Sylvan Lake Aquatic Vegetation Management Plan Update 2009
Noble County, Indiana

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SYLVAN LAKE AQUATIC VEGETATION MANAGMEENT PLAN 2009
NOBLE COUNTY, INDIANA

EXECUTIVE SUMMARY

This document is intended to summarize the aquatic plant surveys and the aquatic herbicide treatment in 2009 in Sylvan Lake, Noble County, Indiana. The following summary specifically addresses the results of the aquatic plant chemical treatments conducted during the 2009 season and compares the results with variations in the plant communities at Sylvan Lake over a period of the past three growing seasons. Although the Sylvan Lake Improvement Association has been involved with the LARE program for 5 years and 2009 was the last year in their 5-year plan, the SLIA will continue to treat the aquatic exotic species in Sylvan Lake.

In 2009, the only method of control was chemical in nature and was intended to target Eurasian water milfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus*), coontail (*Ceratophyllum demersum*), and algae (*Filamentous algae*). Eurasian water milfoil and curly-leaf pondweed are exotic to Indiana lakes. On May 12, 2009, 275 acres of curly-leaf pondweed were treated by Weed Patrol Inc. (Elkhart, Indiana) within the lake. On May 29, 2009, Weed Patrol Inc. treated an additional 5 acres of curly-leaf pondweed at the inlet to the lake. On May 28 and 29, 2009 approximately 48 acres of Eurasian water milfoil was treated throughout the lake. On August 11, 2009, approximately 10 acres of coontail and algae were treated. Due to differences in acreage treated and dosage utilized, treatment methodologies differed for the three target species. A low rate of Aquathol K herbicide (0.5 ppm) was used to control curly-leaf pondweed in some parts of the lake while not harming native pondweeds or other aquatic species. A higher rate of Aquathol K herbicide (1.0 ppm) was also used to treat the curly-leaf pondweed in Pit Basin due to the species overabundance in this part of the lake. The inlet to Sylvan Lake is located in Pit Basin and has only recently been identified as the main source of curly-leaf pondweed infestation. A three-year treatment plan was implemented in Sylvan Lake in 2007 to treat areas where curly-leaf pondweed was identified in dense beds in previous years and in 2007. Since then, treatment has continued in those areas to attempt to minimize the turion bank. Areas were treated selectively for Eurasian water milfoil using 2, 4-D. Areas treated for coontail were treated with Reward.

Tier II surveys were conducted during the spring (May 15 to June 15) and summer (July 15 to August 30). The former is a pre-treatment survey which occurred to determine the nature of the plant community, and the latter is a mid-summer survey to determine how the aquatic plant community responded following treatment. In Sylvan Lake, the spring, pre-treatment survey was completed following the initial curly-leaf pondweed treatment but prior to the Eurasian water milfoil treatment. In 2010, however, the spring Tier II survey will be required to take place prior to the curly-leaf pondweed treatment.

JFNew's review of Tier II surveys from 2003 to 2009 indicates that herbicidal treatment of curly-leaf pondweed is providing control of this exotic species in Sylvan Lake.

However, the Eurasian water milfoil population has not followed a stable trend in recent years. Comparison of spring Tier II survey data from 2003, 2005, 2007, 2008, and 2009, data indicate that Eurasian water milfoil frequency and dominance decreased from 2003 to 2007, increased in 2008, and decreased again in 2009. This is not the case for curly-leaf pondweed populations; in 2003, curly-leaf pondweed was present at nearly 45% of the sites, 9% of the sites in 2005, and 29% of the sites in 2007, decreased to 8% of the sites in 2008, but increased to 27% of sites in 2009. One possible explanation for this is that curly-leaf pondweed in Sylvan Lake has historically undergone less rigorous treatment than treatments targeting Eurasian water milfoil. In 2007 and 2008 up to 300 acres of curly-leaf pondweed was treated, which would account for the decrease in density over those two years, but it increased from 2008 to 2009, most likely due to the cool spring and early summer we had and the contributing lake upstream of Henderson Ditch that is abundant in curly-leaf pondweed. There is a small lake upstream of Sylvan Lake and the curly-leaf infestation in that lake is most likely feeding the turion bank in Sylvan Lake, specifically, Pit Basin where the inlet is located. Ownership of the lake is still being determined for funding and treatment purposes.

Although 2009 was the final year of the three-year cycle for treating curly-leaf pondweed in Sylvan Lake, curly-leaf pondweed should continue to be treated in 2010. The exotic species has not been eradicated from the lake and is still a major problem in Pit Basin so treatment efforts should continue. This treatment would be less extensive in 2010 and more of a spot treatment in areas where curly-leaf pondweed has historically been identified in dense beds.

The effects of the treatment on the native aquatic plant community are unclear throughout the entire lake, although most native aquatic plants identified in previous years were still present during the 2009 surveys. Comparing the 2009 spring and summer Tier II survey metrics indicates that the quality of the native aquatic plant community in Sylvan Lake increased following treatment. After an unseasonably cool spring and the treatment of curly-leaf pondweed in May, most of the native plants from previous years' surveys were identified in 2009, as documented during the spring and summer surveys. Coontail still dominated the aquatic plant community before and after treatment. The effects of the treatment on the native aquatic plant community are still unclear in Pit Basin due to the dense beds of curly-leaf pondweed, Eurasian water milfoil, and coontail that still thrive in that part of the lake.

Additional items including a public meeting and a meeting between the contractor, LARE program staff, the district fisheries biologist, and a representative from the Sylvan Lake Improvement Association (SLIA), also occurred in concert with this aquatic plant management plan update. The details of these are not repeated here, but were utilized to generate recommendations as follows:

1. Treatment should occur when water temperatures approach 50°.
2. Treatment of 60 acres of curly-leaf pondweed is proposed for 2010.
3. Treatment in Pit Basin should occur at a rate of 1 mg/L (0.6 to 3.8 gallons/acre depending on depth) of Aquathol K. Treatment throughout the rest of the lake

should occur at a rate of 0.5 mg/L where curly-leaf pondweed has been observed in the past.

4. Treatment of approximately 60 acres of Eurasian water milfoil with 2,4-D throughout Sylvan Lake. Areas are identified in the following sections, but should be confirmed prior to treatment occurring in 2010.
5. Implement control of native species whose growth has reached nuisance levels, specifically, control of coontail and filamentous algae within Sylvan Lake. At this time, it is estimated that control of coontail will cover up to 30 acres and control of filamentous algae will cover up to 25 acres in 2010.
6. Continue pre-treatment assessments to determine where treatment in 2010 needs to occur.

In 2010, treatment, aquatic plant community assessment, and plan updates are anticipated to cost $53,000. Treatment costs should be reduced over the following years and at a minimum should not exceed $53,000.

Budget estimate for the action plan.

Task	2010	2011	2012
Curly-leaf pondweed treatment - 60 acres	$18,000	$15,000	$15,000
Eurasian water milfoil treatment- 60 acres	$24,000	$24,000	$24,000
Plant sampling and plan update	$6,000	$6,000	$6,000
Native plant and algae treatment	$5,000	$5,000	$5,000
Total	**$53,000**	**$51,500**	**$51,500**

During the 2009 growing season the following actions were taken.

- May 12, 2009: 275 acres of curly-leaf pondweed treated.
- May 19, 2009: Tier II spring aquatic plant survey completed.
- May 29, 2009: 5 acres of curly-leaf pondweed treated at inlet to lake.
- May 28-29, 2009: 48 acres of Eurasian water milfoil treated.
- August 4, 2009: Tier II summer aquatic plant surveys completed.
- August 11, 2009: 10 acres of coontail and algae treated.
- September 30, 2009: Public meeting to discuss initial aquatic plant survey results and treatment.
- November 19, 2009: Meeting between the SLIA, JFNew, and IDNR to discuss 2010 treatment options.

ACKNOWLEDGEMENTS

The Indiana Department of Natural Resources Division of Fish and Wildlife as part of the Lake and River Enhancement Program (LARE) provided funding for the development of this plan. The plan has been developed in cooperation with the Sylvan Lake Improvement Association (SLIA). Fieldwork, data analysis and map generation was performed by JFNew with the assistance of the SLIA volunteers. Special thanks to Ralph Cristman for his exceptional driving skills and Jeff Bauermeister, Joe Costello, Angela Sturdevant, and Tony Cunningham for their input and oversight. Contributors include: Betsy Ewoldt, Scott Namestnik, and Tom Estrem.

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SYLVAN LAKE AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2009
NOBLE COUNTY, INDIANA

1.0 Introduction

This report serves as an update to the Sylvan Lake Aquatic Plant Management Plan Revision 2007-2011 (JFNew, 2007). This update will serve to track changes in the vegetative community, to adjust the action plan as needed, and to maintain eligibility for additional LARE funds. Items covered include a review of details of the 2006, 2007, 2008, and 2009 vegetation control efforts; spring and summer Tier II results from the 2009 season; a comparison of Tier II results from 2003 to 2009 completed by the IDNR, Weed Patrol, and JFNew; a recap from the public meeting and the planning meeting; and a discussion of potential management implications of the results. This plan will also detail the results of the 3-year curly-leaf pondweed treatment that was completed in 2009. The plan update was funded by the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement Program (LARE) and the Sylvan Lake Improvement Association (SLIA). This is the fourth year that the SLIA has been involved in aquatic plant management planning through the LARE program.

During the 2009 growing season the following actions were taken.

- May 12, 2009: 275 acres of curly-leaf pondweed treated.
- May 19, 2009: Tier II spring aquatic plant survey completed.
- May 29, 2009: 5 acres of curly-leaf pondweed treated at inlet to lake.
- May 28-29, 2009: 48 acres of Eurasian water milfoil treated.
- August 4, 2009: Tier II summer aquatic plant surveys completed.
- August 11, 2009: 10 acres of coontail and algae treated.
- September 30, 2009: Public meeting to discuss initial aquatic plant survey results and treatment.
- November 19, 2009: Meeting between the SLIA, JFNew, and IDNR to discuss 2010 treatment options.

Although Sylvan Lake has been involved with the LARE program for five years, and technically this is their final year for funding through the LARE program, the SLIA plans to continue treatment efforts in the years to come. Other funding sources available for the lake association are detailed in subsequent sections of this report.

2.0 Watershed and Lake Characteristics

Sylvan Lake is a headwaters lake in the Great Lakes Basin. Surface water drains to Sylvan Lake via three primary routes: through Henderson Ditch, through an unnamed tributary which enters through the northwest corner of the lake, and via direct drainage. Oviatt Ditch drains into Henderson Ditch before it reaches Sylvan Lake. Henderson Ditch empties into Sylvan Lake in the lake's northeast corner. This ditch is a legal drain, which means that the drain is maintained by the drainage board. Furthermore, any activity in and around the drain must be approved by the drainage board prior to the activity occurring. An unnamed tributary transports water to Sylvan Lake from the watershed north of the lake emptying into the lake along its northern boundary.

Sylvan Lake consists of two deep basins surrounded by shallower water. The lake's deepest point lies in the southeast basin of the 669-acre lake. Here, the lake extends to its maximum depth of 33 feet (10 m; Table 1). One shallower hole lies east of the deepest hole in the lake reaching a maximum depth of 30 feet (9.1 m).

Table 1 summarizes the surface area, volume, and other geographic information for Sylvan Lake and its watershed. Sylvan Lake possesses various expanses of shallow water. The lake's area gradually increases with depth to a water depth of about 10 feet (3 m) before the rate of change increases. This rate (slope of lake bottom) continues to the lakes maximum depth (33 feet or 10 m). Sylvan Lake holds approximately 6,690 acre-feet of water.

Table 1. Morphological characteristics of Sylvan Lake.

Characteristic	Value
Surface Area	669 acres
Volume	6,690 acre-feet
Maximum Depth	33 feet
Mean Depth	10 feet
Shoreline Length	71,157 feet
Shoreline Development Ratio	3.7
Residence Time	0.7 years (256 days)

Watershed and lake descriptions, including shoreline development in Sylvan Lake, have not changed in the past year. For more detailed information about shoreline descriptions and information see the Sylvan Lake Aquatic Plant Management Plan Revision 2007-2011 (JFNew, 2007).

3.0 Lake Uses

General lake use areas and high quality, natural shorelines are identified in Figure 1. Specifically, the undeveloped shoreline areas in Sylvan Lake are shown in red in Figure 1. Wave action from skiing and fast speed boating impacts natural shorelines on the east side and along all the islands on the east half of Sylvan Lake. The high use areas in Sylvan Lake are found throughout the lake. These areas in the lake are shown in green. There have been no changes in the past two years for the activities that occur on Sylvan Lake. There are no new important habitat areas within Sylvan Lake, but the natural shorelines remain protected and undisturbed.

General lake use areas and high quality, natural shorelines have not changed in the past two years. There are no new or existing studies being conducted at Sylvan Lake. For more detailed information about lake uses or historic studies see the Sylvan Lake Aquatic Plant Management Plan Revision 2007-2011 (JFNew, 2007).

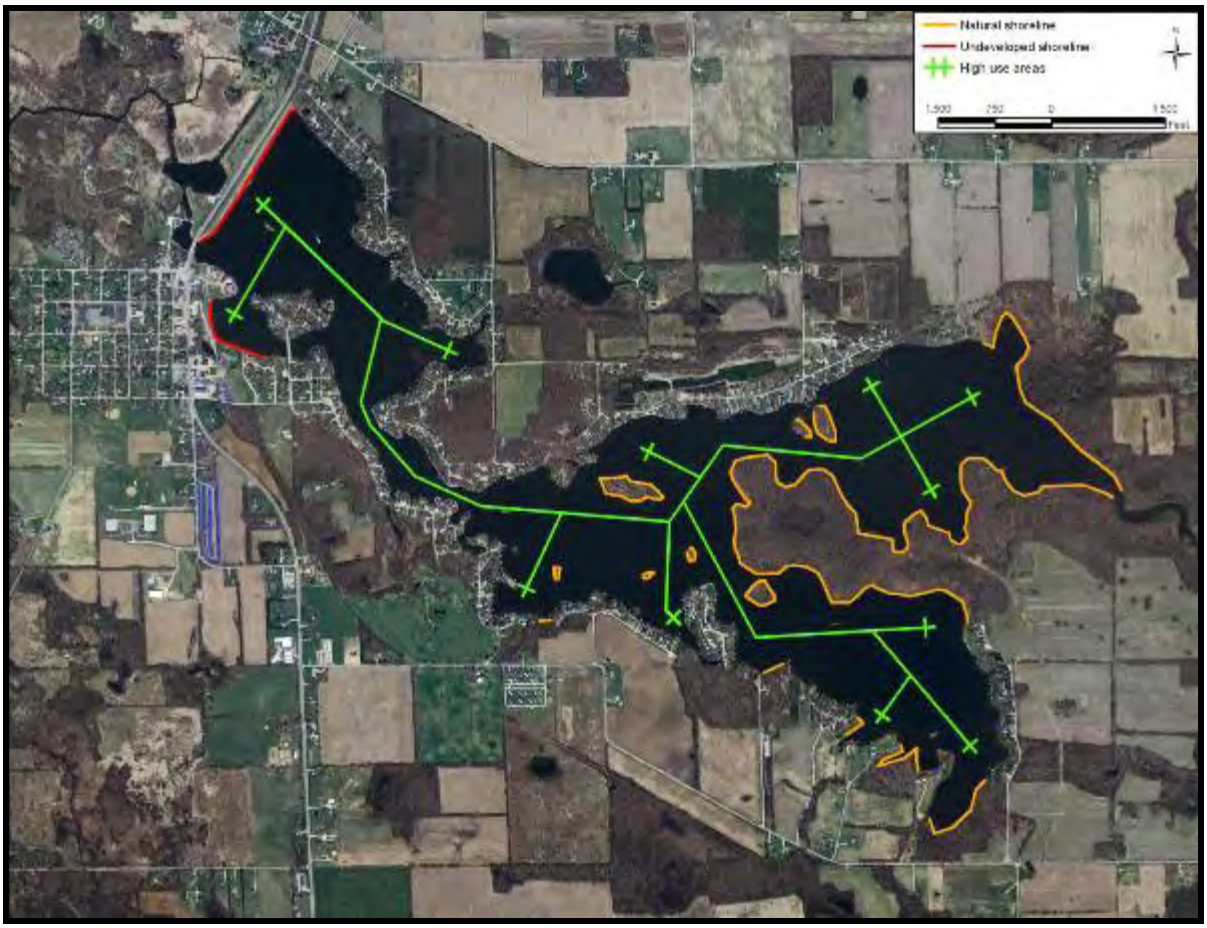


Figure 1. Lake use areas within Sylvan Lake.

4.0 Fisheries

No new fisheries information was available this year. See Sylvan Lake Aquatic Vegetation Management Plan Revision 2007-2011 (JFNew, 2007).

5.0 Problem Statement

The composition and structure of the lake's rooted plant community often provide insight into the long term water quality of a lake. While sampling the lake water's chemistry (dissolved oxygen, nutrient concentrations, etc.) is important, water chemistry sampling offers a single snapshot of the lake's condition. Because rooted plants live for many years in a lake, the composition and structure of this community reflects the water quality of the lake over a longer term.

The composition and structure of a lake's rooted plant community also help determine the lake's fish community composition and structure. Submerged aquatic vegetation provides cover from predators and is a source of forage for many different species of fish (Valley et al., 2004). However, extensive and dense stands of exotic aquatic vegetation can have a negative impact on the fish community. For example, a lake's bluegill population can become stunted because dense vegetation reduces their foraging ability, resulting in slower growth. Additionally, dense stands reduce predation

by largemouth bass and other piscivorous fish on bluegill which results in increased intraspecific competition among both prey and predator species (Olsen et al., 1998). Vegetation removal can have variable results on improving fish growth rates (Cross et al., 1992, Olsen et al., 1998). Conversely, lakes with depauperate plant communities may have difficulty supporting some top predators that require emergent vegetation for spawning. In these and other ways, the lake's rooted plant community illuminates possible reasons for a lake's fish community composition and structure.

A lake's rooted plant community impacts the recreational uses of the lake. Swimmers and power boaters desire lakes that are relatively plant-free, at least in certain portions of the lake. In contrast, anglers prefer lakes with adequate rooted plant coverage, since those lakes offer the best fishing opportunity. Before lake users can develop a realistic management plan for a lake, they must understand the existing rooted plant community and how to manage that community. This understanding is necessary to achieve the recreational goals lake users may have for a given lake.

Previous aquatic plant assessments identified the predominance of curly-leaf pondweed and the presence of Eurasian water milfoil as the two primary exotic nuisance species located within Sylvan Lake. These species continue to be problematic throughout the areas previously identified. Eurasian water milfoil was identified in larger, more extensive beds in 2008, but decreased in 2009. Although it has decreased in frequency this year, Eurasian water milfoil remains a nuisance in a few areas of the lake. Now that the final year of 300 acre curly-leaf pondweed treatment is completed, the lake association should concentrate on treating the areas of Eurasian water milfoil that are causing problems for lake users. There are no new areas in Sylvan Lake where native plants are of special concern. The natural shoreline areas in Sylvan Lake should be taken into consideration when applying a chemical treatment and the native plants throughout the lake should be protected when possible.

The presence of Eurasian water milfoil in Sylvan Lake is of concern, but it is not uncommon for lakes in the region. Eurasian water milfoil is an aggressive, non-native species common in northern Indiana lakes. It often grows in dense mats excluding the establishment of other plants. For example, once the plant reaches the water's surface, it will continue growing horizontally across the water's surface. This growth pattern has the potential to shade other submerged species preventing their growth and establishment. In addition, Eurasian water milfoil does not provide the same habitat potential for aquatic fauna as many native pondweeds. Its leaflets serve as poor substrate for aquatic insect larvae, the primary food source of many panfish.

Depending upon water chemistry, curly-leaf pondweed can be more or less aggressive than Eurasian water milfoil. Its presence in the lake is a concern because, like Eurasian water milfoil, curly-leaf pondweed can spread across the lake's surface forming dense mats ultimately shading out native species. Like many exotic invasive species, curly-leaf pondweed gains a competitive advantage over native submerged species by sprouting early in the year. The species can do this because it is more tolerant of cooler water temperature than many of the native submerged species. Curly-leaf pondweed

experiences a die-back during early to mid-summer. This die-back can degrade water quality by releasing nutrients into the water column and increasing the biological oxygen demand.

6.0 Vegetation Management Goals and Objectives

Listed below are three goals formulated by the LARE program staff and the IDNR Division of Fish and Wildlife Biologists and approved by the Sylvan Lake Improvement Association. The objectives and actions used to meet the goals are discussed in the **Management Action Strategy Section**.

Aquatic Plant Management Goals:

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species.
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species. In 2010, continue treatment of curly-leaf pondweed to deplete the turion population and decrease the frequency of curly-leaf pondweed to 10% or less in Sylvan Lake.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant, fish and wildlife resources.

Historic treatment efforts support these three goals. Efforts to control the growth and spread of curly-leaf pondweed and Eurasian water milfoil should eventually result in a stable, diverse, native aquatic plant community. Specific outcomes of the current year's treatment efforts will be discussed in further detail in subsequent sections.

7.0 Plant Management History

On May 12, 2009, Weed Patrol treated 275 acres of curly-leaf pondweed. Additionally, on May 29, 2009, Weed Patrol treated 5 acres near the inlet in Pit Basin. 48 acres of Eurasian water milfoil was treated throughout Sylvan Lake on May 28-29, 2009 (Table 2). Both treatments occurred during sunny conditions (approximately 50ºF water temperature). A third treatment which was not funded by the LARE program occurred on August 11, 2009 for coontail (5 acres) and algae (5 acres). Figures 2, 3, and 4 indicate the specific locations, plant species targeted, and size of area targeted during the aforementioned herbicide application. For selective Eurasian water milfoil control, roughly 2 ppm of 2,4-D herbicide (approximately 1 gallon per acre depending on the depth and size of the area) was applied. Often an herbicide can be applied at a lighter rate when treating big areas. For curly-leaf pondweed control, 0.5 mg/L of Aquathol K herbicide was used (applied at a rate of approximately 1 gallon per acre) in some areas and at a rate of 1.0 mg/L in others this year. The different rates used in Sylvan Lake this year were suggested by the district fisheries biologist and the IDNR based on results from other lake treatments that have produced good results in dense areas of curly-leaf pondweed. Pit Basin has historically dense beds of curly-leaf pondweed and has only recently been allowed treatment, so a higher rate of chemical was applied. For both treatments, herbicide was applied by making narrow passes through the treatment area. Coontail was treated with Reward at a rate of 1.5 gal/acre.

Coontail has historically not been controlled in Pit Basin even though this area of the lake has been severely infested with the species in recent years. The SLIA has only been given permission to treat areas of the lake for dense beds of coontail in areas along developed shorelines. Since most of Pit Basin where coontail is an issue has natural shorelines, permits have not been granted to treat these areas. If a permit were granted for the SLIA to treat all areas of the lake where coontail was a nuisance, the dense beds would decline and coontail population throughout the lake would likely decrease. Some of the dense beds of coontail in Pit Basin may migrate around that area of the lake to try to survive treatment the first year, but with proper treatment methods and timing control of the species should be observed immediately.

Table 2. Eurasian water milfoil and curly-leaf pondweed treatment history within Sylvan Lake, 1997 to present (2009).

Year	Eurasian water milfoil acreage	Curly-leaf pondweed acreage
1997	129	0
1998	79	0
1999	7	80
2000	75	88.5
2001	20	90
2002	12	99
2003	15	85
2004	10	94
2005	0	120
2006	20	120
2007	18.5	265
2008	15	275
2009	48	280

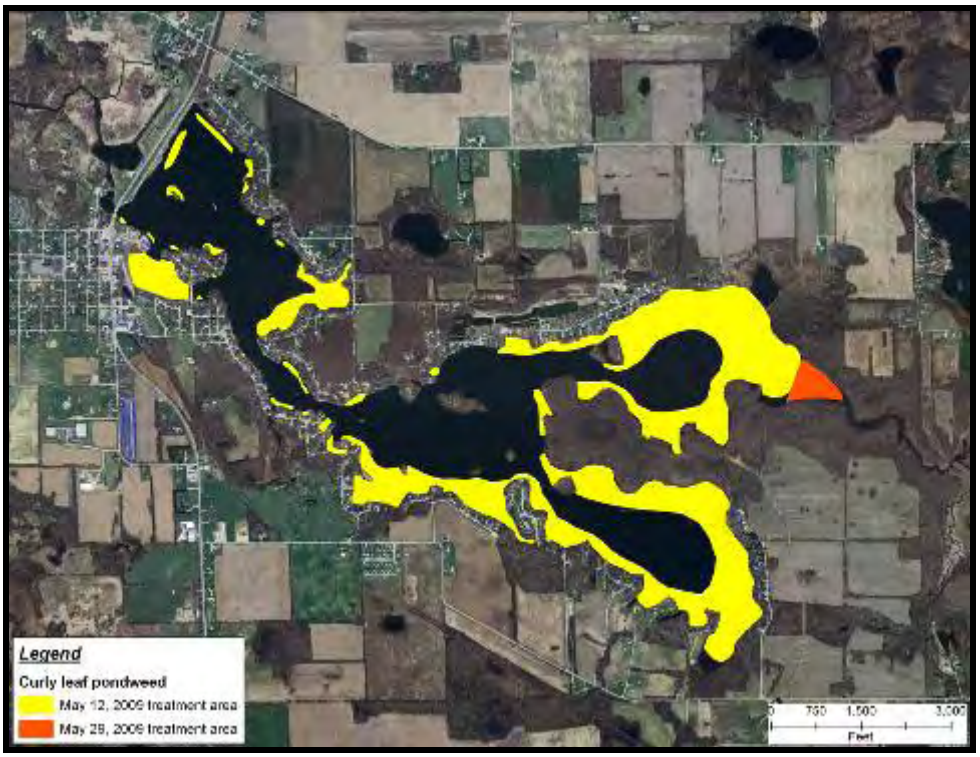


Figure 2. Curly-leaf pondweed treatment areas located on Sylvan Lake. Weed Patrol completed treatment on May 12 and 29, 2009.

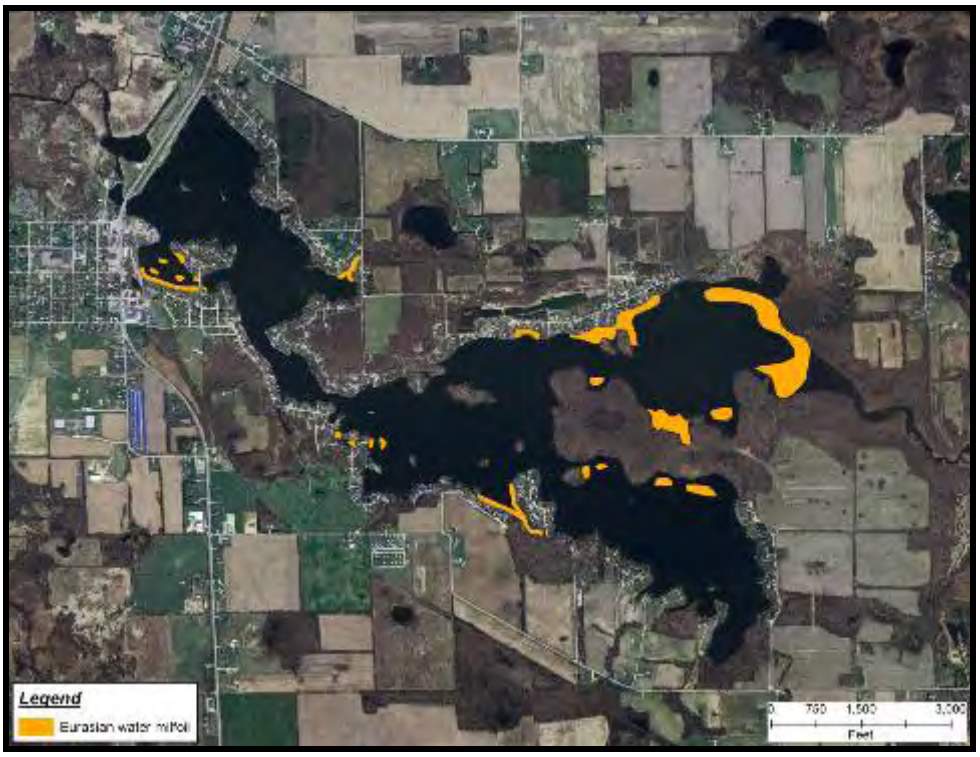


Figure 3. Eurasian water milfoil treatment areas located on Sylvan Lake. Weed Patrol completed treatment for Eurasian water milfoil on May 28-29, 2009.

Figure 4. Coontail and algae treatment areas located on Sylvan Lake. Weed Patrol completed treatment for coontail on August 11, 2009.

8.0 Aquatic Plant Community Characterization

8.1 Methods

JFNew surveyed Sylvan Lake's plant community on May 19 and August 4, 2009 according to the Indiana Department of Natural Resources sampling protocols (IDNR, 2007). JFNew examined the entire littoral zone of the lake during each of the two assessments. Surveys were completed using the Tier II survey protocol updated by the IDNR LARE staff in May 2007 (IDNR, 2007). The survey protocol generally follows previous Tier II protocols and is most similar to the 2006 protocol, which requires that the sampling points be stratified over the entire depth of the lake's littoral zone. Total points sampled per stratum were determined as follows:

1. Appendix D of the survey protocol was consulted to determine the number of points to be sampled and the maximum sampling depth. This determination was based on the lake size (surface area) and trophic status.
2. Table 3 of the survey protocol was referenced as an indicator of the number of sample points per stratum. Table 3 in this report lists the sampling strategy for Sylvan Lake.

Stratum refers to depth at which plants were observed. Dominance presented in subsequent tables was calculated by the IDNR protocol. The frequency per species presented in subsequent tables provides a measure of the frequency of a species in each stratum.

Table 3. Tier II sampling strategy for Sylvan Lake using the 2007 Tier II protocol.

Lake	Size	Trophic Status	Number of Points	Stratification of Points
Sylvan	669 acres	Mesotrophic	90	29 pts 0-5 foot stratum 27 pts 5-10 foot stratum 24 pts 10-15 foot stratum 10 pts 15-20 ft stratum

8.2 2009 Sampling Results

Spring (May) and summer (August) exotic species surveys and spring and summer Tier II surveys were completed on Sylvan Lake in 2009 by JFNew. The survey schedule is detailed in Table 4. No samples were sent to an outside taxonomist for vouchering or identification. No rare, threatened, or endangered species were identified within Sylvan Lake during the 2009 surveys.

Table 4. Survey schedule for pre-treatment and Tier II surveys.

Survey	Date
Spring exotic species survey	May 19, 2009
Summer exotic species survey	August 4, 2009
Spring Tier II -Spring	May 19, 2009
Summer Tier II -Summer	August 4, 2009

8.2.1 Exotic Species Mapping

Exotic species locations are detailed in Figure 5. Additional plant community information is discussed in detail in the following sections.

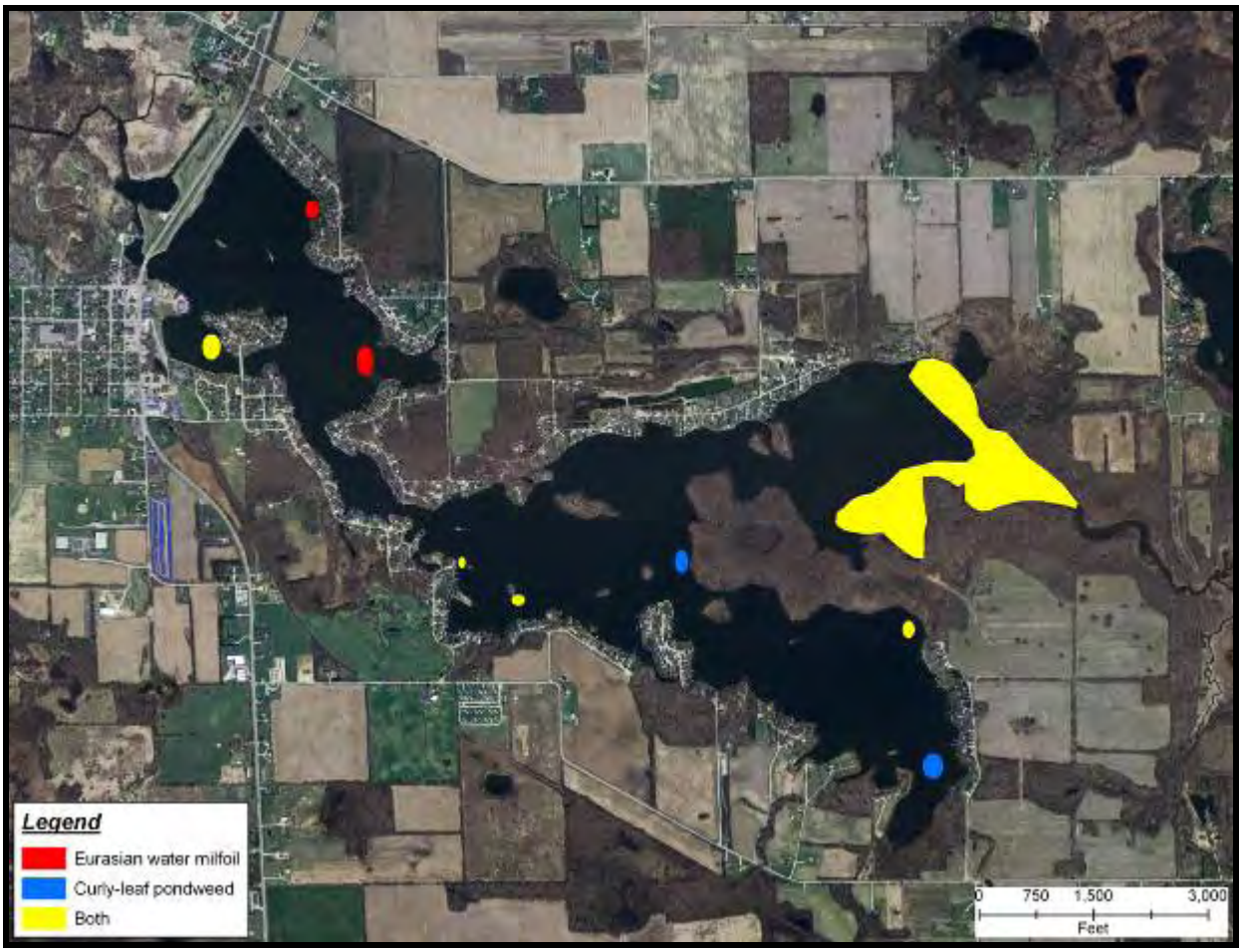


Figure 5. Dense curly-leaf pondweed, Eurasian water milfoil, and coontail locations identified within Sylvan Lake on May 19, 2009.

Spring Assessment

The dominant plant species found in Sylvan Lake include coontail, Eurasian water milfoil, and filamentous algae (Table 5). There are a number of problem areas located throughout the lake. Eurasian water milfoil was identified at multiple sampling points and was a problem at these sites during the spring survey. Surveys were not conducted at the peak of curly-leaf pondweed growth, and there were only a few areas where it was identified in Sylvan Lake during the spring survey (Figure 5). Based on survey points, curly-leaf pondweed was found in rather low densities, but was dispersed evenly throughout the lake. To adequately assess the density of curly-leaf pondweed, an assessment should be conducted in April or early May, before treatment, to adequately quantify the presence and location of curly-leaf pondweed within Sylvan Lake.

Table 5. Aquatic plant species observed in Sylvan Lake during the spring and summer surveys completed May 19 and August 4, 2009.

Scientific Name	Common Name	Stratum	Spring	Summer
Agrostis alba	Redtop	Emergent	X	X
Agrostis alba palustris	Bent grass	Emergent	X	X
Asclepias incarnata	Swamp milkweed	Emergent	X	X
Brasenia schreberi	Water shield	Emergent	X	X
Carex comosa	Bearded sedge	Emergent	X	X
Ceratophyllum demersum	Coontail	Submergent	X	X
Chara species	Chara species	Submergent		X
Cicuta bulbifera	Bulblet-bear water-hemlock	Emergent	X	X
Decodon verticillatus	Whirled loosestrife	Emergent	X	X
Eleocharis erythropoda	Bald spikerush	Emergent	X	X
Eleocharis palustris	Creeping spikerush	Emergent	X	X
Elodea canadensis	Common water weed	Submergent	X	X
Elodea nuttallii	Western water weed	Submergent		X
Filamentous algae	Filamentous algae	Algae	X	X
Heteranthera dubia	Water star grass	Submergent	X	X
Hibiscus sp.	Hibiscus	Emergent	X	X
Iris virginica	Blue-flag iris	Emergent	X	X
Juncus species	Rush species	Emergent	X	X
Lemna minor	Common duckweed	Floating	X	X
Lemna trisulca	Star duckweed	Floating	X	X
Lythrum salicaria	Purple loosestrife	Emergent	X	X
Mentha spicata	Spearmint	Emergent	X	X
Myriophyllum spicatum	Eurasian water milfoil	Submergent	X	X
Najas guadalupensis	Southern naiad	Submergent		X
Nelumbo lutea	American lotus	Floating	X	X
Numphaea tuberosa	White water lily	Floating	X	X
Nuphar advena	Spatterdock	Floating	X	X
Phalarus arundinacea	Reed canary grass	Emergent	X	X
Polygonum amphibium stipulaceum	Water knotweed	Emergent	X	X
Polygonum coccineum	Water hearsease	Emergent	X	X
Polygonum lapathifolium	Willow-weed	Emergent	X	X
Pontederia cordata	Pickerel weed	Emergent	X	X
Potamogeton berchtoldii	Slender pondweed	Submergent	X	
Potamogeton crispus	Curly-leaf pondweed	Submergent	X	
Potamogeton pusillus	Small pondweed	Sumbergent		X
Potamogeton zosteriformis	Flat-stem pondweed	Submergent	X	
Scirpus pungens	Chairmaker's rush	Emergent	X	X
Typha angustifolia	Narrow leafed cattail	Emergent	X	X
Typha latifolia	Broad leafed cattail	Emergent	X	X
Typha x *glauca*	Blue cattail	Emergent	X	X

Summer Assessment

There were four additional plant species: southern naiad (*Najas guadalupensis*), Chara (*Chara* species), Western water weed (*Elodea nuttallii*), and small pondweed (*Potamogeton pusillus*) identified during the summer survey, and a few from the spring survey were not found. Eurasian water milfoil frequency decreased from spring to

summer. Dense areas of Eurasian water milfoil were identified along the southern shoreline and in small areas along the northern shoreline of Sylvan Lake. Curly-leaf pondweed was found at one survey site during the summer survey.

8.2.2 Tier II

Two Tier II surveys were completed in order to document changes in the plant community resulting from the aquatic herbicide treatment. The Tier II surveys were completed on May 19, 2009 (pre-treatment) and on August 4, 2009 (post-treatment). Raw data is included in Appendix B. Transparency was measured using a Secchi disk prior to both sampling events. Transparency was found to be 9.3 feet in the spring and 2.8 feet during the summer survey. Based on the survey protocol, plants were sampled to a depth of 20 feet. However, plants were only present to a maximum depth of 10 feet during the spring, pre-treatment survey and to a depth of 13 feet during the summer, post-treatment survey. IN 2007, ninety sites were randomly selected within the littoral zone based on the stratification indicated in the protocol. These same sites have been sampled during each Tier II survey since 2007.

During the pre-treatment survey, coontail dominated the plant community over most depths (0-20 feet; Table 6). This species was found at the highest percentage of sites throughout all depths sampled (34%). Throughout all depths sampled, Eurasian water milfoil was somewhat frequent at 16% of the sites. Coontail, filamentous algae, and Eurasian water milfoil dominated Sylvan Lake in the 0-5, 5-10, and 10-15 foot strata. Coontail maintained the highest frequencies for the top two strata. Frequencies of coontail decreased with increasing depth occurring at 71% and 33% of the sites in the 0-5 and 5-10 foot strata. Dominance of coontail decreased from a high of 41 in the 0-5 foot stratum to 10.5 at 5-10 feet. Curly-leaf pondweed frequencies and dominances followed similar patterns with the highest frequency occurring in the 0-5 foot stratum measuring 38%. Eurasian water milfoil was found in relatively high frequency and dominance throughout all depths sampled, with its highest results being in the 0-5 foot stratum measuring 46% and dominance of 14.2. Compared to previous years, Eurasian water milfoil frequency during the spring survey was lower than it has been. Curly-leaf pondweed was at its lowest frequency during the spring 2008 survey compared to previous years (8%, Appendix D), but increased to 27% in 2009. The 2004, 2005, and 2007 spring surveys indicated a frequency of Eurasian water milfoil between 3% and 12%. Sampling locations are shown in Figure 6. Eurasian water milfoil, curly-leaf pondweed and coontail locations documented during the pre-treatment survey are shown in Figures 7, 8, and 9, respectively. See Appendix C for more detailed information regarding the data analysis in Pit Basin.

Table 6. Spring (pre-treatment) Tier II survey metrics and results for entire lake strata as collected May 19, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Sylvan Lake.					
County:	Noble	Total Sites:	90	Mean species/site:	0.90
Date:	5/19/2009	Sites with plants:	42	SE Mean species/site:	0.13
Secchi (ft):	9.3	Sites with native plants:	31	Mean native species/site:	0.48
Maximum Plant Depth (ft):	10.0	Number of species:	8	SE Mean natives/site:	0.08
Trophic Status:	Mesotrophic	Number of native species:	6	Species diversity:	0.73
		Maximum species/site:	4	Native species diversity:	0.44

All Depths (0 to 20 ft)		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Species			**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	34.4	65.6	21.1	4.4	8.9	15.8
Potamogeton crispus	Curly-leaf pondweed	26.7	73.3	21.1	5.6	0.0	7.6
Myriophyllum spicatum	Eurasian water milfoil	15.6	84.4	11.1	3.3	1.1	5.3
Elodea canadensis	Common elodea	8.9	91.1	8.9	0.0	0.0	1.8
Heteranthera dubia	Water star grass	1.1	98.9	1.1	0.0	0.0	0.2
Potamogeton berchtoldii	Slender pondweed	1.1	98.9	1.1	0.0	0.0	0.2
Potamogeton zosteriformes	Flat-stem pondweed	1.1	98.9	1.1	0.0	0.0	0.2
Stuckenia pectinatus	Sago pondweed	1.1	98.9	1.1	0.0	0.0	0.2
Filamentous Algae		57.8					
Depth: 0 to 5 ft		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Species			**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	70.8	29.2	33.3	8.3	29.2	40.8
Myriophyllum spicatum	Eurasian water milfoil	45.8	54.2	33.3	12.5	0.0	14.2
Potamogeton crispus	Curly-leaf pondweed	37.5	62.5	33.3	4.2	0.0	9.2
Elodea canadensis	Common elodea	25	75.0	25.0	0.0	0.0	5.0
Heteranthera dubia	Water star grass	4.2	95.8	4.2	0.0	0.0	0.8
Stuckenia pectinatus	Sago pondweed	4.2	95.8	4.2	0.0	0.0	0.8
Potamogeton berchtoldii	Slender pondweed	0	100.0	0.0	0.0	0.0	0.0
Potamogeton zosteriformes	Flat-stem pondweed	0	100.0	0.0	0.0	0.0	0.0
Filamentous Algae		79.2					
Depth: 5 to 10 ft		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Species			**0**	**1**	**3**	**5**	
Potamogeton crispus	Curly-leaf pondweed	35.7	64.3	26.2	9.5	0.0	11.0
Ceratophyllum demersum	Coontail	33.3	66.7	26.2	4.8	2.4	10.5
Myriophyllum spicatum	Eurasian water milfoil	7.1	92.9	4.8	0.0	2.4	3.3
Elodea canadensis	Common elodea	4.8	95.2	4.8	0.0	0.0	1.0
Potamogeton berchtoldii	Slender pondweed	2.4	97.6	2.4	0.0	0.0	0.5
Potamogeton zosteriformes	Flat-stem pondweed	2.4	97.6	2.4	0.0	0.0	0.5
Heteranthera dubia	Water star grass	0.0	100.0	0.0	0.0	0.0	0.0
Stuckenia pectinatus	Sago pondweed	0.0	100.0	0.0	0.0	0.0	0.0
Filamentous Algae		71.4					
Depth: 10 to 15 ft		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Species			**0**	**1**	**3**	**5**	
Filamentous Algae		21.4					

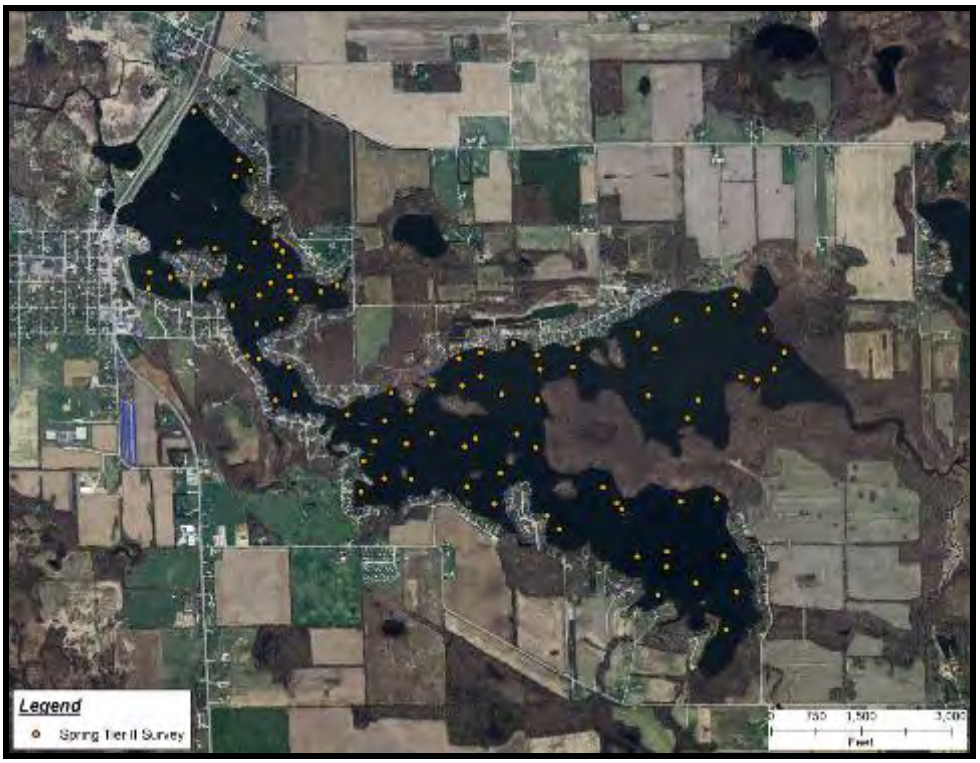


Figure 6. Sampling locations for the Sylvan Lake spring Tier II survey, May 19, 2009.

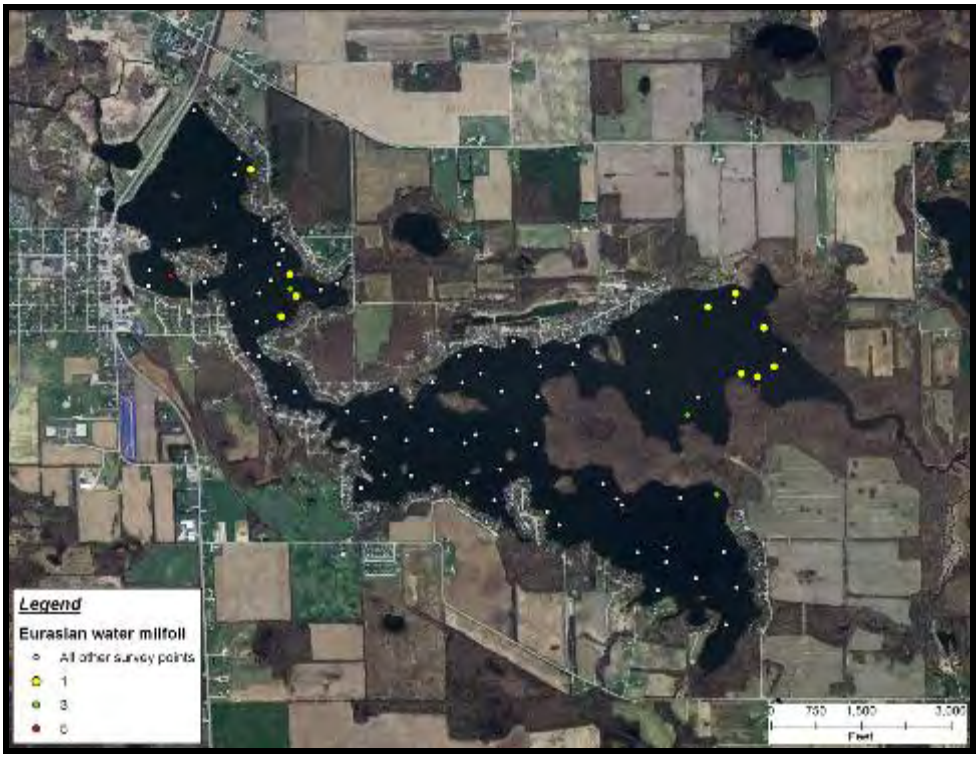


Figure 7. Eurasian water milfoil locations and densities as surveyed May 19, 2009.

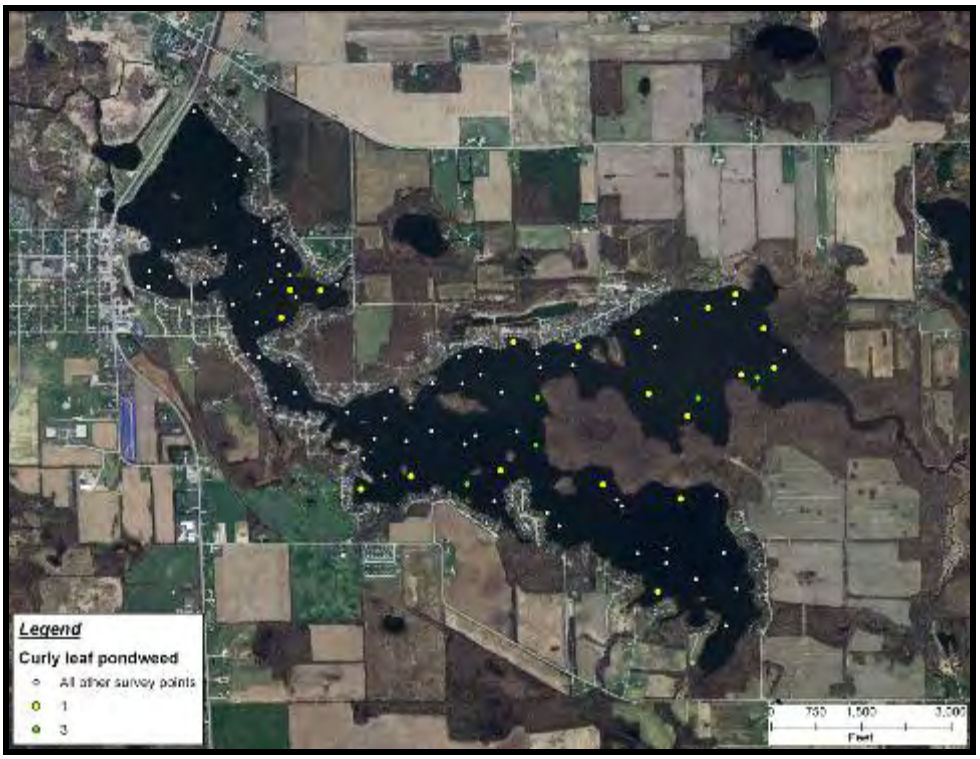


Figure 8. Curly-leaf pondweed locations and densities as surveyed May 19, 2009.

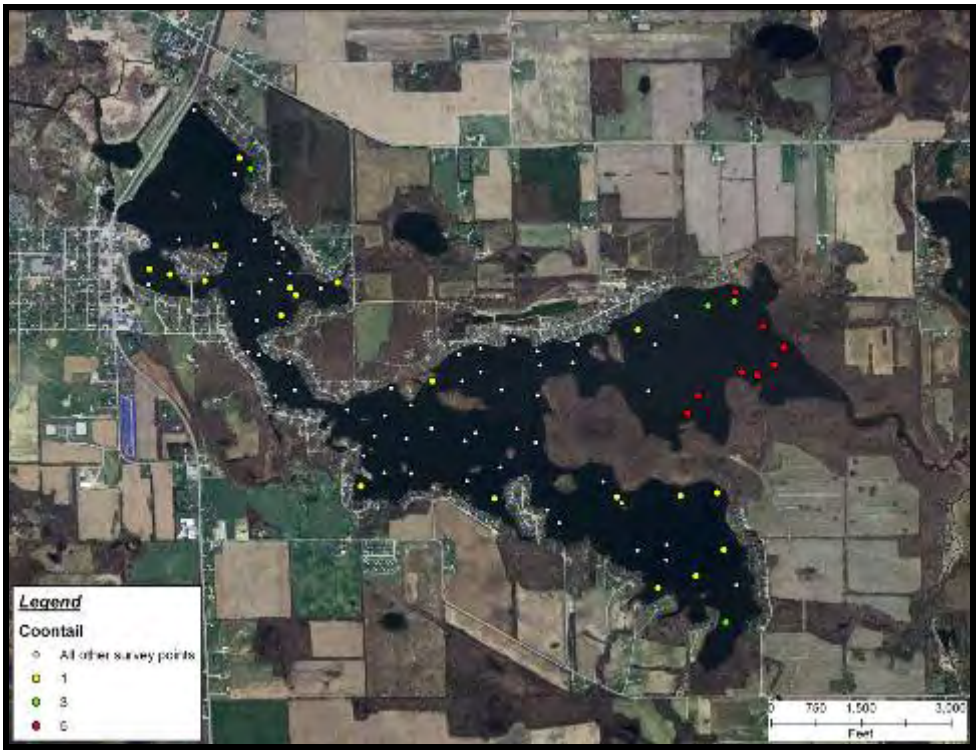


Figure 9. Coontail locations and densities as surveyed May 19, 2009.

Following treatment, coontail was still the most abundant species in Sylvan Lake (Table 7). Coontail was present at 39% of the sample sites. Filamentous algae was the only other species found frequently throughout all the sampled depths during the summer survey. Coontail dominated the shallowest strata (0-5 feet) and was identified at 90% of the sites in this stratum. Coontail also possessed the highest dominance (49) and was more than 19 times as dominant as any other species in this stratum. Eurasian water milfoil was found at fewer sites during the post-treatment survey (4% compared to 16% during pre-treatment) and curly-leaf pondweed was only identified at 1% of sample sites during the post-treatment survey compared to 27% of the sites during the pre-treatment survey. Compared to previous years, Eurasian water milfoil frequency during the summer survey was lower than it has been. The summer 2007 survey was the only other summer survey that produced a high frequency of Eurasian water milfoil (30%). The 2003 to 2005 summer surveys observed Eurasian water milfoil between 10% and 12% (Appendix D). Figure 10 documents plant sampling locations for the summer survey. The locations where Eurasian water milfoil, curly-leaf pondweed, and coontail were identified during the post-treatment surveys is shown in Figures 11, 12, and 13, respectively). See Appendix C for more detailed information regarding the data analysis for Pit Basin.

Table 7. Summer (post-treatment) Tier II survey metrics and results for entire lake strata as collected August 4, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Sylvan Lake.					
County:	Noble	Total Sites:	90	Mean species/site:	0.61
Date:	8/4/2008	Sites with plants:	38	SE Mean species/site:	0.10
Secchi (ft):	2.8	Sites with native plants:	36	Mean native species/site:	0.56
Maximum Plant Depth (ft):	13	Number of species:	10	SE Mean natives/site:	0.08
Trophic Status:	Mesotrophic	Number of native species:	8	Species diversity:	0.57
		Maximum species/site:	4	Native species diversity:	0.49

All Depths (0 to 20 ft)		**Frequency of**	**Rake score frequency per species**				**Plant**
Species		**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	38.89	61.11	20.00	13.33	5.56	17.56
Elodea canadensis	Common water weed	5.56	94.44	5.56	0.00	0.00	1.11
Myriophyllum spicatum	Eurasian water milfoil	4.44	95.56	4.44	0.00	0.00	0.89
Heteranthera dubia	Water star grass	3.33	96.67	3.33	0.00	0.00	0.67
Najas guadalupensis	Southern naiad	3.33	96.67	3.33	0.00	0.00	0.67
Chara species	Chara species	1.11	98.89	1.11	0.00	0.00	0.22
Elodea nuttallii	Western water weed	1.11	98.89	1.11	0.00	0.00	0.22
Stuckenia pectinatus	Sago pondweed	1.11	98.89	1.11	0.00	0.00	0.22
Potamogeton pusillus	Small pondweed	1.11	98.89	1.11	0.00	0.00	0.22
Potamogeton crispus	Curly-leaf pondweed	1.11	98.89	1.11	0.00	0.00	0.22
Filamentous Algae		46.67					
Depth: 0 to 5 ft		**Frequency of**	**Rake score frequency per species**				**Plant**
Species		**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	90.48	9.52	33.33	38.10	19.05	48.57
Myriophyllum spicatum	Eurasian water milfoil	14.29	85.71	14.29	0.00	0.00	2.86
Potamogeton pusillus	Small pondweed	14.29	85.71	14.29	0.00	0.00	2.86
Najas guadalupensis	Southern naiad	9.52	90.48	9.52	0.00	0.00	1.90
Chara species	Chara species	9.52	90.48	9.52	0.00	0.00	1.90
Elodea canadensis	Common water weed	4.76	95.24	4.76	0.00	0.00	0.95
Heteranthera dubia	Water star grass	4.76	95.24	4.76	0.00	0.00	0.95
Elodea nuttallii	Western water weed	4.76	95.24	4.76	0.00	0.00	0.95
Stuckenia pectinatus	Sago pondweed	4.76	95.24	4.76	0.00	0.00	0.95
Filamentous Algae		85.71					
Depth: 5 to 10 ft		**Frequency of**	**Rake score frequency per species**				**Plant**
Species		**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	35.90	64.10	23.08	10.26	2.56	13.33
Myriophyllum spicatum	Eurasian water milfoil	5.13	94.87	5.13	0.00	0.00	1.03
Chara species	Chara species	2.56	97.44	2.56	0.00	0.00	0.51
Potamogeton crispus	Curly-leaf pondweed	2.56	97.44	2.56	0.00	0.00	0.51
Filamentous Algae		43.59					
Depth: 10 to 15 ft		**Frequency of**	**Rake score frequency per species**				**Plant**
Species		**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	9.09	90.91	9.09	0.00	0.00	1.82
Najas guadalupensis	Southern naiad	4.55	95.45	4.55	0.00	0.00	0.91
Potamogeton pusillus	Small pondweed	4.55	95.45	4.55	0.00	0.00	0.91
Filamentous Algae		22.73					
Depth: 15 to 20 ft		**Frequency of**	**Rake score frequency per species**				**Plant**
Species		**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Filamentous Algae		25.00					

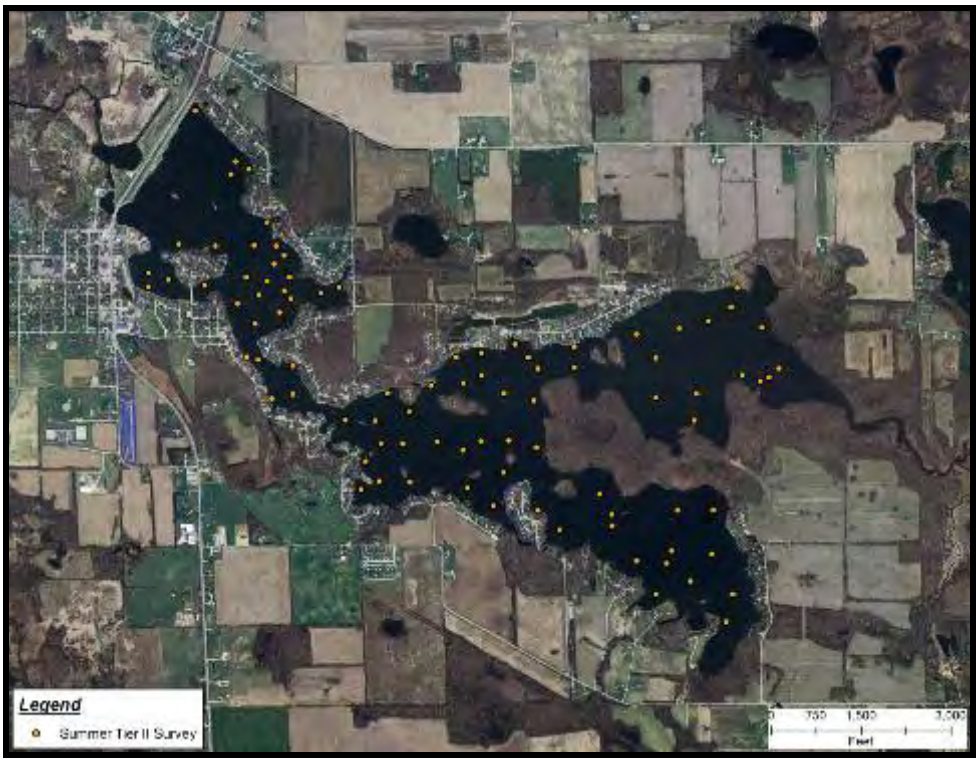


Figure 10. Sampling locations for the Sylvan Lake summer Tier II survey, August 4, 2009.

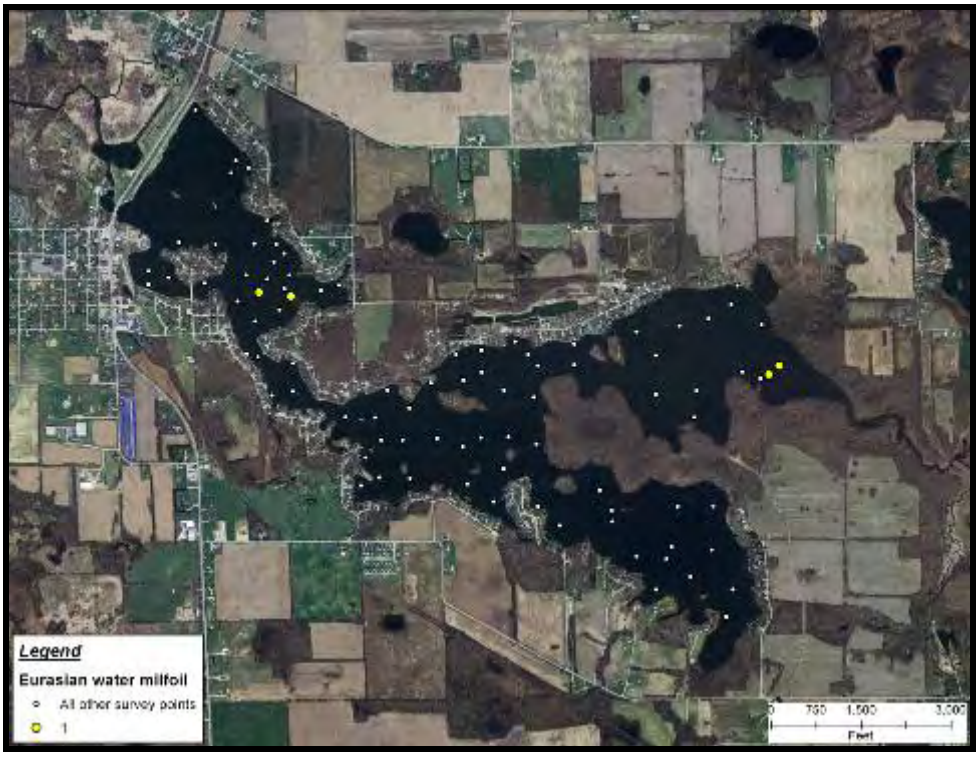


Figure 11. Eurasian water milfoil locations and densities as surveyed August 4, 2009.

Figure 12. Curly-leaf pondweed locations and densities as surveyed August 4, 2009.

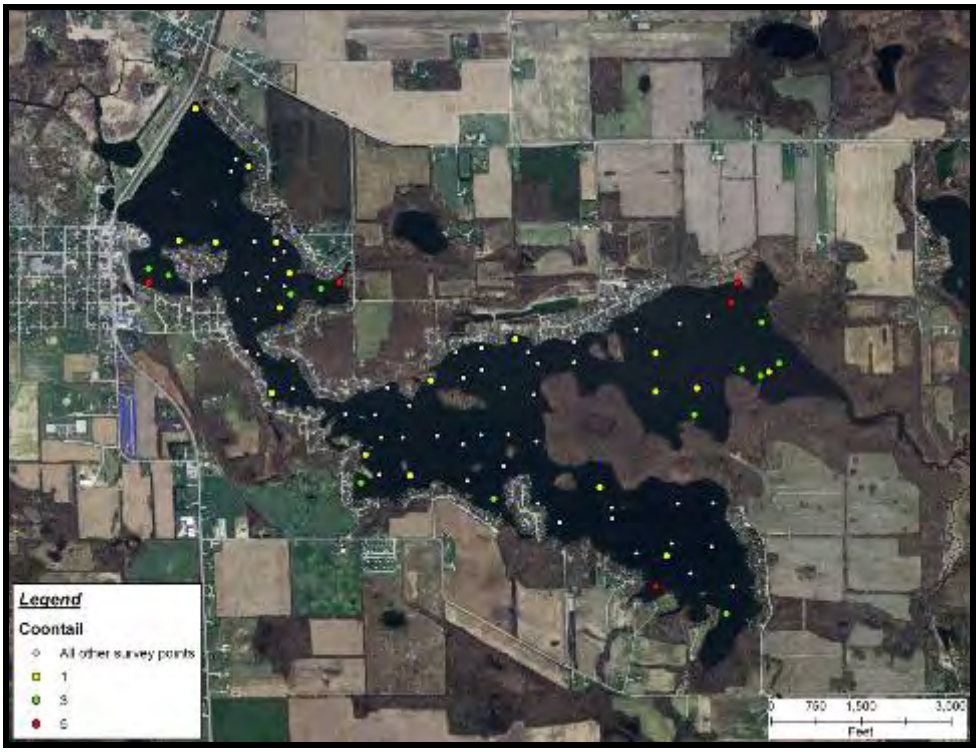


Figure 13. Coontail locations and densities as surveyed August 4, 2009.

Based on the data presented in Figure 14, water quality in Sylvan Lake has shown the same trends from spring to summer every year. Sylvan Lake shows a trend of having good water quality in the spring (May-June), and poor water quality in the summer (July-August). This is probably due to a number of activities occurring in the lake such as algal blooms and an overabundance of nuisance and exotic aquatic species. The decrease in water quality in Sylvan Lake is due to recreational uses as well, such as boating and high-speed personal water craft usage. Coontail and Eurasian water milfoil dominate the littoral zone all year, which at high frequencies can cause a decrease in water quality. Every spring, the secchi disk transparency is between 7.5 feet and 9.3 feet. In the summer it declines to 3 feet.

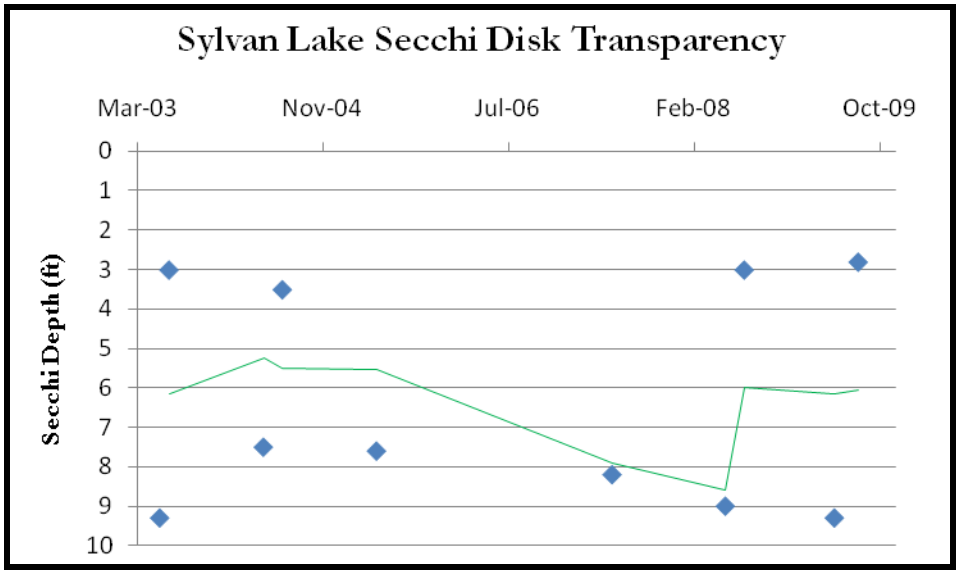


Figure 14. Historic Secchi disk transparency data for Sylvan Lake.

When recently collected data is compared with data reported by Pearson (2004), Sylvan Lake possessed similar results in 2009 to the lakes surveyed by Pearson (Table 8). Sylvan Lake possessed 8 and 10 species during the pre- and post-treatment surveys, while Pearson collected only eight species on average. Sylvan Lake possessed more native species during the summer survey (8 compared to Pearson's 7), but fewer in the spring survey (6). Sylvan Lake did not demonstrate better species richness, native species richness, rake diversity, or native rake diversity in 2009 compared to Pearson's averages.

Table 8. A comparison of the aquatic plant community in Sylvan Lake with the average values for plant community metrics found by Pearson (2004) in his survey of 21 northern Indiana lakes.

	June 2003	July 2003	May 2005	July 2005	June 2007	July 2007	June 2008	August 2008	May 2009	August 2009	Indiana Average (2004)
% of littoral sites containing plants	-	-	70%	73%	69%	70%	89%	75%	47%	42%	-
Number of species collected	5	10	3	5	13	10	10	9	8	10	8
Number of native species collected	3	8	1	3	11	8	8	8	6	8	7
Species Richness (Avg. # species/site)	1.46	1.41	-	-	1.25	1.79	1.57	1.21	0.90	0.61	1.61
Native Species Richness	0.76	1.23	0.08	0.74	0.90	1.38	1.07	0.88	0.48	0.55	1.33
Rake Diversity (SDI)	0.66	0.62	0.86	1.06	0.78	0.83	0.73	0.66	0.73	0.57	0.62
Native Rake Diversity (SDI)	0.16	0.51	0.08	0.88	0.70	0.76	0.57	0.50	0.44	0.49	0.5

Aquatic Vegetation Sampling Discussion

The primary focus of an aquatic vegetation management plan is to document changes within the aquatic plant community pre- and post-treatment and to develop plans for future work. Eurasian water milfoil and curly-leaf pondweed were the two exotic species targeted in the herbicide treatment that occurred on May 12, 28, 29 and August 11, 2009. Sylvan Lake underwent a decrease in both the relative density and site abundance of curly-leaf pondweed. However, curly-leaf pondweed naturally declines in the summer due to increased water temperatures. The three-year treatment program for curly-leaf pondweed on Sylvan Lake may have been more effective if treatment had been taking place on the main source of turion production. In 2009, after treatment and the surveys were completed, the small lake upstream of Sylvan Lake was observed as having an over abundance of curly-leaf pondweed in the lake. This could be a reason why curly-leaf pondweed frequencies were higher during the spring survey in 2009 than they were in 2008. The results from the first treatment in 2007 seemed promising as only 8% of the sites in 2008 observed curly-leaf pondweed, while 30% of the sites in 2007 identified curly-leaf pondweed. In 2009, with curly-leaf pondweed increasing in frequency again to 27% of the sites, the results of the three-year program will be more defined in the spring of 2010 when a pre-treatment survey is conducted. The treatment of Eurasian water milfoil also decreased the frequency and dominance of the Eurasian water milfoil community within Sylvan Lake.

The effects of the treatment on the native aquatic plant community are unclear. Comparing the 2009 spring and summer Tier II survey metrics indicates that the quality of the native aquatic plant community in Sylvan Lake increased following treatment (Table 9). The percentage of littoral sites containing plants was the only metric to decrease following treatment. Variables that may impact plant bed composition include increased boat traffic, predation, and physical stressors such as increased temperatures as the season progressed. Additionally, natural variations of the plant community

throughout the littoral zone may also explain the initial decline as the IDNR used different survey points than those used by JFNew.

Since we cannot account for all the spatial variables impacting the plant community, such as boat-traffic and changes in nutrient availability, or for temporal variables like climactic conditions, including temperature and precipitation levels, an exact and precise analysis regarding the impact of herbicide treatment upon Sylvan Lake's aquatic plant community is not possible. Still, general trends emerge from the data that are useful for the purpose of management decisions. When comparing data for Eurasian water milfoil, site frequencies and dominance, all appear to decrease for spring survey data, except in 2008. This suggests that Eurasian water milfoil populations do not consistently follow the same trends each year and a long, cool spring may have a negative impact on plant growth.

Table 9. Variation in site frequency and dominance of Eurasian water milfoil and curly-leaf pondweed within Sylvan Lake from 2003 to 2009. Spring data is in bold.

Common Name	Date	Site Frequency	Dominance
Eurasian water milfoil	**6/2/03**	**28.6**	**12.7**
	7/23/03	9.7	3.0
	5/10/05	**12.4**	**1.7**
	7/27/05	13.5	3.0
	6/4/07	**4.9**	**1.5**
	7/26/07	30.0	9.6
	6/9/08	**42.2**	**22.2**
	8/13/08	33.0	11.0
	5/19/09	**15.6**	**5.3**
	8/4/09	4.4	0.9
Curly-leaf pondweed	**6/2/03**	**44.9**	**21.0**
	7/23/03	8.2	1.6
	5/10/05	**94.3**	**4.5**
	7/27/05	2.9	1.0
	6/4/07	**29.6**	**6.9**
	7/26/07	11.1	2.2
	6/9/08	**7.8**	**2.0**
	8/13/08	0	0
	5/19/09	**26.7**	**7.6**
	8/4/09	1.1	0.2

When comparing curly-leaf pondweed data, a decline in frequency and distribution is suggested. However, a closer look at the data indicates that the population may be more cyclical in nature. Spring survey data from 2003, 2005, and 2007 indicates that an increase in frequency and dominance occurred from 2003 to 2005. This was followed by a decline in frequency as well as mean and relative density from 2005 to 2007. However, the dominance of curly-leaf pondweed increased from 2005 to 2007, then

decreased again from 2007 to 2008, and increased from 2008 to 2009. Curly-leaf pondweed also decreased in the summer survey as a result of early-season treatment and higher water temperatures; it was not identified at any of the sites in the 2008 summer survey. Summer data indicates that curly-leaf pondweed decreased in frequency and dominance from 2003 to 2005. However, increases in frequency and dominance occurred from 2005 to 2007. This suggests that herbicide application may have little effect on the growth of curly-leaf pondweed during the summer because this species usually dies out by early summer. The growth pattern of curly-leaf pondweed further supports this hypothesis. Curly-leaf pondweed typically grows in cooler water and dies back as water temperatures increase. If applied at the correct time, when water temperatures are low and turions have not yet formed, the application of herbicide limits the growth of curly-leaf pondweed and the formation of turions. If this occurs routinely each year, the overall production of curly-leaf pondweed should decrease. This appears to be the case in Sylvan Lake this year. The density and distribution of curly-leaf pondweed appeared to be decreasing during the spring surveys conducted on the lake from 2007 to 2008, but then increased in 2009. Summer production of curly-leaf pondweed appears to be decreasing also. Although coontail is a native aquatic species, it has been at nuisance levels within Sylvan Lake in recent years.

In 2008, coontail was observed at 67% (spring) and 60% (summer), which is average when compared to previous year's survey results (Appendix D). In 2003, 2004, and 2007, coontail increased in frequency from spring to summer, but in 2008, coontail frequency decreased, which might be a result of the curly-leaf pondweed, Eurasian water milfoil, and coontail treatment completed in 2008. As another result of this year's treatment, coontail was identified at 34% of the sampled sites in the spring and at 39% of the sites in the summer. Treatment of coontail should be limited to developed locations where access to the lake is limited.

9.0 Aquatic Vegetation Management Alternatives

A good aquatic plant management plan includes a variety of management techniques applicable to different parts of a lake depending on the lake's water quality, the characteristics of the plant community in different parts of the lake, and lake users' goals for different parts of the lake. Many aquatic plant management techniques, including chemical control, harvesting, and biological control, require a permit from the IDNR. Depending on the size and location of the treatment area, even individual residents may need a permit to conduct a treatment. Residents should contact the IDNR Division of Fish and Wildlife before conducting any treatment.

The following paragraphs describe some aquatic plant management techniques that may be applicable to Sylvan Lake, given its specific ecological condition. The alternatives that will be discussed include no action, institutional protection, environmental manipulation, nutrient reduction, mechanical harvesting, bottom covers, biological control, chemical control, and preventive measures.

9.1 No Action

Herbicide applications have been used long-term at Sylvan Lake to control Eurasian water milfoil and curly-leaf pondweed. With no change in treatment type or methodology, these treatments will likely continue. However, the no action alternative really targets the idea that no treatment will occur. Without any treatment, exotic species will continue to grow unchecked throughout Sylvan Lake resulting in a species population that is at a minimum the same size or larger than that observed during the 2009 surveys. This will likely result in a decrease in native plant density and diversity, the formation of a monoculture of exotic species, and a loss of any high quality species that may be present in Sylvan Lake. Additionally, the growth of these nuisance species could increase nutrient cycling within Sylvan Lake thereby making more nutrients available to plants and algae ultimately resulting in a decline in the lake's water quality. This would likely eventually result in reduced access for shoreline and offshore users and overall limit recreational access.

9.2 Institutional Protection of Beneficial Vegetation

Invasive species often colonize disturbed areas first before moving to other areas of the lake. The protection of native and/or beneficial aquatic vegetation can prevent the growth of exotic or nuisance species. This can be accomplished in two ways: limiting user impacts to beneficial plants due to boating or recreational uses and not over-treating beneficial plant beds. Users can restrict the use of specific areas of Sylvan Lake through the use of buoys or the establishment of user zones. The second methodology, over-treating of native plant beds, could be a concern in Sylvan Lake in the future. This issue occurs when a beneficial, native plant bed is deemed to be a nuisance and treatment of this area begins. Once the native plant community is weakened through treatment, exotic species can move into these areas colonizing open sediment. Once a foothold is established, the aggressive, exotic species can then out-compete native varieties. As aquatic plant treatment at Sylvan Lake has occurred on a large-scale historically, this may have been an issue in the past and could continue to be an issue in the future. The Sylvan Lake Improvement Association should be aware of this issue and tailor their treatment efforts to not impact beneficial native species.

9.3 Environmental Manipulation/Water Level Manipulation

Environmental manipulation often refers to manipulating the lake's water level to control vegetation. This occurs by raising water levels resulting in drowning the plants or lowering the water level to freeze or heat the aquatic plant community. This type of treatment is limited to lakes where water levels are easily manipulated. Water level manipulation can be effective at controlling exotic or invasive species in Sylvan Lake; however, this treatment will be no more or less effective for exotic or invasive native species. Additionally, exotic or invasive species may colonize newly exposed substrate resulting from water level manipulation. Sylvan Lake's water control structure does not offer ease of water-level manipulation. However, this has occurred in the past when dam repair was completed and therefore, could be used again in the future.

9.4 Nutrient Reduction

Like terrestrial vegetation, aquatic vegetation has several habitat requirements that need to be satisfied in order for the plants to grow or thrive. Aquatic plants depend on sunlight as an energy source. The amount of sunlight available to plants decreases with depth of water as algae, sediment, and other suspended particles block light penetration. Consequently, most aquatic plants are limited to maximum water depths of approximately 10-15 feet (3-4.5 m), but some species, such as Eurasian water milfoil, have a greater tolerance for lower light levels and can grow in water deeper than 32 feet (10 m) (Aikens et al., 1979). Hydrostatic pressure rather than light often limits plant growth at deeper water depths (15-20 feet or 4.5-6 m).

Water clarity affects the ability of sunlight to reach plants, even those rooted in shallow water. Lakes with clearer water have an increased potential for plant growth. Sylvan Lake possesses moderately better water clarity than the average Indiana lake. The Secchi disk depth measured during the plant survey was 8.6 feet in the spring and was estimated to be 6 feet in the summer. As a general rule of thumb, rooted plant growth is restricted to the portion of the lake where water depth is less than or equal to 2 to 3 times the lake's Secchi disk depth. This does not hold true in Sylvan Lake, where rooted plants were observed in water to a depth of approximately 14 feet, which is slightly less than two times the lake's average Secchi disk depth.

Aquatic plants also require a steady source of nutrients for survival. Many aquatic plants, also known as aquatic macrophytes, differ from microscopic algae (which are also plants) in their uptake of nutrients. Aquatic macrophytes receive most of their nutrients from the sediments via their root systems rather than directly utilizing nutrients in the surrounding water column. Some competition with algae for nutrients in the water column does occur. The amount of nutrients taken from the water column varies for each macrophyte species. Because macrophytes obtain most of their nutrients from the sediments, lakes, which receive high watershed inputs of nutrients to the water column, will not necessarily have aquatic macrophyte problems. However, lakes with large sources of readily-available nutrients (phosphorus and nitrogen), typically contain higher density aquatic plant communities. Reductions in nutrients can both increase and decrease aquatic plant density. Increases in plant density occur due to improved water clarity, which often results in more plant growth. Sylvan Lake contains relatively high nutrient levels and therefore would be expected to contain a high density aquatic plant community. However, moderate light penetration and a reservoir of nutrients provide a relatively dense and very diverse community. The reduction of nutrient inputs to Sylvan Lake will likely not alter the aquatic plant community as a whole. Rather, localized effects of the nutrient reduction will likely occur in the areas of the lake closest to the change in nutrient resources.

9.5 Mechanical Harvesting

Harvesting involves the physical removal of vegetation from lakes. Harvesting should also be viewed as a short-term management strategy. Like chemical control, harvesting needs to be repeated yearly and sometimes several times within the same year. (Some carry-over from the previous year has occurred in certain lakes.) Despite this,

harvesting is often an attractive management technique because it can provide lake users with immediate access to areas and activities that have been affected by excessive plant growth. Mechanical harvesting is also beneficial in situations where removal of plant biomass will improve a lake's water chemistry. (Chemical control leaves dead plant biomass in the lake to decay and consume valuable oxygen.)

Macrophyte response to harvesting often depends upon the species of plant and particular way in which the management technique is performed. Pondweeds, which rely on sexual reproduction for propagation, can be managed successfully through harvesting. However, many harvested plants, especially milfoil, can re-root or reproduce vegetatively from the cut pieces left in the water. Plants harvested several times during the growing season, especially late in the season, often grow more slowly the following season (Cooke et al., 1993). Harvesting plants at their roots is usually more effective than harvesting higher up on their stems (Olem and Flock, 1990). This is especially true with Eurasian water milfoil and curly-leaf pondweed. Benefits are also derived if the cut plants and the nutrients they contain are removed from the lake. Harvested vegetation that is cut and left in the lake ultimately decomposes, contributing nutrients and consuming oxygen.

Hand harvesting may be the most economical means of harvesting on Sylvan Lake. Hand harvesting is recommended in small areas where human uses are hampered by extensive growths (docks, piers, beaches, boat ramps). In these small areas, plants can be efficiently cut and removed from the lake with hand cutters such as the Aqua Weed Cutter (Figure 15). In less than one hour every 2-3 weeks, a homeowner can harvest 'weeds' from along docks and piers. Depending on the model, hand-harvesting equipment for smaller areas cost from $50 to $1500 (McComas, 1993). To reduce the cost, several homeowners can invest together in such a cutter. Alternatively, a lake association may purchase one for its members. This sharing has worked on other Indiana lakes with aquatic plant problems. Use of a hand harvester is more efficient and quick-acting, and less toxic for small areas than spot herbicide treatments. Hand harvesting or using a boat-mounted mechanical harvester to harvest vegetation covering areas larger than 625 square feet requires a permit from the IDNR Division of Fish and Wildlife. (The IDNR Division of Fish & Wildlife can assist lake residents in determining whether a permit is needed and how to obtain one.)

Figure 15. An aquatic weed cutter designed to cut emergent weeds along the edge of ponds. It has a 48" cutting width, uses heavy-duty stainless steel blades, can be sharpened, and comes with an attached 20' rope and blade covers.

9.6 Bottom Covers

Bottom shading by covering bottom sediments with fiberglass or plastic sheeting materials provides a physical barrier to macrophyte growth. Buoyancy and permeability are key characteristics of the various sheeting materials. Buoyant materials (polyethylene and polypropylene) are generally more difficult to apply and must be weighted down. Unfortunately, sand or gravel anchors used to hold buoyant materials in place can act as substrate for new macrophyte growth. Any bottom cover materials placed on the lake bottom must be permeable to allow gases to escape from the sediments; gas escape holes must be cut in impermeable liners. Commercially available sheets made of fiberglass-coated screen, coated polypropylene, and synthetic rubber are non-buoyant and allow gases to escape, but cost more (up to $66,000 per acre or $163,000 per hectare for materials, Cooke and Kennedy, 1989). Indiana regulations specifically prohibit the use of bottom covering material as a base for beaches.

Due to the prohibitive cost of the sheeting materials, sediment covering is recommended for only small portions of lakes, such as around docks, beaches, or boat mooring areas. This technique may be ineffective in areas of high sedimentation, since sediment accumulated on the sheeting material provides a substrate for macrophyte growth. The IDNR requires a permit for any permanent structure on the lake bottom, including anchored sheeting.

9.7 Biological Control

Biological control involves the use of one species to control another species. Often when a plant species that is native to another part of the world is introduced to a new region with suitable habitat, it grows rapidly because its native predators have not been introduced to the new region along with the plant species. This is the case with some of the common pest plants in northeast Indiana such as Eurasian water milfoil and purple loosestrife. Neither of these species is native to Indiana, yet both exist in and around Noble County.

Researchers have studied the ability of various insect species to control both Eurasian water milfoil and purple loosestrife. Cooke et al. (1993) points to four different species that may reduce Eurasian water milfoil infestations: *Triaenodes tarda*, a caddisfly, *Cricotopus myriophylii*, a midge, *Acentria nivea*, a moth and *Litodactylus leucogaster*, a

weevil. Recent research efforts have focused on the potential for *Euhrychiopsis lecontei*, a native weevil, to control Eurasian water milfoil. Purple loosestrife biocontrol researchers have examined the potential for three insects, *Gallerucella calmariensis, G. pusilla*, and *Hylobius transversovittatus,* to control the plant.

While the population of purple loosestrife on Sylvan Lake is relatively small and therefore may not be suitable for biological control efforts, it may be worthwhile for Sylvan Lake residents to understand the common biocontrol mechanisms for this species should the situation on the lake change. Likewise, as Eurasian water milfoil is present in Sylvan Lake, residents should be cognizant of infestation issues and biocontrol mechanisms for Eurasian water milfoil. Therefore, treatment options for the plant are discussed below merely as reference material for use in case of future infestation. Residents should also be aware that under new regulations an IDNR permit is required for the implementation of a biological control program on a lake.

9.7.1 Biological Control of Eurasian Water milfoil

Euhrychiopsis lecontei has been implicated in a reduction of Eurasian water milfoil in several Northeastern and Midwestern lakes (USEPA, 1997). *E. lecontei* weevils reduce milfoil biomass by two means: one, both adult and larval stages of the weevil eat different portions of the plant and two, tunneling by weevil larvae cause the plant to lose buoyancy and collapse, limiting its ability to reach sunlight. The weevils' actions also cut off the flow of carbohydrates to the plant's root crowns impairing the plant's ability to store carbohydrates for over wintering (Madsen, 2000). Techniques for rearing and releasing the weevil in lakes have been developed and under appropriate conditions, use of the weevil has produced good results in reducing Eurasian water milfoil. A nine-year study of nine southeastern Wisconsin lakes suggested that weevil activity might have contributed to Eurasian water milfoil declines in the lakes (Helsel et al, 1999).

Cost effectiveness and environmental safety are among the advantages to using the weevil rather than traditional herbicides in controlling Eurasian water milfoil (Christina Brant, EnviroScience, personal communication). Cost advantages include the weevil's low maintenance and long-term effectiveness versus the annual application of an herbicide. In addition, use of the weevil does not have use restrictions that are required with some chemical herbicides. Use of the weevil has a few drawbacks. The most important one to note is that reductions in Eurasian water milfoil are seen over the course of several years in contrast to the immediate response seen with traditional herbicides. Therefore, lake residents need to be patient. Additionally, the weevils require natural shorelines for over-wintering.

The Indiana Department of Natural Resources released *E. lecontei* weevils in three Indiana lakes to evaluate the effectiveness of utilizing the weevils to control Eurasian water milfoil in Indiana lakes. The results of this study were inconclusive (Scribailo and Alix, 2003), and the IDNR considers the use of the weevils on Indiana lakes an unproven technique and only experimental (Rich, 2005). If future infestation of Eurasian water milfoil should occur, Sylvan Lake residents should take the lack of proven

usefulness in Indiana lakes into consideration before attempting treatment of the lake's Eurasian water milfoil with the *E. lecontei* weevils.

9.7.2 Biological Control of Purple Loosestrife

Biological control may also be possible for inhibiting the growth and spread of the emergent purple loosestrife. Like Eurasian water milfoil, purple loosestrife is an aggressive non-native species. Once purple loosestrife becomes established in an area, the species will readily spread and take over the shallow water and moist soil environment, excluding many of the native species which are more valuable to wildlife. Conventional control methods including mowing, herbicide applications, and prescribed burning have been unsuccessful in controlling purple loosestrife.

Some control has been achieved through the use of several insects. A pilot project in Ontario, Canada reported a decrease of 95% of the purple loosestrife population from the pretreatment population (Cornell Cooperative Extension, 1996). Four different insects were utilized to achieve this control. These insects have been identified as natural predators of purple loosestrife in its native habitat. Two of the insects specialize on the leaves, defoliating a plant (*Gallerucella calmariensis* and *G. pusilla*), one specializes on the flower, while one eats the roots of the plant (*Hylobius transversovittatus*). Insect releases in Indiana to date have had mixed results. After six years, the loosestrife of Fish Lake in LaPorte County is showing signs of deterioration.

Like biological control of Eurasian water milfoil, use of purple loosestrife predators offers a cost-effective means for achieving long-term control of the plant. Complete eradication of the plant cannot be achieved through use of a biological control. Insect (predator) populations will follow the plant (prey) populations. As the population of the plant decreases, so will the population of the insect since their food source is decreasing.

9.8 Chemical Control

Herbicides are the most traditional means of controlling aquatic vegetation. Herbicides have been used in the past on Sylvan Lake as detailed in previous sections. Additionally, it is likely that some residents may have conducted their own spot treatments around piers and swimming areas. It is important for residents to remember that any chemical herbicide treatment program should always be developed with the help of a certified applicator who is familiar with the water chemistry of the target lake. In addition, application of a chemical herbicide may require a permit from the IDNR, depending on the size and location of the treatment area. Information on permit requirements is available from the IDNR Division of Fish and Wildlife or conservation officers.

There are two major disadvantages associated with chemical control of aquatic plants. The primary concern associated with chemical use is user concerns regarding safety. Chemicals undergo rigorous testing prior to licensing. Testing is completed by the USEPA with the final registration occurring within each state. All herbicides are required to result in low toxicity to humans and wildlife and to not persist or bioaccumulate within

the environment. Secondarily, users are often concerned due to water use restriction. Restrictions must be posted prior to treatment and can be in the form of irrigation or full body contact. Finally, nutrient releases can occur due to the large volume of dying plant material. This disadvantage can be controlled through correct timing of aquatic plant treatment.

Herbicides vary in their specificity to given plants, method of application, residence time in the water, and the use restrictions for the water during and after treatments. Herbicides occur in two forms: contact and systemic. There are three primary contact herbicides used for controlling submerged aquatic vegetation: diquat (trade name Reward), endothall (trade name Aquathol K), and copper-based formulations (trade names Komeen, Clearigate, and Nautique). Contact herbicides are effective for controlling submerged vegetation on the short term. Such herbicides have historically lacked selectivity resulting in killing non-target plants and sometimes even fish species in a lake. However, recent research suggests that some contact herbicides can be effective for the control of exotic species with relatively minor effects on native species (Skogerboe and Getsinger, 2002). Additionally, it should be noted that the timing and dosage of contact herbicides can improve their selectivity and control, and that this control can be extended to attempt long-term control. Reward is the typical contact herbicide used for mid-season treatment. Diquat or copper-based contact herbicides are fast-acting and, based on this, these herbicides are typically used to control nuisance vegetation around docks or in high-use areas. However, plants can recover quickly from treatments of these herbicides; recovery can occur as quickly as four to eight weeks after treatment.

Research completed by Skogerboe and Getsinger (2002) indicate that treatment rates of endothall as low as 0.5 to 1.0 mg/L can effectively control curly-leaf pondweed and Eurasian water milfoil. However, higher application rates (1.0 mg/L) of endothall provide better long-term control of curly-leaf pondweed and are required to sustain adequate chemical concentrations within large treatment areas (UPI, no date). Further research indicates that early spring application of endothall at a rate of 1.0 mg/L provides nearly 90% reduction in root biomass production and greater than 90% reduction in turion production (Poovey et al., 2002). (Poovey et al. (2002) defined early spring curly-leaf pondweed treatment as March or April when water temperatures are below 15 ^{o}C, 59 ^{o}F.) Furthermore, research indicates that late spring or early summer treatment after turions have formed is ineffective at long-term control of curly-leaf pondweed and that treatment methodology does not reduce turion production. Aquathol K manufacturers recommend that treatment occur on or before temperatures reach 50 ^{o}F and suggest that early season treatment control “reduces turion production and may reduce the curly-leaf population over time” (UPI, no date). The following treatment rates are their recommendations for effective control of curly-leaf pondweed:

- Large treatment area: 1.0 mg/L (ppm) or 0.6 gallons/acre-foot
- Spot treatment: 1.5 mg/L (ppm) or 1.0 gallons/acre-foot

In Sylvan Lake, treatment would likely occur along large areas and therefore could occur under the lower treatment rate (1.0 mg/L). However, given Sylvan Lake’s depth

and residence time and the desire for long-term control, it is likely that the higher treatment rate (1.0 mg/L) will provide better long-term control. This translates to application of 0.6 gallons/acre in areas measuring 1 foot deep or less, application of 1.3 gallons/acre in areas 2 feet deep, application of 2.6 gallons/acre in areas 4 feet deep, and 3.8 gallons/acre in areas measuring 8 feet deep (UPI, 2007).

Systemic herbicides are those that work within the system of the plant itself. These herbicides are transported to the root system resulting in killing the entire plant. The three most common systemic herbicides used for the control of Eurasian water milfoil are fluoridone (trade name Sonar or Avast!), 2,4-D (trade name Aqua-Kleen, DMA4, or Navigate), and triclopyr (trade name Renovate). (Additionally, imazapyr, glyphosate, and triclopyr can be used for the control of purple loosestrife.) Fluoridone is typically recommended for whole lake treatment of Eurasian water milfoil and curly-leaf pondweed due to the lower tolerance of these species to fluoridone compared with other aquatic plant species. Smith (2002) noted control of Eurasian water milfoil to the point of limited detectability following whole-lake treatment with fluoridone. Additionally, most Eurasian water milfoil strains have a lower tolerance to fluoridone than most other aquatic plant species; therefore, if fluoridone is properly applied, control of Eurasian water milfoil can occur with little harm to native species (AERF, 2005).

Triclopyr and 2,4-D are typically used for spot treatment of small areas of broad-leaf plants (dicots) like coontail, water milfoil, and waterweed. Treatment with triclopyr is a good option if Eurasian water milfoil populations are not dense or abundant. Treatment using triclopyr must be aggressive in order to result in adequate Eurasian water milfoil control. Neither chemical affects monocots such as eel grass or pondweeds and are not effective in the control of curly-leaf pondweed. 2,4-D is a cheaper alternative than triclopry; however, 2,4-D can impact other native species like coontail.

While providing a short-term fix to the nuisances caused by aquatic vegetation, chemical control is not a lake restoration technique. Herbicide and algaecide treatments do not address the reasons why there is an aquatic plant problem, and treatments need to be repeated each year to obtain the desired control. In addition, some studies have shown that long-term use of copper sulfate (algaecide) has negatively impacted some lake ecosystems. Such impacts include an increase in sediment toxicity, increased tolerance of some algae species, including some blue-green (nuisance) species, to copper sulfate, increased internal cycling of nutrients, and some negative impacts on fish and other members of the food chain (Hanson and Stefan, 1984 cited in Olem and Flock, 1990).

Chemical treatment should be used with caution on Sylvan Lake since treated plants are often left to decay in the water. This will contribute nutrients to the lake's water column. Additionally, plants left to decay in the water column will consume oxygen. Historic water quality sampling showed that Sylvan Lake possessed relatively moderate nutrient concentrations compared to many Indiana lakes. Nonetheless, as evidenced during the plant survey, the lake's total phosphorus concentration is high enough to support filamentous algae and, based on the water chemistry samples collected during

the previous in-lake assessments (Crisman, 1990), the lake may also experience algal blooms. The plankton community present in Sylvan Lake illustrates this issue in that the community is dominated by blue-green algae. Furthermore, the blue-green algae that comprised the largest portion of the plankton community have been known to cause taste, odor, and toxicity problems in other lakes. Chemical treatment is likely the best way to control growth and spread of Eurasian water milfoil and curly-leaf pondweed in Sylvan Lake. Herbicides (and algaecides; chara is an algae) that are non-specific or require whole lake applications to work are generally not recommended for treatment in Sylvan Lake.

9.9 Preventive Measures

Preventive measures are necessary to curb the spread of nuisance aquatic vegetation. Although milfoil is thought to 'hitchhike' on the feet and feathers of waterfowl as they move from infected to uninfected waters, the greatest threat of spreading this invasive plant is humans. Plant fragments snag on boat motors and trailers as boats are hauled out of lakes (Figure 16). Milfoil, for example, can survive for up to a week in this state; it can then infect a milfoil-free lake when the boat and trailer are launched next. It is important to educate boaters to clean their boats and trailers of all plant fragments each time they retrieve them from a lake. The Stop Aquatic Hitchhikers! campaign offers information on the prevention of spreading exotic invasive species. Visit their website at for more information: www.protectyourwaters.net

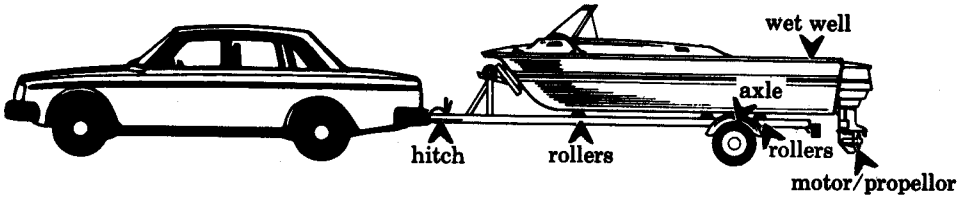


Figure 16. Locations where aquatic macrophytes are often found on boats and trailers.

Educational programs are effective ways to manage and prevent the spread of aquatic nuisance species (ANS) such as Eurasian water milfoil, zebra mussels, and others. Of particular help are signs at boat launch ramps asking boaters to check their boats and trailers both before launching and after retrieval. All plants should be removed and disposed of in refuse containers where they cannot make their way back into the lake. The Illinois-Indiana Sea Grant Program has examples of boat ramp signs and other educational materials that can be used at Sylvan Lake. Eurasian water milfoil is present in Sylvan Lake and other area lakes; therefore, educational programs and lake signage will help prevent the spread of this nuisance species into other parts of the lake or into other area lakes. This is particularly important given the popularity of Sylvan Lake. Non-resident anglers and other visitors will use their boats in other lakes in addition to Sylvan Lake, potentially spreading Eurasian water milfoil to uninfested lakes. Signs addressing any best management practices to prevent the spread of nuisance aquatic species will ultimately help protect all lakes as new nuisance (often non-native) species

are finding their way to Indiana lakes all the time. The IDNR can provide these signs in electronic format if the SLIA wishes to handle printing and posting.

10.0 Public Involvement

A public meeting was held September 30, 2009 to discuss aquatic plant survey results and to conduct a user survey regarding the use of Sylvan Lake and its aquatic plant management program. (Appendix A contains detailed results from the user survey.) Thirteen lake users responded to the survey this year. The responses from meeting attendees indicate that nearly all of them use the lake for boating (92%) and swimming (92%), while a high percentage use the lake for fishing (77%). Another 54% of respondents indicated that Sylvan Lake is used for irrigation. Sylvan Lake is primarily a recreational lake; therefore, these responses are in line with expectations and have been consistent over the last 3 years.

Respondents were also questioned about their perceived problems with the lake. Figure 17 details the responses of users in regards to perceived problems in Sylvan Lake. The main concern of Sylvan Lake users is dredging needs (77%). Too many aquatic plants were identified by 54% of respondents, while 46% identified too many boats on Sylvan Lake as a problem. Thirty-eight (38%) of lake users think that there is too much fishing on Sylvan Lake and most of the specific complaints in the past and this year regarding this concern were directed at the bass tournaments that take place on the lake. Concerns regarding overuse by non-residents seem to be an issue for 15% of lake users at Sylvan Lake. Concerns regarding jet skis (or other personal watercraft) on the lake and those dealing with perceived overuse of the lake by non-residents are an issue for 8% of Sylvan Lake users, down from 26% in 2008.

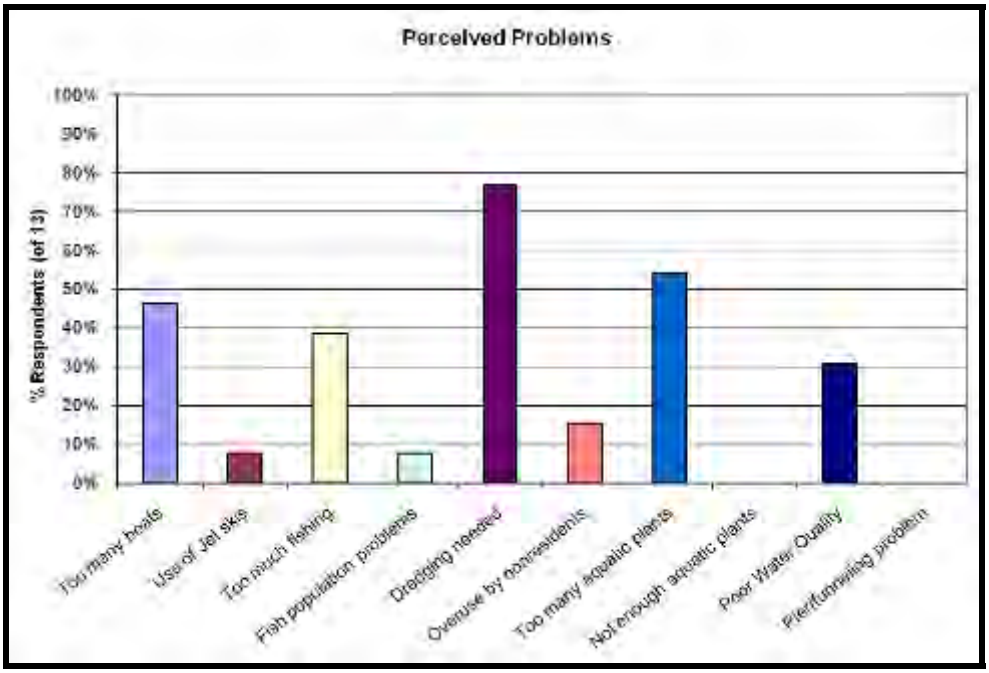


Figure 17. Perceived problems from Sylvan Lake users.

Compared to the 2007 and 2008 surveys that were completed by lake users, the 2009 results are very similar to last year's results. The main use of the lake is for boating, swimming, and fishing. Sylvan Lake continues to be a recreational lake and the survey results from 2007, 2008, and 2009 are in line with expectations. The main concern for this year had been the number two concern in 2007 and 2008, but dredging needs are now the number one concern for Sylvan Lake. In 2007, 91% of respondents said that too many aquatic plants are present in the lake. In 2008, 79% of respondents agreed that there are still too many aquatic plants in Sylvan Lake. In 2009, only 54% of respondents said that too many aquatic plants are present in the lake and 77% thought that dredging needs are now the number one concern.

The LARE biologist (Angela Sturdevant), district fisheries biologist (Jed Pearson), and association representative (Joe Costello) met November 19, 2009 to discuss the 2008 aquatic plant treatment and identify aquatic plant treatment options for 2009. About a dozen people were at the meeting. From this meeting, it was determined that the following would occur:

1. All areas identified as possessing dense Eurasian water milfoil beds should be treated in 2010.
2. Efforts to adequately catalog the curly-leaf pondweed community with early season surveys should also occur.
3. Since it is deemed necessary and of high priority for Sylvan Lake residents, a plan for treatment of curly-leaf pondweed should be continued. 60 acres of curly-leaf pondweed should be treated in early spring 2010 in areas where curly-leaf pondweed has been identified in high frequency in the past or if it is seen during the pre-treatment survey to prevent additional turion production.

Based on this information, a grant application to treat Eurasian water milfoil and curly-leaf pondweed should be submitted to the LARE program staff. Although LARE aquatic plant treatment funds are limited, future efforts are targeted at accommodating Eurasian water milfoil and early-season curly-leaf pondweed treatments. Money may be available for Eurasian water milfoil and curly-leaf pondweed treatment in the future.

Frequent contact with the SLIA members is important for keeping the lake association members and homeowners aware of treatment taking place in the lake. This contact is also valuable for advertising public meetings that should be attended by those who want to hear about happenings within the lake and voice their concerns about the lake. Based on the lake user surveys, the main concern in Sylvan Lake in the past has been too many aquatic plants, but in 2009 the main concern is now dredging.

11.0 Public Education

Education efforts should include information about Indiana's newest aquatic species of concern, hydrilla, which was identified in Lake Manitou (Fulton County) in 2006. Hydrilla is an extremely aggressive submerged aquatic plant species that looks similar to common elodea. The basic difference is the number of leaves: hydrilla contains five leaves while common elodea only contains three leaves. Efforts to educate individuals on the control, spread, and issues associated with this and other exotic species should

follow the Stop Aquatic Hitchhikers! campaign which can be found at www.protectyourwaters.net. At a minimum, the SLIA should post warnings and send information to Sylvan Lake residents about this plant. Many lake users and homeowners attend regular public meetings including the public meeting in September 2009 to discuss the Tier II survey and current year treatment results.

Finally, steps can be taken by individual property owners that will also help preserve and enhance Sylvan Lake. The following is a list of potential actions that individuals can undertake:

1. Reduce the frequency and amount of fertilizer, herbicide, or pesticide used for lawn care.
2. Use only phosphorus-free fertilizer.
3. Consider re-landscaping lawn edges, particularly those along the watershed's lakes, to include low profile prairie species that are capable of filtering runoff water better than turf grass.
4. Consider resurfacing concrete or wooden seawalls with glacial stone and planting native emergent vegetation along shorelines or in front of resurfaced or existing concrete or wooden seawalls to provide fish and invertebrate habitat and dampen wave energy.
5. Keep organic debris like lawn clipping, leaves, and animal waste out of the water.
6. Properly maintain septic systems. Systems should be pumped regularly and leach fields should be properly cared for.
7. Examine all drains that lead from roads, driveways, and rooftops to the watershed.
8. Obey speed limits through the lakes.
9. Thoroughly clean all material from boats and trailers after lake use and refrain from dumping bait buckets into the lake to prevent the spread of exotic species.
10. Accept the presence of native aquatic vegetation.
11. Do not destroy emergent vegetation growing along the shoreline unless it is an exotic species.
12. Minimize the size of impact area for use of piers and beaches.

12.0 Integrated Management Action Strategy

The focus of the action strategy should be to meet the three goals identified earlier. These are as follows:

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species.
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species. In 2010, continue treatment of 60 acres of curly-leaf pondweed to deplete the turion population and decrease the frequency of curly-leaf pondweed to 10% of less in Sylvan Lake.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant, fish and wildlife resources.

Each goal, along with objectives to meet this goal, is listed below. Following each objective are the actions which should be taken in order to achieve the objective.

12.1 Goal 1: Maintain a stable and diverse aquatic plant community.

The focus of the first goal is the development and maintenance of a stable, diverse aquatic plant community. To meet this goal, the SLIA should focus both on the emergent plant community and on the submerged plant community as both of these combine to create the aquatic plant community currently present within Sylvan Lake.

Objective 1: Maintain and enhance the diversity of the rooted floating and emergent portions of the aquatic plant community.

Sylvan Lake's rooted plant diversity and the areas of rooted and floating species should be protected and enhanced, if possible. The typical community displayed in Figure 18 details the density and diversity that is present in the lake. The lake supports moderate rooted plant diversity within the upper basins and this undoubtedly plays a role in supporting its healthy fishery. The density and diversity of the shallow water, emergent plant community prevents shoreline erosion and sediment resuspension; limits the ability for nuisance waterfowl to enter and exit the water onto the shoreline; provides habitat and cover for fish, amphibians, birds, and other wildlife; and filters nutrients that enter the lake from the lakeshore. Management techniques that are not species specific, such as contact herbicides, large scale harvesting, or dredging in bays, should be avoided to ensure the protection of the high quality community. Additionally, Sylvan Lake residents may wish to consider re-establishing portions of the emergent plant community that previously existed in the lake. This practice would be best implanted once treatments have proven effective at controlling the invasive exotic species in Sylvan Lake. One particular area in which this could occur would be the area around Twin Island where boating access is limited. After some of the invasive exotic species are removed from that area it may be best to wait a year or two and observe what native aquatic plants move into the area and then decide on a plan of action involving re-establishing native plants in specific area if needed. Additionally, restoration of eroding shorelines would also enhance the emergent and rooted floating plant community.

Figure 18. Typical emergent and rooted floating plant community present in Sylvan Lake.

Sylvan Lake residents should also take steps to restore the lake's shoreline vegetation. Purple loosestrife and reed canary grass were identified in several locations along Sylvan Lake's lakeshore and in adjacent lawns. Both of these species are introduced from Eurasia and spread rapidly through prolific seed production, vegetative growth, and cultivation. Without individual control, both species can spread along the lakeshore inhibiting boat mooring and individual access to the lake. The LARE program does not typically provide funding for the control of either of these species due to budget constraints. Nonetheless, residents should become familiar with these plants and methods for their control. The two ways to control the spread of both species is through excavation and the application of herbicides. If excavation is the selected method for removal, individuals should be sure to remove the entire root structure as both plants can re-sprout from the roots. The use of chemicals can limit regrowth. Any chemicals, like Rodeo, used to control these species must be approved for application near water. Removal of these species and replacement of native species along the shoreline would return many of the functions provided by healthy riparian areas. Landowners should replace these plants with native species that provide equal or better quality aesthetics and are more useful to birds, butterflies, and other wildlife for cover and food. Reed canary grass can be replaced with switch grass, prairie cordgrass, or big blue stem depending on the landowner's desired landscaping. Swamp blazing star, swamp

milkweed, cardinal flower, blue-flag iris, or blue lobelia all offer more habitat and aesthetic variety than that offered by purple loosestrife. A mixture of these species will allow for colorful blooms throughout the growing season.

Objective 2: Maintain the density and diversity of the submerged portion of the aquatic plant community.

Sylvan Lake's aquatic plant community is relatively diverse. The lake's submerged community contained 8 and 10 species during the two aquatic plant surveys. This diversity is normal for area lakes and could be improved with improved water quality and control of exotic species. The variety of submerged plant species present in Sylvan Lake provides fish cover and habitat for macroinvertebrates, amphibians, and reptiles; filters nutrients; and increases the aesthetic conditions present in Sylvan Lake. Lake residents and users should become aware of the quality of their aquatic plant community and should limit the control or removal of the native populations of submerged aquatic plants. Native species should be controlled only in those locations where the density of aquatic plants limits the owner's aesthetic value or negatively impacts lake use. Control of native communities should be limited in shallow areas or around docks; treatment should only occur if there are difficulties in maneuvering boats to and from docks or other shoreline structures. Other specifics of native plant control are detailed below.

12.2 Goal 2: Reduce negative impacts from exotic and/or invasive species.

The focus of the second goal is reducing the negative impacts from aquatic exotic or invasive species. This goal can be accomplished by reducing the density and coverage of current populations of exotic and/or invasive species and preventing the introduction of new species and the spread of current species to areas of the lake where exotic, invasive species are currently not present. Goal 2 builds on the objectives detailed in Goal 1 in that efforts to reach Goal 2 will assist the SLIA in reaching Goal 1.

Objective 1: Reduce the density and abundance of Eurasian water milfoil to 10% frequency.

Eurasian water milfoil is present in somewhat moderate densities along most of the shoreline within Sylvan Lake. In order to prevent the continued spread of Eurasian water milfoil to other locations within the lake, treatment of the invasive exotic species should be continued in 2010. Eurasian water milfoil reproduces through fragmentation and can rapidly spread to other areas of the lake and can reach nuisance levels. This species can displace native vegetation and has a tendency to form dense canopies that shade out native vegetation. In order to control Eurasian water milfoil within Sylvan Lake, the use of 2,4-D (Navigate) or Renovate for spot treatment of populations is recommended. Up to 60 acres of Eurasian water milfoil are recommended for treatment. The cost of this treatment is approximately $24,000 if 2,4-D is used for treatment within Sylvan Lake. Additional annual follow-up treatments will be necessary to control Eurasian water milfoil populations within Sylvan Lake since the goal is to keep it at a manageable level (10% cover) rather than to eradicate it. However, until the effects of the curly-leaf pondweed treatment are evident, the IDNR is hesitant to treat all areas of

potential Eurasian water milfoil in 2010. Larger treatment areas to control Eurasian water milfoil will most likely be prescribed in 2011.

In order to aid in the control of Eurasian water milfoil, lake residents and users should be educated as to their impact on the spread of the plant. Eurasian water milfoil spreads through fragmentation, which allows one small piece of Eurasian water milfoil to colonize other areas of the lake. It is very important that boaters avoid driving through areas of the lake currently infested with Eurasian water milfoil as this can chop the plant thereby creating fragments. These fragments can then be carried to other areas on boat propellers or float to other areas of the lake. It is also important the boaters remove all plant fragments from their boat propeller and trailer before traveling from lake to lake. If signs are currently not posted at the boat ramp detailing the need to clean boats and trailers, then signs should be posted warning boat owners and users to check their equipment for plant fragments.

Objective 2: Reduce the density and abundance of curly-leaf pondweed to 10% frequency.

Treatment of curly-leaf pondweed through the LARE program has typically been limited to those lakes where infestations cover large percentages of the water's surface area. Historically, Sylvan Lake has been one such lake where curly-leaf pondweed treatment is funded through the LARE program. Curly-leaf pondweed typically senesces during the height of the recreational season, which is one reason that treatment of this species is not always of high priority. However, curly-leaf pondweed can be a nuisance and control should be initiated as part of the long-term strategy to protect and improve the native submerged plant community. Curly-leaf pondweed is currently found in moderate densities (27% in the spring) throughout the lake. Historically, curly-leaf pondweed covered nearly 300 acres of Sylvan Lake. The SLIA's long-term goal is to reduce curly-leaf pondweed density within the lake resulting in its eradication from the lake. An acceptable percent cover of the lake has not been determined at this time. However, discussion with the SLIA suggests that less than 10% cover of curly-leaf pondweed within the lake would meet their expectations. An acceptable cover for Eurasian water milfoil in Sylvan Lake is also suggested to be less than 10%. Aquathol K is recommended for treatment of specified areas (Figure 19) and should continue to occur next summer to reduce the growth and production of turions, which can last for multiple seasons after treatment. Given the desire to ensure long-term control of curly-leaf pondweed and to reduce the production of turions, curly-leaf pondweed treatment should occur at a rate of 1 mg/L (0.6 gallons/acre in shallow water to 3.8 gallons/acre in deeper water) before water temperatures reach 50 ^{o}F. Estimates completed by Weed Patrol suggest that treatment of curly-leaf pondweed should continue to decline over time with an estimated treatment of 60 acres in 2010 (Figure 19). 60 acres of curly-leaf pondweed should be treated in early spring 2010 where large beds still exist, mostly in Pit Basin.

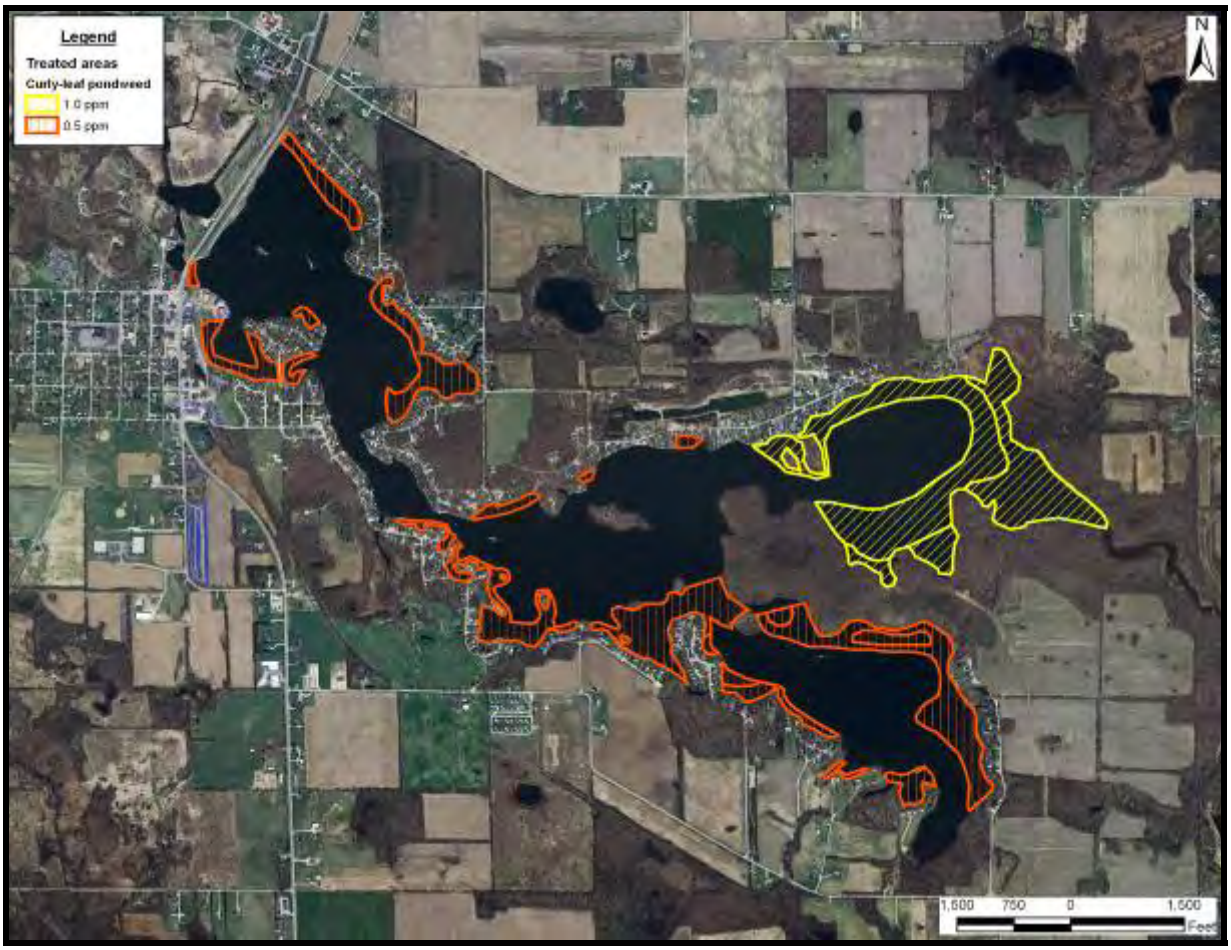


Figure 19. Curly-leaf pondweed populations targeted for treatment in 2010.

In addition to the in-lake treatment of curly-leaf pondweed, the small lake upstream of Henderson Ditch is being reviewed for possible treatment in the future. Tony Cunningham (Clarke) visited the small lake (Figure 20) in 2009 in pursuit of finding the source of the curly-leaf pondweed that infests Pit Basin each spring. This small lake is infested with curly-leaf pondweed, which depending on water flow and connectivity to Sylvan Lake, could be the main source of the turions that thrive in Pit Basin and then spread through Sylvan Lake.

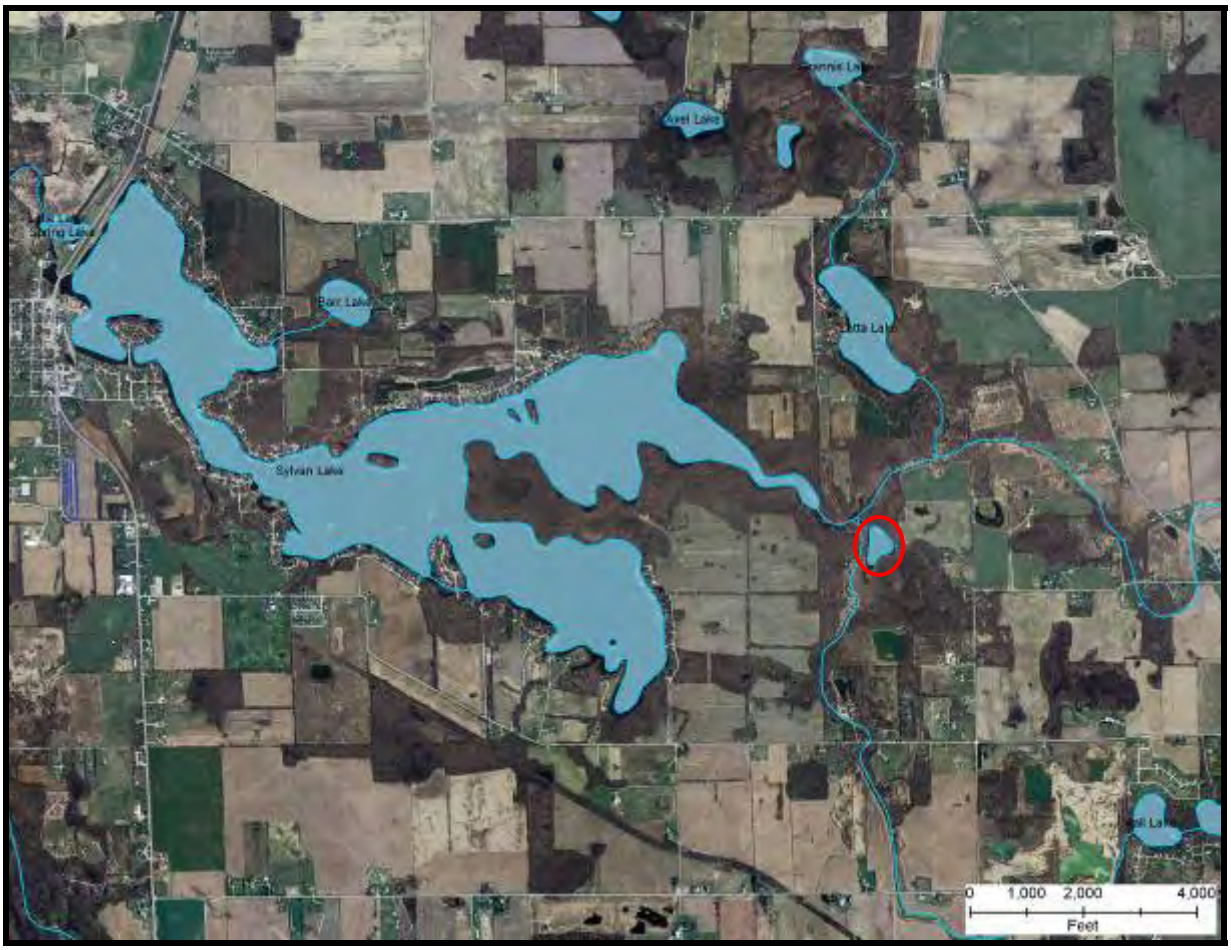


Figure 20. Lake infested with curly-leaf pondweed upstream of Sylvan Lake.

Objective 3: Prevent the spread of purple loosestrife and reed canary grass.
Both purple loosestrife and reed canary grass can be detrimental to native shoreline wetland species. Currently, control of these species is not funded through the LARE program. Nonetheless, if either of these species is present on an individual property, then the species should be removed by excavation or herbicide. Removal or herbicide application should occur prior to the plants flowering.

Objective 4: Educate lake users and shoreline owners about the impacts of exotic and invasive species.
Currently, Indiana is home to five aquatic exotic, invasive species: Eurasian water milfoil, curly-leaf pondweed, Brazilian elodea, hydrilla, and parrot feather. To date, hydrilla has only been identified in Lake Manitou in Rochester, Indiana. Brazilian elodea has been found in Griffy Lake in Bloomington, Indiana and a number of private ponds in Southern Indiana. Parrot Feather (*Myriophyllum aquaticum*) has recently been discovered in Meserve Lake, Steuben County. In order to prevent the spread of this and other exotic species, lake users should be educated regarding the potential impacts of these species and the threat of their spread. All five species spread by fragmentation allowing them to colonize from one area to another within a lake and from lake to lake.

Therefore, it is imperative that users remove all plant fragments from boats and trailers when entering and exiting lakes. Posting signs at the boat ramp will help reinforce this effort. The SLIA should include information about hydrilla, Brazilian elodea, parrot feather, Eurasian water milfoil, and curly-leaf pondweed in their newsletters. In addition to their spread by boats and boat trailers, invasive species are also known to be spread by transplanting backyard pond plants and dumping aquaria into lakes. Educational information about these and other exotic species can be found at the Stop Aquatic Hitchhikers! website (www.protectyourlake.net).

12.3 Goal 3: Provide reasonable recreational access while minimizing the negative impacts on plants, fish, and wildlife resources.

This goal focuses on the control of exotic species for recreational purposes; however, the control of a limited number of native species, including coontail, may also be necessary to meet reasonable recreational access goals. Sylvan Lake is primarily a recreation lake where swimming, fishing, and pleasure boating are balanced with skiing, high speed boating, and the use of personal watercraft. In order to maintain aesthetic and ecological quality in Sylvan Lake, it may be necessary to balance recreational uses.

Objective 1: Allow boat access through the control of aquatic vegetation around boat docks.

Native species proliferate in many areas of Sylvan Lake. If allowed to spread, these plants may begin to restrict shoreline owner access to the lake from their dock. In these areas, hand removal or spot chemical treatment of plants can be implemented. Up to 625 square feet of vegetation can be removed from an individual shoreline without a permit. Removal of native aquatic vegetation should be limited in Sylvan Lake to only those areas where boat access is necessary. This typically measures 20 to 30 feet off of the shoreline. Native vegetation areas that remain shallow but occur outside this distance from the shoreline should be allowed to continue in their native form. Additionally, aquatic plants should not be treated farther than 100 feet from the lakeshore. No extraneous removal of aquatic vegetation is recommended at this time. If plants are removed from the lake by hand, they should not be left along the shoreline to desiccate. Rather, plants should be removed from the lakeshore and deposited in compost piles, gardens, or bagged for removal. If hand-pulling is not an option, residents should contact a certified aquatic applicator to implement treatment.

Objective 2: Control coontail population growth along shallow, populated areas of the lake.

Coontail growth along the shallow shelf present in the lower basin of Sylvan Lake has reached nuisance levels. Areas where control should occur are limited to those locations where coontail limits individual's access from their pier to the lake. Additionally, treatment should not occur along natural, undeveloped shorelines or in areas where boat access is not a high priority. The only areas of the lake where this might not apply is Pit Basin where large beds of coontail continue to thrive. The areas prioritized for treatment are shown in Figure 21.

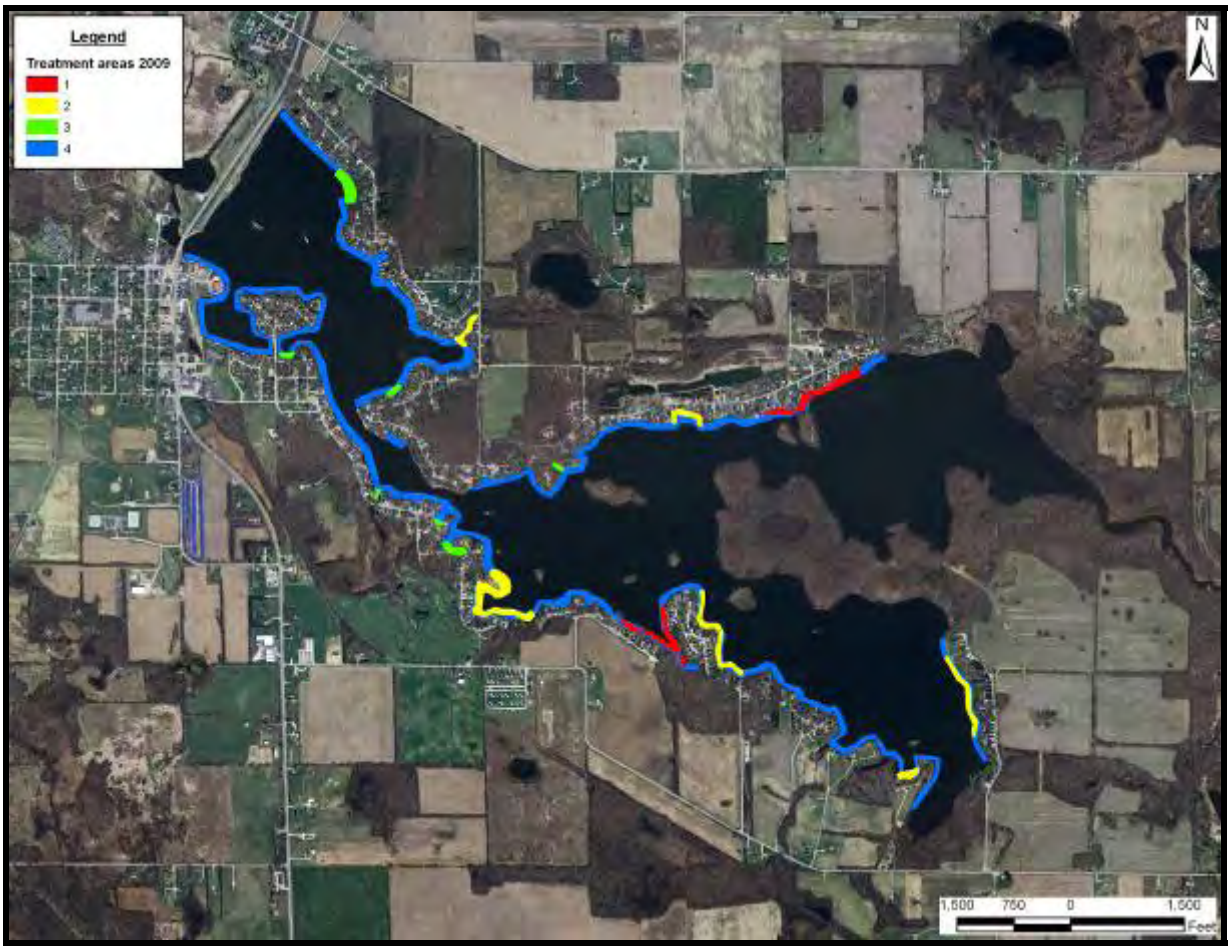


Figure 21. Priority areas of treatment in 2010.

12.4 Immediate Action Plan

The LARE Aquatic Plant Management Plan grant was provided to the Sylvan Lake Improvement Association in 2008 for the purpose of funding aquatic vegetation controls on the lake in 2009. These controls should be approached using a three-prong effort: control of exotic species and nuisance native species; restoration or preservation of native plant communities; and education of lake users. Below, recommended actions are listed in order of importance. It should be noted that some of these actions may be funded through the LARE program; however, alternate sources of public or private monies may need to be obtained by the SLIA in order to implement these actions.

1. Continue treatment of Sylvan Lake's curly-leaf pondweed population with low-dose (1 mg/L) Aquathol K before water temperatures reach 50 ^{o}F. 100 acres of curly-leaf pondweed should be treated in early spring 2010 to prevent additional turion production.
2. Continue spot treatment of up to 60 acres of Eurasian water milfoil throughout the lake. Areas to be treated are located along much of the developed shoreline of the lake, which possesses a narrow shelf upon which dense aquatic plant growth occurs. Treatment should occur along only those areas where resident

access is a priority. Additionally, treatment should not extend more than 100 feet from the shoreline.

3. Maintain at least 60% frequency of coontail, while limiting treatments to nuisance areas, mainly along developed shorelines. Continue spot treatment of no more than 30 acres of coontail in the lake.
4. Monitor the plant community using aquatic plant surveys for next two years (2010-2011). These surveys should occur prior to treatment and following treatment to assess the effectiveness of controls and response of native plant community to these treatments. Surveys should include an assessment of the number of turions present in the substrate, if a method is developed and included in the IDNR monitoring program. In 2010, surveys should consist of a Tier II survey prior to treatment of either curly-leaf pondweed or Eurasian water milfoil. A pre-treatment distribution map of all invasive exotic species should also be completed.
5. Post signs at all access sites warning boaters of the potential for invasive plant species introductions from boat trailers. Signs should implore boaters to clean trailers, propellers, and boats of all vegetative fragments when entering and leaving Sylvan Lake. This is especially important given the high density of off-shore users on the lake. Information concerning the potential spread of Eurasian water milfoil and hydrilla should be distributed to all SLIA members and lake users.
6. Investigate potential options to reduce nutrient and sediment loading to the lake through watershed management planning or implementation projects.
7. Remove purple loosestrife and reed canary grass from individual properties.
8. Maintain dock areas with physical plant removal when possible or by contracting professional applicators. Treatments should not exceed 100 feet from shoreline for submersed vegetation and treatment of rooted floating vegetation should be limited to boating lanes.
9. Educate lake users on best management practices in order to improve water quality.

12.5 Resources for Aquatic Management

There are many other sources of potential funding, other than the LARE program, that the SLIA can get help from in order to improve the quality of Sylvan Lake. Many government agencies assist in projects designed to improve environmental quality.

The USDA has many programs to assist environmental improvement. More information on the following programs can be found at www.usda.gov.

Watershed Protection and Flood Prevention Program
Conservation Reserve Program
Wetlands Reserve Program
Grassland Reserve Program
Wildlife Habitat Incentive Program
Small Watershed Rehabilitation Program

The following programs are offered by the U.S. Fish and Wildlife Service (USFWS). More information about the USFWS can be found at www.fws.gov.

Partners for Fish and Wildlife Program
Bring Back the Natives Program
Native Plant Conservation Program

The Environmental Protection Agency, the Indiana Department of Environmental Management, and the U.S. Forest Service also have numerous programs for funding. A few of these are listed below. More information can be found at www.in.gov/idem and www.fs.fed.us.

U.S. Environmental Protection Agency Environmental Education Program (EPA)
NPDES Related State Program (IDEM)
Community Forestry Grant Program (U.S. Forest Service)

13.0 Project Budget

Table 10 contains an **estimated** budget for the aquatic vegetation management action plan. The majority of the annual cost is associated with annual curly-leaf pondweed control costs, which are estimated to occur across about 100 acres in 2010. Because the main treatment recommended consists of curly-leaf pondweed treatment with the idea of reducing the resident population over time, it is necessary for a pretreatment Tier II survey and an exotic species distribution survey to occur within Sylvan Lake. From these surveys, treatment and community distributions maps will be developed. It is our recommendation that the Sylvan Lake Improvement Association requests $53,000 from the LARE program. This budget includes $18,000 for additional curly-leaf pondweed treatment, $24,000 for Eurasian water milfoil treatment, and $6,000 for aquatic plant surveys and plan updates. The SLIA's contribution for this would be $5,300 (10%). If the LARE program cannot provide the SLIA with all of this then the treatment of Eurasian water milfoil, coontail, and/or algae should be funded through the lake association. It is possible that this project may not be fully-funded due to a continued hydrilla treatment in Lake Manitou that may use a large percentage of potential LARE funds.

Table 10. Budget estimate for the action plan.

Task	2010	2011	2012
Curly-leaf pondweed treatment - 60 acres	$18,000	$15,000	$15,000
Eurasian water milfoil treatment- 60 acres	$24,000	$24,000	$24,000
Plant sampling and plan update	$6,000	$6,000	$6,000
Native plant and algae treatment	$5,000	$5,000	$5,000
Total	**$53,000**	**$51,500**	**$51,500**

Costs for aquatic plant assessment and treatment in 2010 are as follows:

- Eurasian water milfoil treatment of approximately 60 acres with 2,4-D at a cost of $400 per acre for a total cost of $24,000.

- Early season curly-leaf pondweed treatment of approximately 60 acres of curly-leaf pondweed should be treated in early spring 2010, regardless of whether curly-leaf pondweed plants are observed in those areas, in order to treat sprouting turions that may not be captured with a rake throw, with the intention of depleting the turion bank over a three-year time-span. Aquathol K should be applied at a rate of 1.0 ppm to 60 acres. It is estimated that treatment of 60 acres at a rate of 1.0 ppm will cost approximately $300/acre for a cost of $18,000.
- Native plant and algae treatment is estimated at $5,000 to treat coontail and filamentous algae.
- Standard LARE assessment, public meeting, and plan update costs are based on 2007 LARE requirements (pre-treatment exotic species distribution survey; one post-treatment Tier II survey; public meeting; plan update). Assessment costs are estimated to total $2,500, while the plan update is anticipated to occur at a cost of $3,500.

Total fees for 2010 aquatic plant assessment, herbicide application, and plan updated are estimated at $53,000. LARE has historically provided funding of up to $20,000 for aquatic plant treatment and provides monies for surveys and plan updates. All of these monies require a 10% match.

The following time schedule is anticipated for aquatic plant management activities for Sylvan Lake in 2010:

March-April 2010	Curly-leaf pondweed assessment and pre-treatment distribution mapping
April-early May, 2010	Curly-leaf pondweed treatment
May 15-June 15, 2010	Tier II spring survey
June-August	Eurasian water milfoil treatment
August-October, 2010	Public meeting
November, 2010	Meeting between IDNR LARE and fisheries staff, SLIA, and contractor
December 15, 2010	Plan update and permit
January 15, 2011	LARE application for 2011 funding due

14.0 Monitoring and Plan Update Procedures

Monitoring shall follow procedures determined by the LARE program. Likewise, plan updates will conform to LARE requirements. This includes, but is not limited to: early season assessment and treatment for curly-leaf pondweed, exotic species map development, public meetings and outreach. This will allow for continued monitoring of the aquatic plant community within Sylvan Lake, which is one of the primary goals of the LARE aquatic plant management planning program. Additionally, continued monitoring will allow for the determination of the effectiveness of control methods, identify changes in the native plant community, and detect the extent of known and future exotic species infestations. Each year's data should be analyzed and used to revise or update this plan

and implementation strategy which may subsequently lead to changes in the initial recommendations in this plan.

15.0 References Cited

Aikens, S.A. P.R. Newroth, and I. Wile. 1979. The biology of Canadian weeds, 34 *Myriophyllum spicatum*. L. Can. J. Plant Sci. 59:201-215.

Aquatic Ecosystem Restoration Foundation. 2005. Aquatic Plant Management: Best management practices in support of fish and wildlife habitat.

Cooke, G.D., and R.H. Kennedy. 1989. Water Quality Management for Reservoirs and Tailwaters. Report 1. In-lake Reservoir Water Quality Management Techniques. Tech. Rep. E-89-1. U.S. Army Corps of Engineers. Vicksburg, Mississippi.

Cooke, G.D., E.B. Welch, S.A. Peterson and P.R. Newroth. 1993. Restoration and Management of Lakes and Reservoirs, Second Edition. Lewis Publishers, Boca Raton.

Cornell Cooperative Extension. 1996. Video- "Restoring the Balance: Biological Control of Purple Loosestrife". Cornell University Media Services, Ithaca, New York.

Crisman, T.L. 1990. A final feasibility study for Sylvan Lake, Indiana. Sylvan Lake Improvement Association, Rome City, IN. 124 pp.

Cross, T. K., M. C. McInherny, and R. A. Davis. 1992. Macrophyte removal to enhance bluegill, largemouth bass and northern pike populations. Section of Technical Services Investigational Report 415. Minnesota Department of Natural Resources, Division of Fish and Game, St. Paul, MN.

Hanson, M.J. and H.G. Stefan. 1984. Side effects of 58 year of copper sulfate treatment of the Fairmont Lakes, Minnesota. Water Res. Bull. 20:889-900.

Helsel, D.R., S.A. Nichols and R.S. Wakeman. 1999. Impact of aquatic plant management methods on Eurasian water milfoil populations in southeast Wisconsin. J. Lake and Reserv. Mgmt., 15(2): 159-167.

Indiana Department of Natural Resources. 2007. Tier II aquatic vegetation survey protocol. Indianapolis, Indiana.

JFNew. 2007. Sylvan Lake Aquatic Plant Management Plan Revision 2007-2011. Noble County, IN. Walkerton, IN.

Madsen, J.D. 2000. Advantages and disadvantages of aquatic plant management. LakeLine, 20(1):22-34.

McComas, S. 1993. Lake Smarts. The Terrene Institute, Washington, D. C. 215 pp.

Olem, H. and G. Flock, eds. 1990. Lake and Reservoir restoration guidance manual. 2nd edition. EPA 440/4-90-006. Prepared by NALMS for USEPA, Washington, D.C.

Olem, H. and G. Flock, eds. 1990. Lake and Reservoir restoration guidance manual. 2nd edition. EPA 440/4-90-006. Prepared by NALMS for USEPA, Washington, D.C.

Olsen, M. H., S. R. Carpenter, P. Cunningham, S. Gafny, B. R. Herwig, N. P. Nibbelink, T. Pellett, C. Storlie, A. S. Trebitz, and K. A. Wilson. 1998. Managing macrophytes to improve fish growth: a multi-lake experiment. Fisheries 23:6-12.

Pearson, J. 2004. A sampling method to assess occurrence, abundance and distribution of submersed aquatic plants in Indiana lakes. Indiana Department of Natural Resources, Division of Fish and Wildlife, Indianapolis, Indiana.

Poovey, Angela G., Skogerboe, J.G. and C.S. Owens. 2002. Spring Treatments of Diquat and Endothall for Curlyleaf Pondweed Control. Journal of Aquatic Plant Management, 40: 63-67.

Rich, C.F. 2005. Correspondence with JFNew regarding the Four Lakes Diagnostic Study dated June 17, 2005.

Scribailo, R.W. and M.S. Alix. 2003. Final report on the weevil release study for Indiana lakes. Indiana Department of Natural Resources, Division of Soil Conservation, Indianapolis, Indiana.

Skogerboe, J.G. and K.D. Getsinger. 2002. Endothall species selectivity evaluation: northern latitude aquatic plant community. Journal of Aquatic Plant Management, 40: 1-5.

Smith, C.S. 2002. Houghton Lake management feasibility study. Prepared for the Houghton Lake Improvement Board. Remetrix LLC, Indianapolis, Indiana.

United States Environmental Protection Agency. 1997. Use of aquatic weevils to control a nuisance weed in Lake Bomoseen, Vermont. Watershed Protection: Clean Lakes Case Study. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA 841-F-97-002.

United Phosphorus, Inc. No date. Early Season Control of Curly-leaf pondweed.

United Phosphorus, Inc. 2007. Early Season Control of Curly-leaf pondweed.

Valley, R. D., T. K. Cross, and P. Radomski. 2004. The role of submersed aquatic vegetation as habitat for fish in Minnesota lakes, including implications of non-native plant invasions and their management. Special Publication 160. Minnesota Department of Natural Resources, Division of Fish and Wildlife, St. Paul, MN.

Weed Patrol, Inc. 2005. Sylvan Lake Aquatic Vegetation Management Plan Draft. Noble County, Indiana. Elkhart, IN.

APPENDIX A:

LAKE USER SURVEY RESULTS

SYLVAN LAKE
AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2009

Lake Use Survey Results: September 30, 2009
13 Respondents

Lake Name: Sylvan Lake

Are you a lake property owner? Yes 100% No 0%

Are you currently a member of your lake association? Yes 100% No 0%

How many years have you been at the lake?
<2 yrs 8% 2 – 5 yrs 0% 5-10 yrs 0% > 10 years 92%

How do you use the lake (mark all that apply)
92% Swimming 54% Irrigation 92% Boating 0% Drinking water
77% Fishing 0% Other

Do you have aquatic plants at your shoreline in nuisance quantities?
Yes 38% No 62%

Do you currently participate in a weed control project on the lake?
Yes 92% No 8%

Does aquatic vegetation interfere with your use or enjoyment of the lake?
Yes 62% No 38%

Does the level of vegetation in the lake affect your property values?
Yes 85% No 8%

Are you in favor of continuing efforts to control vegetation on the lake?
Yes 100% No 0%

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded?
Yes 100% No 0%

Mark any of these you think are problems on your lake:
46% Too many boats access the lake
8% Use of jet skis on the lake
38% Too much fishing
8% Fish population problem
77% Dredging needed
15% Overuse by nonresidents
54% Too many aquatic plants
0% Not enough aquatic plants
31% Poor water quality
0% Pier/funneling problem

Please add any comments:

APPENDIX B:

TIER II SURVEY RAW DATA

SYLVAN LAKE
AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2009

Sylvan Lake spring Tier II survey raw data collected May 19, 2009.

	Filamentous algae	Coontail	Common water weed	Water star grass	Eurasian water milfoil	Slender pondweed	Curly-leaf pondweed	Sago pondweed	Flat stem pondweed		
DEPTH	FILALG	CERDEM	ELOCAN	HETDUB	MYRSPI	POTBER	POTCRI	STUPEC	POTZOS	Lat	Long
3	p	3	1		1					-85.3682	41.4991
4	p	1			3		1			-85.3659	41.4936
4	p	1		1	3			1		-85.3402	41.4838
4	p	5								-85.3359	41.4904
5	p	1								-85.3574	41.4892
5	p				1					-85.3659	41.4943
5		1								-85.3630	41.4938
5		1								-85.3688	41.4996
5										-85.3745	41.4938
5	p	1								-85.3537	41.4837
5	p	3								-85.3398	41.4778
5	p	5			3		1			-85.3419	41.4875
5	p	5	1		1		3			-85.3376	41.4892
5	p	5	1		1		1			-85.3366	41.4896
5	p	5	1		1		1			-85.3371	41.4914
5	p	5	1		1		1			-85.3388	41.4930
6	p						1			-85.3524	41.4910
6	p	1			1					-85.3655	41.4933
6										-85.3674	41.4968
6										-85.3669	41.4886
6	p	1					1			-85.3618	41.4844
6	p									-85.3505	41.4832
6	p									-85.3498	41.4826
6	p	5	1		1		1			-85.3386	41.4893
7	p									-85.3599	41.4889
7	p	1								-85.3744	41.4946
7	p	1								-85.3704	41.4956
7	p									-85.3616	41.4858
7	p	1					1			-85.3439	41.4795
7	p									-85.3391	41.4795
7	p	1				1	1			-85.3424	41.4837
7	p						1			-85.3471	41.4844
7	p	5	1				3			-85.3412	41.4883
7	p	3								-85.3389	41.4926
7	p	3	1		1		1			-85.3405	41.4924
7	p						1			-85.3484	41.4907
8	p									-85.3587	41.4881
8	p	1			1		1		1	-85.3665	41.4923
8	p	1			5					-85.3732	41.4943
8	p						3			-85.3554	41.4846
8	p						1			-85.3533	41.4851
8		1					1			-85.3448	41.4914
8	p									-85.3510	41.4905
9										-85.3544	41.4906
9	p						1			-85.3640	41.4935
9	p	1								-85.3711	41.4940
9										-85.3604	41.4850
9							1			-85.3588	41.4849
9	p	1								-85.3416	41.4800
9	p						3			-85.3511	41.4863
9	p						3			-85.3510	41.4884
9	p						1			-85.3442	41.4885
10										-85.3557	41.4904
10	p									-85.3555	41.4891
10	p									-85.3625	41.4879
10										-85.3660	41.4901
10										-85.3671	41.4940
10										-85.3667	41.4957
10	p									-85.3433	41.4807
10	p	1								-85.3398	41.4812
10	p	1								-85.3463	41.4837
10	p									-85.3488	41.4899
11										-85.3680	41.4958
11										-85.3716	41.5018
11										-85.3424	41.4919
11										-85.3438	41.4907
12										-85.3544	41.4895
12	p									-85.3691	41.4989
12										-85.3609	41.4867
12										-85.3451	41.4812
12	p									-85.3523	41.4869
12										-85.3531	41.4887

	Filamentous algae	Coontail	Common water weed	Water star grass	Eurasian water milfoil	Slender pondweed	Curly-leaf pondweed	Sago pondweed	Flat stem pondweed		
DEPTH	FILALG	CERDEM	ELOCAN	HETDUB	MYRSPI	POTBER	POTCRI	STUPEC	POTZOS	Lat	Long
12										-85.3508	41.4898
13	p									-85.3657	41.4889
13										-85.3680	41.4921
13										-85.3694	41.4930
14										-85.3686	41.4907
14										-85.3575	41.4870
14										-85.3433	41.4814
15										-85.3679	41.4905
15										-85.3665	41.4947
15										-85.3663	41.4954
15										-85.3726	41.4959
15										-85.3603	41.4876
16										-85.3678	41.4934
17										-85.3590	41.4866
17										-85.3555	41.4864
17										-85.3460	41.4834
18										-85.3548	41.4867
19										-85.3689	41.4947

Sylvan Lake summer Tier II survey raw data collected August 4, 2009.

	Filamentous algae	Coontail	Chara	Common water weed	Western water weed	Water star grass	Eurasian water milfoil	Southern naiad	Curly leaf pondweed	Sago pondweed	Small pondweed	Flat stem pondweed	Lat	Long
DEPTH	FILALG	CERDEM	CHARA	ELOCAN	ELONUT	HETDUB	MYRSPI	NAJGUA	POTCRI	STUPEC	POTPUS	POTZOS	X	Y
2	p	1				1							-85.3683	41.4991
3	p							1					-85.3672	41.4967
3	p	1								1			-85.3704	41.4957
3	p	3											-85.3374	41.4891
3	p	5											-85.3387	41.4933
4	p	3	1			1	1						-85.3659	41.4932
4	p	1										1	-85.3659	41.4942
4	p	1											-85.3671	41.4887
4													-85.3511	41.4834
4	p	3											-85.3398	41.4782
4	p	3											-85.3415	41.4873
4		3		1	1		1						-85.3362	41.4896
5	p	1											-85.3523	41.4910
5	p	1											-85.3574	41.4892
5	p	5											-85.3629	41.4937
5	p	5		1									-85.3745	41.4939
5	p	3											-85.3618	41.4845
5	p	3											-85.3538	41.4836
5		5											-85.3440	41.4795
5	p	3											-85.3385	41.4894
5	p	1		1			1	1					-85.3369	41.4892
6													-85.3601	41.4888
6									1				-85.3691	41.4995
6	p	3											-85.3733	41.4942
6	p	1						1					-85.3615	41.4858
6	p												-85.3554	41.4845
6	p												-85.3498	41.4825
6													-85.3393	41.4794
6	p	3		1									-85.3372	41.4915
6	p	5		1									-85.3391	41.4925
6													-85.3449	41.4913
6													-85.3487	41.4908
7	p	3											-85.3640	41.4935
7		3											-85.3745	41.4945
7	p												-85.3607	41.4849
7													-85.3531	41.4851
7													-85.3487	41.4898
7		1											-85.3413	41.4886
7	p												-85.3515	41.4903
8													-85.3588	41.4880
8	p	1											-85.3666	41.4926
8													-85.3711	41.4939
8	p	1											-85.3588	41.4848
8	p												-85.3419	41.4800
8	p												-85.3511	41.4863
8	p												-85.3512	41.4884
9													-85.3543	41.4906
9	p												-85.3559	41.4904
9													-85.3658	41.4902
9	p	1											-85.3433	41.4809
9													-85.3404	41.4832
9	p	1											-85.3473	41.4841
9													-85.3405	41.4918
9		1											-85.3437	41.4902
10		1											-85.3726	41.4958
10													-85.3451	41.4810
10													-85.3530	41.4888
10													-85.3509	41.4898
10		1											-85.3438	41.4884
10													-85.3423	41.4915
11													-85.3543	41.4896
11													-85.3659	41.4889
11		1											-85.3715	41.5018
11													-85.3406	41.4812
12													-85.3555	41.4892
12													-85.3627	41.4877
12	p												-85.3679	41.4905
12													-85.3681	41.4921
12	p						1						-85.3678	41.4934
12													-85.3605	41.4866
12													-85.3528	41.4866
13	p												-85.3609	41.4876
13	p	1				1							-85.3667	41.4956
13													-85.3686	41.4906
13													-85.3592	41.4865
14													-85.3662	41.4936
14													-85.3662	41.4952
14													-85.3693	41.4989
14													-85.3556	41.4862
15													-85.3673	41.4940
15	p												-85.3669	41.4948
15													-85.3545	41.4866
16													-85.3691	41.4930

	Filamentous algae	Coontail	Chara	Common water weed	Western water weed	Water star grass	Eurasian water milfoil	Southern naiad	Curly leaf pondweed	Sago pondweed	Small pondweed	Flat stem pondweed	Lat	Long
DEPTH	FILALG	CERDEM	CHARA	ELOCAN	ELONUT	HETDUB	MYRSPI	NAJGUA	POTCRI	STUPEC	POTPUS	POTZOS	X	Y
16													-85.3680	41.4957
16													-85.3686	41.4942
17													-85.3571	41.4866
17													-85.3430	41.4814
17	p												-85.3426	41.4833
20													-85.3466	41.4826
20	p												-85.3466	41.4831

APPENDIX C:

PIT BASIN DATA ANALYSIS

SYLVAN LAKE
AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2009

Pit Basin Data Analysis

This analysis section was created to be a benchmark for treatment in Pit Basin since it is a new treatment area in Sylvan Lake. The area has not previously been granted permission from the district fisheries biologist to treat, probably due to the expanse of natural shoreline and absence of human inhabitance. This analysis will include data in subsequent years at Pit Basin continues to be treated for curly-leaf pondweed and any other invasive exotic species that may cause a problem in the future.

During the pre-treatment survey in 2007 for Pit Basin, coontail dominated the plant community over most depths (0-15 feet; Table A). This species was found at the highest percentage of sites throughout the entire sampled water column (78.6%) and also had the highest dominance. Throughout all sampled depths, filamentous algae and curly-leaf pondweed were relatively frequent and were found at 78.6% and 35.7% of the sites, respectively (Table A). Coontail, filamentous algae, and curly-leaf pondweed dominated Pit Basin in every stratum (0-20 feet). Coontail maintained the highest frequencies for all the strata. Frequencies of coontail decreased with increasing depth with coontail occurring at 100%, 80%, and 50% of the sites in the 0-5, 5-10, and 10-15 foot strata. Coontail's frequency in the 15-20 foot strata was 100%. Dominance also decreased from a high of 70 in the 0-5 foot stratum to 40 at 5-10 feet, and 10 at the 10-15 foot stratum. Curly-leaf pondweed was identified in Pit Basin with its highest frequency and dominance occurring in the 15-20 foot stratum measuring 100% and 20, respectively. Curly-leaf pondweed had a frequency of 25%, 40%, 25%, and 100% in the 0-5, 5-10, 10-15, and 15-20 foot strata, respectively. Eurasian watermilfoil was found in low frequency and dominance throughout the entire sampled water column, with its highest results being in the 5-10 foot stratum measuring 20% and dominance of 12. Figure A documents sampling locations sites and where curly-leaf pondweed was identified during the pre-treatment survey.

Six species were present in Pit Basin during the spring survey, four of which were native species. Compared to the rest of Sylvan Lake, this number of species is relatively low. There were 13 species in the whole lake during the spring survey, 11 of which were native. During the spring 2008 survey, only four species were identified in Pit Basin. Coontail and common water weed were the only native species identified in Pit Basin; Eurasian watermilfoil and curly-leaf pondweed were both present as well. Curly-leaf pondweed decreased in Pit Basin from spring 2007 to spring 2008 from 36% to 15%. Coontail increased between these surveys from 79% to 91% and Eurasian watermilfoil also increased from 7% to 46%. Common water weed also increased from the spring 2007 (14%) to the spring 2008 (62%) surveys.

In 2009, Pit Basin had similar results with the number of native species and exotic species during the spring and summer surveys. Curly-leaf pondweed was much more frequent during the spring survey (71%) than in previous years. Eurasian water milfoil was also prevalent, identified at 50% of the survey sites in Pit Basin. Although treatment efforts are continuing to take place in Pit Basin, the 2008 and 2009 treatments seem to have done little to impact the curly-leaf pondweed turion bank.

Table A. Spring (pre-treatment) Tier II survey metrics and results for Pit Basin as collected June 4, 2007.

Occurrence and abundance of submersed aquatic plant species in Pit Basin.					
Total Sites:	14	Mean species / site:	1.5	Native diversity:	0.44
Littoral Sites:	14	Maximum species / site:	3	Species diversity:	0.65
Littoral Depth (ft):	16	Number of species:	6	SE Mean natives / site:	0.16
Date:	6/4/2007	Littoral sites with plants:	13	Mean natives / site:	1.07
Lake:	Pit Basin	Secchi(ft):	8.2	SE Mean species / site:	0.20

All depths (0-20 feet)		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	78.57	21.43	42.86	14.29	21.43	38.57
Potamogeton crispus	Curly-leaf pondweed	35.71	64.29	35.71	0.00	0.00	7.14
Elodea canadensis	Common water weed	14.29	85.71	7.14	7.14	0.00	5.71
Myriophyllum spicatum	Eurasian watermilfoil	7.14	92.86	0.00	7.14	0.00	4.29
Potamogeton gramineus	Grassy pondweed	7.14	92.86	7.14	0.00	0.00	1.43
Najas guadalupensis	Southern naiad	7.14	92.86	7.14	0.00	0.00	1.43
Filamentous algae	Filamentous algae	78.57					
0-5 foot Stratum		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	100.00	0.00	25.00	25.00	50.00	70.00
Potamogeton crispus	Curly-leaf pondweed	25.00	75.00	25.00	0.00	0.00	5.00
Elodea canadensis	Common water weed	25.00	75.00	0.00	25.00	0.00	15.00
Filamentous algae	Filamentous algae	100.00					
5-10 foot Stratum		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	80.00	20.00	40.00	20.00	20.00	40.00
Potamogeton crispus	Curly-leaf pondweed	40.00	60.00	40.00	0.00	0.00	8.00
Myriophyllum spicatum	Eurasian watermilfoil	20.00	80.00	0.00	20.00	0.00	12.00
Najas guadalupensis	Southern naiad	20.00	80.00	20.00	0.00	0.00	4.00
Filamentous algae	Filamentous algae	100.00					
10-15 foot Stratum		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	50.00	50.00	50.00	0.00	0.00	10.00
Potamogeton crispus	Curly-leaf pondweed	25.00	75.00	25.00	0.00	0.00	5.00
Potamogeton gramineus	Grassy pondweed	25.00	75.00	25.00	0.00	0.00	5.00
Filamentous algae	Filamentous algae	25.00					
15-20 foot Stratum		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Potamogeton crispus	Curly-leaf pondweed	100.00	0.00	100.00	0.00	0.00	20.00
Elodea canadensis	Common water weed	100.00	0.00	100.00	0.00	0.00	20.00
Ceratophyllum demersum	Coontail	100.00	0.00	100.00	0.00	0.00	20.00
Filamentous algae	Filamentous algae	100.00					

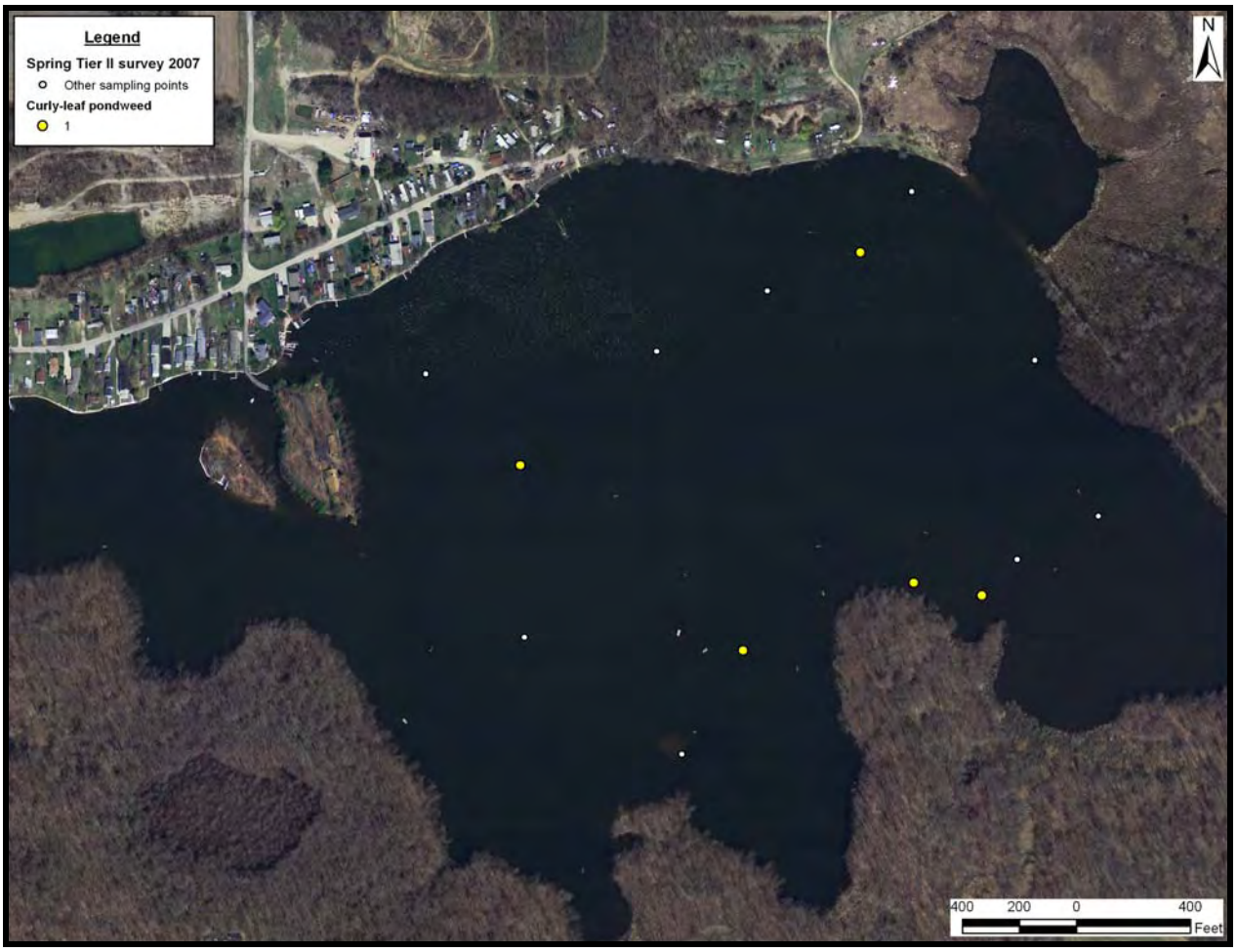


Figure A. Curly-leaf pondweed locations and densities as surveyed June 4, 2007.

Following treatment, coontail was still the most abundant species in Sylvan Lake (Table B). Coontail was present at 67% of the sample sites and had the greatest relative and mean densities throughout the entire sampled water column and in each of the two strata (0-5 feet and 5-10 feet). Throughout the entire sampled water column, chara, Eurasian watermilfoil, and filamentous algae were relatively frequent and were found at 47%, 33%, and 27% of the sites, respectively. Coontail dominated the shallowest strata (0-5 feet) and was identified at 75% of the sites in this stratum. Coontail also possessed the highest dominance (75) and was more than three times as dominant as any other species in this stratum. Common water weed, curly-leaf pondweed, Eurasian watermilfoil, and chara were also prevalent in the 0-5 foot stratum and were present at 50%, 25%, 25%, and 25% of the sites, respectively. Eurasian watermilfoil was found at more sites during the post-treatment survey (33% compared to 7% during pre-treatment). Curly-leaf pondweed was identified at 13% of the sites throughout the entire sampled water column in Pit Basin. Figure B details plant sampling locations and the locations where curly-leaf pondweed was identified during the post-treatment surveys.

Table B. Summer (post-treatment) Tier II survey metrics and results for entire lake strata as collected July 27, 2007.

Occurrence and abundance of submersed aquatic plant species in Pit Basin.					
Total Sites:	15	Mean species / site:	1.87	Native diversity:	0.64
Littoral Sites:	0	Maximum species / site:	4	Species diversity:	0.76
Littoral Depth (ft):	9	Number of species:	6	SE Mean natives / site:	0.31
Date:	7/26/2007	Littoral sites with plants:	10	Mean natives / site:	1.40
Lake:	Pit Basin	Secchi(ft):	N/A	SE Mean species / site:	0.38

All depths (0-10 feet)		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	66.67	33.33	20.00	6.67	40.00	48.00
Chara species	Chara species	46.67	53.33	40.00	6.67	0.00	12.00
Myriophyllum spicatum	Eurasian watermilfoil	33.33	66.67	33.33	0.00	0.00	6.67
Elodea canadensis	Common water weed	20.00	80.00	13.33	6.67	0.00	6.67
Potamogeton crispus	Curly-leaf pondweed	13.33	86.67	13.33	0.00	0.00	2.67
Najas guadalupensis	Southern naiad	6.67	93.33	6.67	0.00	0.00	1.33
Filamentous algae	Filamentous algae	26.67					

0-5 foot Stratum		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	75.00	25.00	0.00	0.00	75.00	75.00
Elodea canadensis	Common water weed	50.00	50.00	25.00	25.00	0.00	20.00
Potamogeton crispus	Curly-leaf pondweed	25.00	75.00	25.00	0.00	0.00	5.00
Myriophyllum spicatum	Eurasian watermilfoil	25.00	75.00	25.00	0.00	0.00	5.00
Chara species	Chara species	25.00	75.00	25.00	0.00	0.00	5.00
Najas guadalupensis	Southern naiad	0.00	100.00	0.00	0.00	0.00	0.00
Filamentous algae	Filamentous algae	25.00					

5-10 foot Stratum		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	77.78	22.22	33.33	11.11	33.33	46.67
Chara species	Chara species	66.67	33.33	55.56	11.11	0.00	17.78
Myriophyllum spicatum	Eurasian watermilfoil	44.44	55.56	44.44	0.00	0.00	8.89
Potamogeton crispus	Curly-leaf pondweed	11.11	88.89	11.11	0.00	0.00	2.22
Najas guadalupensis	Southern naiad	11.11	88.89	11.11	0.00	0.00	2.22
Elodea canadensis	Common water weed	11.11	88.89	11.11	0.00	0.00	2.22
Filamentous algae	Filamentous algae	33.33					

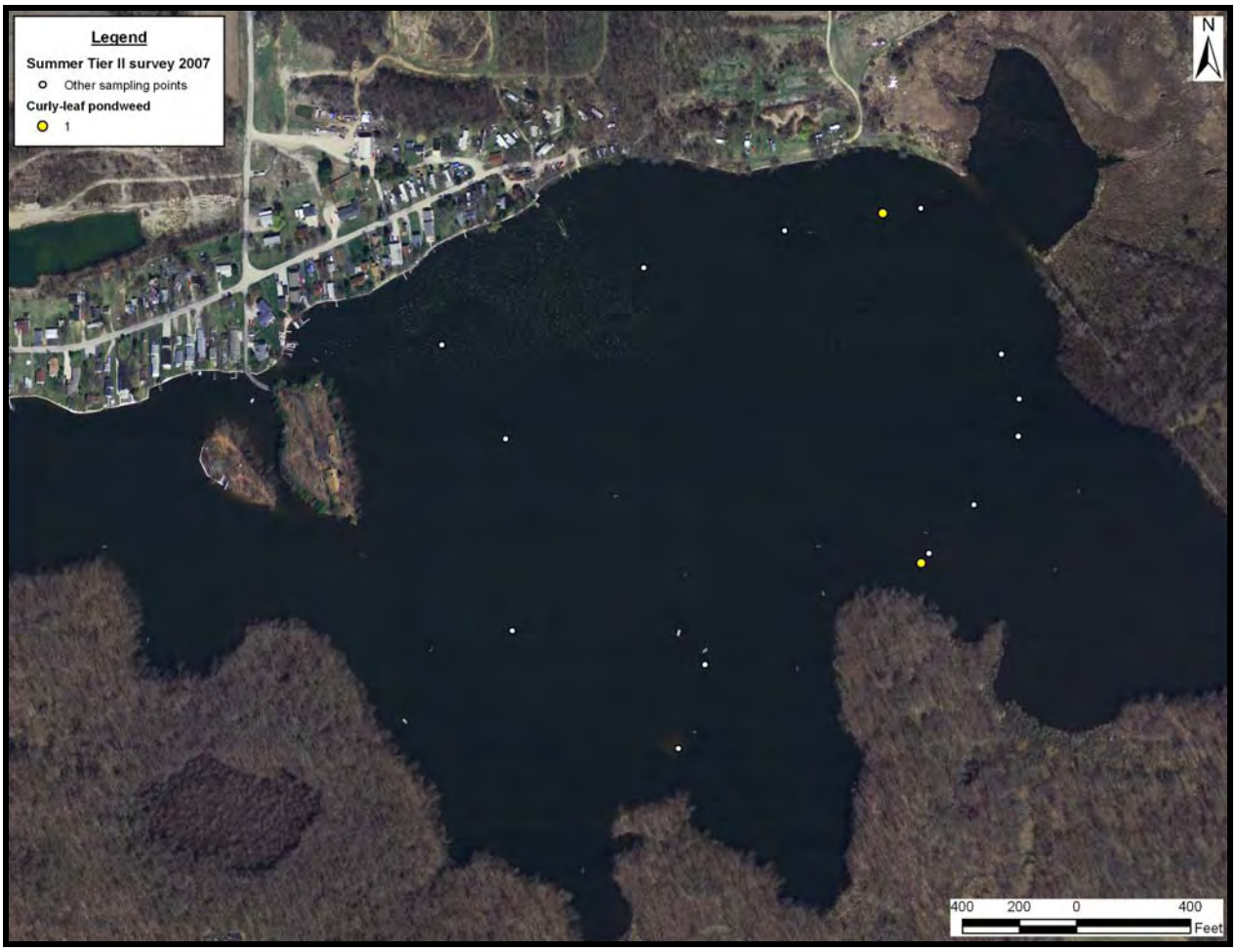


Figure B. Curly-leaf pondweed locations and densities as surveyed in Pit Basin July 27, 2007.

Although the spring Tier II survey was meant to be a pre-treatment survey, curly-leaf pondweed was treated on May 5, 2008, outside of our sampling window, therefore our results for this year's curly-leaf pondweed assessment are inconclusive because we did not conduct a survey before 275 acres in the lake were treated with Aquathol K. Coontail was the dominant species throughout the entire sampled water column (0-20 feet), found at 92% of the sites. Coontail had a frequency of 100% and 89% in the 0-5 and 5-10 foot strata, respectively. No plants were found below 10 feet in the Pit Basin during the spring survey. Curly-leaf pondweed was identified at 15% of the sites, 0% in the 0-5 foot stratum and 22% in the 5-10 foot stratum. Eurasian watermilfoil was found at a relatively high frequency in Pit Basin, at 46% of the sites sampled throughout the entire water column. Eurasian watermilfoil was identified at 25% and 56% of the sites in the 0-5 and 5-10 foot strata, respectively. Figure C details plant sampling locations and the locations where curly-leaf pondweed was identified during the pre-treatment surveys.

Table C. Spring (pre-treatment) Tier II survey metrics and results for entire lake strata as collected June 9, 2008.

Occurrence and abundance of submersed aquatic species in Pit Basin.					
Total Sites:	13	Mean species / site:	2.15	Native diversity:	0.48
Littoral Sites:	13	Maximum species / site:	4	Species diversity:	0.68
Littoral Depth (ft):	10	Number of species:	4	SE Mean natives / site:	0.18
Date:	6/9/2008	Littoral sites with plants:	12	Mean natives / site:	1.54
Lake:	Pit Basin	Secchi(ft):	9	SE Mean species / site:	0.30

All depths (0-10 feet)		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	92.31	7.69	30.77	7.69	53.85	64.62
Elodea canadensis	Common water weed	61.54	38.46	30.77	23.08	7.69	27.69
Myriophyllum spicatum	Eurasian watermilfoil	46.15	53.85	30.77	15.38	0.00	15.38
Potamogeton crispus	Curly-leaf pondweed	15.38	84.62	15.38	0.00	0.00	3.08
Filamentous algae	Filamentous algae	76.92					

0-5 foot Stratum		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Elodea canadensis	Common water weed	100.00	0.00	50.00	25.00	25.00	50.00
Ceratophyllum demersum	Coontail	100.00	0.00	0.00	0.00	100.00	100.00
Myriophyllum spicatum	Eurasian watermilfoil	25.00	75.00	25.00	0.00	0.00	5.00
Filamentous algae	Filamentous algae	100.00					

5-10 foot Stratum		**Frequency of Occurrence**	**Rake score frequency per species**				**Plant Dominance**
Scientific Name	**Common Name**		**0**	**1**	**3**	**5**	
Ceratophyllum demersum	Coontail	88.89	11.11	44.44	11.11	33.33	48.89
Myriophyllum spicatum	Eurasian watermilfoil	55.56	44.44	33.33	22.22	0.00	20.00
Elodea canadensis	Common water weed	44.44	55.56	22.22	22.22	0.00	17.78
Potamogeton crispus	Curly-leaf pondweed	22.22	77.78	22.22	0.00	0.00	4.44
Filamentous algae	Filamentous algae	66.67					

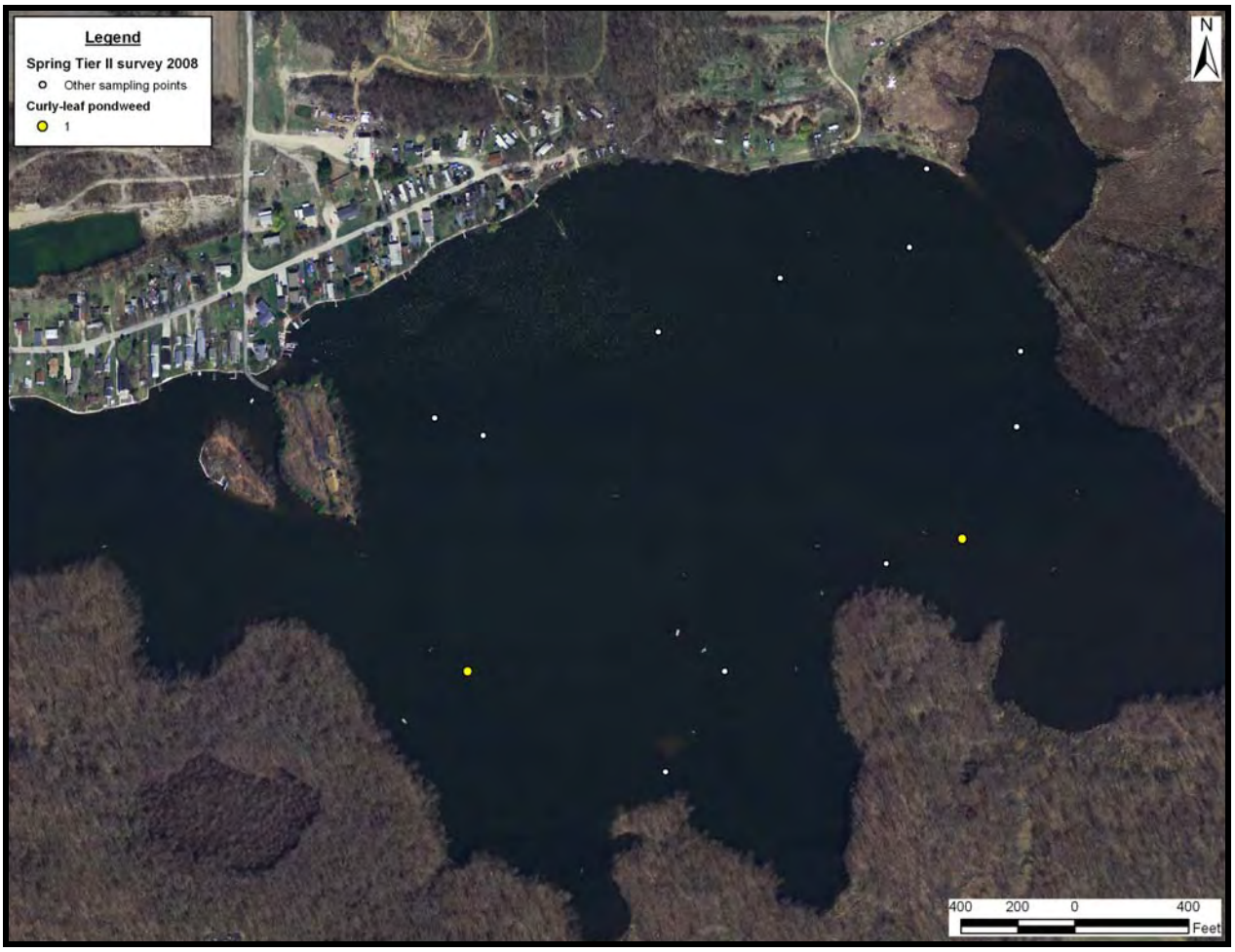


Figure C. Curly-leaf pondweed locations and densities as surveyed in Pit Basin June 9, 2008.

Table D. Summer (post-treatment) Tier II survey metrics and results for entire lake strata as collected August 13, 2008.

Occurrence and abundance of submersed aquatic plant species in Pit Basin.					
Total Sites:	14	Mean species / site:	1.43	Native diversity:	0.41
Littoral Sites:	12	Maximum species / site:	3	Species diversity:	0.59
Littoral Depth (ft):	9	Number of species:	5	SE Mean natives / site:	0.21
Date:	8/13/2008	Littoral sites with plants:	12	Mean natives / site:	1.14
Lake:	Pit Basin	Secchi:	N/A	SE Mean species / site:	0.25

All depth (0-10 ft)		**Frequency of**	**Rake score frequency per species**				**Plant**
Scientific Name	**Common Name**	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	85.71	14.29	50.00	7.14	28.57	42.86
Myriophyllum spicatum	Eurasian watermilfoil	28.57	71.43	28.57	0.00	0.00	5.71
Elodea canadensis	Common water weed	14.29	85.71	14.29	0.00	0.00	2.86
Utricularia vulgaris	Common bladderwort	7.14	92.86	7.14	0.00	0.00	1.43
Najas guadalupensis	Southern naiad	7.14	92.86	7.14	0.00	0.00	1.43
Filamentous algae	Filamentous algae	42.86					
Depth: 0-5 ft		**Frequency of**	**Rake score frequency per species**				**Plant**
Scientific Name	**Common Name**	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	100.00	0.00	33.33	16.67	50.00	66.67
Myriophyllum spicatum	Eurasian watermilfoil	33.33	66.67	33.33	0.00	0.00	6.67
Najas guadalupensis	Southern naiad	16.67	83.33	16.67	0.00	0.00	3.33
Elodea canadensis	Common water weed	16.67	83.33	16.67	0.00	0.00	3.33
Filamentous algae	Filamentous algae	66.67					
Depth: 5-10 ft		**Frequency of**	**Rake score frequency per species**				**Plant**
Scientific Name	**Common Name**	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	100.00	0.00	83.33	0.00	16.67	33.33
Myriophyllum spicatum	Eurasian watermilfoil	33.33	66.67	33.33	0.00	0.00	6.67
Utricularia vulgaris	Common bladderwort	16.67	83.33	16.67	0.00	0.00	3.33
Elodea canadensis	Common water weed	16.67	83.33	16.67	0.00	0.00	3.33
Filamentous algae	Filamentous algae	33.33					

Pit Basin was treated with 1.0 ppm Aquathol K on May 5, 2008. The higher dosage rate seems to be controlling the curly-leaf pondweed well, but the southeast area of Pit Basin has proven difficult to navigate while performing the surveys due to the overabundance of Eurasian watermilfoil and coontail. The areas where we were able to conduct rake tosses and visual observation, we noticed a decrease in curly-leaf pondweed from spring 2007 to spring 2008 as well as summer 2007 to summer 2008. During the spring 2007 survey, curly-leaf pondweed was identified in Sylvan Lake at a frequency of 30%. It decreased to only 11% during the summer survey, but since curly-leaf pondweed usually sineces in early June this frequency is still high for the lake. During the spring 2008 survey, curly-leaf pondweed was only identified at 8% of the sites sampled in Sylvan Lake and it wasn't observed anywhere in Sylvan Lake in the summer 2008 survey (Table D). Appendix E has a full list of species identified in Sylvan Lake and their frequencies and dominance, from 2003 to 2008.

Although the spring Tier II survey was meant to be a pre-treatment survey, curly-leaf pondweed was treated on May 12, 2009, outside of our sampling window, therefore our results for this year's curly-leaf pondweed assessment are inconclusive because we did

not conduct a survey before 275 acres in the lake were treated with Aquathol K. If surveys are conducted in 2010, the pre-treatment survey should be coordinated with the herbicide applicator to ensure that the survey is done before any treatment occurs on the lake. Coontail was the dominant species throughout the entire sampled water column (0-20 feet), found at 77% of the sites. Coontail had a frequency of 100% (100% in 2008) and 83% (89%) in the 0-5 and 5-10 foot strata, respectively. Curly-leaf pondweed was identified at 71% of the sites (15% in 2008), 83% (0%) in the 0-5 foot stratum and 83% (22%) in the 5-10 foot stratum. Eurasian watermilfoil was found at a relatively high frequency in Pit Basin, at 50% (46%) of the sites sampled throughout the entire water column. Eurasian watermilfoil was identified at 83% (25%) and 33% (56%) of the sites in the 0-5 and 5-10 foot strata, respectively. Figure D details plant sampling locations and the locations where curly-leaf pondweed was identified during the pre-treatment surveys.

Table E. Spring (pre-treatment) Tier II survey metrics and results for entire lake strata as collected May 19, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Pit Basin.					
County:	Noble	Total Sites:	14	Mean species/site:	2.50
Date:	5/19/2009	Sites with plants:	12	SE Mean species/site:	0.43
Secchi (ft):	-	Sites with native plants:	11	Mean native species/site:	1.29
Maximum Plant Depth (ft):	9.0	Number of species:	4	SE Mean natives/site:	0.22
Trophic Status:	Mesotrophic	Number of native species:	2	Species diversity:	0.74
		Maximum species/site:	4	Native species diversity:	0.48

All Depths (0 to 15 ft)		**Frequency of**	**Rake score frequency per species**				**Plant**
Species		**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	78.6	21.4	7.1	14.3	57.1	67.1
Potamogeton crispus	Curly leaf pondweed	71.4	28.6	57.1	14.3	0.0	20.0
Elodea canadensis	Common water weed	50.0	50.0	50.0	0.0	0.0	10.0
Myriophyllum spicatum	Eurasian water milfoil	50.0	50.0	42.9	7.1	0.0	12.9
Filamentous Algae		78.6					
Depth: 0 to 5 ft		**Frequency of**	**Rake score frequency per species**				**Plant**
Species		**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	100.0	0.0	0.0	0.0	100.0	100.0
Myriophyllum spicatum	Eurasian water milfoil	83.33333333	16.7	66.7	16.7	0.0	23.3
Potamogeton crispus	Curly leaf pondweed	83.33333333	16.7	66.7	16.7	0.0	23.3
Elodea canadensis	Common water weed	66.66666667	33.3	66.7	0.0	0.0	13.3
Filamentous Algae		100					
Depth: 5 to 10 ft		**Frequency of**	**Rake score frequency per species**				**Plant**
Species		**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
Ceratophyllum demersum	Coontail	83.3	16.7	16.7	33.3	33.3	56.7
Potamogeton crispus	Curly leaf pondweed	83.3	16.7	66.7	16.7	0.0	23.3
Elodea canadensis	Common water weed	50.0	50.0	50.0	0.0	0.0	10.0
Myriophyllum spicatum	Eurasian water milfoil	33.3	66.7	33.3	0.0	0.0	6.7
Filamentous Algae		83.33333333					

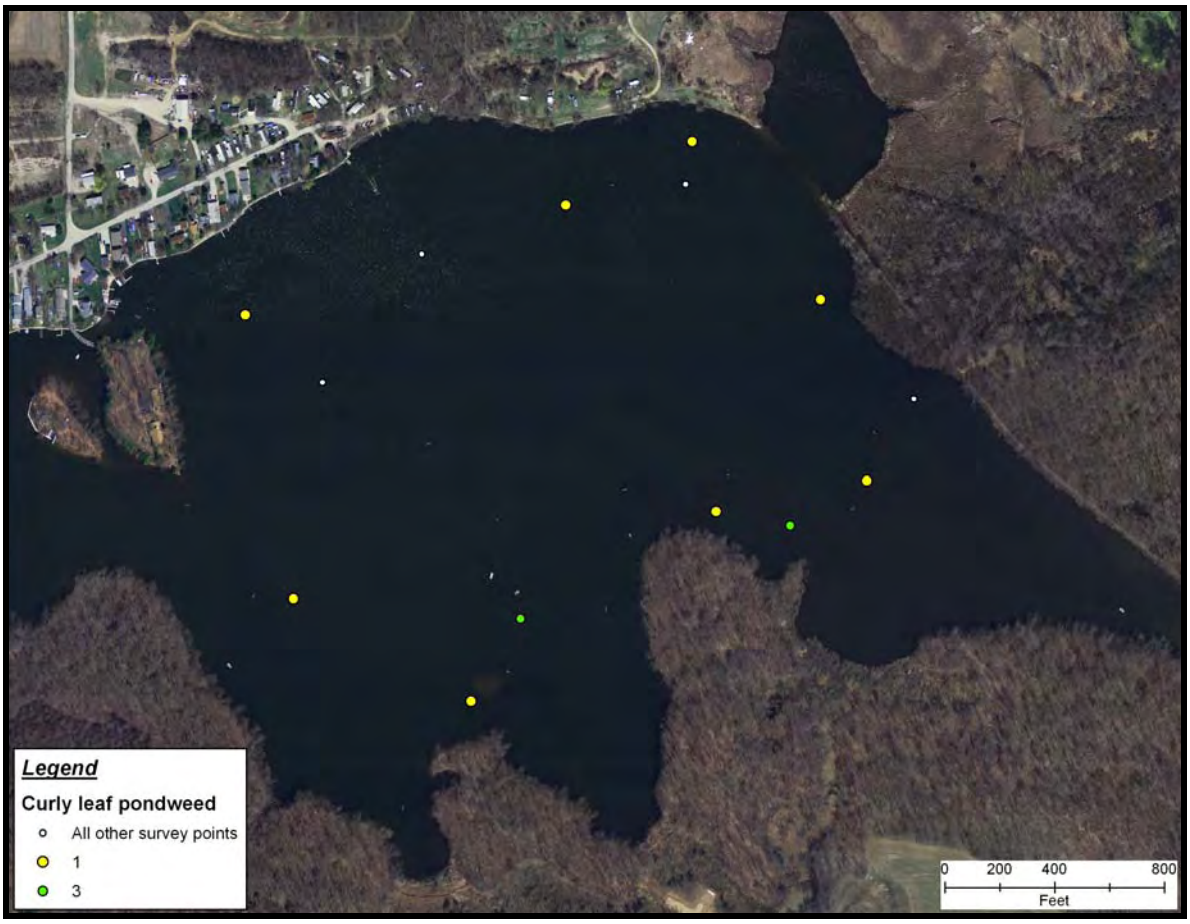


Figure D. Curly-leaf pondweed locations and densities as surveyed in Pit Basin May 19, 2009.

Table F. Summer (post-treatment) Tier II survey metrics and results for entire lake strata as collected August 4, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Pit Basin.					
County:	Noble	Total Sites:	14	Mean species/site:	1.36
Date:	8/4/2009	Sites with plants:	11	SE Mean species/site:	0.34
Secchi (ft):	-	Sites with native plants:	11	Mean native species/site:	1.21
Maximum Plant Depth (ft):	10	Number of species:	5	SE Mean natives/site:	0.26
Trophic Status:	Mesotrohpic	Number of native species:	4	Species diversity:	0.60
		Maximum species/site:	4	Native species diversity:	0.52

All Depths (0 to 10 ft)		Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species			0	1	3	5	
Ceratophyllum demersum	Coontail	78.6	21.4	28.6	35.7	14.3	41.4
Elodea canadensis	Common water weed	28.6	71.4	28.6	0.0	0.0	5.7
Myriophyllum spicatum	Eurasian water milfoil	14.3	85.7	14.3	0.0	0.0	2.9
Elodea nuttallii	Western water weed	7.1	92.9	7.1	0.0	0.0	1.4
Najas guadalupensis	Southern naiad	7.1	92.9	7.1	0.0	0.0	1.4
Filamentous Algae		50.0					
Depth: 0 to 5 ft		Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species			0	1	3	5	
Ceratophyllum demersum	Coontail	100.0	0.0	16.7	66.7	16.7	60.0
Elodea canadensis	Common water weed	33.3	66.7	33.3	0.0	0.0	6.7
Myriophyllum spicatum	Eurasian water milfoil	33.3	66.7	33.3	0.0	0.0	6.7
Elodea nuttallii	Western water weed	16.7	83.3	16.7	0.0	0.0	3.3
Najas guadalupensis	Southern naiad	16.7	83.3	16.7	0.0	0.0	3.3
Filamentous Algae		83.3					
Depth: 5 to 10 ft		Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species			0	1	3	5	
Ceratophyllum demersum	Coontail	62.5	37.5	37.5	12.5	12.5	27.5
Elodea canadensis	Common water weed	25.0	75.0	25.0	0.0	0.0	5.0
Filamentous Algae		25.0					

Pit Basin was treated with 1.0 ppm Aquathol K on May 12, 2009. The higher dosage rate seemed to be controlling the curly-leaf pondweed well in 2008 and 2009, but the southeast area of Pit Basin has proven difficult to navigate while performing the surveys due to the overabundance of Eurasian watermilfoil and coontail. The areas where we were able to conduct rake tosses and visual observation, we noticed a decrease in curly-leaf pondweed from spring 2007 to spring 2008 as well as summer 2007 to summer 2008, but the spring 2009 survey resulted in high frequencies of curly-leaf pondweed. This may have been due to the earlier survey date, May 19 versus June 9, and the cool weather spring we had in 2009. During the spring 2007 survey, curly-leaf pondweed was identified in Sylvan Lake at a frequency of 30%. It decreased to only 11% during the summer survey, but since curly-leaf pondweed usually senesces in early June this frequency is still high for the lake. During the spring 2008 survey, curly-leaf pondweed was only identified at 8% of the sites sampled in Sylvan Lake and it wasn't observed anywhere in Sylvan Lake in the summer 2008 survey (Table D). In 2009, curly-leaf pondweed was very frequent (71%) and should continue to be treated each year until the turion bank has been depleted. Although treatment efforts on this part of the lake have been occurring for a few years now, the curly-leaf does not seem to be decreasing from year to year.

Tony Cunningham found the source of the curly-leaf pondweed this year, tracing it to a small private lake upstream of Henderson Ditch. This lake is infested with curly-leaf pondweed and treatment efforts should include that lake. Appendix E has a full list of species identified in Sylvan Lake and their frequencies and dominance, from 2003 to 2009.

APPENDIX D:

AQUATIC PLANT 5 YEAR SUMMARY

SYLVAN LAKE
AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2009

Sylvan Lake 5-year summary

SURVEY	DFW	DFW	WP		JFN	JFN	JFN		DFW	DFW		JFN	JFN	JFN		Target
Date	6/2/03	5/12/04	5/10/05		6/4/07	6/9/08	5/19/09		7/23/03	7/26/04		7/26/07	8/13/08	8/4/09		
Depth range (ft)	to 10'		to 15'		to 20'	to 20'	to 20'		to 10'	to 10.5'		to 15'	to 20'	to 20'		
Sample sites (n)	147	5.9	150		81	90	90		147	148		90	91	90		
Secchi (ft)	9.3	7.5	7.6		8.2	9.0	9.3		3.0	3.5			3.0	2.8		>=3
Littoral depth (ft)	10.0	8.0	15.2		16.0	13.0	10.0		10.0	10.5		14.0	12.0	13.0		
Coverage (%)	83	78	70		63	71			87	80		62	62			80
Native coverage (%)	70	32							86	75						80
Species (N)	5	6	3		13	10	8		10	10		10	9	10		8
Native species (N)	3	4	1		11	8	6		8	8		8	8	8		8
Species/site (max)	3	3	3		7	8	4		4	5		6	5	4		
Species/site (mean)	1.46	1.17	0.86		1.25	1.57	0.90		1.41	1.63		1.79	1.21	0.61		
Native species/site (mean)	0.73	0.39	0.08		0.90	1.07	0.48		1.23	1.26		1.38	0.88	0.56		
Species diversity	0.66	0.54			0.78	0.73	0.73		0.62	0.81		0.83	0.66	0.57		
Native species diversity	0.16	0.56			0.70	0.57	0.44		0.51	0.73		0.76	0.50	0.49		
Species occurrence (%)																**Target**
Bladderwort													1.1			
Chara	2.7	8.5			4.9	2.2			9.5	11.5		27.8	2.2	1.1		
Coontail	66.7	23.7	11.4		46.9	66.7	34.4		81.0	44.6		55.6	60.4	38.9		60.0
Curly-leaf pondweed	44.9	74.6	94.3		29.6	7.8	26.7		8.2	25.0		11.1		1.1		
Eel grass					3.7	2.2							1.1			
Elodea					3.7	17.8	8.9					7.8	8.8	6.7		
Eurasian water milfoil	28.6	3.4	12.4		4.9	42.2	15.6		10.2	12.2		30.0	33.0	4.4		
Flat-stem pondweed	3.4	5.1			2.5		1.1		28.6	1.4						***
Fries pondweed									0.7							***
Grassy pondweed					8.6							16.7				***
Horned pondweed					6.2	4.4										***
Leafy pondweed						2.2				40.5			4.4			***
Naiad					9.9	8.9			1.4	23.6		20.0	8.8	3.3		
Northern water milfoil					2.5							2.2				
Sago pondweed		1.7			1.2	7.8	1.1		0.7	0.7				1.1		***
Small pondweed							1.1		0.7	1.4				1.1		***
Water stargrass						2.2	1.1		0.7	2.0			1.1	3.3		
Filamentous algae	100.0	11.9			53.1	70.0	57.8		0.7	21.6		31.1	36.3	46.7		
Species dominance																**Target**
Bladderwort													0.2			
Chara	1.4	2.4			1.0	0.4			6.0	6.4		9.1	0.4	0.2		
Coontail	35.1	5.4	2.6		16.3	37.3	15.8		47.8	18.6		29.8	25.7	17.6		
Curly-leaf pondweed	21.5	42.7	67.7		6.9	2.0	7.6		1.6	7.2		2.2		0.2		
Eel grass					0.7	0.4	1.8						0.2	1.3		
Elodea					1.2	5.8	5.3					2.9	2.2	0.9		
Eurasian water milfoil	13.1	0.7	3.0			22.2	0.2		3.1	3.2		16.2	11.0			
Flat-stem pondweed	0.7	1.0			0.5				8.4	0.3						
Fries pondweed									0.1							
Grassy pondweed					1.7							5.1				
Horned pondweed					2.2	0.4										
Leafy pondweed						0.9				19.2			1.3			
Naiad					2.0	1.8			0.3	9.3		6.2	2.2			
Northern water milfoil					0.5							0.4		0.7		
Sago pondweed		0.3			0.3		0.2		0.1	0.1		2.4		0.2		
Small pondweed							0.2		0.1	0.3				0.2		
Water stargrass						0.4	0.2		0.1	0.4			0.2	0.7		

*** = combined coverage of thin-leaved pondweeds to reach 40%

APPENDIX E:

2010 AQUATIC PLANT TREATMENT PERMIT APPLICATIONS

SYLVAN LAKE
AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2009

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT

State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987

[x] Whole Lake [ ] Multiple Treatment Areas
Check type of permit

INSTRUCTIONS: Please print or type information

FOR OFFICE USE ONLY
License No.
Date Issued
Lake County

Return to:
DEPARTMENT OF NATURAL RESOURCES
Division of Fish and Wildlife
Commercial License Clerk
402 West Washington Street, Room W273
Indianapolis, IN 46204

FEE: $5.00

Applicant's Name: Joe Costello	Lake Assoc. Name: Sylvan Lake Improvement Association	
Rural Route or Street: PO Box 696		Phone Number: 260-854-4658
City and State: Rome City, Indiana		ZIP Code: 46784
Certified Applicator (if applicable):	Company or Inc. Name: Weed Patrol, Inc.	Certification Number:
Rural Route or Street:		Phone Number:
City and State:		ZIP Code:

Lake (One application per lake): Sylvan Lake	Nearest Town: Rome City	County: Noble
Does water flow into a water supply		[ ] Yes [ ] No

Please complete one section for *EACH* treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area # 1	LAT/LONG or UTM's	
Total acres to be controlled 100	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft) 12	Expected date(s) of treatment(s) April - May	

Treatment method: [x] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Aquathol K

Plant survey method: [x] Rake [ ] Visual [ ] Other (specify) Formal Plant Survey

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Curlyleaf Pondweed	X	80% (seasonal)
Coontail		34.4%
Eurasian Watermilfoil		15.6%
Elodea		8.9%
Water star grass		1.1%
Slender pondweed		1.1%
Flat stem pondweed		1.1%
Sago pondweed		1.1%
Filamentous algae		present

Treatment Area #	2	LAT/LONG or UTM's	
Total acres to be controlled	60	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	10	Expected date(s) of treatment(s)	April - May

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Renovate 3, Renovate OTF, 2,4-D

Plant survey method: [X] Rake [ ] Visual [ ] Other (specify) Formal plant survey

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Curlyleaf Pondweed		80% (seasonal)
Coontail		34.4%
Eurasian Watermilfoil	X	15.6%
Elodea		8.9%
Water star grass		1.1%
Slender pondweed		1.1%
Flat stem pondweed		1.1%
Sago pondweed		1.1%
Filamentous Algae		present

INSTRUCTIONS: Whoever treats the lake fills in "Applicant's Signature" unless they are a professional. If they are a professional company who specializes in lake treatment, they should sign on the "Certified Applicant" line.

Applicant Signature	Date
Certified Applicant's Signature	Date

FOR OFFICE ONLY

[ ] Approved [ ] Disapproved	Fisheries Staff Specialist
[ ] Approved [ ] Disapproved	Environmental Staff Specialist

Mail check or money order in the amount of $5.00 to:

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
COMMERCIAL LICENSE CLERK
402 WEST WASHINGTON STREET ROOM W273
INDIANAPOLIS, IN 46204

Treatment Area #	3	LAT/LONG or UTM's	
Total acres to be controlled	25	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	5	Expected date(s) of treatment(s)	

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Copper Sulfate, Cygnet Plus

Plant survey method: [X] Rake [X] Visual [ ] Other (specify) Formal plant survey

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Curlyleaf Pondweed		80% (seasonal)
Coontail		34.4%
Eurasian Watermilfoil		15.6%
Elodea		8.9%
Water star grass		1.1%
Slender pondweed		1.1%
Flat stem pondweed		1.1%
Sago pondweed		1.1%
Chara Algae	X	1.1%
Filamentous Algae	X	present

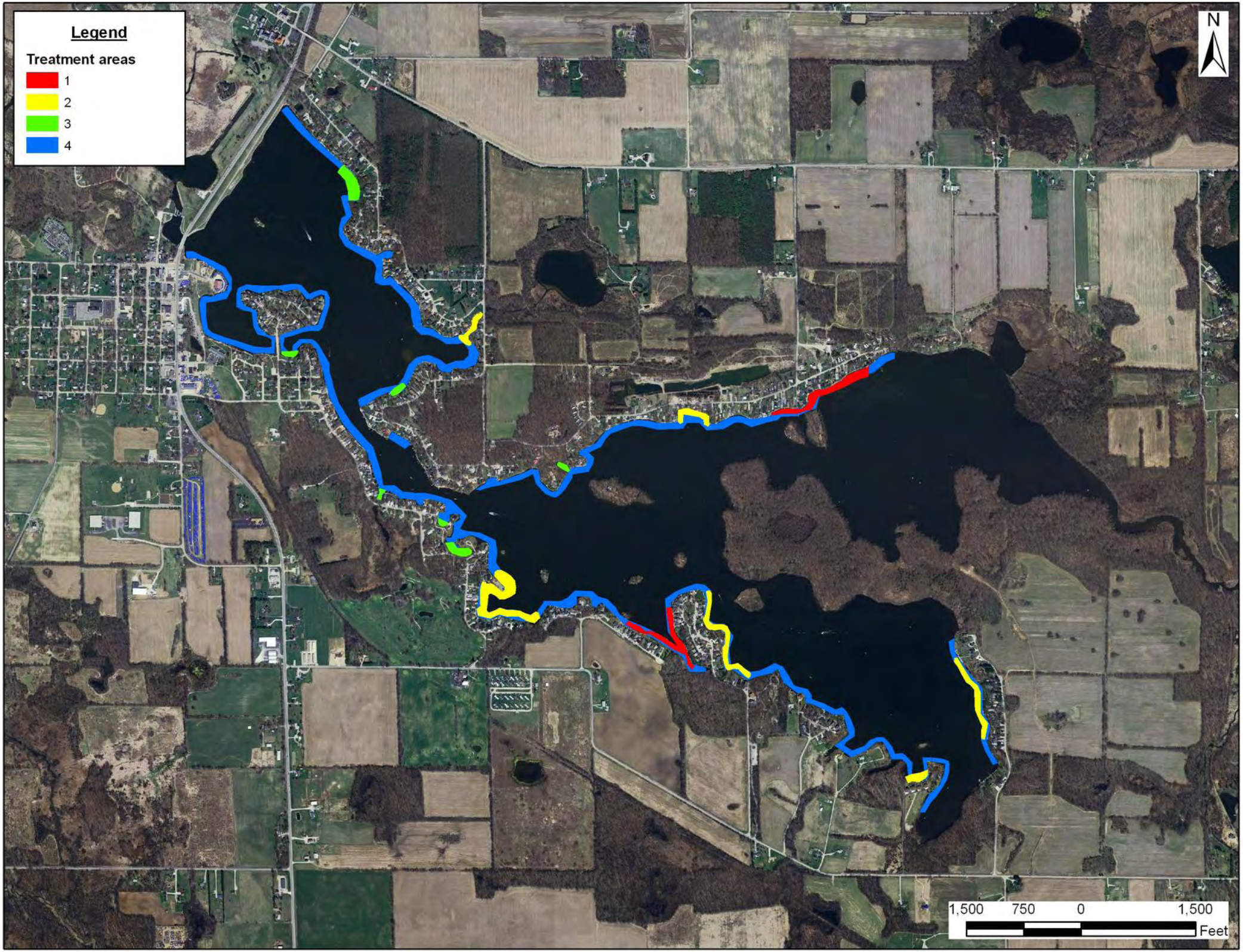
Treatment Area #	4	LAT/LONG or UTM's	
Total acres to be controlled	30	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	5	Expected date(s) of treatment(s)	

Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Reward, Cygnet Plus

Plant survey method: [X] Rake [ ] Visual [ ] Other (specify) Formal plant survey

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Curlyleaf Pondweed		80% (seasonal)
Coontail	X	34.4%
Eurasian Watermilfoil		15.6%
Elodea		8.9%
Water star grass		1.1%
Slender pondweed		1.1%
Flat stem pondweed		1.1%
Sago pondweed		1.1%
Chara Algae		1.1%
Filamentous Algae		present


Legend
Treatment areas
1
2
3
4
N
1,500
750
0
1,500
Feet