Rice Lake to limit increase in macrophyte density.

Objective 4.1-Evaluate the sources of phosphorus into Rice Lake that can contribute to higher density macrophyte growth.

There is concern over the sources of nutrients (phosphorus) into Rice Lake, especially potential loading from Bear Creek. This is largely due to the cranberry production taking place adjacent to Bear Creek. There is no history of evaluating phosphorus sources into Rice Lake. It is understood that reducing future phosphorus loading can help with reducing the density of aquatic macrophytes.

[redacted]

[redacted]

In order to complete this action, a monitoring program will be set up. This will entail collecting bi-weekly water samples from Bear Creek, in addition to 4 storm events, running from May to September. A simplistic method for estimating flow will be used to calculate loading from Bear Creek. In addition, 2 samples per month will be collected at the deep hole in the lake. The nutrient data from Echo Lake will be used to estimate the nutrients entering from the Turtle Creek. Then the Rice Lake watershed will be modeled to get an estimate for the Bear Creek (and other) contributions. Since the input of the cranberry production is not known to be into Bear Creek or Turtle Creek below the lake (or both), a delineation of the watershed around the lake is imparitive.

It is understood that excess nutrients can contribute to excessive macrophyte growth. By understanding the sources of nutrients, mitigation of nutrients will be more possible, which could reduce macrophyte density in the future.

Goal 5: Educate Rice Lake residents on the value of aquatic plants and the potential outcomes of an unbalanced environment.

Objective 5.1- Educate property owners about the importance of native aquatic plants and shoreline plants annually.

[redacted]

[redacted]

Objective 5.2- Provide education to property owners about the importance of native buffers in the riparian zone and the effects of fertilizer on increase in macrophyte density.

[redacted]

[10] Details for this action project would be worked out by a consultant that does/designs study.

Native plant buffers can reduce phosphorus immensely. Some literature cites reductions of up to 40%. Since Rice Lake has extensive macrophyte growth, leading to a need for reduction, mitigation of incoming nutrients could help. Since the runoff from lawns and development will run into the lake at the property owner's riparian, it could increase the macrophyte growth in that location, which is where it has the most impact on recreation use.

Implementation Plan

Actions	Timeline	Estimated cost	Hours from volunteers	Party to oversee / manage	Comments
A-critical habitat analysis	July 2012	$1500 (if done by consultant)	0	Consultant or WDNR	Could inquire to have DNR complete
B-Preserve critical habitat and sensitive plants Full Lake PI survey	Ongoing with plant density reduction 2016	None $3000	0	Consultant, WDNR, and Rice Lake Association Consultant	
C-Addition of CBCW trainees	By 2013 four more trained	None except travel to site	8 hours training per person	Aquatic Plant Lead/Rice Lake Association	Lead will try to recruit
D-Contact private boat landing owner about signs	Summer 2012	Signs estimated $200 or if DNR can provide	4 hours	Rice Lake Association/Plant lead	
E-On water CBCW education near landing	Summer 2012 and ongoing	In-kind only	8 hours each for 2 volunteers-4 key dates (64 hours)	CBCW Lead Volunteers	Will need CBCW training earlier in 2012.
F-Create volunteer monitoring crew, train and monitor lake for AIS	Summer 2012 and ongoing	In-kind $200 if hire consultant for training or if AIS Coordinator then none	2 hours training 2 hours every 2 weeks per volunteer to monitor	Plant Lead Possibly consultant	Contact AIS Cooridnator from Iron County about possible training for AIS monitoring
G-Create navigation corridors with mechanical harvest or chemical herbicide application	Summer 2012 and annually if thresholds met	$140/acre foot + $300 fee per application Harvester[11] $500 for evaluation	4 hours for monitoring	Plant lead Applicator Consultant	Consultant may be needed depending on DNR requirements
H-Evaluate navigation channel density and determine application needs	2013 and annually thereafter	None if volunteer $400 for consultant	4 hours	Plant lead and/or consultant	Volunteers must be trained and comfortable with

[11] Two mechanical harvesters for purchase (smaller versions) were estimated at $21,500 and $39,000.

					methods
Actions	**Timeline**	**Estimated cost**	**Hours from volunteers**	**Party to oversee/manage**	**Comments**
I-Assistance in evaluation of fisheries and aquatic plant density including a fish survey	2013-14	None (if DNR fisheries completes)	None	Rice Lake Association (will arrange or contact) and Wisconsin DNR	Contact fisheries staff-Lawrence Eslinger
J-Delineate watershed of Rice Lake including landuse.	2013-14	$800	Could land-truth some for accuracy (up to 8 hours)	Consultant	Apply for grant-possibly small scale
K-Evaluate phosphorus sources into Rice Lake, including Bear Creek and compare phosphorus source mitigation capabilities	2013-14	$3000 (estimated)	40 hours	Consultant	Apply for a small scale planning grant.
L,M and N-Education materials and speakers to education about lake ecology and aquatic plants	2012-2016	$1000 for newsletters and education materials	40 hours	Rice Lake Association Iron County Land and Water Dept.	Could be part of a grant such as AIS or Planning Grant

Table 9: Implementation plan.

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