Joslin Lake

Lyndon Township, Washtenaw County

Michigan

Management Opinion

2007

Executive Summary:

~ Milfoil, curly leaf pondweed, and starry stonewort are expected to grow to nuisance levels in 2008 and for years to come if appropriate management actions not taken. Aggressive, but selective control is recommended all of these plants.

~ Some discrete control of near-shore, native plants may be required to improve swimming and boat access near some residences.

~ 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.

~ The lake must be monitored to 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, and red ludwigia.

Prepared by:

G. Douglas Pullman, Ph.D.
Aquest Corporation
1110 South Drive
Flint, MI 48503
aquest@mac.com

Joslin Lake

2007 Management Opinion

Purpose of Inquiry:

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

Introduction:

Joslin Lake is located in Lyndon Township, Washtenaw County, Michigan. Some shoreline residents on the north end of the lake are located in Unadilla Township, Livingston County. The submersed vegetation community was briefly surveyed by Washtenaw County and Aquest Corporation personnel during 2007 as part of a review of conditions that can be used to form the basis for a lake improvement and management plan. These kinds of data are critical to provide direction for the implementation of lake management plans and as a means of assessing the efficacy of lake management programs.

Administrative and Management Authority:

The residents of Joslin Lake have requested that the Washtenaw County Board of Public Works investigate the feasibility of establishing a special assessment district to administer a program to implement and fund improvements to the lake.

Morphometric Data:

Lake Size:	187 acres
Maximum Depth	20 feet
Mean Depth	~ 3.5 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 to make it easier for opportunistic or nuisance species to become established and flourish. Ecosystem functions are compromised by a wide range of conditions which are referred to as natural and cultural (man-made) disturbances. 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 are commonly described as not meeting the expectations of lake user groups from an aesthetic, utilitarian, or recreational perspective. 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 Joslin 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 Joslin 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 sediments 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 is 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 only. 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 Management Plan

Joslin Lake is a 187 acre lake, located in Lyndon Township, Washtenaw County, Michigan. There are several inlet channels and “ditches” located around the lake with a signficant inlet on the northeastern shore that appears to connect the lake to several located to the north. Water exits the lake over a control structure located at the end of a channel on south end of the lake. Water flows from Joslin Lake to South Lake in the Pinkney State Recreation Area. Nearly all of the lake is less than 5’ deep and appears to be suitable for the support of luxuriant plant growth. There is a MI DNR public launch site on the southeastern shore.

The organic content and fertility of the sediments in Joslin Lake appear 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 near the northern and eastern shorelines. 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 areas 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 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 can sometimes grow to nuisance levels over muck sediments. The combination of opportunistic plant species and nuisance algae growth in areas dominated by organic sediments can cause these areas of lakes to be considered as unsightly or undesirable. Consequently, these areas may require more management effort and expense to be maintained as acceptable levels. Joslin 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 watermifoil, curly leaf pondwed, and starry stonewort.

Cultural Use Considerations:

Joslin 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:

Approximately one half of the entire shoreline of Joslin Lake has been developed for residential uses. All of the residences on Joslin Lake appear to be "year round" dwellings. Extensive wetlands are located around the southern and western shorelines of the lake. The Joslin Lake watershed is characterized by mixed uses which includes agriculture, forested areas, some residential, and the afore mentioned wetland complexes. Waterside landscapes should be managed to minimize disturbance of the lake ecosystem.

Biological Survey Overview:

Milfoil: According to reports, the exotic plant species, watermilfoil has only been been recognized as a problem in Joslin Lake for a few years. The dominant milfoil genotype in Joslin Lake is not known. The milfoil plants could be hybrid types, however, it is impossible to make a definitive determination without genetic analysis.

Curly Leaf Pondweed: Curly leaf pondweed is another exotic invasive plant species, like milfoil. 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 has been successfully managed in Joslin Lake for many years.

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 identified in Joslin Lake in 2007 and appears to be spreading. It will probably become a modest nuisance in 2008. Starry stonewort is a charoid species that is nearly impossible 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 Joslin 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. It is important to remember that starry stonewort is likely to crowd out most native plant species, including the pondweeds. Any problems that may have occurred as a result of pondweed production is likely to diminish in the coming years as starry stonewort spreads and dominates Joslin Lake.

Other Considerations. A suspicious looking and potentially hybrid watermilfoil was found in Lower Straits Lake in 1992 by Aquest and State regulatory personnel. The plant exhibited characteristics of both Eurasian watermilfoil and the native Northern Watermilfoil and was dubbed "norasian watermilfoil". Unfortunately, most North American aquatic plant biologists doubted that such a hybrid might exist. Genetic analysis of plant chlorophyll by University of Connecticut researchers in 2003 finally determined that a hybrid was indeed present in that lake and several others. Extensive studies related to herbicide tolerance are being conducted at the University of Michigan - Flint. It appears that there are several Eurasian watermilfoil and hybrid milfoil genotypes that are tolerant of a wide range of herbicide and biological controls. The strain of milfoil in Joslin lake may tolerate some the common aquatic herbicides so it is important to monitor the outcome of any herbicide treatment program. Since the discovery of management tolerant strains of milfoil, Aquest scientists have worked with various aquatic herbicide applicators to develop effective means to manage a wide range of milfoil genotypes. For this reason, a combination of control agents is recommended to provide adequate and consistent control of milfoil in Joslin Lake.

Management Program Specifications:

The Joslin Lake higher plant community appears to be in a threatened condition. Milfoil and starry stonewort are present in Joslin lake and will have a profound impact on lake ecology, recreation, and lake management and improvement budgets. Ecosystem stability will be compromised by the uncontrolled spread of these species; however, some recreational values may be temporarily enhanced by the spread of starry stonewort. Starry stonewort has been observed to make areas of some lakes more accessible to boating. On the other hand, the fishery may decline as a result of the spread and proliferation of starry stonewort. Current MI DEQ policies prohibit the effective management of starry stonewort for the protection of fisheries. The fishery will decline as a result of excessive plant cover. Plant community monitoring is strongly indicated for 2008.

Blue green algae blooms were not conspicuously present in Joslin Lake in 2007. 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. Residents are advised to monitor the lake for the presence of zebra mussels and report any findings to County officials. Phytoplankton monitoring is also recommended for 2008.

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 starry stonewort all need to be aggressively managed as soon as possible. Starry stonewort management strategies are still in development; however, action needs to be taken to protect the lake and fishery

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 Joslin 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 Joslin Lake. It is anticipated that a discrete 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 Joslin Lake as possible. However, the management of starry stonewort will be required to protect chara populations and other species. Best management practices have not yet been determined for starry stonewort. Some trial and error management strategy development will be required to effectively manage starry stonewort in Joslin Lake. The management plan for starry stonewort must be created within the context of proximity to other plants which are known to be a part of the submersed flora of Joslin Lake.

Water lily and spadderdock are common in Joslin Lake. They do not appear to constitute a significant nuisance accept 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:

Michigan DEQ places restrictions on the use of aquatic herbicides and in turn have created a barrier to the use and implementation of strategies that would have the greatest benefit for Joslin Lake. The application of contact herbicides and algaecides is recommended for the control of nuisance plant growth in Joslin Lake in 2008. Contact 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 milfoil and starry stonewort. Representatives of the lake should make a thorough assessment or request the assistance of Aquest Corporation before herbicides are applied to the lake in midsummer. The control of nuisance pondweed production should be restricted to discrete applications to those areas plagued by excessive growth near boat docks and swimming areas. One or possibly two algaecide applications may be necessary for the control of nuisance algae and starry stonewort. Lake resident participation in this part of the management program is essential. The expected spread and proliferation of starry stonewort is likely to eliminate the need for mechanical harvesting in Joslin Lake because it is expected to eliminate any nuisance rooted plant production from the middle of the lake where harvesting operations are normally concentrated. Waterlily controls are not recommended for a variety of reasons at this time.

Estimated Costs:

The cost for weed control in 2009 is estimated to be near $38,000. This includes:

- Two herbicide applications (65 acres early summer, 10 acres midsummer),
- Discrete control of near-shore nuisance vegetation (with early summer application),
- Application of algaecides for starry stonewort control (40 acres, several applications during the course of the year), and
- Filamentous algae (40 acres, several applications during the course of the year).

The cost of the State of Michigan permit application fee will be $800.

Limnological monitoring, fisheries habitat analysis, phytoplankton community monitoring and related services are expected to be $10,364.

The total cost of improvements and program management is estimated to be $51,268 for the first year of an assessment period.

The total cost of lake improvements and monitoring for 5 years is estimated and provided on the attached estimate form. 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 boundries of the special assessment district.

Joslin Lake, Washtenaw County, MI

Estimated Budget Worksheet for: 2008

Year 1

Lake Improvements
Nuisance Control √ $37,625

	# of Tmt Events	TMT Area	EWM Control	TMT Area	CLP Control	TMT Area	Celery Contol	TMT Area	Other Nuisance Contol	TMT Area	Broad Spectrum	TMT Area	Chara Algae	TMT Area	Filament Algae	TMT Area	Plankton Algae
Herbicides	2	75	$26,250														
Algaecides	2											75	$7,125	50	$4,250		
Mechanical	0																
Other																	

Professional Services			**Administrative Services**			**Regulatory Costs**		
Vegetation Monitoring	√	$4,696	Local Administration Costs	√	$600	Permit Fee	√	$800
WQ Monitoring	√	$2,768	Communications	√	$630	Special Permit Application Prep		
Fishery Monitoring	√	$2,900	Contractor Bids	√	$600	Regulatory Study Requirements		
Special Studies			SAD Hearings	√	$648			

TOTAL ESTIMATED COST $51,267

Year 2

Annual Inflation Rate 2%

Lake Improvements
Nuisance Control √ $38,378

	# of Tmt Events	TMT Area	EWM Control	TMT Area	CLP Control	TMT Area	Celery Contol	TMT Area	Other Nuisance Contol	TMT Area	Broad Spectrum	TMT Area	Chara Algae	TMT Area	Filament Algae	TMT Area	Plankton Algae
Herbicides	2	75	$26,775														
Algaecides	2											75	$7,268	50	$4,335		
Mechanical	0																
Other																	

Professional Services			**Administrative Services**			**Regulatory Costs**		
Vegetation Monitoring	√	$4,790	Local Administration Costs	√	$612	Permit Fee	√	$800
WQ Monitoring	√	$2,823	Communications	√	$643	Special Permit Application Prep		
Fishery Monitoring	√	$2,958	Contractor Bids			Regulatory Study Requirements		
Special Studies			SAD Hearings					

TOTAL ESTIMATED COST $51,003

Year 3

Annual Inflation Rate 2%

Lake Improvements
Nuisance Control √ $46,090

	# of Tmt Events	TMT Area	EWM Control	TMT Area	CLP Control	TMT Area	Celery Contol	TMT Area	Nuisance Contol	TMT Area	Broad Spectrum	TMT Area	Chara Algae	TMT Area	Filament Algae	TMT Area	Plankton Algae
Herbicides	2	75	$27,311					15	$5,462								
Algaecides	2											90	$8,895	50	$4,422		
Mechanical	0																
Other																	

Professional Services			**Administrative Services**			**Regulatory Costs**		
Vegetation Monitoring	√	$4,886	Local Administration Costs	√	$624	Permit Fee	√	$800
WQ Monitoring	√	$2,880	Communications	√	$655	Special Permit Application Prep		
Fishery Monitoring	√	$3,017	Contractor Bids			Regulatory Study Requirements		
Special Studies			SAD Hearings					

TOTAL ESTIMATED COST $58,952

Year 4

Annual Inflation Rate 2%

Lake Improvements
Nuisance Control √ $46,216

	# of Tmt Events	TMT Area	EWM Control	TMT Area	CLP Control	TMT Area	Celery Contol	TMT Area	Other Nuisance Contol	TMT Area	Broad Spectrum	TMT Area	Chara Algae	TMT Area	Filament Algae	TMT Area	Plankton Algae
Herbicides	2	75	$27,857					25	$9,286								
Algaecides	2											90	$9,073	50	$4,510		
Mechanical	0																
Other																	

Professional Services			**Administrative Services**			**Regulatory Costs**		
Vegetation Monitoring	√	$4,983	Local Administration Costs	√	$637	Permit Fee	√	$800
WQ Monitoring	√	$2,937	Communications			Special Permit Application Prep		
Fishery Monitoring	√	$3,078	Contractor Bids			Regulatory Study Requirements		
Special Studies			SAD Hearings					

TOTAL ESTIMATED COST $58,651

Year 5

Annual Inflation Rate 2%

Lake Improvements
Nuisance Control √ $53,851

	# of Tmt Events	TMT Area	EWM Control	TMT Area	CLP Control	TMT Area	Celery Contol	TMT Area	Other Nuisance Contol	TMT Area	Broad Spectrum	TMT Area	Chara Algae	TMT Area	Filament Algae	TMT Area	Plankton Algae
Herbicides	2	75	$28,414					40	$15,154								
Algaecides	2											100	$10,283	50	$4,600		
Mechanical	0																
Other																	

Professional Services			**Administrative Services**			**Regulatory Costs**		
Vegetation Monitoring	√	$5,083	Local Administration Costs	√	$649	Permit Fee	√	$800
WQ Monitoring	√	$2,996	Communications	√	$682	Special Permit Application Prep		
Fishery Monitoring	√	$3,139	Contractor Bids	√	$649	Regulatory Study Requirements		
Special Studies			SAD Hearings	√	$701			

TOTAL ESTIMATED COST $68,552

5 YEAR TOTAL COST ESTIMATE **$288,425**

ANNUAL AVERAGE COST **$57,685**

Aquest Corporation ~ 1110 South Drive ~ Flint, MI 48503 ~ 810-237-8893 ~ aquest@mac.com

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.