Management Opinion

2013

Prepared by:

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For The:

Pleasant Lake Property Owners Association

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Pleasant Lake

Freedom Township, Washtenaw County

Michigan

Management Opinion

2013

Executive Summary:

~ Milfoil, curly leaf pondweed, and hybrid weedy pondweeds are primary nuisance species in Pleasant Lake and are expected to grow to nuisance levels in 2014 and for years to come if appropriate management actions not taken. There are approximately 60 acres that are typically allowed for treatment of these four species (genotypes) by the MI DEQ. Aggressive, but selective control is recommended all of these plants near developed shorelines. Milfoil and curly leaf pondweed also grow in deeper areas of the lake and may be considered to be a nuisance by some lake users and residents. Highly targeted and selective control of these two species is tentatively recommended for the approximately 47 acres where treatment might be considered. Because the species richness of the lake is so high and because there is a preponderance of desirable plant species, the use of species selective aquatic herbicides is recommended. The impacts associated with the application of aquatic herbicides are rapid but ephemeral. And, because herbicides can be precisely targeted to nuisance species, only minimal collateral impacts may be observed on many of the highly desirable species found in the lake.

~ Starry stonewort was not found in the lake; however, it is believed that it will invade the lake sooner than later. Interestingly, starry stonewort may eliminate the need for herbicide use in some areas, but will still require that the area of application for algaecides be increased for proper management of this nuisance algae species.

~ Conditions need to be monitored to evaluate the outcome of future treatment programs, increasing impact of starry stonewort, and the probably proliferation of harmful algae. It is also critical that the monitoring program detect the invasion of several submersed plant species that have recently been found in nearby lakes. These species include, cylindro (blue green algae), hydrilla, invasive pondweed, fanwort, and red ludwigia.

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Pleasant Lake

2013 Management Opinion

Purpose of Inquiry:

To evaluate status of the submersed macrophytic flora of Pleasant Lake and develop a basis for a lake management plan.

Introduction:

Pleasant Lake is located in Freedom Township, Washtenaw County, Michigan. The submersed aquatic plant community was surveyed according to the procedures necessary to perform a LakeScan™ analysis of the lake macrophyte (large plant) community. These data are necessary to develop basis for a proper lake improvement and management plan.

Administrative and Management Authority:

The residents of Pleasant Lake have assumed responsibility for the management of Pleasant Lake; however, they have contacted Washtenaw County representatives to determine if it is feasible to create a management program that is administered by the County.

Morphometric Data:

Lake Size:	202 acres
Maximum Depth	35 feet
Mean Depth	~ 10.4 feet
Nuisance Vegetation Management Area	~75 acres

note: These data were approximated from a Institute for Fisheries Research/MI DNR map which was downloaded from the MI DNR website. This are only approximations.

Management Objectives Overview:

Lakes are complex. Aquatic ecosystems are comprised of number of independent but related systems similar to systems found in people or any other organisms. When considering human health we may focus on cardiac health (circulatory system), bone strength (skeletal system), or nervous or motor disorders (nervous system) and the impact of diet, environment, and genetics on all of those systems. Similarly some of the lake systems that must be considered in a lake management plan include the open water (limnetic) and near shore or bottom associated (littoral and pelagial, respectively) systems. Usually, nuisance conditions develop more rapidly when ecosystem disturbance(s) reaches a level that internal mechanisms in a lake are altered or impacted in a way that makes it easier for opportunistic or nuisance species to become established and flourish. Ecosystem functions are compromised by a wide range of human and natural activity. Common sources of cultural disturbance include shoreline development, recreation, changes in water levels, sediment loading, and essential plant nutrient equilibria, the introduction of invasive species.

Some of the more common biological problems found in Michigan Lakes include poor water clarity, blue green algae blooms, excessive rooted and vascular plant growth, macroalgae (plant-like algae) over growth, nuisance mats of filamentous algae, declining fisheries, and nuisance fish and wildlife. It is good practice to identify the root cause of lake problems, in order to implement the best known remedies. However, causative agents can be difficult to identify and sometimes nearly impossible to correct.

Because there are only a limited selection of nuisance aquatic vegetation management tools, it is usually necessary to apply remedies to treat the symptoms of the problem rather than the source of the problem. Lake management plans are used to guide the decision making required to create a prescriptive course of action to remedy obvious problems or their symptoms and to recommend activities that will help to protect, preserve, or improve the resource. This must be done within the context of all available technology, current regulatory considerations, the sociological disposition of the shoreline community, and available financial resources. Fortunately, there are a variety of things that can be done to enhance and protect lakes. There are no simple cures for many lake problem but there are things that can be done year after year to improve conditions and remediate some of the consequences of ecosystem disturbance.

Disturbed lake ecosystems are typically characterized by low species diversity and habitat complexity. They often fail to meet the expectations of lake user groups from an aesthetic, utilitarian, or recreational perspectives. For this reason, management plans must be multi-faceted and directed toward mitigating against disturbance while causing as little additional disturbance as possible. Compared to the wide variety methods, tools, and strategies used in terrestrial vegetation management practice and agriculture, there are relatively few aquatic plant management tools and strategies. There is no way to manipulate the aquatic environment to provide and sustain the wide range of conditions that are possible in terrestrial systems. Lakes that are geographically predisposed to a certain condition and must necessarily be managed within that context. It is not possible to sustain the conditions found in some relatively unproductive (clear, few weeds) upper great lakes regions lakes in most of the lakes in Michigan. Swimming pool conditions can be created but not sustained. Therefore, the Pleasant Lake Management plan is intended to foster the growth of plants that posses characteristics that are consistent with the expectations of lake users. This discourse forms the basis for the Pleasant Lake Improvement Plan.

Aquest TIP:

Aquatic Plant Myths and Misinformation

Rooted Plants and Phosphorus

Aquatic plants continue to be the source and subject of misunderstanding and misinformation. During the late 1960's, scientists identified phosphorus, a plant fertilizer and frequent pollutant, to be one of the principal reasons for declining water quality in lakes, reservoirs , rivers, and ponds. It was determined and has been confirmed repeatedly that phosphorus can stimulate suspended algae growth and lead to nuisance algae blooms which can make water resources look like "pea soup". Unfortunately, technical bulletins and scores of publications glibly state that phosphorus pollution can lead to nuisance plant growth too. Actually the converse can be true. The total area covered by nuisance plant growth is frequently limited by available light and the depth of the water resources. If phosphorus levels are not high enough to support nuisance suspended algae production, then the water will be clearer, there will be greater light penetration, and rooted aquatic plants can grow to greater depths. Rooted plants may become an even greater problem where they are already growing at nuisance levels. What about phosphorus and the potential to stimulate greater rooted plant growth? Rooted aquatic plants use their roots to extract phosphorus from the sediments. Most sediment contain more that enough phosphorus to support luxuriant aquatic plant growth. Other factors seem to be more important in limiting rooted plant growth, such as wind fetch and water flow, substrate type, nitrogen and light availability. The key here is that watershed management that focuses on phosphorus loading limits may help to reduce the intensity of algae blooms but may actually worsen rooted plant problems by improving the clarity of the water.

General Goals of the Lake Management Plan

1. Preserve or enhance ecosystem stability by protecting species and habitat diversity, This can only be accomplished with the application of targeted, selective management of nuisance opportunistic plant species such as watermilfoil, curly leaf pondweed, and starry stonewort.

2. Monitor the resource to evaluate the effectiveness or outcome of any applied management efforts and to identify any species that might invade and proliferate and diminish biological and habitat diversity of the lake.

3. Enhance recreational options through the discrete and localized control of nuisance plants near critical use areas. This will not include the maintenance of localized and specific problems that may exist in the water immediately adjacent to a very limited number of home sites. A balance shall be established between the maintenance of ecosystem stability and recreational use demands.

Aquest Tip:

Choosing the Right Tool

The growth of nuisance native species can be controlled by chemical, biological, or mechanical strategies. Once a lake has been invaded by an invasive aquatic plant or alga species, control efforts must be applied to that lake every year or the invasive species will return and over-take the lake again. It is absolutely critical that the proper strategy or range of management tools be applied to a given nuisance condition in a lake. Failure to apply the proper tool or to do nothing at all will result in further degradation of aquatic resources.

Aquatic herbicides algaecide can be applied to provide selective control of many, but not all nuisance plant and algae species in Michigan. Selective control is key for the improvement of plant community biodiversity and habitat complexity. Aquatic herbicides only provide relief or control of nuisance plant species for 6 weeks to 2 years, depending on the herbicide and the target species. The recent emergence of herbicide tolerant plant genotypes make it necessary to use different herbicides and combinations of herbicides to maintain the effectiveness of these management tools.

Mechanical harvesting is used to alleviate nuisance conditions but can create selective pressures that favor the growth and domination many of the most weedy and opportunistic plant species and depress the production of more desirable plants if it is improperly applied to a set of conditions. Like any management tool, harvesting can cause serious ecosystem damage if it is not used properly.

Currently, there are no independently proven biocontrol methods that can be used to protect or improve submersed aquatic plant community biodiversity. The milfoil weevil has not been proven to be an effective agent for attaining sustainable lake management goals by independent sources.

Fundamental Considerations of the Vegetation Community Management Plan

The organic content and fertility of the sediments in Pleasant Lake appears to be variable and range from very low fertility in some areas to highly enriched organic substrates in others. Nearly the entire bottom of the lake appears to be capable of the support of vegetation except for some shallow, sandy, wave swept areas. Contrary to popular opinion, studies clearly demonstrate that the highly organic or mucky areas of lakes are not particularly favorable for submersed rooted aquatic plant growth. These sediment types are found in many areas of the lake. They are commonly dominated by floating leaf or aerial leaf species such as water lilies and wetland plants. Only the most opportunistic rooted plant species seem to be able to colonize these areas and many of these plants are considered to be weedy and undesirable. Plants that have no roots such as coontail, bladderwort, filamentous and charoid

algae, including starry stonewort, can sometimes grow to nuisance levels over muck sediments. Pleasant Lake contains several species that are capable of nuisance growth over all types of sediments, including muck sediments. The most important plants in this group are Eurasian or hybrid watermilfoil, curly leaf pondweed, and hybrid weedy pondweeds.

Cultural Use Considerations:

Pleasant Lake is classified as a "multi-use" or "multi-sports" lake. It is used for boating, power boating, skiing, swimming, fishing, wild life production, and lawn irrigation. Consequently, it is critical to manage the vegetation community to accommodate the requirements of a wide range of uses. Tall plants are needed to provide refuge and nursery for the fishery and create edge effect to improving fishing. Low growing plants should cover the bottom of the lake where boating and swimming occur.

Watershed Considerations:

Most of the entire shoreline of Pleasant Lake has been developed for residential uses. All of the residences on Pleasant Lake appear to be "year round" dwellings. An extensive wetland is located on the eastern shore of the lake. The Pleasant Lake watershed is characterized by mixed uses but is dominated by agricultural use. A livestock production area is located on the north side of the western basin of the lake. This area drained into the lake, but flows have been diverted away from the lake in recent years. The flora of the area adjacent to this production area reflects the impacts from this waterside use. Waterside landscapes should be managed to minimize disturbance of the lake ecosystem.

Biological Survey Overview:

Milfoil: According to reports, watermilfoil has not been universally recognized as a problem in Pleasant Lake. The dominant milfoil genotype in Pleasant Lake is not known, but it appears to be a Eurasian watermilfoil hybrid. Previous attempts to suppress the production of this plant appear to have been unsuccessful. It was observed in 62% of all AROS and was co-dominant with Chara and weedy hybrid pondweeds.

Curly Leaf Pondweed: Curly leaf pondweed is another exotic invasive plant species, like Eurasian watermilfoil. It is widespread and creates significant problems in many Michigan lakes prior to the Fourth of July holiday. It has all the same abilities to diminish plant community biodiversity and destabilize ecosystems as does milfoil. It is; however, among the easiest plants to suppress being sensitive to a broad range of aquatic herbicides. It was observed in 26% of all of the AROS's.

Starry Stonewort: Dr. Doug Pullman, Aquest Corporation was the first to identify starry stonewort in a Michigan inland lake in the early spring of 2006. Since that time it has been found in numerous lakes from Ludington to lakes throughout SE Michigan. This plant is actually an alga species that strongly resembles native Michigan charoid species. It appears that starry stonewort is more aggressive than any other plant currently found in Michigan Lakes. It was not found in Pleasant Lake in 2013; however, it may be present and was not observed because it can co-mingle with chara. It is very likely that it will invade Pleasant Lake because it is spread easily by birds and people and because it is found in many Washtenaw County lakes. Starry stonewort is a charoid species that is nearly difficult to distinguish from other native or endemic Michigan chara species. Endemic chara rarely grows taller than 6" but starry stonewort has been observed to grow 7' tall. Starry stonewort can crowd out even the most aggressive and opportunistic species such as milfoil and curly leaf pondweed. Once introduced into a lake, it can seriously diminish plant community biodiversity. It has also been found to blanket fish spawning areas and for this reason (and others) is currently believed to be a significant threat to the fisheries of inland Michigan Lakes. Fortunately, it is fairly easy and relatively inexpensive to control.

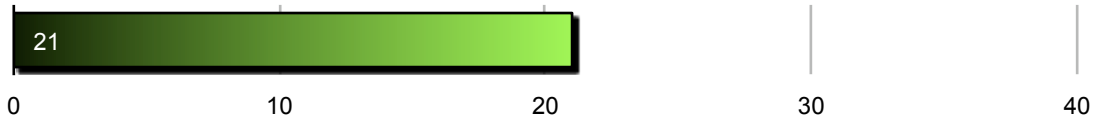
Pondweeds: Native broadleaf pondweed species have also been recognized to be problematic in Pleasant Lake by some of the lake residents. Nuisance plant growth of this type is generally subjected to discrete, contact herbicide, controls that are restricted to those areas where the pondweeds interfere with swimming and boat dock access. In contrast to the management of milfoil

and other opportunistic species, mechanical harvesting can be used for native pondweed control without creating worse problems.

Other Considerations. Pleasant Lake is considered to be weedy by nearly every perspective. Unlike many lakes, watermilfoil and curly leaf pondweed are not the only primary nuisance species in Pleasant Lake. Weedy hybrid pondweeds are nearly as dominant as milfoil and curly leaf pondweed. Should milfoil and curly leaf pondweed be successfully suppressed, hybrid pondweeds are likely to expand and it may be difficult to satisfy the expectations of some lake users or residents.

LakeScan™ Overview:

Total Plant Species Present (Species Richness)



Twenty-one submersed aquatic plant species were observed in Pleasant Lake in 2013. The average number of species observed in 24 lakes in 2012 was 17. Species richness in Pleasant lake is considered to be very good relative to most other Michigan Lakes.

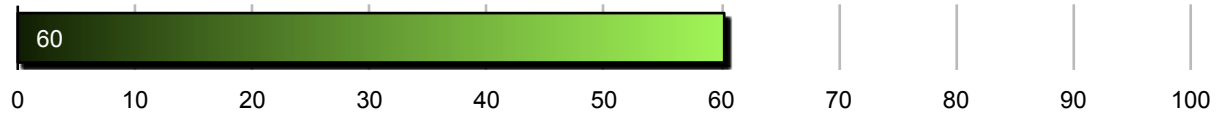
Average Number of Plant Species Found at AROS's

The average number of species found at the AROS in Pleasant Lake is considered to be very good compared to other Michigan Lakes.

Maximum Number of Plant Species Found at Any AROS

The maximum number of species found at the AROS in Pleasant Lake is considered to be excellent and much greater than the number typically found in other Michigan Lakes.

LakeScan™ Whole Lake Plant Community Biodiversity 40 Index



The biodiversity of the plant community in Pleasant Lake is considered to be very good and slightly greater than the biodiversity calculated for 24 Michigan inland lakes in 2012 which was 54.

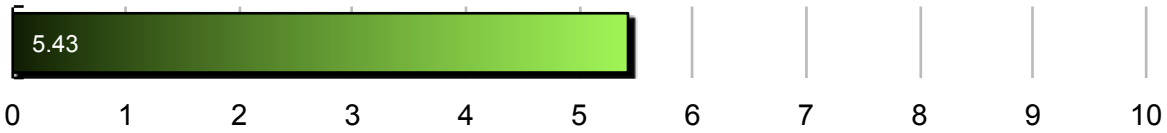
Total LakeScan™ Whole Lake Total Morphotypes

The total number of distinct plant morphotypes in Pleasant Lake is considered to be very good and slightly greater than the total found in most Michigan inland lakes.

LakeScan™ Whole Lake Plant Morphological Diversity 26 Index

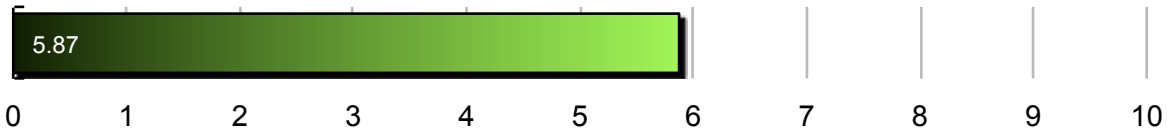
The morphodiversity index in Pleasant Lake is considered to be average and similar to values observed in most Michigan inland lakes. Even though there is a greater number of distinct plant morphotypes in Pleasant Lake, the morphotypes are not dispersed throughout the lake. Hence the morphotype index value for the lake is lower than might be expected.

Mean Coefficient of Conservatism "C" Value



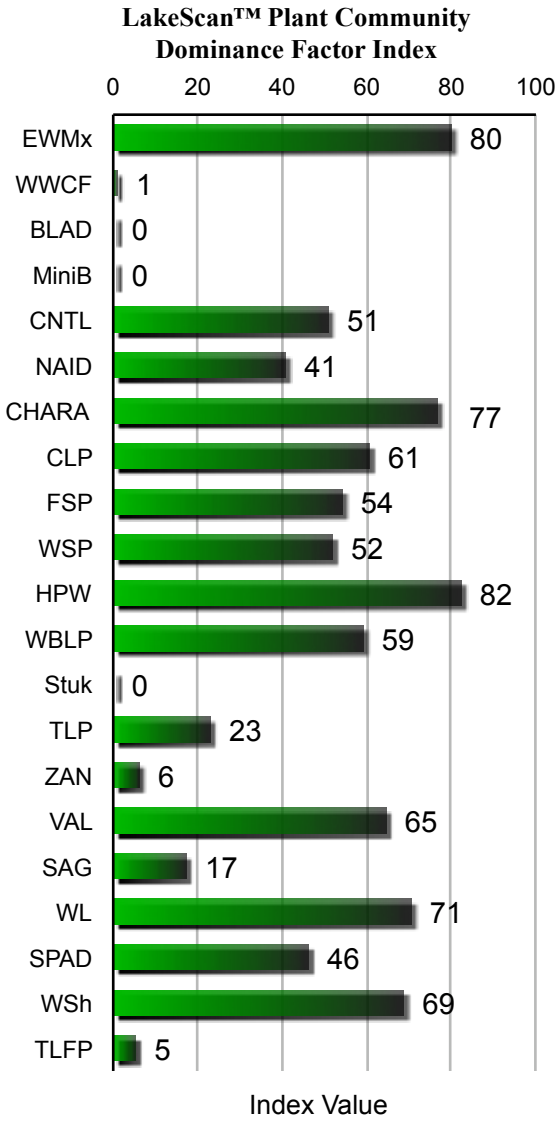
The mean coefficient of conservatism or "C" value found in Pleasant Lake is considered to be greater than the value found in most Michigan inland lakes and suggests that the quality of the plant community is very good.

LakeScan™ Invasive Weed "Weediness" Index Value



The LakeScan™ invasive weediness index in Pleasant Lake in 2013 is near the average value found in most Michigan inland lakes. Lakes such as these are usually managed in a fairly aggressive manner.

PLANT NAME, CODES, AND SELECTED ATTRIBUTES								
	CODE #	SHORT NAME	COMMON NAME	SCIENTIFIC NAME	"C" VALUE	"I" VALUE	"T" VALUE	MORPHOTYPE
1	2	EWMx	Eurasian Watermilfoil Hybrid	*Myriophyllum spicatum x sibiricum*	3	8	1	feathery
2	22	WWCF	White Water Crowsfoot	*Ranunculus sp.*	8	4	3	feathery
3	25	BLAD	Common Bladderwort	*Utricularia vulgaris L.*	7	4	3	feathery
4	27	MiniB	Mini-Bladderwort	*Utricularia sp.*	9	4	4	feathery
5	33	CNTL	Coontail	*Ceratophyllum sp.*	3	7	2	bushy
6	50	NAID	Naiad	*Najas sp.*	4	7	2	bushy
7	60	CHARA	Chara	*Chara sp.*	6	3	4	bushy
8	75	CLP	Curly Leaf Pondweed	*Potamogeton crispus L.*	2	9	1	narrow leafy
9	76	FSP	Flat Stem Pondweed	*Potamogeton zosteriformis Fern.*	6	5	2	narrow leafy
10	102	WSP	White Stem Pondweed	*Potamogeton praelongus Wulfen*	8	5	3	broad leafy
11	109	HPW	Hybrid Pondweed	*Potamogeton Hybrid*	5	5	2	broad leafy
12	110	WBLP	Weedy Broad Leaf Pondweed	*Potamogeton amplifolius Hybrid*	4	6	2	broad leafy
13	115	Stuk	Sago Pondweed	*Stuckenia sp.*	3	6	2	stringy
14	117	TLP	Thin Leaf Pondweed	*Potamogeton sp.*	5	5	4	stringy
15	120	ZAN	Horned Pondweed	*Zannichellia palustris L.*	7	5	3	stringy
16	125	VAL	Wild Celery	*Vallisneria americana Michaux*	3	7	2	grassy
17	126	SAG	Sagittaria	*Sagittaria sp.*	7	0	4	grassy
18	150	WL	Waterlily	*Nymphaea sp.*	6	5	2	floating leaf
19	153	SPAD	Spadderdock	*Nuphar sp.*	6	5	2	floating leaf
20	155	WSh	Water Shield	*Brasenia schreberi J.F. Gmel.*	7	5	3	floating leaf
21	166	TLFP	Thin and Floating Leaf Pondweed	*Potamogeton sp.*	5	0	3	floating leaf pondweed



The LakeScan™ plant dominance analysis demonstrates that milfoil and curly leaf pondweed are co dominant with a number of hybrid pondweeds. Typically milfoil and curly leaf pondweed would be clearly dominant and any management program would target these two species. The outcome of the management plant would typically satisfy most lake users and resident. If the lake is to appear less weedy, it will be necessary to target some of the hybrid weedy pondweeds, in addition to the exotic species and hybrids.

Management Program Specifications:

The Pleasant Lake higher plant community appears to be in a stable condition. Milfoil, hybrid pondweeds, water lilies, and wild celery dominate the submersed flora of the lake and are considered to have created weedy conditions. Current MI DEQ aquatic herbicide use policies allow for widespread management of Eurasian watermilfoil, milfoil hybrids and curly leaf pondweed. These policies will also allow for temporary suppression of nearly all submersed aquatic plant species, other than water lilies, in areas of the lake that are less than 5' deep or less than 300' off shore – whichever area is less. The total area that could be managed by this relatively non-selective, but temporary method is approximately 60 acres.

Blue green algae blooms were not conspicuously present in Pleasant Lake in 2013. The expansion of zebra mussel populations can lead to the development of conditions that would favor blue green algae production and needs to be closely monitored.

Runoff from shoreline development and imprudent aquatic plant management could cause significant disturbances and exacerbate some problems in the lake. Dense shoreline vegetation, including turf grass can serve to filter plant nutrients from runoff before it reaches the lake where it can fertilize suspended algae growth. Although there are many underlying causes of blue green algae blooms (see *Aquest Tip*), nutrient enriched runoff can help to support blue green algae production. Efforts need to be adopted to reduce nutrient loading to the lake. A ban on the use of phosphorus as a fertilizer should be enacted near the lake. Rooted aquatic plants derive their nutrients from the sediments and are not directly affected by nutrients in the water. See the included *Aquest Tip* for further explanation.

The recommended lake improvement program is intended to preserve key ecosystem functions that are necessary to support positive ecosystem attributes. Native, invasive plant controls may be needed in the short term, but should still be strictly limited to only those areas where it is absolutely necessary. Milfoil, curly leaf pondweed and weedy hybrid pondweeds all need to be aggressively managed if the lake weediness index is to be reduced. Failure to implement such a management plan will result in conditions that seriously restrict recreational uses of the lake.

Management Recommendations

Management Objectives:

The introduction and evolution of invasive plant and animal species in Michigan's inland lakes coupled with the emergence in increasingly disturbance tolerant "native" or hybrid genotypes represents a significant threat to the stability and integrity of inland lake ecosystems. Consequently, the principal management objective of the Pleasant Lake vegetation management plan should be to suppress the production of invasive submersed plant species to the greatest degree possible.

The management of Eurasian watermilfoil and curly leaf pondweed can be accomplished by the application species selective aquatic herbicides, and create little further disturbance of the ecosystem.

Although the management of native plant species (broad leaf pondweeds and thin leaf pondweeds) is not a primary objective of the lake management plan some of these plant species were observed to grow at a nuisance level in Pleasant Lake. It is anticipated that a shoreline submersed vegetation management program will be necessary in some areas to alleviate nuisance conditions.

Chara production should be encouraged and supported to cover as much of the bottom of Pleasant Lake as possible.

Water lily and spadderdock are common in Pleasant Lake. They do not appear to constitute a significant nuisance in most of the lake at this time. The MI DEQ will not permit the use of herbicides in some of the areas where the water lilies may be considered to be a significant nuisance. Mechanical harvesting is not regulated by the MI DEQ and can be used to clear lanes through the water lilies in some parts of the lake.

Action Plan:

Doing Nothing: It appears that the weediness of Pleasant Lake is not universally accepted by all lake users and shoreline residents. Milfoil is typically a serious nuisance in Michigan inland lakes; however, it is only co-dominant with several other plant species in Pleasant Lake. Several hybrid pondweed genotypes appear to create as great a recreational impediment as do milfoil and curly leaf pondweed. It is not expected that conditions will worsen in the lake if nothing is done, until it is invaded by starry stonewort. It is conceivable that the Pleasant Lake ecosystem can remain in a stable condition until it is invaded by starry stonewort.

Targeted Weed Management: of the 21 species of plants observed in Pleasant Lake, only four species are considered to be a nuisance or undesirable. Milfoil, curly leaf pondweed, and 2 species of weedy pondweed are the only species considered to be problematic at this time. Milfoil and Curly Leaf Pondweed shall be considered as T1 species by LakeScan™ nomenclature and should be targeted aggressively where ever possible, throughout the lake. The nuisance hybrid pondweeds are considered to be T2 species by LakeScan™ nomenclature and should be targeted for suppression in the MZL-3 areas of the lake. A special combination of herbicides should be applied to the lake as soon as nuisance plant production and temperature permit the application of these agents. An initial herbicide/algaecide application, made in the early summer, should provide acceptable control of nuisance species through the Fourth of July Holiday. A midsummer contact herbicide application may be required to manage nuisance native pondweed production and milfoil hybrids. Unlike harvesting, these herbicide combos can be used to target specific plant species and serve to protect and enhance the production of the many desirable species in Pleasant Lake. There are no biological controls that can be used to target all four of these target plants. It may also be desirable to target milfoil in the off-shore areas designated as part of MZL-1 with a very selective control strategy. Some may consider this to be optional since the nuisance level created by milfoil is low compared to other lakes. Selective treatments tend to be more expensive than some other treatment scenarios. The ultimate invasion, spread and proliferation of starry stonewort is expected to radically change the focus and nature of the management program. Even though this weed was not found in the lake in 2013, and management decisions must be based on the likely invasion of the lake and necessary changes to the management program. Water lily controls are not recommended for a variety of reasons at this time.

Estimated Annual Budget For Pleasant Lake

TOTAL ESTIMATED COST, 2014: $53,184

1 Aquatic Nuisance Plant Management and Plant Community Improvements: $42,920

	Zone	Total Acres	Target Species	Strategy Options	Option Name	Sub Total
1.a Early season herbicide applications, late May to early June	All of MZL 3	62	T-1 to T-2	3101.2	Triclo Play	$23,870
	All of MZL 1	47	T-1	1720.10	2,4-D	$17,625
1.c Early season filamentous algae, late June	MZL 3	15		3503.1	Copper Combo	$1,425

2 Monitoring and Program Guidance: $6,364

2.a LakeScan™ lake vegetation community monitoring, data analysis, and reporting — incl.

Specification of submersed aquatic flora management goals and short term objectives
Collection and analysis of critical vegetation community data

Detection of new or emerging threats to ecological stability and critical functions (new invasives)
Evaluation of program efficiencies and efficacy (based on LakeScan™ data analysis)
Lake to lake data comparisons (based on LakeScan™ data analysis)
Year to year data comparisons (based on LakeScan™ data analysis)
Technical guidance provided to County and SAD constituents
Meetings and Reports (all critical vegetation community metrics presented in annual report)

2.b Lake vegetation management prescriptives — incl.

2.c Contractor communication, technology review and development — incl

3 Administrative, Regulatory, and Permit Costs and Overhead: $3,900

3.a State of Michigan MI DEQ aquatic nuisance control permit — $900

(Cost is currently $800; however, SB444, which has just been passed by committee
and which will soon be voted on by both Michigan legislative branches, has an inflation factor
built into the permit fee formula. This cost has been extrapolated from the text of this bill and
is estimated and then averaged over the 5 year assessment period.)

3.b Township Administrative Support (typically 6%) — $3,000

Collection and maintenance of assessment fund
Management of all receivables and payables
Contractor bids, communications, and management
Critical participation in permitting issues

3.c Contingencies (5% of total but this figure depends on township) — $0

NOTES ON TOTAL ESTIMATED ANNUAL COSTS:

Currently, there are no federal, State, or local grants available for invasive species management. Consequently, the costs of improvements are usually borne by those who are benefited by the actions of the proposed improvement program. An assessment formula can be devised by the Township and County with significant input from local residents that can equitably distribute the costs of the improvements according to relative benefits derived by those that reside or own property within the boundaries of the special assessment district.

Further Reading

Aquest Corporation strives to create concise reports that are not bloated with "filler". Consequently, we have developed a number of narratives that help to understand some of the concepts and ideas used to develop the lake management plan. These are provided as "Aquest Tips" and are offered to assist the reader if they wish to gain a deeper understanding of the fundamentals of the management plan.. Some are included in the report and identified in text boxes. Others are attached to the management plan update for those who wish to read and consider their content.

Aquest TIP:

Blue Green Algae Part 1:

Why All the Concern?

Blue green algae blooms are becoming increasingly common in Michigan. Blooms can appear as though green latex paint has been spilled on the water, or resemble an oil slick in enclosed bays or along leeward shores. Blue green algae blooms are usually temporal events and may disappear as rapidly as they appear. Blue green algae blooms are becoming more common for a variety of reasons; however, the spread and impact of the zebra mussels has been closely associated with blooms of blue green algae according to MSU researchers.

Blue green algae really a form of bacteria known as the cyanobacteria. They are becoming an important issue for lake managers, riparian property owners and lake users because studies have revealed that substances made and released into the water by some of these nuisance algae (cyanobacteria) can be toxic or carcinogenic. They are known to have negative impacts on aquatic ecosystems can potentially poison and sicken pets, livestock, and wildlife. Blue green algae and can have both direct and indirect negative impacts on fisheries. Persons can be exposed to the phytotoxins by ingestion or dermal absorption (through the skin). They can also be exposed to toxins by inhalation of aerosols created by overhead irrigation, strong winds, and boating activity. Studies are in progress to determine how serious the potential risks are to lake users and those exposed to blue green algae tainted water by other means.

An invasive, exotic blue green alga has recently been found in Michigan. Cylindro is also capable of producing phytotoxins and has been implicated in some public health incidents in Florida. Work groups in Indiana and Wisconsin have not reported similar incidents in their respective states. Unfortunately cylindro blooms are not obvious and the water must be sampled and analyzed to detect their presence.

It is estimated that approximately one half of obvious blue green algae blooms contain phytotoxins. Water resource managers and users are urged to not panic, but remain pre-cautious. Until studies are completed, it is recommended that persons not swim in waters where blue green algae blooms are conspicuously present. Specifically persons should avoid contact with water where blooms appear as though green latex paint has been spilled on the water, or where the water in enclosed bays appears to be covered by an "oil slick". Pets should be prevented from drinking from tainted water. Because the blue green algae toxins can enter the human body through the lungs as aerosols it is suggested that water where there are obvious blue green algae blooms not be used for irrigation of areas where persons may be exposed to the irrigation water. Blue green algae blooms are usually temporal events and may disappear as rapidly as they appear, so it is important to closely monitor lakes that contain occasional or persistent blue green algae blooms.

Fortunately, blue green algae can be easily controlled by a variety of methods. There is increasing evidence that the blue green algae can be targeted specifically with certain algaecides. These strategies could help lake managers to selectively manage and improve suspended algae communities. The MI DEQ does not permit these treatments, so lake users are advised to use caution when entering blue green tainted water.

Aquest TIP:

Blue Green Algae Part 2:

Why Do Blue Greens Become a Problem:

Blue Green Algae are probably not very good competitors with other, more desirable forms of algae. They typically bloom and become a nuisance when resources are limiting or when biotic conditions reach certain extremes. Some of the reasons that blue green algae can bloom and become noxious are listed below:

1. **TP and TN**

   The total phosphorus (TP) concentration in a water resource is usually positively correlated with the production of suspended algae (but not rooted plants, i.e. seaweed). Very small amounts of phosphorus may result in large algae blooms. If the ratio of total nitrogen (TN) to total phosphorus is low (<20), suspended algae production may become nitrogen limited and noxious blue green algae may dominate a system because they are able to "fix" their own nitrogen from atmospheric sources. Other common and desirable algae are not able to do this.

2. **Free Carbon Dioxide**

   All plants, including algae, use carbon dioxide in photosynthesis. Alkalinity, pH, temperature, and the availability of free carbon dioxide are all closely related and inter-regulated in what can be referred to as a lake water buffering system. Concentrations of these key water constituents will shift to keep pH relatively constant. Carbon dioxide is not very soluble (think about the bubbles of carbon dioxide that escape soda pop). The availability of this essential substance can be in short supply in lake water. Many blue green algae contain gas "bubble" that allow them to float upward in the water column toward the water surface where they can access carbon dioxide from the atmosphere. Consequently, blue green algae that can float have a competitive advantage in lakes where carbon dioxide is in low supply in the water. This is also why blooms form near the surface of the water.

3. **Biotic Factors**

   Zebra mussels and zooplankton (microscopic, free-floating, animals) are filter feeding organisms that strain algae and other substances out of the lake water for food. They already know about the blue green algae and find them unpalatable. Studies have shown that filter feeding organisms often reject blue green algae and feed selectively on the good algae. Over time, and given enough filter feeding organisms, a lake will experience a net loss in "good" algae and a gain in "bad" blue green algae as the "good" algae are consumed and the "bad" algae are rejected and "spit" back into the water. This is one of the most disturbing factors association with the invasion and proliferation of the zebra mussel. Lakes that are full of zebra mussel may not support the production of "good" algae and experience a partial collapse of the system of "good" algae that are necessary to support the fishery.

Aquest Tip:

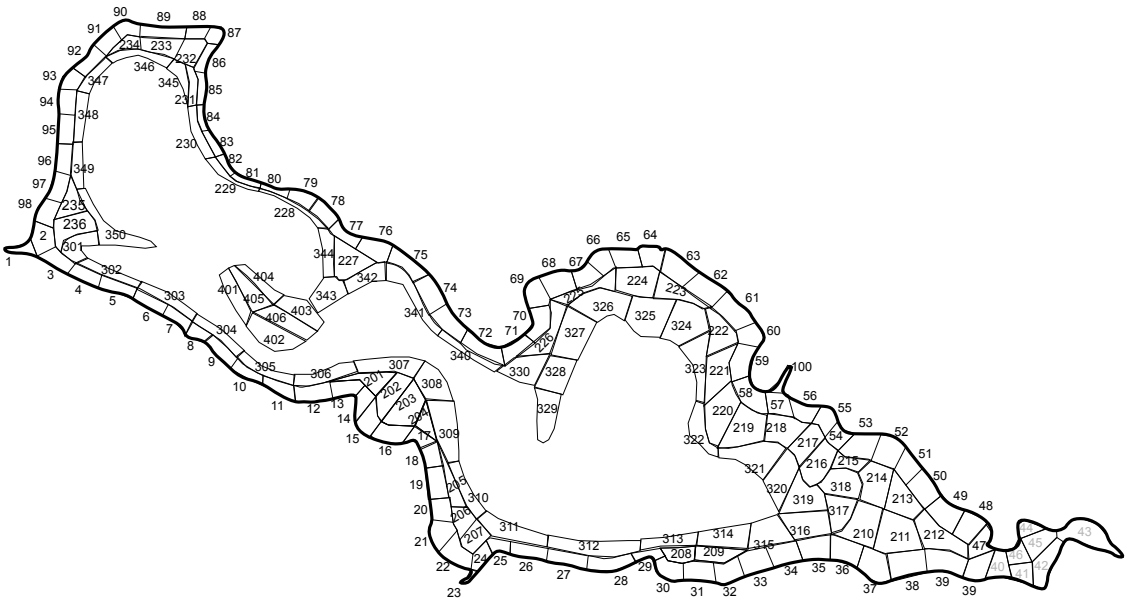
Rationale for Managing Aquatic Vegetation

Lake leaders and managers cringe when they hear someone say that "the lake has never been this bad before". Often the comment is made without accurate recollection of of recent lake conditions; however, there is truth in the statement when lakes are considered within the context of the past several decades. When aquatic vegetation cover and biomass become sufficiently high to disrupt the natural balance of a lake and interfere with recreation people begin to seek solutions to the problems. Aquatic weeds are usually referred to as being a nuisance or invasive. The list of nuisance and invasive plants has grown much longer in the past three decades as weedy species have invaded North America from other continents and other species have become more problematic as they respond to human activity and the introduction of foreign species. Excessive aquatic plant growth interferes with nearly all forms of recreation and causes many biological problems. For example, dense plant growth at the water surface impedes exchange of gases between the air and water, thereby contributing to nighttime dissolved oxygen depletion and large daily pH fluctuations. Dense invasive species growth can cause the desirable plants to decline and can destroy the quality of spawning habitats. Production of desirable sport fish (e.g., largemouth bass) is maximized at intermediate levels of plant cover and biomass. Boaters and swimmer are usually satisfied with the conditions that support a good fishery. It is fortunate that there a number of things that can be done to improve or renovate aquatic plant communities to enhance recreation, improve fishery habitats, and make lakes more resilient to the invasion of new or emerging weeds.

The list of invasive plant species that create problems in Michigan lakes is expanding rapidly. Invasive species are often exotic, which are plants that do not naturally occur in the same geographical area but invade lakes after being introduced from other parts of the world. Invasive plants do not necessarily have to be exotic. Native species or hybrids can emerge as invasive plant genotypes that dominate parts of a lake in response to the selective pressures placed on aquatic vegetation communities as a result of human activity and invasion of other invasive species. Exotic and invasive plant genotypes typically form dense mono-specific (single species) plant beds that result in a loss of plant community diversity, habitat complexity, ecosystem stability, and resilience. Lake quality is seriously degraded unless unless interventions are applied and the offensive plant species are suppressed. It is not possible to reduce the total amount of aquatic plant biomass that is produced in a lake. And, it may not even be desirable to do that. Generally the problem is not really too much plant growth, but too much of the wrong kind of plant growth.

At moderate density levels, aquatic plants provide important benefits to the lake, including sediment stabilization, invertebrate habitat and cover for small fish. Thus, management of problem aquatic plant growth should be carried in such a way as to preserve desirable aquatic vegetation or preferred plant species. Most preferred species are characteristic of stable, undisturbed ecosystems and are not usually considered to be a nuisance. Effective aquatic plant management can preserve beneficial aquatic vegetation in a number of ways. Selective techniques control problem species with minimal effect on desirable ones. Desirable vegetation can also be preserved by limiting the application of control techniques to areas where they are needed. In general, areas in every lake should be set aside to support different types of plants. For example some of these areas may support plants that may interfere with boating, but create good "edge effect" for anglers. There are lower growing plant species that should be maintained in areas of the lake where boating is really important. Because invasive species fail to recognize the boundaries of the lake management plan proper vegetation management is a "whole lake proposition". It is certain that a lakes in Michigan will never have "been so bad" unless responsible lake communities take action to mitigate against the consequences of ecosystem disturbance and target invasive species for suppressive management activity.

An AROS Map for Pleasant Lake



Management Zone Level Map