Aquatic Enhancement
& Survey, Inc.

Aquatic Plant Management Plan for
Stone and Brokesha Lakes 2007-2011
Lagrange County, Indiana

Prepared for the Stone Lake Conservation Club

February 25, 2008

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Executive Summary

Stone and Brokesha Lakes are two natural kettle lakes of 104 and 29 acres respectively. The lakes are located in extreme northwestern Lagrange County Indiana. They are generally low to moderate in nutrient levels (Stone is classified "mesotrophic" and Brokesha "oligotrophic") and generally have good warm season water clarity compared with most other northeast Indiana lakes. The shoreline of Stone Lake is nearly 100 percent developed with single family homes and cottages. The shoreline of Brokesha Lake is less than 10 percent developed. The lakes are connected by a navigable channel. The public can gain access to Stone Lake through a County owned ramp on the Northwestern shore of Stone Lake. From Stone Lake boaters can access Brokesha through the connecting channel. Boating, fishing, and swimming are all popular activities at the lakes. Waterskiing and other high speed boating is prohibited by a state enforced 10mph/no wake speed limit which applies to Indiana public lakes under 200 acres in size.

Stone Lake contained a moderately diverse aquatic flora in 2007 while Brokesha had relatively low plant diversity for an Indiana Lake. Both lakes had been extensively colonized by the non-native plant Eurasian watermilfoil *Myriophyllum spicatum* prior to 2005. Curlyleaf pondweed *Potamogeton crispus*, another invasive exotic aquatic plant is also present in the lakes. The invasive exotic wetland species Purple Loosestrife *Lythrum salicaria* and Phragmites *Phragmites australis* have colonized areas along the shoreline of the two lakes. For several years Eurasian watermilfoil impaired the aesthetic quality of the lakes and provided a significant hindrance to the recreational activities of the lake's users. The Stone Lake Conservation Club held several meetings in 2003 and 2004 to discuss the aquatic plant problems. In 2004 the Stone Lake Conservation Club sought cost-share assistance from the Indiana Department of Natural Resources for the management of exotic plants. Weed Patrol Inc. developed an initial draft plant management plan in 2005. This plan supplants the Weed Patrol, Inc. plan and associated update. This plan's purpose is to help the Stone Lake Conservation Club and Indiana Department of Natural Resources direct plant management efforts at Stone and Brokesha Lakes toward the following set of goals:

1. Maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality.

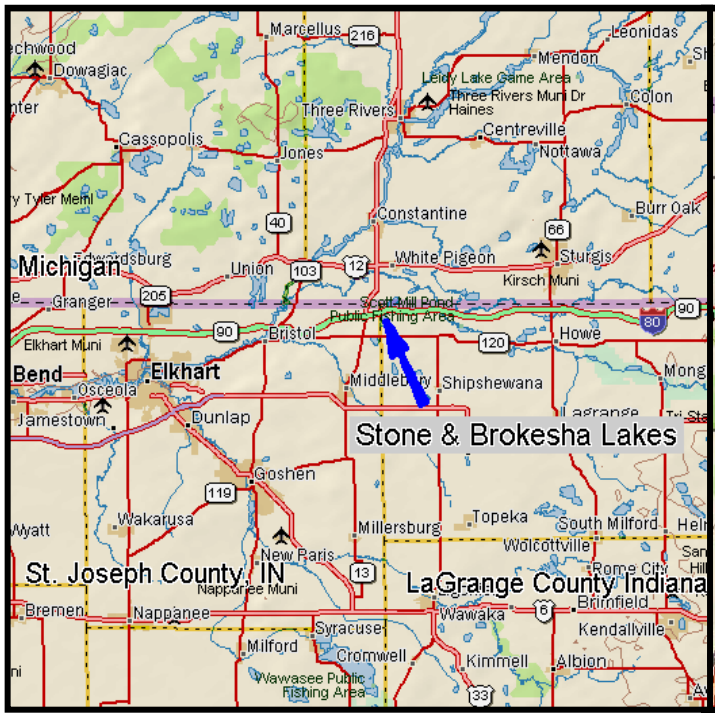
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.

3. Provide reasonable public recreational access while minimizing the negative impacts on plant, fish, and wildlife resources.

A whole lake fluridone (Sonar) treatment was utilized to control 26 acres of Eurasian watermilfoil in both lakes during the 2005 season. In 2006 and 2007 returning Eurasian watermilfoil has been noted and treated on both lakes. Treatment in 2007 totaled 10 acres of milfoil growth. Because Eurasian watermilfoil appears to be gradually recolonizing Stone and Brokesha Lakes it is recommended that treatment of these plants be continued on a seek-and-destroy basis in 2007 utilizing 2,4-D granular aquatic herbicide. Control with 2,4-D will be a cost effective way to achieve selective control of Eurasian watermilfoil, especially with the deeper milfoil growth present in Stone Lake. The use of Renovate 3 (trichlopyr) herbicide could be considered in future treatments if control with 2,4-D is not successful. To prevent the growth of Curlyleaf pondweed from emerging as a problem it is also recommended that an early-season treatment be added to the management regime in 2008 to control it. To continue with successful management of aquatic plants in Stone and Brokesha Lakes the Stone Lake Conservation Club is advised to treat all areas of significant Curlyleaf pondweed and Eurasian watermilfoil growth in 2008. For Curlyleaf control an early season (in April or water temp approx. 55 F) treatment with Aquathol K herbicide should be performed on approximately 7 acres as needed. The early treatment may be able to successfully prevent reproduction of the Curlyleaf plants thus

diminishing their numbers in later seasons. The chemical treatment of Eurasian watermilfoil with 2,4-D granular aquatic herbicide is recommended on an estimated 30 total acres of growth through the course of the 2008 season. Small colonies of Phragmites (Giant Reed Grass) plants noted on the shore of the lake's connecting channel should also be treated if they are identified as the invasive variety of that plant in 2008 to protect the biological integrity of area wetland systems. Treatment will be most cost effective currently while the number of these plants is small. Continued efforts at educating lake users about the spread and management of invasive aquatic plants are also recommended. Because taking care of the Stone and Brokesha Lakes watershed will ultimately help to minimize future aquatic plant problems on the lakes the Stone Lake Conservation Club is advised to address any erosion noted in the watershed and encourage the use of Phosphorus free fertilizers on area lawns. Based on the growth area in 2007 a cost estimate of $2100.00 is provided for early-season treatment of Stone and Brokesha Lakes' Curlyleaf pondweed in 2008 (7 acres). An estimated 23 acres of returning Eurasian watermilfoil may need to be treated in 2008 at a cost of $9568.00 with another 7 acres of regrowth treated late in the season for a cost of $2912.00. The associated plant community monitoring, public meeting, and 2008 season update preparation are estimated to cost $4750.00. The total estimated cost for the recommended aquatic plant control program in 2008 is $19,530.00. Actual treatment areas should be adjusted during the 2008 season through on-site surveys of emerging growth. The Stone Lake Conservation Club and IDNR should maintain the flexibility to adjust the management program on the fly in response to actual growth areas as plant growth can vary considerably from season to season. Costs estimates for the plan in 2008-2011 are detailed in the table below.

●Success Benchmarks Elimination of all significant Curlyleaf stands within two weeks of treatment on both lakes. A late-season Tier II occurrence of Eurasian watermilfoil of 10% or less on Stone and 5% or less on Brokesha.	**2008**	**2009**	**2010**	**2011**
Month/Activity				
April, Map Curlyleaf pondweed And Eurasian watermilfoil growth	900.00	945.00	992.00	1042.00
April/May (H2O temp app. 55 F or soon after emergence) Treat Curlyleaf pondweed as needed (.5-1ppm Aquathol K)	2100.00	2205.00	2315.00	2431.00
May, Begin Eurasian treatments on main lake as needed (approx. 23 ac.)	9568.00	10046.00	10549.00	11076.00
July, Tier II Survey	1700.00	1785.00	1874.00	1968.00
July, Eurasian retreatment or new area treatment as needed 7 ac.	2912.00	3058.00	3210.00	3371.00
Treatment of Phragmites	200.00			
As arranged, Public Meeting	350.00	368.00	386.00	405.00
October/November, Permit Meeting	200.00	210.00	221.00	232.00
December, Plan Update Document Due	1600.00	1680.00	1764.00	1852.00
Total Cost, Pesticide Applications	**$14780.00**	**$15309.00**	**$16074.00**	**$16878.00**
Total Cost, Consultant	**$4750.00**	**$4988.00**	**$5237.00**	**$5499.00**
Total	**$19530.00**	**$20297.00**	**$21311.00**	**$22377.00**



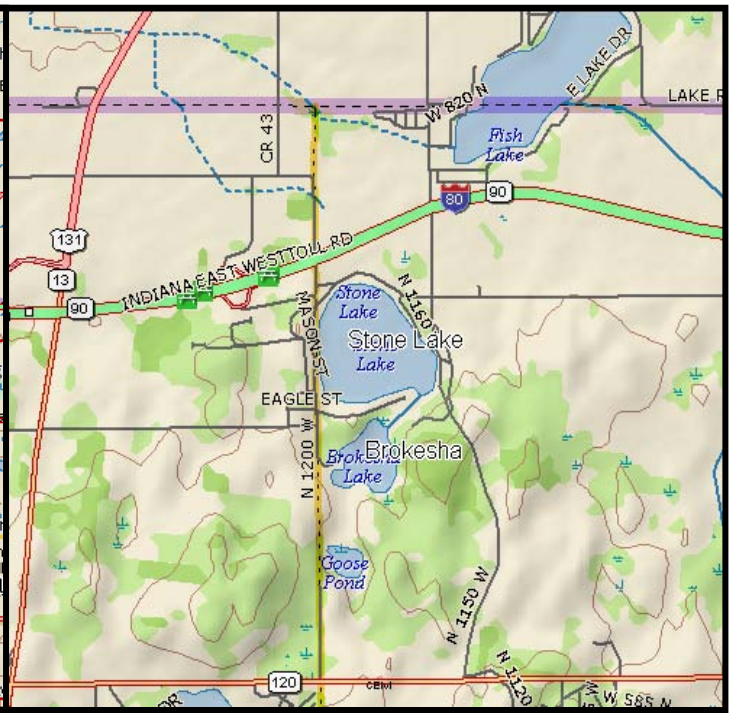


Figure 2 Stone and Brokesha Lakes General Location

Figure 1 Stone and Brokesha Lakes and Surrounding Area

1.0 Introduction

The Stone Lake Conservation Club has long sought to manage Stone and Brokesha Lakes to provide a long term recreational resource and quality habitat for fish and wildlife. Within the last ten years the excessive growth of the exotic invasive aquatic plant Eurasian watermilfoil began to impair the enjoyment of the lakes' residents and those who accessed the lake through the public ramp. In 2004 the Stone Lake Conservation Club sought and was granted assistance with the problem through the INDR Division of Fish and Wildlife's Lake and River Enhancement (LARE) program. Cost-share funds were provided to develop an aquatic plant management plan. For the original plant management plan draft for Stone and Brokesha Lake see *Stone Lake Aquatic Plant Management Plan 2005-2008* (Weed Patrol Inc. 2005) After receiving additional assistance for exotic plant control in 2005 the Stone Lake Conservation Club hired Weed Patrol Inc. to perform a whole lake treatment on both lakes with Sonar aquatic herbicide (fluridone). Milfoil was under control by the end of 2005 but was still present in areas of the lake beyond 10 feet in depth. Eurasian watermilfoil did not return in Brokesha Lake in 2006. In 2006 treatment of Eurasian watermilfoil with 2,4-D granular herbicide commenced on approximately a four acre area of Stone Lake. For 2007 the Stone Lake Conservation Club applied for further LARE assistance to continue treatment of exotic plants and redevelop the lakes' plant management plan. The Stone Lake Conservation Club hired Aquatic Enhancement & Survey, Inc. to treat approximately 10 acres of Eurasian watermilfoil on Stone and Brokesha Lakes and complete this redeveloped aquatic plant management plan.

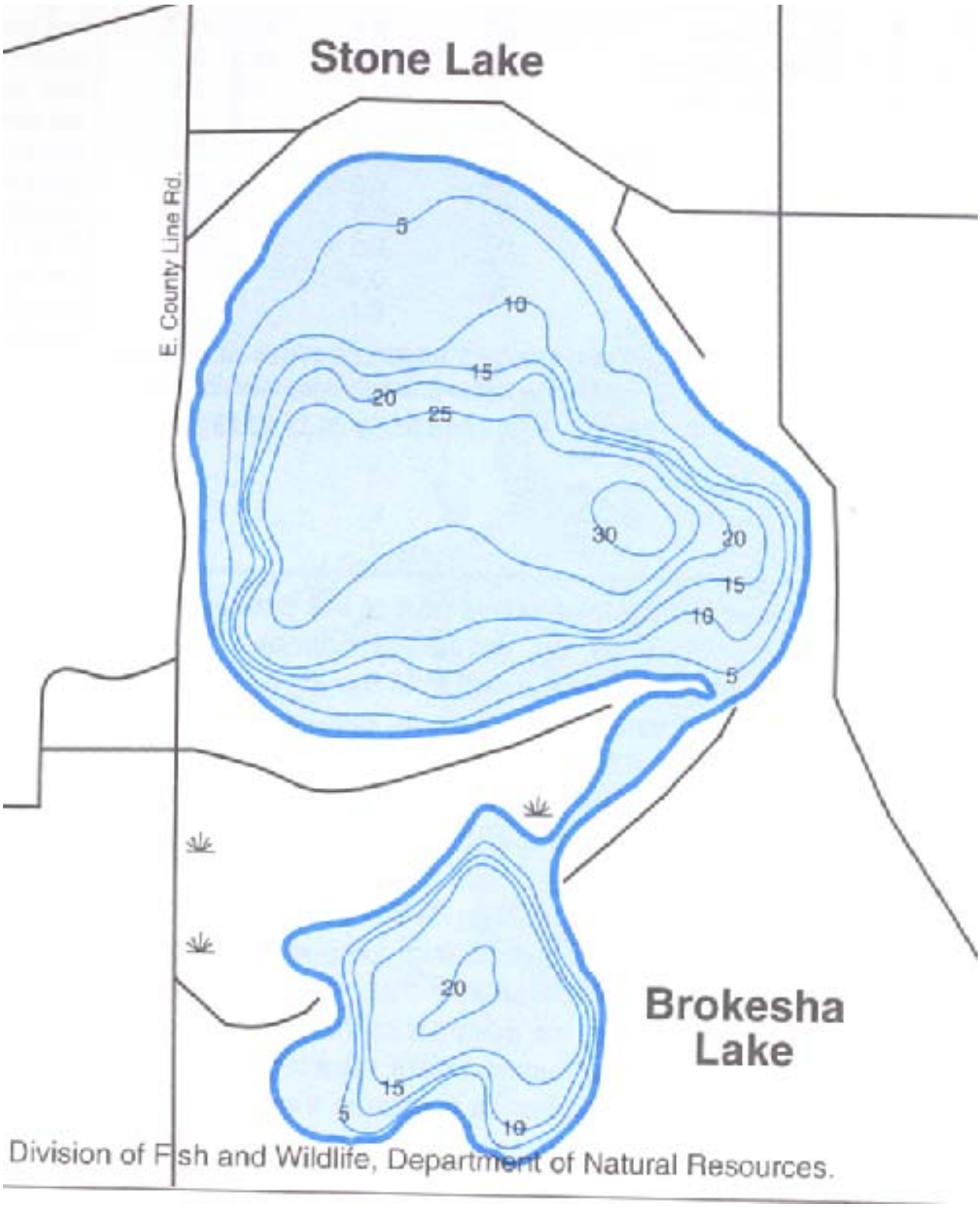


Figure 3 Contour Maps of Stone and Brokesha Lakes, Reproduced with the Permission of The Sportsman's Connection (IDNR depth data)

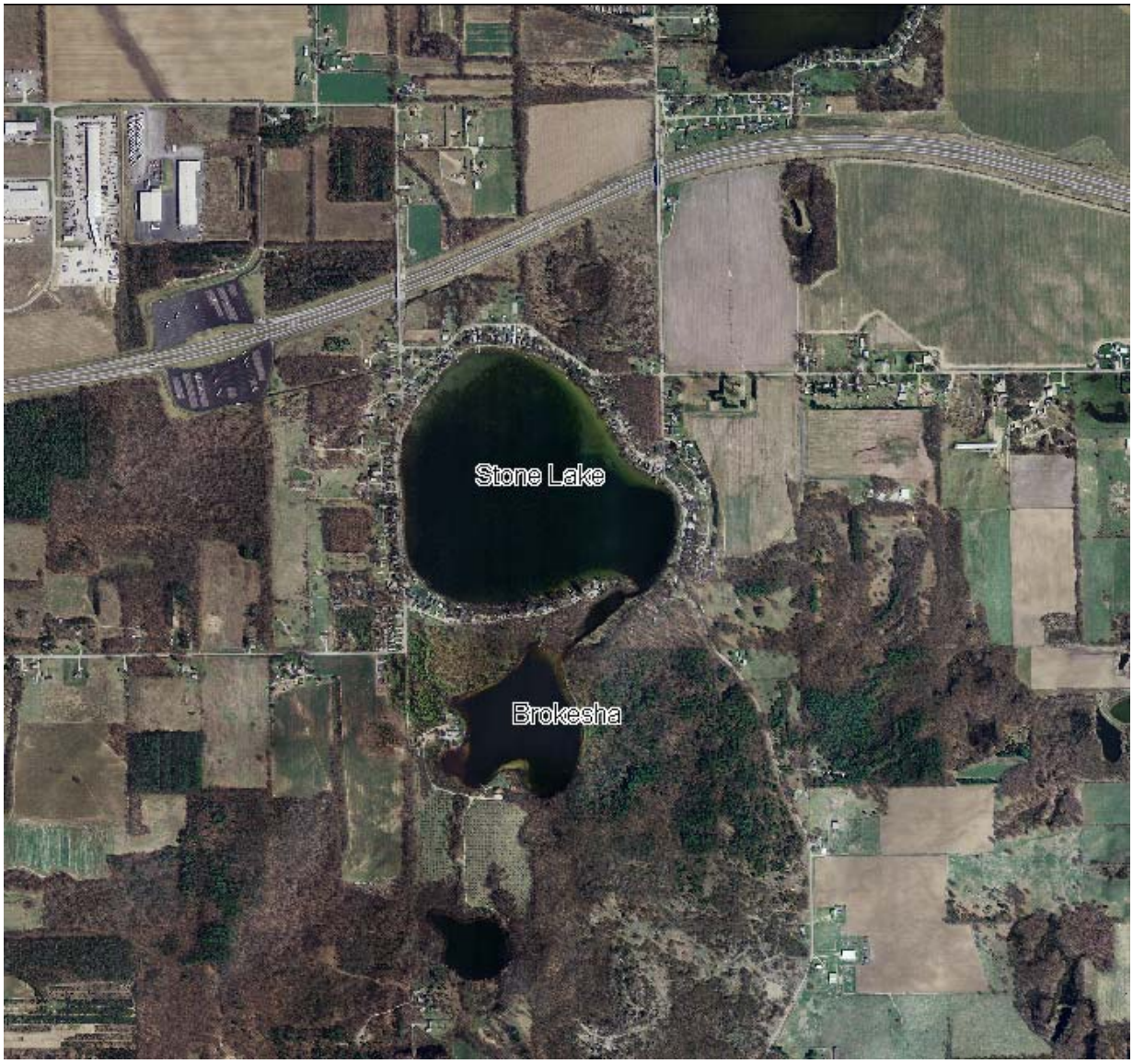
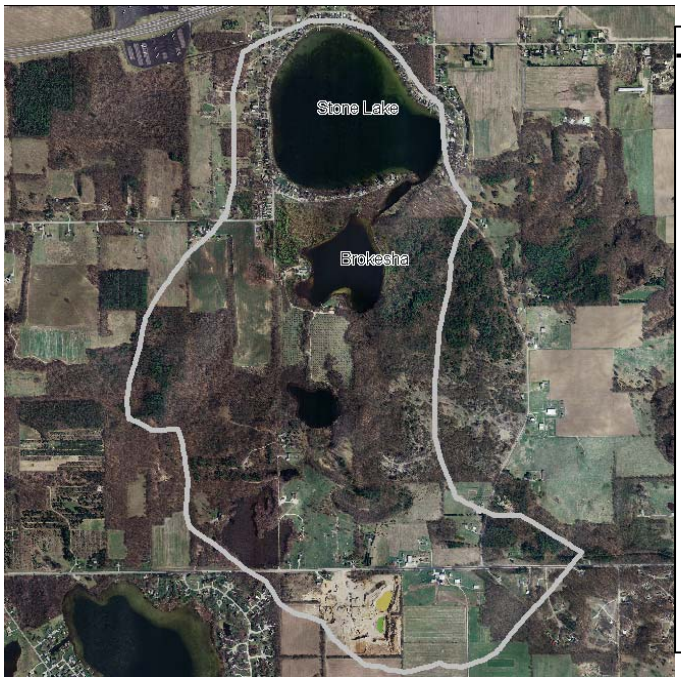


Figure 4 Air Photo of Stone and Brokesha Lakes and the Surrounding Area

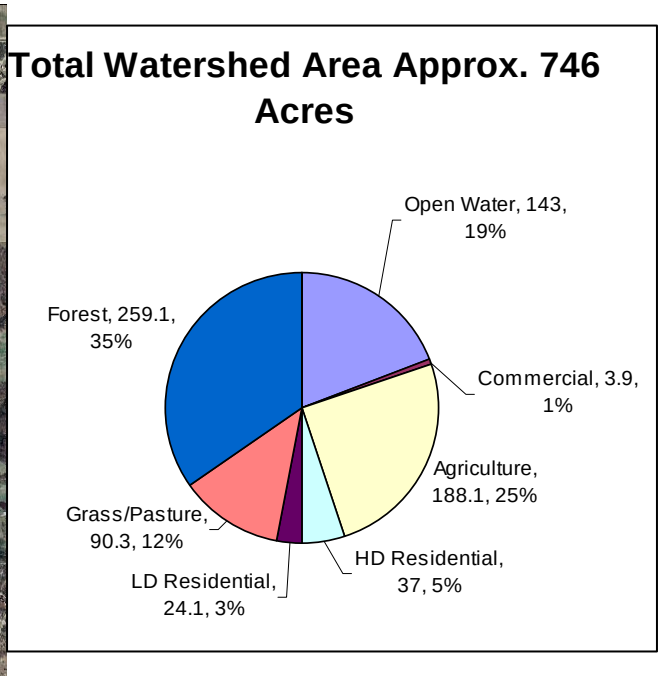
2.0 Watershed and Lake Characteristics

Stone and Brokesha (also known as Mud Lake) are two interconnected natural kettle lakes located in extreme northwestern Lagrange County, Indiana. Kettle lakes are basins formed by blocks of ice that broke free of the main glaciers that covered northeastern Indiana approximately 15,000 years ago. Stone and Brokesha are 104 and 29 surface acres respectively. Stone Lake has a maximum depth of 30 feet and an average depth of 14 feet. Brokesha Lake has a maximum depth of 20 feet and an average depth of 10 feet. The shoreline of Stone Lake is nearly 100 percent developed with single family homes and cottages. The shoreline of Brokesha is lightly developed, containing only a few homes with approximately 90 percent of the shoreline being woodland. Stone and Brokesha owe their good water quality to their relatively small (746 acre) watershed (see map 1 below), 36 percent of which is forested. The watershed also contains some agricultural lands (25 percent), pasture (12 percent) and small areas of wetlands and developed lands. Stone Lake is roughly circular with no significant islands or bays. The Shoreline of Brokesha is slightly more complex. The bathymetry of the Stone Lake (figure 3

above) is characterized by a deep center with a wide littoral shelf along the lakes north edge and a relatively narrow one along the south and west sides. The edge of the littoral shelf along the west side of the lake is irregular and has a steep edge making chemical treatment of a band of vegetation along the drop-off in this area difficult. The wide flat littoral shelf along the north side of the lake provides a significant area for the growth of aquatic plants. Brokesha is characterized by a deep central area surrounded by a very narrow littoral shelf. Because of this narrow littoral shelf habitat suitable for the growth of aquatic plants is limited. Stone and Brokesha are naturally subject to significant variation in water levels, but their level has recently been stabilized with the installation of a well system that contributes water to the lakes as needed. Both lakes generally display limited nutrient levels with Stone considered "mesotrophic" (moderate in nutrients) and Brokesha considered "oligotrophic" (low in nutrients) under the standards established by the Indiana Department of Environmental Management. Water clarity is generally good. In July of 2007 a Secchi depth of 17 feet was recorded at Stone Lake while a Secchi depth of 11.6 feet was recorded on Brokesha. Previous studies that have taken place at Stone and Brokesha Lakes include a hydrographic survey in 1960 by IDNR, IDNR general fish surveys in 1967, 1977, 1982, and 2007 and a Tier II aquatic plant survey performed by IDNR fisheries personnel in 2007.



Map 1 The Stone and Brokesha Watershed



Graph 1 Land Uses in the Stone and Brokesha Watershed

3.0 Lake Uses

With regard to swimming, fishing, and boating nearly the entire developed shoreline of Stone Lake can be considered "high use" (figure 5 below). Nearly all residents have watercraft and must navigate in and out of shoreline docking areas. On Brokesha high use areas are limited to the few developed frontages there. Because it's a constraint to boat passage the channel between the lakes would also be considered a high use area. With the no wake/10 mph. state imposed speed limit boat traffic is limited to low speed cruising on both lakes. Noting these high use areas will be important both in preventing vegetative spread of fragmenting exotic plants and prioritizing areas for plant control.

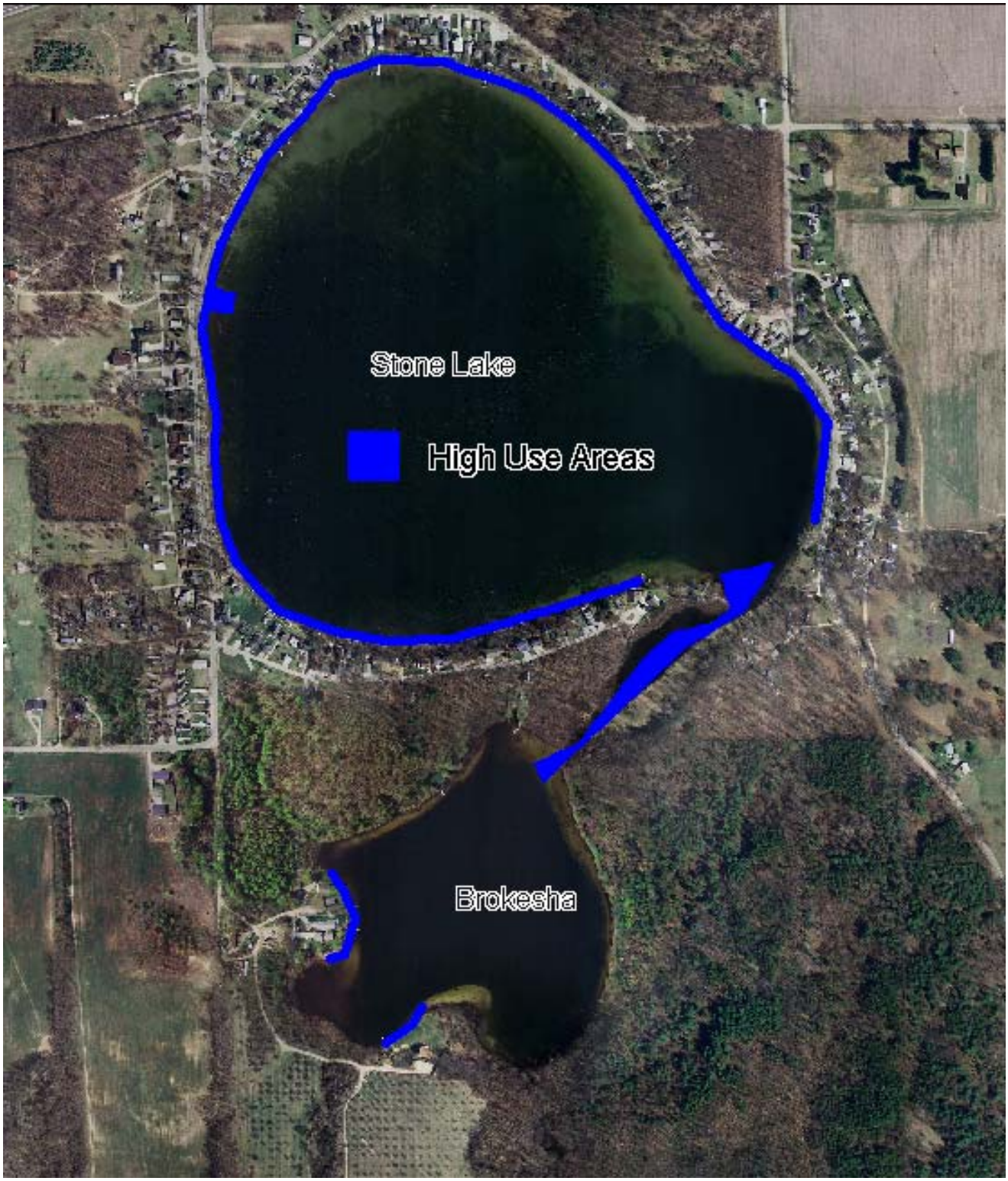


Figure 5 High Use Areas of Stone and Brokesha Lakes

Common Name of Fish (Stone Lake 2007)	Number Collected	Percent of Catch	Length Range
Bluegill	271	32.2	1.7-9.4
Largemouth Bass	251	29.8	3.5-1.6
Redear	123	14.6	3.3-9.8
Warmouth	83	9.9	2.1-7.5
Yellow perch	72	8.6	8.0-11.6
Black Crappie	16	1.9	4.0-11.4
Brown Bullhead	12	1.4	13.1-15.0
Yellow bullhead	6	.7	8.1-10.5
Golden Shiner	3	.4	9.3-9.4
Redfin pickerel	2	.2	11.6-12.5
Bowfin	1	.1	19.6
Green sunfish	1	.1	7.1
Walleye	1	.1	27.2
Brook silversides	Present		
Total (14 species)	842		

Table 1 Fish Data from the 2007 IDNR Fish Survey of Stone Lake

Common Name of Fish (Brokesha Lake, 2007)	Number Collected	Percent of Catch	Length Range
Bluegill	161	46.4	1.2-10.5
Largemouth Bass	79	22.8	3.5-19.8
Redear	67	19.3	2.1-9.1
Warmouth	17	4.9	3.6-6.6
Yellow perch	14	4.0	6.1-10.2
Yellow bullhead	6	1.7	7.9-12.5
Spottail Shiner	1	.3	2.2-2.8
Brown Bullhead	1	.3	10.6
Redfin pickerel	1	.3	3.3
Total (9 species)	347		

Table 2 Fish Data from the 2007 IDNR Fish Survey for Brokesha Lake

4.0 Fisheries

Fishing is a popular activity at Stone and Brokesha Lakes. Indiana Department of Natural Resources fisheries biologists have performed general fish surveys on Stone and Brokesha in 1967, 1977, 1982 and again in 2007. Data from the 2007 survey is listed in table one and two above. In the 2007 survey a total of 842 fish representing 14 species were collected from Stone Lake and 347 fish were collected from Brokesha representing nine species. To collect fish for the survey the biologists used a combination of gill-netting, trap netting, and nighttime D.C. electrofishing. Analysis of the fish data from 2007 was still ongoing at the time of this report, but Stone and Brokesha appear to offer some good fishing opportunities. Stone Lake Conservation Club members have expressed the desire for more large bass in the Stone and Brokesha lake fishery. The idea of boosting bass growth rates by culling bass numbers through allowing smaller bass to be harvested has been discussed but has not been implemented. It is notable that an unspecified species of milfoil was growing in the lake per the 1982 IDNR Fish Report. Since no milfoil species other than Eurasian watermilfoil has been noted in the

LARE funded surveys, it is likely that the milfoil present in 1982 was Eurasian watermilfoil. With regard to Stone and Brokesha Lakes' fishery maintaining good habitat through a healthy growth of native aquatic plants will be beneficial. To help insure predatory success and normal growth rates for Largemouth bass it may be beneficial to prevent an excessive amount of exotic plant growth. Excessive plant growth can increase habitat complexity to the point of reducing the success of predatory fish in catching prey species.

5.0 Problem Statement

Exotic plants provide impairment to Stone and Brokesha Lakes indirectly by out-competing more beneficial native species and potentially contributing to a loss of plant diversity or an alteration of aquatic community functioning. Exotic vegetation has a direct affect by impairing the recreational use and aesthetic appeal of the lakes.

6.0 Vegetation Management Goals and Objectives

The IDNR Division of Fish and Wildlife and LARE program staff have formulated three aquatic vegetation management goals that apply to Stone and Brokesha Lakes and other Indiana Lakes. The goals are as follows:

1. Maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality.

2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.

3. Provide reasonable public recreational access while minimizing the negative impacts on plant, fish, and wildlife resources.

Recommended management activities at Stone and Brokesha Lakes will be geared toward attainment of these goals and the following measurable benchmarks for success in that regard should be applied to Stone and Brokesha Lakes:

1. Elimination of all significant Curlyleaf stands within two weeks of treatment on both lakes.

2. A late-season Tier II occurrence of Eurasian watermilfoil of 10% or less on Stone and 5% or less on Brokesha.

7.0 Plant Management History

Treatments for Eurasian watermilfoil have been ongoing at Stone and Brokesha Lakes since 2005. Prior to 2005 no active plant management was performed. Management activities since 2005 are summarized in table 3 below. In the 2007 season a total of 10 acres of Eurasian watermilfoil were mapped and treated. The vast majority was in Stone Lake. The initial treatment was performed June 13 when 6.3 acres of milfoil in Stone Lake was treated with 2,4-D granular herbicide (figure 7 below). On August 9, 2007 a 3.5 acre follow up treatment was performed in Stone Lake to retreat milfoil that had regrown or new seasonal growth that was spotted (figure 8 below). A .2 acre treatment was performed the same day on Brokesha where a small number of milfoil plants were noted growing near the dock and beach areas on the lake's west side (figure 8 below). The 2,4-D granular herbicide (trade name Navigate) was applied at the rate of 100 pounds per surface acre for both the early and late-season treatments. Areas of regrowth where the early and late season treatments overlapped included the channel between the lakes and the drop-off area along the Stone Lake's south side. Other management activities at Stone and Brokesha include the recent installation of two lakeside wells to supply groundwater flow to the lakes and stabilize lake levels during dry periods. Prior to this the lake levels would drop significantly during droughty conditions. During some seasons watercraft passage through the channel between the lakes was impaired by lagging water levels. Since most submersed non-native plants in the lake grow in relatively deep water the effects of lake-level stabilization on exotic plant growth will likely be minimal, but sediment disturbance by watercraft, wakes, and wind-driven waves may have been lessened by the lake level stabilization. Other activities to limit nutrient and sediment contributions include the addition of glacial stone to several hundred feet of shoreline to stabilize lakeside soils. No other known significant management activities to limit nutrient and sediment input to the lakes have taken place in the last ten years. Water quality and clarity at Stone and Brokesha has generally been good.

Year	Activity	Approx. Acreage mapped/treated	Treatment Result	Funding
2005	Whole Lake Fluridone Treatment For Eurasian watermilfoil (both lakes 6 bump 6ppb)	26 (ac. Milfoil)	Good overall results by season's end, but healthy milfoil remained in deeper water in Stone. Results were excellent in Brokesha	SLCC/LARE
2006	Seek and Destroy Treatment of all significant noted Eurasian watermilfoil with granular 2.4-D	4 (Stone Lake only)	Good overall results in treated area.	SLCC/LARE
2007	Seek and Destroy Treatment of all significant noted Eurasian watermilfoil with granular 2.4-D	10 acres Stone Lake. Less than .5 acre on Brokesha	Good results in treated areas. Some regrowth noted in treatment areas after the first treatment. Early and late season treatment areas partially overlap.	SLCC/LARE

Table 3 Summary of Plant Control History on Stone and Brokesha Lakes

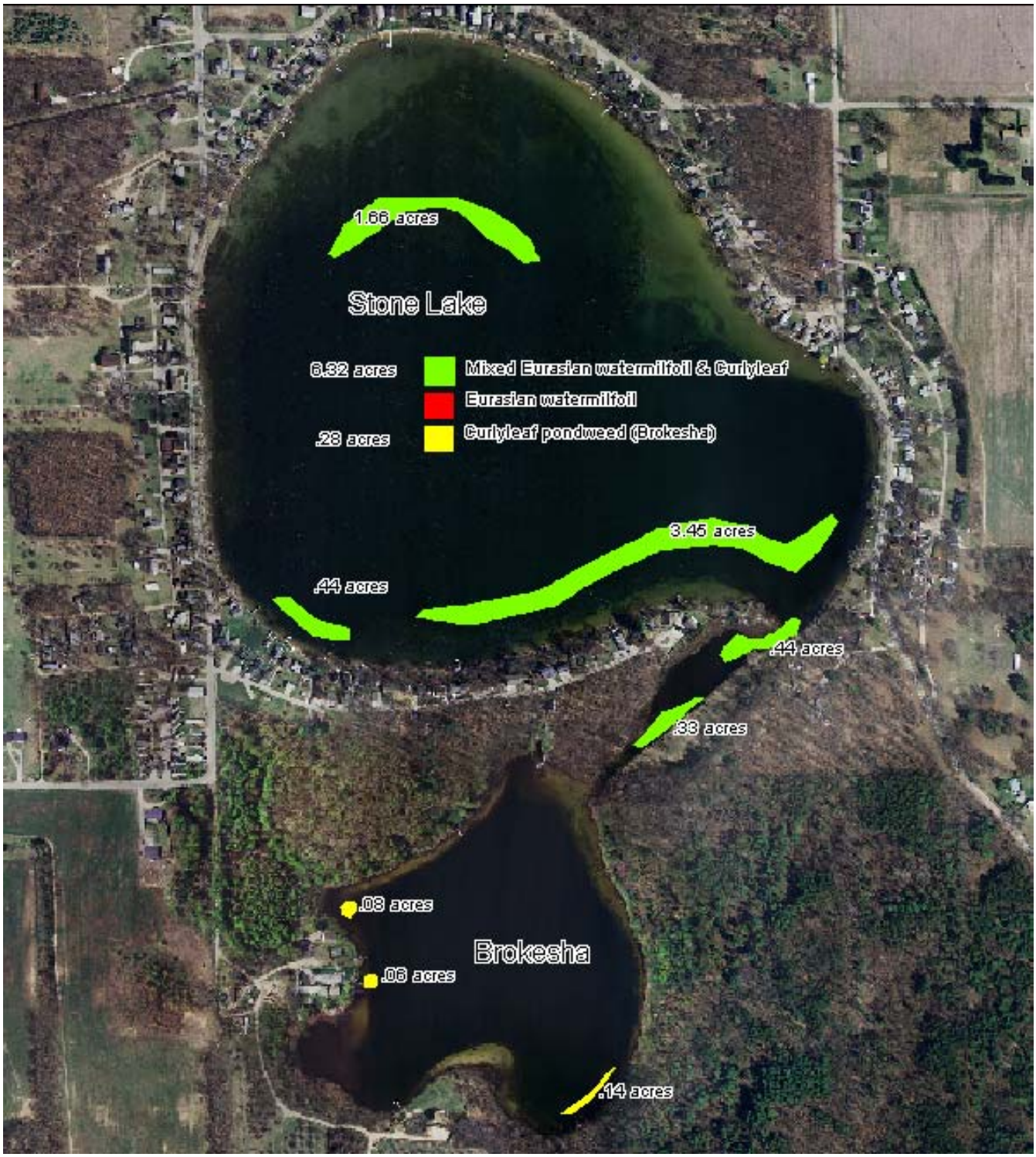


Figure 6 Pre-treatment Exotic Plant Distribution Map for Stone and Brokesha 5/15/07

Figure 7 June 13, 2007 Eurasian Watermilfoil Treatment Areas for Stone Lake

Figure 8 August 9, 2007 Eurasian Watermilfoil Treatment Areas for Stone and Brokesha Lakes

8.0 Aquatic Plant Community Characterization

8.1 Methods

Two primary methods of observation were used to characterize the lakes' plant communities during the 2007 season. Exotic plant beds were mapped mainly by visual observation. Extensive time was spent running a zigzag pattern over the lake's littoral zone to establish the boundaries for dense exotic plant growth. This was complimented by Tier II quantitative survey plant collection data, prior knowledge of the lake's typical plant growth pattern, and a contour map. A handheld WAAS Enabled GPS unit was also helpful in marking the general boundaries of exotic plantbeds for mapping. To characterize the lake's plant community quantitatively and produce objective data for analysis and tracking of overall plant community composition, Tier II Plant surveys were utilized as described in the next section.

8.1.1 Tier II

Tier II stratified random sampling was utilized on May 15, 16 and July 25 of 2007 to establish random plant sampling points and quantify approximate species biomass at each respective point. The Tier II aquatic plant sampling protocol used was established by INDR and is available in full in *Tier II Aquatic Vegetation Survey Protocol, May 2007* (IDNR 2007). In Tier two sampling, data collection points are established within given depth strata of the lake according to lake size and trophic status listing. The "oligotrophic" status was used to determine sampling points for both lakes and sampling was performed to a depth of 25 feet. A toss and retrieval of a specially fabricated two sided rake (figure 9) on a rope is used to sample vegetation from the lake bottom at each point. After retrieval of the rake a score is assigned to each recovered plant species by separating the species and placing them back on the rake. Thickness of the plants when placed back on the rake is recorded as measured by equally spaced marks on the rake tines. This measurement assigns a rake score of one, three, or five to each species as a basic measure of biomass. Plants seen but not recovered on the rake are marked as "observed only". Filamentous algae is recorded only as "present" if recovered on the rake. Location data for sampling points was collected using a WAAS enabled GPS unit. Data points were then downloaded to geographic information system (GIS) software for placement on a map. Because aquatic plant species vary in their prominence during various part of the growing season sampling is performed in both the late and early season during plant plan development. In treatment seasons the two survey regime can also allow for a pre-treatment and post-treatment comparison of the lake's plant community. Data collected during the Tier II survey is then used to calculate a set of statistical descriptors developed by IDNR to help characterize plant communities in Indiana waters (Pearson 2004). The Tier II sampling points (30 in Brokesha and 50 in Stone) for the early and late season surveys in 2007 are displayed in figures 10 and 11 below.

Figure 9 Tier II Plant Sampling Rake

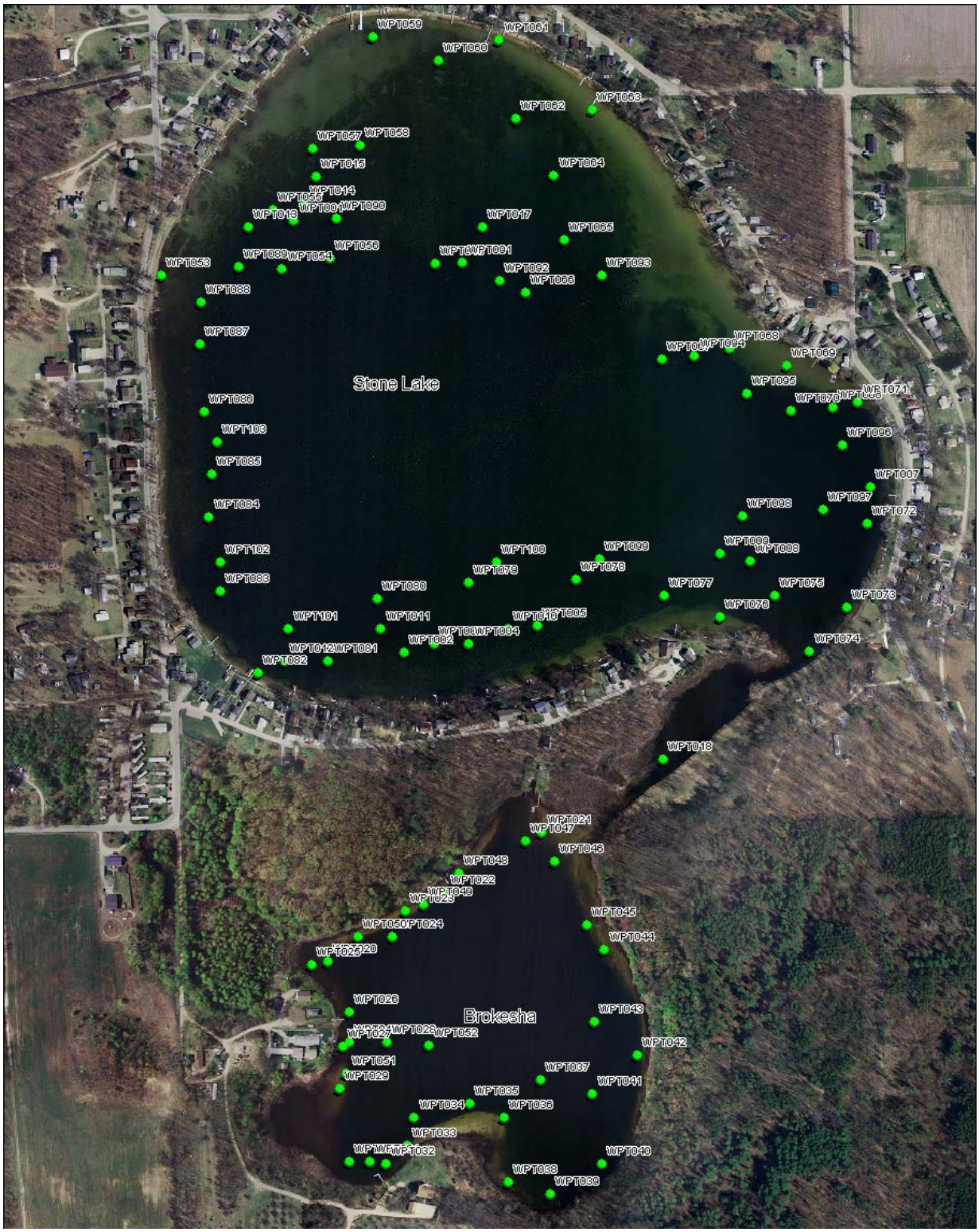


Figure 10 Early Season (5-15,16-07) Tier II Sampling Points for Stone and Brokesha

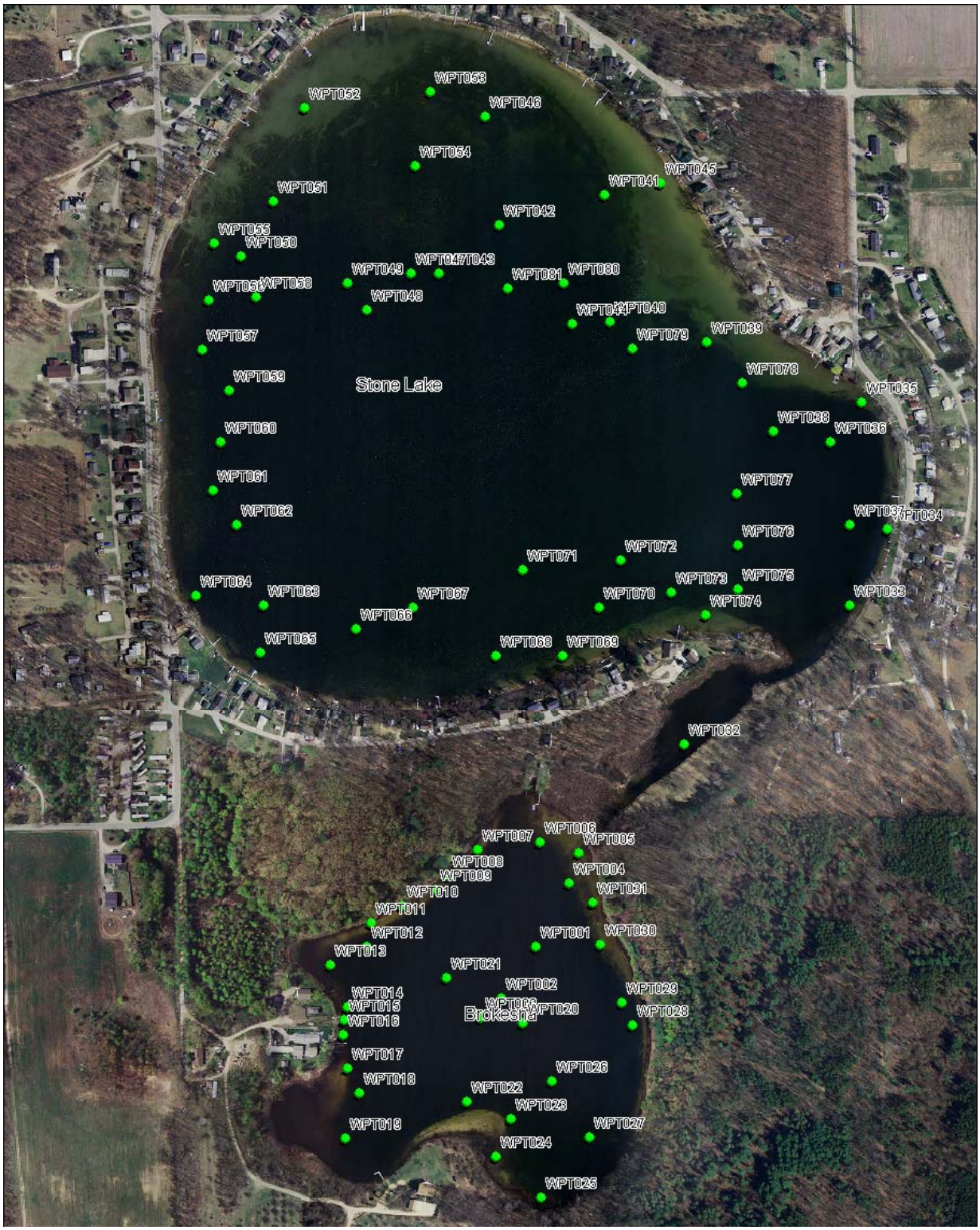


Figure 11 Late Season (7-25-07) Tier II Sampling Points for Stone and Brokesha

8.2 Results

8.2.1 Tier II
Macrophyte Inventory Discussion

During the 2007 surveys Chara *Chara sp.* was noted growing to a depth of 23 feet in Stone Lake and 11.5 feet in Brokesha. Filamentous algae was noted growing to a depth of 14 feet in Brokesha. This suggests that in future sampling it may be appropriate to maintain a depth limit for sampling of 25 feet in Stone and 15 feet in Brokesha. The tables below contain plant community descriptors for the early and late season Tier II surveys. Descriptors from a set of 21 other Indiana Lakes (Pearson 2004) are provided to provide insights into how Stone and Brokesha compare. Tables 4-11 below show the overall tier II data including species specific data. With nine species noted in the early survey Stone Lake was just above the 21 lake average of 8 species. In the July survey eight species were collected. The number of native species was equal to the 21 lake average of seven. The number of species per site was below the 21 lake average on both surveys, but the species diversity index was slightly above average. The Eurasian watermilfoil occurrence was 11.8 percent in the May Survey and had climbed to 14 percent in the July survey despite treatment. Curlyleaf pondweed occurred at 3.9 percent of sampling sites in the May survey and had all completed its typical early-seasonal life cycle and dropped out by the time the July survey was performed. From the Tier II data it appears that if the program of control for exotic plants is continued on Stone Lake it would be reasonable to establish a goal of holding Eurasian watermilfoil at an occurrence of ten percent or less in the sampling. It does not appear likely that Curlyleaf pondweed will show up the single late-season Tier II that will be performed in 2008, so a reasonable benchmark for Curlyleaf control would be to have no significant plants noted in the designated Curlyleaf treatment area within two weeks after treatment. Stone Lake's plant community in the May survey in 2008 was solidly dominated by native species with Chara occurring at 60.8 percent of sampling sites, Variable pondweed *Potamogeton gramineus* occurring at 21.6 percent, and Largeleaf pondweed *Potamogeton amplifolius* occurring at 13.7 percent of sites. In the late season results Chara again was most common at 68 percent of sites, with both Largeleaf pondweed and Variable pondweed second at 20 percent. Slender naiad *Najas flexilis* was the third most common at 16 percent of sites. Most of Stone Lake's 90 acre littoral area contains some amount of beneficial native plant growth and should be considered a beneficial area. The channel between the lakes and deeper areas that have been heavily colonized by Eurasian watermilfoil should be considered problem areas.

Brokesha Lake had only four species in the May survey compared to the 21 lake average of 8 species. The total number of native species was three compared to seven for the 21 lake average. The mean species per site was two, slightly above the 21 lake average of 1.61. The species diversity index for Brokesha was only .28, well below the 21 lake average of .66. In the July survey the number of species had risen to 8 and the number of native species was 7, identical to the 21 lake average. The mean number of species per site was 1.37, slightly below the 21 lake average of 1.61, but the diversity index score was .71, higher than the .66 score of the 21 lake average. The Curlyleaf pondweed occurrence was 3.2 percent in the May survey and 3.3 percent in July. It would also be reasonable to maintain a 2008 season treatment-response benchmark of finding no significant stands of Curlyleaf pondweed standing within two weeks after treatment on Brokesha. Since no Eurasian watermilfoil was recovered in either Tier II survey a frequency of occurrence of five percent or less should be very attainable if chemical control is initiated in 2008. Chara was most common in the early season Brokesha survey occurring at 51.6 percent of sampling sites. Curlyleaf pondweed was second highest in occurrence at 3.2 percent of sites and Variable pondweed and Sago pondweed *Stuckenia pectinata* both occurred at 3.2 percent (a single site each). During the late season Spiny naiad *Najas marina* had become most common on Brokesha with an occurrence of 53.3 percent. Chara was second highest occurring at 46.7 percent of sites and Sago pondweed was third at 16.7 percent of sampling sites. Because Brokesha supported relatively little aquatic vegetation all areas of its 15 acre littoral zone that contain native

plants should be considered beneficial areas. The small amount of exotic plant growth present should be considered problem areas, especially near the docking areas on the lakes West side where watercraft may hasten their spread. No areas of plant growth were noted where protection from watercraft disturbance is warranted. Disturbances by watercraft are limited by the no-wake/10 mph speed limit in effect. No rare, threatened, or endangered species were noted in the 2007 surveys and no voucher specimens were collected during sampling. A check of the National Heritage database also did not indicate any known RTE species at Stone and Brokesha.

Descriptor	Stone Lake 5/16/07	range for 21 other Indiana lakes	mean for 21 other Indiana lakes
# Sampling sites	51		
Total number of species	9	1 to 17	8
Total number of native species	7	1 to 16	7
Mean number of species per site	1.29	.38 to 2.66	1.61
Species diversity index (SDI), 0-1 scale	.72	0.0 to .91	0.66
Aquatic Vegetation % frequency of Occurrence	80		
Secchi Depth	22.3		
Eurasian watermilfoil % Frequency of Occurrence	11.8		
Curlyleaf pondweed % Frequency of Occurrence	3.9		

Table 4 Plant Community Descriptors for the 5/16/07 Stone Lake Tier II

Descriptor	Stone Lake 7/25/07	range for 21 other Indiana lakes	mean for 21 other Indiana lakes
# Sampling sites	50		
Total number of species	8	1 to 17	8
Total number of native species	7	1 to 16	7
Mean number of species per site	1.58	.38 to 2.66	1.61
Species diversity index (SDI), 0-1 scale	.76	0.0 to .91	0.66
Aquatic Vegetation % frequency of Occurrence	80		
Secchi Depth	17		
Eurasian watermilfoil % Frequency of Occurrence	14		
Curlyleaf pondweed % Frequency of Occurrence	0		

Table 5 Plant Community Descriptor for the 7/25/07 Stone Lake Tier II

Descriptor	Brokesha Lake 5/15/07	range for 21 other Indiana lakes	mean for 21 other Indiana lakes
# Sampling sites	31		
Total number of species	4	1 to 17	8
Total number of native species	3	1 to 16	7
Mean number of species per site	2	.38 to 2.66	1.61
Species diversity index (SDI), 0-1 scale	.28	0.0 to .91	0.66
Aquatic Vegetation % frequency of Occurrence	55		
Secchi Depth	11.5		
Eurasian watermilfoil % Frequency of Occurrence	0		
Curlyleaf pondweed % Frequency of Occurrence	3.2		

Table 6 Plant Community Descriptors from the 5/15/07 Brokesha Lake Tier II

Descriptor	Brokesha Lake 7/25/07	range for 21 other Indiana lakes	mean for 21 other Indiana lakes
# Sampling sites	30		
Total number of species	8	1 to 17	8
Total number of native species	7	1 to 16	7
Mean number of species per site	1.37	.38 to 2.66	1.61
Species diversity index (SDI), 0-1 scale	.71	0.0 to .91	0.66
Aquatic Vegetation % frequency of Occurrence	83		
Secchi Depth	11.6		
Eurasian watermilfoil % Frequency of Occurrence	0		
Curlyleaf pondweed % Frequency of Occurrence	3.3		

Table 7 Plant Community Descriptors from the 7/25/07 Brokesha Lake Tier II

Occurrence and Abundance of Submersed Aquatic Plants - Overall

Lake:	Stone	Secchi(ft):	22.3	SE Mean species / site:	0.14
Date:	5/16/2007	Littoral sites with plants:	41	Mean natives / site:	1.14
Littoral Depth (ft):	22.0	Number of species:	9	SE Mean natives / site:	0.13
Littoral Sites:	48	Maximum species / site:	3	Species diversity:	0.72
Total Sites:	51	Mean species / site:	1.29	Native diversity:	0.65

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	60.8	39.2	19.6	7.8	33.3	42.0
POTGRA Variable pondweed	21.6	78.4	21.6	0.0	0.0	4.3
POTAMP Largeleaf pondwe	13.7	86.3	11.8	2.0	0.0	3.5
MYRSPI Eurasian milfoil	11.8	88.2	5.9	2.0	3.9	6.3
ZOSDUB Water stargrass	9.8	90.2	0.0	0.0	9.8	9.8
NAJFLE Slender naiad	3.9	96.1	3.9	0.0	0.0	0.8
POCRI Curlyleaf	3.9	96.1	3.9	0.0	0.0	0.8
NAJGUA Southern naiad	2.0	98.0	2.0	0.0	0.0	0.4
ZANPAL Horned pondweed	2.0	98.0	2.0	0.0	0.0	0.4

Table 8 Overall Stone Lake Tier II Plant Data for the May Survey

Occurrence and Abundance of Submersed Aquatic Plants - Overall

Lake:	Stone	Secchi(ft):	17.0	SE Mean species / site:	0.17
Date:	7/25/2007	Littoral sites with plants:	40	Mean natives / site:	1.44
Littoral Depth (ft):	23.0	Number of species:	8	SE Mean natives / site:	0.17
Littoral Sites:	49	Maximum species / site:	5	Species diversity:	0.76
Total Sites:	50	Mean species / site:	1.58	Native diversity:	0.72

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	68.0	32.0	22.0	8.0	38.0	47.2
POTAMP Largeleaf pondwe	20.0	80.0	12.0	4.0	4.0	8.8
POTGRA Variable pondweed	20.0	80.0	20.0	0.0	0.0	4.0
NAJFLE Slender naiad	16.0	84.0	10.0	4.0	2.0	6.4
MYRSPI Eurasian milfoil	14.0	86.0	10.0	0.0	4.0	6.0
ZOSDUB Water stargrass	12.0	88.0	6.0	0.0	6.0	7.2
NAJMAR Spiny naiad	4.0	96.0	4.0	0.0	0.0	0.8
STUPEC Sago pondweed	4.0	96.0	4.0	0.0	0.0	0.8

Table 9 Overall Stone Lake Tier II Plant Data for the July Survey

Occurrence and Abundance of Submersed Aquatic Plants - 0 to 5 ft.

Lake: Stone	Secchi(ft): 22.3	SE Mean species / site: 0.18	
Date: 5/16/2007	Littoral sites with plants: 9	Mean natives / site: 1.00	
Littoral Depth (ft): 22.0	Number of species: 6	SE Mean natives / site: 0.15	
Littoral Sites: 10	Maximum species / site: 2	Species diversity: 0.66	
Total Sites: 10	Mean species / site: 1.10	Native diversity: 0.60	

Species	Frequency of Occurrence	Score Frequency 0	1	3	5	Dominance
CHAR Chara	60.0	40.0	60.0	0.0	0.0	12.0
POTAMP Largeleaf pondwe	10.0	90.0	0.0	10.0	0.0	6.0
MYRSPI Eurasian milfoil	10.0	90.0	10.0	0.0	0.0	2.0
NAJGUA Southern naiad	10.0	90.0	10.0	0.0	0.0	2.0
POTGRA Variable pondwee	10.0	90.0	10.0	0.0	0.0	2.0
ZANPAL Horned pondweed	10.0	90.0	10.0	0.0	0.0	2.0
NAJFLE Slender naiad	0.0	100.0	0.0	0.0	0.0	0.0
					0.0	0.0
					0.0	0.0

Table 10 0-5 foot Stone Lk Tier II Data 5/16/07

Occurrence and Abundance of Submersed Aquatic Plants - 0 to 5 ft.

Lake: Stone	Secchi(ft): 17.0	SE Mean species / site: 0.42	
Date: 7/25/2007	Littoral sites with plants: 9	Mean natives / site: 2.10	
Littoral Depth (ft): 23.0	Number of species: 6	SE Mean natives / site: 0.38	
Littoral Sites: 10	Maximum species / site: 4	Species diversity: 0.75	
Total Sites: 10	Mean species / site: 2.20	Native diversity: 0.73	

Species	Frequency of Occurrence	Score Frequency 0	1	3	5	Dominance
CHAR Chara	80.0	20.0	50.0	10.0	20.0	36.0
NAJFLE Slender naiad	60.0	40.0	40.0	20.0	0.0	20.0
POTAMP Largeleaf pondwe	30.0	70.0	20.0	10.0	0.0	10.0
POTGRA Variable pondwee	30.0	70.0	30.0	0.0	0.0	6.0
MYRSPI Eurasian milfoil	10.0	90.0	10.0	0.0	0.0	2.0
ZOSDUB Water stargrass	10.0	90.0	10.0	0.0	0.0	2.0
NAJMAR Spiny naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 11 0-5 foot Stone Lk Tier II Data 7/25/07

Occurrence and Abundance of Submersed Aquatic Plants - 5 to 10 ft.

Lake:	Stone	Secchi(ft):	22.3	SE Mean species / site:	0.26
Date:	5/16/2007	Littoral sites with plants:	10	Mean natives / site:	2.30
Littoral Depth (ft):	22.0	Number of species:	5	SE Mean natives / site:	0.26
Littoral Sites:	10	Maximum species / site:	3	Species diversity:	0.76
Total Sites:	10	Mean species / site:	2.30	Native diversity:	0.76

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	80.0	20.0	0.0	30.0	50.0	68.0
POTGRA Variable pondwee	60.0	40.0	60.0	0.0	0.0	12.0
POTAMP Largeleaf pondwe	40.0	60.0	40.0	0.0	0.0	8.0
ZOSDUB Water stargrass	30.0	70.0	0.0	0.0	30.0	30.0
NAJFLE Slender naiad	20.0	80.0	20.0	0.0	0.0	4.0
MYRSPI Eurasian milfoil	0.0	100.0	0.0	0.0	0.0	0.0
NAJGUA Southern naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 12 5-10 feet Stone Lk Tier II Data 5/16/07

Occurrence and Abundance of Submersed Aquatic Plants - 5 to 10 ft.

Lake:	Stone	Secchi(ft):	17.0	SE Mean species / site:	0.43
Date:	7/25/2007	Littoral sites with plants:	9	Mean natives / site:	2.60
Littoral Depth (ft):	23.0	Number of species:	6	SE Mean natives / site:	0.43
Littoral Sites:	10	Maximum species / site:	5	Species diversity:	0.79
Total Sites:	10	Mean species / site:	2.60	Native diversity:	0.79

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	70.0	30.0	20.0	10.0	40.0	50.0
POTAMP Largeleaf pondwe	60.0	40.0	30.0	10.0	20.0	32.0
POTGRA Variable pondwee	60.0	40.0	60.0	0.0	0.0	12.0
ZOSDUB Water stargrass	40.0	60.0	20.0	0.0	20.0	24.0
STUPEC Sago pondweed	20.0	80.0	20.0	0.0	0.0	4.0
NAJFLE Slender naiad	10.0	90.0	0.0	0.0	10.0	10.0
MYRSPI Eurasian milfoil	0.0	100.0	0.0	0.0	0.0	0.0
NAJMAR Spiny naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 13 5-10 feet Tier II Stone Lake Data 7/25/07

Occurrence and Abundance of Submersed Aquatic Plants - 10 to 15 ft.

Lake:	Stone	Secchi(ft):	22.3	SE Mean species / site:	0.33
Date:	5/16/2007	Littoral sites with plants:	9	Mean natives / site:	1.18
Littoral Depth (ft):	22.0	Number of species:	6	SE Mean natives / site:	0.30
Littoral Sites:	11	Maximum species / site:	3	Species diversity:	0.80
Total Sites:	11	Mean species / site:	1.73	Native diversity:	0.69

Species	Frequency of Occurrence	Score Frequency 0	1	3	5	Dominance
CHAR Chara	54.5	45.5	18.2	0.0	36.4	40.0
MYRSPI Eurasian milfoil	36.4	63.6	18.2	9.1	9.1	18.2
POTGRA Variable pondweed	27.3	72.7	27.3	0.0	0.0	5.5
ZOSDUB Water stargrass	18.2	81.8	0.0	0.0	18.2	18.2
POCRI Curlyleaf	18.2	81.8	18.2	0.0	0.0	3.6
POTAMP Largeleaf pondwee	18.2	81.8	18.2	0.0	0.0	3.6
NAJFLE Slender naiad	0.0	100.0	0.0	0.0	0.0	0.0
NAJGUA Southern naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 14 10-15 foot Stone Lake Tier II Data 5/16/07

Occurrence and Abundance of Submersed Aquatic Plants - 10 to 15 ft.

Lake:	Stone	Secchi(ft):	17.0	SE Mean species / site:	0.27
Date:	7/25/2007	Littoral sites with plants:	9	Mean natives / site:	1.20
Littoral Depth (ft):	23.0	Number of species:	6	SE Mean natives / site:	0.20
Littoral Sites:	10	Maximum species / site:	3	Species diversity:	0.71
Total Sites:	10	Mean species / site:	1.50	Native diversity:	0.61

Species	Frequency of Occurrence	Score Frequency 0	1	3	5	Dominance
CHAR Chara	70.0	30.0	0.0	20.0	50.0	62.0
MYRSPI Eurasian milfoil	30.0	70.0	20.0	0.0	10.0	14.0
NAJMAR Spiny naiad	20.0	80.0	20.0	0.0	0.0	4.0
NAJFLE Slender naiad	10.0	90.0	10.0	0.0	0.0	2.0
POTAMP Largeleaf pondwee	10.0	90.0	10.0	0.0	0.0	2.0
POTGRA Variable pondweed	10.0	90.0	10.0	0.0	0.0	2.0

Table 15 10-15 foot Tier II Stone Lake Data 7/25/07

Occurrence and Abundance of Submersed Aquatic Plants - 15 to 20 ft.

Lake: Stone	Secchi(ft): 22.3	SE Mean species / site: 0.13		
Date: 5/16/2007	Littoral sites with plants: 8	Mean natives / site: 0.70		
Littoral Depth (ft): 22.0	Number of species: 3	SE Mean natives / site: 0.15		
Littoral Sites: 10	Maximum species / site: 1	Species diversity: 0.41		
Total Sites: 10	Mean species / site: 0.80	Native diversity: 0.24		

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	60.0	40.0	10.0	0.0	50.0	52.0
MYRSPI Eurasian milfoil	10.0	90.0	0.0	0.0	10.0	10.0
POTGRA Variable pondweed	10.0	90.0	10.0	0.0	0.0	2.0
NAJFLE Slender naiad	0.0	100.0	0.0	0.0	0.0	0.0
NAJGUA Southern naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 16 15-20 foot Stone Lake Tier II Data 5/16/07

Occurrence and Abundance of Submersed Aquatic Plants - 15 to 20 ft.

Lake: Stone	Secchi(ft): 17.0	SE Mean species / site: 0.20		
Date: 7/25/2007	Littoral sites with plants: 9	Mean natives / site: 1.00		
Littoral Depth (ft): 23.0	Number of species: 3	SE Mean natives / site: 0.15		
Littoral Sites: 10	Maximum species / site: 2	Species diversity: 0.40		
Total Sites: 10	Mean species / site: 1.20	Native diversity: 0.18		

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	90.0	10.0	10.0	0.0	80.0	82.0
MYRSPI Eurasian milfoil	20.0	80.0	10.0	0.0	10.0	12.0
ZOSDUB Water stargrass	10.0	90.0	0.0	0.0	10.0	10.0
NAJFLE Slender naiad	0.0	100.0	0.0	0.0	0.0	0.0
NAJMAR Spiny naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 17 15-20 foot Stone Lake Tier II Data 7/25/07

Occurrence and Abundance of Submersed Aquatic Plants - 20 to 25 ft.

Lake:	Stone	Secchi(ft):	22.3	SE Mean species / site:	0.17
Date:	5/16/2007	Littoral sites with plants:	5	Mean natives / site:	0.50
Littoral Depth (ft):	22.0	Number of species:	1	SE Mean natives / site:	0.17
Littoral Sites:	6	Maximum species / site:	1	Species diversity:	0.00
Total Sites:	10	Mean species / site:	0.50	Native diversity:	0.00

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	50.0	50.0	10.0	10.0	30.0	38.0
MYRSPI Eurasian milfoil	0.0	100.0	0.0	0.0	0.0	0.0
NAJFLE Slender naiad	0.0	100.0	0.0	0.0	0.0	0.0
NAJGUA Southern naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 18 20-25 foot Tier II Stone Lake Data 5/16/07

Occurrence and Abundance of Submersed Aquatic Plants - 20 to 25 ft.

Lake:	Stone	Secchi(ft):	17.0	SE Mean species / site:	0.16
Date:	7/25/2007	Littoral sites with plants:	4	Mean natives / site:	0.30
Littoral Depth (ft):	23.0	Number of species:	2	SE Mean natives / site:	0.15
Littoral Sites:	9	Maximum species / site:	1	Species diversity:	0.38
Total Sites:	10	Mean species / site:	0.40	Native diversity:	0.00

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	30.0	70.0	30.0	0.0	0.0	6.0
MYRSPI Eurasian milfoil	10.0	90.0	10.0	0.0	0.0	2.0
NAJFLE Slender naiad	0.0	100.0	0.0	0.0	0.0	0.0
NAJMAR Spiny naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 19 20-25 foot Tier II Stone Lake Data 7/25/07

Occurrence and Abundance of Submersed Aquatic Plants - Overall									
Lake:	Brokesha	Secchi(ft):	11.5	SE Mean species / site:	0.11				
Date:	5/15/2007	Littoral sites with plants:	17	Mean natives / site:	0.58				
Littoral Depth (ft):	11.0	Number of species:	4	SE Mean natives / site:	0.10				
Littoral Sites:	24	Maximum species / site:	2	Species diversity:	0.28				
Total Sites:	31	Mean species / site:	0.61	Native diversity:	0.20				
		Frequency of		Score Frequency					
Species		**Occurrence**		**0**	**1**	**3**	**5**	**Dominance**	
CHAR Chara		51.6		48.4	19.4	16.1	16.1	29.7	
POTCRI Curlyleaf		3.2		96.8	3.2	0.0	0.0	0.6	
POTGRA Variable pondwee		3.2		96.8	3.2	0.0	0.0	0.6	
STUPEC Sago pondweed		3.2		96.8	3.2	0.0	0.0	0.6	

Table 20 Overall Tier II Plant Data for the Brokesha Lake May Survey

Occurrence and Abundance of Submersed Aquatic Plants - Overall									
Lake:	Brokesha	Secchi(ft):	11.6	SE Mean species / site:	0.17				
Date:	7/25/2007	Littoral sites with plants:	25	Mean natives / site:	1.33				
Littoral Depth (ft):	14.0	Number of species:	8	SE Mean natives / site:	0.17				
Littoral Sites:	25	Maximum species / site:	4	Species diversity:	0.71				
Total Sites:	30	Mean species / site:	1.37	Native diversity:	0.70				
		Frequency of		Score Frequency					
Species		**Occurrence**		**0**	**1**	**3**	**5**	**Dominance**	
NAJMAR Spiny naiad		53.3		46.7	46.7	3.3	3.3	14.7	
CHAR Chara		46.7		53.3	6.7	0.0	40.0	41.3	
STUPEC Sago pondweed		16.7		83.3	16.7	0.0	0.0	3.3	
POTGRA Variable pondwee		6.7		93.3	3.3	3.3	0.0	2.7	
POTNAT Floatingleaf pondw		3.3		96.7	0.0	3.3	0.0	2.0	
NAJFLE Slender naiad		3.3		96.7	3.3	0.0	0.0	0.7	
POTCRI Curlyleaf		3.3		96.7	3.3	0.0	0.0	0.7	
SAG sp Saggitaria sp. (subr		3.3		96.7	3.3	0.0	0.0	0.7	

Table 21 Overall Tier II Plant Data for the Brokesha Lake July Survey

Occurrence and Abundance of Submersed Aquatic Plants - 0 to 5 ft.

Lake:	Brokesha	Secchi(ft):	11.5	SE Mean species / site:	0.10
Date:	5/15/2007	Littoral sites with plants:	9	Mean natives / site:	0.90
Littoral Depth (ft):	11.0	Number of species:	1	SE Mean natives / site:	0.10
Littoral Sites:	10	Maximum species / site:	1	Species diversity:	0.00
Total Sites:	10	Mean species / site:	0.90	Native diversity:	0.00

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	90.0	10.0	30.0	30.0	30.0	54.0

Table 22 0-5 Foot Brokesha Lake Tier II Data 5/15/07

Occurrence and Abundance of Submersed Aquatic Plants - 0 to 5 ft.

Lake:	Brokesha	Secchi(ft):	11.6	SE Mean species / site:	0.21
Date:	7/25/2007	Littoral sites with plants:	10	Mean natives / site:	1.70
Littoral Depth (ft):	14.0	Number of species:	5	SE Mean natives / site:	0.21
Littoral Sites:	10	Maximum species / site:	3	Species diversity:	0.62
Total Sites:	10	Mean species / site:	1.70	Native diversity:	0.62

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	90.0	10.0	0.0	0.0	90.0	90.0
NAJMAR Spiny naiad	50.0	50.0	50.0	0.0	0.0	10.0
POTNAT Floatingleaf pondw	10.0	90.0	0.0	10.0	0.0	6.0
NAJFLE Slender naiad	10.0	90.0	10.0	0.0	0.0	2.0
POTGRA Variable pondwee	10.0	90.0	10.0	0.0	0.0	2.0

Table 23 0-5 foot Brokesha Tier II Data 7/25/07

Occurrence and Abundance of Submersed Aquatic Plants - 5 to 10 ft.

Lake:	Brokesha	Secchi(ft):	11.5	SE Mean species / site:	0.26
Date:	5/15/2007	Littoral sites with plants:	5	Mean natives / site:	0.60
Littoral Depth (ft):	11.0	Number of species:	4	SE Mean natives / site:	0.22
Littoral Sites:	10	Maximum species / site:	2	Species diversity:	0.61
Total Sites:	10	Mean species / site:	0.70	Native diversity:	0.50

Species	Frequency of Occurrence	Score Frequency 0	1	3	5	Dominance
CHAR Chara	40.0	60.0	10.0	20.0	10.0	24.0
POTCRI Curlyleaf	10.0	90.0	10.0	0.0	0.0	2.0
POTGRA Variable pondweed	10.0	90.0	10.0	0.0	0.0	2.0
STUPEC Sago pondweed	10.0	90.0	10.0	0.0	0.0	2.0

Table 24 5-10 foot Brokesha Tier II Data 5/15/07

Occurrence and Abundance of Submersed Aquatic Plants - 5 to 10 ft.

Lake:	Brokesha	Secchi(ft):	11.6	SE Mean species / site:	0.28
Date:	7/25/2007	Littoral sites with plants:	10	Mean natives / site:	1.80
Littoral Depth (ft):	14.0	Number of species:	6	SE Mean natives / site:	0.29
Littoral Sites:	10	Maximum species / site:	4	Species diversity:	0.73
Total Sites:	10	Mean species / site:	1.90	Native diversity:	0.70

Species	Frequency of Occurrence	Score Frequency 0	1	3	5	Dominance
NAJMAR Spiny naiad	80.0	20.0	60.0	10.0	10.0	28.0
CHAR Chara	40.0	60.0	20.0	0.0	20.0	24.0
STUPEC Sago pondweed	40.0	60.0	40.0	0.0	0.0	8.0
POTGRA Variable pondweed	10.0	90.0	0.0	10.0	0.0	6.0
POTCRI Curlyleaf	10.0	90.0	10.0	0.0	0.0	2.0
SAG sp Saggitaria sp. (subr	10.0	90.0	10.0	0.0	0.0	2.0
NAJFLE Slender naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 25 5-10 foot Brokesha Tier II Data 7/25/07

Occurrence and Abundance of Submersed Aquatic Plants - 10 to 15 ft.

Lake:	Brokesha	Secchi(ft):	11.5	SE Mean species / site:	0.24
Date:	5/15/2007	Littoral sites with plants:	3	Mean natives / site:	0.60
Littoral Depth (ft):	11.0	Number of species:	1	SE Mean natives / site:	0.24
Littoral Sites:	4	Maximum species / site:	1	Species diversity:	0.00
Total Sites:	5	Mean species / site:	0.60	Native diversity:	0.00

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
CHAR Chara	60.0	40.0	40.0	0.0	20.0	28.0

Table 26 10-15 foot Brokesha Tier II Data 5/15/07

Occurrence and Abundance of Submersed Aquatic Plants - 10 to 15 ft.

Lake:	Brokesha	Secchi(ft):	11.6	SE Mean species / site:	0.00
Date:	7/25/2007	Littoral sites with plants:	5	Mean natives / site:	1.00
Littoral Depth (ft):	14.0	Number of species:	3	SE Mean natives / site:	0.00
Littoral Sites:	5	Maximum species / site:	1	Species diversity:	0.56
Total Sites:	5	Mean species / site:	1.00	Native diversity:	0.56

	Frequency of	Score Frequency				
Species	**Occurrence**	**0**	**1**	**3**	**5**	**Dominance**
NAJMAR Spiny naiad	60.0	40.0	60.0	0.0	0.0	12.0
CHAR Chara	20.0	80.0	0.0	0.0	20.0	20.0
STUPEC Sago pondweed	20.0	80.0	20.0	0.0	0.0	4.0
NAJFLE Slender naiad	0.0	100.0	0.0	0.0	0.0	0.0

Table 27 10-15 Foot Brokesha Tier II Data 7/25/07

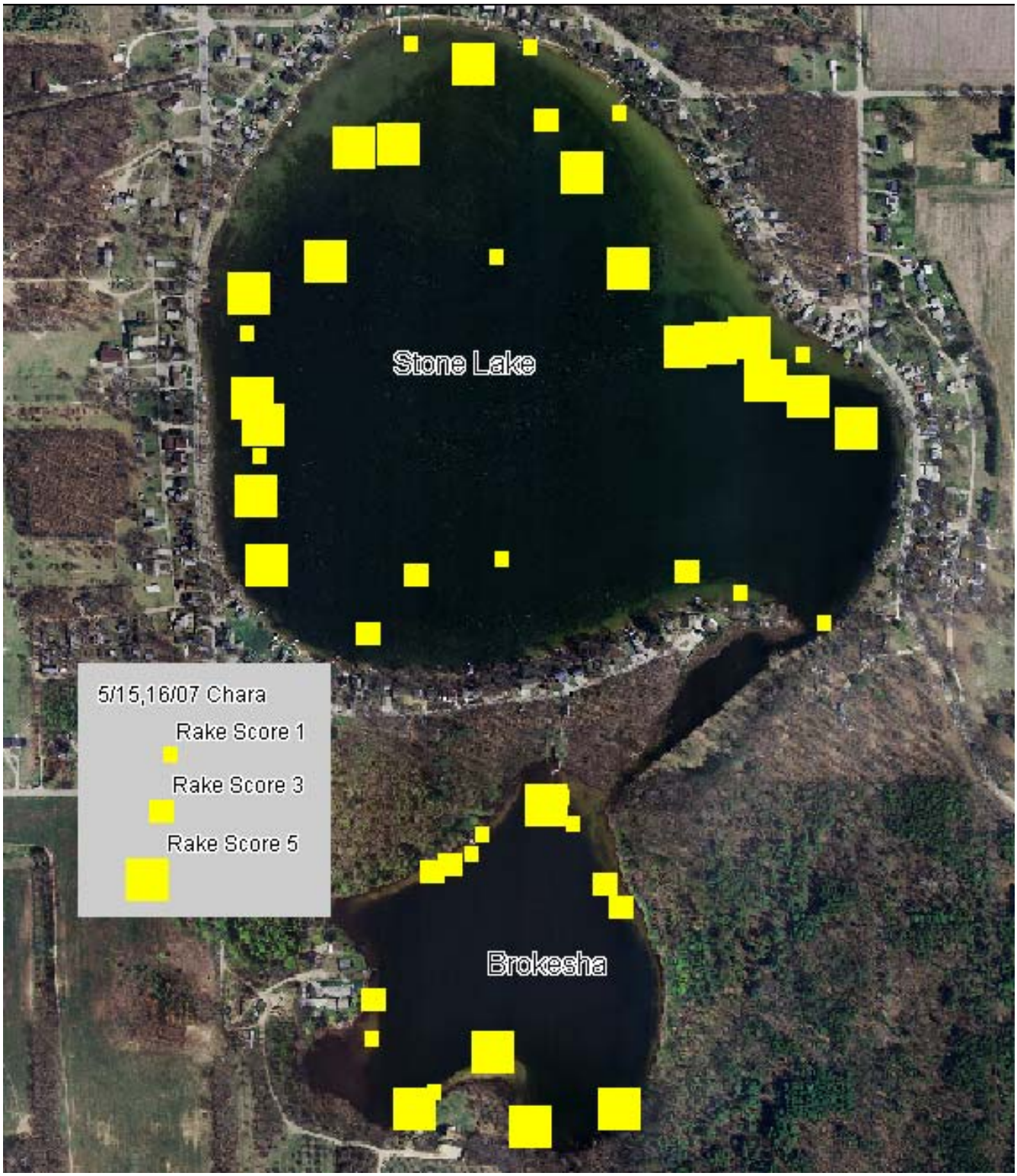


Table 28 Early Season Tier II Survey Sites where Chara Occurred

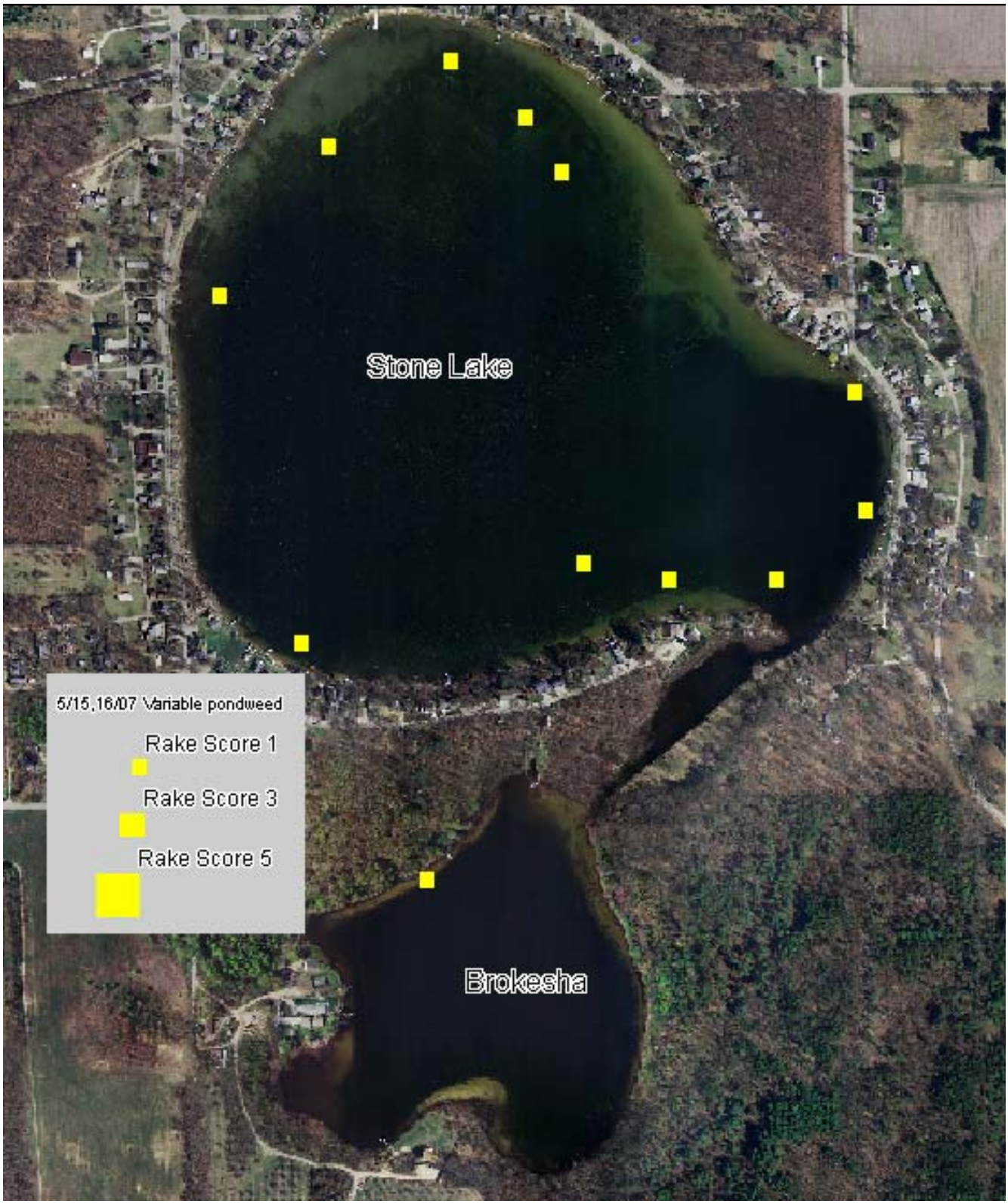


Table 29 Early Season Tier II Survey Sites where Variable pondweed Occurred

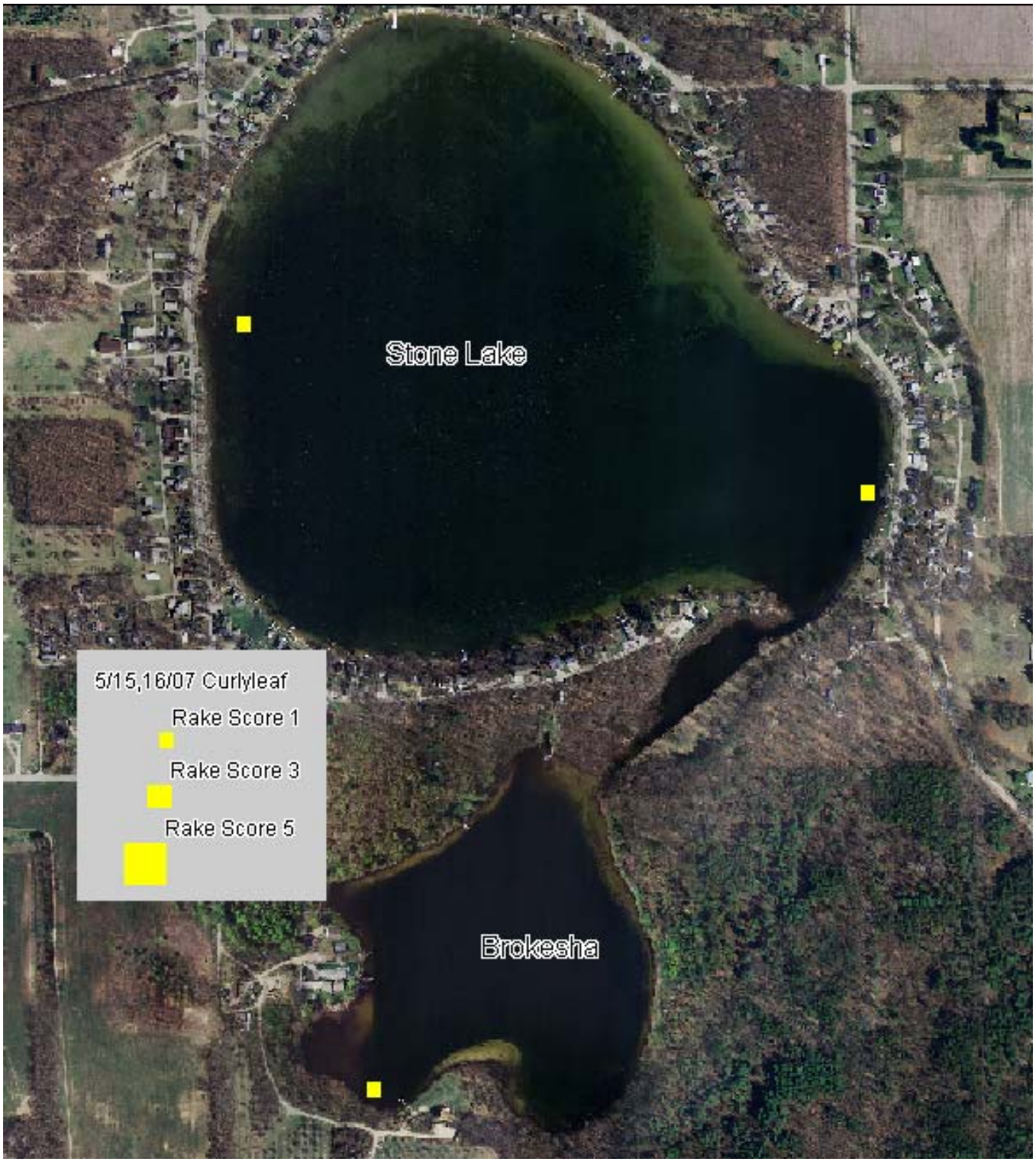


Table 30 Early Season Tier II Survey Sites where Curlyleaf pondweed Occurred

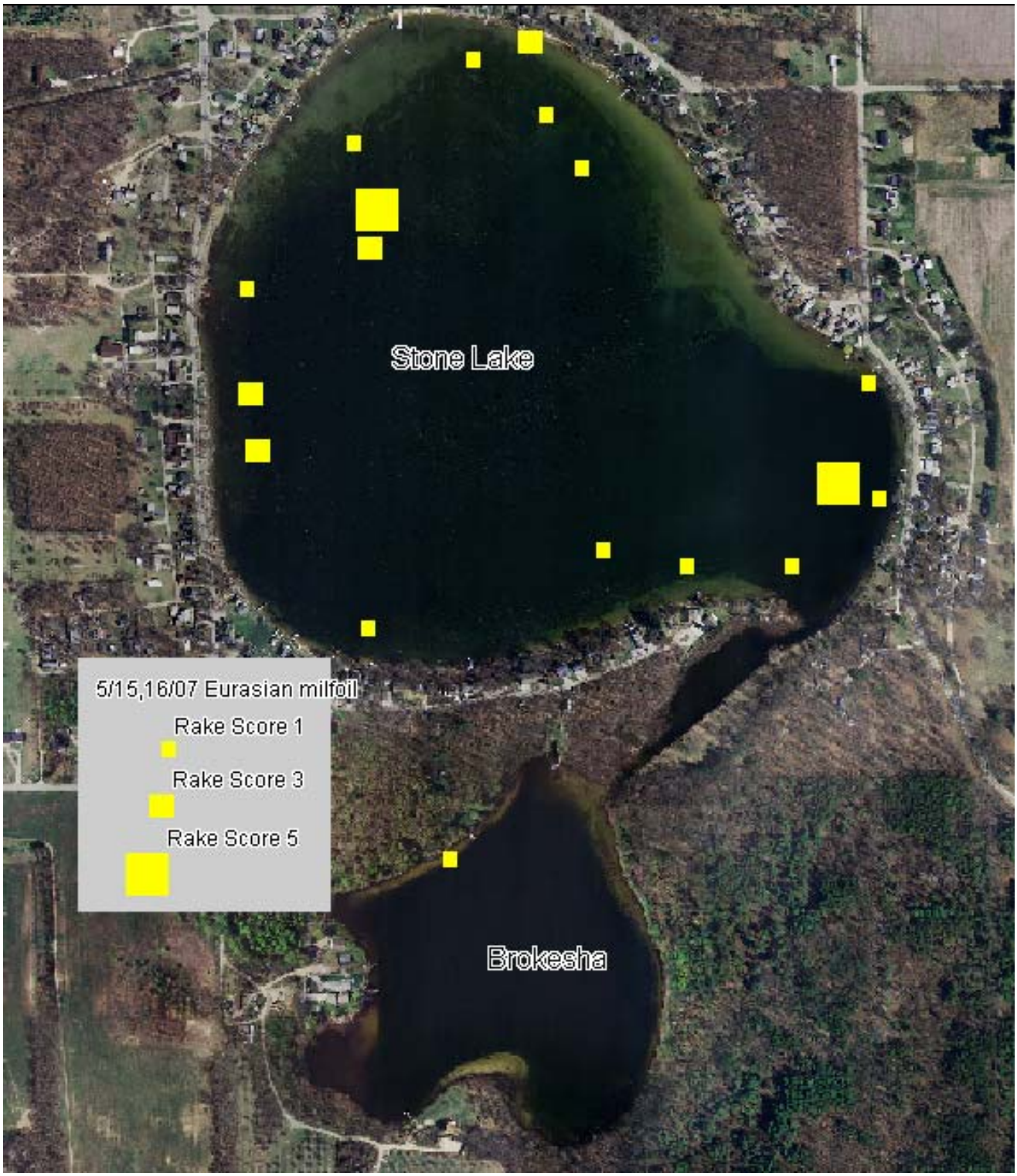


Table 31 Early Season Tier II Survey Sites where Eurasian watermilfoil Occurred

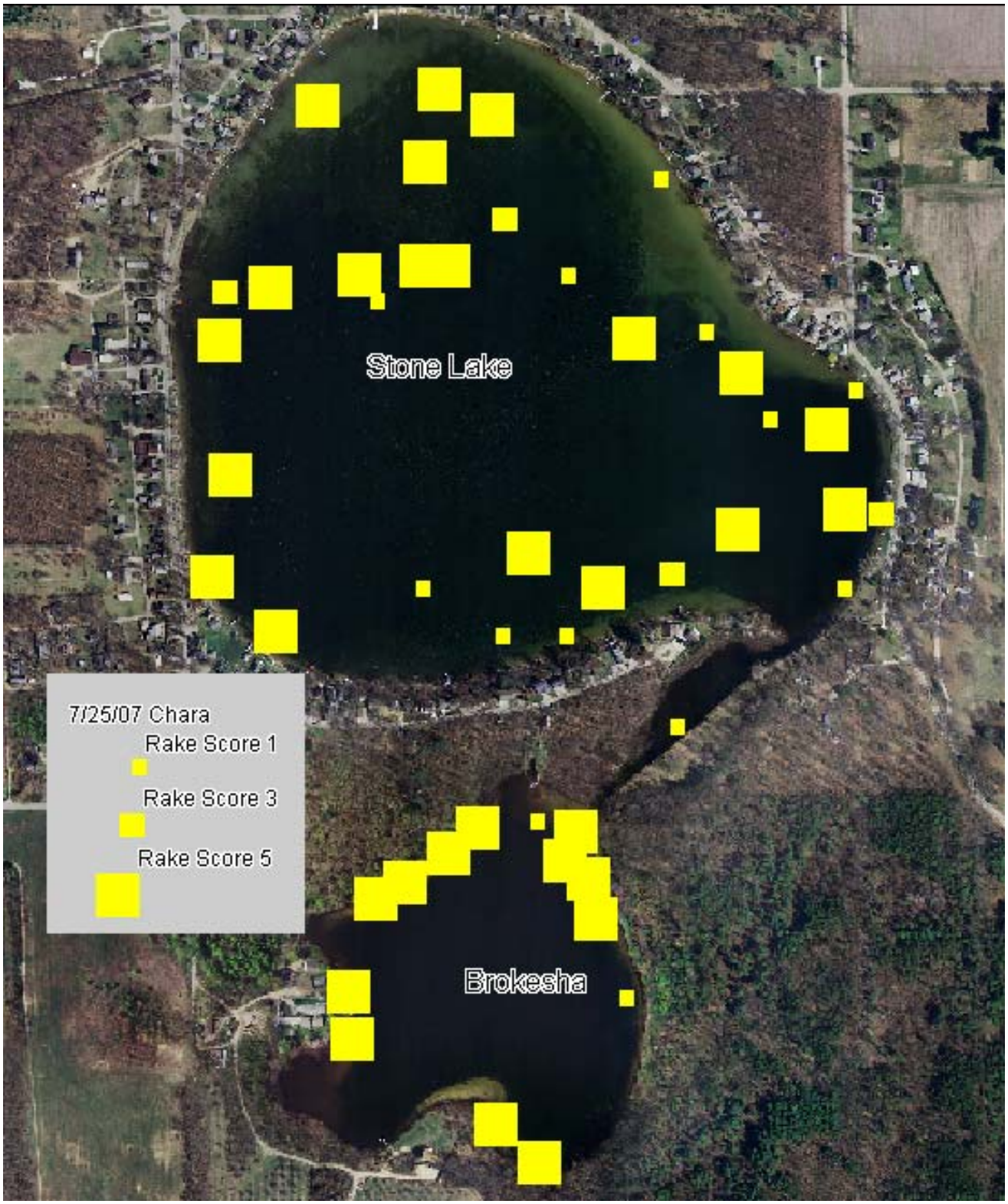


Table 32 Late Season Tier II Survey Sites where Chara Occurred

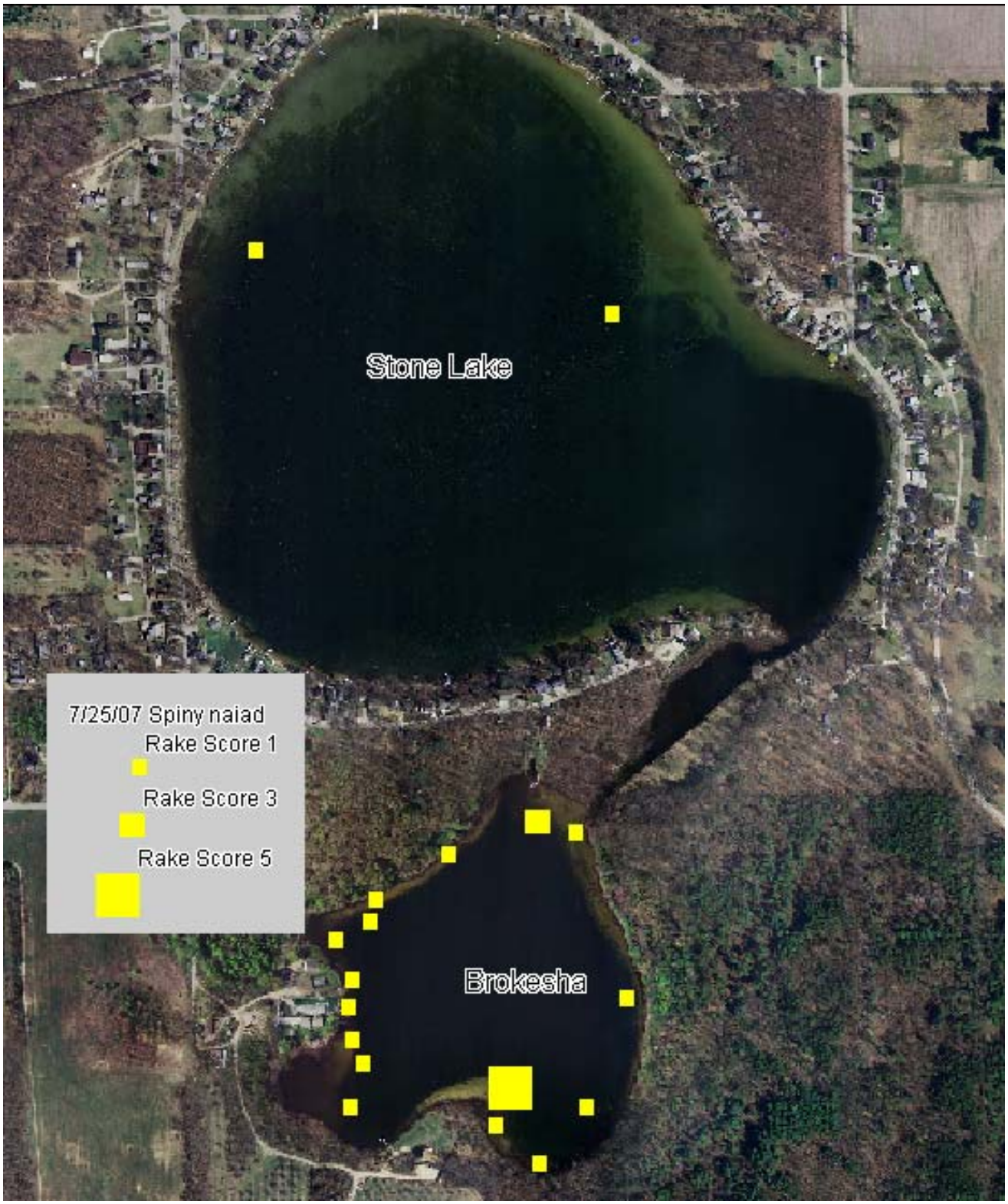


Table 33 Late Season Tier II Survey Sites where Spiny naiad Occurred

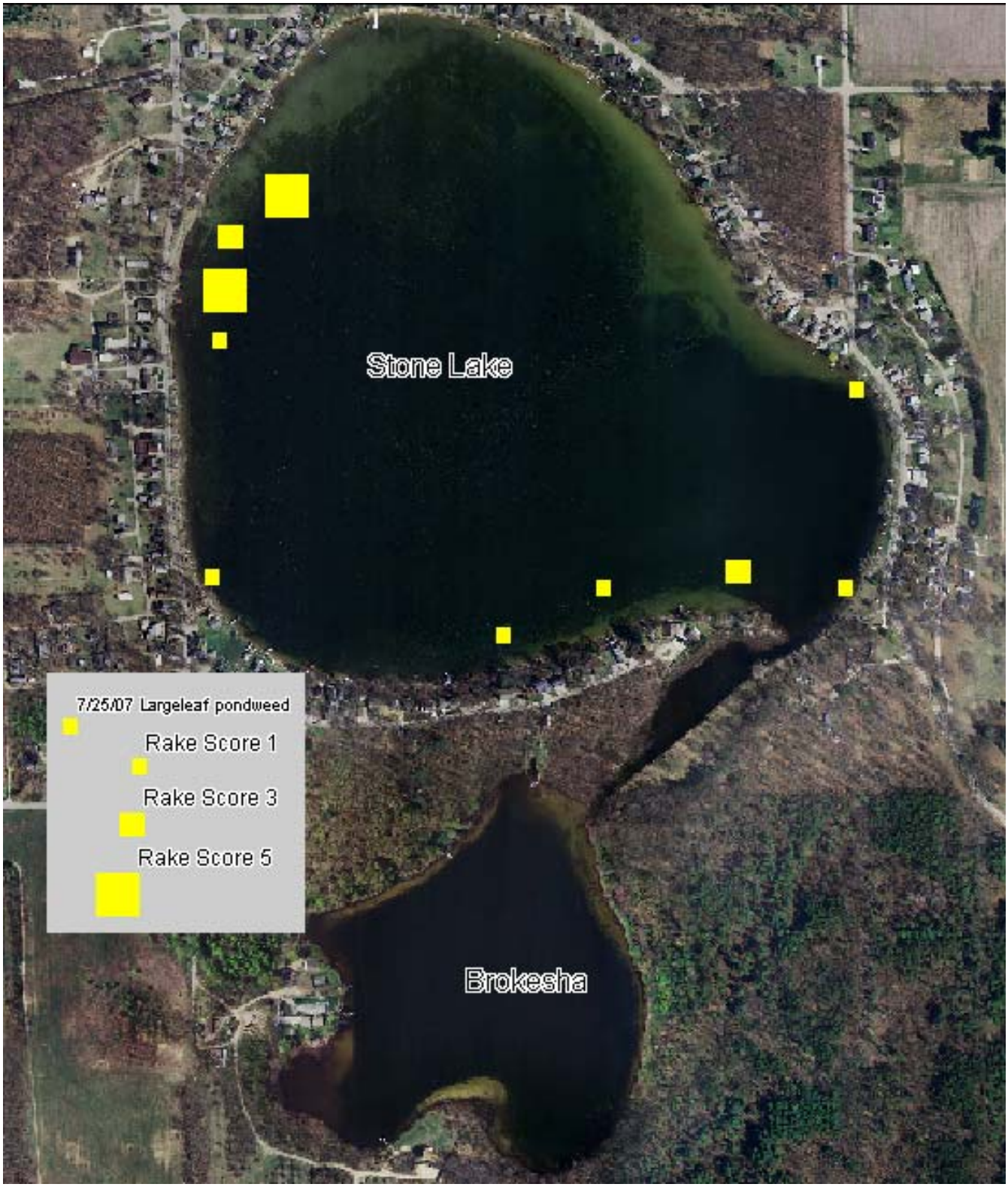


Table 34 Late Season Tier II Survey Sites where Largeleaf pondweed Occurred

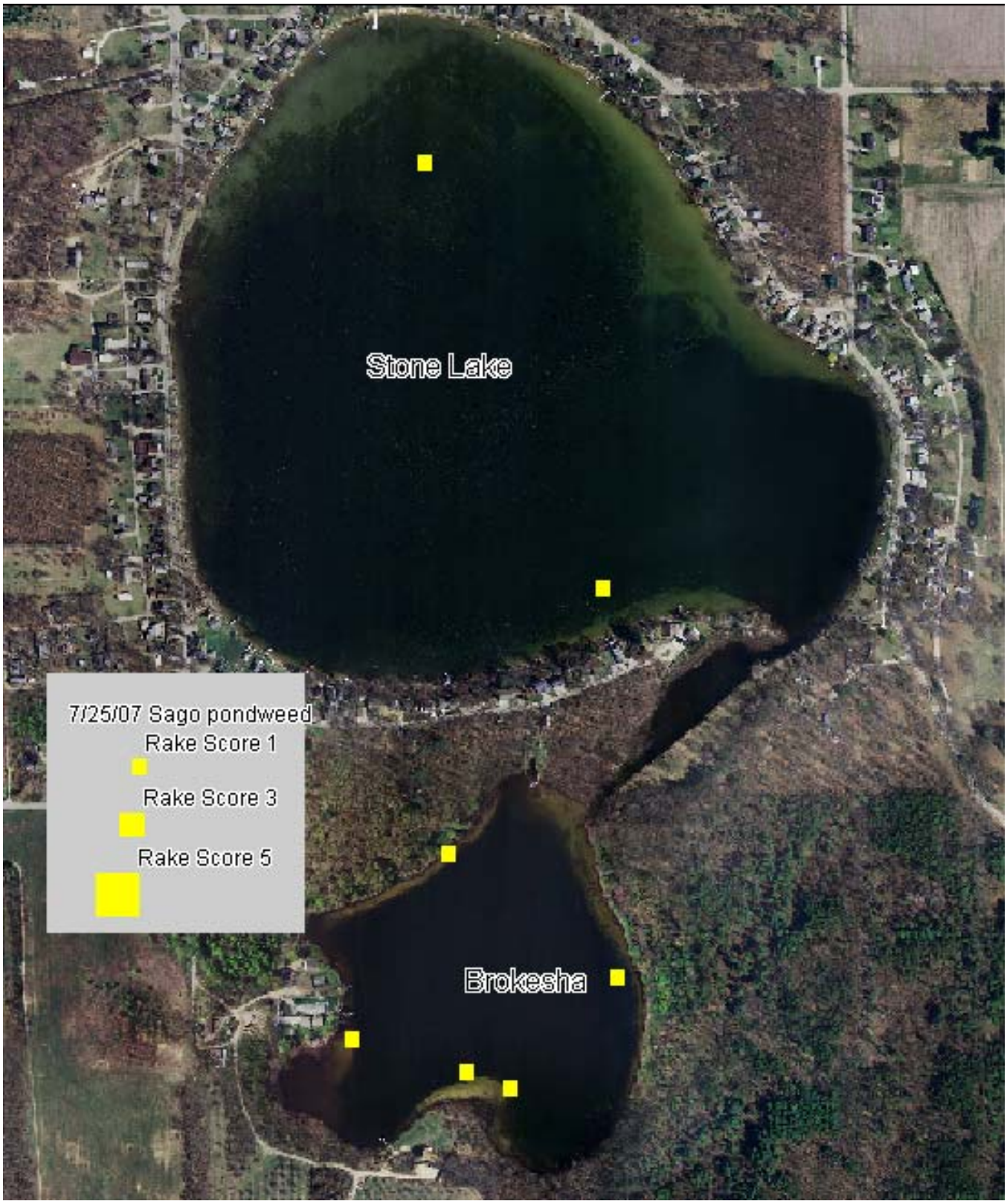


Table 35 Late Season Tier II Survey Sites where Sago pondweed Occurred

9.0 Aquatic Vegetation Management Alternatives

General Options for Controlling Invasive Exotic Aquatic Plants

•Insect Biological Control:

A North American Weevil *Euhrychiopsis lecontie*, may be associated with natural declines in Eurasian milfoil at northern lakes (Sheldon 1994, Bratager et al. 1996, Weinberg 1995). In recent years the weevils have been marketed and stocked as a biological control agent with varying results. Historically associated with the native milfoils, the insects are capable of grazing on Eurasian milfoil as well, while not affecting the majority of native vegetation. A control program involves breeding the weevils in captivity, collecting them and then physically attaching the insects to the target plants in the field. The stocked weevils sometimes produce a modest reduction in milfoil biomass among targeted plants during the first season. In most cases restocking must occur every year to maintain control, in many cases no reduction in plants is noted at all after stocking. Interest in the use of the milfoil weevils has been high. They are often viewed as a natural control method that will be less environmentally damaging than more effective forms of control. At present, the high cost and relatively low reductions in plant biomass associated with weevil stocking programs has severely limited their popularity as a control mechanism.

•Harvesting:

There are several models of machines produced for cutting and removal of aquatic vegetation from lakes. Contractors who own the machines generally hire on to cut plants on an hourly basis with organizations that can provide a set minimum hours of work to cover mobilization costs. Most harvesters are constructed like a floating combine. The floating machine is driven and steered with paddle wheels. An underwater cutting bar cuts plant stems and a driven belt carries the cuttings to the back of the machine where they are deposited in a hopper. When the machines hopper is full the machine operator offloads the aquatic cuttings in a designated area or into the back of a truck for disposal. One advantage of harvesting is the actual removal of plant material and associated nutrients from the lake. Unfortunately, only a very small percentage of a lakes nutrient load is invested in plant biomass at any given time. In most cases the cutting will have to be repeated each season and often multiple cuttings per season are needed to control plant regrowth. A major disadvantage of harvesters is the amount of biological disturbance introduced to the lake during the cutting process. Eurasian watermilfoil maintains the ability to recover very quickly from cutting. Native plants which cannot recover as readily from the harvesting encounter a selective disadvantage. The end result can be a shift in plant biomass away from more beneficial native plants, toward Eurasian watermilfoil. Whereas Eurasian milfoil can reproduce through fragmentation, the potential for free floating cut plants to spread growth by settling in other parts of the lake also must be considered. Aquatic plant cutters also tend to entrain a large number of small fish, turtles, and other aquatic organisms which will be removed from the lake if not screened out by the operator. Because of these problems weed harvesting has become subject to regulation and permitting by the Indiana Department of Natural Resources. Harvesters are often the only effective option for controlling excessive growths of stout native plants that do not respond well to other control methods. They are also often employed in areas where regulatory permitting excludes the use of pesticides.

•Control of Eurasian watermilfoil and Curly-leaf Pondweed with Aquatic Contact Herbicides:

Several aquatic contact herbicides are available for use in Indiana lakes. Aquatic pesticide applications on Indiana public lakes are subject to review and permitting on a seasonal basis with the Indiana Department of natural Resources. In addition aquatic applicators for hire must be licensed through the office of the Indiana State Chemist. In aquatic herbicide applications chemical products are typically dispersed over target plants as liquid or granular formulations using specialized boat-mounted equipment. Most contact herbicides function by eroding the cell membranes of plant tissue disrupting

plant functioning. Control is usually achieved quickly with susceptible plant species often dropping out in less than one week. Aquatic herbicide choices are somewhat limited as EPA approved products must not cause damage to untargeted organisms, provide a hazard to lake users, or leave harmful residues in the environment. Because of these requirements most contact herbicides have a short half-life in an aquatic environment, being lost to soil adhesion, photodegradation, or bacterial decomposition shortly after application. By both accident and design, most aquatic contact herbicides are selectively effective against obnoxious exotic species with Eurasian milfoil, and Curly-leaf pondweed being especially susceptible. Stout native species such as some of the larger native pondweeds and most of the native milfoils largely remain unaffected by marginal applications on larger lakes. This provides the advantage of allowing selective control, dropping out invasive exotics and leaving the native plant community to recover and capitalize on available light. Selective susceptibility needs to be considered when making herbicide choices so that appropriate plant community effects occur. Contact herbicides tend to leave plant root structures intact so regrowth often begins shortly after treatment. Multiple treatments can be needed in some cases to maintain full-season control. Use of some herbicides requires that lake activities such as swimming or lawn irrigation be restricted near the treatment area during a post treatment waiting period. Water-use restrictions generally apply within 100 feet of the application area. Waiting periods for swimming and other water-uses vary between zero and 120 days depending on the product used.

•Aquatic Plant Control with 2-4-D Granular Translocated Aquatic Herbicide:
Granular formulations of 2-4-D herbicide have been used for many years to control Eurasian watermilfoil. In lawn, agricultural, and aquatic applications 2-4-D is used to selectively control plants which are biologically classified as "broadleaves". Aquatic plants in this category include Eurasian and Native milfoils and Coontail *Ceratophyllum echinatum*. 2-4-D is a translocated or "systemic" aquatic herbicide. It is absorbed by target plants and transported through their vascular systems, affecting remote parts of the plant including the root structure. This offers the theoretical advantage of actually killing more plants and providing longer term control. Well-timed 2-4-D applications in some cases provide seasonal control of Eurasian watermilfoil with regrowth occurring the following season. Occasionally reapplication is needed within the same season. With milfoil infestations, 2-4-D offers the advantage of being highly selective for milfoil with the pondweeds, and most other native plants remaining completely unaffected. Because granular pellets sink into plant foliage or to the lake botton and slowly release their active ingredients they can sometimes be more effective than liquid formulations in deepwater applications like that needed at Stone Lake. Granular 2-4-D use typically restricts swimming near the treatment area for one day, and requires a waiting period on the use of lake water for lawn irrigation, so ornamental and garden plants will not be damaged.

•Aquatic Plant Control with Trichlopyr Translocated Aquatic Herbicide:
Available in a liquid formulation or granular flake (OTF) as Renovate 3® aquatic herbicide, trichlopyr offers broadleaf specific systemic control of aquatic plants in a liquid herbicide. This offers the advantage of easier handling and application over 2-4-D. Results have been similar to the use of 2-4-D. Improved application techniques and the use of adjuvants show some promise of possible providing multi-seasonal control with the use of Trichlopyr. The current labels allows the restricted use of dosed lake water to be adjusted in accordance with lake-water assay results, greatly reducing the time of restriction in most cases. The label application rates for Renovate 3® make deep water applications like those needed on Stone Lake rather expensive when compared with label rates for granular 2,4-D applications. The Renovate 3® On Target Flake should be considered as an alternative control at Stone and Brokesha if 2,4-D does not achieve desired control.

•Aquatic Plant Control with Fluridone Translocated Aquatic Herbicide:
Two aquatic herbicide formulations containing fluridone are currently available under the trade names Avast!® and Sonar®. Fluridone is an extremely effective aquatic herbicide at very small concentrations

in lakes and ponds, while it displays a relatively low toxicity to fish and mammals. Unlike most other aquatic herbicides it's also environmentally persistent, often remaining in the dosed waterbody in minute, but measurable amounts over the course of several months. Fluridone is absorbed by plant shoots from water, and from hydrosoil by the roots of aquatic vascular plants. In susceptible plants, fluridone inhibits the formation of carotene. In the absence of carotene chlorophyll is rapidly photodegraded causing plants to become chlorotic (whiteish) and eventually drop out. Like many other herbicides fluridone is capable of a high degree of selective control at proper dosages. Within the assemblage of plants in most Indiana lakes, Curly-leaf pondweed and Eurasian watermilfoil are most susceptible. For control of Eurasian milfoil fluridone is introduced into a lake at the calculated rate of six to twelve parts-per-billion. Assays are often performed within the first two weeks after initial dosing to assess a hit or miss on a target concentration. A second dosage is often used to maintain the target concentration for a period of 60 to 90 days as the product is allowed to work. At a 6 PPB dosage rate fluridone is highly selective for Eurasian watermilfoil and Curly-leaf pondweed. Control typically lasts the entire season with occasional carryover effects during the second season. At dosages of 10 to 12 PPB Eurasian watermilfoil control is typically complete by the end of the first season and often extends through the second season, but a variety of native plants may be impacted. One major advantage of Fluridone use is its persistence and slow activity. During the extended treatment period the product mixes throughout the upper strata of the entire lake basin, allowing it to reach all exotic target plants in contact with the water. This also means that consideration must be given to possible impacts downstream from the target lake. Because of its slow rate of activity fluridone also offers the advantage of providing for gradual breakdown of target plants, providing a more gradual release of nutrients than faster acting herbicides. This decreases the chances of developing oxygen deficits or excessive algal blooms in shallow lakes. Because of the high cost of fluridone herbicides, their use is often reserved for lakes with extensive littoral areas showing profound mat-forming infestations and severely impaired recreational use. The only water-use restriction associated with fluridone is a wait on the use of lake water for lawn and garden irrigation of 14 to 30 days depending on dose rate.

•Aquatic Plant Control with Triploid Grass Carp (White Amur):
The Asiatic Grass Carp *Ctenopharyngodon idella* have become popular as an introduced exotic biological control for rooted aquatic plants in ponds and southern U.S. lakes. Grass Carp are native to river systems of Russia and China. The species was first imported to the southern United States in 1963. Like most biological controls herbivorous grass carp have remained extremely popular despite some problems associated with their use. Stocking of grass carp was initially illegal in many states including Indiana. Because grass carp are a possibly detrimental exotic species, resource managers feared a destructive establishment of viable wild populations. This process had already occurred with the common carp which remains a destructive influence in our aquatic habitats. Proponents of the plant-eating fish argued that viable breeding habitat for the carp was not present in the United States. That argument was refuted when viable reproduction was noted in the 1980's in tributaries to the Mississippi. When a technique was developed for producing genetically altered triploid grass carp stock with greatly reduced fertility, laws in many states including Indiana were changed to allow stocking of the sterile fish in private waters. The possibility still exists for fish producers to bypass the necessary hatchery process and market fertile fish. Illegally stocked fertile grass carp have been found in some locations. Use of any grass carp remains illegal in twelve states including Michigan. Despite remaining controversy, some regulatory agencies encourage their use in ponds and lakes publishing stocking guidelines and even offering the fish for sale. Grass carp have been introduced into thousands of private ponds and many larger reservoirs in the southern United States with mixed results. Often stockings in large waterbodies bring either complete eliminations of vegetation or very little decline at all (Cassani 1995). Grass Carp are selective feeders and unfortunately tend to prefer most native plant species over Eurasian watermilfoil. Results of grass carp stocking vary with the plant species assemblage present in stocked waters and variations in Lake Morphometry. In general, stocking at low rates can be expected to produce a shift in plant biomass away from preferred species food plants,

toward unpreferred. At high stocking rates the fish will consume all rooted aquatic vegetation in the system. This causes a shift in plant biomass toward planktonic and filamentous algae as fish waste and feeding activity boosts lake nutrient levels. At sustained high numbers, the fish will consume filamentous algae, emergent aquatic plants, and even terrestrial vegetation within their reach at the lake's edge. Shoreline erosion can become a problem when this occurs. At the end result of sustained high stocking rates lake plant biomass will be maintained in planktonic algae, which the fish are unable to utilize as a food source. This can obviously lead to water clarity problems and unstable oxygen levels, especially in the temperate northern U.S. Successful use of grass carp on ponds and in large southern lakes often trades water clarity for alleviation of rooted plant problems. This technique can be effectively employed where water clarity and high oxygen levels are not a priority. In the case of most Indiana natural lakes where water quality and clarity is a high priority, use of herbivorous fish as a management technique would not be wise or legal.

•Benthic Barriers for Aquatic Plant Control

Sheets of plastic or rubber material have been used to exclude aquatic plant growth. Usually owners of small ponds or swimming areas will employ this technique by placing the liner on the bottom and depositing sand or pea gravel on the liner. One drawback with this technique is the tendency for gasses to build up beneath impermeable liner material pushing it up from the bottom. This occurs as decomposition in the lake sediments produces hydrogen sulfide and carbon dioxide gasses. Using mesh liners or permeated liners can alleviate this problem somewhat, but obviously will allow plants to grow through the liner. Bottom liners also effectively exclude areas of benthic habitat and are generally not permitted by IDNR in public lakes for this reason.

Option	Benefits	Drawbacks
No Control	No dollar cost, No water-use restrictions	Further loss of plant diversity, degraded fish & wildlife value, possible further Sportfish stunting, Impeded recreational use, aesthetic problems
Biocontrol Weevils	No swimming restrictions, No watering restrictions	Often ineffective, Cost prohibitive
Biocontrol Grass Carp	No water-use restrictions, possible multi-season control	Results not-predictable, illegal in Indiana public waters, may cause water clarity/quality problems, limited selectivity
Harvesting	No water-use restrictions, Removes some nutrients from lake	May hasten spread Eurasian milfoil through fragmentation and hydrosoil disturbance, Expensive, May result in regrowth within same season, Requires plant disposal site, Non-selective
Benthic liners	No water-use restrictions, possible multi-seasonal control	Impairs benthic habitat, Not generally permitted in Indiana Public Waters, Not feasible in deep water, Inherent maintenance problems
Aquatic Pesticides (2-4-D)	Highly selective control, Very effective	Intermediate expense, difficult application, Swimming and irrigation restrictions, Generally provides one season's control
Aquatic Pesticides(Renovate)	Highly selective control, Very effective	Expensive- materials expense, Swimming and irrigation restrictions, Generally provides one season's control,
Aquatic Pesticides (Sonar a.s.)	Highly selective control, Very effective, Multi-seasonal control	Expensive product, irrigation restriction, possible damage to non-target vegetation
Aquatic Pesticides (contact herbicides) (diquat dibromide or endothols)	Some selectivity, Very effective, fast acting, least expensive application	Generally provides on season's control, Possible regrowth in late season, Swimming, Irrigation, and possible fish consumption restrictions

Table 36 General Plant Management Alternatives, Drawbacks and Advantages

10.0 Public Involvement

A public meeting for Stone and Brokesha's plant management program was incorporated into the regular association meeting on July 21, 2007 at residence near the lake. The meeting was extremely well attended. Approximately 40 people were present. This is typical attendance for Stone and Brokesha Association meetings. Survey results indicate that the majority were lake property owners or their family members. Information about ongoing plant management and monitoring efforts was presented by Aquatic Enhancement & Survey, Inc. A discussion was held about the status and goals of the Stone and Brokesha Lakes Plant Management Plan and opportunity was provided for lake residents to ask questions and provide input regarding the plant management and water-use restrictions involved. Samples of Curlyleaf pondweed, Eurasian watermilfoil, and Purple loosestrife were provided to help the lake users to recognize these invasive plants. The Lake Use Survey below was distributed to those present, filled out, and collected. Twenty-seven surveys were returned. All 27 respondents indicated that they were lake property owners. All were also association members. When asked how long they had resided at the lake 12 respondents indicated they were 20+ year residents, seven were 0-5 year residents, six were 11-20 year residents and two were 6-10 year residents. Nineteen respondents indicated that the growth of aquatic plants had detracted from their enjoyment of the lake at some point, five said it had not. When asked whether the lakes contained aquatic plants in nuisance quantities at the current time (post treatment) 12 respondents marked "yes" nine marked "no". When asked whether they felt that the level of aquatic vegetation at the lake affects their property value 21 indicated it did, while only three said it did not. All 27 respondents said they were in favor of continued vegetation control. Overall the meeting attendants were very interested in continuing efforts to manage exotic plants at the lakes and were pleased with plant management results thus far.

Stone & Brokesha Lakes User Survey 7/21/07

1. Are you a lake property owner? Yes_____ No_____

2. Are you currently a member of the Stone Lake Conservation Club? Yes ___ No___

3. How many years have you been at the lake? (circle one) 0-5 years
6-10 years
11-20 years
more than 20 years

4. Has the growth of aquatic plants on Either Lake ever negatively affected your enjoyment of the lake(s)? Yes_____ No_____

5. How do you use the lake(s)? (mark all that apply)
___Swimming ___Irrigation (including lawn) ___Enjoy View and Atmosphere
___Boating ___Fishing _____View Wildlife _____Skiing/boarding/Tubing

Other _____

6. Do you feel that Either Lake has Aquatic plants in nuisance quantities at this time(2007)?
Yes ___ No ___

7. Do you feel the level of vegetation in the lake affects your property values? Yes ___ No ___

8. Are you in favor of continuing efforts to control vegetation on the lake? Yes ___
No ___

9. Mark any of these you think are problems on your lake:
___ Too much fishing
___ Canada Geese
___ Excessive boat traffic
___ Dredging needed
___ Too many aquatic plants
___ Not enough aquatic plants
___ Poor water clarity
___ Additional Speed enforcement needed

Other_____

Please add any additional comments on the back:

☐ Check here if commenting on the back

11.0 Public Education

The Stone Lake Conservation Club should set reasonable goals for increasing awareness among lake users about lake health issues. The association newsletter and summer meetings can serve as the primary vehicles for disseminating information. The Stone Lake Conservation Club typically holds an annual general meeting in July at a residence near the lake. With approximately 119 homes on Stone and Brokesha it is likely that residents from approximately 15-20 percent of lakeside homes attended the public meeting in 2007. The association's newsletter can help reach those who do not attend. An association website might be another way that relevant information can be shared. The following areas should be addressed:

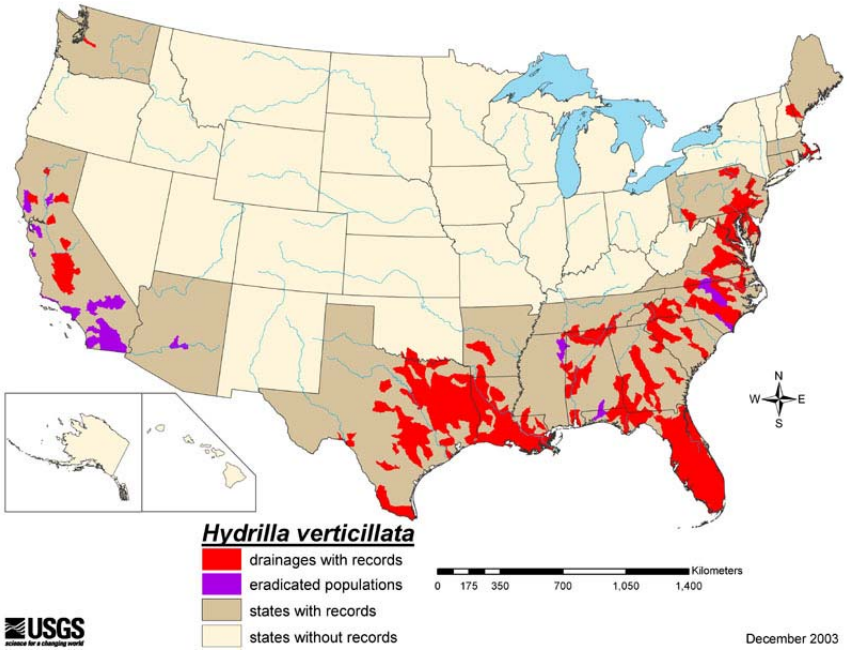
●Prevention of the spread of Exotic Invasive Aquatic and Wetland Species
An effort should be made to make lake users aware that their own boat trailers could have introduced Curlyleaf pondweed or Eurasian watermilfoil to Stone and Brokesha Lakes or could spread these plants to other lakes if care is not taken to remove vegetative debris. Basic plant identification should be addressed including Hydrilla *Hydrilla verticillata*, so new invasive species appearing can be spotted early on by the lake users. Information on Hydrilla is presented in the next report section.

●Prevention of lake nutrient enrichment.
An effort should be made to encourage all lake residents to switch to no-phosphorus lawn fertilizers. Residents should also be made aware that soils lost through erosion in the watershed carry nutrients into the lake's waters as do sediments mobilized from the lake's bottom and shoreline by watercraft. Area residents should be aware of proper erosion control techniques needed at construction sites within the watershed. Stone and Brokesha probably have such good water quality because much of the watershed is woodland. Residents should be aware that water quality can change with changes in the use of those areas.

●Expectations and water use restrictions associated with Plant Management
Residents should be made aware that LARE funds are intended to address only Exotic species of aquatic plants and control of plants will not occur throughout the whole lake. It is also important that residents understand and obey the posted water use restrictions associated with any chemical treatments performed.

11.1 Hydrilla and its implications for Stone and Brokesha Lakes

Keeping lake residents and users aware of the possibility of bringing in new invasive species on watercraft trailers will be especially important now that Hydrilla has been found in Indiana. Hydrilla *Hydrilla verticillata* is an invasive submersed aquatic plant thought to be native to Africa, Australia, and parts of Asia. As a hearty growing plant Hydrilla was used in aquariums and this led to its introduction into Florida waters in 1960. Since then Hydrilla has spread to become the single most problematic plant in the United States. (See USGS map below) In Florida alone millions are spent in controlling the growth of Hydrilla each year. The potential exists for the same type of damage on Indiana waterways if Hydrilla is allowed to spread. Like many invasive aquatic plants Hydrilla can form dense surface mats depriving native plant communities of light, decreasing plant community diversity, and causing serious impairment of recreational activities including fishing, swimming, and boating.



Known occurrences of Hydrilla in the U.S. in 2003. From the USGS website, http://nas.er.usgs.gov/taxgroup/plants/docs/hy_verti.html

Hydrilla mats clog the surface of Lake Conroe Texas. Photo courtesy of Earl Chilton, Texas Parks and Wildlife Department

Hydrilla can spread by fragmentation or the production of seeds, tubers (root structures), or turions (seed-like plant buds). Because of the potential for spread through fragmentation, plant material hitching a ride on watercraft trailers is probably a major mechanism of introduction. Tubers and turions can be very hearty, surviving dry periods or herbicide treatments and remaining hidden in the lake bottom for extended periods of time. Because of these characteristics great ecological damage and recreational impairment can occur in watersheds colonized by Hydrilla. In 2006 Hydrilla was discovered in Lake Manitou and its outlet stream in Rochester Indiana (Fulton County). This is the first

known occurrence of this plant in the Midwest. The Indiana Department of Natural Resources has devised a plan for eradicating and controlling the Hydrilla to prevent spread to other water bodies. Checks of other lakes in close proximity to Lake Manitou have not located any Hydrilla, so it is possible that the plant is only in and immediately downstream of Lake Manitou at this time. However, it's also possible that other lakes contain young Hydrilla infestations that have yet to be recognized so it's important that associations and lake residents learn to identify this plant. Acting early in spotting Hydrilla can help prevent spread and ultimately save a huge cost to the ecology and recreational value of Indiana lakes. At some point other infestations may occur as a result of plants being transported to Indiana from out-of-state. Whereas Stone and Brokesha Lakes are a popular fishing destination, there is a definite possibility that this plant could appear in the Lake in the future. Information on Hydrilla identification should be presented to the Lake users at meetings as a regular part of the lake resident educational program.

Hydrilla is similar in appearance to the native plant Elodea and also Brazilian elodea, an exotic (also recently found in Indiana). It forms long stems containing many whorls of short leaves. Photo Courtesy of Dr. John H. Rodgers, Jr.

11.1.1 Hydrilla Identification

Hydrilla strongly resembles the native aquatic plant Elodea *Elodea canadensis* and the introduced species Brazilian elodea *Egeria Densa*. Both these species can be found in Indiana although the occurrence of Brazilian elodea has been very limited thus far. Hydrilla is a long slender plant that sometimes branches and has short leaves arranged around the stem in a star-like (whorled) pattern. Characteristics which differentiate Hydrilla from Elodea and Brazilian Elodea include a typical leaf count of five in the whorl. Brazillian elodea typically has four to six leaves but never three, and native Elodea usually has three. (fig 31) Small teeth are also present on the midrib of Hydrilla leaves and may give the plant a "rough" feel. Hydrilla also has small serrations along the leaf edges (fig 32). Another distinguishing characteristic of Hydrilla is the presence of tubers (.2 to .4 inch long off-white structures attached to the root) (fig 33).

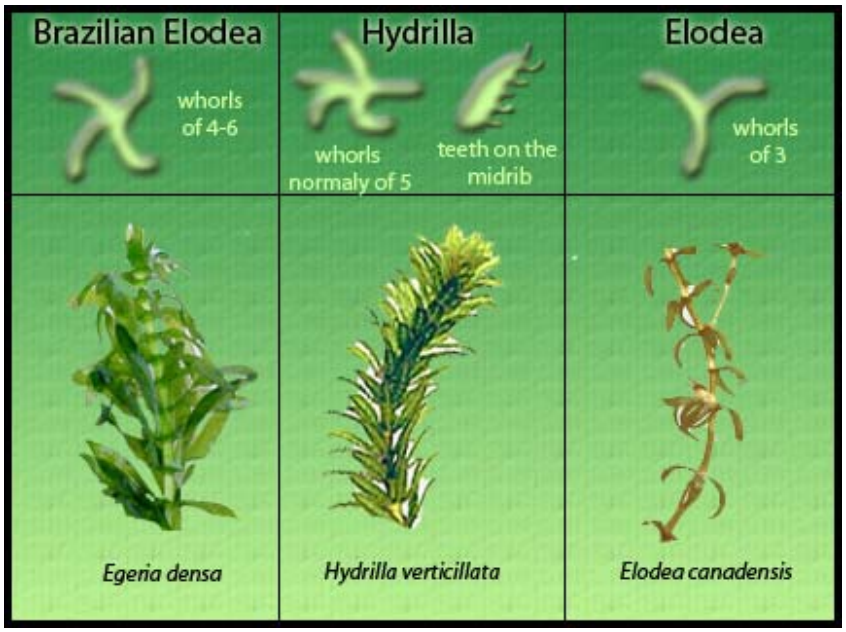


Fig. 1 Brazilian elodea has a typical leaf count of 4-6, while Hydrilla's is usually 5, and Elodea's 3. Drawing courtesy of Rob Nelson at ExploreBiodiversity.com

Fig. 2 Edges of Hydrilla leaves have fine serrations visible upon close examination. Photo Courtesy of Dr. John H. Rodgers, Jr.

Fig. 3 Hydrilla plants with tubers attached. Photo courtesy of King County Natural Resources and Parks, Water and Land Resources Division.

Anyone noting the presence of Hydrilla or Brazilian elodea is asked to immediately contact Doug Keller, Invasive species coordinator for the Indiana Department of Natural Resources at 317-234-3883, email: **dkeller@dnr.in.gov**. If you have questions about the identity of aquatic plants found, photos of the plants can be e-mailed to Doug for basic identification to determine if further action is required. More information on stopping the spread of invasive aquatic species is available online at **http://www.protectyourwaters.net/**

12.0 Integrated Management Action Strategy

Exotic plant management at Stone and Brokesha should take an approach consisting of three tiers of action working toward this plan's primary goals:

Tier 1. Nutrient and Sediment control.
The Stone Lake Conservation Club should be vigilant in spotting and addressing nutrient and sediment sources in the watershed, stopping pollutants at their source before water quality can be impacted.

Tier 2. Public Education.
The above educational points can potentially prevent a very costly infestation of new exotic plants and animals at the lakes, saving resources that can be utilized to address current problems.

Tier 3. Exotic Plant Control.
Addressing the submersed aquatic non-native plants present on a lakewide basis with professional applications of EPA approved aquatic pesticides and monitoring results closely can potentially limit their spread, and preserve the native plant community while providing relief to lake users. The proposed treatment regime is detailed in the budget and timeline in the next section. A treatment response benchmark of a reduction in Eurasian watermilfoil late-season Tier II occurrence to 10 percent or below should be pursued. For Curlyleaf pondweed a goal of having all significant treated plants drop out within two weeks of an early-season treatment is reasonable on both Stone and Brokesha. On Brokesha benchmark of keeping Eurasian watermilfoil Tier II occurrence at or below five percent of sampling sites should be pursued. Several small colonies of Phragmites were noted along the shoreline of the channel between the lakes and also along the Brokesha lake shoreline. Treatment of these plants should be initiated in 2008 if these plants are confirmed as the invasive variety of these plants. The cost of treatment is included in the budget/timeline below. A basic assessment of the extent of Purple loosestrife colonization should also take place in 2008 with a plan for their control to be added to the 2008 update.

13.0 Project Budget & Timeline

2008 Season ●**Success Benchmarks:** Elimination of all significant Curlyleaf stands within two weeks of treatment on both lakes. A Tier II occurrence of Eurasian watermilfoil of 10% or less on Stone and 5% or less on Brokesha			
Month	**Activity**	**Acreage**	**Cost Estimate**
April	Map Curlyleaf pondweed And Eurasian watermilfoil growth		900.00
April/May (soon after emergence)	Treat Curlyleaf pondweed as needed (.5-1ppm Aquathol K)	7	2100.00
May	Begin Eurasian treatments on main lake as needed (2,4-D granular)	23.00	9568.00
July	Tier II Survey		1700.00
July	Retreatments as needed (2,4-D granular)	7.00	2912.00
August	Treat Phragmites along channel and Brokesha Shoreline	1<	200.00
As arranged	Public Meeting		350.00
October/November	Permit Meeting		200.00
December	Plan Update Document Due		1600.00
	Total Cost, Pesticide Applications		**$14780.00**
	Total Cost, Consultant		**$4750.00**
	Total		**$19530.00**

2009 Season ●**Success Benchmarks:** Elimination of all significant Curlyleaf stands within two weeks of treatment on both lakes. A Tier II occurrence of Eurasian watermilfoil of 10% or less on Stone and 5% or less on Brokesha			
Month	**Activity**	**Acreage**	**Cost Estimate**
April	Map Curlyleaf pondweed And Eurasian watermilfoil growth		945.00
April/May (soon after emergence)	Treat Curlyleaf pondweed as needed (.5-1ppm Aquathol K)	7	2205.00
May	Begin Eurasian treatments on main lake as needed (2,4-D granular)	23.00	10046.00
July	Tier II Survey		1785.00
July	Retreatments as needed (2,4-D granular)	7.00	3058.00
As arranged	Public Meeting		368.00
October/November	Permit Meeting		210.00
December	Plan Update Document Due		1680.00
	Total Cost, Pesticide Applications		**$15309.00**
	Total Cost, Consultant		**$4988.00**
	Total		**$20297.00**

2010 Season **●Success Benchmarks:** Elimination of all significant Curlyleaf stands within two weeks of treatment on both lakes. A Tier II occurrence of Eurasian watermilfoil of 10% or less on Stone and 5% or less on Brokesha			
Month	**Activity**	**Acreage**	**Cost Estimate**
April	Map Curlyleaf pondweed And Eurasian watermilfoil growth		992.00
April/May (soon after emergence)	Treat Curlyleaf pondweed as needed (.5-1ppm Aquathol K)	7	2315.00
May	Begin Eurasian treatments on main lake as needed (2,4-D granular)	23.00	10549.00
July	Tier II Survey		1874.00
July	Retreatments as needed (2,4-D granular)	7.00	3210.00
As arranged	Public Meeting		386.00
October/November	Permit Meeting		221.00
December	Plan Update Document Due		1764.00
	Total Cost, Pesticide Applications		**$16074.00**
	Total Cost, Consultant		**$5237.00**
	Total		**$21311.00**

13.0 Project Budget & Timeline

2011 Season ●**Success Benchmarks:** Elimination of all significant Curlyleaf stands within two weeks of treatment on both lakes. A Tier II occurrence of Eurasian watermilfoil of 10% or less on Stone and 5% or less on Brokesha			
Month	**Activity**	**Acreage**	**Cost Estimate**
April	Map Curlyleaf pondweed And Eurasian watermilfoil growth		1042.00
April/May (soon after emergence)	Treat Curlyleaf pondweed as needed (.5-1ppm Aquathol K)	7	2431.00
May	Begin Eurasian treatments on main lake as needed (2,4-D granular)	23.00	11076.00
July	Tier II Survey		1968.00
July	Retreatments as needed (2,4-D granular)	7.00	3371.00
As arranged	Public Meeting		405.00
October/November	Permit Meeting		232.00
December	Plan Update Document Due		1852.00
	Total Cost, Pesticide Applications		**$16878.00**
	Total Cost, Consultant		**$5499.00**
	Total		**$22377.00**

14.0 Monitoring and Plan Update Procedures

The Stone and Brokesha Lakes aquatic plant management program should be monitored and updated on an annual basis. Monitoring will consist of monitoring not only the lake's plant community, but the thoughts and opinions of the lake's users. To monitor the lake's plants exotic growth will be remapped each spring and compared with the previous season's growth pattern. A tier II survey in the late season after treatment has been initiated will serve to characterize the lake's overall plant community statistically and also gage if treatment bench marks have been attained. If treatment response bench marks are not attained changes in the treatment timing, chemical used, or integrated approach will all be options for setting a new course toward success. To monitor the thoughts and opinions of lake users at least one public meeting should be held annually and a survey distributed. An open forum at the meeting should exist to allow for discussion of water-use restrictions associated with treatments, new problems arising at the lake, or treatment effectiveness. Updates on program progress and developments should be issued in the Stone Lake Conservation Club Newsletter.

15.0 Literature Cited

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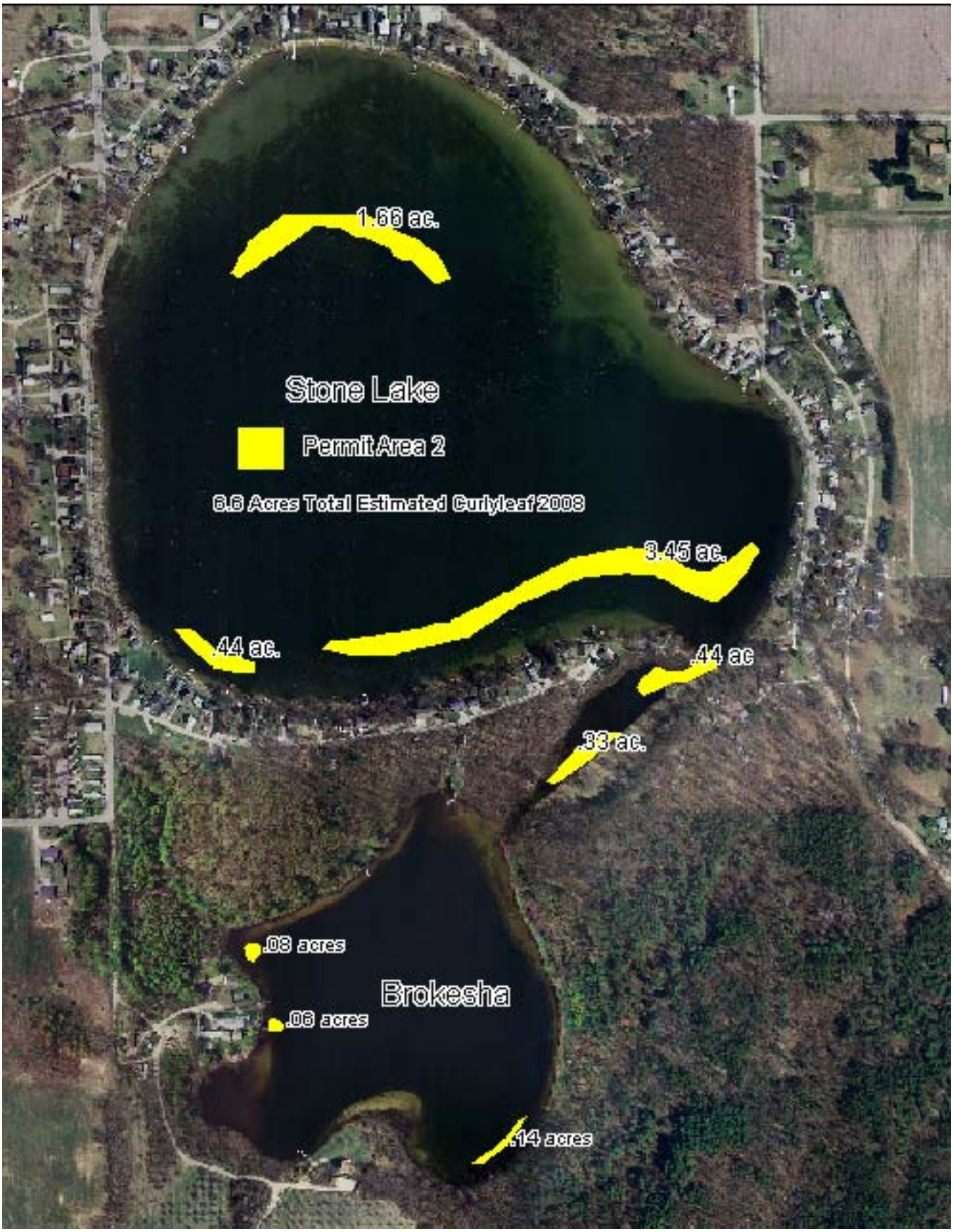
16.0 Appendices

Appendix 16.1
Plant Survey Data Sheets

Appendix 16.2
Treatment Data and Maps


1.66 ac.
Stone Lake
Permit Area 2
6.6 Acres Total Estimated Curlyleaf 2008
3.45 ac.
.44 ac.
.44 ac
.33 ac.
.08 acres
Brokesha
.06 acres
.14 acres

Stone Lake
2008 Estimated Eurasian watermilfoil
Permit Area 1
23 Acres Initial
6 ac. Retreatment
29 ac. Season Total
2008 Estimated Eurasian watermilfoil
.73 ac. Initial
.27ac. Retreat
1 ac. Total
Brokesha

Appendix 16.3
IDNR Vegetation Permit Application

Appendix 16.4
Pesticide Use Restrictions / Pesticide Labels

Appendix 16.5
Resources for Aquatic Vegetation Management
(Funding and technical assistance)

Appendix 16.6
State Regulations Relevant to Aquatic Plant Management