Pine Lake

Survey Results & Recommendations 2012

Submitted By:

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TABLE OF CONTENTS

Survey Results & Recommendations

Introduction

Characteristics of the Lake

Pine Lake is an 660-acre lake located in Prarieville Township, Barry County, Michigan (T1N R10W Sec 5,6,7,8). Pine Lake is irregularly shaped.

Rooted vegetation covers a large amount of the littoral zone of the lake. A majority of the shoreline has been developed for single family year-round homes and seasonal summer cottages. A formal lake-use survey was not included in this study, but observations made while working on the lake indicate that the lake is used for fishing, boating and swimming.

Integrated Plant Management

An Integrated Plant Management program should focus on preserving and protecting desirable plant life while controlling unwanted "weed" species through remediation activities. In addition, preventative programs should strive to keep the lake free of unwelcome plants that are known to be pests elsewhere in the region.

The first step of an Integrated Plant Management Program is to *evaluate* and record current lake conditions and lake residents' goals. Next is to *prescribe* a lake specific management plan to control unwanted plant growth. *Implementation* of the agreed upon lake management plan is the final step of the program. After the program has been implemented, results should be assessed. The key to a successful Plant Management Program is to minimize the total long term impacts of noxious aquatic vegetation while preventing new infestations and protecting the aquatic environment.

Why Do Aquatic Plants Become a Nuisance?

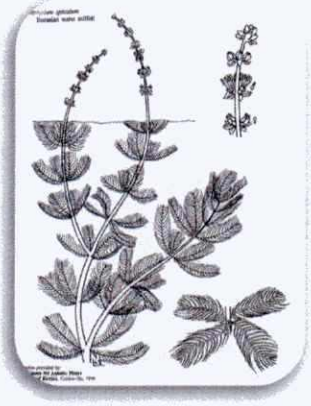
In moderation, aquatic plants are good for the lake, providing habitat for fish and other organisms and stabilizing bottom sediments. Plants get to be a problem when their growth becomes excessive and interferes with the use of the lake. At high levels, even native plants can disrupt the balance and be viewed as "invasive". A number of factors can result in excessive growth of aquatic plants. In many, or perhaps most cases, several factors have combined to result in the problem.

Exotic plant species cause many of the most serious weed problems. Exotic plants are plants that are not native to this region, which have been brought to the area and released.

Because they often have few natural enemies (their pests, pathogens, etc. may not have come over with them), they grow out of control. When exotic aquatic plants such as Eurasian watermilfoil and Curlyleaf pondweed invade a lake, they often form extensive and dense populations, crowd out native species and reduce the quality of habitat for other organisms.

Human activities also increase the input of nutrients and nutrient-rich sediments to the lake. Nutrients feed the growth of algae in the water and settle on the bottom, where they provide a rich substrate for aquatic plant growth. Nutrient inputs increase the overall growth of all aquatic plants (exotic and native) and algae. Preventing excess nutrients from entering your lake is much less expensive than trying to fix the problems they cause.

Eurasian watermilfoil



EWM, an exotic species, is an extremely aggressive submerged aquatic plant that has the abilities to form a monoculture among vegetation. EWM spreads by fragmentation (every inch of plant can sprout new growth) and has a very strong root system. EWM forms a canopy above native plants, choking out the competition. EWM also has the ability to overwinter underneath the ice, allowing it to be present throughout the winter. This gives the plant a head start in growing during the spring and chokes out native plants very quickly. EWM should be controlled as soon as it is found within a waterbody to prevent further infestation and loss of native plant diversity. . Once a native plant is lost in a lake, there is no guarantee it will return. Eurasian watermilfoil was the most abundant plant species on Pine Lake at the time of survey

Curlyleaf pondweed

Curlyleaf pondweed, an exotic species, usually emerges early each spring, flowers and sets seed in the late spring and early summer, and then collapses by the first week in July. There are, however, exceptions to this pattern regarding juvenile plants, part of this re-growth community can occasionally be found in the late summer or early autumn. These small plants are capable of over-wintering below ice cover. Curlyleaf can be a severe nuisance during the early part of the peak recreational use season. Early control of this species is recommended so that the plant is not allowed to produce large quantities of biomass that die naturally and decompose in early July when water temperatures and the potential for oxygen stress are high Early treatment/management is also encouraged to take place prior to seed production therefore, reducing the next generation of early pondweed growth. Curlyleaf pondweed was found during the survey but at fairly low levels.

Algae

Algae are basically divided into planktonic, filamentous, and macroalgae forms. Planktonic algae are microscopic, free floating plants, often referred to as "water bloom". In large number, the algae can cause water to appear Pine, brown, yellow, or even red. Filamentous algae, commonly called "pond scum" can form raft-like masses over the water surface. Since they are vulnerable to winds and currents, they are generally restricted to bays, bayous, and sheltered shorelines. Filamentous algae can grow attached to the lake bottom, weeds and docks. The filamentous algae will frequently detach from the lake bottom and form floating mats. The macroalgae includes three types, chara, starry stonewort and nitella. Chara grows like a carpet on the bottom of the lake. It is nature's water filter and is excellent for fish bedding. Chara grows approximately one inch a week during the summer months.

An over abundance of algae is an indicator that there is an excess amount of nutrients within the water column/lake, causing the waterbody to become overly productive. Algae are very beneficial in a lake ecosystem and can be thought of as the base of the food chain. Therefore, some alga is required.

However, when an alga reaches the point of hindering the use of the lake, control measures are available. Firstly, actions should be taken within the watershed to promote a healthy lake ecosystem and decrease nutrient loading, etc. However, no immediate change will be seen with these actions. Therefore, many lakes opt to include limited algae control within their management program.

Management Goals for Pine Lake

- The primary goal of aquatic plant management in Pine Lake is the control of exotic aquatic plants. The exotic plant species, Eurasian watermilfoil and Curlyleaf pondweed should be controlled throughout Pine Lake. The abundance of these species should be reduced to the maximum extent possible, and efforts should be made to reduce their recovery after treatment.
- Aquatic plant management should preserve species diversity and cover of native plants sufficient to provide habitat for fish and other aquatic organisms. Native plants should be managed to encourage the growth of plants that support the Pine Lake fishery (by creating structure and habitat) provided that they do not excessively interfere with recreational uses of the lake (e.g., swimming and fishing) in high-use areas. Where they must be managed, management techniques that reduce the stature of native plants without killing them (e.g., harvesting, contact herbicides) should be used whenever possible. Specific areas should be set aside where native plants will not be managed, to provide habitat for fish and other aquatic organisms. Muskgrass (*Chara*) should be allowed to grow throughout the lake, except in where it grows so tall as to interfere with boating and swimming.
- The species Starry stonewort, if found on the Pine Lake should be actively controlled and managed. Starry stonewort is in the same family as Muskgrass (Chara) but is considered to be an exotic invasive species. Starry stonewort, which looks very similar to the beneficial species Chara, is appearing in more and more lakes. Chara is a highly desired plant because it is typically low growing, keeps the water clear and can slow down the invasion of exotic weed species. Starry stonewort also forms dense mats, but unlike chara, it can grow from 5 to 7 feet tall. Starry stonewort can be very detrimental to a lake's ecosystem and has the ability to kill off native plants and have a negative impact on a lake's fisheries. In addition to Starry stonewort, the exotic species Cabomba is in several lakes in the area and prevention is the best strategy at this point.

Starry stonewort

- The invasive terrestrial plants, Purple loosestrife and Phragmities should be controlled along the shoreline and adjacent wetlands where present. Both species are exotic and have the ability to displace beneficial native vegetation. Purple loosestrife grows 2 -4 feet tall and is a vibrant magenta color. It is very aggressive and can quickly become the dominant wetland vegetaion. Phragmites (common reed) is a wetland grass that ranges in height from 6 to 15 feet tall. "Phrag" quickly becomes the dominant feature in aquatic ecosystems, aggressively invading shorelines, wetlands, and ditches. This plant creates dense "strands" - walls of weeds crowding out beneficial native wetland vegetation and indigenous waterfowl habitats. Spreading by fragmentation and an extensive root system, Phragmites ultimately out-competes native plant life for sun, water and nutrients.

Phragmites

- Conditions in Pine Lake should not be allowed to deteriorate below present levels. Expansion of aquatic plant problems should trigger an adjustment in the aquatic vegetation management strategy. To support such responses, an annual record of vegetation and management should be maintained.

- Preventative measures that protect the lake from further nutrient enrichment should be identified and implemented.

Vegetation Survey Results

Planning/Evaluation

Vegetation surveys determine the locations of target and non-target plant species. The results of the surveys are used to determine the most appropriate management strategy. The vegetation surveys also document the success of the prescribed management program. An AVAS survey is the State of Michigan's method for conducting a complete aquatic vegetation survey. The Aquatic Vegetation Assessment Site (AVAS) survey divides the parts of the lake capable of growing plants (littoral zone) into subareas and records the cover of each aquatic plant found in each "site". This method of surveying takes into account not only the types of plant species present in the lake but also the densities of those species. AVAS surveys are also an excellent way to track plant species trends over time. A goal of invasive plant management is to have native plants increase while exotic plants decrease over time. The success of this goal can be illustrated through the use of the AVAS data collected over several years.

Table 1: Plant Species Found In Pine Lake – May 25, 2012

AVAS Code	Common Name	Scientific Name	% Cumulative Cover
	Submerged- Exotic		
1	Eurasian watermilfoil	*Myriophyllum spicatum*	38.45
2	Curlyleaf pondweed	*Potomageton crispus*	5.71
	Submerged- Native		
3	Muskgrass	*Chara*	28.57
4	Thinleaf pondweed	*Potomageton spp.*	4.236.09
5	Flatstem pondweed	*Potomageton zosteriformis*	1.07
7	Whitestem pondweed	*Potomageton praelongus*	3.95
9	Richardsons pondweed	*Potomageton richardsonii*	6.98
10	Illinois pondweed	*Potomageton illnoensis*	.36
11	Largeleaf pondweed	*Potamogeton amplifolius*	19.68
13	Floatingleaf pondweed	*Potamogeton natans*	.55
15	Eelgrass	*Vallisneria americana*	5.0
20	Coontail	*Ceratophyllum demersum*	.36
21	Elodea	*Elodea canadensis*	2.50
22	Bladderwort	*Utricularia spp*	.54
	Emergent- Native		
30	Water lily	*Nymphaea odorata*	22.86
31	Spatterdock	*Nuphar variegate*	6.96
32	Watershield	*Brasenia schreberi*	1.80
38	Arrow arrum	*Peltandra spp*	.36
39	Cattail	*Typha spp.*	2.86
40	Bulrush	*Scirpus spp.*	2.36
	Total		**157.00%**

Aquatic Vegetation

Pine Lake was surveyed on May 25, 2012. Pine Lake supports a diverse community of aquatic plants. Twenty species of aquatic plants were observed during survey of the lake (Table 1). While a number of native plant species were observed, very few were found at nuisance levels. Of the native species, only Largeleaf pondweed and Chara were observed at high abundance. Chara was found in 78.5 % of

the shoreline sites (28.57% cumulative cover) while Largeleaf was found in 67.8% of the shoreline sites (19.68% cumulative cover)

The exotic species Eurasain watermilfoil was the most dominant plant on the lake (38.45% cumulative cover) and occupied 83.9% of shoreline sites. Considerable growth was also observed offshore. The exotic species Curlyleaf pondweed was also observed but at much lower levels. Eurasian watermilfoil and Curlyleaf pondweed are non-indigenous aquatic nuisance species, i.e., plants from other places. These exotic plants cause considerably more problems than most native species. Eurasian watermilfoil can attain nuisance levels of growth at almost any time of year, whereas curly leaf pondweed completes its lifecycle and drops out of the water column by approximately the Fourth of July.

The native plant species in Pine Lake benefit the lake, performing such functions as stabilizing sediments and providing habitat for fish and other aquatic organisms. In general, native species cause few problems, compared with those caused by exotic plants.

Chara

Wild Celery

Variable Pondweed

Strategies for Achieving Lake Management Goals

Aquatic Plant Control Techniques

Areas of the lake that support vegetation will grow plants, despite intense efforts to remove them. Aquatic vegetation provides important benefits to a lake, including stabilizing sediments, providing habitat for fish and other aquatic organisms, and slowing the spread of exotic plant species. In general, native plants interfere less with recreation and other human activities than exotic species. The non-native plant species, Eurasian watermilfoil and curly leaf pondweed concentrate their biomass at the water surface where it strongly interferes with boating, swimming and other human activities. This growth form also allows exotic plants to displace native plants and form a monospecific (i.e., single species) plant community. The dense surface canopies of Eurasian watermilfoil and Curly leaf pondweed provide a lower quality habitat than that provided by a diverse community of native plants. Control of exotic plant species minimizes interference of plant growth with human activities and protects the native vegetation of the lake. The goal of environmentally responsible aquatic plant management, therefore, is not to remove all vegetation, but to control the types of plants that grow in the lake and the height of plants, to minimize interference with human activities.

It is important that control techniques meet the needs and expectations of lake users. Each technique has advantages and disadvantages. Many aquatic plants are relatively susceptible to some control measures but resistant to others. Too often, lake groups select a control technique before determining what their needs are.

Chemical control, or use of aquatic herbicides, is the most common strategy for controlling exotic plant species. Aquatic

herbicides provide predictable results and there is a great deal of research and data regarding theses products. Many of the aquatic herbicides available can be used to selectively control exotic species with minimal or no impact on native species.

Mechanical harvesting is best suited for native plant species. Most native plant species have a higher tolerance to aquatic herbicides and require higher dosage rates (higher cost and reduced selectivity). Mechanical harvesting can be used to provide relief from native plant species if they are causing a recreational nuisance. Harvesting does not kill the plants, but simply reduces it's stature, leaving lower growth for fish habitat and sedimnet stabilization. Mechanical harvesting of Eurasain watermilfoil is **not** recommended as it will expedite its spread throughout a lake through fragmentation.

Biological control options for nuisance aquatic vegetation are limited. Grass carp, which indiscriminately devour aquatic vegetation, have been restricted in many states because of their nonselective grazing and fear they may escape into nonintended waters. The use of the milfoil weevil (Euhrychipsis lecontei) to control Eurasian watermilfoil has been implemented in many Michigan lakes. PLM Lake & Land Management Corp has many years of experience paticapating in weevil stocking, evaluations and longterm observations related to their performance and sustainability. Although the milfoil weevils may impact EWM populations in certain situations, the use of this tool remains unpredictable.

Bacteria product formulations and application techiques has greatly improved in recent years. Granular bacteria products can be applied to specific shoreline areas to reduce organic muck that has acumulated over the years. As waterbodies age, organic sediment can build up due to excessive plant and algae growth. This process is called eutrohpication. Increasing native populations of bacteria can slow this process down. Reductions in the depth of muck may depend on many variables. Most importantly, the percent of sediment that is organic. The more organics in the sediment, the greater the potential for muck reduction via bacteria augmentation.

Aeration can be a beneficial tool to sustain ecological balance within an aquatic ecosystem. By maintaining sufficient oxygen levels throughout a waterbody, the entire eutrophication process can be slowed down, the health of the fishery can be maintained and overall water quality can be improved. The implementation of an aeration system to control rooted aquatic plant growth is not recommended. Rooted plants, such as Eurasian watermilfoil, will not be affected by aeration. Similar to the use of biological control, the impact of aeration on improving water quality and reducing organic sediment will vary greatly from site to site. Therefore, it is extremely important to thoroughly evaluate each site's conditions and expectations before implementing an aeration system.

Integrated Pest Management (IPM) approaches to aquatic plant control IPM emphasize spending more effort evaluating the problem, so that exactly the right control can be applied at just the right time to control the pest. IPM approaches minimize treatment costs and the use of chemicals. Lake management planning ensures the most appropriate, cost-effective treatment for your lake. Planning is an essential phase of Integrated Pest Management and includes lake vegetation surveys, water quality evaluation and a detailed, written lake management plan. Having the plan in place helps lake users know what to expect from lake management. Survey results provide a permanent record of conditions in the lake and the impact of management practices.

Exotic Plant Management

Aquatic herbicides currently represent the most reliable, effective, selective means for controlling Eurasian watermilfoil. There are currently five systemic herbicides, 2,4-D (Navigate), 2,4-D amine (Sculpin G), triclopyr (Renovate 3 & OTF), 2,4-D/Triclopyr combination (Renovate Max G) and fluridone (Sonar or Avast), which can be used to achieve long-term, selective control of Eurasian watermilfoil. Systemic herbicides are capable of killing the entire plant. Several contact herbicides, including diquat (Reward or Solera) can also provide short-term control of Eurasian watermilfoil. These herbicides kill only the shoots of the plant, and plants regrow relatively rapidly from their unaffected below ground parts.

Systemic herbicides control Eurasian watermilfoil with little or no impact on most native plant species. Under ideal conditions, several consecutive annual applications of these herbicides can reduce Eurasian watermilfoil to maintenance (low) abundance, such that only relatively small spot treatments are required to keep it under control. For this strategy to succeed, it is necessary to treat most of the Eurasian watermilfoil in the lake each time.

Harvesting of Eurasian watermilfoil is **not** recommended. This plant spreads by fragmentation and regrows significantly more rapidly than most native plant species; thus continued harvesting of mixed plant beds typically leads to nearly complete domination of the aquatic vegetation by Eurasian watermilfoil.

Short-term control of curly leaf pondweed is easily achieved using low dose rates of a number of aquatic herbicides, including fluridone (Sonar), endothall (Aquathol-K, Hydrothol 191) and diquat (Reward). In the absence of long-term control techniques these contact herbicides should be used to control curly leaf pondweed in areas where it causes problems. Herbicide dose rates used to control curly leaf pondweed should be kept sufficiently low to minimize the impact on native plants. Should cost-effective, environmentally acceptable long-term curly leaf pondweed controls be developed, they should be considered as an option in the future for Pine Lake.

Native Plant Management

Native plants should be controlled primarily by harvesting. Unlike Eurasian watermilfoil, most native plants do not regrow rapidly after harvesting, and a single harvest is often sufficient to control them for the entire summer. Normally low-growing species should not be controlled unless unusually fertile growing conditions allow them to grow tall in areas of high recreational use. Contact herbicides applied at higher rates can be effective at controlling native plants that are causing a nuisance close to shore, in between docks.

Algae Management

Areas of excessive filamentous algal growth or muskgrass (*Chara*) growth can be controlled using copper-based algaecides. Treatments should be confined to shallow areas where these algae cause a serious interference with recreation. Muskgrass should only be controlled where it grows up to the surface. Even in these areas, muskgrass treatments should be designed to take off the top layers of growth without exposing bare sediments, so as to preserve the beneficial functions of this species.

Monitoring

It is important to maintain a record of lake conditions and management activities. Vegetation surveys monitor types and locations of plants in the lake, providing information that is essential to the administration of efficient, cost-effective control measures. Vegetation surveys also document the success or failure of management actions and the amount of native vegetation being maintained in the lake. Water quality monitoring can identify trends in water quality before conditions deteriorate to the point where remediation is prohibitively expensive or impossible. Records of past conditions and

management activities also help to keep management consistent despite changes in the membership of the Lake Association. Records should include (at a minimum):

- Temperature, dissolved oxygen and Secchi disk depth should be measured in the lake. Temperature and dissolved oxygen profiles should be obtained in the deep hole, so as to monitor the timing and extent of oxygen depletion in the hypolimnion (i.e., bottom water).
- Total phosphorus and nitrates should be measured in the surface and bottom water at least two times per season (spring and late summer) to monitor nutrient accumulation in the hypolimnion.
- Lake vegetation should be surveyed on an annual basis (late-spring and/or late summer/early fall) to document the results of plant management efforts and provide information necessary for planning future management.

Nutrient Loading Abatement

Lakeshore property owners should be encouraged to use phosphorus-free fertilizers on lawns and other areas that drain into Pine Lake or the adjacent wetlands. Lakeshore residents should also be encouraged to manage their waterside landscapes according to the recommendations outlined in publications on this topic available from the MSU Extension.

It is also important to remember that rooted plants derive most of their key nutrients from the sediments; thus they respond slowly, if at all, to reductions in nutrient loading. In fact, if reductions in nutrient loading lead to improved water clarity, the growth of rooted plants will probably increase.

If organic material (muck) accumulates to undesirable levels in shoreline areas, bacterial treatments should be considered as a way to alleviate the buildup. PLM MD (Muck Digestion) Pellets are a combination of natural beneficial bacteria, enzymes, and vitamins that stimulate the biological activity of the lake bottom. This stimulation allows the bacteria to feed on the organic sediment, therefore reducing the muck levels over time.

Prevention

Eurasian watermilfoil and curly leaf pondweed were possibly introduced to Pine Lake by plant fragments carried on boats and/or boat trailers. A variety of other troublesome exotic plants and animals that can be introduced to Pine Lake are also transported this way. Preventing their inadvertent introduction to Pine Lake can significantly lower the cost of future lake management. Education can be an effective preventative measure. Newsletter articles should alert lake residents to the threat from exotic nuisance plants and animals. Warning signs should be erected at any public boat access sites, if applicable, that encourage boaters to clean boats and trailers when launching or removing watercraft from the lake.

Pine Lake Management Recommendations for 2012

Management options are dependent on many factors, including but not limited too, species abundance (density), species richness, species location and many lake characteristics. Whenever an exotic species is found within an aquatic environment, action needs to be taken to prevent long term ecological damage as well as recreational and aesthetic loss that will take place. Based on conditions observed during the survey, it is recommended that management focus on the control of Eurasian watermilfoil as well as the control and monitoring of other exotic species.

Submersed Aquatic Plants

Spring Fluridone (Sonar) Application

Sonar aquatic herbicide (active ingredient, fluridone), applied to Pine Lake on a whole-lake basis, would provide control of Eurasian watermilfoil. This strategy is expected to dramatically reduce Eurasian watermilfoil abundance to a maintenance level in the lake. The low dosage rate allowed in Michigan can provide selective control of Eurasian watermilfoil with little or no damage to beneficial native plant species. To implement this option, a year of water quality and vegetation monitoring is required.

Conventional Herbicide treatments

Treatments with the herbicides, Triclopyr and/or 2,4-D, in localized treatment areas to slow the spread of Eurasian watermilfoil should be conducted. The herbicides Triclopyr and 2,4-D, control Eurasian watermilfoil with little or no impact on most native plant species. Since they are selective, systemic herbicides, they can actually kill Eurasian watermilfoil plants. Under ideal conditions, several consecutive annual applications of Renovate or 2,4-D can reduce Eurasian watermilfoil to a maintenance (low) abundance. For this strategy to succeed, it is necessary to treat all the Eurasian watermilfoil in the lake each time they are applied. Recent Michigan regulation restricting 2,4-D use in the vicinity of drinking water wells may result in the inability to apply 2,4-D near the shoreline of the lake.

Triclopyr is a systemic herbicide with selectivity very similar to 2,4-D. Triclopyr is not subject to the well setback restrictions that currently affect 2,4-D. Therefore, triclopyr can be used to control Eurasian watermilfoil in near shore areas. A combination of both systemic herbicides in Pine Lake could greatly reduce the growing Eurasian watemilfoil problem.

Several contact herbicides, including diquat (Reward) can also provide short-term control of Eurasian watermilfoil. These herbicides kill only the shoots of the plant, and plants regrow relatively rapidly from their unaffected belowground parts.

Mechanically harvesting nuisance native vegetation is environmentally safe and can provide immediate relief from dense native vegetation that impedes recreational activities and aesthetic values. **Mechanical harvesting should not be conducted near or in any area infested with Eurasian watermilfoil.**

Nuisance native plant management can also be initiated into a lake management program with conventional herbicide treatments if desired. Native plant treatments are completed using only contact herbicides in beach areas. Contact herbicides will not target the root system of the plant. Native plant management is completely optional.

Purple loosestrife should also be addressed around the perimeter of the lakes to prevent the further spread of this exotic species. The systemic herbicide, Renovate 3, is effective at selectively controlling Purple loosestrife. Since Renovate 3 is a systemic herbicide, the root system of the plant will be killed not just the foliage.

Aquatic vegetation and water quality will be monitored to document the condition of the lake and to provide warning of any changes in the condition of the lake that need to be addressed by additional lake management activities.

The recommended management program for 2012:

- A spring vegetation survey (to evaluate conditions in the lake and direct management efforts)
- Water quality evaluation should continue
- A fall vegetation survey

Final Recommendations

Based on the current density of Eurasian watermilfoil, management options should be considered to protect the recreational and ecological values of Pine Lake, as well as property values surrounding Pine Lake. It is most likely that Eurasian watermilfoil densities will expand if left unmanaged. A management program should allow for management on a lake wide basis. A majority of the Eurasian watermilfoil is growing near the drop-off where water depths quickly increase. Plants in this area often go unnoticed to recreational users until they reach the surface. Eurasian watermilfoil will quickly reach the surface and continue to spread and inhibit fishing/boating/swimming, etc as well as having long term negative effects on the ecological habitat. Management of this species needs to start as soon as possible.

All available tools and options should be evaluated when making management decisions. In order to provide lake wide management, a Special Assessment District (SAD) should be established to ensure adequate funding and permissions and for MI-DEQ permit approval. If an SAD program is not established, written permission needs to be collected from each property owner within treatment area.

Explanation of DEQ-Format Lake Vegetation Maps and Summary Sheets

The maps are in a standard format as required by the Michigan Department of Environmental Quality (DEQ). The maps divide the parts of the lake capable of growing aquatic plants into subareas and record the cover of each aquatic plant species found in each area. Vegetation summary sheets summarize the information from the maps in a form that the DEQ uses to make decisions about permits.

Notations on the map are interpreted as follows:

Number (= plant species) Letter (=approximate cover of this plant)

For Example:

"1b" indicates plant species #1 at a density of b

Species are usually numbered according to a standardized numbering system (at right). We often reproduce the species number key and species name abbreviations on the map itself. The cover codes a, b, c and d are used to describe the approximate coverage of each plant within the map area, as described in the following table.

Cover Code	Approximate Cover Range
a	1-2%
b	3-20%
c	21-60%
d	61-100%

Thus the example "1b" refers to Eurasian watermilfoil covering between 3 and 20 percent of the area of the lake in which this code appears.

Shading on the map is used to identify areas of overall plant coverage, locations of problem exotic species or areas requiring management. A key on the map should indicate exactly what is indicated by shading.

No	Plant Name
1	Eurasian watermilfoil
2	Curly leaf pondweed
3	Chara
4	Thinleaf pondweed
5	Flatstem pondweed
6	Robbins pondweed
7	Variable pondweed
8	White stem pondweed
9	Richardsons pondweed
10	Illinois pondweed
11	Large leaf pondweed
12	American pondweed
13	Floating leaf pondweed
14	Water stargrass
15	Wild celery
16	Sagittaria (submersed)
17	Northern watermilfoil
18	Green watermilfoil
19	Two-leaved watermilfoil
20	Coontail
21	Elodea
22	Bladderwort
23	Mini Bladderwort
24	Buttercup
25	Naiad
26	Brittle naiad
27	Sago Pondweed
28	
29	
30	Water Lily
31	Spatterdock
32	Water shield
33	Lemna minor
34	Greater duckweed
35	Watermeal
36	Arrowhead
37	Pickerelweed
38	Arrow arum
39	Cattail
40	Bulrush
41	Iris
42	Swamp loosestrife
43	Purple loosestrife

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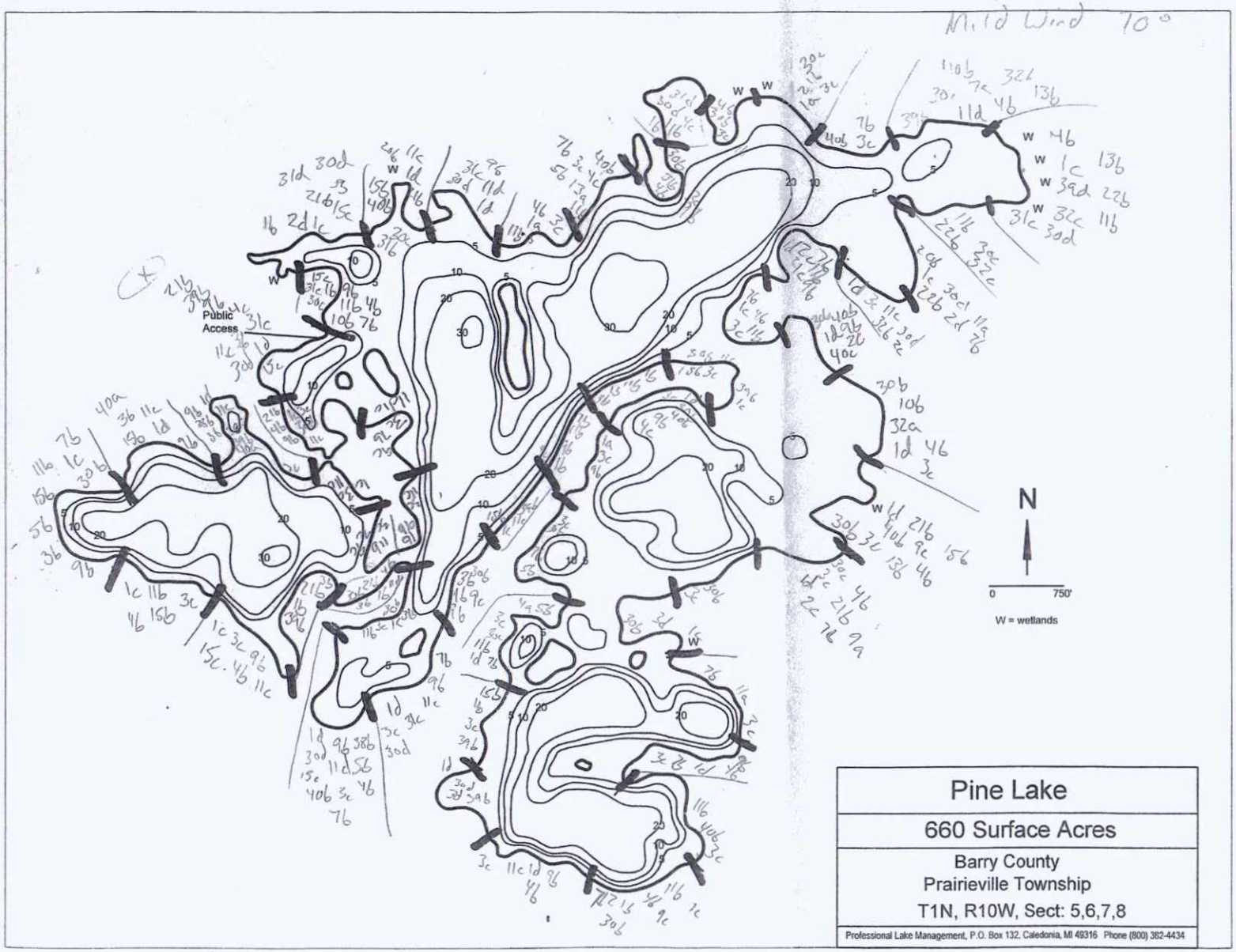
Lake: Pine County: Barry Survey Date : May 25, 2012

Standard Aquatic Vegetation Summary Sheet

		Total number of AVAS's for each Density Category					Calculations				Sum of Columns 5-8	Total No. of AVAS	Col 9 divided by Col 10
Code		A	B	C	D		A x 1	B x 10	C x 40	D x 80			
No	Plant Name	1	2	3	4		5	6	7	8	9	10	11
1	Eurasian watermilfoil	3	11	15	18		3	110	600	1440	2153	56	38.45
2	Curly leaf pondweed	0	0	4	2		0	0	160	160	320	56	5.71
3	Chara	0	8	34	2		0	80	1360	160	1600	56	28.57
4	Thinleaf pondweed	1	18	4	0		1	180	160	0	341	56	6.09
5	Flatstem pondweed	0	6	0	0		0	60	0	0	60	56	1.07
6	Robbins pondweed	0	0	0	0		0	0	0	0			
7	Variable pondweed	1	18	1	0		1	180	40	0	221	56	3.95
8	White stem pondweed	0	0	0	0		0	0	0	0			
9	Richardsons pondweed	1	19	5	0		1	190	200	0	391	56	6.98
10	Illinois pondweed	0	2	0	0		0	20	0	0	20	56	0.36
11	Large leaf pondweed	2	18	13	5		2	180	520	400	1102	56	19.68
12	American pondweed	0	0	0	0		0	0	0	0			
13	Floating leaf pondweed	1	3	0	0		1	30	0	0	31	56	0.55
14	Water stargrass	0	0	0	0		0	0	0	0			
15	Wild celery	0	8	5	0		0	80	200	0	280	56	5.00
16	Sagittaria (submersed)	0	0	0	0		0	0	0	0			
17	Northern watermilfoil	0	0	0	0		0	0	0	0			
18	Green watermilfoil	0	0	0	0		0	0	0	0			
19	Two-leaved watermilfoil	0	0	0	0		0	0	0	0			
20	Coontail	0	2	0	0		0	20	0	0	20	56	0.36
21	Elodea	0	10	1	0		0	100	40	0	140	56	2.50
22	Bladderwort	0	3	0	0		0	30	0	0	30	56	0.54
23	Mini Bladderwort	0	0	0	0		0	0	0	0			
24	Buttercup	0	0	0	0		0	0	0	0			
25	Naiad	0	0	0	0		0	0	0	0			
26	Brittle naiad	0	0	0	0		0	0	0	0			
27	Sago Pondweed	0	0	0	0		0	0	0	0			
28	Cabomba	0	0	0	0		0	0	0	0			
29	Starry Stonewort	0	0	0	0		0	0	0	0			
30	Water Lily	0	16	8	10		0	160	320	800	1280	56	22.86
31	Spatterdock	0	3	5	2		0	30	200	160	390	56	6.96
32	Water shield	1	2	2	0		1	20	80	0	101	56	1.80
33	Lemna minor	0	0	0	0		0	0	0	0			
34	Greater duckweed	0	0	0	0		0	0	0	0			
35	Watermeal	0	0	0	0		0	0	0	0			
36	Arrowhead	0	0	0	0		0	0	0	0			
37	Pickerelweed	0	0	0	0		0	0	0	0			
38	Arrow arum	0	2	0	0		0	20	0	0	20	56	0.36
39	Cattail	0	8	0	1		0	80	0	80	160	56	2.86
40	Bulrush	2	9	1	0		2	90	40	0	132	56	2.36
41	Iris	0	0	0	0		0	0	0	0			
42	Swamp loosestrife	0	0	0	0		0	0	0	0			
43	Purple loosestrife	0	0	0	0		0	0	0	0			
44	Phragmites	0	0	0	0		0	0	0	0			
45		0	0	0	0		0	0	0	0			

Total cumulative cover **157.00**

Water Registration
May 2012
Mild Wind 70°



Pine Lake

660 Surface Acres

Barry County
Prairieville Township
T1N, R10W, Sect: 5,6,7,8

Professional Lake Management, P.O. Box 132, Caledonia, MI 49316 Phone (800) 382-4434