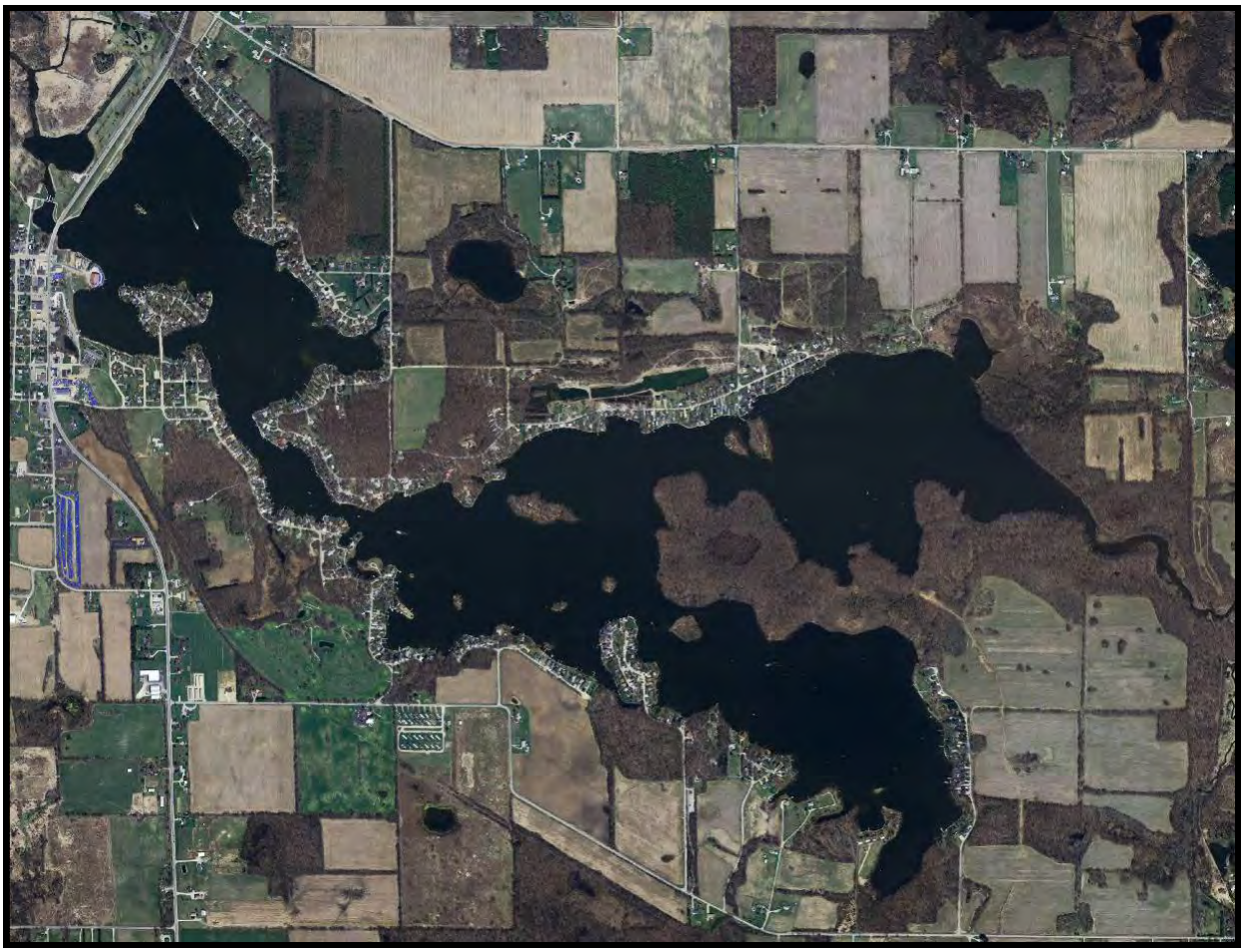
# Sylvan Lake Aquatic Vegetation Management Plan Update 2008
## Noble County, Indiana

**March 1, 2009**



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# SYLVAN LAKE AQUATIC VEGETATION MANAGMEENT PLAN UPDATE 2008
# NOBLE COUNTY, INDIANA

## EXECUTIVE SUMMARY

This document is intended to update the 2007 Aquatic Plant Management Plan and build on aquatic plant treatment efforts within Sylvan Lake, Noble County, Indiana. The following report specifically addresses the results of the aquatic plant chemical treatments conducted during the 2008 season and compares the results with variations in the plant communities at Sylvan Lake over a period of the past two growing seasons. This report captures and interprets information regarding previous aquatic plant management at Sylvan Lake.

In 2008, the only method of control was chemical in nature and was intended to target Eurasian watermilfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus*), and coontail (*Ceratophyllum demersum*). Eurasian watermilfoil and curly-leaf pondweed are exotic to Indiana lakes. On May 5, 2008, 275 acres of curly-leaf pondweed were treated by Weed Patrol Inc. (Elkhart, Indiana) within the lake. On June 17, 2008, Weed Patrol Inc. treated approximately 29 acres of coontail throughout the lake, while the final treatment of Eurasian watermilfoil and coontail (*Ceratophyllum demersum*) occurred over 15 acres on July 24th within the eastern portion of the lake. Three separate treatments occurred which targeted these three different species. 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 some of the curly-leaf pondweed in other parts of the lake. Areas were treated selectively for Eurasian watermilfoil and coontail using 2, 4-D. Areas treated for coontail alone were treated with Reward.

Two 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 curly-leaf pondweed treatment but prior to the Eurasian watermilfoil treatment. Comparison of 2008 spring and summer Tier II survey data shows that the relative density and abundance of curly-leaf pondweed decreased from the spring to the summer survey. Relative and mean densities of Eurasian watermilfoil also decreased from the spring to the summer.

JFNew's review of Tier II surveys from 2003 to 2008 indicates that herbicidal treatment of curly-leaf pondweed is providing control of this exotic species in Sylvan Lake. However, the Eurasian watermilfoil population has increased in recent years. Comparison of spring Tier II survey data from 2003, 2005, 2007, and 2008, data indicate that Eurasian watermilfoil frequency and dominance decreased from 2003 to 2007, but increased in 2008. 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, 29% of the sites in 2007, and decreased to 8% of the sites in 2008. One possible explanation for this is that curly-leaf pondweed in Sylvan Lake has historically undergone less rigorous treatment than treatments targeting Eurasian watermilfoil. In 2007 and 2008 up to 300 acres of curly-leaf pondweed was treated, which would account for the decrease in density over the last two years.

Curly-leaf pondweed should continue to be treated in 2009. This treatment would be the third consecutive year that almost 300 acres in Sylvan Lake has been treated for curly-leaf pondweed. The consensus in Indiana is that multi-year treatment of curly-leaf pondweed is the best method to control the invasive species. The turions produced by curly-leaf pondweed are responsible for it spreading throughout Sylvan Lake. The almost 300 acres treated for curly-leaf pondweed in previous years should be treated again in 2009 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.

The effects of the treatment on the native aquatic plant community are unclear. Comparing the 2008 spring and summer Tier II survey metrics indicates that the quality of the native aquatic plant community in Sylvan Lake decreased following treatment. The native rake diversity (SDI), native species richness, site species native diversity, and number of native plants all decreased following treatment. Coontail dominated the aquatic plant community before and after treatment.

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°. At this time, treatment of 275 acres of curly-leaf pondweed is estimated to occur in 2009.
2. Treatment of approximately 275 acres of curly-leaf pondweed throughout Sylvan Lake. Treatment of 95 acres should occur at a rate of 1 mg/L (0.6 to 3.8 gallons/acre depending on depth) of Aquathol K. 180 acres should be treated at a rate of 0.5 mg/L where curly-leaf pondweed has been observed in the past.
3. Treatment of approximately 67 acres of Eurasian watermilfoil with 2,4-D throughout Sylvan Lake. Areas are identified in the following sections, but should be confirmed prior to treatment occurring in 2009.
4. 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 2009.
5. Continue pre- and post-treatment assessments to determine how the aquatic plant community within Sylvan Lake changes over time.

In 2009, treatment, aquatic plant community assessment, and plan updates are anticipated to cost $90,800. Treatment costs should be reduced over the following years and at a minimum should not exceed $90,800.

**Budget estimate for the action plan.**

| Task | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| Curly-leaf pondweed treatment -275 acres | $51,000 | $5,000 | $5,000 | $5,000 |
| Eurasian watermilfoil treatment-67 acres | $26,800 | $26,800 | $26,800 | $26,800 |
| Plant sampling and plan update | $8,000 | $8,000 | $8,000 | $8,000 |
| Native plant and algae treatment | $5,000 | $5,000 | $5,000 | $5,000 |
| **Total** | **$90,800** | **$44,800** | **$44,800** | **$44,800** |

## 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, Gwen White, Angela Sturdevant, and Tony Cunningham for their input and oversight. Contributors include: Betsy Ewoldt, Scott Namestnik, and Lynn Cudlip.

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# SYLVAN LAKE AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2008
# 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 as a tool 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, and 2008 vegetation control efforts; spring and summer Tier II results from the 2008 season; a comparison of Tier II results from 2003 to 2008 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. 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 2008 growing season the following actions were taken.

- May 5, 2008: 275 acres of curly-leaf pondweed treated.
- June 9, 2008: Tier II spring aquatic plant survey completed.
- June 17, 2008: 29 acres of coontail treated.
- July 24, 2008: 15 acres of coontail and Eurasian watermilfoil treated.
- August 13, 2008: Tier II summer aquatic plant surveys completed.
- November 1, 2008: Public meeting to discuss initial aquatic plant survey results and treatment.
- November 7, 2008: Meeting between the SLIA, JFNew, and IDNR to discuss 2009 treatment options.

## 2.0 Watershed and Lake Characteristics

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

A public meeting was held November 1, 2008 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.) Nineteen lake users responded to the survey this year. The responses from meeting attendees indicate that nearly all of them use the lake for boating (95%) and swimming (89%), while a high percentage use the lake for fishing (74%). Another 58% 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.

Respondents were also questioned about their perceived problems with the lake. Figure 1 details the responses of users in regards to perceived problems in Sylvan Lake. The main concern of Sylvan Lake users is that too many aquatic plants are present in the lake (79%). Dredging needs were identified by 63% of respondents, while 47% identified poor water quality within Sylvan Lake as a problem. Thirty-two (32%) of lake users think that there is too much fishing on Sylvan Lake and most of the specific complaints regarding this concern were directed at the bass tournaments that take place on the lake. Concerns regarding too many boats or 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 26% of Sylvan Lake users. Complaints about non-resident use include noise pollution, speeding on and off the lake, and installation of docks at non-resident locations.

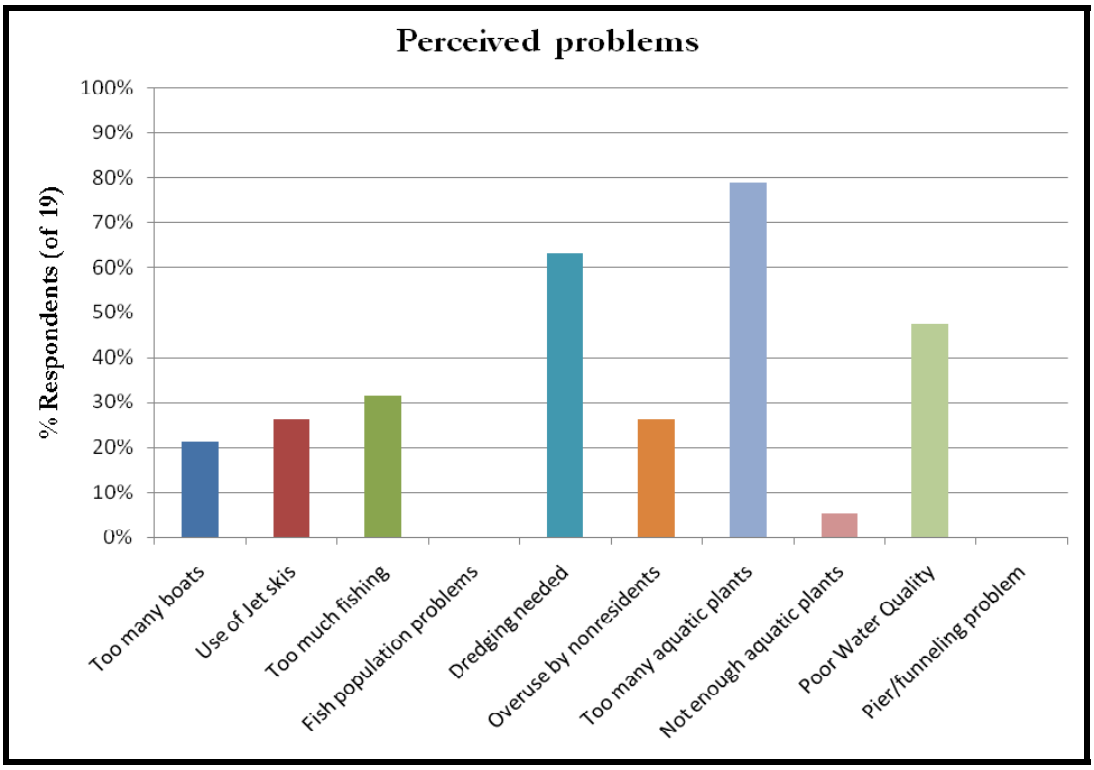


**Figure 1. Perceived problems from Sylvan Lake users.**

Many lake users commented on the need for additional weed control in the lake and realize that they may have too many invasive aquatic plant species and not enough native plant species. The need to treat Eurasian watermilfoil (*Myriophyllum spicatum*) will continue to be a priority for this lake. There were only one or two specific comments about dredging even though 63% of users thought it is necessary. A consensus, which the survey did not provide, on locations that need to be dredged would help determine whether or not there is a serious issue in Sylvan Lake.

Compared to the 2007 survey that was completed by lake users, the 2008 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 and 2008 are in line with expectations. The main concern this year is also the same as last year. 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. Dredging needs were still the second highest concern for respondents, but only a few people made specific comments as to where the problem areas are located. These comments are listed in Appendix A.

## 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 Exotic Plants in Sylvan Lake

Previous aquatic plant assessments identified the predominance of curly-leaf pondweed and the presence of Eurasian watermilfoil as the two primary exotic nuisance species located within Sylvan Lake. These species continue to be problematic throughout the areas previously identified. Eurasian watermilfoil was identified in larger, more extensive beds in 2008 and therefore should be a priority for treatment in 2009 or 2010 since the final year of curly-leaf pondweed treatment will occur in 2009. Once the large area treatment of curly-leaf pondweed is completed in 2009 the lake association should concentrate on treating the areas of Eurasian watermilfoil that are causing poor water quality and problems for lake users to enjoy the lake.

## 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 2009, continue treatment of 275 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.

Historic treatment efforts support these three goals. Efforts to control the growth and spread of curly-leaf pondweed and Eurasian watermilfoil 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

Between 1987 and 1997, aquatic plant treatment within Sylvan Lake was limited to individual residences along the shoreline of the lake (Weed Patrol, 2005 draft). During this ten year period, management of the aquatic plant community focused on the growth of a diverse community throughout as much of the lake as possible without limiting individual's use of the lake for regular recreational activities. Eurasian watermilfoil treatment began in 1997 and continued with wide-spread treatment throughout the lake for three out of four years from 1997 to 2000 (Weed Patrol, 2005 draft). Since that time, spot treatment of Eurasian watermilfoil and curly-leaf pondweed occurred throughout the lake. The focus of these treatments continues to be the developed areas of the lake near the lake's outlet. This results in the upstream portions of the lake not being treated. These areas may act as a nursery for both Eurasian watermilfoil and curly-leaf pondweed. Table 1 displays the treatment of exotic species, namely curly-leaf pondweed and Eurasian watermilfoil, since 1997.

Following the 2005 assessment, a permit application was submitted to the IDNR to treat approximately 300 acres of curly-leaf pondweed, 15 acres of Eurasian watermilfoil, and 50 acres each of filamentous algae and coontail. A similar permit application was submitted in 2006 and in 2007 for treatment of curly-leaf pondweed, Eurasian watermilfoil, coontail, and algae. In total, 120 acres of curly-leaf pondweed were treated throughout Sylvan Lake in both 2005 and 2006. In 2005, Eurasian watermilfoil was treated in concert with coontail treatment which covered approximately 20 acres. In 2006, 20 acres of Eurasian watermilfoil were treated throughout Sylvan Lake. In 2007, 265 acres of curly-leaf pondweed, 18.5 acres of Eurasian watermilfoil, and 7.5 acres of coontail were treated throughout Sylvan Lake.

**Table 1. Eurasian watermilfoil and curly-leaf pondweed treatment history within Sylvan Lake, 1997 to present (2008).**

| Year | Eurasian watermilfoil 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 |

On May 5, 2008, Weed Patrol treated 275 acres of curly-leaf pondweed. Additionally, on July 24, 2008, Weed Patrol treated a total of 15 acres of Eurasian watermilfoil and coontail. Both treatments occurred during sunny conditions (approximately 50ºF water temperature). A third treatment which was not funded by the LARE program occurred on June 17, 2008 for coontail (approximately 29 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 watermilfoil

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 observed 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.

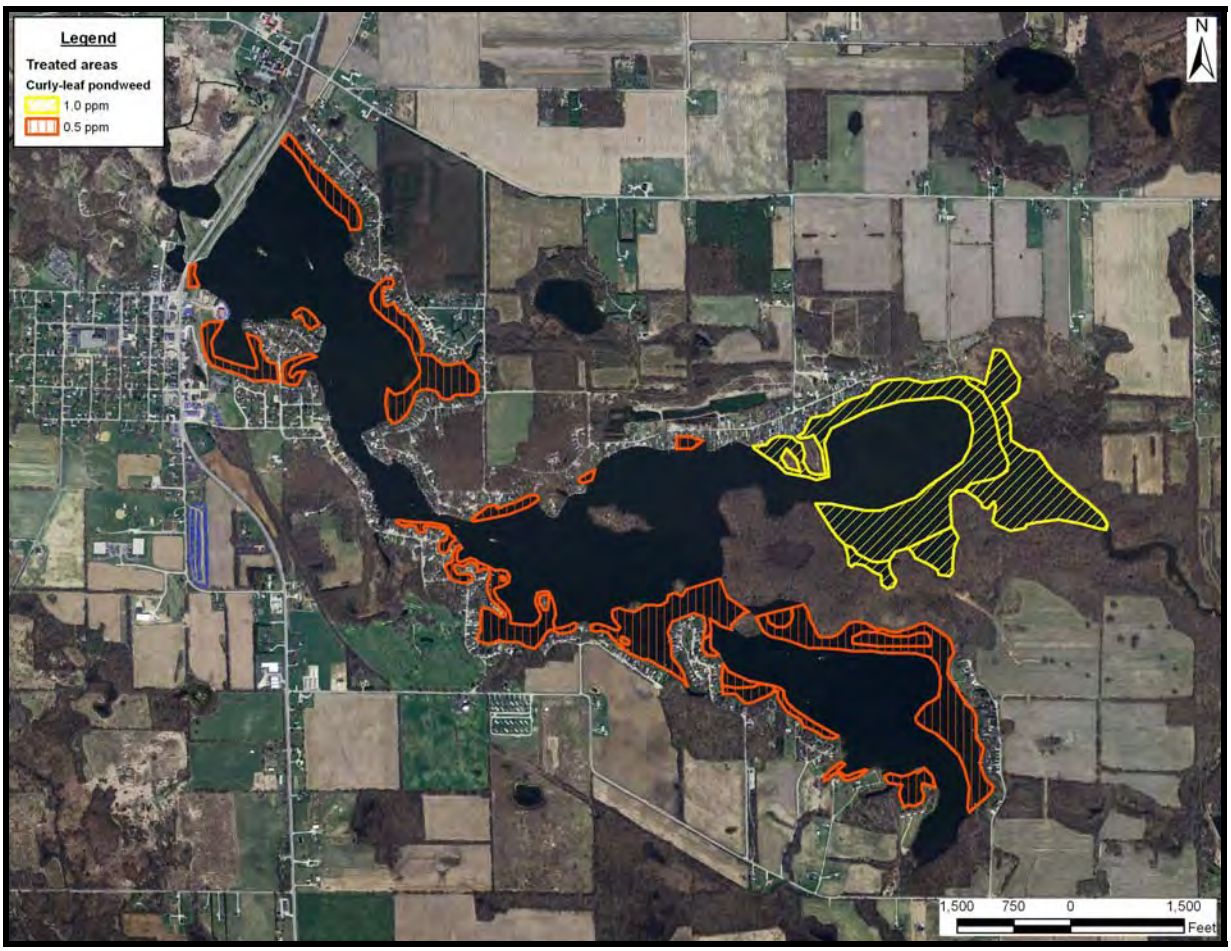


**Figure 2. Curly-leaf pondweed treatment areas located on Sylvan Lake. Weed Patrol completed treatment on May 5, 2008.**

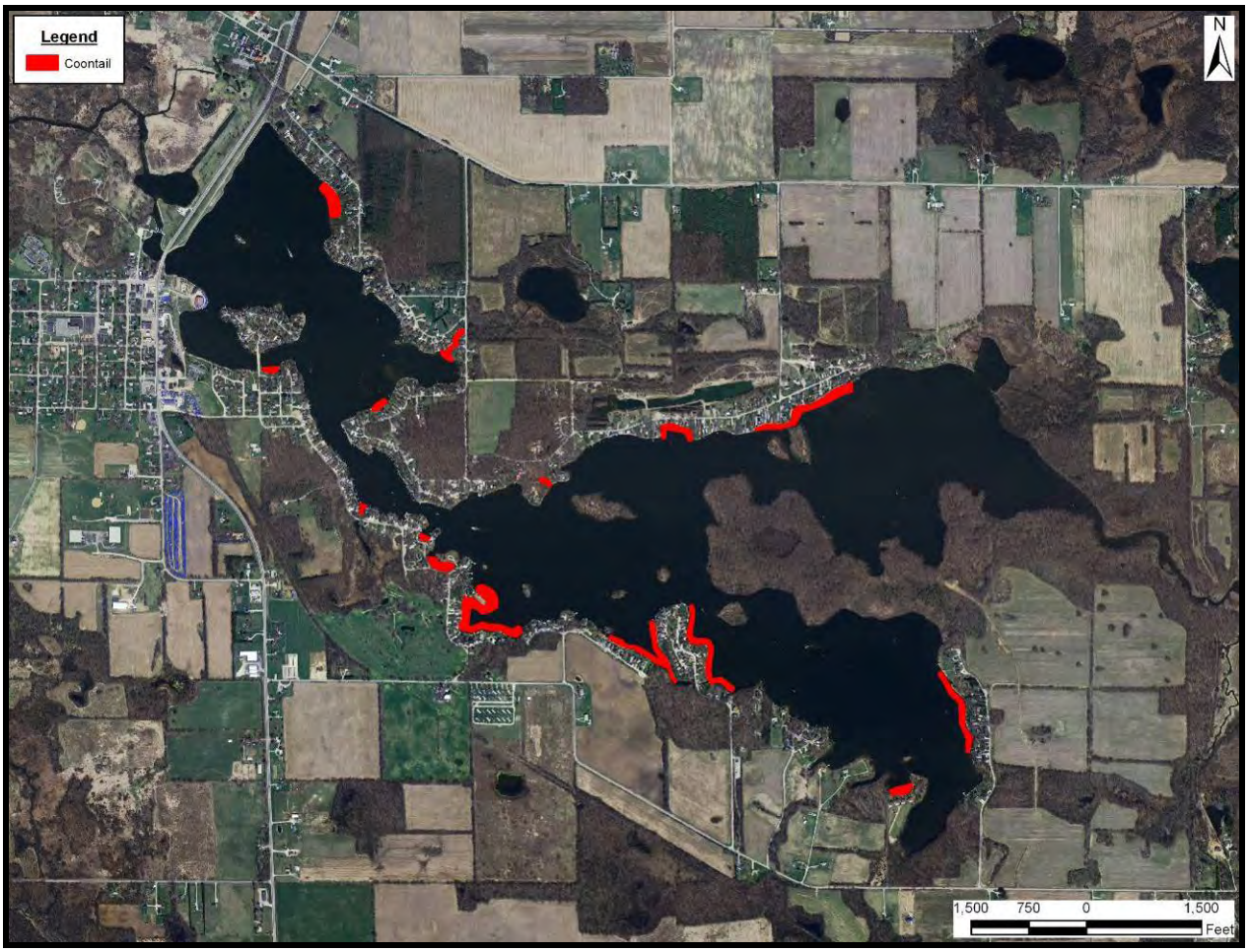


**Figure 3. Coontail treatment areas located on Sylvan Lake. Weed Patrol completed treatment for coontail on June 17, 2008.**

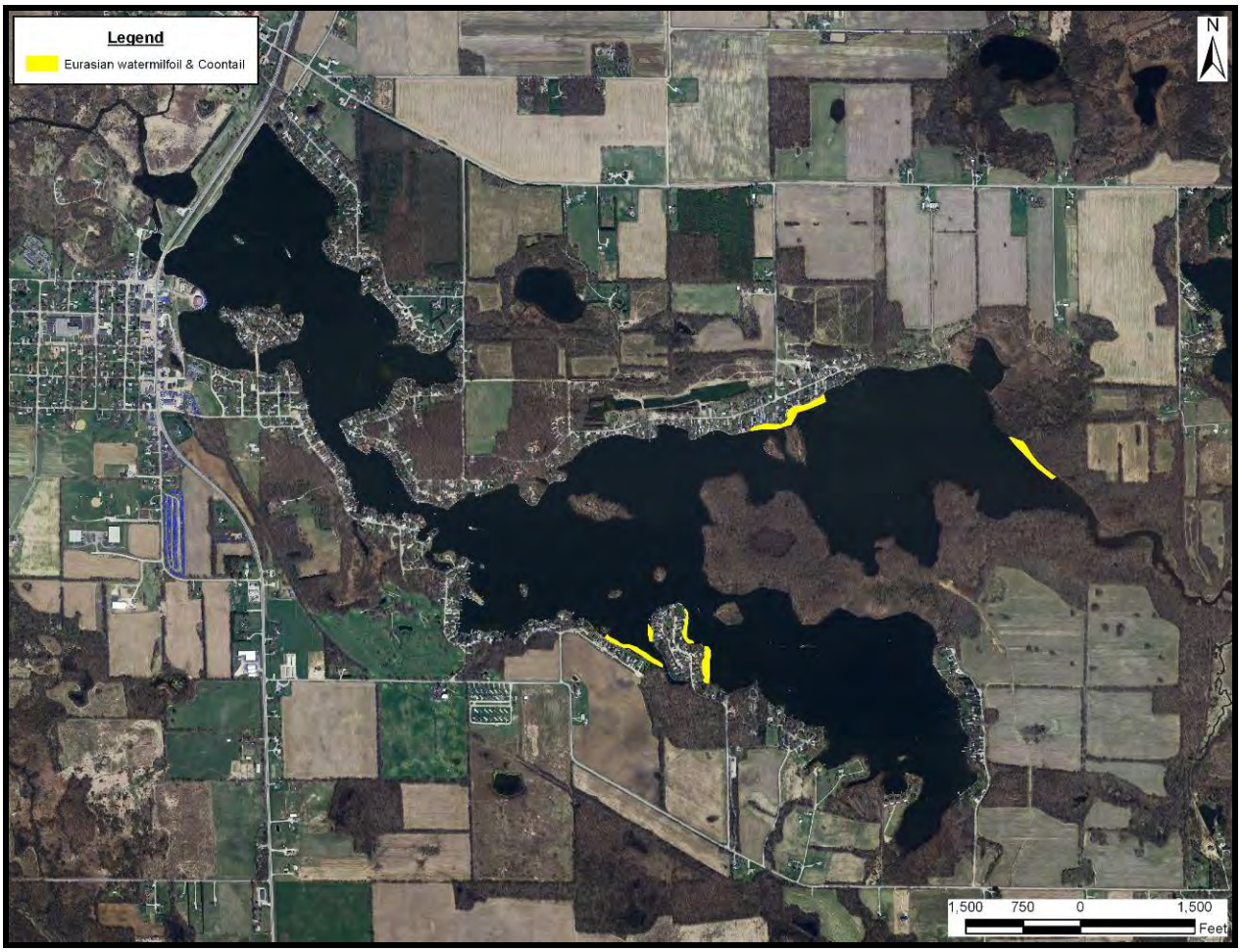


**Figure 4. Eurasian watermilfoil and coontail treatment areas located on Sylvan Lake. Weed Patrol completed treatment for Eurasian watermilfoil and coontail on July 24, 2008.**

## 8.0 Aquatic Plant Community Characterization

### 8.1 Methods

JFNew surveyed Sylvan Lake's plant community on June 9 and August 13, 2008 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 2 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 2. 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<br>27 pts 5-10 foot stratum<br>24 pts 10-15 foot stratum<br>10 pts 15-20 ft stratum |

### 8.2 2008 Sampling Results

Spring (June) and summer (August) exotic species surveys and spring and summer Tier II surveys were completed on Sylvan Lake in 2008 by JFNew. An additional survey of the coontail community was completed on June 12, 2008. The survey schedule is detailed in Table 3. No samples were sent to an outside taxonomist for vouchering or identification.

**Table 3. Survey schedule for pre-treatment and Tier II surveys.**

| Survey | Date |
|---|---|
| Spring exotic species survey | June 9, 2008 |
| Summer exotic species survey | August 13, 2008 |
| Spring Tier II -Spring | June 9, 2008 |
| Summer Tier II -Summer | August 13, 2008 |
| Coontail community mapping | June 12, 2008 |

#### 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.

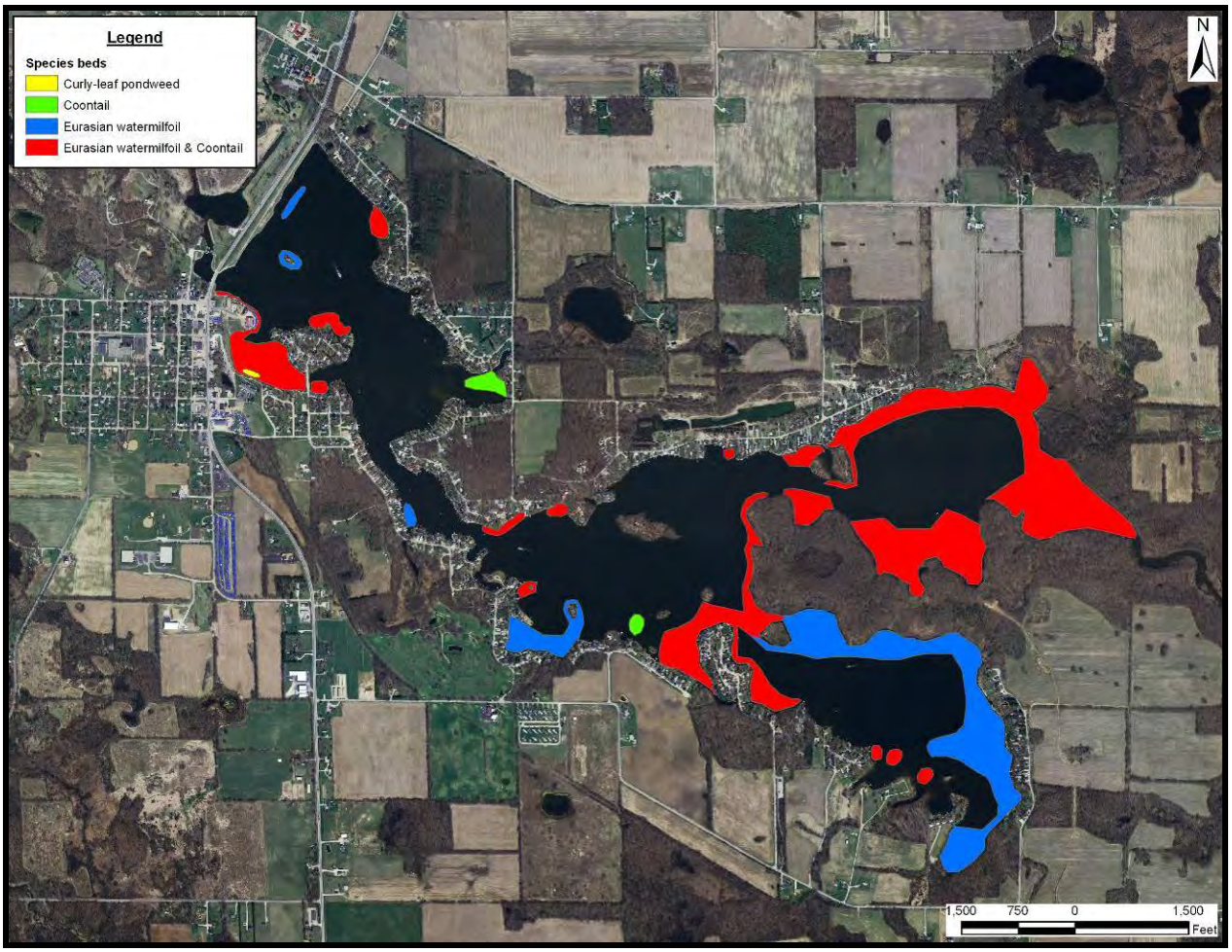


**Figure 5. Dense curly-leaf pondweed, Eurasian watermilfoil, and coontail locations identified within Sylvan Lake on June 9, 2008.**

## Spring Assessment

The dominant plant species found in Sylvan Lake include coontail, Eurasian watermilfoil, and filamentous algae (Table 4). One state rare species, horned pondweed (*Zannichellia palustris*) was identified during the spring assessment. Locations of this species are displayed in Figure 6. There are a number of problem areas located throughout the lake. Eurasian watermilfoil 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 4. Aquatic plant species observed in Sylvan Lake during the spring and summer surveys completed June 9 and August 13, 2008.**

| 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 | 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 |
| *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 watermilfoil | Submergent | X | X |
| *Najas guadalupensis* | Southern naiad | Submergent | X | 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 crispus* | Curly leaf pondweed | Submergent | X | |
| *Potamogeton foliosis* | Leafy pondweed | Submergent | X | 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 |
| *Utricularia vulgaris* | Common bladderwort | Submergent | | X |
| *Valisneria americana* | Eel grass | Submergent | X | X |
| *Zannichellia palustris** | Horned pondweed | Submergent | X | |

*State rare species

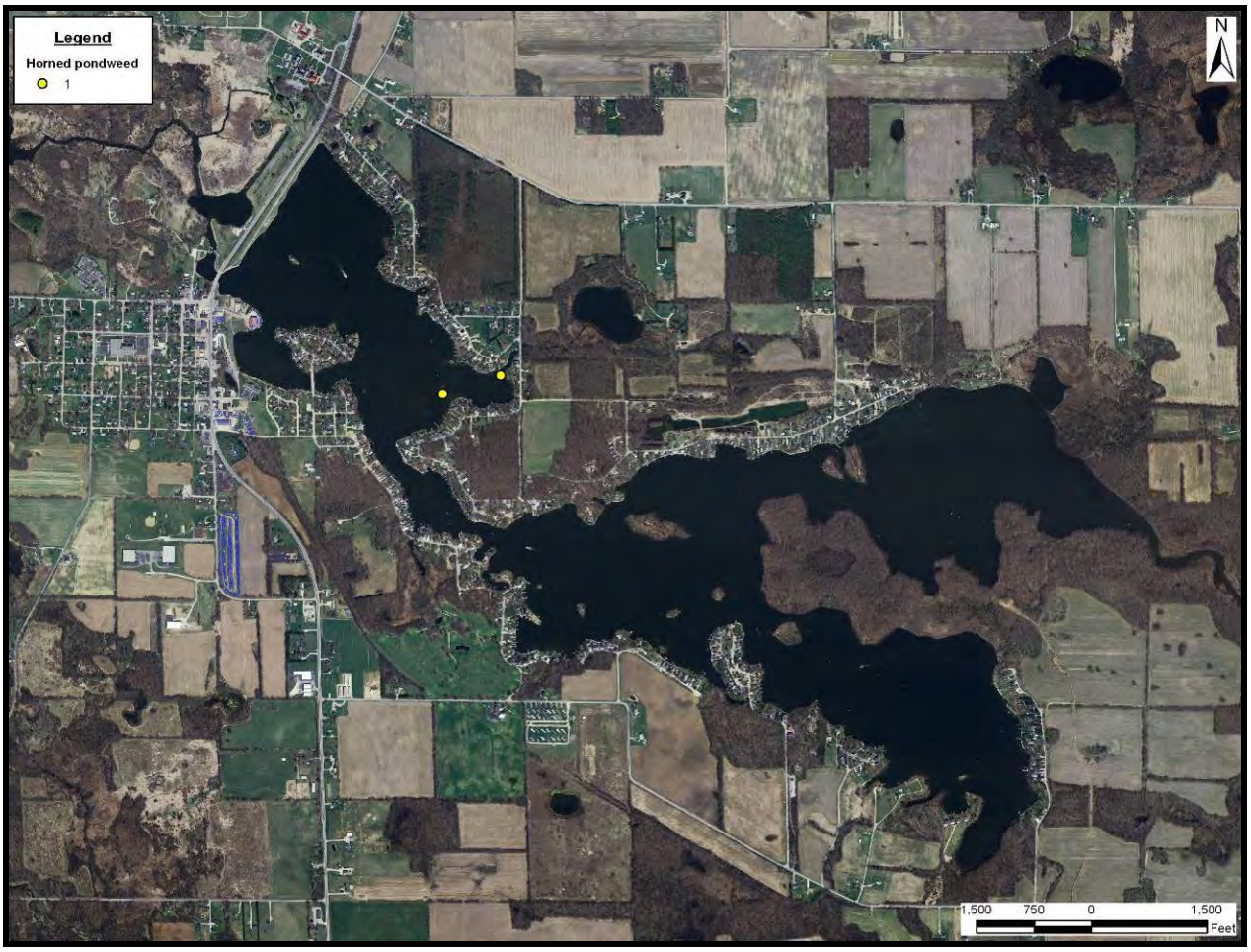


**Figure 6. Horned pondweed (state rare species) locations and dominance as surveyed June 9, 2008.**

**Summer Assessment**

There was one additional plant species, common bladderwort (*Utricularia vulgaris*) identified during the summer survey, and a few from the spring survey were not found. Those not found in the summer include curly-leaf pondweed and horned pondweed. Eurasian watermilfoil frequency decreased from spring to summer. Dense areas of Eurasian watermilfoil were identified along the southern shoreline and in small areas along the northern shoreline of Sylvan Lake. Curly-leaf pondweed was not found during the summery 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 June 9, 2008 (pre-treatment) and on August 13, 2008 (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 9.0 feet in the spring and 3.0 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 13 feet during the spring, pre-treatment survey and to a depth of 12 feet during the summer, post-treatment survey. Ninety sites were randomly selected within the littoral zone

based on the stratification indicated in the protocol. Results of the sampling are detailed in Appendix C.

During the pre-treatment survey, coontail dominated the plant community over most depths (0-20 feet; Table 5). This species was found at the highest percentage of sites throughout all depths sampled (67%). Throughout all depths sampled, Eurasian watermilfoil was relatively frequent at 42% of the sites (Table 5). Coontail, filamentous algae, and Eurasian watermilfoil dominated Sylvan Lake in the 0-5, 5-10, and 10-15 foot strata (Appendix C; spring). Coontail maintained the highest frequencies for the top three strata. Frequencies of coontail decreased with increasing depth occurring at 93%, 76%, 44%, and 0% of the sites in the 0-5, 5-10, 10-15, and 15-20 foot strata. Dominance also decreased from a high of 67 in the 0-5 foot stratum to 38.8 at 5-10 feet, and 8.9 at the 10-15 foot stratum. Curly-leaf pondweed frequencies and dominances followed similar patterns with the highest frequency and dominance occurring in the 0-5 foot stratum measuring 14% and 4.3, respectively. Eurasian watermilfoil was found in relatively high frequency and dominance throughout all depths sampled, with its highest results being in the 5-10 foot stratum measuring 61% and dominance of 37.9. Compared to previous years, Eurasian watermilfoil frequency during the spring survey was higher than it has been. The spring 2003 survey was the only other summer survey that produced a high frequency of Eurasian watermilfoil (29%). Curly-leaf pondweed was at its lowest frequency during the spring 2008 survey compared to previous years (8%; Appendix E). The 2004, 2005, and 2007 spring surveys indicated a frequency of Eurasian watermilfoil between 3% and 12%. Figures 7-10 document sampling locations (Figure 7), sites where Eurasian watermilfoil (Figure 8), sites where curly-leaf pondweed (Figure 9), and sites where coontail (Figure 10) were identified during the pre-treatment survey. See Appendix D for more detailed information regarding the data analysis in Pit Basin.

**Table 5. Spring (pre-treatment) Tier II survey metrics and results for entire lake strata as collected June 9, 2008.**

| Occurrence and abundance of submersed aquatic plants in Sylvan Lake. | | | | | |
|---|---|---|---|---|---|
| County: | Noble | Sites with plants: | 64 | Mean species/site: | 1.57 |
| Date: | 6/9/2008 | Sites with native plants: | 62 | Standard error (ms/s): | 0.15 |
| Secchi (ft): | 9 | Number of species: | 10 | Mean native species/site: | 1.07 |
| Maximum plant depth (ft): | 13 | Number of native species: | 8 | Standard error (mns/s): | 0.11 |
| Trophic status: | Mesotrophic | Maximum species/site: | 8 | Species diversity: | 0.73 |
| Total sites: | 90 | | | Native species diversity: | 0.57 |

| All depths (0-20 ft) | | 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 | 31.11 | 11.11 | 24.44 | 37.33 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 42.22 | 57.78 | 21.11 | 7.78 | 13.33 | 22.22 |
| *Elodea canadensis* | Common water weed | 17.78 | 82.22 | 13.33 | 3.33 | 1.11 | 5.78 |
| *Najas guadalupensis* | Southern naiad | 8.89 | 91.11 | 8.89 | 0.00 | 0.00 | 1.78 |
| *Potamogeton crispus* | Curly leaf pondweed | 7.78 | 92.22 | 6.67 | 1.11 | 0.00 | 2.00 |
| *Potamogeton foliosis* | Leafy pondweed | 4.44 | 95.56 | 4.44 | 0.00 | 0.00 | 0.89 |
| *Zannichellia palustris* | Horned pondweed | 2.22 | 97.78 | 2.22 | 0.00 | 0.00 | 0.44 |
| *Vallisneria americana* | Eel grass | 2.22 | 97.78 | 2.22 | 0.00 | 0.00 | 0.44 |
| *Heteranthera dubia* | Water star grass | 2.22 | 97.78 | 2.22 | 0.00 | 0.00 | 0.44 |
| *Chara* species | Chara species | 2.22 | 97.78 | 2.22 | 0.00 | 0.00 | 0.44 |
| *Filamentous algae* | Filamentous algae | 70.00 | | | | | |

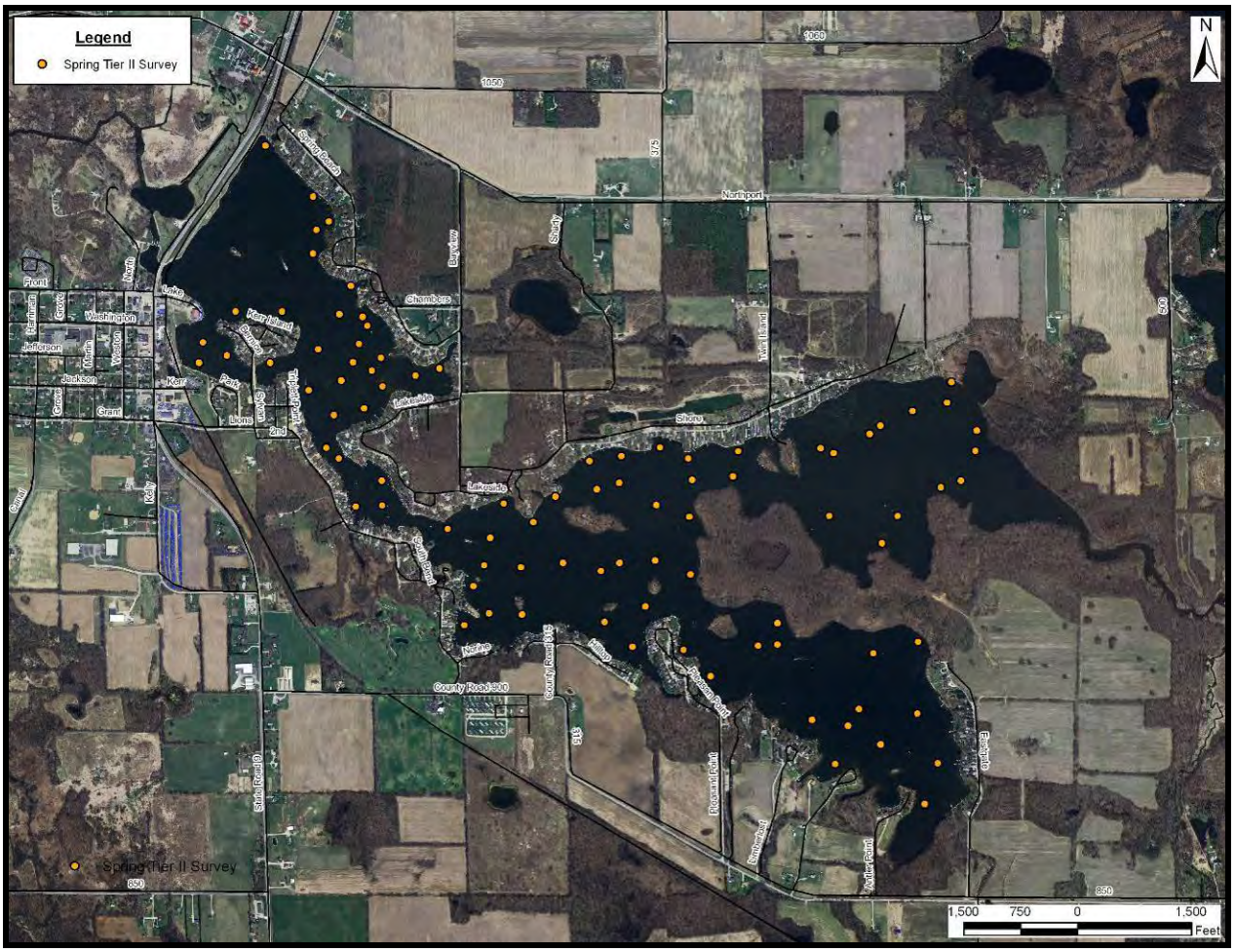


**Figure 7. Sampling locations for the Sylvan Lake spring Tier II survey, June 9, 2008.**

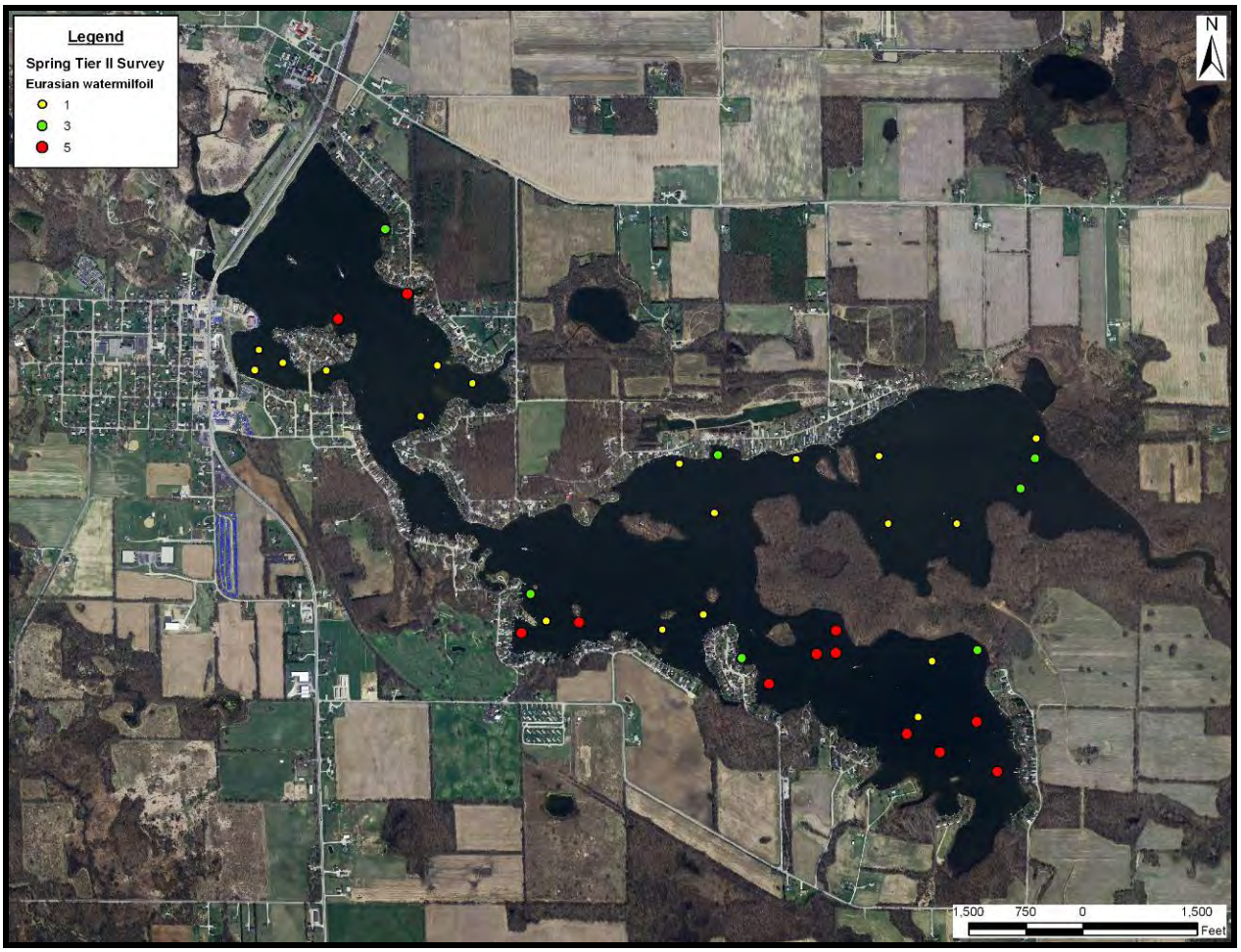


**Figure 8. Eurasian watermilfoil locations and densities as surveyed June 9, 2008.**

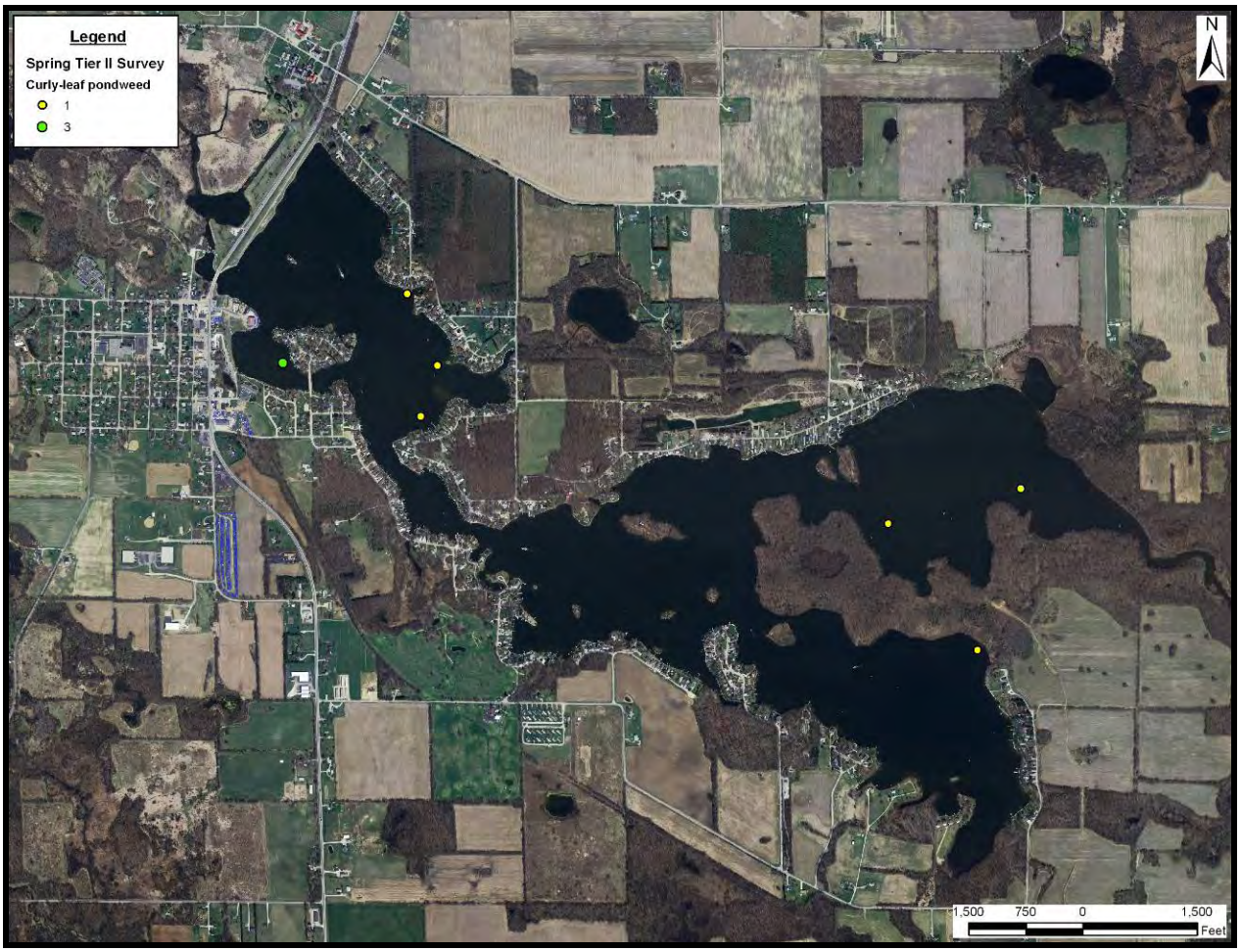


**Figure 9. Curly-leaf pondweed locations and densities as surveyed June 9, 2008.**

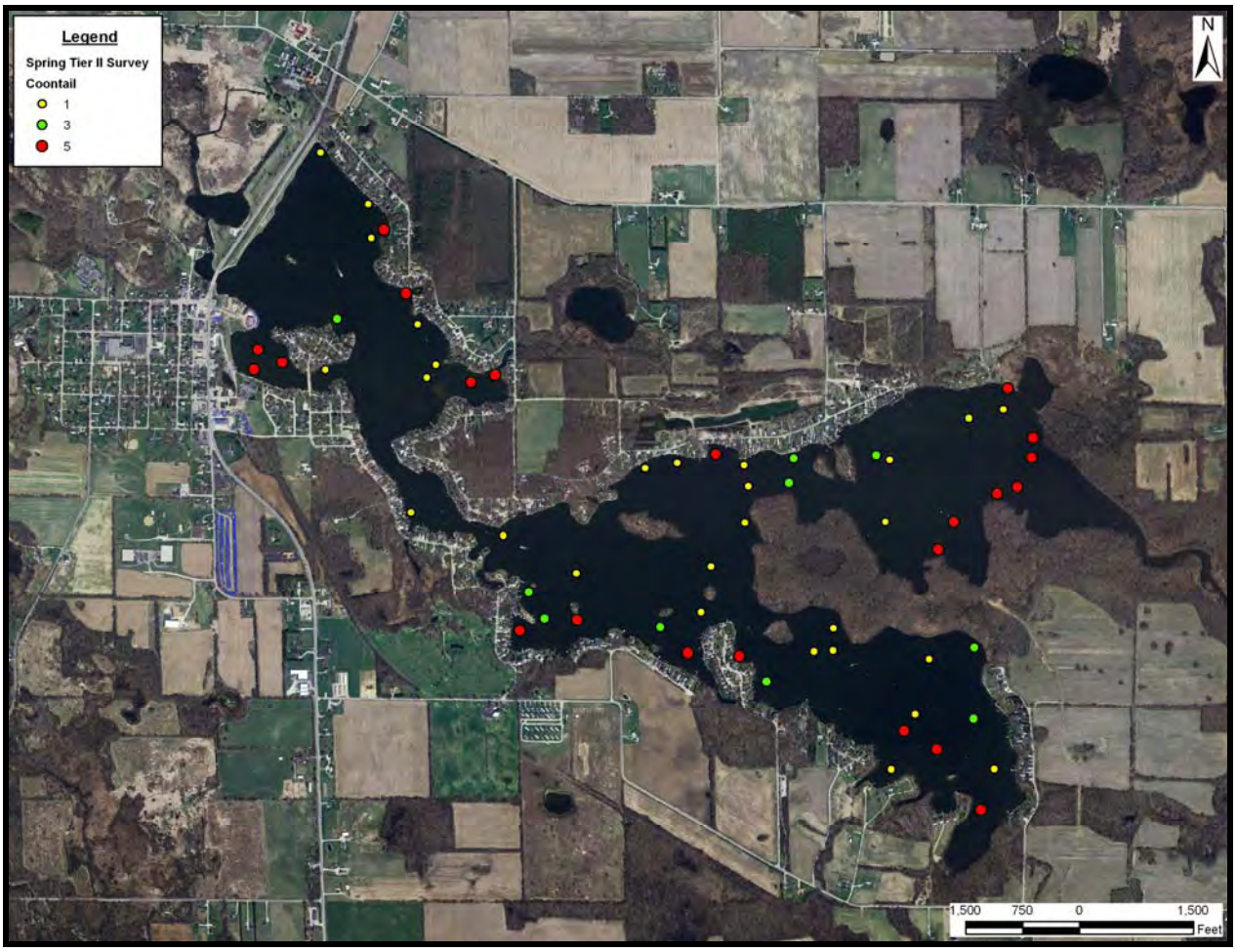


**Figure 10. Coontail locations and densities as surveyed June 9, 2008.**

Following treatment, coontail was still the most abundant species in Sylvan Lake (Table 6). Coontail was present at 60% of the sample sites. Throughout all depths sampled, filamentous algae and Eurasian watermilfoil were relatively frequent and were found at 36% and 33% of the sites, respectively (Appendix C; summer). Coontail dominated the shallowest strata (0-5 feet) and was identified at 95% of the sites in this stratum. Coontail also possessed the highest dominance (47.6) and was more than twice as dominant as any other species in this stratum. Filamentous algae, Eurasian watermilfoil, southern naiad, and common water weed were also prevalent in the 0-5 foot stratum and were present at 71%, 62%, 24%, and 24% of the sites, respectively. The frequency and dominance of all species decreased with depth. Eurasian watermilfoil was found at fewer sites during the post-treatment survey (33% compared to 42% during pre-treatment) and curly-leaf pondweed was not identified during the post-treatment survey compared to 8% of the sites during the pre-treatment survey. Compared to previous years, Eurasian watermilfoil frequency during the summer survey was higher than it has been. The summer 2007 survey was the only other summer survey that produced a high frequency of Eurasian watermilfoil (30%). The 2003 to 2005 summer surveys observed Eurasian watermilfoil between 10% and 12% (Appendix E). Figures 11-13 detail plant sampling locations (Figure 11), the locations where Eurasian watermilfoil (Figure 12), and the locations where coontail (Figure 13) were identified during the post-treatment surveys. See Appendix D for more detailed information regarding the data analysis for Pit Basin.

**Table 6. Summer (post-treatment) Tier II survey metrics and results for entire lake strata as collected August 13, 2008.**

| Occurrence and abundance of submersed aquatic plants in Sylvan Lake. | | | | | |
|---|---|---|---|---|---|
| County: | Noble | Sites with plants: | 56 | Mean species/site: | 1.21 |
| Date: | 8/13/2008 | Sites with native plants: | 56 | Standard error (ms/s): | 0.13 |
| Secchi (ft): | 3 | Number of species: | 9 | Mean native species/site: | 0.88 |
| Maximum plant depth (ft): | 12 | Number of native species: | 8 | Standard error (mns/s): | 0.10 |
| Trophic status: | Mesotrophic | Maximum species/site: | 5 | Species diversity: | 0.66 |
| Total sites: | 91 | | | Native species diversity: | 0.50 |

| All depths (0-20 ft) | | Frequency of Occurrence | Rake score frequency per species | | | | Plant Dominance |
|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | | **0** | **1** | **3** | **5** | |
| *Ceratophyllum demersum* | Coontail | 60.44 | 39.56 | 38.46 | 10.99 | 10.99 | 25.27 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 32.97 | 67.03 | 25.27 | 4.40 | 3.30 | 10.99 |
| *Najas guadalupensis* | Southern naiad | 8.79 | 91.21 | 7.69 | 1.10 | 0.00 | 2.20 |
| *Elodea canadensis* | Common water weed | 8.79 | 91.21 | 7.69 | 1.10 | 0.00 | 2.20 |
| *Potamogeton foliosis* | Leafy pondweed | 4.40 | 95.60 | 3.30 | 1.10 | 0.00 | 1.32 |
| *Chara* species | Chara species | 2.20 | 97.80 | 2.20 | 0.00 | 0.00 | 0.44 |
| *Vallisneria americana* | Eel grass | 1.10 | 98.90 | 1.10 | 0.00 | 0.00 | 0.22 |
| *Utricularia vulgaris* | Common bladderwart | 1.10 | 98.90 | 1.10 | 0.00 | 0.00 | 0.22 |
| *Heteranthera dubia* | Water star grass | 1.10 | 98.90 | 1.10 | 0.00 | 0.00 | 0.22 |
| *Filamentous algae* | Filamentous algae | 36.26 | | | | | |

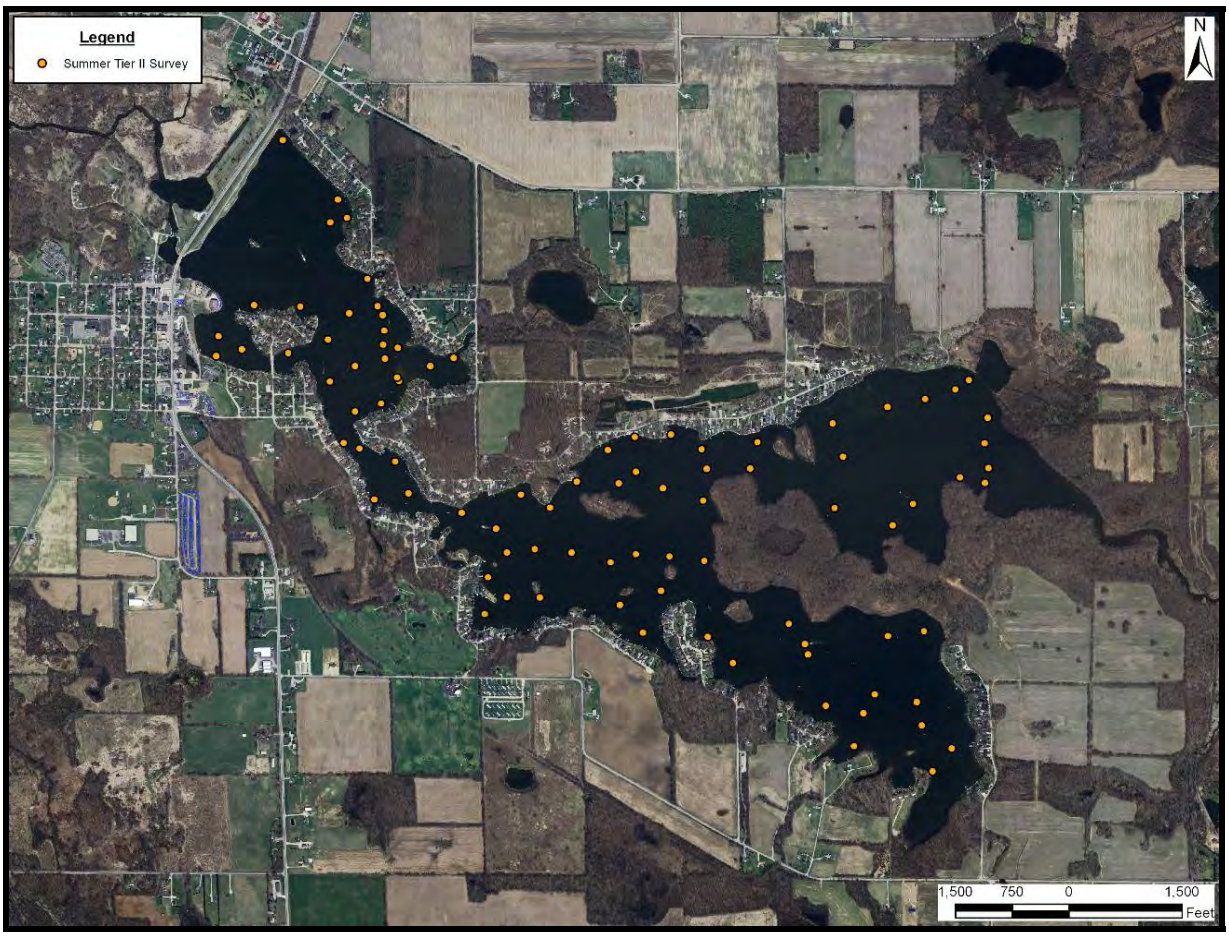


**Figure 11. Sampling locations for the Sylvan Lake summer Tier II survey, August 13, 2008.**

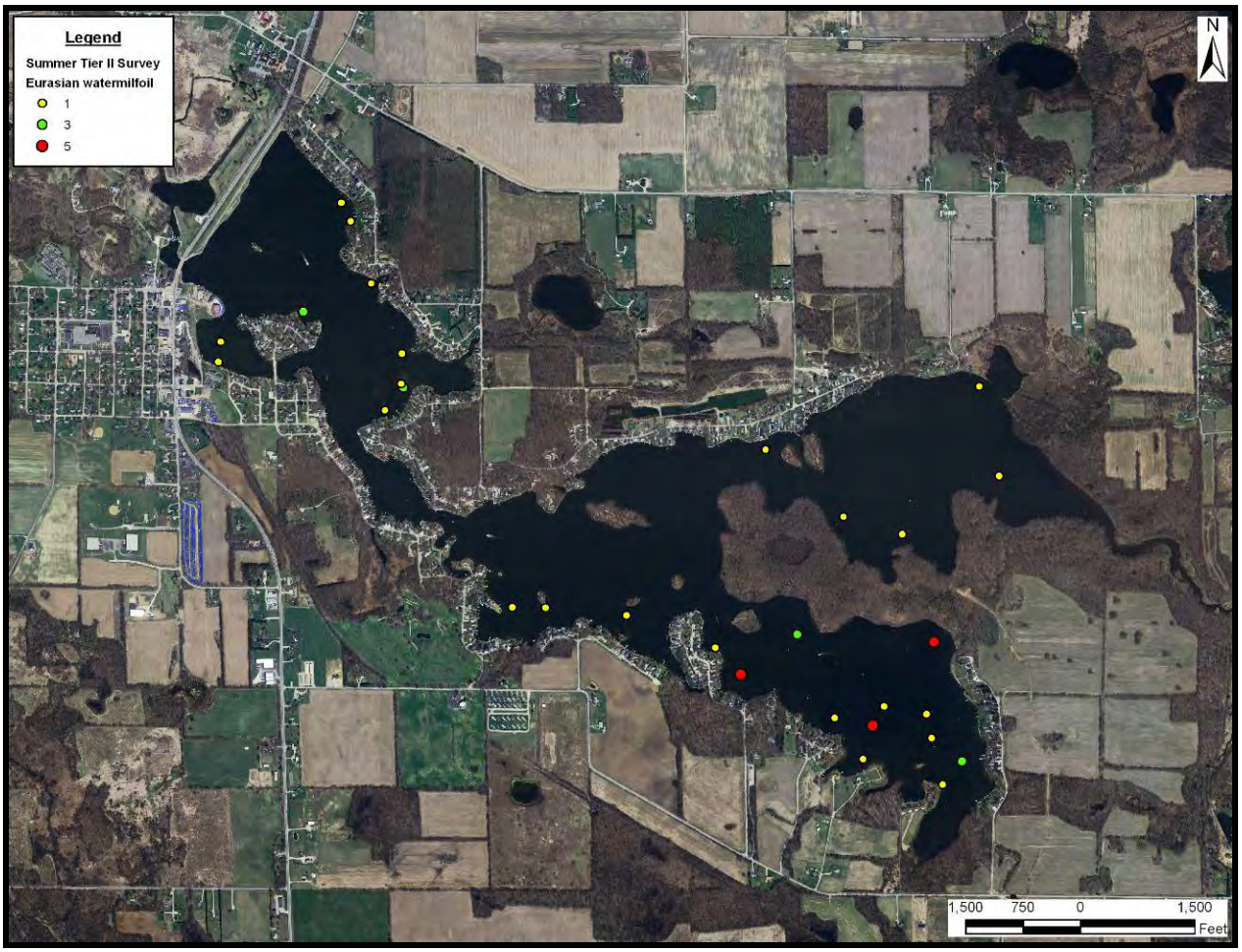


**Figure 12. Eurasian watermilfoil locations and densities as surveyed August 13, 2008.**

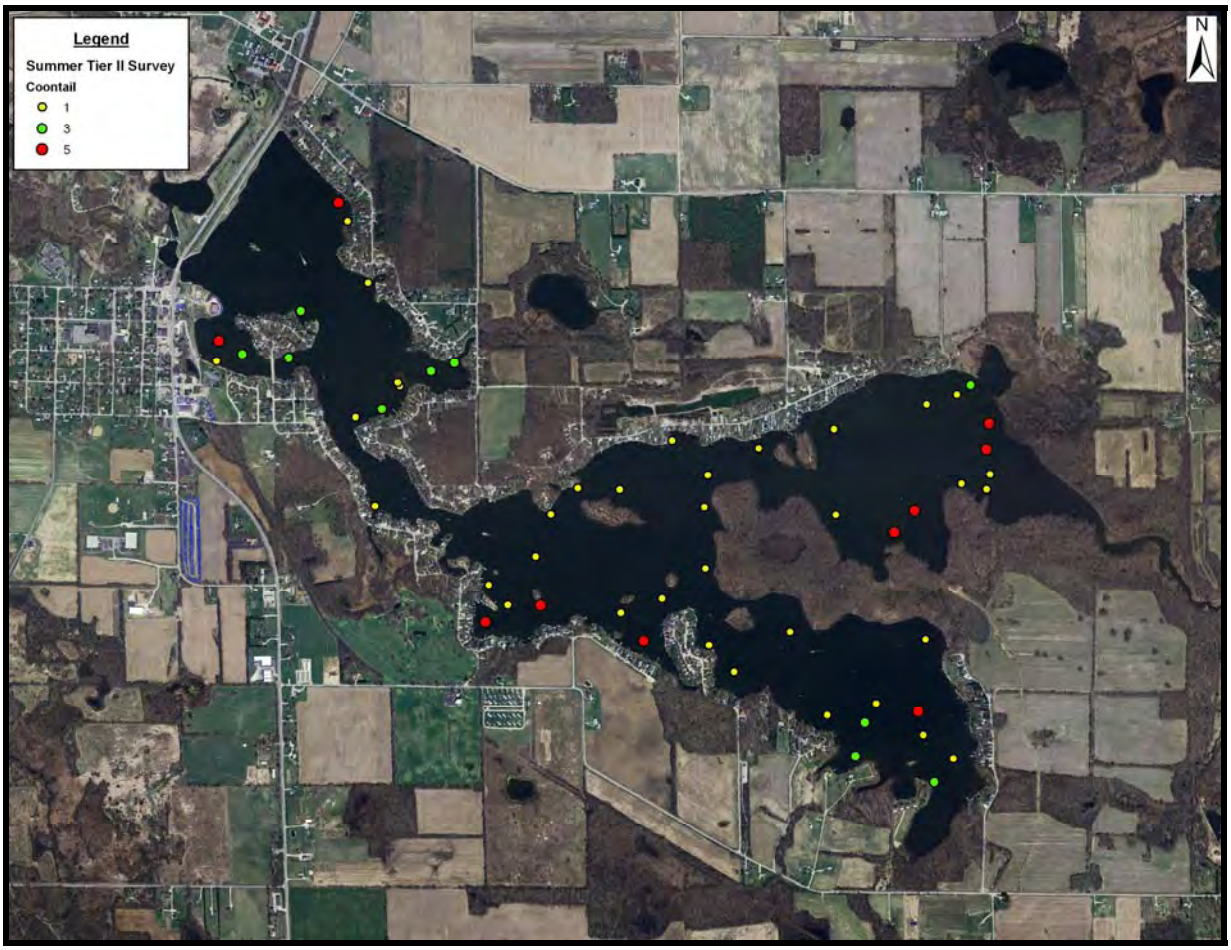


**Figure 13. Coontail locations and densities as surveyed August 13, 2008.**

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. Coontail and Eurasian watermilfoil 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 only 3 feet. During the Tier II survey in July 2007 we were unable to get a transparency reading due to weather and a lack of visibility.

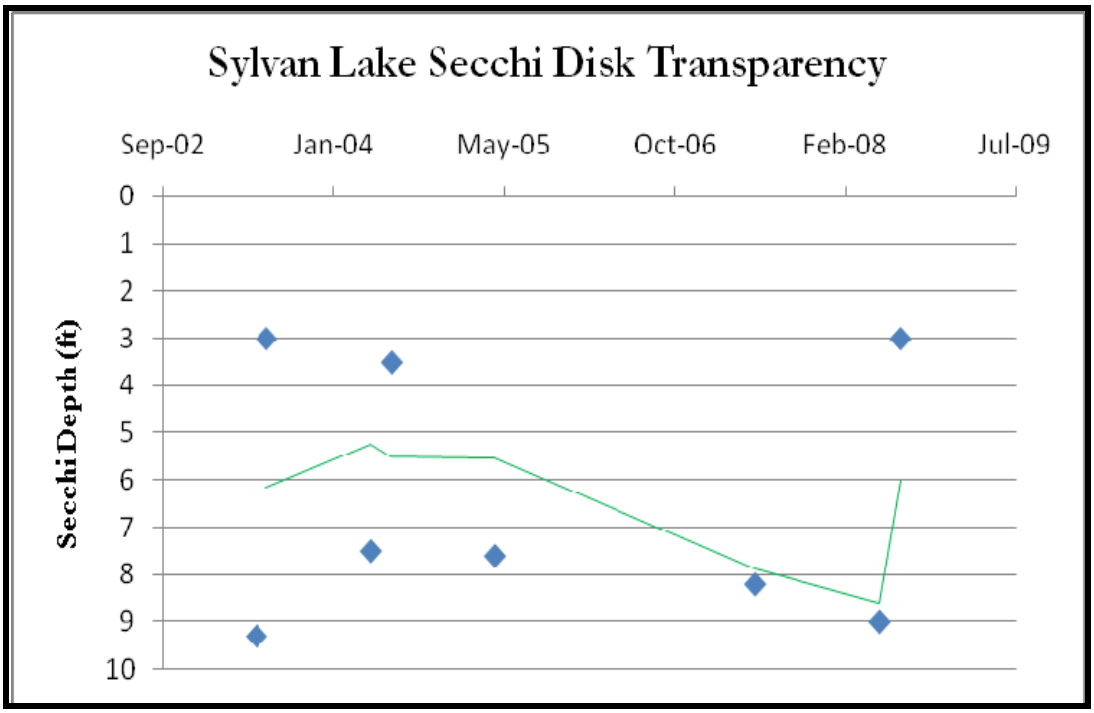


**Figure 14. Historic Secchi disk transparency data for Sylvan Lake.**

When recently collected data is compared with data reported by Pearson (2004), Sylvan Lake possessed similar results in 2008 to the lakes surveyed by Pearson (Table 7). Sylvan Lake possessed 10 and 9 species during the pre- and post-treatment surveys, while Pearson collected only eight species on average. Sylvan Lake possessed more native species (8 compared to Pearson's 7) and greater rake diversity (0.73 and 0.66 for pre- and post-treatment, respectively compared with 0.62 by Pearson) than that recorded during Pearson's survey. Native rake diversity was very similar this year to Pearson's previous studies, but both the native species richness and species richness were lower than Pearson's average.

**Table 7. 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 | Indiana Average (2004) |
|---|---|---|---|---|---|---|---|---|---|
| % of littoral sites containing plants | - | - | 70% | 73% | 69% | 70% | 89% | 75% | - |
| Number of species collected | 5 | 10 | 3 | 5 | 13 | 10 | 10 | 9 | 8 |
| Number of native species collected | 3 | 8 | 1 | 3 | 11 | 8 | 8 | 8 | 7 |
| Species Richness (Avg. # species/site) | 1.46 | 1.41 | - | - | 1.25 | 1.79 | 1.57 | 1.21 | 1.61 |
| Native Species Richness | 0.76 | 1.23 | 0.08 | 0.74 | 0.90 | 1.38 | 1.07 | 0.88 | 1.33 |
| Rake Diversity (SDI) | 0.66 | 0.62 | 0.86 | 1.06 | 0.78 | 0.83 | 0.73 | 0.66 | 0.62 |
| Native Rake Diversity (SDI) | 0.16 | 0.51 | 0.08 | 0.88 | 0.70 | 0.76 | 0.57 | 0.50 | 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 watermilfoil and curly-leaf pondweed were the two exotic species targeted in the herbicide treatment that occurred on May 5 and July 24, 2008. Sylvan Lake underwent a decrease in both the relative density and site abundance of curly-leaf pondweed. However, the true impact of the treatment on curly-leaf pondweed populations remains elusive as curly-leaf pondweed density naturally declines in the summer due to increased water temperatures. The treatment of Eurasian watermilfoil did not visibly impact the Eurasian watermilfoil community within Sylvan Lake. However, frequency of occurrence during the spring and summer surveys changed from 42% to 33%, respectively. While this apparent decrease bodes well for the lake, placing these results in perspective with previous years' numbers shows little improvement in trying to control this species.

The effects of the treatment on the native aquatic plant community are unclear. Comparing the 2008 spring and summer Tier II survey metrics indicates that the quality of the native aquatic plant community in Sylvan Lake decreased following treatment. The percentage of littoral sites containing plants was the only metric to increase following treatment. Temporal 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 watermilfoil, site frequencies and dominance, all appear to decrease for spring survey data until this year. This suggests that Eurasian watermilfoil populations have started to increase in the last year. Summer survey data also supports this trend. Site frequencies and dominance scores calculated for summer survey data increased during this survey. This suggests that the Eurasian watermilfoil population is increasing in both density and distribution (Table 8).

**Table 8. Variation in site frequencyand dominance of Eurasian watermilfoil and curly-leaf pondweed within Sylvan Lake from 2003 to 2008. Spring data is in bold.**

| Common Name | Date | Site Frequency | Dominance |
|---|---|---|---|
| Eurasian watermilfoil | **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 |
| 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 | -- | -- |

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 and mean and relative density from 2005 to 2007. However, the dominance of curly-leaf pondweed increased from 2005 to 2007 and then decreased again from 2007 to 2008. Curly-leaf pondweed also decreased in the summer survey as a result of early-season treatment; it was not identified at any of the sites in 2008. 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. 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 appears to be decreasing during the spring surveys conducted on the lake and 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 E). 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 watermilfoil, and coontail treatment completed in 2008. Treatment of coontail should continue in subsequent years (2009-2012) if it remains at nuisance levels within the lake.

## 9.0 Aquatic Vegetation Management Alternatives

For more information on general aquatic vegetation management alternatives see the Sylvan Lake Aquatic Plant Management Plan Revision 2007-2011 (JFNew, 2007).

### 9.1 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 watermilfoil. 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 °C (59 °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 °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 watermilfoil are fluridone (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.) Fluridone is typically recommended for whole lake treatment of Eurasian watermilfoil and curly-leaf pondweed due to the lower tolerance of these species to fluridone compared with other aquatic plant species. Smith (2002) noted control of Eurasian watermilfoil to the point of limited detectability following whole-lake treatment with fluridone. Additionally, most Eurasian watermilfoil strains have a lower tolerance to fluridone than most other aquatic plant species; therefore, if fluridone is properly applied, control of Eurasian watermilfoil 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, watermilfoil, and waterweed. Treatment with triclopyr is a good option if Eurasian watermilfoil populations are not dense or abundant. Treatment using triclopyr must be aggressive in order to result in adequate Eurasian watermilfoil 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 triclopyr; 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 watermilfoil 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.

### 9.2 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 15). 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 for more information: www.protectyourwaters.net

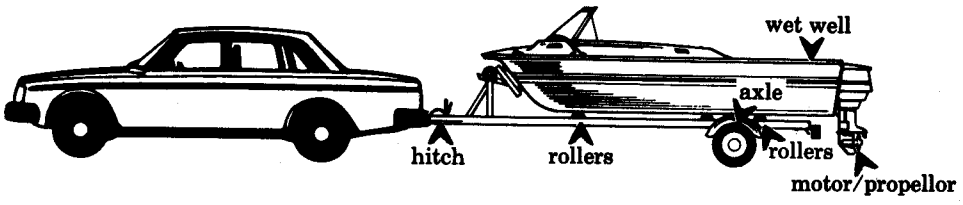


**Figure 15. Locations where aquatic macrophytes are often found on boats and trailers.**

Educational programs are effective ways to manage and prevent the spread of aquatic nuisance species (ANS) such as Eurasian watermilfoil, 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 watermilfoil 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 watermilfoil 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

The LARE biologists (Gwen White and Angela Sturdevant), district fisheries biologist (Jed Pearson), and association representatives (Jeff Bauermeister and Joe Costello) met November 7, 2008 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 watermilfoil beds should be treated in 2009.
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. 275 acres of curly-leaf pondweed should be treated in early spring 2009, regardless of whether or 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. Beginning in 2010, spot treatments of remaining scattered curly-leaf pondweed plants may be necessary to prevent additional turion production.

Based on this information, a grant application to treat Eurasian watermilfoil 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 watermilfoil and early-season curly-leaf pondweed treatments. Money may be available for Eurasian watermilfoil and curly-leaf pondweed treatment in the future.

Frequent contact with the SLIA members is important to JFNew's goal in keeping the lake association members and homeowners aware of treatment taking place in the lake and any public meetings that should be attended by those who want to hear about happenings within the lake and also voice their concerns about the lake. Based on the lake user surveys, the main concern in Sylvan Lake is too many aquatic plants. Some lake users have noted that there aren't enough native aquatic plants, which is an encouraging sign that treatment is working and that some lake users would like to re-establish the native plant community.

## 11.0 Public Education

Education efforts targeting 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. Appendix E contains more detailed information on hydrilla, its habitat, and its distribution. 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 JFNew attends in the fall to discuss the Tier II survey results 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, then 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.
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 2009, continue treatment of 275 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 16 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 a specific area. Additionally, restoration of eroding shorelines would also enhance the emergent and rooted floating plant community.

**Figure 16. 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 easiest ways to control the spread of both species is through hand pulling or digging and the application of herbicides. If hand digging is the selected method for removal, individuals should be sure to remove the entire root structure as purple loosestrife can re-sprout from the roots. The use of chemicals can limit regrowth. Any chemicals, such as Rodeo, used to control these species must be approved for application near water. Removal of these species and restoration of 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 as habitat and a food source. Reed canary grass should be replaced with switch grass, Indian grass, or even 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 also 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 10 and 9 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 watermilfoil to 10% frequency.*
Eurasian watermilfoil is present in relatively high density along most of the shoreline within Sylvan Lake. In order to prevent the continued spread of Eurasian watermilfoil to other locations within the lake, treatment of the invasive exotic species should be continued in 2009. Eurasian watermilfoil 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 watermilfoil within Sylvan Lake, the use of 2,4-D (Navigate) or Renovate for spot treatment of populations is recommended. Up to 67 acres of Eurasian watermilfoil are recommended for treatment. The cost of this treatment is approximately $26,800 if 2,4-D is used for treatment within Sylvan Lake. Additional annual follow-up treatments will be necessary to control Eurasian watermilfoil 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 watermilfoil in 2009. Larger treatment areas to control Eurasian watermilfoil will most likely be prescribed in 2010.

In order to aid in the control of Eurasian watermilfoil, lake residents and users should be educated as to their impact on the spread of the plant. Eurasian watermilfoil spreads through fragmentation, which allows one small piece of Eurasian watermilfoil to colonize other areas of the lake. It is very important that boaters avoid driving through areas of the lake currently infested with Eurasian watermilfoil 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 low densities (8% 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 watermilfoil in Sylvan Lake is also suggested to be less than 10%. Aquathol K is recommended for treatment of specified areas (Figure 17) and should continue to occur next summer (the last year in the three-year treatment cycle) 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 275 acres in 2009 (Figure 17). 275 acres of curly-leaf pondweed should be treated in early spring 2009, regardless of whether or 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. Beginning in 2010, spot treatments of remaining scattered curly-leaf pondweed plants may be necessary to prevent additional turion production.

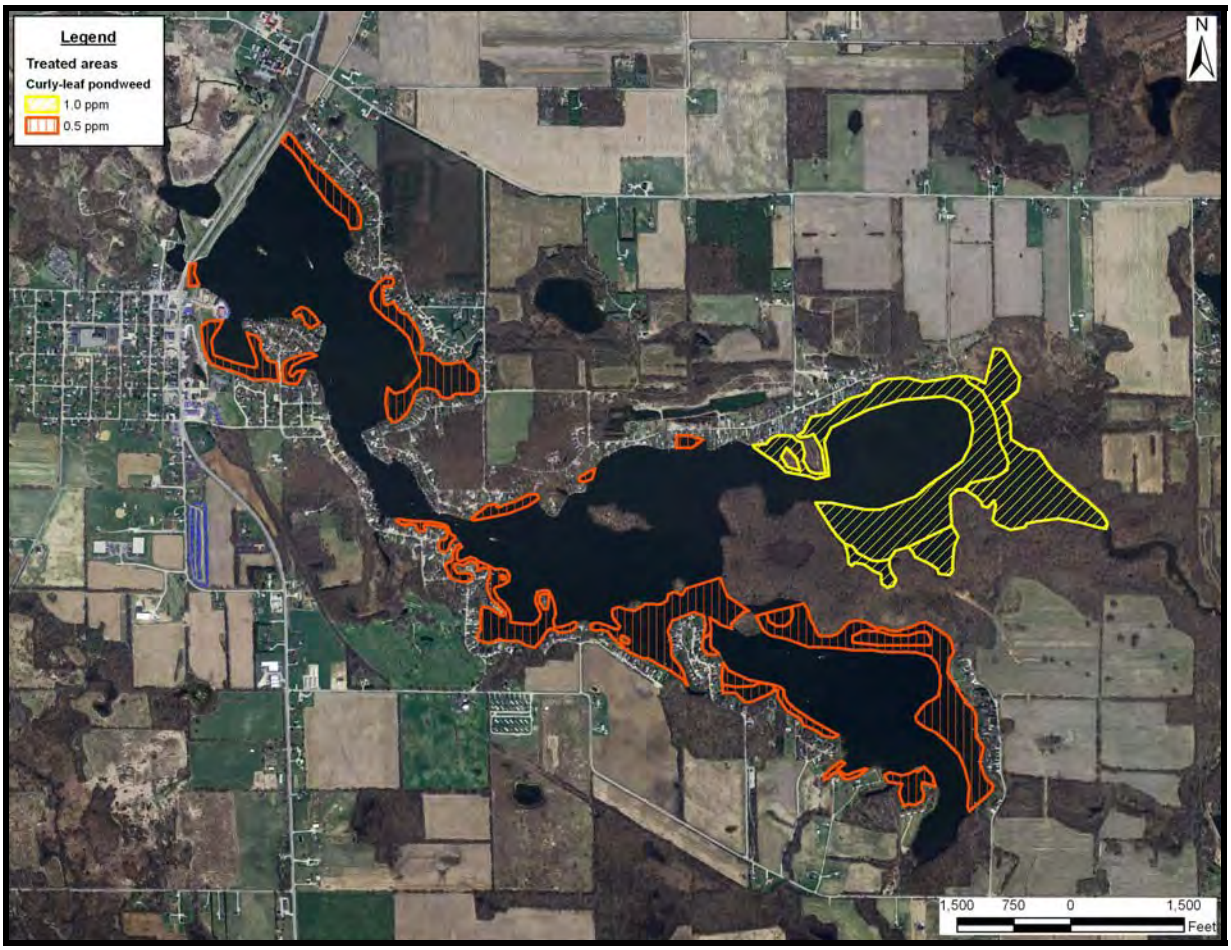


**Figure 17. Curly-leaf pondweed populations targeted for treatment in 2009.**

*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 and 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 through hand pulling and removal of the root structure. Removal 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 watermilfoil, 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 watermilfoil,

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 continue to grow, 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 should 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 is 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 areas prioritized for treatment are displayed as #4 in Figure 18. Native control of less than 60% of the littoral zone is set for this year.

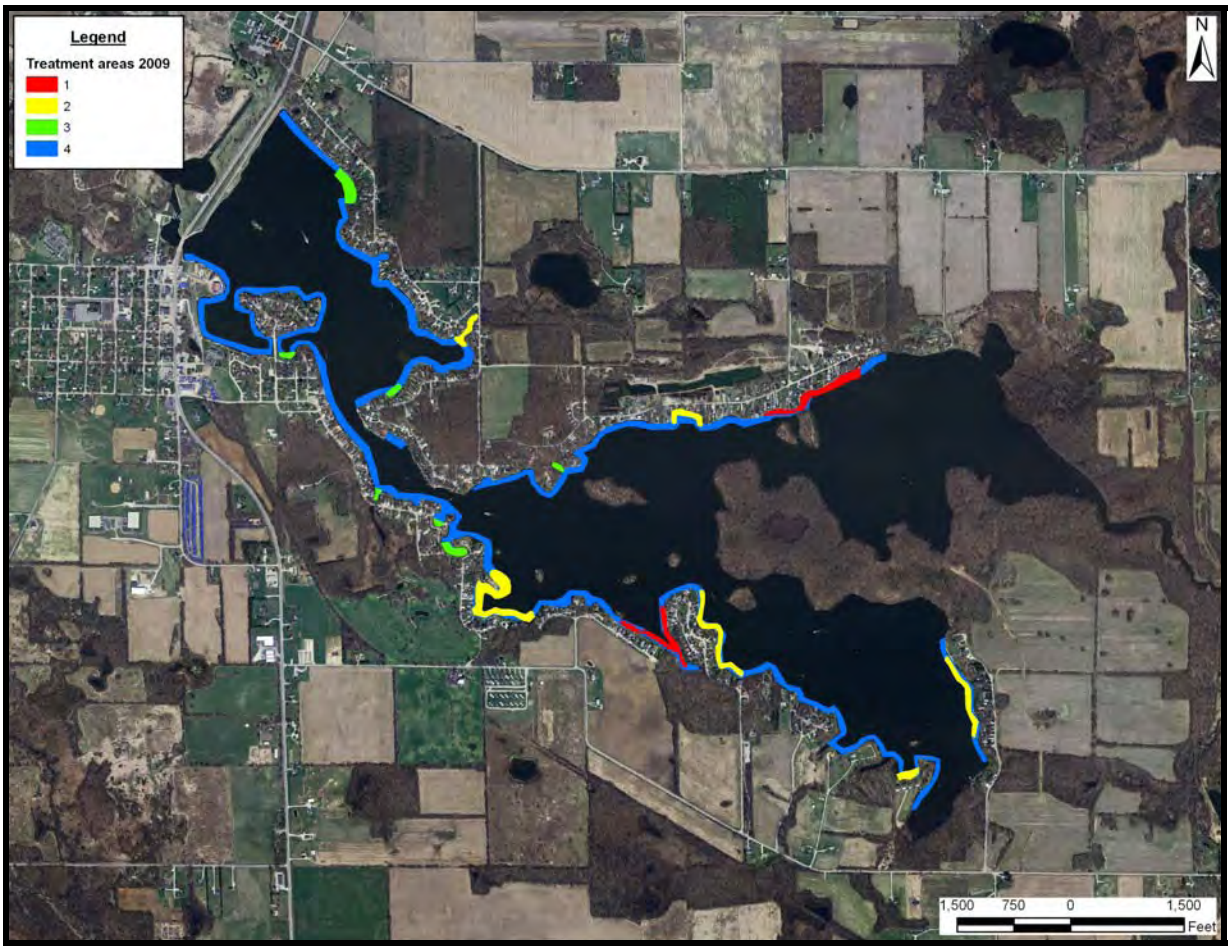


**Figure 18. Priority areas of treatment in 2009.**

### 12.4 Immediate Action Plan

The LARE Aquatic Plant Management Plan grant was provided to the Sylvan Lake Improvement Association for the purpose of funding aquatic vegetation controls on the lake. 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 °F. 275 acres of curly-leaf pondweed should be treated in early spring 2009, 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. Beginning in 2010, spot treatments of remaining scattered curly-leaf pondweed plants may be necessary to prevent additional turion production.
2. Continue spot treatment of up to 67 acres of Eurasian watermilfoil 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. Continue spot treatment of up to 30 acres of coontail to eventually reduce frequency below 60%. This target frequency for coontail was set due to previous survey results and may be reduced in the following years. Early season treatment of coontail should be implemented in 2009 to reduce the frequency of coontail in the littoral zone.
4. Monitor the plant community using aquatic plant surveys for next four years (2009-2012). These surveys should occur both 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 2009, surveys should consist of a Tier II survey prior to treatment of either curly-leaf pondweed or Eurasian watermilfoil and a pre-treatment distribution map of all invasive exotic species should be completed. A second, post-treatment reconnaissance survey and Tier II survey should occur following treatment. Efforts should be made to align post-treatment survey dates with similar dates of surveys in the past. These surveys should be continued through 2012.
5. Post signs at all access sites in 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 watermilfoil 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.

## 13.0 Project Budget

Table 9 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 the 275 acre area in 2009 to complete the three-year curly-leaf pondweed treatment cycle. Because the main treatment recommended in Sylvan Lake consists of curly-leaf pondweed treatment with the idea of reducing the resident population over time, it is necessary for two Tier II surveys 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 $85,800 from the LARE program. This budget includes the $51,000 for the final year of curly-leaf pondweed treatment, the $26,800 for Eurasian watermilfoil treatment, and $8,000 for aquatic plant surveys and plan updates. The SLIA's contribution for this would be $8,580 (10%). If the LARE program cannot provide the SLIA with all of this then the treatment of Eurasian watermilfoil, coontail, and/or algae will be funded through the lake association. A permit for this treatment is included in Appendix F. This permit should be submitted by the association and, once a contractor is selected for the treatment, the permit can be completed. It is possible that this project may not be fully-funded due to a recent hydrilla infestation in Lake Manitou that may use a large percentage of potential LARE funds.

**Table 9. Budget estimate for the action plan.**

| Task | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|
| Curly-leaf pondweed treatment -275 acres | $51,000 | $5,000 | $5,000 | $5,000 |
| Eurasian watermilfoil treatment-67 acres | $26,800 | $26,800 | $26,800 | $26,800 |
| Plant sampling and plan update | $8,000 | $8,000 | $8,000 | $8,000 |
| Native plant and algae treatment | $5,000 | $5,000 | $5,000 | $5,000 |
| **Total** | **$90,800** | **$44,800** | **$44,800** | **$44,800** |

Costs for aquatic plant assessment and treatment in 2009 are as follows:

- Eurasian watermilfoil treatment of approximately 67 acres with 2,4-D at a cost of $400 per acre for a total cost of $26,800.
- Early season curly-leaf pondweed treatment. 275 acres of curly-leaf pondweed should be treated in early spring 2009, 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 95 acres and at a rate of 0.5 ppm to 180 acres. It is estimated that treatment of 95 acres at a rate of 1.0 ppm will cost approximately $300/acre and treatment of 180 acres at 0.5 ppm will cost approximately $125/acre for a total cost of $51,000.
- 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 $3,000, while the plan update is anticipated to occur at a cost of $5,000.

Total fees for 2008 aquatic plant assessment, herbicide application, and plan updated are estimated at $90,800. 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 2009:

| | |
|---|---|
| March-April 2009 | Curly-leaf pondweed assessment and pre-treatment distribution mapping |
| April-early May, 2009 | Curly-leaf pondweed treatment |
| May 15-June 15, 2009 | Tier II spring survey |
| June-August | Eurasian watermilfoil treatment |
| July 15-August 30, 2009 | Tier II post-treatment assessment |
| August-October, 2009 | Public meeting |
| November, 2009 | Meeting between IDNR LARE and fisheries staff, SLIA, and contractor |
| December 15, 2009 | Plan update and permit |
| January 15, 2010 | LARE application for 2010 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, post-treatment surveys, exotic species map development, and 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.

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# APPENDIX A:

# LAKE USER SURVEY RESULTS

# SYLVAN LAKE
# AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2008

# Lake Use Survey Results: November 2008
## 19 Respondents

Lake Name: Sylvan Lake

Are you a lake property owner? Yes 95% No 5%

Are you currently a member of your lake association? Yes 95% No 5%

How many years have you been at the lake?
<2 yrs 0% 2 – 5 yrs 10.5% 5-10 yrs 26% > 10 years 53%

How do you use the lake (mark all that apply)
89.5% Swimming 57.9% Irrigation 94.7% Boating 0.00% Drinking water
73.7% Fishing 5.3% Other

Do you have aquatic plants at your shoreline in nuisance quantities?
Yes 89.5% No 10.5%

Do you currently participate in a weed control project on the lake?
Yes 94.7% No 5.3%

Does aquatic vegetation interfere with your use or enjoyment of the lake?
Yes 94.7% No 5.3%

Does the level of vegetation in the lake affect your property values?
Yes 84.2% No 10.5%

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:
21.1% Too many boats access the lake
26.3% Use of jet skis on the lake
31.6% Too much fishing
0% Fish population problem
63.2% Dredging needed
26.3% Overuse by nonresidents
79% Too many aquatic plants
5.3% Not enough aquatic plants
47.4% Poor water quality
0% Pier/funneling problem

Please add any comments:

| Comment |
| --- |
| Please contact me regarding dredging needed. Would like to discuss procedures, etc., Pam Baker 260-854-3350 |
| Need to have better weed control |
| Need an effective weed program |
| Too much fishing- they have too many tournaments. Dredging needed -probably in som eparts of the lake. Maybe that would help with some of the weeds. The weeds were so bad this year in front of our house we had trouble getting the boat out. We spent hours cleaning out the weeds. A big problem is "what do we do with the weeds after we dig out?" |
| INDR protects the invasive "egyptian lotus" on the east end of the lake. These are taking over large areas of the shoreline and prevent boating fishing or swimming! |
| Aquatic plants not controlled properly |
| Early morning fishing tournaments with powerful and noisy boats racing at top speed to fishing sites at 6:00a.m.. There are such thick weeds I have difficulty getting my boat to the dock. |
| way too many bass fishing tournaments! |
| Some weed control in travel areas is needed. But all areas where there are know {no} houses should be left alone |
| To many boats in fishing tournaments - we were unable to get any of our boats out for over 1 month due to a weed problem. Holiday weekends are to dangerous for the people who live here to use - there are to many crazy people on the lake on Holidays. |
| It is a major concern that the lake be as natural a habitat as possible. Because of invasive species of aquatic plants, I feel the weed control is necessary but should be done very carefully. I can see that sometimes the spraying creates more problems in the form of PILES of dead vegetation that deplete the water of oxygen and stink to high heaven. The lake is as unusable then as it is when it is full of weeds. It horrifies me to see the water birds swimming in just sprayed water and eating the vegetation. I hate seeing fish with sores. So I guess I feel that it is a very delicate project to get rid of problems in the lake but allow it to be what nature meant it to be. A healthy, natural, user friendly lake is good for property values. I want a lake, not a swimming pool. |
| We are in a very serious need for dredging along the So East side of Hilltop Rd along Sower farm. If it continues to get worse, we will all be affected. |

# APPENDIX B:

# TIER II SURVEY RAW DATA

# SYLVAN LAKE
# AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2008

**Spring Tier II survey raw data as collected June 9, 2008.**

| DEPTH | FILALG | CERDEM | CHARA | ELOCAN | HETDUB | MYRSPI | NAJGUA | POTCRI | POTFOL | VALAME | ZANPAL | X_POINT | Y_POINT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | p | | | | | | | | | | 1 | 636418.3234 | 4594786.8120 |
| 3 | p | 1 | | | | 1 | 1 | 1 | | | | 636409.1532 | 4594903.0930 |
| 3 | p | 5 | | | 1 | 3 | 1 | | | 1 | | 636191.4716 | 4595446.5860 |
| 3 | p | 3 | | | | 3 | | 1 | | | | 638584.1986 | 4593792.9550 |
| 3 | p | 5 | | 1 | | | | | | | | 638432.9529 | 4594189.5230 |
| 3 | p | 5 | | 5 | | | | | | | | 638702.5982 | 4594841.3430 |
| 4 | p | 5 | | | | | | | | | | 637436.0124 | 4593755.8010 |
| 4 | p | 5 | | | | | | | | | | 638620.5291 | 4593142.6940 |
| 4 | p | 5 | | 3 | | 1 | | | | | | 638806.1512 | 4594646.7860 |
| 5 | p | 5 | | 1 | | 3 | | | | | | 637536.2013 | 4594560.0380 |
| 5 | | 1 | | | | | | | | | | 637253.2367 | 4594499.4330 |
| 5 | | | | | | | | | | | | 637031.0252 | 4594250.4940 |
| 5 | p | 5 | | 1 | | | 1 | | | | 1 | 636645.1503 | 4594864.4050 |
| 5 | p | 5 | | 1 | | 1 | 1 | | | | | 635678.4521 | 4594872.5380 |
| 5 | p | 5 | | 1 | | 1 | | 3 | | | | 635790.6475 | 4594903.4880 |
| 5 | p | 3 | | | | 5 | | | | | | 636009.2351 | 4595083.3880 |
| 5 | p | 1 | | | | 1 | | | | | | 635965.2948 | 4594876.4990 |
| 5 | p | 5 | | 1 | 1 | 5 | 1 | 1 | 1 | 1 | | 636283.4937 | 4595188.7520 |
| 5 | p | 1 | | | | | | | | | | 636316.9829 | 4594302.8810 |
| 5 | p | 5 | | 1 | | 5 | | | | | | 636760.1769 | 4593832.8060 |
| 5 | p | 5 | | | | 5 | | | | | | 636990.5330 | 4593880.1390 |
| 5 | p | 3 | | | | 1 | | | | | | 637323.9899 | 4593855.2010 |
| 5 | p | 5 | | | | 3 | | | | | | 637643.3345 | 4593746.2620 |
| 5 | p | 3 | 1 | | | 5 | | | | | | 637752.8555 | 4593644.0950 |
| 5 | p | 1 | 1 | | | | | | | | | 638258.0427 | 4593297.9740 |
| 5 | p | 1 | | | | 5 | | | | | | 638671.0181 | 4593306.7830 |
| 5 | p | 1 | | 1 | | 5 | | | | | | 638017.9304 | 4593861.5800 |
| 5 | p | 5 | | 1 | | | | | | | | 638666.0172 | 4594416.5510 |
| 6 | p | 1 | | | | 1 | | 1 | | | | 638219.2993 | 4594294.3340 |
| 6 | p | 5 | | | | 1 | | | | | | 638494.6912 | 4594298.6380 |
| 6 | p | 5 | | 3 | | 3 | | 1 | | | | 638746.6412 | 4594444.7690 |
| 6 | p | 5 | | 3 | | 3 | | | | | | 638803.0780 | 4594565.7050 |
| 6 | p | 1 | | 1 | | | | | | | | 638685.4656 | 4594756.6870 |
| 6 | p | 1 | | | | | | | | | | 637649.4675 | 4594517.4160 |
| 7 | | | | | | | | | | | | 637117.8285 | 4594356.2870 |
| 7 | p | | | | | | | | | | | 636910.8473 | 4594323.4020 |
| 7 | p | 1 | | | | | 1 | | 1 | | | 636127.6363 | 4595547.1750 |

| DEPTH | FILALG | CERDEM | CHARA | ELOCAN | HETDUB | MYRSPI | NAJGUA | POTCRI | POTFOL | VALAME | ZANPAL | X_POINT | Y_POINT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | p | 3 | | 1 | | 3 | | | | | | 636794.8881 | 4593990.5840 |
| 7 | p | 1 | | | | 1 | | | | | | 637485.7125 | 4593919.8900 |
| 7 | p | 1 | | | | 5 | | | | | | 638018.1775 | 4593773.7000 |
| 7 | | | | | | | | | | | | 637664.7772 | 4594050.5420 |
| 7 | p | 3 | | | | 1 | | | | | | 637849.1532 | 4594548.4410 |
| 8 | | 1 | | | | 1 | | | | | | 637380.9073 | 4594522.6450 |
| 8 | p | | | | | 1 | | 1 | | | | 636344.8161 | 4594697.8290 |
| 8 | p | 5 | | | | 1 | | | 1 | | | 636549.8628 | 4594833.2370 |
| 8 | p | 1 | | | | | | | | | | 636142.1443 | 4595412.7340 |
| 8 | p | 5 | | | | 1 | | | | | | 635693.9274 | 4594953.7830 |
| 8 | p | 3 | | | | 1 | | | | | | 636857.9994 | 4593883.2950 |
| 8 | p | 5 | | | | 5 | | | | | | 638439.4788 | 4593379.7560 |
| 8 | p | 1 | | | | 5 | | | | | | 637941.8024 | 4593768.0960 |
| 8 | p | 1 | | | | | | | | | | 637656.7148 | 4594282.3360 |
| 8 | p | 3 | | | | | | | | | | 637830.7923 | 4594448.0230 |
| 9 | p | | | | | | | | | | | 636251.3951 | 4594809.7790 |
| 9 | p | 5 | | | | 5 | | | | | | 638307.7428 | 4593452.5970 |
| 9 | | 1 | | | | | | | | | | 638547.3794 | 4594721.1750 |
| 10 | | | | | | | | | | | | 636420.2578 | 4594409.6030 |
| 10 | p | 3 | | | | 5 | | | | | | 638585.8180 | 4593505.5840 |
| 10 | | | | | | 1 | | | | | | 637523.6851 | 4594326.6790 |
| 10 | p | 1 | | | | | | | | | | 637667.5286 | 4594431.8990 |
| 10 | | | | | | | | | | | | 638417.7091 | 4594661.7150 |
| 10 | p | 3 | | 1 | | 1 | | | | | | 638179.6739 | 4594565.5970 |
| 10 | | 1 | | | | | | | | | | 638232.2380 | 4594547.8440 |
| 11 | | | | | | | | | | | | 637284.1871 | 4594387.2370 |
| 11 | | | | | | | | | | | | 637373.1697 | 4594414.3190 |
| 11 | | | | | | | | | | | | 636424.1266 | 4594309.0140 |
| 11 | p | 1 | | | | | | | | | | 635931.8477 | 4595748.4040 |
| 11 | p | 1 | | | | | | | | | | 637522.7904 | 4594105.2790 |
| 11 | | | | | | | | | | | | 638161.7980 | 4593473.8970 |
| 11 | p | 1 | | | | 1 | | | | | | 638350.3429 | 4593520.4420 |
| 12 | p | 1 | | | | | | | | | | 636689.1398 | 4594218.0970 |
| 12 | | | | | | | | | | | | 636224.8831 | 4594670.7470 |
| 12 | | | | | | | | | | | | 636836.6993 | 4594074.9950 |
| 12 | | | | | | | | | | | | 636857.9994 | 4594185.4400 |
| 12 | p | 1 | | | | | | | | | | 636984.2218 | 4594069.4730 |
| 12 | p | | | | | | | | | | | 637152.5347 | 4594089.6880 |

| DEPTH | FILALG | CERDEM | CHARA | ELOCAN | HETDUB | MYRSPI | NAJGUA | POTCRI | POTFOL | VALAME | ZANPAL | X_POINT | Y_POINT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | p | 1 | | | | 1 | | | 1 | | | 638404.3315 | 4593745.6210 |
| 13 | | 1 | | | | | 1 | | | | | 636332.1639 | 4595066.1360 |
| 13 | p | | | | | | 1 | | | | | 636130.5379 | 4595317.9480 |
| 13 | | | | | | | | | | | | 635823.5324 | 4595079.5190 |
| 13 | p | 1 | | | | | | | | | | 636373.2625 | 4594850.4010 |
| 16 | | | | | | | | | | | | 636246.1615 | 4594494.7170 |
| 16 | | | | | | | | | | | | 636195.8671 | 4594537.2740 |
| 16 | | | | | | | | | | | | 636353.0555 | 4595030.7640 |
| 16 | | | | | | | | | | | | 636120.9781 | 4594767.4600 |
| 16 | p | | | | | | | | | | | 636297.8207 | 4594883.2860 |
| 16 | | | | | | | | | | | | 636320.1614 | 4594957.4560 |
| 16 | p | | | | | | | | | | | 637379.6038 | 4594093.2380 |
| 17 | | | | | | | | | | | | 636239.3125 | 4595075.8080 |
| 17 | | | | | | | | | | | | 637305.0536 | 4594058.9210 |
| 18 | | | | | | | | | | | | 636156.8007 | 4594932.5960 |

**Summer Tier II survey raw data as collected August 13, 2008.**

| DEPTH | FILALG | CERDEM | CHARA | ELOCAN | HETDUB | MYRSPI | NAJGUA | POTFOL | UTRVUL | VALAME | X_COOR | Y_COOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | | 1 | | | | 1 | 1 | | | | 636405.295 | 4594777.844 |
| 3 | p | 1 | 1 | | 1 | 1 | | | | 1 | 636194.195 | 4595428.822 |
| 3 | p | 5 | | | | 1 | | | | | 638416.778 | 4594204.972 |
| 4 | | 1 | | 1 | | 3 | | 1 | | | 636414.466 | 4594763.045 |
| 4 | p | 1 | | 3 | | 1 | | | | | 635673.283 | 4594855.109 |
| 4 | | 1 | | | | | | | | | 636322.187 | 4594277.299 |
| 4 | p | 5 | | 1 | | | | | | | 636773.659 | 4593814.639 |
| 4 | p | 3 | | | | 1 | | | | | 638272.349 | 4593296.302 |
| 4 | p | 3 | | | | 1 | | | | | 638593.017 | 4593199.065 |
| 4 | p | 1 | | | | 5 | 1 | | | | 638548.772 | 4593772.473 |
| 4 | | 1 | | | | | | | | | 638685.079 | 4594404.725 |
| 4 | p | 1 | | | | | | | | | 638784.957 | 4594384.051 |
| 5 | | | | | | | | | | | 636194.885 | 4594507.439 |
| 5 | p | 3 | | 1 | | | 1 | 1 | | | 636632.881 | 4594862.177 |
| 5 | p | 1 | | | | 1 | 1 | 3 | | | 636280.964 | 4595180.636 |
| 5 | p | 5 | | | | 1 | | | | | 636155.156 | 4595502.616 |
| 5 | p | 3 | | | | 3 | | | | | 636011.094 | 4595063.698 |
| 5 | p | 1 | | | | 1 | | | | | 637676.353 | 4593735.163 |
| 5 | p | 5 | | 1 | | | | | | | 638497.477 | 4594292.697 |
| 5 | | 5 | | | | | | | | | 638791.854 | 4594651.271 |
| 5 | p | 3 | | | | 1 | 1 | | | | 638715.346 | 4594803.425 |
| 6 | | 1 | | | | | | | | | 637138.027 | 4594362.479 |
| 6 | p | 3 | | | | | | | | | 635777.746 | 4594884.899 |
| 6 | | 5 | | | | 1 | | | | | 636996.011 | 4593886.068 |
| 6 | p | 5 | 1 | | | | | | | | 637413.615 | 4593748.573 |
| 6 | p | 3 | | | | 5 | | | | | 638308.769 | 4593432.345 |
| 6 | | 1 | | | | 3 | | | | | 638667.356 | 4593293.190 |
| 6 | p | 1 | | | | | | | | | 637658.455 | 4594045.558 |
| 6 | | 1 | | | | | | | | | 637306.526 | 4594358.694 |
| 6 | | 1 | | | | 1 | | | | | 638180.948 | 4594270.652 |
| 6 | p | 1 | | | | 1 | | | | | 638798.436 | 4594445.403 |
| 6 | p | 5 | | 1 | | | | | 1 | | 638781.316 | 4594545.170 |
| 7 | | 1 | | | | | | | | | 637515.414 | 4594562.201 |

| DEPTH | FILALG | CERDEM | CHARA | ELOCAN | HETDUB | MYRSPI | NAJGUA | POTFOL | UTRVUL | VALAME | X_COOR | Y_COOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7 | | 1 | | | | | | | | | 636784.881 | 4593966.091 |
| 7 | p | 1 | | | | 3 | | | | | 638002.593 | 4593793.253 |
| 7 | | | | | | | | | | | 637836.759 | 4594427.934 |
| 7 | | 1 | | | | | | | | | 638660.966 | 4594764.122 |
| 7 | | 1 | | | | | | | | | 638167.047 | 4594617.981 |
| 8 | | 3 | | 1 | | 1 | 3 | | | | 636342.722 | 4594670.816 |
| 8 | p | 3 | | | | | | | | | 636538.326 | 4594828.034 |
| 8 | | 3 | | | | | | | | | 635965.089 | 4594872.006 |
| 8 | | 1 | | | | | | | | | 637483.942 | 4593921.487 |
| 8 | p | 1 | | | | 5 | | | | | 637779.605 | 4593629.878 |
| 8 | p | 1 | | | | 1 | | | | | 638546.795 | 4593385.822 |
| 8 | | 1 | | | | | | | | | 637649.450 | 4594293.588 |
| 8 | | 1 | | | | 1 | | | | | 637865.758 | 4594536.218 |
| 9 | | 1 | | | | | | | | | 637030.286 | 4594254.497 |
| 9 | | | | | | | | | | | 636403.753 | 4594433.352 |
| 9 | p | | | | | 1 | 1 | 1 | | | 636407.076 | 4594899.829 |
| 9 | p | 1 | | | | 1 | | | | | 636862.866 | 4593886.050 |
| 9 | p | 1 | | | | 1 | | | | | 637319.192 | 4593861.486 |
| 9 | p | 5 | | | | 1 | | | | | 638522.755 | 4593482.249 |
| 9 | | | | | | | | | | | 638403.604 | 4593749.693 |
| 9 | | 1 | | | | | | | | | 637660.602 | 4594423.644 |
| 9 | | 1 | | | | | | | | | 638538.586 | 4594723.421 |
| 9 | | | | | | | | | | | 637640.739 | 4594503.733 |
| 10 | | | | | | | | | | | 636912.340 | 4594306.483 |
| 10 | p | 5 | | 1 | | 1 | 1 | | | | 635681.392 | 4594936.725 |
| 10 | | 1 | | | | 1 | | | | | 638157.805 | 4593461.489 |
| 10 | | 1 | | | | 1 | | | | | 638353.976 | 4593509.242 |
| 10 | | | | | | | | | | | 637516.724 | 4594062.237 |
| 11 | | | | | | | | | | | 635929.184 | 4595743.211 |
| 11 | | | | | | | | | | | 638386.762 | 4594689.076 |
| 12 | p | | | | | | | | | | 637368.909 | 4594549.993 |
| 12 | | 1 | | | | | | | | | 636238.691 | 4594637.402 |
| 12 | | 1 | | | | | | | | | 636972.058 | 4594085.143 |
| 12 | | | | | | | | | | | 637120.461 | 4594073.456 |

| DEPTH | FILALG | CERDEM | CHARA | ELOCAN | HETDUB | MYRSPI | NAJGUA | POTFOL | UTRVUL | VALAME | X_COOR | Y_COOR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | | | | | | | | | | | 637376.054 | 4594408.052 |
| 13 | | | | | | | | | | | 637260.573 | 4594495.088 |
| 13 | | | | | | | | | | | 636344.192 | 4595033.390 |
| 13 | | | | | | | | | | | 635825.226 | 4595067.004 |
| 13 | | | | | | | | | | | 636860.618 | 4594068.856 |
| 13 | | | | | | | | | | | 638211.085 | 4594480.918 |
| 14 | p | | | | | | | | | | 636674.294 | 4594228.235 |
| 14 | | | | | | | | | | | 636234.971 | 4594822.726 |
| 14 | | | | | | | | | | | 636814.300 | 4594165.241 |
| 15 | | | | | | | | | | | 636347.720 | 4594911.970 |
| 15 | | | | | | | | | | | 636323.039 | 4595069.538 |
| 15 | | | | | | | | | | | 636125.311 | 4595409.175 |
| 16 | | | | | | | | | | | 636458.725 | 4594305.500 |
| 16 | | | | | | | | | | | 636355.229 | 4594855.678 |
| 16 | | | | | | | | | | | 636133.743 | 4594757.853 |
| 16 | | | | | | | | | | | 637382.131 | 4594069.065 |
| 17 | | | | | | | | | | | 636259.660 | 4594484.994 |
| 17 | p | | | | | | | | | | 636350.770 | 4594970.441 |
| 17 | | | | | | | | | | | 636124.704 | 4594929.662 |
| 17 | | | | | | | | | | | 637485.171 | 4594341.667 |
| 20 | | | | | | | | | | | 636208.110 | 4595038.482 |
| 20 | | | | | | | | | | | 637279.649 | 4594033.984 |
| 20 | | | | | | | | | | | 638068.373 | 4593712.199 |
| 20 | | | | | | | | | | | 638080.640 | 4593669.793 |

# APPENDIX C:

# TIER II SURVEY RESULTS

# SYLVAN LAKE
# AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2008

| Occurrence and abundance of submersed aquatic plants in Sylvan Lake. | | | | | |
|---|---|---|---|---|---|
| County: | Noble | Sites with plants: | 64 | Mean species/site: | 1.57 |
| Date: | 6/9/2008 | Sites with native plants: | 62 | Standard error (ms/s): | 0.15 |
| Secchi (ft): | 9 | Number of species: | 10 | Mean native species/site: | 1.07 |
| Maximum plant depth (ft): | 13 | Number of native species: | 8 | Standard error (mns/s): | 0.11 |
| Trophic status: | Mesotrophic | Maximum species/site: | 8 | Species diversity: | 0.73 |
| Total sites: | 90 | | | Native species diversity: | 0.57 |

| All depths (0-20 ft) | | Frequency of | Rake score frequency per species | | | | Plant |
|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *Ceratophyllum demersum* | Coontail | 66.67 | 33.33 | 31.11 | 11.11 | 24.44 | 37.33 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 42.22 | 57.78 | 21.11 | 7.78 | 13.33 | 22.22 |
| *Elodea canadensis* | Common water weed | 17.78 | 82.22 | 13.33 | 3.33 | 1.11 | 5.78 |
| *Najas guadalupensis* | Southern naiad | 8.89 | 91.11 | 8.89 | 0.00 | 0.00 | 1.78 |
| *Potamogeton crispus* | Curly leaf pondweed | 7.78 | 92.22 | 6.67 | 1.11 | 0.00 | 2.00 |
| *Potamogeton foliosis* | Leafy pondweed | 4.44 | 95.56 | 4.44 | 0.00 | 0.00 | 0.89 |
| *Zannichellia palustris* | Horned pondweed | 2.22 | 97.78 | 2.22 | 0.00 | 0.00 | 0.44 |
| *Vallisneria americana* | Eel grass | 2.22 | 97.78 | 2.22 | 0.00 | 0.00 | 0.44 |
| *Heteranthera dubia* | Water star grass | 2.22 | 97.78 | 2.22 | 0.00 | 0.00 | 0.44 |
| *Chara species* | Musk grass species | 2.22 | 97.78 | 2.22 | 0.00 | 0.00 | 0.44 |
| *Filamentous algae* | Filamentous algae | 70.00 | | | | | |

| 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 | 92.86 | 7.14 | 25.00 | 14.29 | 53.57 | 67.14 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 60.71 | 39.29 | 21.43 | 14.29 | 25.00 | 37.86 |
| *Elodea canadensis* | Common water weed | 39.29 | 60.71 | 32.14 | 3.57 | 3.57 | 12.14 |
| *Najas guadalupensis* | Southern naiad | 17.86 | 82.14 | 17.86 | 0.00 | 0.00 | 3.57 |
| *Potamogeton crispus* | Curly leaf pondweed | 14.29 | 85.71 | 10.71 | 3.57 | 0.00 | 4.29 |
| *Zannichellia palustris* | Horned pondweed | 7.14 | 92.86 | 7.14 | 0.00 | 0.00 | 1.43 |
| *Vallisneria americana* | Eel grass | 7.14 | 92.86 | 7.14 | 0.00 | 0.00 | 1.43 |
| *Heteranthera dubia* | Water star grass | 7.14 | 92.86 | 7.14 | 0.00 | 0.00 | 1.43 |
| *Chara species* | Musk grass species | 7.14 | 92.86 | 7.14 | 0.00 | 0.00 | 1.43 |
| *Potamogeton foliosis* | Leafy pondweed | 3.57 | 96.43 | 3.57 | 0.00 | 0.00 | 0.71 |
| *Filamentous algae* | Filamentous algae | 92.86 | | | | | |

| 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 | 76.47 | 23.53 | 38.24 | 17.65 | 20.59 | 38.82 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 55.88 | 44.12 | 32.35 | 8.82 | 14.71 | 26.47 |
| *Elodea canadensis* | Common water weed | 14.71 | 85.29 | 8.82 | 5.88 | 0.00 | 5.29 |
| *Potamogeton crispus* | Curly leaf pondweed | 8.82 | 91.18 | 8.82 | 0.00 | 0.00 | 1.76 |
| *Potamogeton foliosis* | Leafy pondweed | 5.88 | 94.12 | 5.88 | 0.00 | 0.00 | 1.18 |
| *Najas guadalupensis* | Southern naiad | 2.94 | 97.06 | 2.94 | 0.00 | 0.00 | 0.59 |
| *Filamentous algae* | Filamentous algae | 76.47 | | | | | |

| Depth: 10-15 ft | | Frequency of | Rake score frequency per species | | | | Plant |
|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *Ceratophyllum demersum* | Coontail | 44.44 | 55.56 | 44.44 | 0.00 | 0.00 | 8.89 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 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 |
| *Potamogeton foliosis* | Leafy pondweed | 5.56 | 94.44 | 5.56 | 0.00 | 0.00 | 1.11 |
| *Filamentous algae* | Filamentous algae | 50.00 | | | | | |

| Depth: 15-20 ft | | Frequency of | Rake score frequency per species | | | | Plant |
|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *Filamentous algae* | Filamentous algae | 20.00 | | | | | |

| Occurrence and abundance of submersed aquatic plants in Sylvan Lake. | | | | | |
|---|---|---|---|---|---|
| County: | Noble | Sites with plants: | 56 | Mean species/site: | 1.21 |
| Date: | 8/13/2008 | Sites with native plants: | 56 | Standard error (ms/s): | 0.13 |
| Secchi (ft): | 3 | Number of species: | 9 | Mean native species/site: | 0.88 |
| Maximum plant depth (ft): | 12 | Number of native species: | 8 | Standard error (mns/s): | 0.10 |
| Trophic status: | Mesotrophic | Maximum species/site: | 5 | Species diversity: | 0.66 |
| Total sites: | 91 | | | Native species diversity: | 0.50 |

| All depths (0-20 ft) | | Frequency of | Rake score frequency per species | | | | Plant |
|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *Ceratophyllum demersum* | Coontail | 60.44 | 39.56 | 38.46 | 10.99 | 10.99 | 25.27 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 32.97 | 67.03 | 25.27 | 4.40 | 3.30 | 10.99 |
| *Najas guadalupensis* | Southern naiad | 8.79 | 91.21 | 7.69 | 1.10 | 0.00 | 2.20 |
| *Elodea canadensis* | Common water weed | 8.79 | 91.21 | 7.69 | 1.10 | 0.00 | 2.20 |
| *Potamogeton foliosis* | Leafy pondweed | 4.40 | 95.60 | 3.30 | 1.10 | 0.00 | 1.32 |
| *Chara* species | Chara species | 2.20 | 97.80 | 2.20 | 0.00 | 0.00 | 0.44 |
| *Vallisneria americana* | Eel grass | 1.10 | 98.90 | 1.10 | 0.00 | 0.00 | 0.22 |
| Utricularia vulgaris | Common bladderwart | 1.10 | 98.90 | 1.10 | 0.00 | 0.00 | 0.22 |
| *Heteranthera dubia* | Water star grass | 1.10 | 98.90 | 1.10 | 0.00 | 0.00 | 0.22 |
| *Filamentous algae* | Filamentous algae | 36.26 | | | | | |

| 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 | 95.24 | 4.76 | 47.62 | 23.81 | 23.81 | 47.62 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 61.90 | 38.10 | 47.62 | 9.52 | 4.76 | 20.00 |
| *Najas guadalupensis* | Southern naiad | 23.81 | 76.19 | 23.81 | 0.00 | 0.00 | 4.76 |
| *Elodea canadensis* | Common water weed | 23.81 | 76.19 | 19.05 | 4.76 | 0.00 | 6.67 |
| *Potamogeton foliosis* | Leafy pondweed | 14.29 | 85.71 | 9.52 | 4.76 | 0.00 | 4.76 |
| *Vallisneria americana* | Eel grass | 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 |
| *Chara* species | Chara species | 4.76 | 95.24 | 4.76 | 0.00 | 0.00 | 0.95 |
| Utricularia vulgaris | Common bladderwart | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| *Filamentous algae* | Filamentous algae | 71.43 | | | | | |

| 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 | 82.50 | 17.50 | 57.50 | 12.50 | 12.50 | 31.50 |
| *Myriophyllum spicatum* | Eurasian watermilfoil | 42.50 | 57.50 | 32.50 | 5.00 | 5.00 | 14.50 |
| *Najas guadalupensis* | Southern naiad | 7.50 | 92.50 | 5.00 | 2.50 | 0.00 | 2.50 |
| *Elodea canadensis* | Common water weed | 7.50 | 92.50 | 7.50 | 0.00 | 0.00 | 1.50 |
| Utricularia vulgaris | Common bladderwart | 2.50 | 97.50 | 2.50 | 0.00 | 0.00 | 0.50 |
| *Potamogeton foliosis* | Leafy pondweed | 2.50 | 97.50 | 2.50 | 0.00 | 0.00 | 0.50 |
| *Chara* species | Chara species | 2.50 | 97.50 | 2.50 | 0.00 | 0.00 | 0.50 |
| *Vallisneria americana* | Eel grass | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| *Heteranthera dubia* | Water star grass | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| *Filamentous algae* | Filamentous algae | 37.50 | | | | | |

| Depth: 10-15 ft | | Frequency of | Rake score frequency per species | | | | Plant |
|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *Ceratophyllum demersum* | Coontail | 11.11 | 88.89 | 11.11 | 0.00 | 0.00 | 2.22 |
| *Filamentous algae* | Filamentous algae | 11.11 | | | | | |

| Depth: 15-20 ft | | Frequency of | Rake score frequency per species | | | | Plant |
|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *Filamentous algae* | Filamentous algae | 8.33 | | | | | |

# APPENDIX D:

# PIT BASIN DATA ANALYSIS

# SYLVAN LAKE
# AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2008

**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.

**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** | **Rake score frequency per species** | | | | **Plant** |
|---|---|---|---|---|---|---|---|
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *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** | **Rake score frequency per species** | | | | **Plant** |
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *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** | **Rake score frequency per species** | | | | **Plant** |
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *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** | **Rake score frequency per species** | | | | **Plant** |
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *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** | **Rake score frequency per species** | | | | **Plant** |
| **Scientific Name** | **Common Name** | **Occurrence** | **0** | **1** | **3** | **5** | **Dominance** |
| *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 | | | | | |

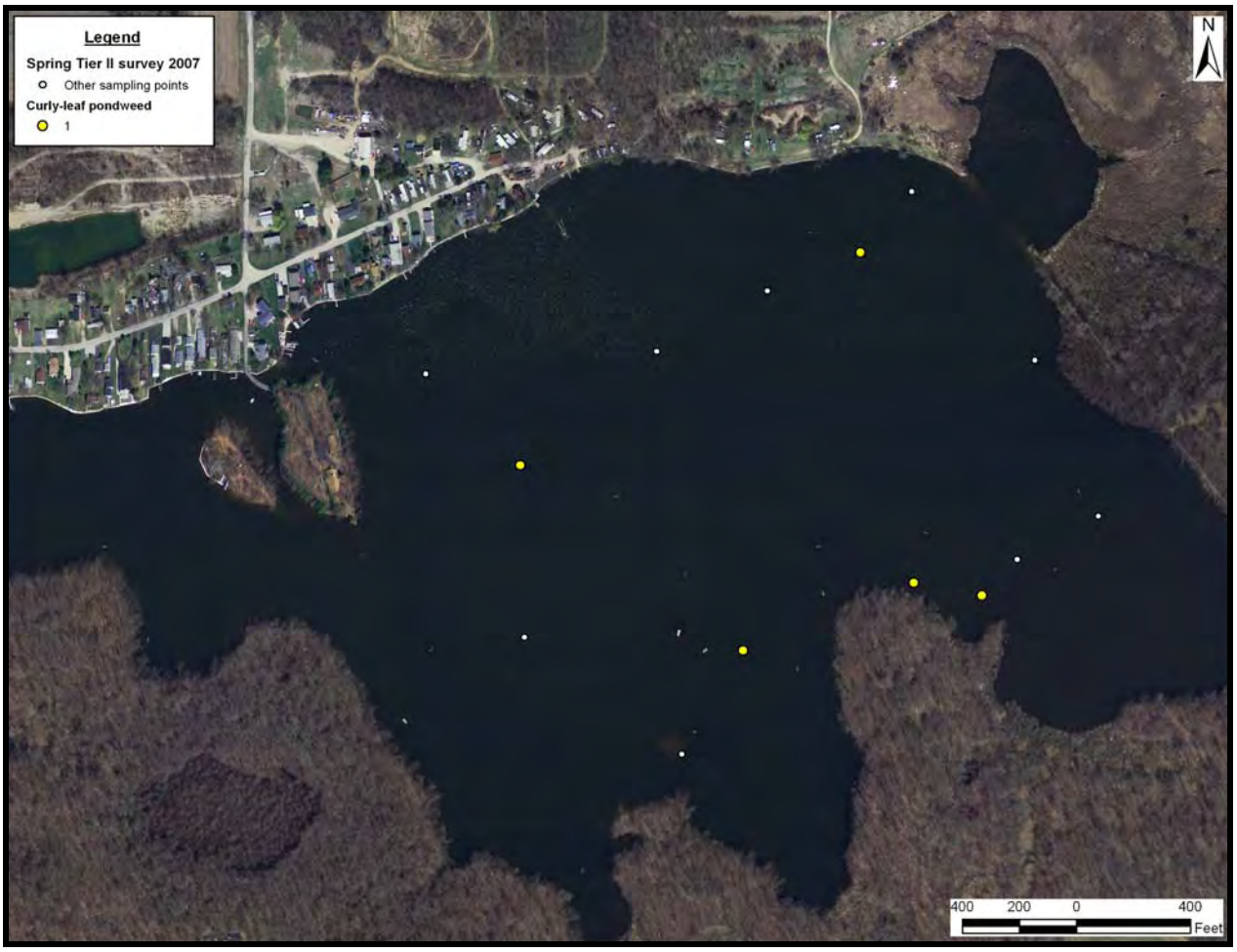



**Figure A. Curly-leaf pondweed locations and densities as surveyed June 4, 2007.**

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 | | | | | |

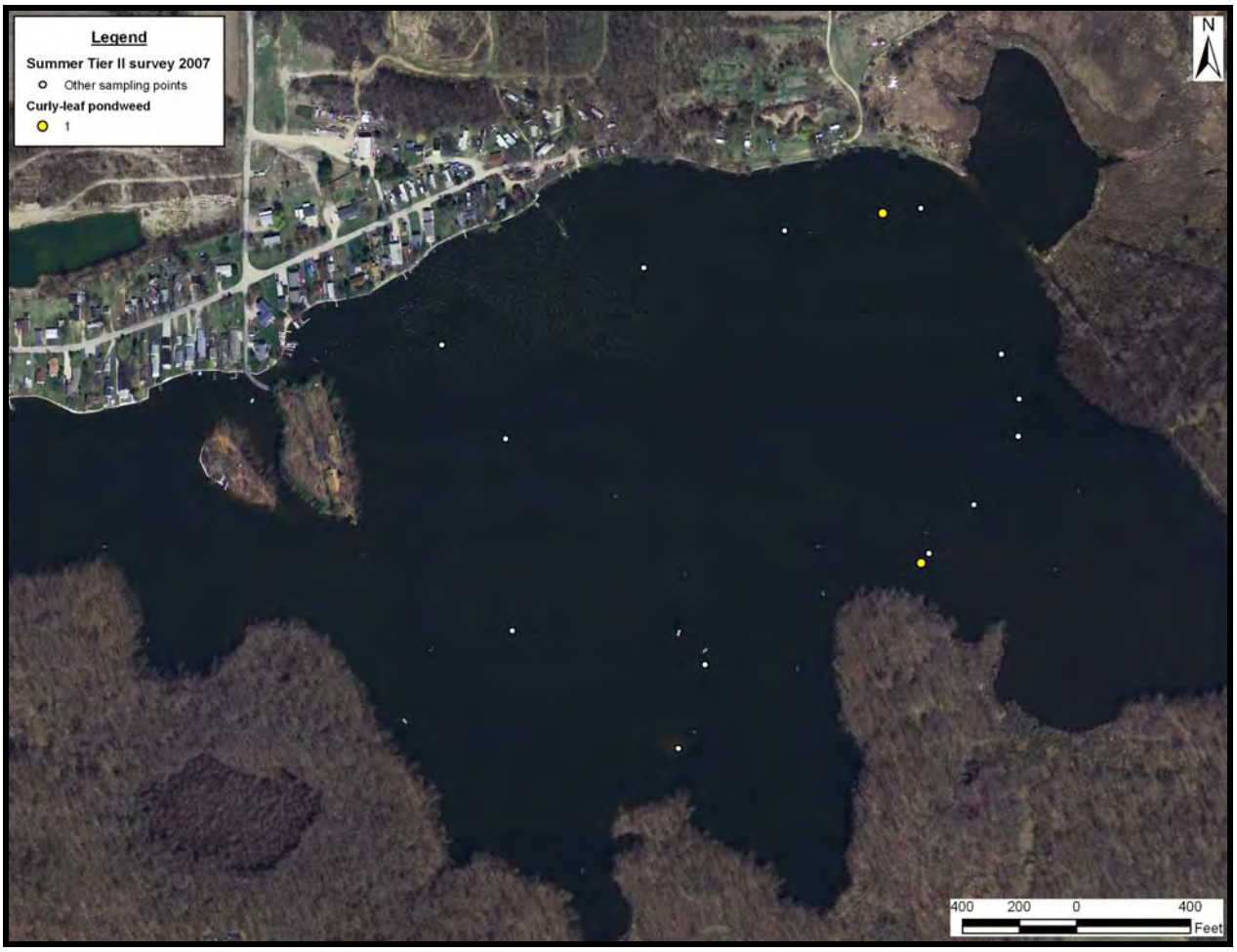



**Figure B. Curly-leaf pondweed locations and densities as surveyed in Pit Basin July 27, 2007.**

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 | | | | | |

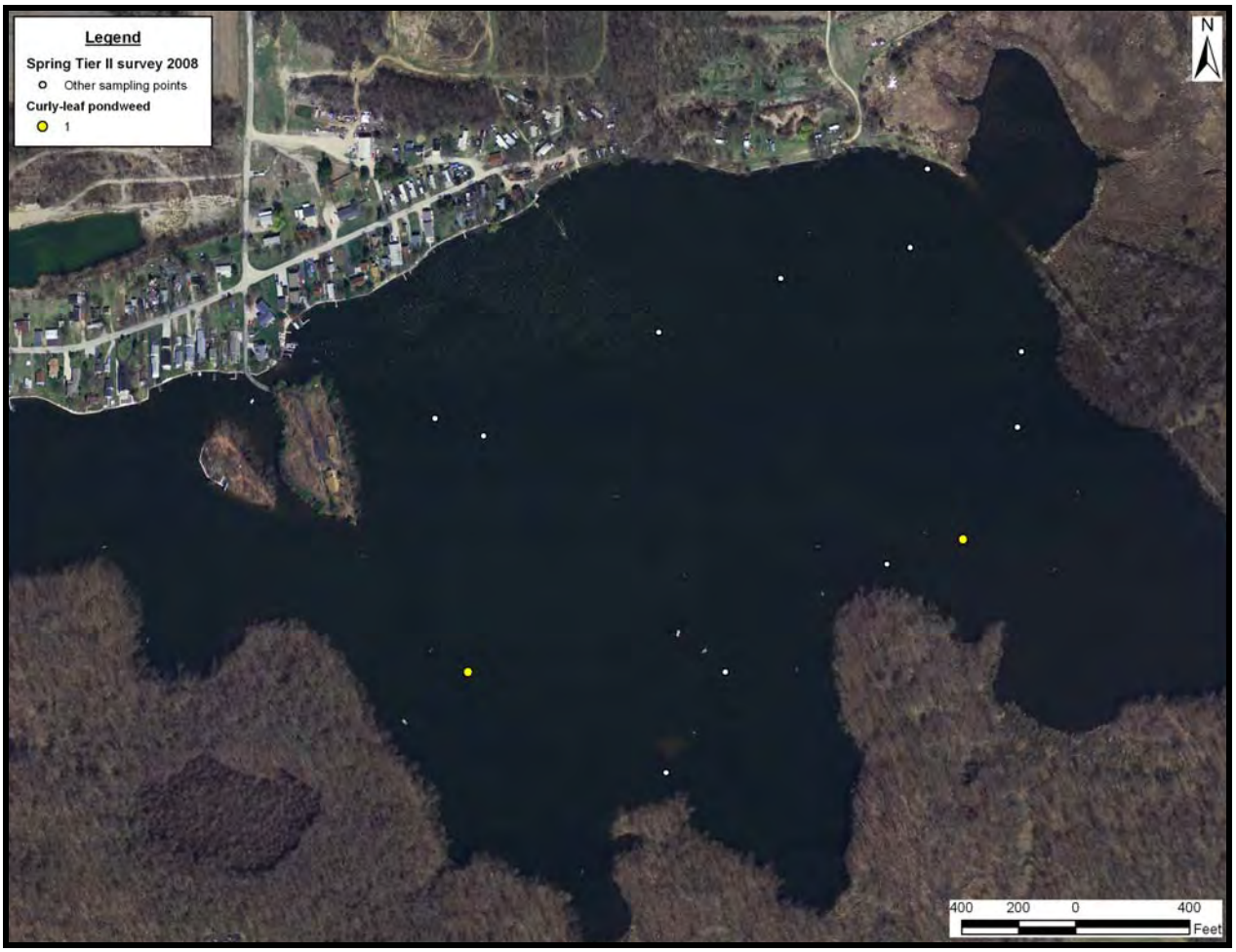



**Figure C. Curly-leaf pondweed locations and densities as surveyed in Pit Basin June 9, 2008.**

**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.

# APPENDIX E:

# AQUATIC PLANT 5 YEAR SUMMARY

# SYLVAN LAKE
# AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2008

Sylvan Lake 5-year summary

| SURVEY | DFW | DFW | WP | JFN | JFN | DFW | DFW | JFN | JFN | Target |
|---|---|---|---|---|---|---|---|---|---|---|
| Date | 6/2/03 | 5/12/04 | 5/10/05 | 6/4/07 | 6/9/08 | 7/23/03 | 7/26/04 | 7/26/07 | 8/13/08 | |
| Depth range (ft) | to 10' | | to 15' | to 20' | to 20' | to 10' | to 10.5' | to 15' | to 20' | |
| Sample sites (n) | 147 | 5.9 | 150 | 81 | 90 | 147 | 148 | 90 | 91 | |
| Secchi (ft) | 9.3 | 7.5 | 7.6 | 8.2 | 9.0 | 3.0 | 3.5 | | 3.0 | >=3 |
| Littoral depth (ft) | 10.0 | 8.0 | 15.2 | 16.0 | 13.0 | 10.0 | 10.5 | 14.0 | 12.0 | |
| 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 | 10 | 10 | 10 | 9 | 8 |
| Native species (N) | 3 | 4 | 1 | 11 | 8 | 8 | 8 | 8 | 8 | 8 |
| Species/site (max) | 3 | 3 | 3 | 7 | 8 | 4 | 5 | 6 | 5 | |
| Species/site (mean) | 1.46 | 1.17 | 0.86 | 1.25 | 1.57 | 1.41 | 1.63 | 1.79 | 1.21 | |
| Native species/site (mean) | 0.73 | 0.39 | 0.08 | 0.90 | 1.07 | 1.23 | 1.26 | 1.38 | 0.88 | |
| Species diversity | 0.66 | 0.54 | | 0.78 | 0.73 | 0.62 | 0.81 | 0.83 | 0.66 | |
| Native species diversity | 0.16 | 0.56 | | 0.70 | 0.57 | 0.51 | 0.73 | 0.76 | 0.50 | |
| **Species occurrence (%)** | | | | | | | | | | **Target** |
| Bladderwort | | | | | | | | | 1.1 | |
| Chara | 2.7 | 8.5 | | 4.9 | 2.2 | 9.5 | 11.5 | 27.8 | 2.2 | |
| Coontail | 66.7 | 23.7 | 11.4 | 46.9 | 66.7 | 81.0 | 44.6 | 55.6 | 60.4 | 60.0 |
| Curly-leaf pondweed | 44.9 | 74.6 | 94.3 | 29.6 | 7.8 | 8.2 | 25.0 | 11.1 | | |
| Eel grass | | | | 3.7 | 2.2 | | | | 1.1 | |
| Elodea | | | | 3.7 | 17.8 | | | 7.8 | 8.8 | |
| Eurasian water milfoil | 28.6 | 3.4 | 12.4 | 4.9 | 42.2 | 10.2 | 12.2 | 30.0 | 33.0 | |
| Flat-stem pondweed | 3.4 | 5.1 | | 2.5 | | 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 | |
| Northern water milfoil | | | | 2.5 | | | | 2.2 | | |
| Sago pondweed | | 1.7 | | 1.2 | 7.8 | 0.7 | 0.7 | | | *** |
| Small pondweed | | | | | | 0.7 | 1.4 | | | *** |
| Water stargrass | | | | | 2.2 | 0.7 | 2.0 | | 1.1 | |
| Filamentous algae | 100.0 | 11.9 | | 53.1 | 70.0 | 0.7 | 21.6 | 31.1 | 36.3 | |
| **Species dominance** | | | | | | | | | | **Target** |
| Bladderwort | | | | | | | | | 0.2 | |
| Chara | 1.4 | 2.4 | | 1.0 | 0.4 | 6.0 | 6.4 | 9.1 | 0.4 | |
| Coontail | 35.1 | 5.4 | 2.6 | 16.3 | 37.3 | 47.8 | 18.6 | 29.8 | 25.7 | |
| Curly-leaf pondweed | 21.5 | 42.7 | 67.7 | 6.9 | 2.0 | 1.6 | 7.2 | 2.2 | | |
| Eel grass | | | | 0.7 | 0.4 | | | | 0.2 | |
| Elodea | | | | 1.2 | 5.8 | | | 2.9 | 2.2 | |
| Eurasian water milfoil | 13.1 | 0.7 | 3.0 | | 22.2 | 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 | | |
| Sago pondweed | | 0.3 | | 0.3 | | 0.1 | 0.1 | 2.4 | | |
| Small pondweed | | | | | | 0.1 | 0.3 | | | |
| Water stargrass | | | | | 0.4 | 0.1 | 0.4 | | 0.2 | |

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

# APPENDIX F:

# 2009 AQUATIC PLANT TREATMENT PERMIT APPLICATIONS

# SYLVAN LAKE
# AQUATIC VEGETATION MANAGEMENT PLAN UPDATE 2008

# 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 300 | 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 | | 50.4% |
| Eurasian Watermilfoil | | 27.7% |
| Southern Naiad | | 7.6% |
| Elodea | | 7.6% |
| Chara Algae | | 3.4% |
| Vallisneria | | 1.7% |
| Bladderwort | | 0.8% |
| Water Star Grass | | 0.8% |
| Filamentous Algae | | present |
| | | |
| | | |

| | | | |
|---|---|---|---|
| Treatment Area # | 2 | LAT/LONG or UTM's | |
| Total acres to be controlled | 67 | 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 | | 50.4% |
| Eurasian Watermilfoil | X | 27.7% |
| Southern Naiad | | 7.6% |
| Elodea | | 7.6% |
| Chara Algae | | 3.4% |
| Vallisneria | | 1.7% |
| Bladderwort | | 0.8% |
| Water Star Grass | | 0.8% |
| 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 | | 50.4% |
| Eurasian Watermilfoil | | 27.7% |
| Southern Naiad | | 7.6% |
| Elodea | | 7.6% |
| Chara Algae | X | 3.4% |
| Vallisneria | | 1.7% |
| Bladderwort | | 0.8% |
| Water Star Grass | | 0.8% |
| 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) | |

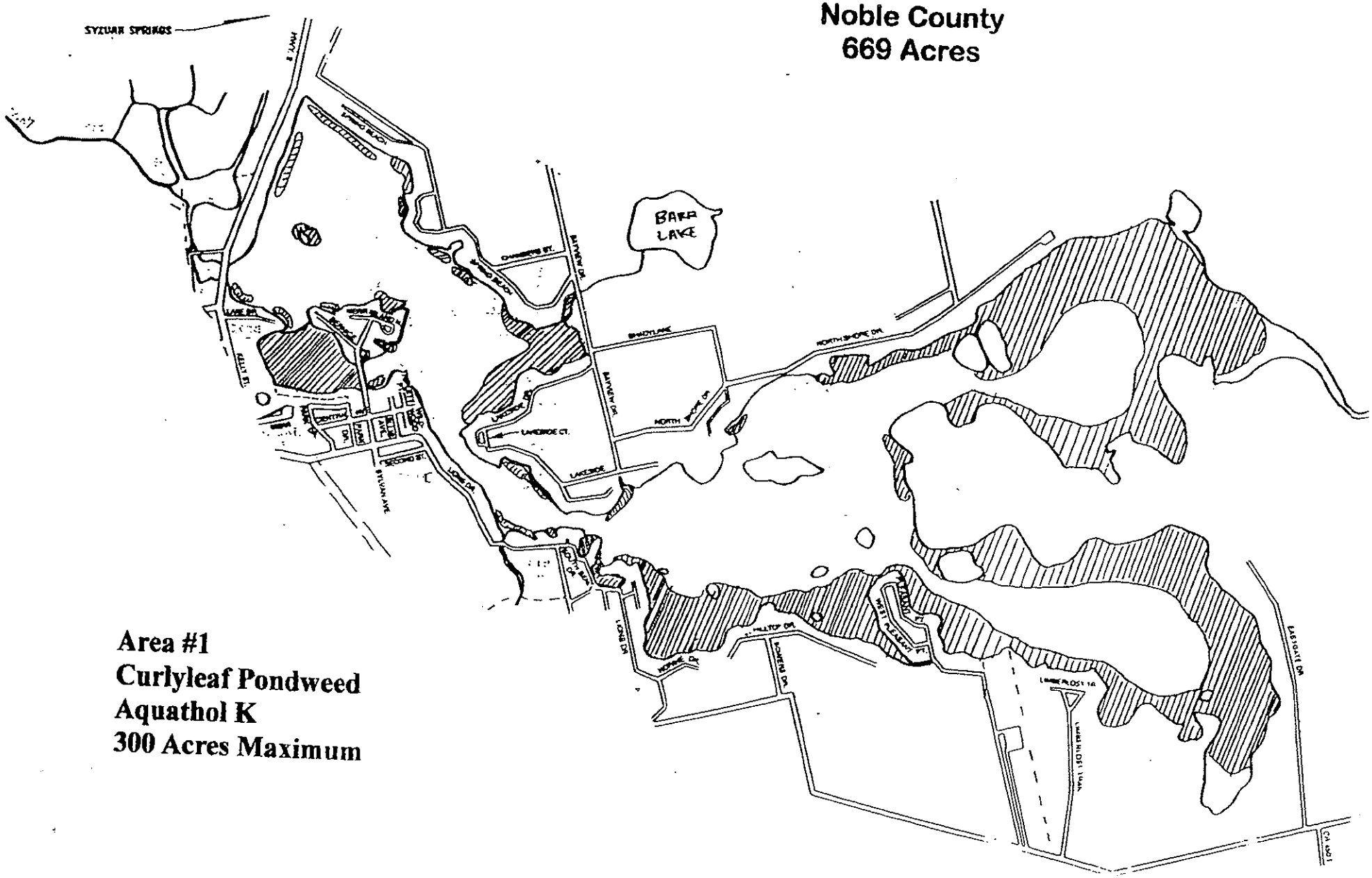
Treatment method: [X] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

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

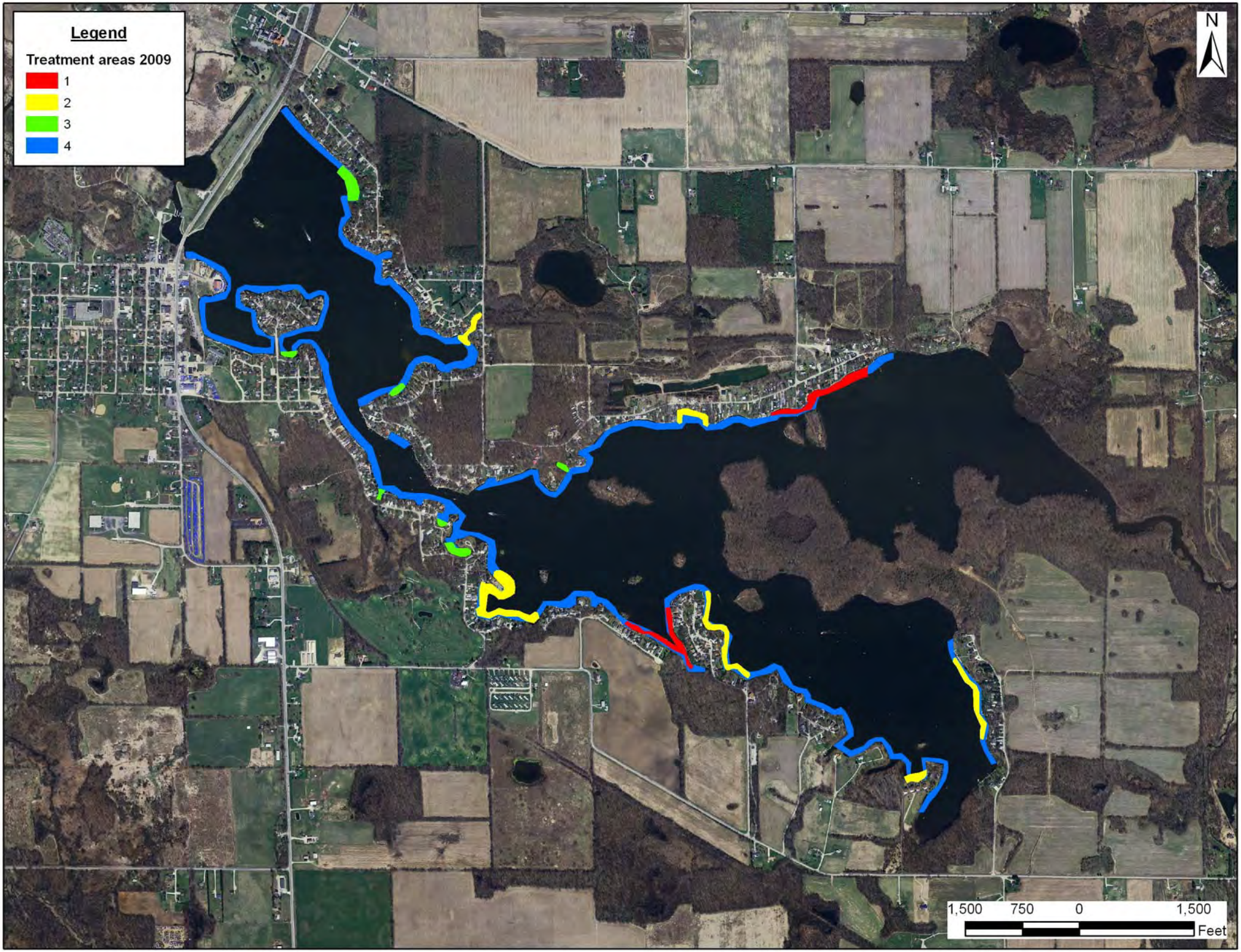
| Aquatic Plant Name | Check if Target Species | Relative Abundance % of Community |
|---|---|---|
| Coontail | X | 50.4% |
| Eurasian Watermilfoil | | 27.7% |
| Southern Naiad | | 7.6% |
| Elodea | | 7.6% |
| Chara Algae | | 3.4% |
| Vallisneria | | 1.7% |
| Bladderwort | | 0.8% |
| Water Star Grass | | 0.8% |
| Filamentous Algae | | present |
| | | |

# Sylvan Lake
## Noble County
## 669 Acres




**Area #1**
**Curlyleaf Pondweed**
**Aquathol K**
**300 Acres Maximum**

*WEED PATROL, INC.*
*1922 FIELDHOUSE AVE.*
*ELKHART, IN 46517*


Legend
Treatment areas 2009
1
2
3
4
N
1,500
750
0
1,500
Feet