Aquatic Plant Management Plan

Deer Lake

Polk County Wisconsin

March 2005

Sponsored by:

Deer Lake Conservancy / Deer Lake Association

In-Lake Subcommittee

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Introduction

This Aquatic Plant Management Plan for Deer Lake presents a coordinated strategy for preventing and managing aquatic plant problems. The plan reviews public input, reports existing conditions, discusses management alternatives, and recommends action items. The document is required for Department of Natural Resources permits for herbicide applications. The Deer Lake Association and lake residents will carry out plan action items and recommended actions.

Public Input for Plan Development

In-Lake Committee

A joint committee of the Deer Lake Association and the Deer Lake Conservancy guided the development of this plan and the studies and public input that support the plan. The committee consists of members from both organizations. Each organization has a role in management of aquatic plants in Deer Lake. The Deer Lake Conservancy focuses primarily on long-term management by working to control watershed sources of phosphorus and sediments. Phosphorus levels control density and amounts of algae in the lake and sediments provide nutrients that augment the substrate for rooted aquatic plants. The Deer Lake Association's role is to manage immediate lake concerns such as aquatic plant chemical applications.

Deer Lake Owners Survey

The In-Lake Committee conducted a survey of Deer Lake property owners in 2002. The survey was distributed to over 300 households on Deer Lake and had a response of about 200. The survey asked respondents to 'list in order of priority (1, 2, 3), which of the following are most important:'

- Weeds
- Swimmer's itch
- Algae
- Safety
- Screening of Shoreline & Appearance
- Other

The results, ranked* from greatest to least order of priority, are:

PRIORITY	1	2	3	4	5
Weeds	65	33	28	6	1
Algae	24	46	31	12	5
Swimmer's Itch	22	37	32	8	7
Safety	24	18	19	24	4
Shoreline	7	5	14	10	29

*Ranking order determined by the sum of the first three priorities

The 'other' comments are not reported here.

Weeds, algae and swimmer's itch received the top three priority rankings by half or more of the respondents.

Deer Lake Improvement Association - 2003 Annual Meeting

The Deer Lake Improvement Association annual meeting was held on July 19, 2003. At that meeting, members expressed concerns with:

- Aquatic plant management
- Curly leaf pondweed
- Copper sulfate treatment for filamentous algae control
- Swimmer's itch control
- Fish kills
- High water levels causing bank erosion and fallen trees

Lake Management Concerns

This aquatic plant management plan addresses the top two concerns of lake residents:

- Excessive Algae - Algae in the lake (planktonic) and filamentous algae (attached to rooted plants)

- Weeds – Curly leaf pondweed control, native plant protection, swimming areas, channels to open water and exotic plant prevention

Lake Information[1]

Deer Lake is an 812-acre lake located in Polk County, Wisconsin in the Towns of St. Croix Falls (S25, T34N, R18W) and Balsam Lake (S30 and S29, T34N, R17W). Its subwatersheds, primarily on the north side of the lake, total almost 5800 acres.

The Deer Lake Conservancy and Deer Lake Association together sponsored a comprehensive in-lake study and aquatic plant survey in 2003 with assistance from Department of Natural Resources planning grant funds. This aquatic plant management plan uses the results of these studies for background information and management recommendations.

The 2003 in-lake studies followed comprehensive implementation of watershed practices recommended in studies sponsored by the Deer Lake Association and supported by Department of Natural Resources planning grant funds in the early 1990's. The Deer Lake Conservancy implemented these watershed practices from 1997 through 2004 with the help of many partners including the Department of Natural Resources and the Polk County Land and Water Resources Department.

Water Quality Summary

The Deer Lake Improvement Association has participated in Wisconsin's Self-Help Lake Monitoring program since 1987 (Secchi disk) and the Expanded Self-Help Lake Monitoring (phosphorus and chlorophyll) since 1991. There are two self- help monitoring sites on Deer Lake: at the deepest location of both the East and West basins. Water quality in 2003, as indicated by phosphorus, chlorophyll and Secchi disk (summer averages), was the best measured in recent years (see Figures 2a-c). There is some indication Deer Lake water quality is improving in the last five years, providing evidence the reductions in watershed phosphorus inputs are having a positive impact.

Measurements of temperature and dissolved oxygen indicate the mid-summer thermocline depth fluctuates between 17 and 20 feet in both the East and West Basin of Deer Lake.

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[1] Much of this information is taken from previously prepared reports including: *Lake and Watershed Planning and Analysis. Deer Lake Management Plan.* Dick Osgood. February 2004.
Macrophyte Survey. Deer Lake, Polk County Wisconsin. Steve Schieffer and Robert Bursik. Summer 2003.

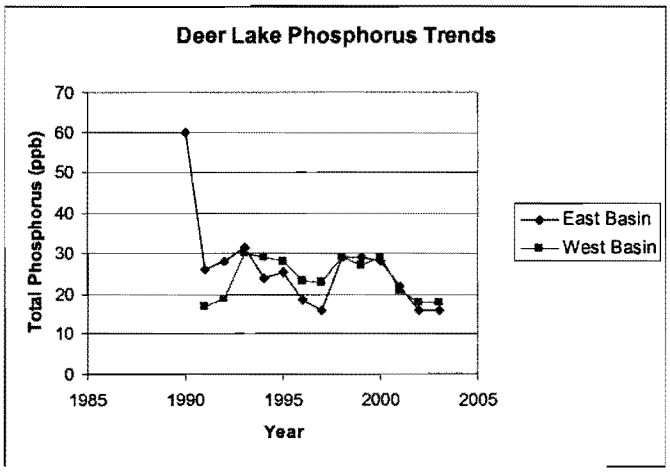


Figure 1. Deer Lake Phosphorus Trends

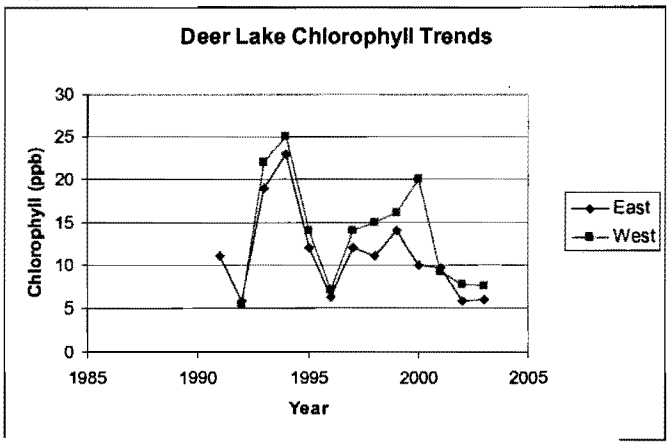


Figure 2. Deer Lake Chlorophyll Trends

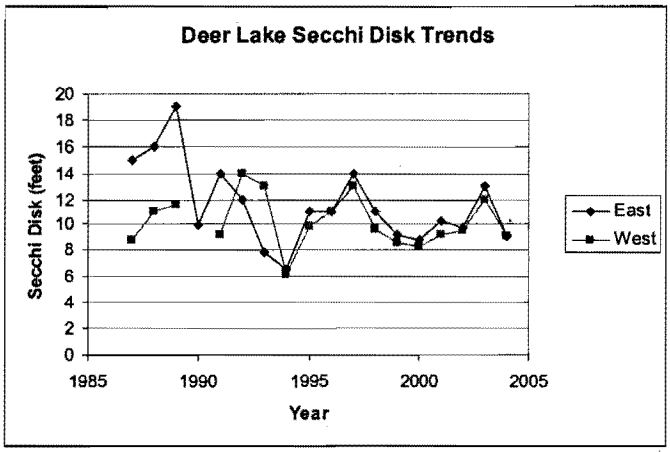


Figure 3. Deer Lake Secchi Disk Trends

Internal Phosphorus Inputs

Sediment samples were collected from six locations in Deer Lake on August 20, 2003 (Figure 1) to determine the magnitude of internal phosphorus loading to the lake's nutrient budget. For Deer Lake, the sediment release rate is estimated to be, is 6.4 mg P/ m^2/d. When this rate is applied to the anoxic sediments in Deer Lake, the internal phosphorus load is estimated to be 1,833 pounds annually.

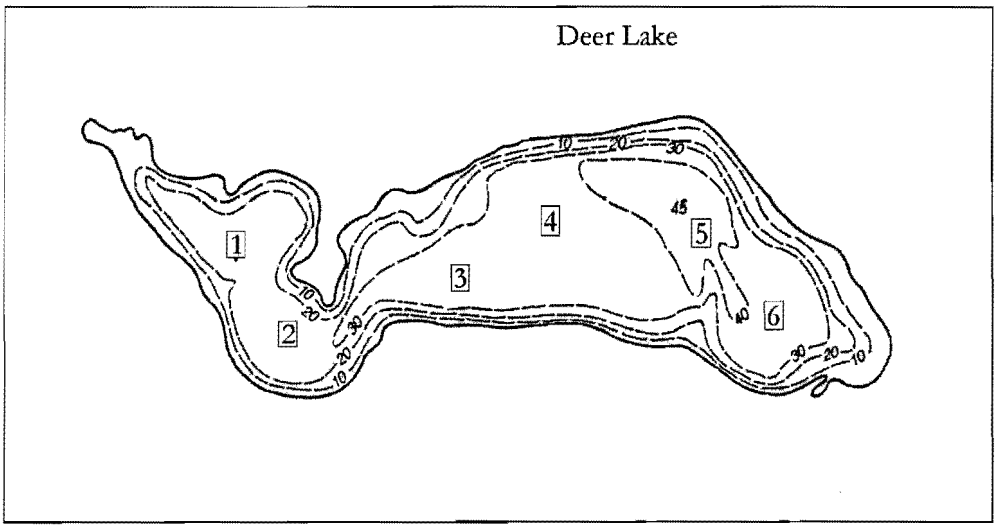


Figure 4. Deer Lake Sediment Sample Locations, August 20, 2003.

Watershed Description

The Deer Lake watershed, primarily on the north side of the lake, totals almost 5,800 acres. The watersheds are divided into seven subwatersheds for management purposes. Inflow is through intermittent drainages. The outflow is at the southeast corner of the lake through a small creek.

Land cover and conservation practices effectiveness were recently evaluated in a study by JEO Consulting Group (March 2003). The predominant land cover in 2000 in all Deer Lake Watersheds was cropland, followed by forestland and grassland. Forest cover with residential land use predominates in the watershed area closest to the lake. The phosphorus load from watershed runoff is estimated to be 2,996 pounds annually.

The JEO analysis found a 51 percent reduction in watershed phosphorus loading (or 28 percent total loading) to the lake from 1996 to 2000. The reductions resulted from changing land cover and installation of conservation practices.

The Deer Lake Conservancy is continuing to work on implementation of watershed practices to reach an ambitious goal of 36 percent total phosphorus loading to the lake.

Planned projects include wetland restoration following final acquisition of the Flagstad Farm property in watershed 6 and treatment of or reduction of agricultural runoff to a pond that flows to the lake from watershed 1.

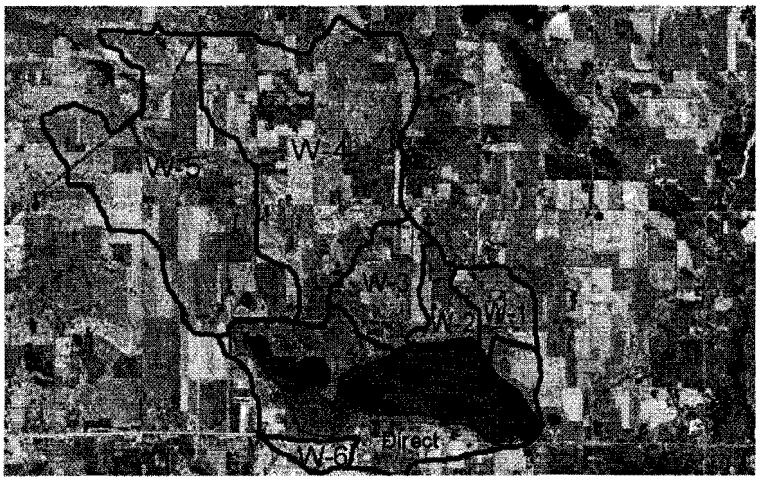


Figure 5. Deer Lake Watersheds

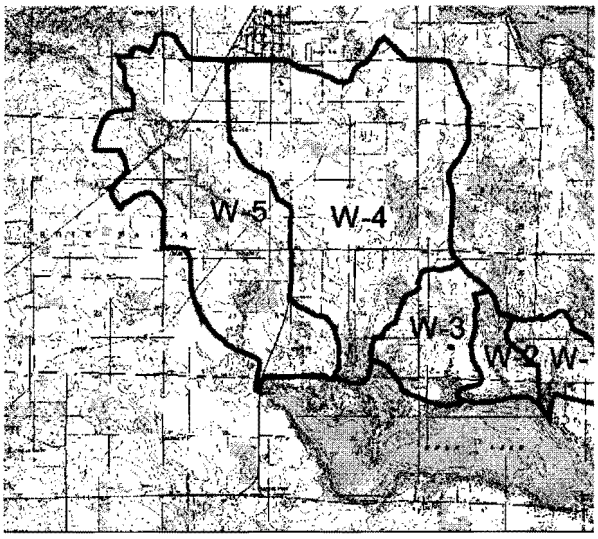


Figure 6. Deer Lake North Watersheds on Topographic Map

Intensity of Water Use

Primary human use areas

The shoreline of Deer Lake is largely developed for residential use with 330 residences many with large homes constructed for year-round use. A public boat landing owned by the Town of St. Croix Falls is located at the northwest corner of the lake. A private boat launch is located at the southeast corner of the lake near the outlet. There is a swimming beach owned by a private church camp at the northeast corner of the lake near the outlet of watershed 1. Lake residents use focuses around their docks placed in the relatively shallow, littoral zone of the lake.

Habitat areas for fish, waterfowl and other wildlife

The littoral, or plant supporting, zone of the lake provides critical habitat for fish, waterfowl and other wildlife. It is found in a narrow band around Deer Lake at depths up to about 20 feet.

The DNR sensitive area study (1992) identified three areas that merit special protection of aquatic habitat. In the same report, they describe all of Deer Lake as unique. "Areas of aquatic vegetation provide the necessary seasonal or life stage requirements of the associated fisheries, and the aquatic vegetation offers water quality or erosion control benefits to the body of water." In the designated sensitive areas, aquatic vegetation removal is limited to navigational channels no greater than 25 feet wide. Chemical treatments are discouraged and if navigational channels must be cleared, pulling by hand is preferable.

Resource Value of Site A

Sensitive area A is located at the northwestern end of Deer Lake and includes the public boat launch. This area encompasses approximately 2,500 feet of shoreline. The area provide important habitat for centrarchid (bass and panfish) and esocid (northern pike and muskellunge) spawning and nursery areas. This area also provides important habitat for forage species. Wildlife also are reliant upon this area for habitat. Eagles, loons, herons, waterfowl, songbirds, furbearers, turtles, and amphibians benefit from this valuable habitat.

Resource Value of Site B

Sensitive area B is located adjacent to Area A, extending along the western shoreline of Deer Lake. This area encompasses approximately 1,200 feet of shoreline.

The habitat values mentioned mirror those described for site A above.

Resource Value of Site C

Sensitive area C encompasses a small bay at the northwestern corner of Deer Lake. This bay comprises the entrance of Rock Creek. Approximately 600 feet of shoreline are located in this sensitive area.

The habitat values mentioned mirror those described for site A above.

Rare, endangered or protected species habitat

The east half of Deer Lake is in Sections 25 and 34 of the Town of St. Croix Falls. The west half is located in Sections 29 and 30 in the Town of Balsam Lake. Rare species are noted in the Town of St. Croix Falls (T34N, R18W) and in the Town of Balsam Lake (T34N, R17W). Records are provided to the public by Town rather than section, so there is no indication if the incidences of these species occur in and immediately surrounding Deer Lake.

Species listed in the Town of St. Croix Falls:

Red Shouldered Hawk	*Buteo lineatus*	Threatened
Lake Sturgeon	*Acipenser fulvescens*	Special Concern
Blue Sucker	*Cycleptus elongates*	Threatened
Western Sand Darter	*Etheostoma clarum*	Special Concern
Banded Killifish	*Fundulus diaphanous*	Special Concern
River Redhorse	*Moxostoma carinatum*	Threatened

Species listed in the Town of Balsam Lake:

Bald Eagle	*Haliaeetus leucocephalus*	Special Concern
Osprey	*Pandion haliaetus*	Threatened
Banded Killifish	*Fundulus diaphanous*	Special Concern

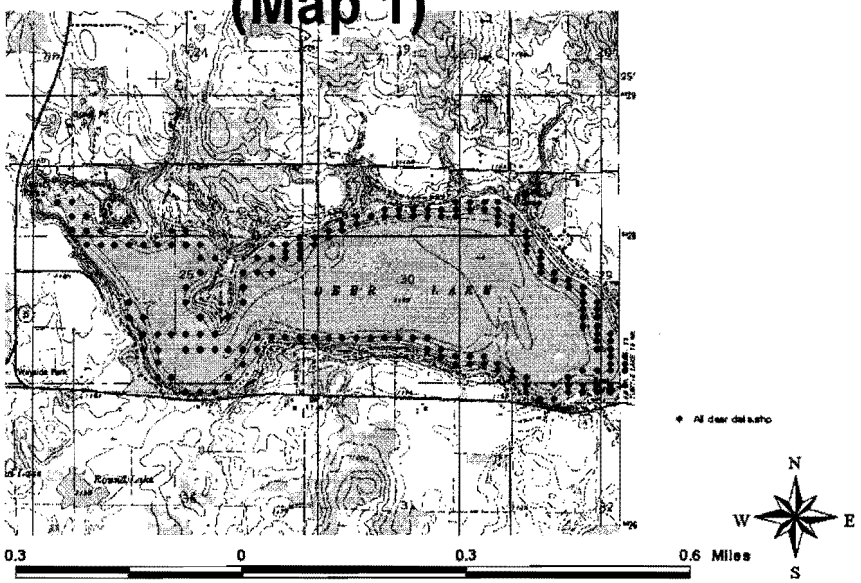
Plant Community

Aquatic species in Deer Lake were characterized with a baseline survey in June and August 2003. The survey used the point intercept method for macrophyte sampling. Methods and results are described in Appendix A. Map 1 illustrates the 192 sampling points located in the survey with a Global Positioning System (GPS).

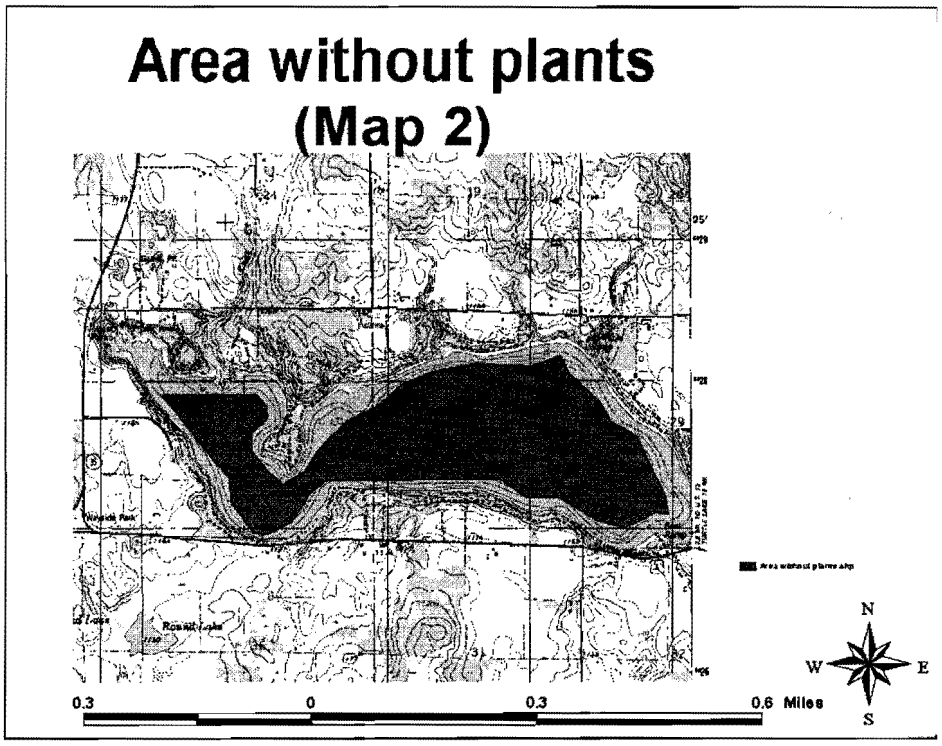
Aquatic Plant Survey Results

The survey found that Deer Lake has a healthy, diverse native plant community found in a narrow zone along the water's edge. One invasive aquatic species, curly leaf pondweed (*Potamageton crispus*) was found. Eurasian watermilfoil, an invasive, nonnative species of concern, was not located in this survey or any previous surveys of Deer Lake.

Sampling Points Plot (Map 1)



Deer Lake has an abundance of high quality aquatic vegetation in its littoral regions. Forty-one percent of Deer Lake is littoral, with a water depth that allows the growth of rooted aquatic vascular plants. The littoral zone is found as a continuous band around the margin of the lake. This zone extends toward the center of the lake in water greater than six meters deep in some areas, another indication of high water quality and an overall healthy ecosystem. Map 2 shows the portions of the lake that are too deep to support rooted aquatic plant growth.



June 2003 sampling results

Seventeen vascular plant species and two categories of algae (filamentous algae and *Chara* sp.) were recorded during the mid-June survey (Table 1). White-stem pondweed (*Potamogeton praelongus*) and coontail *(Ceratophyllum demersum*) were the most frequently found species (46%). Northern milfoil (*Myriophyllum sibericum*), curly leaf pondweed (*Potamogeton crispus*), flat-stemmed pondweed (*Potamogeton zosteriformis*) and water celery (*Vallisneria americana*) also had high frequencies. *Potamogeton* (the pondweeds) was the most diverse vascular plant group by far, containing nearly half of the aquatic vascular plant flora found in Deer Lake (eight species). Curly leaf pondweed was the only non-native species documented in Deer Lake during this study (there was no Eurasian watermilfoil found).

August 2003 sampling results

Nineteen species were found during the mid-August sampling, including 15 vascular species documented during the mid-June sampling as well as the filamentous algae and *Chara* sp. (Table 2). No diverse-leaf pondweed (*Potamogeton diversifolius*) or sago pondweed (*Potamogeton pectinatus*), which were found in June, were found during the mid-August survey. Two species, wild rice (*Zizania palustris*) and greater duckweed (*Spirodela polyrhiza*) were found in mid-August but not during mid-June sampling. The increase in frequencies of coontail, flat-stemmed pondweed, and water celery are notable from mid-June to mid-August while there was a profound decrease in frequency of curly leaf pondweed from 28% to 1%. This decrease is expected, as this plant dies back in late-June.

Table 1. Species found during mid-June sampling and the frequency of each species.

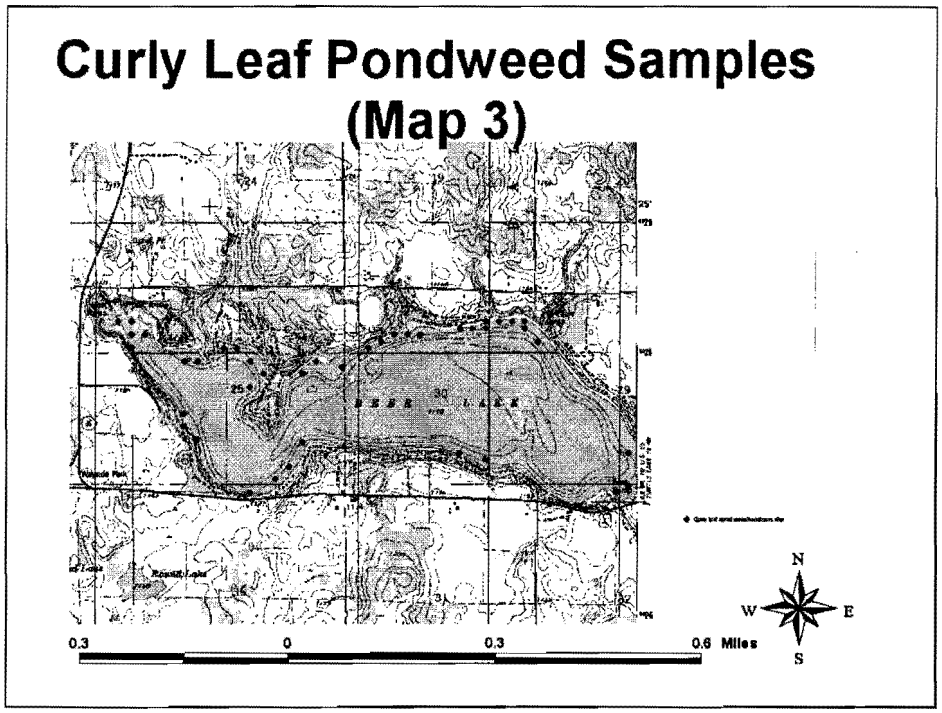
Species	Number of points sampled	Frequency[2]
1. *Potamageton praelongus*	67	0.46 or 46%
2. *Potamageton amphlifolius*	17	0.12 or 12%
3. *Potamageton crispus**	41	0.28 or 28%
4. *Myriophyllum sibiricum*	45	0.31 or 31%
5. *Potamageton zosteriformis*	56	0.39 or 39%
6. *Vallisneria americana*	54	0.37 or 37%
7. Filamentous algae	96	0.66 or 66%
8. *Ceratophyllum demersum*	16	0.11 or 11%
10. *Potamageton robbinsii*	10	0.07 or 7%
11. *Potamageton diversifolius*	8	0.055 or 5.5%
12. *Nymphaea odorata*	1	0.006 or 0.6%
13. *Potamageton pectinatus*	2	0.013 or 1.3%
14. *Chara spp.*	5	0.034 or 3.4%
15. *Potamageton pusillus*	4	0.028 or 2.8%
16. *Najas flexilis*	5	0.034 or 3.4%
17. *Bidens beckii*	2	0.013 or 1.3%
18. *Wolfia columbiana*	1	0.006 or 0.6%
19. *Lemna minor*	1	0.006 or 0.6%

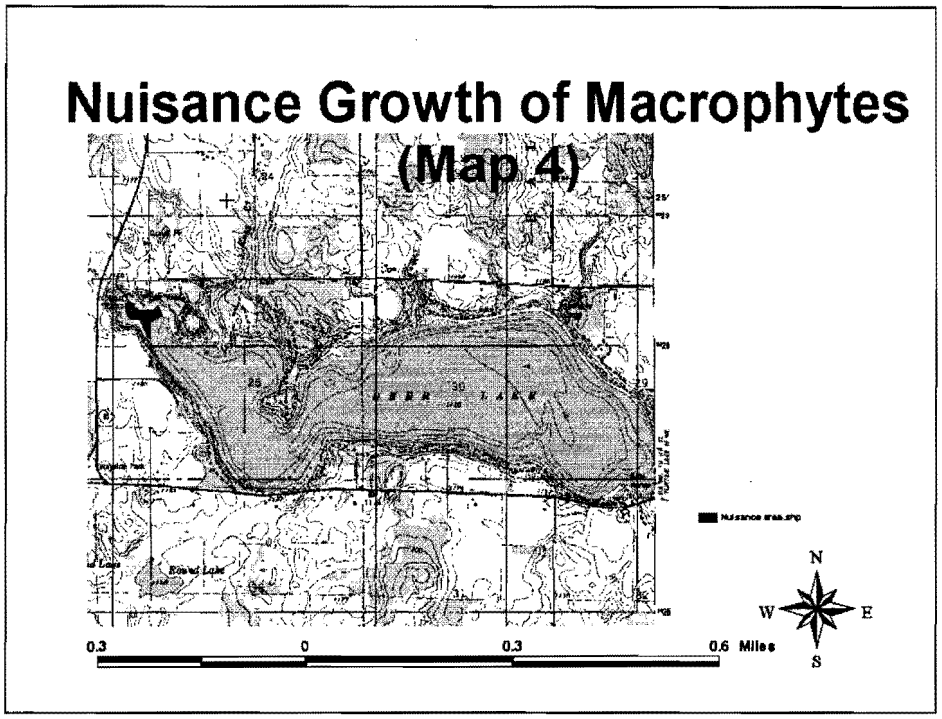
[2] Frequency of each species equals number of samples that the species was found in / total number of samples that contained aquatic plants (146 samples contained aquatic plants in the mid-June survey).

Nuisance stands of aquatic plants

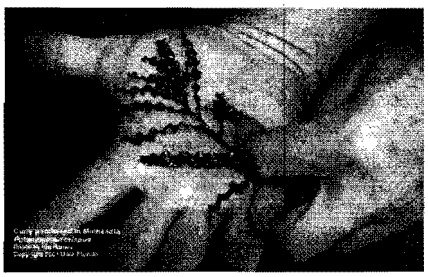
Few portions of the littoral zone of Deer Lake have what the plant surveyors deemed nuisance stands of aquatic plants. The exceptions are areas supporting curly leaf pondweed (Map 3) and the extremely dense stands of aquatic vegetation on the western end of the lake near the public boat landing (Map 4). During the early survey in June and the late survey in August this bay had nuisance plant growth thick enough to hinder boat use, swimming, and fishing.

Some of the curly leaf pondweed stands, particularly on the north side of the lake were dense enough and extensive enough to be a concern, particularly if they continue to spread. These stands are thick enough to hinder recreational use. Further displacement of native aquatic species with curly leaf pondweed will also degrade fisheries habitat and the overall health of the lake. It is important to note that the curly pondweed does die back in the summer, and these stands eventually had only native plants that were not at nuisance levels (based on our mid-August sampling).





Invasive Species of Concern



Curly leaf pondweed (*Potamogeton crispus*)[3]

Identification:

Curly leaf pondweed is an invasive aquatic species found in a variety of aquatic habitats, including permanently flooded ditches and pools, rivers, ponds, inland lakes, and even the Great Lakes. Curly leaf pondweed prefers alkaline or high nutrient waters 1 to 3 meters deep. Its leaves are strap-shaped with rounded tips and undulating and finely toothed edges. Leaves are not modified for floating, and are generally alternate on the stem. Stems are somewhat flattened and grow to as long as 2 meters. The stems are dark reddish-green to reddish-brown, with the midvein typically tinged with red. Curly leaf pondweed is native to Eurasia, Africa and Australia and is now spread throughout most of the United States and southern Canada.

Characteristics:

New plants typically establish in the fall from freed turions (branch tips). The winter form is short, with narrow, flat, relatively limp, bluish-green leaves. This winter form can grow

[3] Information from GLIFWC Plant Information Center (http://www.glifwc.org/epicenter)

beneath the ice and is highly shade-tolerant. Rapid growth begins with warming water temperatures in early spring – well ahead of native aquatic plants.

Reproduction and dispersal:
Curly leaf pondweed reproduces primarily vegetatively. Numerous turions are produced in the spring. These turions consist of modified, hardened, thorny leaf bases interspersed with a few to several dormant buds. The turions are typically 1.0 – 1.7 cm long and 0.8 to 1.4 cm in diameter. Turions separate from the plant by midsummer, and may be carried in the water column supported by several leaves. Humans and waterfowl may also disperse turions. Stimulated by cooler water temperatures, they germinate in the fall, over-wintering as a small plant. The next summer they mature, producing reproductive tips of their own. Curly leaf pondweed rarely produces flowers.

Ecological impacts:
Rapid early season growth may form large, dense patches at the surface. This canopy overtops most native aquatic plants, shading them and significantly slowing their growth. The canopy lowers water temperature and restricts absorption of atmospheric oxygen into the water. The dense canopy formed often interferes with recreational activities such as swimming and boating.

In late spring, pondweed dies back, releasing nutrients that may lead to algae blooms. Resulting high oxygen demand caused by decaying vegetation can adversely affect fish populations. The foliage of curly pondweed is relatively high in alkaloid compounds possibly making it unpalatable to insects and other herbivores.

Curly leaf pondweed control:
Small populations of curly leaf pondweed in otherwise un-infested water bodies should be attacked aggressively. Hand-pulling, suction dredging, or spot treatments with contact herbicides are recommended. Cutting should be avoided because fragmentation of plants may encourage their re-establishment. In all cases, care should be taken to remove all roots and plant fragments, to keep them from re-establishing.

Control of large populations (such as those found in Deer Lake) requires a long-term commitment that may not be successful. A prudent strategy includes a multi-year effort aimed at killing the plant before it produces turions, thereby depleting the seed back over time. It is also important to maintain, and perhaps augment, native populations to retard the spread of curly leaf and other invasive plants. Invasive plants will aggressively infest disturbed areas of the lake, such as those where native plant nuisances have been controlled through chemical applications.

A variety of methods may be considered for control of nuisance populations of curly leaf pondweed including manual control, chemical control, cultural control and biological control. These methods are described in the management section on following pages.

The Army Corps of Engineers Aquatic Plant Information System (APIS) identifies three herbicides for control of curly leaf pondweed: Diquat, Endothall, and Fluridone. Fluridone requires exposure of 30 to 60 days making it infeasible to target a discreet area in a lake system. The other herbicides act more rapidly. Herbicide labels provide water use restriction

following treatment. Diquat (Reward) has the following use restrictions: drinking water 1-3 days, swimming and fish consumption 0 days. Endothall (Aquathol K) has the following use restrictions: drinking water 7 – 25 days, swimming 0 days, fish consumption 3 days.

Dick Osgood's 2004 Lake Management report recommends:

> *The Deer Lake Association coordinate the aquatic plant nuisance control activities of its members to emphasize as much control effort as possible on curlyleaf pondweed and minimize control of native plants. Further, I recommend that control activities for curlyleaf pondweed occur early in the season (in May) to take advantage curlyleaf pondweed's life cycle and the fact that turions (seeds) are not yet produced. Because native plants begin growing later, there will be a tradeoff (less control of native plant nuisances) when emphasizing curlyleaf pondweed control.*

Early season herbicide treatment:[4]

Studies have demonstrated that curly leaf can be controlled with Aquathol K (a formulation of Endothall) in 55 - 60 degree F water, and that treatments of curly leaf this early in its life cycle can prevent turion formation. Staff from the Minnesota Department of Natural Resources and the U.S Army Engineer Research and Development Center are conducting further trials of this method. Balsam Lake (Polk County, Wisconsin) treated two sites totaling 13 acres in early June of 2004, and will follow up with ongoing treatment and monitoring of the effectiveness of this method.

[4] Research in Minnesota on Control of Curly Leaf Pondweed. Minnesota Wendy Crowell, Minnesota Department of Natural Resources. Spring 2002.

Eurasian watermilfoil[5]

Identification

Eurasian watermilfoil is a submersed aquatic plant native to Europe, Asia, and northern Africa. It is the only non-native milfoil in Wisconsin. Like the native milfoils, the Eurasian variety has slender stems whorled by submersed feathery leaves and tiny flowers produced above the water surface. The flowers are located in the axils of the floral bracts, and are either four-petaled or without petals. The leaves are threadlike, typically uniform in diameter, and aggregated into a submersed terminal spike. The stem thickens below the inflorescence and doubles its width further down, often curving to lie parallel with the water surface. The fruits are four-jointed nut-like bodies. Without flowers or fruits, Eurasian watermilfoil is nearly impossible to distinguish from Northern water milfoil. Eurasian watermilfoil has 9-21 pairs of leaflets per leaf, while Northern milfoil typically has 7-11 pairs of leaflets. Coontail is often mistaken for the milfoils, but does not have individual leaflets.

Characteristics

Eurasian watermilfoil grows best in fertile, fine-textured, inorganic sediments. In less productive lakes, it is restricted to areas of nutrient-rich sediments. It has a history of becoming dominant in eutrophic, nutrient-rich lakes, although this pattern is not universal. It is an opportunitistic species that prefers highly disturbed lakebeds, lakes receiving nitrogen and phosphorous-laden, and heavily used lakes. Optimal growth occurs in alkaline systems with a high concentration of dissolved inorganic carbon. High water temperatures promote multiple periods of flowering and fragmentation.

Reproduction and dispersal:

Unlike many other plants, Eurasian watermilfoil does not rely on seed for reproduction. It seeds germinate poorly under natural conditions. It reproduces vegetatively by fragmentation, allowing it to disperse over long distances. The plant produces fragments after fruiting once or twice during the summer. These shoots may then be carried downstream by water currents or inadvertently picked up by boaters. Milfoil is readily dispersed by boats, motors, trailers, bilges, live wells, or bait buckets, and can stay alive for weeks if kept moist.

Once established in an aquatic community, milfoil reproduces from shoot fragments and stolons (runners that creep along the lake bed). As an opportunistic species, Eurasian watermilfoil is adapted for rapid growth early in spring.

Ecological impacts:

Eurasian watermilfoil's ability to spread rapidly by fragmentation and effectively block out sunlight needed for native plant growth often results in monotypic stands. Monotypic stands

[5] Wisconsin DNR Invasive Species Factsheets from www.dnr.state.wi.us.

of Eurasian milfoil provide only a single habitat, and threaten the integrity of aquatic communities in a number of ways; for example, dense stands disrupt predator-prey relationships by fencing out larger fish, and reducing the number of nutrient-rich native plants available for waterfowl.

Dense stands of Eurasian watermilfoil also inhibit recreational uses like swimming, boating, and fishing. Some stands have been dense enough to obstruct industrial and power generation water intakes. The visual impact that greets the lake user on milfoil-dominated lakes is the flat yellow-green of matted vegetation, often prompting the perception that the lake is "infested" or "dead". Cycling of nutrients from sediments to the water column by Eurasian watermilfoil may lead to deteriorating water quality and algae blooms of infested lakes.

Control methods:

Preventing a Eurasian watermilfoil invasion requires various efforts. The first component is public awareness of the necessity to remove weed fragments at boat landings. Inspection programs should provide physical inspections as well as a direct educational message. Native plant beds must be protected from disturbance caused by boaters and indiscriminate plant control that disturbs these beds. The watershed management program will keep nutrients from reaching the lake and reduce the likelihood that Eurasian milfoil colonies will establish and spread.

Monitoring is also important, so that introduced plants can be controlled immediately. The lake association and lakeshore owners should check for new colonies and control them before they spread. The plants can be hand pulled or raked. It is imperative that all fragments be removed from the water and the shore.

If Eurasian watermilfoil is introduced, additional control methods should be considered including mechanical control, chemical control, and biological control. As always, prevention is the best approach to invasive species management.

Because Eurasian watermilfoil is found in nearby lakes, it is prudent to provide a contingency plan to be best prepared to control milfoil, should it be found in the lake. A contingency plan should include a systematic monitoring program and a fund to provide timely treatments.

Goals for Aquatic Plant Management

1) Protect and restore healthy native aquatic plant communities.

2) Prevent the introduction of Eurasian watermilfoil and other invasive, exotic aquatic species.

3) Reduce filamentous algae density.

4) Control curly leaf pondweed and other introduced aquatic invasive plants.

5) Reduce levels of nuisance aquatic plants to allow safe, enjoyable recreation such as swimming and boating.

Protection of Native Plant Communities

Deer Lake supports healthy and diverse plant communities that are well-above average when compared to other lakes within the North Central Hardwoods Ecoregion of Wisconsin. However, the littoral zone, which supports all of the aquatic vegetation occurs in a relatively narrow band around the margins (covering 41% of the lake area total). If a waterfront property owner sprays even a narrow region in front of their property, it could have very significant negative effects on healthy, desirable native stands of plants. Herbicide use can result in removal of the native aquatic plants that are responsible for the lake's high water quality and excellent fisheries habitat, while potentially hastening the spread of undesirable non-native plants such as curly pondweed or even Eurasian watermilfoil (if introduced). In selecting management options, care must be taken to protect native plant communities.

Discussion of Management Options

Techniques to control the growth and distribution of aquatic plants are discussed below. In most cases, a combination of techniques must be used to reach plan goals. The application, location, timing and combination of techniques must be considered carefully.

Watershed conservation practices

The ultimate goal of watershed conservation practices is the reduction of total annual phosphorus loading by 36% from when watershed studies were conducted in the early 1990's. This reduction is projected to bring summer in-lake phosphorus concentrations to 20 ppb. This level of phosphorus concentration will result in increased water clarity through a decrease in suspended and potentially filamentous algae growth.

Alum treatment

The 2004 Lake Management Report recommends an alum treatment to control release of phosphorus from bottom sediments. This treatment is projected to reduce summer

phosphorus concentrations to 18 ppb without additional watershed practices and to 14 ppb with planned watershed practices. Either level will significantly increase water clarity and aid in achieving plan goals by reducing suspended and filamentous algae growth in Deer Lake. The In-Lake Committee has not recommended proceeding with this alum treatment.

Biological control

Generally, development of biological control technology has been based largely on the premise that, because the target invasive plants have been brought to a new habitat without their accompanying herbivores and pathogens, the best approach to manage these species is to find their native pests and introduce them from their native land. While this theory has worked in application for control of some nonnative aquatic plants (alligatorweed and, possibly, purple loosestrife), results have been varied (Madsen, 2000). As well, it is unsound policy to introduce a new non-native species, even if it is to control another. Biological control is not proposed for management of aquatic plants in Deer Lake.

Revegetation with native plants

Another aspect to biological control is native plant restoration. The reationale for revegetation 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 nonnative species, a propagule bank probably exists that will restore the community after nonnative plants have been controlled (Madsen, Getsinger, and Turner, 1994).

The authors of the aquatic plant survey recommend revegetating areas treated with herbicide to remove curly leaf pondweed.

> *It is our suggestion that [early season crispus herbicide treatments] also be coupled with revegetation with warm water active species such as coontail to prevent its immediate return in treated areas. In other words, take advantage of [curly leaf pondweed's] tendency to die back in the summer by establishing fast-growing species there after it has been killed.*

We do not recommend the particular plant species for revegetating Deer Lake at this time. Coontail is often considered a nuisance, so we do not recommend that plant for revegetation. Other native plants, while slower growing, are less likely to become established as a nuisance. Finally, intentional revegetation of native plants is not a well-established practice at this time. The expectation is that there will be an adequate seed bank and/or drift of native plant propagules to reestablish native aquatic plants once curly leaf pondweed is reduced.

Plan recommendation
Monitor natural re-growth of native vegetation following early season curly leaf treatment before attempting to revegetate with native plants. Revegetation could be instituted if native plants do not establish themselves in treatment areas.

Physical control

In physical management, the environment of the plants is manipulated, which in turn acts upon the plants. Several physical techniques are commonly used: dredging, drawdown, benthic (lake bottom) barriers, shading or light attenuation, and nutrient inactivation. Physical control is not currently proposed for management of aquatic plants in Deer Lake.

Comment [MSOffice1]: I have sometimes recommended bottom barriers in cases where small scale control is appropriate. Usually, the control area will be much smaller that what would be allowed using herbicides.

Mechanical control

Mechanical management methods have been widespread in attempts to control aquatic plants. The most common form of mechanical control is actually the use of hand cutters, rakes, or bare hands (no tools) to remove vegetation

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 may be required.

Because large-scale mechanical control tends to be nonselective, we do not recommend this method.

Herbicide and algaecide treatments

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) and have manufacturers committed to the aquatic market (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.

Aquatic Engineering Aquatic Plant Management Activities (2003)

A second aquatic plant evaluation is also available for Deer Lake in 2003[6]. Aquatic Engineering, Inc. conducted inspections, performed treatments and prepared an aquatic plant management program on behalf of the Deer Lake Improvement Association.

2003 Aquatic Plant Inspections

Inspections for Eurasian watermilfoil near the lake's two boat launches were conducted on June 5, July 8, August 4 & 29 and September 30. No Eurasian watermilfoil was found in Deer Lake. The entire littoral zone was inspected for filamentous algae on June 18 & 30, July 1, 8, 21 & 28, August 4, 12, 22 & 26 and September 23. Filamentous algae was noted and treated (see below).

2003 Herbicide Treatments

a. Treatments for Eurasian watermilfoil prevention

June 5 - mixture of Cutrine Plus, Reward & Aquathol K to 2 - 50x100' areas near launches
July 8 - Reward to 2 - 50x100' areas near launches

b. Treatments for filamentous algae (using copper sulfate and Cutrine Plus)

June 18	7.0 acres
July 1	12.4 acres
July 8	6.0 acres
July 21	10.5 acres
August 22	5.5 acres
August 26	6.9 acres

There was no indication whether the treatments areas overlapped from date-to-date.

2003 Aquatic Plant Management Program

The report lists two management objectives:

1. Prevent a Eurasian watermilfoil infestation in Deer Lake using aquatic herbicide treatments near boat launches.

2. Maintain recreational and aesthetic values of Deer Lake using aquatic herbicide treatments to alleviate the impacts of nuisance algae blooms.

[6] 2003 Deer Lake Aquatic Plant Management Technical Report. Aquatic Engineering, Inc. November 17, 2003.

The Aquatic Engineering report stated the Eurasian watermilfoil prevention program successfully prevented the establishment in 2003, although there is not evidence that milfoil was introduced into the lake in the first place. The report also noted the frequent filamentous algae treatments were necessary to control nuisances in the near-term and that reducing lake phosphorus will control these nuisances in the long-term. The report also discussed concerns with curly leaf pondweed and recommended early season herbicide treatments for a period of 3-5 years.

Educational and Information Plan

Aquatic Plant Management Plan Outreach

Plan Action Item
Deer Lake residents will be aware of this aquatic plant management plan and its recommendations through newsletter articles and handouts and presentations at annual meetings.

Aquatic Plant Habitat and Ecosystem Values.

The management challenge for Deer Lake will be to control the aquatic plant nuisances without unduly damaging the native plants and their attendant benefits in the lake. For this to occur, residents must understand the values of aquatic plants in Deer Lake. There seems to be a perception, evidenced by the property owners survey that "all weeds are bad." An important educational message will be communicating the distinction between "good plants" and "bad plants." Some plants are good: in fact, a diverse native plant community is essential for a healthy lake ecosystem. Others are bad: invasive species displace native plants and their benefits.

Another important message will be to discourage boating disturbance within 200 feet of the shoreline. Although this is a no-wake zone according to state regulation, many boaters still travel close to the shoreline. This activity is strongly discouraged for the following reasons:

- Boats may uproot native plants and break aquatic plants into fragments
- Bare substrate is more likely to be colonized by non-native species
- Plant fragments contribute phosphorus to the water as they decay
- Curly leaf pondweed fragments broken up by boat propellers may root and encourage uncontrolled spread of this invasive plant.

Plan Action Item
Provide residents with written materials and present information regarding aquatic plant values at annual meetings.

Eurasian Watermilfoil Prevention

There is a high risk that Eurasian watermilfoil and other aquatic invasive species may become established in Deer Lake. A public boat landing owned by the Town of St. Croix Falls is located at the northwest corner of the lake. Deer Lake is a popular lake for muskellunge fishing. Many fisherman travel from the Twin Cities, Minnesota metropolitan area, and access the lake at this boat landing. With Eurasian watermilfoil present in many urban Twin Cities lakes, such as White Bear Lake and Lake Minnetonka, the danger of transporting plant fragments on boats and motors is very real. The lake is also situated on a major highway, providing easy access to the Twin Cities. According to the Minnesota Sea Grant Office:

> *Eurasian watermilfoil can form dense mats of vegetation and crowd out native aquatic plants, clog boat propellers and make water recreation difficult. Eurasian watermilfoil has spread to over 150 lakes [in Minnesota], primarily in the Twin Cities area.*

Department of Natural Resource scientists have also found Eurasian watermilfoil in the nearby counties of Burnett (Ham Lake and Round Lake) Washburn (Nancy Lake and the Minong Flowage), Barron (Beaver Dam, Sand, Kidney, Shallow, Duck, and Echo Lakes) and Polk (Long Trade) in Wisconsin.

Although the threat of invasion by exotic species is present, a coordinated prevention effort on Deer Lake has not occurred. Lakeshore resident education and access inspections will reduce the risk of an unwanted invasive species introduction to Deer Lake. There are many educational materials available from public sources. Eurasian watermilfoil prevention signs are already posted at the public boat landing.

Plan Action Item
Gather and assemble public information materials about Eurasian watermilfoil prevention for distribution to Deer Lake residents. Residents will be provided with written materials and presented with information at annual meetings.

Plan Action Item
Develop an access inspection program to 1) educate boaters entering Deer Lake, 2) provide a voluntary inspection and 3) allow for boat and trailer cleaning when contamination is observed or suspected.

Plan Action Item
A Eurasian watermilfoil monitoring program will continue for detection and rapid response if an invasion is discovered.

Curly Leaf Pondweed Awareness

Resident understanding of the distinction between curly leaf pondweed and aquatic native plants is critical. With a better understanding of curly leaf pondweed's growth characteristics and negative impacts to the lake, residents may be encouraged to change their purpose from removing all aquatic plants (weeds) to a desire to control the invasive curly leaf pondweed. Poorly informed lake residents may chose wholesale control of "weeds" if unable to distinguish between aquatic plant nuisances of invasive plants from the relative values of native aquatic plants. Better understanding and promotion of reasons for controlling curly leaf pondweed may reduce the desire for complete plant removal in navigation corridors.

Plan Action Item

The Deer Lake Association will provide residents with the information needed to accurately identify curly leaf pondweed. Residents will be encouraged to spray curly leaf pondweed selectively early in the season as an alternative to spraying later in the summer. Residents will be encouraged to hand-pull small stands adjacent to their property. The importance of positive identification and removal of plant fragments will be emphasized. The need to notify the Deer Lake Association so that their site may be monitored will also be communicated.

Site-specific Management / Aquatic Invasive Species Control

Littoral Zone Management

Curly pondweed is a concern in Deer Lake. While it has not yet spread throughout the lake, densities of some of the existing stands, particularly along the north shore, are of immediate concern. If left unchecked, this plant could overtake desirable native plant communities in the lake and potentially lead to water quality problems.

DNR disputes above statement, suggesting that clp location is related to sediment characteristics and that there is no evidence that clp will overtake native plant communities.

Guidance for spraying adjacent to private residences

Curly leaf pondweed reaches nuisance levels restricting navigation from some individual lakeshore property docks. Sites with curly leaf pondweed occurrence in 2003 are noted on Map 3. It is important that residents are aware of the risks of complete clearing of access corridors. Native aquatic plants provide critical habitat for fish and other aquatic creatures. Corridors cleared of native plants may provide sites for colonization by invasive, non-native species.

Guidance for Deer Lake Property Owners

1. General herbicide spraying of nuisance aquatic plants for boat access and swimming is discouraged because of potential damage to this critical habitat zone.
2. DNR currently restricts control activity in the littoral zone (area where plants grow) adjacent to private residences to a width of no more than 25 feet.
3. Residents wishing to control curly leaf with hand pulling may do so throughout their shoreline area, but must be confident of plant identification and remove all plant fragments.
4. Residents with nuisance levels of curly leaf pondweed (prevalent in June) are encouraged to treat corridor access in the early season to coordinate with whole lake nuisance curly leaf control.
5. Residents who treat or pull curly leaf pondweed should notify the Deer Lake Association by April 1 of the treatment year, so that pre and post treatment monitoring may be coordinated.(An annual mailing from the lake association will remind residents of the desired control methods and request notification.)
6. These access corridors will be monitored for re-growth of curly leaf according to the monitoring plan for the boat landing area.
7. Nuisance aquatic plant growth in July and August should be controlled in the access corridors using manual means such as plant rakes. Plant fragments should be removed from the lake and placed on an upland area such as a garden or compost pile.

Curly Leaf Pondweed Nuisance Control

Plan action item
Control curly leaf pondweed, with early season Endothall treatments in areas where nuisance levels are reached, including the public boat landing, along the north shore, and in individual access corridors. Annual treatments are planned, and the treatment areas will be modified using information from detailed plant inventories.

The actual size of the treatment area will be refined following an early May pretreatment survey. The objectives of the treatment are to 1) reduce the density of curly leaf pondweed below nuisance levels (reach low to moderate density) and 2) to facilitate the growth of native species. If curly leaf pondweed control is successful, native species will be managed only to control growth that impedes navigation.

The treatment will occur when water temperatures are between 50 and 60 degrees Fahrenheit to target this invasive species before significant native plant growth has occurred. Insert dosage. Treatment locations will be located using GPS equipment and herbicide application amounts and concentrations will be recorded. Treatment will be preceded and followed by monitoring as described in the monitoring and assessment section below. Treatments and pre- and post-treatment monitoring will occur for minimum of three years. Monitoring results and research results from other projects will guide potential additional treatments of this area.

The Deer Lake Association currently contracts with Lake Management, Inc. for herbicide and algaecide applications and screening for Eurasian watermilfoil introduction. Dragonfly Consulting conducts aquatic plant monitoring activities.

Eurasian Watermilfoil Prevention

The Deer Lake Association treated 50 foot by 100 foot areas at the public boat launch sites with herbicides from 1996 - 2003. This treatment is intended to reduce the likelihood of introduction of Eurasian watermilfoil in Deer Lake by keeping likely Eurasian watermilfoil introduction locations free of vegetation. The Aquatic Engineering 2003 Deer Lake Aquatic Plant Management Technical Report establishes a management objective: "Prevent a Eurasian watermilfoil infestation in Deer Lake through aquatic herbicide treatments near boat launches." The report further concludes that the practice was successful because Eurasian waterfmilfoil did not establish itself in Deer Lake during the summer of 2003.

The efficacy and wisdom of this management method is questioned by Osgood in his management recommendations . . .

> *Preemptive Eurasian watermilfoil herbicide treatments, as were implemented in 2003, lack an objective method for identifying areas where Eurasian watermilfoil could become established and are therefore not effective. Simply, there is no way to know in advance where a Eurasian watermilfoil introduction may take hold. Furthermore, treating these areas will remove existing vegetation and create a habitat more inviting for the aggressive Eurasian watermilfoil.*

Plan Action Item

Preemptive Eurasian water milfoil herbicide treatments are not recommended. Cease the spraying of the 50 X 100 areas. Carefully monitor plant colonization in these areas. Hand pull or spot spray invasive plants that colonize the previously treated area.

The Deer Lake Association approved continuing preemptive treatment for Eurasian watermilfoil at the boat landing areas for 2005 at its annual meeting in July 2004.

Filamentous Algae Treatment

Plan Action Item
Maintain recreational and aesthetic values of Deer Lake using aquatic herbicide treatments to alleviate the impacts of nuisance algae blooms. Filamentous algae treatments will be used to control nuisances in the near-term. Reducing lake phosphorus will control these nuisances in the long-term.

Monitoring and Assessment

Aquatic Plant Surveys

Aquatic plant (macrophyte) surveys are the primary means to track achievement of plan goals. Plan goals are to: 1) Protect and restore healthy native aquatic plant communities; 2) Prevent the introduction of Eurasian watermilfoil and other invasive, exotic aquatic species; 3) Reduce filamentous algae density; and 4) Control curly leaf pondweed and other introduced aquatic invasive plants.

Whole lake surveys

Plan Action Item
Conduct whole lake aquatic plant surveys every three years to track plant species composition and distribution.

The 2003 survey will serve to document whole lake baseline conditions. Applicator and DNR data provides additional historical information. Surveys will be conducted using a point intercept method using the 192 data points developed for the 2003 survey. Results will be used to evaluate the change in the plant community including any change in native plant diversity (number of species per point) and any measurable change in curly leaf pondweed distribution.

Points will also be collected to map the extent of large beds of curly leaf pondweed visible from the lake surface. Areas of nuisance growth will be compared between survey periods. Any reduction (change) in area of nuisance growth will be noted. Costs of control methods will be tracked per area of nuisance controlled.

Comment [MSOffice2]: There should be an annual check in.

More frequent and more detailed surveys as described in following sections will be used to gauge effectiveness of treatment strategies.

DNR comments suggest an abundance rating must be added to whole lake surveys. They were not included in 2003 survey because of cost considerations.

Required monitoring for DNR permit

Pre-treatment Survey – early May

Identify the extent of observable curly leaf pondweed growth in potential treatment areas with GPS coordinate points. At pre-selected random sample points within and outside the treatment area, note aquatic plant species present and their density (1 (low) to 5 (heavy)). At least one sample point will be chosen per acre of treatment area or per selected lake resident access corridor.

At time of treatment

Sample points will be selected to provide at least one sample point per acre in treatment area. For each sample point the following will be recorded:

- Surface water temperature
- Mid-depth water temperature

Five curly leaf pondweed specimens will be collected (if present) at each sample site. The following data will be collected for each plant:

- total plant length (root to terminal apex),
- number of stem nodes,
- number of axial and root turions, and
- aerial coverage.

Post-treatment – early June

Survey must be completed before curly leaf has died back. This survey will help to assess the effectiveness of the treatment and to target next year's spray points (if additional treatment sites are to be added).

Comment [MSOffice3]: How?

Sample sites randomly chosen in the pre-treatment surveys will be resurveyed both within the treatment areas and outside the treatment areas (as control samples) from sites with positive curly leaf pondweed identification. A list of all aquatic plant species present and their density (1 (low) to 5 (heavy)) will be recorded for each sample site.

Post-treatment survey – August

This survey will assess how well native species persist and move-in following early season treatment. The sample sites randomly chosen in the pre-treatment surveys will be resurveyed both within the treatment areas and outside the treatment areas (as control samples). A list of all aquatic plant species present and their density (1 (low) to 5 (heavy)) will be recorded for each sample site using a standardized list of all species identified on Deer Lake to date.

Subsequent seasons

Pre-treatment monitoring will provide data for assessing the effectiveness of treatment the previous year. Follow-up monitoring at a given sample and control site will occur for a minimum of three years following herbicide application.

Plan Action Item

Complete detailed pre- and post-monitoring preceding and following early season Endothall treatment of curly leaf pondweed nuisance areas.

Eurasian Watermilfoil

Plan Action Item
The applicator will continue to check for the presence of Eurasian watermilfoil and other invasive plants. Volunteer or intern boat landing monitors will check boats and clean boats if necessary and provide information to lake users at the public boat

Filamentous Algae Monitoring

Plan Action Item
The applicator will continue to check for the presence of filamentous algae and use GPS equipment to map locations of occurrence prior to chemical applications.
Must ID goals and what constitutes a nuisance level.
Relate filamentous algae levels to in-lake nutrient conditions

In-Lake Self-Help Monitoring

Plan Action Item
Expanded self-help monitoring including at least monthly summer and fall measurements of chlorophyll, total phosphorus, transparency (Secchi depth) along with temperature and dissolved oxygen profiles will continue.

Implementation Plan

Action Items	Timeline	Annual Cost Estimate[7]
Early season curly leaf pondweed treatment	May 2005, 2006, 2007	
Resident information and education	Ongoing July annual meetings	*$4,000
Public boat launch inspection	June – September	*$4,200
Preemptive Eurasian watermilfoil survey and treatment	June – July	
Filamentous algae survey and treatment	June – September	
Whole lake aquatic plant surveys	2006 and 2009	*$3,500[8]
Curly leaf pondweed treatment monitoring	May, June, August	*$3,175
Expanded self-help monitoring	April - September	

Responsible Party for Implementation

Activity	Responsible Party
Overall aquatic plant management planning	Deer Lake Association (In-lake comm.)
Expanded self-help monitoring	DLA Volunteers
Lake Resident Education	DLA and Consultant
Contract with applicator	Chair, DLA Env. Committee
Apply for whole lake herbicide permit	Applicator
Supervise herbicide application	Chair, DLA Env. Committee
Pre and post survey filamentous algae	Applicator
Pre and post survey curly leaf pondweed and natives	Consultant (not applicator)
Eurasian watermilfoil monitoring	Applicator and consultant
Whole lake aquatic plant survey	Consultant (not applicator)
Public boat launch inspection	DLA (Intern)
Rapid response for EWM	Chair, DLA Env. Committee
Apply for individual corridor permits	Riparian Landowners
Monitor annually sprayed corridor sites	Consultant (not applicator)

Comment [MSOffice4]: Let's chat before we complete this.

[7] Costs marked with an asterisk may be covered by a DNR aquatic invasive species grant. The Deer Lake Association applied for a 50% grant February 1, 2005.
[8] Note that this cost applies only every third year.

Sources

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