Griffy Lake
Aquatic Vegetation Management Plan
2009 Update

Monroe County, Indiana

February 23, 2010

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Executive Summary

This report was created in order to update the Griffy Lake Aquatic Vegetation Management Plan (AVMP). The original Griffy Lake AVMP was completed in 2005 in response to the discovery of invasive Brazilian elodea (*Egeria densa*). The primary objective of the original plan was the eradication of Brazilian elodea (Aquatic Control 2005). This was the first public access lake in Indiana to contain this invasive species, so eradication was a priority. Tier 2 surveys completed in 2004 found Brazilian elodea at 32.3% of sample sites. The invasive species Eurasian watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*) were also abundant. The Indiana Department of Natural Resources (IDNR) funded whole lake fluridone treatments in 2006 and 2007. Tier 2 surveys were completed in late summer 2007 and on three occasions in 2008. Brazilian elodea was not detected in any of the surveys. Curlyleaf pondweed and Eurasian watermilfoil were both treated with herbicides during the 2008 season. A total of 15.7 acres of curlyleaf was treated on April 17th and 2.95 acres of milfoil was treated on July 22nd.

Vegetation management efforts in 2009 focused on detection and control of any remaining Brazilian elodea along with detection and control of Eurasian watermilfoil and curlyleaf pondweed. Tier 2 surveys were completed on three different occasions; May 7th, June 30th, and August 18th. Brazilian elodea was not detected during any of the 2009 surveys and native vegetation increased in abundance and diversity when compared to 2008 data. An early season treatment for control of 17.8 acres of curlyleaf pondweed was completed on April 15th and 25.15 acres of Eurasian watermilfoil was treated on May 11th.

Despite exhaustive searches, no Brazilian elodea has been detected in Griffy Lake since spring 2007. It appears that this plant has been eradicated from Griffy Lake. Vegetation sampling can be reduced in 2010. Sampling should consist of an invasive species mapping survey in late spring to map areas of Eurasian watermilfoil and other invasive species that may be present. A Tier 2 survey should be completed in late summer in order to document changes in the plant community and locate areas of invasive species.

Early season treatment of curlyleaf pondweed should be continued in 2010 with low doses of Aquathol K herbicide. The same 17.8 acre area that was treated in 2009 should be slated for treatment in 2010. Any areas of Eurasian watermilfoil should also be treated following the spring invasive species survey. Curlyleaf pondweed and Eurasian watermilfoil treatments would require funding from the City of Bloomington Parks Department. It is recommended that the Parks Department apply for LARE grants for a plan update, plant sampling, and treatment of curlyleaf pondweed and Eurasian watermilfoil. Milfoil appears to be entering the lake from the watershed. The Parks Department has agreed to check the stream and lakes within the Griffy Lake watershed for the presence of milfoil. If milfoil is detected, these areas should be controlled.

Acknowledgements

Funding for the vegetation sampling, treatment, and the plan update was provided by the Indiana Department of Natural Resources (IDNR) Division of Fish and Wildlife with a 10% cost share provided by the Bloomington Parks and Recreation for herbicide treatments. Aquatic Control and IDNR completed the field work, data processing, and map generation. Special thanks are given to Doug Keller, Dave Kittaka, Angela Sturdevant, and Debbie King with the Indiana Department of Natural Resources for their assistance and review of this plan. Special thanks are also given to Angie Smith and Steve Cotter with Bloomington Parks and Recreation for their assistance with this plan. Author of this report is Nathan Long of Aquatic Control. The author would like to acknowledge the valuable input from Brendan Hastie, Tyler Zschiedrich, Leif Wiley, Joey Leach, and Barbie Huber of Aquatic Control for their field assistance, map generation, review, and editing of this report.

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1.0 INTRODUCTION

The original Griffy Lake Aquatic Vegetation Management Plan was created in 2005 following the discovery of Brazilian elodea in Griffy Lake (Aquatic Control 2005). This plan update is the forth update of the original plan. The update was funded by the Indiana Department of Natural Resources with a 10% cost share provided by Bloomington Parks and Recreation and should serve as a tool to track changes in the vegetation community and make the necessary adjustments to the vegetation management action plan. Items covered include an updated problem statement, an update on the management history and goals, an update on water body uses, 2009 sampling results, plant sampling discussion, a review of the 2009 vegetation controls, a review of vegetation management control options, and updates to the budget and action plans. Once reviewed and approved, the update should be included with the original vegetation management plan following the 2008 update.

2.0 PROBLEM STATEMENT

Eurasian watermilfoil, Brazilian elodea, and curlyleaf pondweed are the primary aquatic plant species of concern in Griffy Lake (Figure 1). Brazilian elodea is an invasive species that is rare in Indiana, so control of this species has taken precedence over curlyleaf pondweed and Eurasian watermilfoil. To our knowledge, Griffy Lake was the largest public body of water containing this invasive species in Indiana. Elimination of Brazilian elodea has been a primary aquatic plant management goal for the Indiana Department of Natural Resources and citizens concerned with the well being of Griffy Lake. If left unchecked, this species may have spread to other lakes in Indiana where it could have displaced native vegetation and degraded fisheries due to its ability to form dense monoculture plant beds. Fluridone treatments in 2006 and 2007 have resulted in the apparent eradication of Brazilian elodea from Griffy Lake. The whole lake fluridone treatments also significantly reduced the abundance of invasive Eurasian watermilfoil and curlyleaf pondweed, but these species are still present in Griffy Lake. Control of these two species should continue in order to insure Eurasian watermilfoil and curlyleaf pondweed do not return to pre-fluridone treatment levels. If left unchecked, these non-native invasive species may quickly infest areas once dominated by Brazilian elodea leading to limitations on lake use, reduction in native vegetation abundance and diversity, negative impacts on the fishery, and potential reductions in water quality.

Figure 1. Illustrations of Brazilian elodea (left), Eurasian watermilfoil (center), and curlyleaf pondweed (right) (Illustrations provided by Applied Biochemist).

3.0 MANAGEMENT HISTORY AND GOALS

The primary goal of the original plan was the elimination of Brazilian elodea. This was the first public access lake in Indiana to contain this invasive species, so eradication of this species was a priority. Aquatic Control completed a survey in 2004 and found Brazilian elodea at 32.3% of sample sites. The invasive species Eurasian watermilfoil and curlyleaf pondweed were also found to be abundant in Griffy Lake. The Indiana Department of Natural Resources (IDNR) conducted a survey in 2005 that indicated that Brazilian elodea was continuing to spread throughout the lake. IDNR funded a whole lake fluridone treatment in 2006 as part of the original plan's recommendations. The 2006 treatments significantly reduced Brazilian elodea abundance to the point that no rooted Brazilian elodea was observed by the end of the 2006 season. However, Brazilian elodea stems were collected during late summer rake sampling. Due to the presence of these potentially viable stems, and the importance of eradicating this species, an additional whole lake treatment was planned for 2007. Prior to the treatment, IDNR conducted a Tier 2 survey and found Brazilian elodea present at 2.4% of the sites. Curlyleaf pondweed was the only other invasive species collected and it was discovered at 23.5% of sites. The whole lake treatment was initiated on May 1, 2007. Concentrations of fluridone above 5.0 ppb were maintained in the lake throughout the 2007 growing season. Tier 2 surveys, consisting of 100 points, were completed on August of 2007 and on three occasions in 2008. Brazilian elodea was not detected in any of the surveys.

Tier 2 data and visual observations indicate that curlyleaf pondweed and Eurasian watermilfoil were controlled during the whole lake fluridone treatments. However, curlyleaf pondweed produces axillary turions to survive (reproductive structures). They break off the plant, float to another part of the lake or are deposited in the sediment, and sprout to generate new plant beds in the fall. Once formed, axillary turions are resistant to management techniques, which may make this plant more difficult to control than Eurasian watermilfoil (Bouldan et al. 1994). Long term control of curlyleaf pondweed can be achieved by applying herbicides in the springtime when water temperatures are cool to kill curlyleaf pondweed when plants are young and prevent new turion formation. Moreover, early applications may improve the selective potential of broad-spectrum contact herbicides because fewer native plant species are actively growing in cooler water temperatures and, therefore, are less susceptible to herbicide treatments (Poovey et. al. 2002). Early season treatments were started on Griffy Lake in 2008 when 15.7 acres was treated in April with 1.0 ppm Aquathol K.

Eurasian watermilfoil was likely eliminated from Griffy Lake following the consecutive whole lake treatments. However, milfoil was documented in the upper end of the lake in late summer 2008. This area was immediately treated with Renovate herbicide. Table 1 summarizes the vegetation management history at Griffy Lake from 2006-2008. To our knowledge the only control prior to 2006 was an unsuccessful stocking of milfoil weevils (Scribalio 2003).

Table 1. Griffy Lake treatment history 2006-2008.

Year	Control Technique	Acres	Species Targeted
2006	Whole Lake Fluridone	109	Brazilian elodea
2007	Whole Lake Fluridone	109	Brazilian elodea
2008	Early Spring Endothal & Late Summer Triclopyr	15.7 (clp) 2.9 (ewm)	Curlyleaf pondweed & Eurasian watermilfoil

For review, the current plant management goals for Griffy Lake area listed below (Aquatic Control 2008):

- 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
- Continue to direct efforts to preventing and controlling the negative impacts of aquatic invasive species
- Provide reasonable public recreational access while minimizing the negative impacts on plant and fish and wildlife resources

4.0 WATERSHED AND WATER BODY CHARACTERISTICS

Griffy Lake is a 109-acre reservoir located within the 1,180-acre Griffy Lake Nature Preserve in Monroe County. The lake lies approximately one mile north of Bloomington, Indiana. The maximum depth of Griffy Lake is 31 feet near the dam and the average depth is 10 feet. Griffy Lake was built in 1924 in order to provide additional water supply to the city of Bloomington. The dam was raised to its present height in 1943. The city of Bloomington no longer uses Griffy Lake as a water supply reservoir. Griffy Lake and a large part of the watershed is owned by the city of Bloomington and managed by Bloomington Parks and Recreation. Griffy Lake's drainage basin encompasses approximately 5,160 acres of land including the lake area (Figure 2) (JFNew 2009 & Jones et. al., 1984). The watershed is drained by Griffy Creek, which has three equally sized branches or forks. Presently, the North Fork watershed is fairly pristine, the Middle Fork is in the first stages of urbanization, and the South Fork is rapidly urbanizing (Commonwealth Biomonitoring, 2000). Public access, in the form of a boat ramp, is located in the southeast corner or upper end of the lake. This access site is managed by Bloomington Parks and Recreation. Boating is limited to electric motors only.

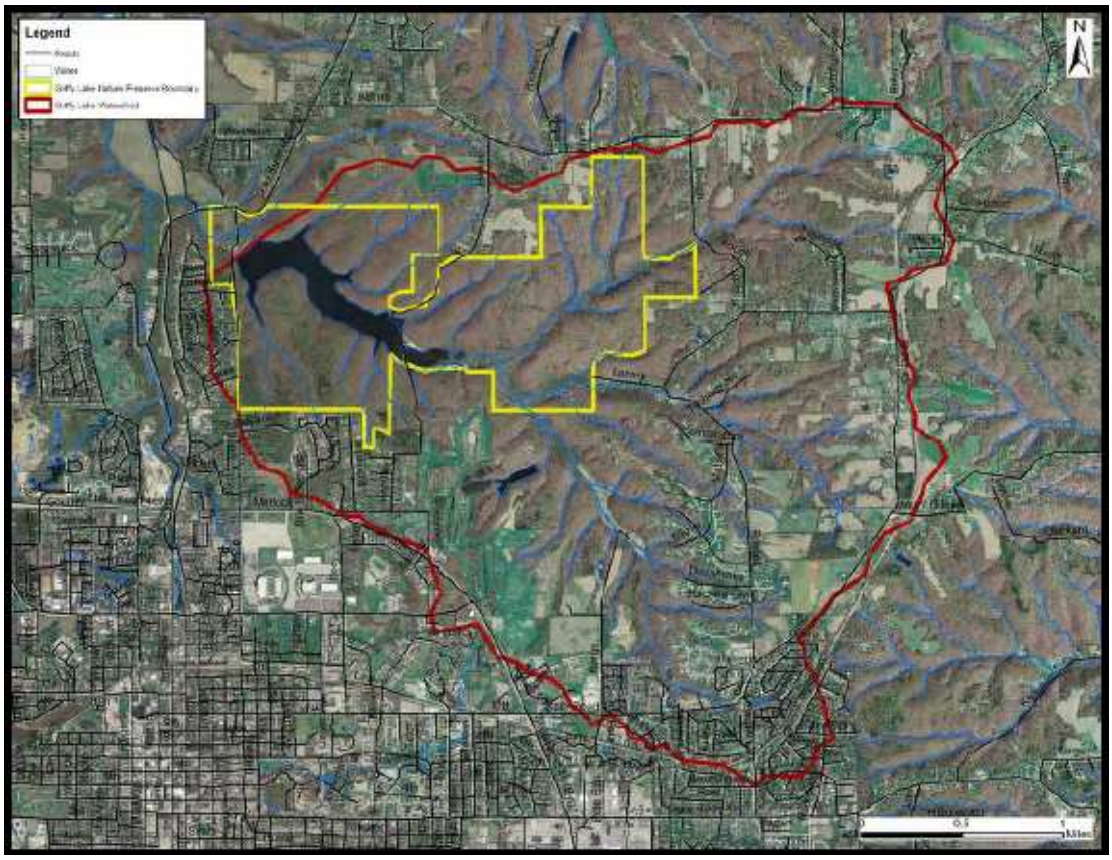


Figure 2. Griffy Lake watershed boundary (JFNew 2008).

Griffy Lake's water quality has been assessed regularly over the past 16 years. In 2008, JFNew completed a Master Plan for Management of the Griffy Lake Nature Preserve which includes a summary of recent water quality data. Most water quality data has been collected by the Indiana Clean Lakes Program, volunteer monitors, and Indiana University students as part of limnology class exercises. Data indicates that water quality in Griffy Lake has remained stable over the past 17 years. Water clarity in Griffy Lake rates as relatively good for the region, and is better than most lakes in Indiana. Since 1991, Secchi disk transparency has ranged from 4.0 feet in April 2006 to 23.0 feet in September 1999. Data collected by a variety of organizations confirms that clarity has remained relatively stable at Griffy Lake over the past 16 years (JFNew 2009).

5.0 PRESENT WATER BODY USES

Griffy Lake and the immediate surroundings are owned by the city of Bloomington and managed by the Bloomington Parks and Recreation department. Griffy Lake is still maintained as a back-up water supply to the city of Bloomington even though the water treatment plant was decommissioned in 1995 (JFNew 2008). There are no permanent dwellings on the shoreline of Griffy Lake. Griffy Lake attracts numerous visitors from the Bloomington area. It is a very popular place for boating, fishing, picnicking, hiking, and environmental education.

On June 15-17, 2009, IDNR completed a fish community survey on Griffy Lake to monitor the fisheries response to the whole lake fluridone treatments in 2006 and 2007.

The survey report was not yet complete at the time this report was written, but the following is a summary of the report provided by IDNR District Fisheries Biologist Dave Kittaka.

A total of 616 fish with a total weight of 330.28 lb was collected. Ten species of fish were identified. Redear was most abundant (32%), followed by largemouth bass (28%), and bluegill (16%). Other species collected included: warmouth, longear sunfish, white suckers, yellow bullhead, channel catfish, black crappie, and black bullhead.

The most notable difference in the fishery since the previous survey in 2004 was the increased growth of bluegill and redear. Growth increased for all year classes of bluegill and redear. When comparing growth to past surveys in 2004 and 1997 there was a significant increase in growth for both species for ages 2 and 3 or year classes 2006 and 2007. This corresponds with the whole lake fluridone treatment for Brazilian Elodea.

Using the same test there was a significant decrease in growth for bass. However, the catch rates improved since 2004. As prey fish became more available, as a result of the whole lake treatment, bass recruitment may have increased and actually reduced growth as the bass population increased beyond the food source.

Griffy Lake continues to provide excellent panfishing opportunities. The high number of bass will continue to provide adequate predation on the bluegill and redear ensuring good growth for these species. Current aquatic vegetation management practices will target invasive species while maintaining native plant diversity (Dave Kittaka-IDNR District Fisheries Biologist, personal communication, December 1, 2009).

6.0 AQUATIC VEGETATION SAMPLING RESULTS

Five different plant surveys were completed on Griffy Lake in 2009. Aquatic Control completed Invasive Species Mapping Surveys on April 9 and May 7, and Tier 2 surveys on May 7, June 30, and August 18.

6.1 Invasive Species Mapping Surveys

6.1.1 Invasive Species Mapping Survey-April 9, 2009

An Invasive Species Mapping Survey was completed on April 9th in order to locate areas of curlyleaf pondweed and Eurasian watermilfoil prior to treatment. Littoral zone areas were surveyed with a 16 ft aluminum boat equipped with an outboard motor and sonar devices. The boat was driven in a zigzag pattern over the littoral area. Rakes were tossed on numerous occasions and visual observations were made. Waypoints were recorded when the survey crew encountered either curlyleaf pondweed or Eurasian watermilfoil. This data was used to create a map identifying areas of invasive species. No Brazilian elodea was detected during the survey. However, curlyleaf pondweed was found to scattered throughout a 17.8 acre area (Figure 3). Eurasian watermilfoil was observed growing in a 0.25 acre area on the north side of the lake (Figure 4).

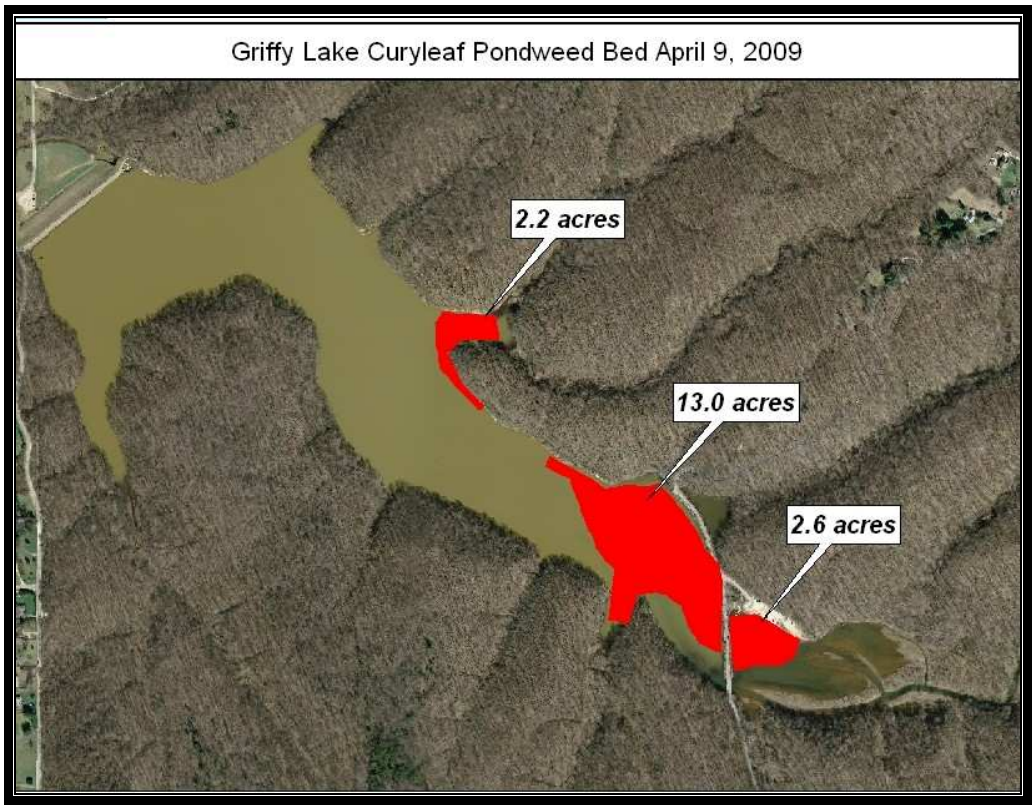


Figure 3. Griffy Lake, curlyleaf pondweed beds, April 9, 2009.

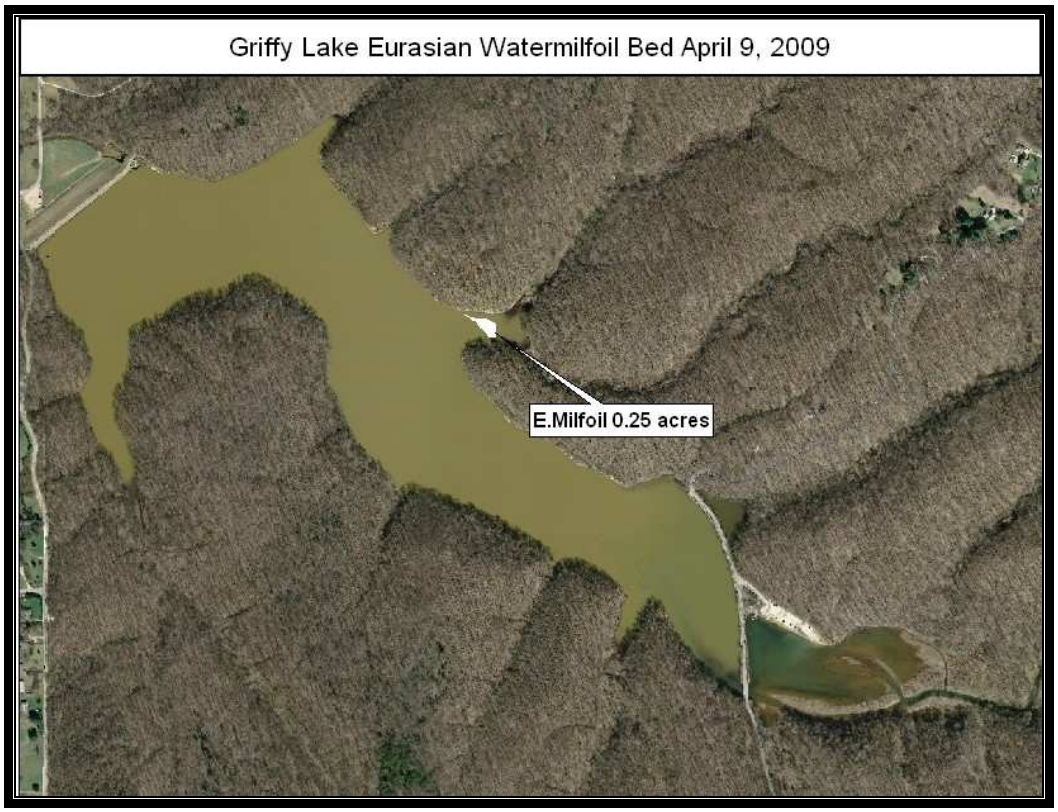


Figure 4. Griffy Lake, Eurasian watermilfoil bed, April 9, 2009.

6.1.2 Invasive Species Mapping Survey-May 7, 2009

An unscheduled Invasive Species Mapping Survey was completed on May 7th. This survey was completed due to the abundance of milfoil and curlyleaf pondweed which was noticed during the Tier 2 survey. Curlyleaf pondweed had been treated on April 15th and appeared to be damaged. However, the fact that it was still present at the same density as it was in early April was concerning and warranted mapping and possible retreatment. A total of 13.5 acres of curlyleaf pondweed was documented (Figure 5). Eurasian watermilfoil had expanded at a rapid rate since the April survey. It was now found encompassing a 25.4 acre area (Figure 6). These areas were chemically treated shortly after the survey.

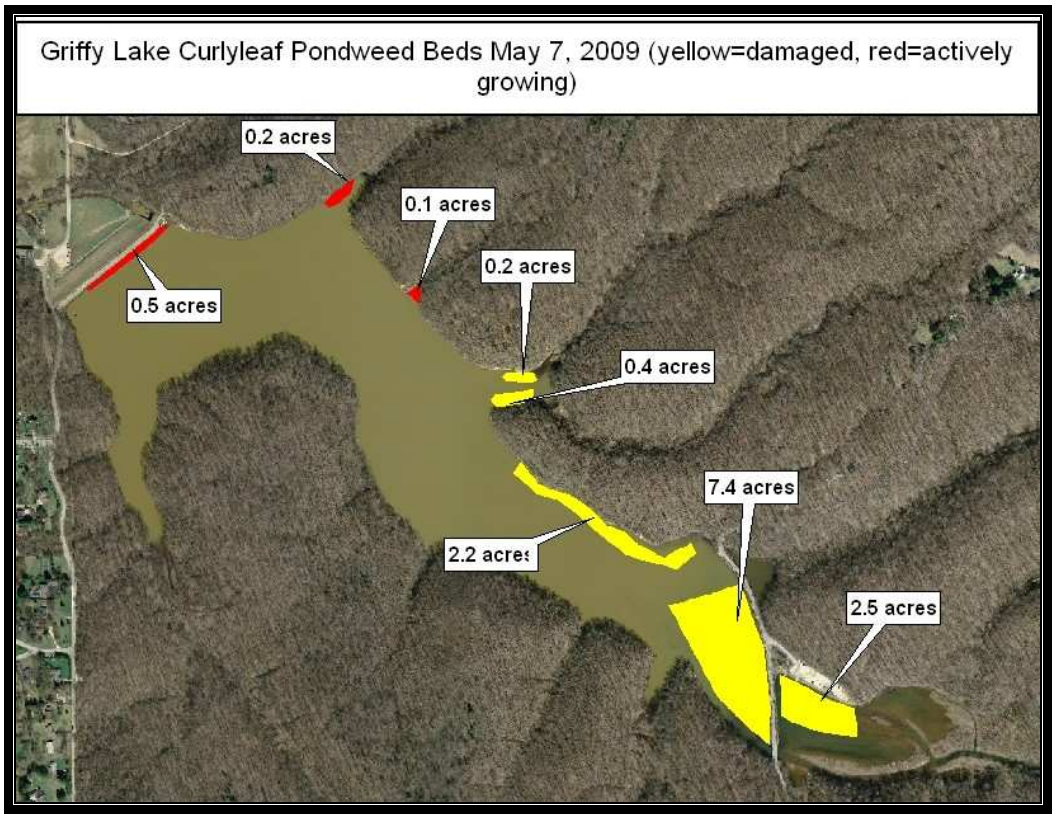


Figure 5. Griffy Lake, curlyleaf pondweed beds, May 7, 2009 (yellow area=damaged or browning plants, red areas=green or actively growing plants).

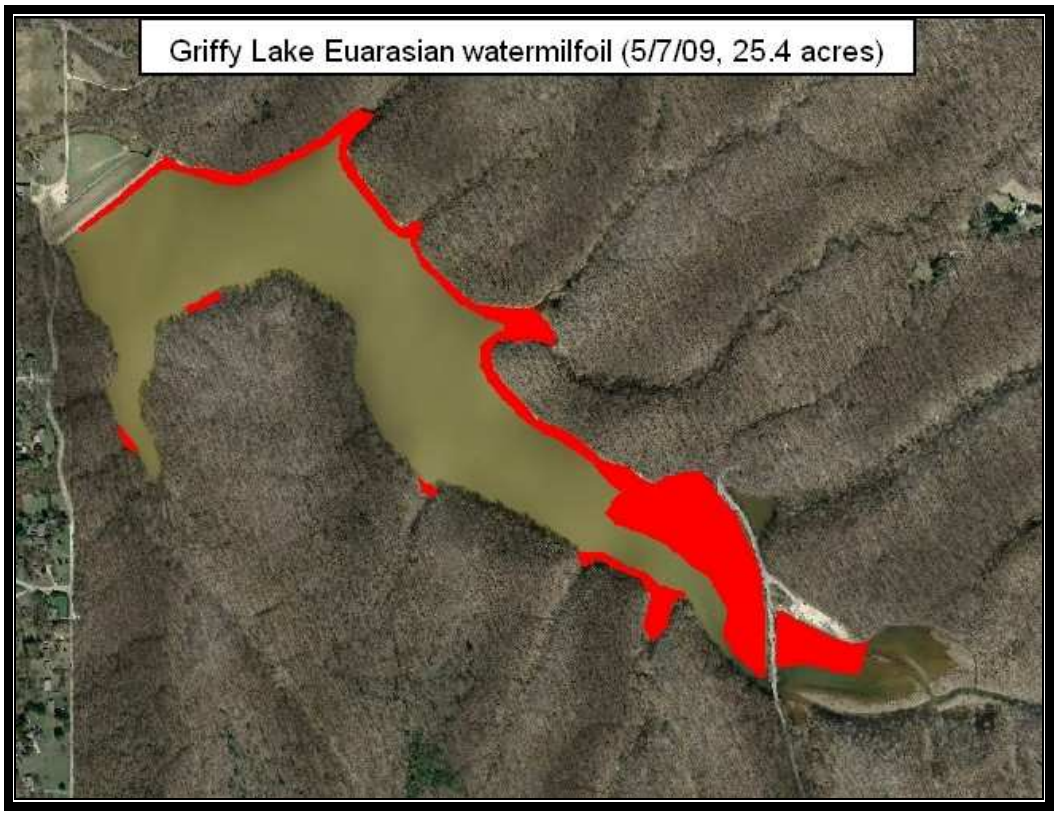


Figure 6. Griffy Lake, Eurasian watermilfoil beds, May 7, 2009.

6.2 Tier 2 Surveys

Three Tier 2 surveys were completed in 2009. The primary purpose of these surveys was to detect any remaining Brazilian elodea. In addition, the surveys also served as a tool to track the recovery of the native plant community following the 2006 and 2007 whole lake treatments. The 2009 Tier 2 protocol was the same as 2007 and 2008 (IDNR 2007) and the same 100 points that were sampled in 2007 and 2008 were again used in the 2009 surveys. These Tier 2 surveys deviated from typical Tier 2 surveys due to the need for detection of Brazilian elodea.

6.2.1 Tier 2 Survey-May 7, 2009

Aquatic Control completed a Tier 2 survey on May 7, 2009. A dissolved oxygen temperature profile was taken near the dam and the results are summarized in Table 2. A Secchi disk reading of 16.0 feet was recorded at the same location.

Table 2. Griffy Lake, Dissolved Oxygen/Temperature Profile, May 7, 2009.

Depth (ft)	Temperature (F)	Dissolved Oxygen (mg/L)
0	65.2	9.6
3	65.1	9.7
6	65.0	9.7
9	61.9	10.0
12	59.0	10.1
15	57.2	9.7
18	54.7	8.9
21	51.3	5.8
24	49.9	3.5
27	48.7	1.3
30	48.3	0.5

The results of the sampling are located in Table 3. The same 100 sites that were sampled in 2008 were sampled again in this survey in order to allow for an accurate comparison. Submersed vegetation was collected at 55% of the sites and plants were growing to a maximum depth of 13.0 feet. Nine species were collected of which seven were native. Chara (*Chara sp.)* occurred at the highest number of sites overall sites and had the highest percent occurrence at all depth ranges (Figure 7). Eurasian watermilfoil was the second most abundant species overall (Figure 8). Southern naiad (*Najas guadalupensis*) ranked third in overall percent occurrence (Figure 9), followed by curlyleaf pondweed (Figure 10), common coontail (*Ceratophyllum demersum*) (Figure 11), and elodea (*Elodea canadensis*). Horned pondweed (*Zannichellia palustris*) (Figure 12), a state threatened species was found at 4% of sites. Leafy pondweed (*Potamogeton foliosus*) and sago pondweed (*Potamogeton pectinatus*) were collected at only two sites. The 0-5 foot depth range had the highest diversity and abundance of vegetation. American water willow (*Justicia americana*) and false loosestrife (*Ludwigia palustris*) were observed but not collected.

Table 3. Griffy Lake, Tier 2 survey results May 7, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (all depths).

County:	Monroe	Total Sites:	100	Mean species/site:	0.83
Date:	5/7/09	Sites with plants:	55	SE Mean species/site:	0.09
Secchi (ft):	16	Sites with native plants:	45	Mean native species/site:	0.55
Max Plant Depth (ft):	13	Number of species:	9	SE Mean natives/site:	0.07
Trophic Status:	Meso	# of native species:	7	Species diversity:	0.83
		Maximum species/site:	4	Native species diversity:	0.74

All Depths (0 to 13 ft)	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Chara	23.0	77.0	17.0	2.0	4.0	8.6
Eurasian watermilfoil	16.0	84.0	14.0	2.0	0.0	4.0
Southern naiad	14.0	86.0	14.0	0.0	0.0	2.8
Curlyleaf pondweed	12.0	88.0	12.0	0.0	0.0	2.4
Coontail	4.0	96.0	4.0	0.0	0.0	0.8
Elodea	4.0	96.0	4.0	0.0	0.0	0.8
Horned pondweed	4.0	96.0	4.0	0.0	0.0	0.8
Leafy pondweed	4.0	96.0	4.0	0.0	0.0	0.8
Sago Pondweed	2.0	98.0	2.0	0.0	0.0	0.4

Other species observed: water willow & false loosestrife

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (0-5 ft).

County:	Monroe	Total Sites:	28	Mean species/site:	1.14
Date:	5/7/09	Sites with plants:	20	SE Mean species/site:	0.18
Secchi (ft):	16	Sites with native plants:	17	Mean native species/site:	0.79
Max Plant Depth (ft):	13	Number of species:	8	SE Mean natives/site:	0.14
Trophic Status:	Meso	# of native species:	6	Species diversity:	0.85
		Maximum species/site:	3	Native diversity:	0.79

Depth: 0 to 5 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Chara	25.0	75.0	17.9	0.0	7.1	10.7
Eurasian watermilfoil	21.4	78.6	17.9	3.6	0.0	5.7
Curlyleaf pondweed	14.3	85.7	14.3	0.0	0.0	2.9
Horned pondweed	14.3	85.7	14.3	0.0	0.0	2.9
Southern naiad	14.3	85.7	14.3	0.0	0.0	2.9
Elodea	10.7	89.3	10.7	0.0	0.0	2.1
Leafy pondweed	10.7	89.3	10.7	0.0	0.0	2.1
Sago Pondweed	3.6	96.4	3.6	0.0	0.0	0.7

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (5-10 ft).

County:	Monroe	Total Sites:	52	Mean species/site:	0.87
Date:	5/7/09	Sites with plants:	30	SE Mean species/site:	0.13
Secchi (ft):	16	Sites with native plants:	24	Mean native species/site:	0.54
Max Plant Depth (ft):	13	Number of species:	8	SE Mean natives/site:	0.09
Trophic Status:	Meso	# of native species:	6	Species diversity:	0.80
		Maximum species/site:	4	Native diversity:	0.67

Depth: 5 to 10 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Chara	23.1	76.9	15.4	3.8	3.8	9.2
Eurasian watermilfoil	19.2	80.8	17.3	1.9	0.0	4.6
Southern naiad	19.2	80.8	19.2	0.0	0.0	3.8
Curlyleaf pondweed	13.5	86.5	13.5	0.0	0.0	2.7
Coontail	5.8	94.2	5.8	0.0	0.0	1.2
Elodea	1.9	98.1	1.9	0.0	0.0	0.4
Leafy pondweed	1.9	98.1	1.9	0.0	0.0	0.4
Sago Pondweed	1.9	98.1	1.9	0.0	0.0	0.4

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (10-15 ft).

County:	Monroe	Total Sites:	16	Mean species/site:	0.38
Date:	5/7/09	Sites with plants:	5	SE Mean species/site:	0.15
Secchi (ft):	16	Sites with native plants:	4	Mean native species/site:	0.31
Max Plant Depth (ft):	13	Number of species:	3	SE Mean natives/site:	0.15
Trophic Status:	Meso	# of native species:	2	Species diversity:	0.50
		Maximum species/site:	2	Native diversity:	0.32

Depth: 10 to 15 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Chara	25.0	75.0	25.0	0.0	0.0	5.0
Coontail	6.3	93.8	6.3	0.0	0.0	1.3
Curlyleaf pondweed	6.3	93.8	6.3	0.0	0.0	1.3

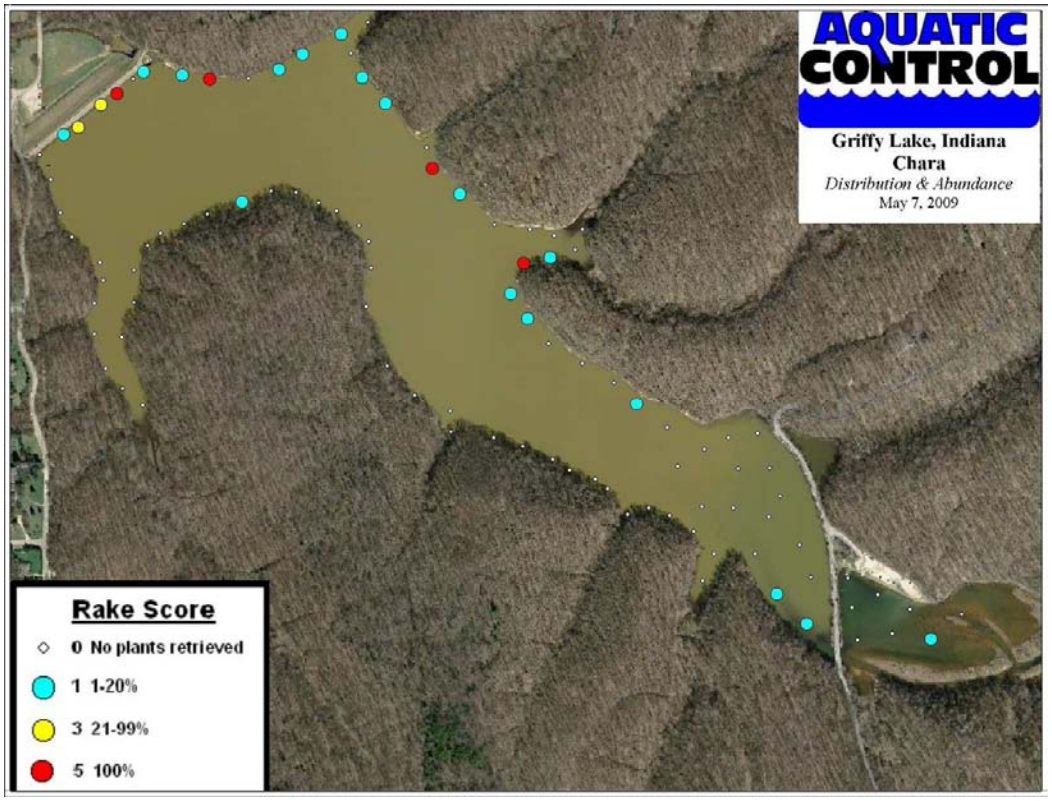


Figure 7. Griffy Lake, Chara distribution and abundance, May 7, 2009.

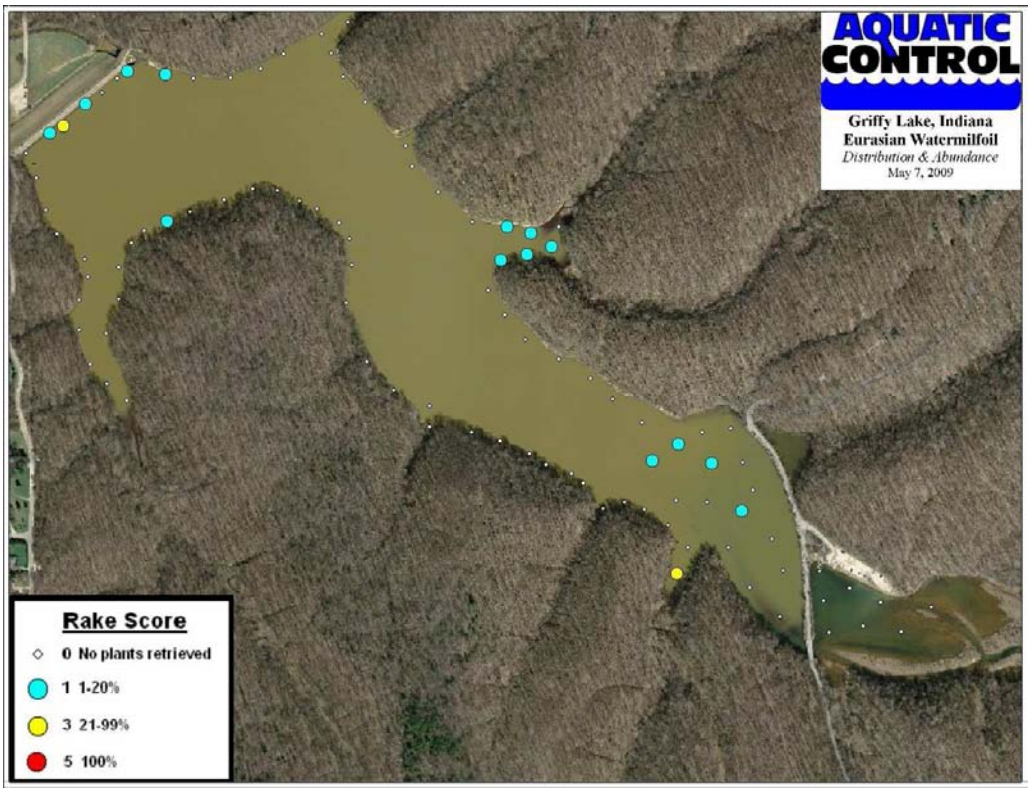


Figure 8. Griffy Lake, Eurasian watermilfoil distribution and abundance, May 7, 2009.

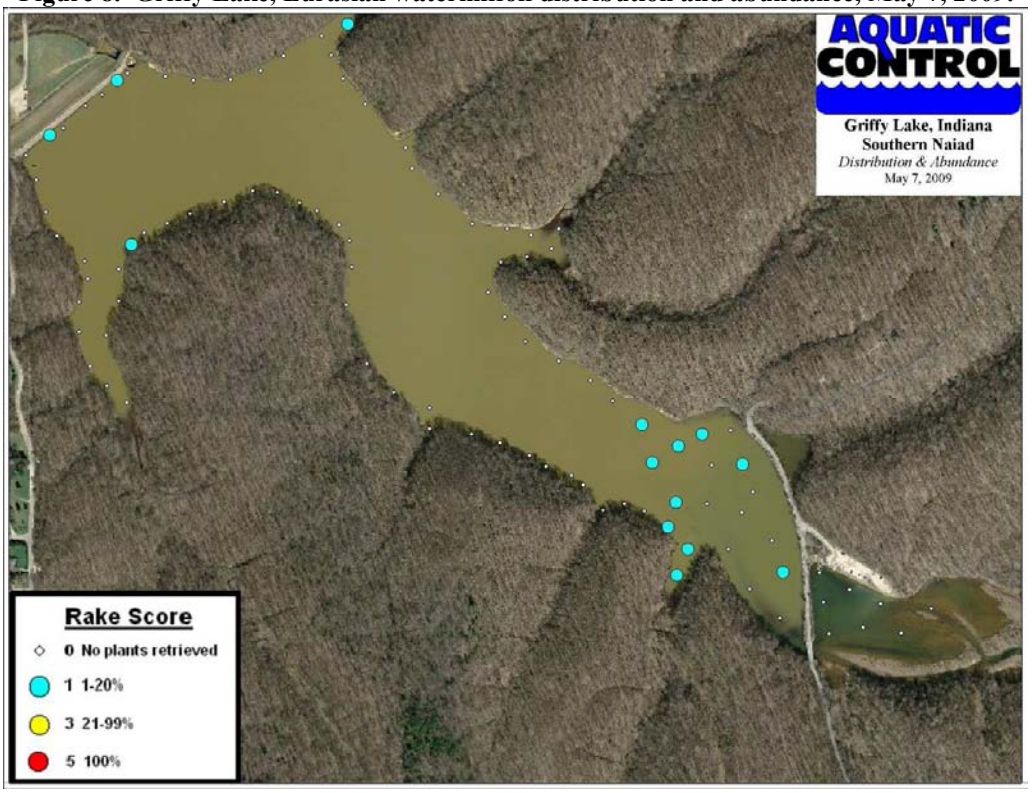


Figure 9. Griffy Lake, southern naiad distribution and abundance, May 7, 2009.

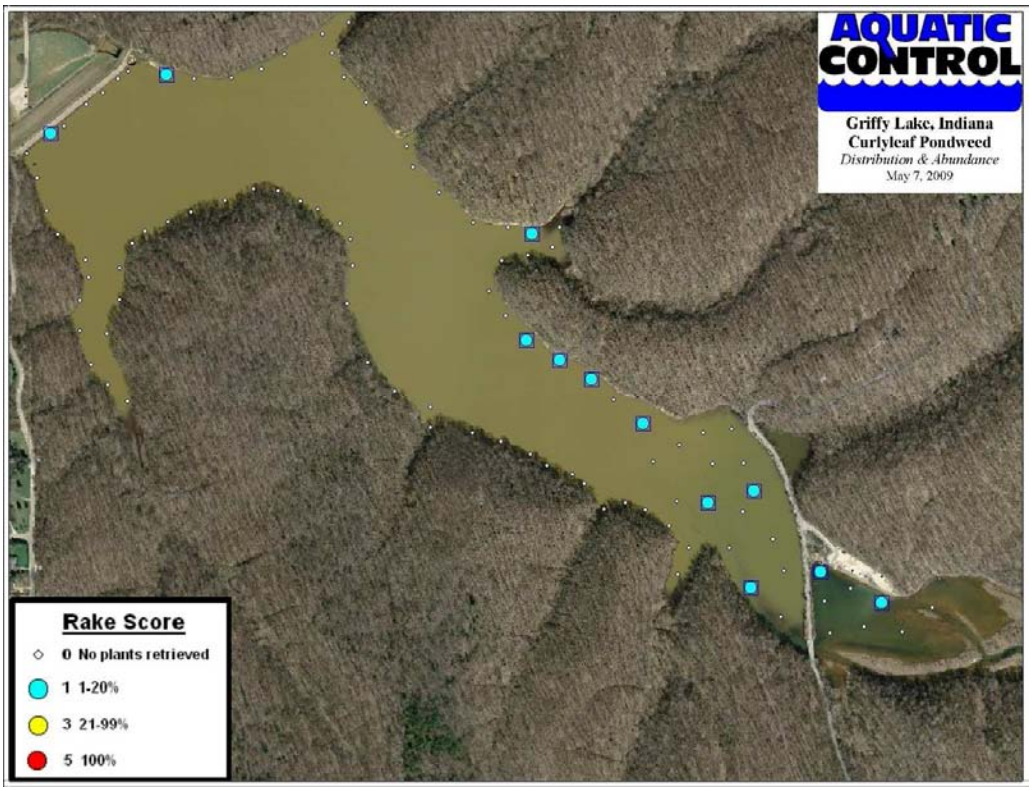


Figure 10. Griffy Lake, curlyleaf pondweed distribution and abundance, May 7, 2009.

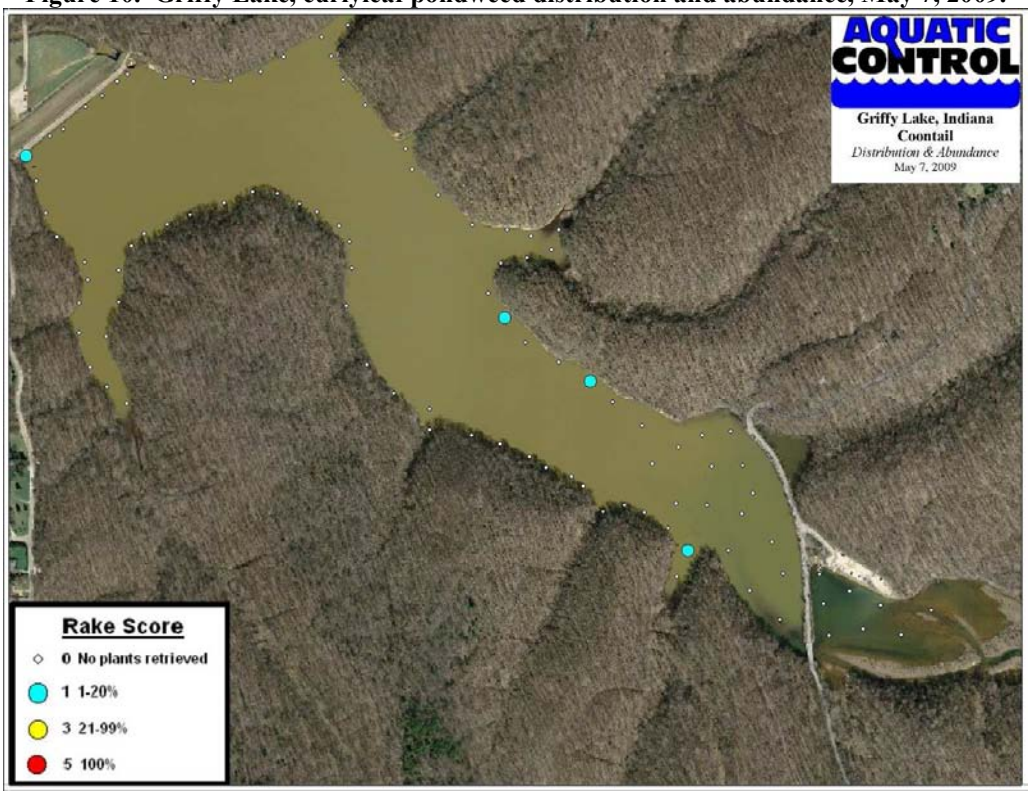


Figure 11. Griffy Lake, common coontail distribution and abundance, May 7, 2009.

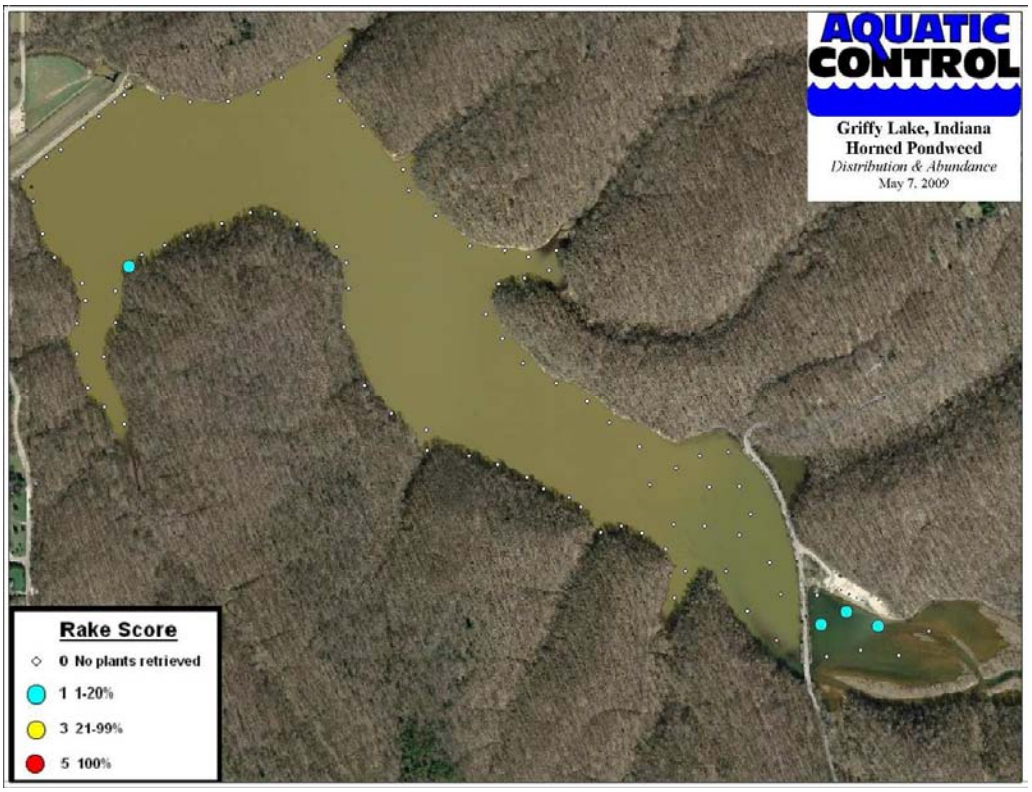


Figure 12. Griffy Lake, horned pondweed distribution and abundance, May 7, 2009.

6.2.2 Tier 2 Survey-June 30, 2009

Aquatic Control completed the second Tier 2 survey on June 30, 2009. A dissolved oxygen temperature profile was taken near the dam and the results are summarized in Table 4. A Secchi disk reading of 11.0 feet was recorded at the same location.

Table 4. Griffy Lake, dissolved oxygen/temperature profile, June 30, 2009.

Depth (ft)	Temperature (F)	Dissolved Oxygen (mg/L)
0	78.8	6.7
3	79.5	6.7
6	79.8	6.6
9	77.1	4.7
12	72.7	3.8
15	65.5	3.7
18	60.9	3.0
21	57.1	0.6
24	55.4	0.4
27	54.0	0.3
30	52.1	0.2

The same 100 sites were sampled and submersed vegetation was collected at 58% of the sites and plants were growing to a maximum depth of 14.0 feet (Table 5). Nine species were collected of which 6 were native. Brittle and southern naiad each occurred at 35%

of the total sites ranking them first in percent occurrence (Figures 13 & 14). Chara ranked third in percent occurrence (Figure 15) followed by common coontail (Figure 16). Elodea ranked fifth in overall percent occurrence followed by horned pondweed (Figure 17), sago pondweed, Eurasian watermilfoil (Figure 20), and curlyleaf pondweed (Figure 21). The depth range with the highest diversity and abundance of vegetation was the 0-5 foot interval. Creeping water primrose (*Ludwigia peploides*), water willow, and cattail (*Typha sp*.) were observed but not collected.

Table 5. Griffy Lake Tier 2 survey results, June 30, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (all depths).

County:	Monroe	Total Sites:	100	Mean species/site:	1.16
Date:	6/30/09	Sites with plants:	58	SE Mean species/site:	0.12
Secchi (ft):	11	Sites with native plants:	50	Mean native species/site:	0.78
Max Plant Depth (ft):	14	Number of species:	9	SE Mean natives/site:	0.10
Trophic Status:	Meso	# of native species:	6	Species diversity:	0.78
		Maximum species/site:	5	Native species diversity:	0.71

All Depths (0 to 14 ft)	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Brittle naiad	35.0	65.0	24.0	10.0	1.0	11.8
Southern naiad	35.0	65.0	21.0	7.0	7.0	15.4
Chara	19.0	81.0	16.0	2.0	1.0	5.4
Coontail	12.0	88.0	11.0	1.0	0.0	2.8
Elodea	6.0	94.0	5.0	0.0	1.0	2.0
Horned pondweed	3.0	97.0	2.0	1.0	0.0	1.0
Sago pondweed	3.0	97.0	1.0	2.0	0.0	1.4
Eurasian watermilfoil	2.0	98.0	2.0	0.0	0.0	0.4
Curlyleaf Pondweed	1.0	99.0	1.0	0.0	0.0	0.2

Other species observed: creeping primrose, water willow, cattail

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (0-5 ft).

County:	Monroe	Total Sites:	18	Mean species/site:	2.11
Date:	6/30/09	Sites with plants:	17	SE Mean species/site:	0.31
Secchi (ft):	11	Sites with native plants:	16	Mean native species/site:	1.50
Max Plant Depth (ft):	14	Number of species:	7	SE Mean natives/site:	0.27
Trophic Status:	Meso	# of native species:	6	Species diversity:	0.77
		Maximum species/site:	5	Native diversity:	0.72

Depth: 0 to 5 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Southern naiad	66.7	33.3	44.4	11.1	11.1	26.7
Brittle naiad	61.1	38.9	38.9	16.7	5.6	23.3
Chara	27.8	72.2	27.8	0.0	0.0	5.6
Elodea	27.8	72.2	22.2	0.0	5.6	10.0
Horned pondweed	16.7	83.3	11.1	5.6	0.0	5.6
Coontail	5.6	94.4	5.6	0.0	0.0	1.1
Sago pondweed	5.6	94.4	0.0	5.6	0.0	3.3

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (5-10 ft).

County:	Monroe	Total Sites:	37	Mean species/site:	1.78
Date:	6/30/09	Sites with plants:	33	SE Mean species/site:	0.16
Secchi (ft):	11	Sites with native plants:	26	Mean native species/site:	1.05
Max Plant Depth (ft):	14	Number of species:	8	SE Mean natives/site:	0.14
Trophic Status:	Meso	# of native species:	5	Species diversity:	0.75
		Maximum species/site:	4	Native diversity:	0.66

Depth: 5 to 10 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Brittle naiad	64.9	35.1	45.9	18.9	0.0	20.5
Southern naiad	51.4	48.6	24.3	13.5	13.5	26.5
Coontail	24.3	75.7	21.6	2.7	0.0	5.9
Chara	21.6	78.4	18.9	2.7	0.0	5.4
Eurasian watermilfoil	5.4	94.6	5.4	0.0	0.0	1.1
Sago pondweed	5.4	94.6	2.7	2.7	0.0	2.2
Curlyleaf pondweed	2.7	97.3	2.7	0.0	0.0	0.5
Elodea	2.7	97.3	2.7	0.0	0.0	0.5

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (10-15 ft).

County:	Monroe	Total Sites:	38	Mean species/site:	0.32
Date:	6/30/09	Sites with plants:	8	SE Mean species/site:	0.11
Secchi (ft):	11	Sites with native plants:	8	Mean native species/site:	0.32
Max Plant Depth (ft):	14	Number of species:	3	SE Mean natives/site:	0.11
Trophic Status:	Meso	# of native species:	3	Species diversity:	0.61
		Maximum species/site:	3	Native diversity:	0.61

Depth: 10 to 15 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Chara	15.8	84.2	10.5	2.6	2.6	6.3
Southern naiad	10.5	89.5	10.5	0.0	0.0	2.1
Coontail	5.3	94.7	5.3	0.0	0.0	1.1

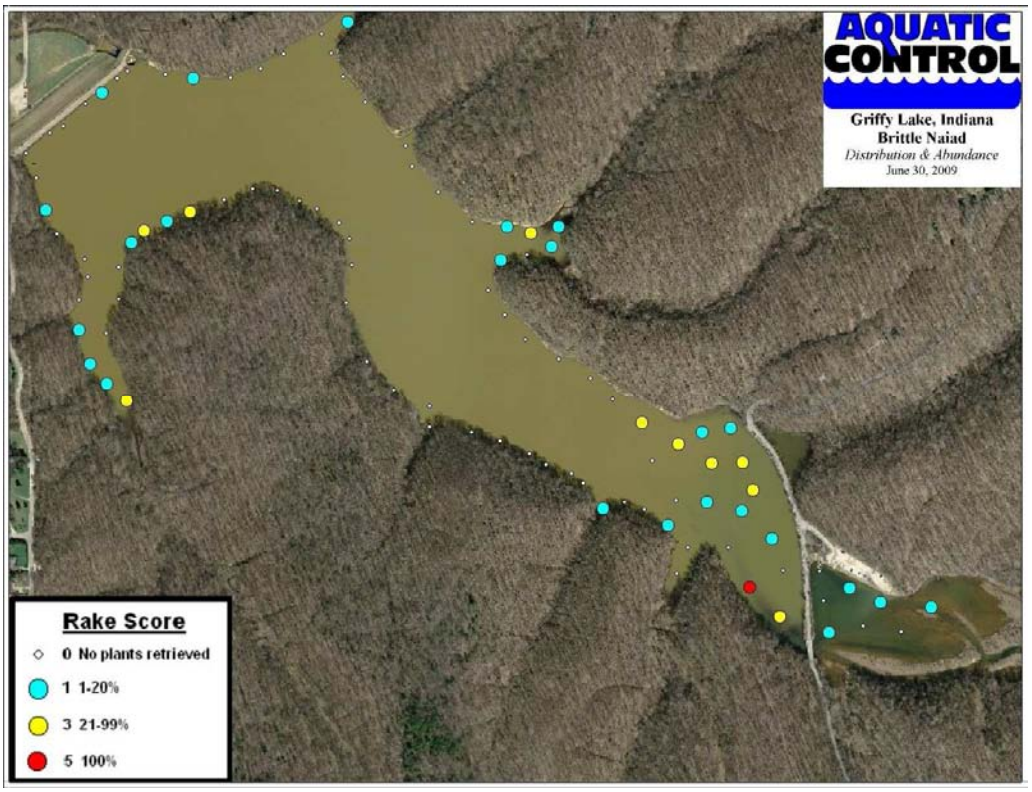


Figure 13. Griffy Lake, brittle naiad distribution and abundance, June 30, 2009.

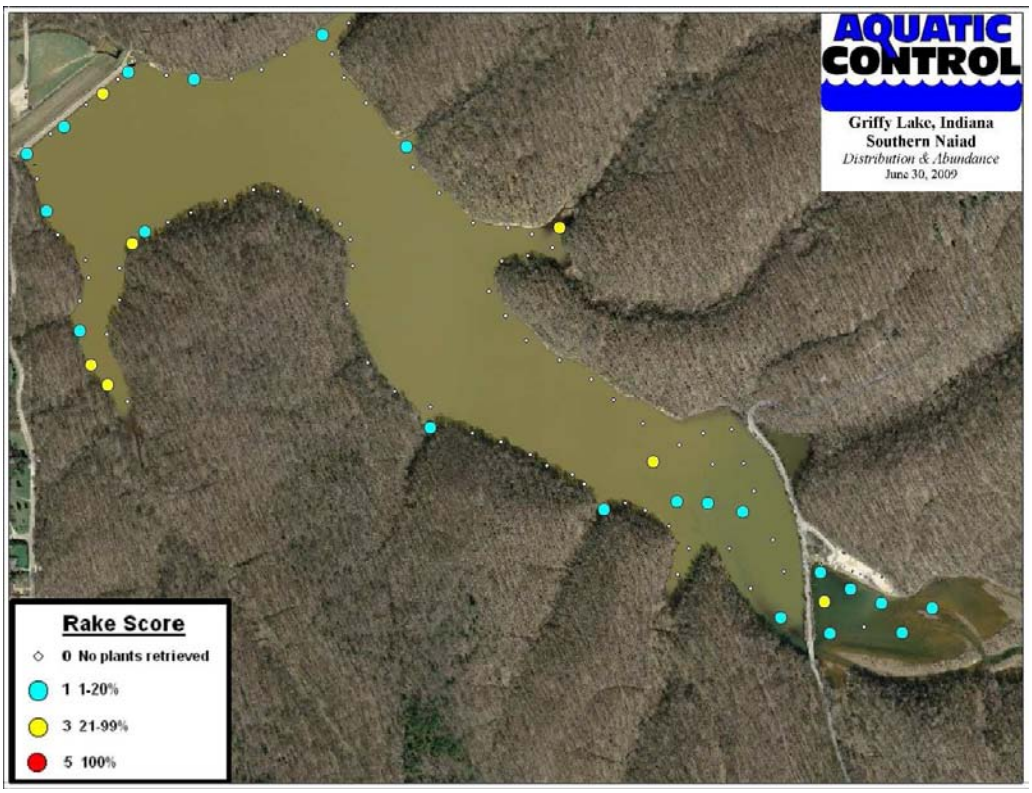


Figure 14. Griffy Lake, southern naiad distribution and abundance, June 30, 2009.

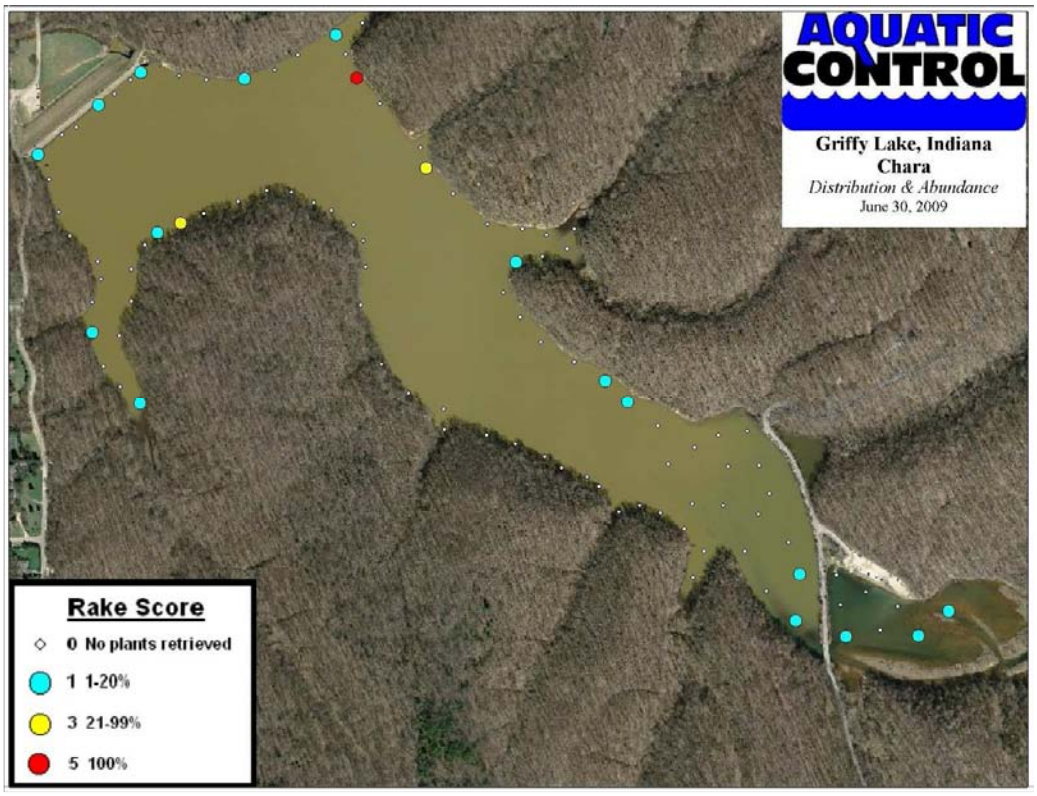


Figure 15. Griffy Lake, Chara distribution and abundance, June 30, 2009.

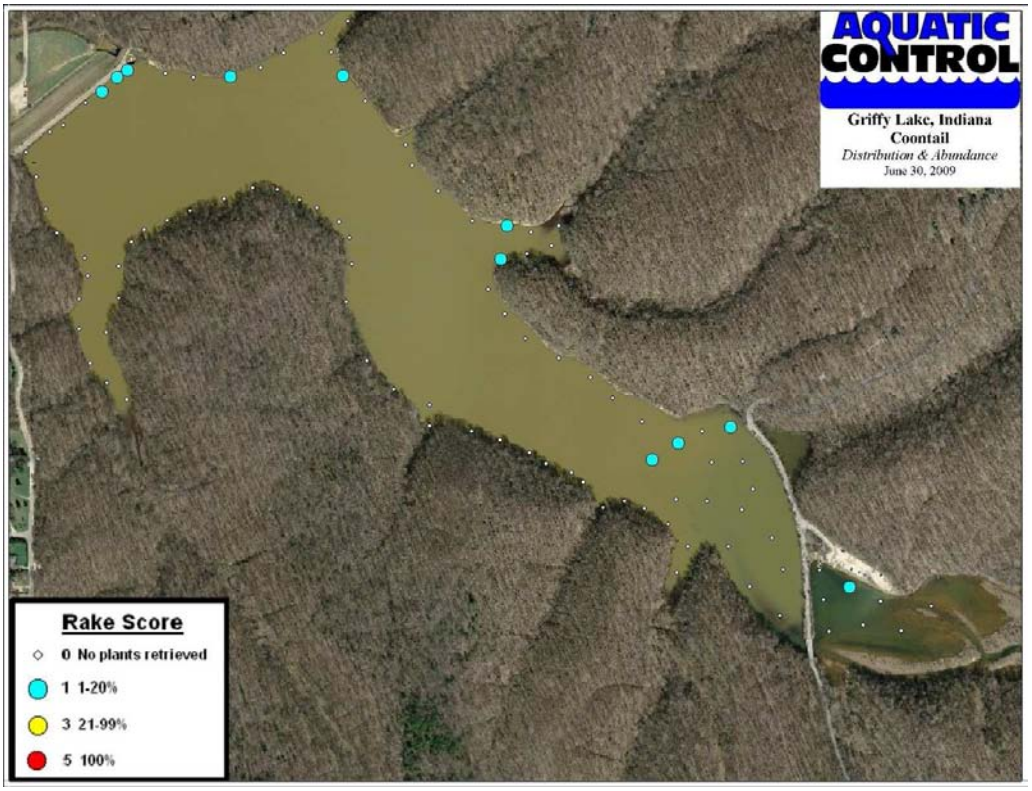


Figure 16. Griffy Lake, common coontail distribution and abundance, June 30, 2009.

Figure 17. Griffy Lake, horned pondweed distribution and abundance, June 30, 2009.

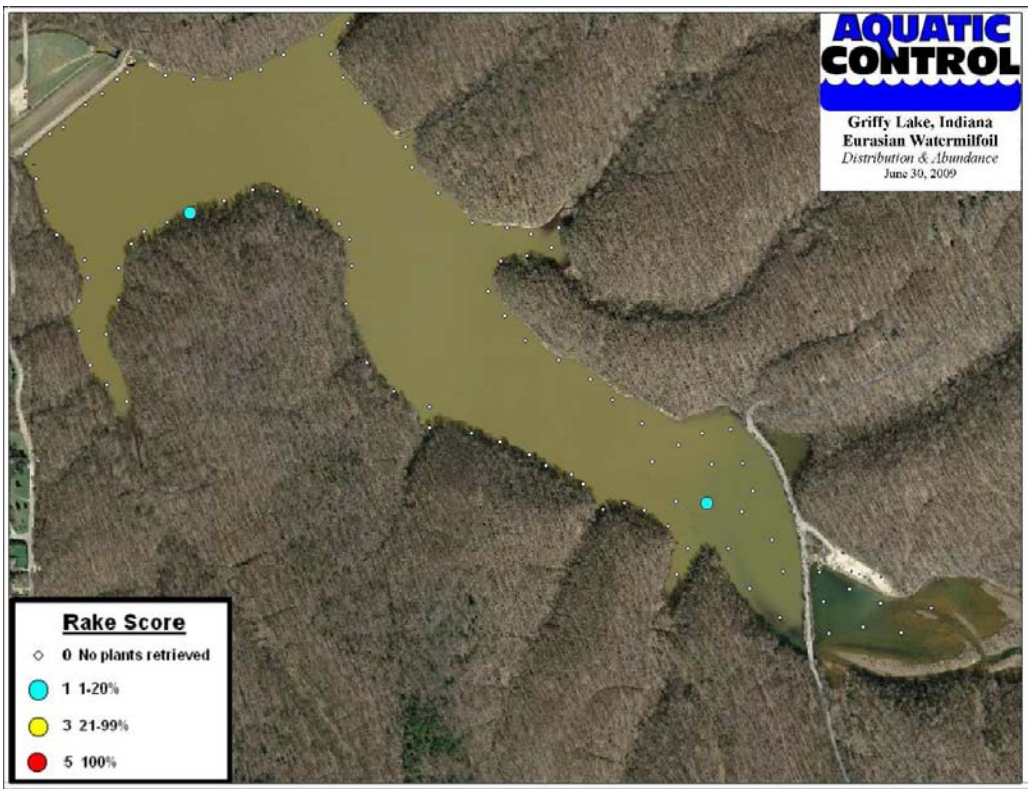


Figure 18. Griffy Lake, Eurasian watermilfoil distribution and abundance, June 30, 2009.

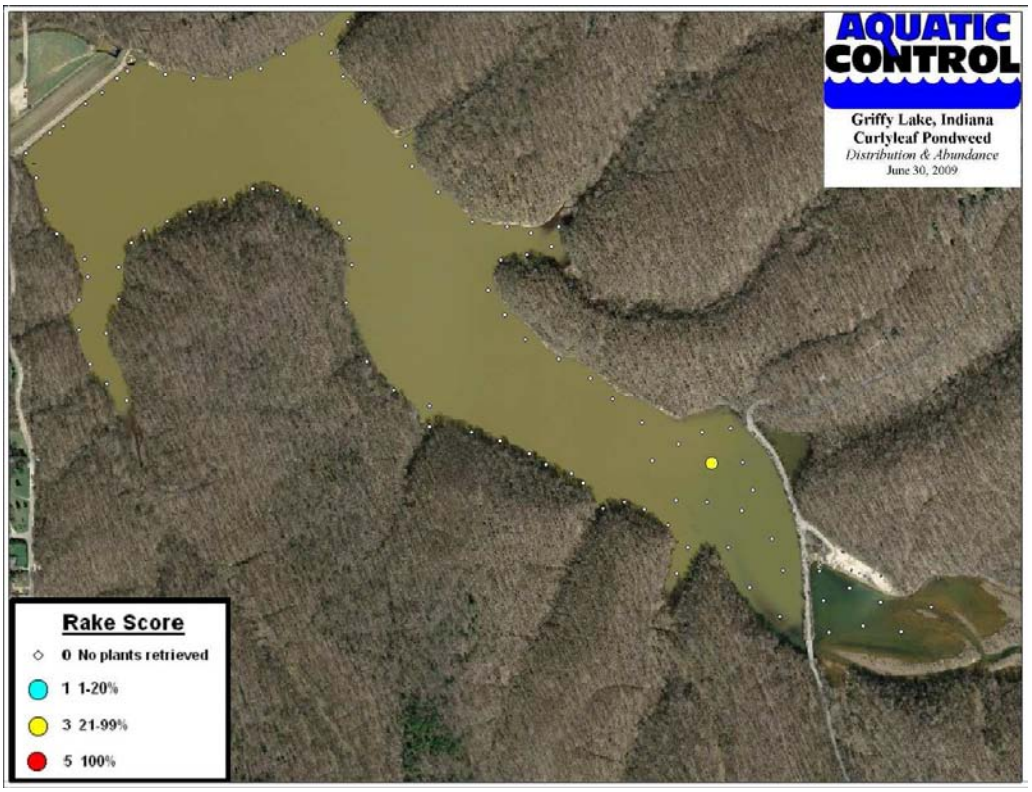


Figure 19. Griffy Lake, curlyleaf pondweed distribution and abundance, June 30, 2009.

6.2.3 Tier 2 Survey-August 18, 2009

Aquatic Control completed the final Tier 2 survey on August 18, 2009. Results of the dissolved oxygen/temperature profile are summarized in Table 6. A Secchi disk reading was taken two days after the survey and found to be 12.0 feet

Table 6. Griffy Lake, dissolved oxygen/temperature profile, August 18, 2009.

Depth (ft)	Temperature (F)	Dissolved Oxygen (mg/L)
0	81.6	9.4
3	82.1	8.6
6	82.1	8.2
9	81.4	10.0
12	77.5	9.0
15	71.6	4.3
18	66.2	2.2
21	61.6	1.1
24	58.0	0.7

The same 100 sites were sampled and submersed vegetation was present at 75% of the sites and growing to a maximum depth of 14.0 feet (Table 7). Ten species were collected of which 7 were native. Southern naiad occurred at the highest percentage of sites (Figure 20). Brittle naiad ranked second in percent occurrence (Figure 21) followed by common coontail (Figure 22), Chara (Figure 23), sago pondweed, elodea, small pondweed (*Potamogeton pusillus*), flatstem pondweed (*Potamogeton zosteriformis*),

curlyleaf pondweed (Figure 24), and Eurasian watermilfoil (Figure 25). Cattail, creeping water primrose, water willow, purple loosestrife (*Lythrum salicaria*), hibiscus (*Hibiscus sp.)*, and American pondweed (*Potamogeton nodosus*) were observed but not collected. The shallow water zone had the highest diversity and highest percentage of sites with vegetation.

Table 7. Griffy Lake Tier 2 survey results, August 18, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (all depths).

County:	Monroe	Total Sites:	100	Mean species/site:	1.43
Date:	8/18/09	Sites with plants:	75	SE Mean species/site:	0.12
Secchi (ft):	12	Sites with native plants:	66	Mean native species/site:	1.01
Max Plant Depth (ft):	14	Number of species:	10	SE Mean natives/site:	0.09
Trophic Status:	Meso	# of native species:	7	Species diversity:	0.74
		Maximum species/site:	5	Native species diversity:	0.64

All Depths (0 to 14 ft)	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Southern naiad	56.0	44.0	22.0	11.0	23.0	34.0
Brittle naiad	40.0	60.0	17.0	5.0	18.0	24.4
Coontail	18.0	82.0	13.0	3.0	2.0	6.4
Chara	8.0	92.0	4.0	3.0	1.0	3.6
Sago pondweed	7.0	93.0	4.0	0.0	3.0	3.8
Elodea	5.0	95.0	4.0	1.0	0.0	1.4
Small pondweed	5.0	95.0	4.0	0.0	1.0	1.8
Flatstem pondweed	2.0	98.0	2.0	0.0	0.0	0.4
Curlyleaf pondweed	1.0	99.0	1.0	0.0	0.0	0.2
Eurasian watermilfoil	1.0	99.0	1.0	0.0	0.0	0.2

Other species observed: Cattail, creeping water primrose, Hibiscus, water willow, purple loosestrife, American pondweed

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (0-5 ft).

County:	Monroe	Total Sites:	25	Mean species/site:	2.04
Date:	8/18/09	Sites with plants:	23	SE Mean species/site:	0.25
Secchi (ft):	12	Sites with native plants:	21	Mean native species/site:	1.36
Max Plant Depth (ft):	14	Number of species:	9	SE Mean natives/site:	0.19
Trophic Status:	Meso	# of native species:	7	Species diversity:	0.74
		Maximum species/site:	5	Native diversity:	0.64

Depth: 0 to 5 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Southern naiad	76	24	16	20	40	55.2
Brittle naiad	64	36	20	12	32	43.2
Elodea	20	80	16	4	0	5.6
Coontail	16	84	12	4	0	4.8
Sago pondweed	12	88	8	0	4	5.6
Chara	4.0	96.0	4.0	0.0	0.0	0.8
Curlyleaf pondweed	4.0	96.0	4.0	0.0	0.0	0.8
Flatstem pondweed	4.0	96.0	4.0	0.0	0.0	0.8
Small pondweed	4.0	96.0	4.0	0.0	0.0	0.8

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (5-10 ft).

County:	Monroe	Total Sites:	46	Mean species/site:	1.61
Date:	8/18/09	Sites with plants:	40	SE Mean species/site:	0.15
Secchi (ft):	12	Sites with native plants:	33	Mean native species/site:	1.13
Max Plant Depth (ft):	14	Number of species:	8	SE Mean natives/site:	0.13
Trophic Status:	Meso	# of native species:	6	Species diversity:	0.72
		Maximum species/site:	4	Native diversity:	0.61

Depth: 5 to 10 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Southern naiad	67.4	32.6	32.6	8.7	26.1	37.8
Brittle naiad	45.7	54.3	19.6	4.3	21.7	28.3
Chara	13.0	87.0	4.3	6.5	2.2	7.0
Coontail	13.0	87.0	6.5	2.2	4.3	7.0
Sago pondweed	8.7	91.3	4.3	0.0	4.3	5.2
Small pondweed	8.7	91.3	6.5	0.0	2.2	3.5
Eurasian watermilfoil	2.2	97.8	2.2	0.0	0.0	0.4
Flatstem pondweed	2.2	97.8	2.2	0.0	0.0	0.4

Occurrence and Abundance of Submersed Aquatic Plants in Griffy Lake (10-15 ft).

County:	Monroe	Total Sites:	25	Mean species/site:	0.72
Date:	8/18/09	Sites with plants:	12	SE Mean species/site:	0.18
Secchi (ft):	12	Sites with native plants:	12	Mean native species/site:	0.60
Max Plant Depth (ft):	14	Number of species:	4	SE Mean natives/site:	0.14
Trophic Status:	Meso	# of native species:	3	Species diversity:	0.66
		Maximum species/site:	3	Native diversity:	0.55

Depth: 10 to 15 ft	Frequency of Occurrence	Rake score frequency per sp.				Plant Dominance
Species		**0**	**1**	**3**	**5**	
Coontail	32	68	28	4	0	8.00
Southern naiad	24	76	12	8	4	11.20
Brittle naiad	12	88	12	0	0	2.40
Chara	4	96	4	0	0	0.80

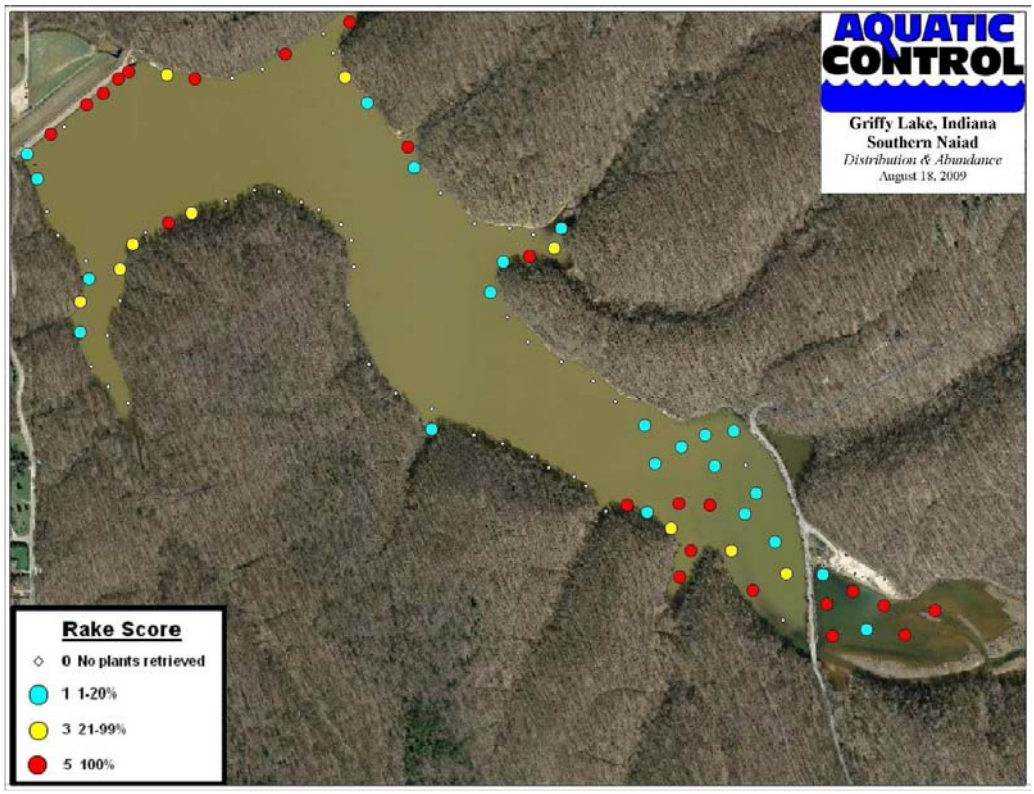


Figure 20. Griffy Lake, southern naiad distribution and abundance, August 18, 2009.

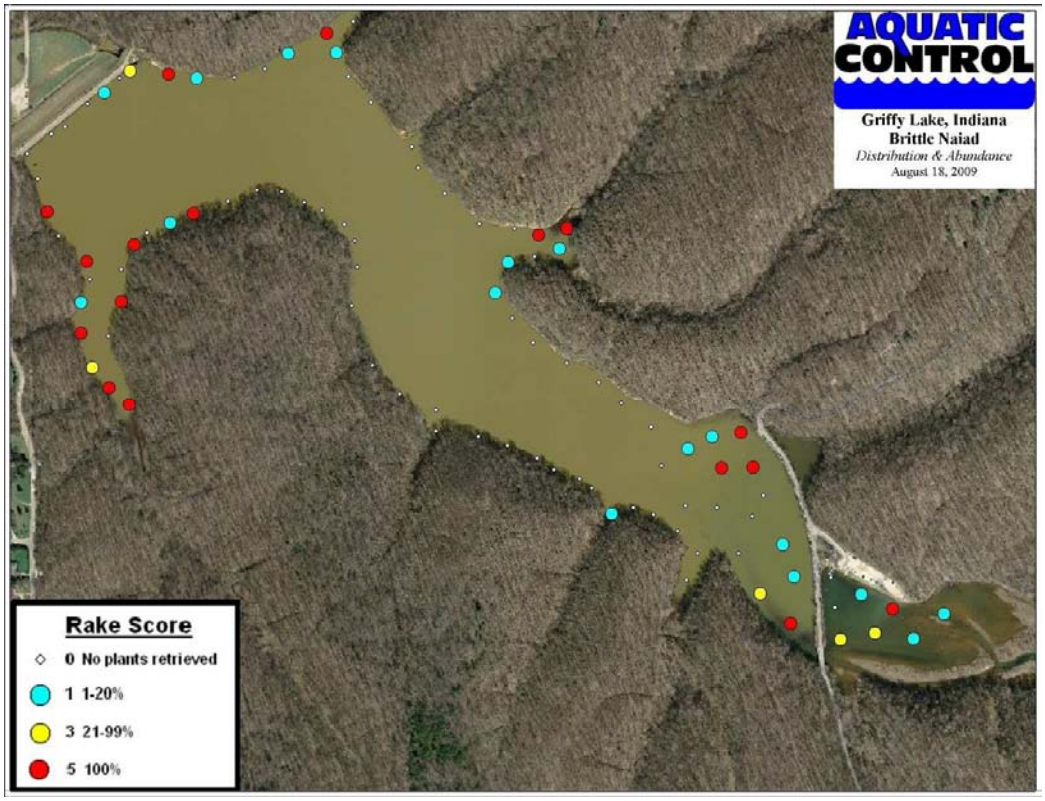


Figure 21. Griffy Lake, brittle naiad distribution and abundance, August 18, 2009.

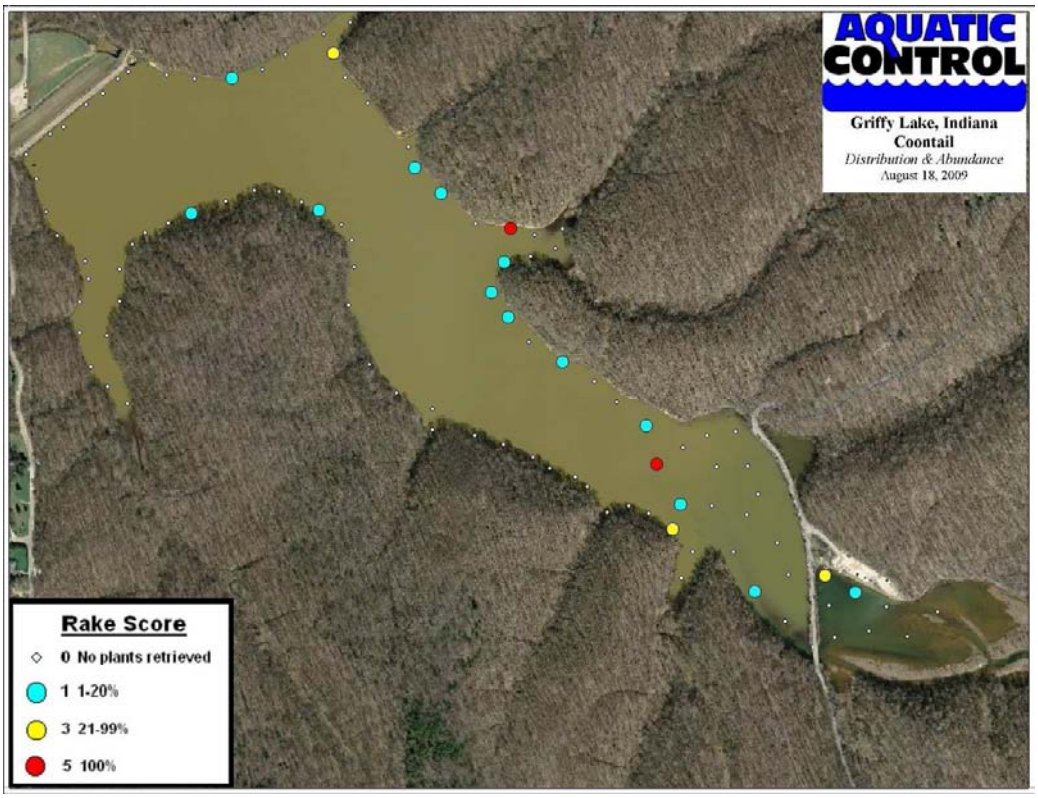


Figure 22. Griffy Lake, coontail distribution and abundance, August 18, 2009.

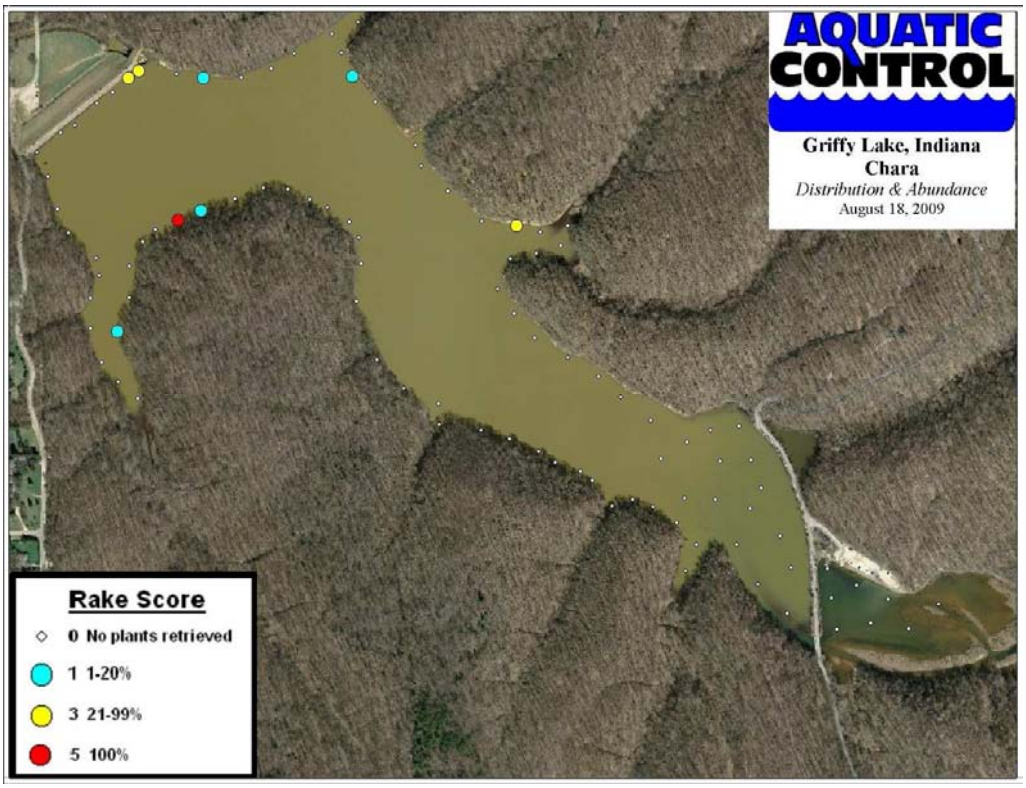


Figure 23. Griffy Lake, Chara distribution and abundance, August 18, 2009.

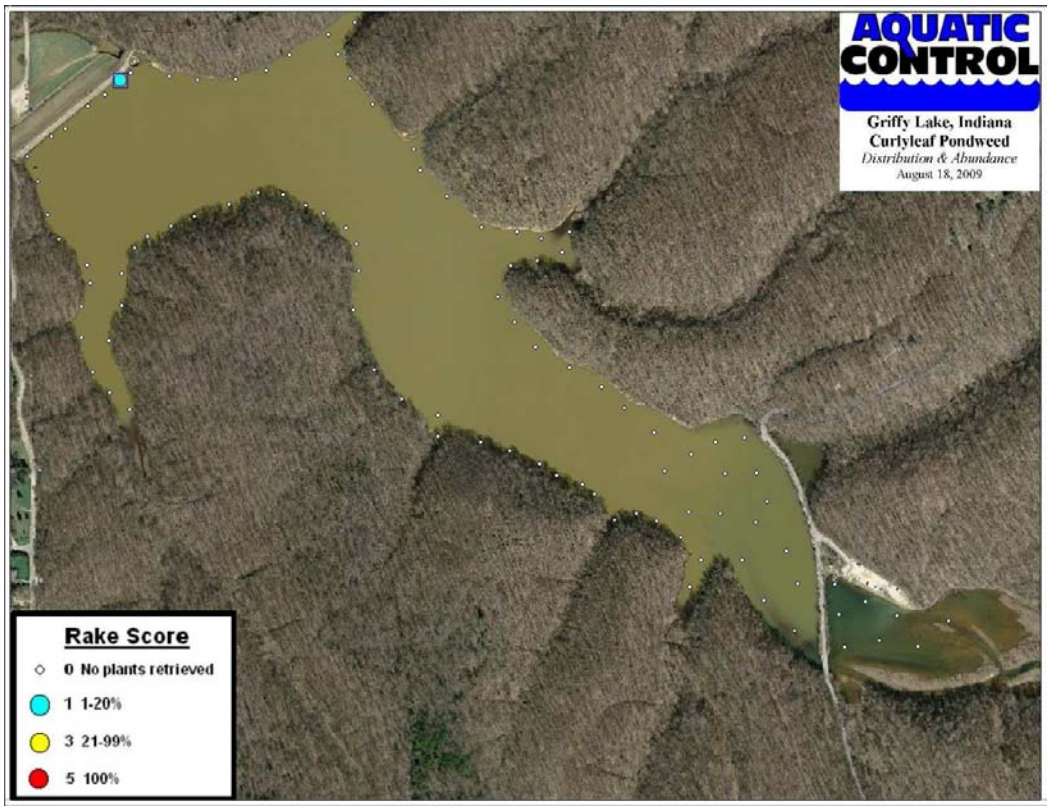


Figure 24. Griffy Lake, curlyleaf pondweed distribution and abundance, August 18, 2009.

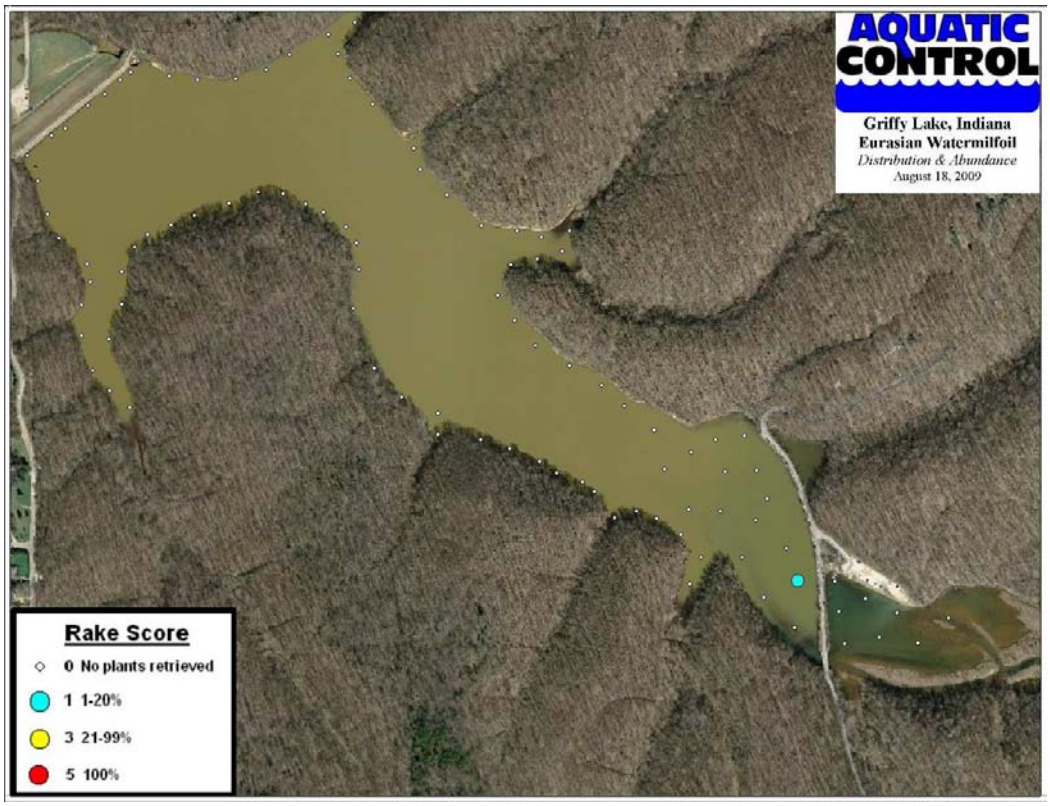


Figure 25. Griffy Lake, Eurasian watermilfoil distribution and abundance, August 18, 2009.

6.3 Aquatic Vegetation Sampling Discussion

As previously mentioned, the primary goal of the vegetation management plan is the eradication of Brazilian elodea. In order to meet this goal, whole lake fluridone treatments were completed in 2006 and 2007. The primary focus of the 2008 and 2009 sampling was on the detection of Brazilian elodea and none was detected. It appears that Brazilian elodea is no longer present in Griffy Lake.

Brazilian elodea was not the only invasive species found during previous sampling. Eurasian watermilfoil was also abundant prior to the fluridone applications. This species is very susceptible to fluridone at low rates and was not collected during the August 2006 or 2007 sampling. However, following the 2008 flood events, milfoil was detected in Griffy Lake. It is likely that this species is present in the watershed, but the location has yet to be discovered. Milfoil returned in 2009 and was approaching pre-whole lake fluridone treatment levels. However, treatments completed in May reduced milfoil occurrence from 19% in early May to 2% in late June and 1% by August.

Curlyleaf pondweed is another invasive species in Griffy Lake. This plant was damaged by the fluridone treatments but returned in 2008, but likely returned due to the presence of reproductive structures called turions (curlyleaf pondweed turions are not affected by herbicide and can remain viable in the bottom sediments for several years). Treatments in 2008 and 2009 appeared to be effective at controlling this plant and likely prevented production of new turions. Controls should continue in order to prevent this species from spreading to areas previously occupied by Eurasian watermilfoil and Brazilian elodea.

Brittle naiad is an exotic species that appears to have expanded in Griffy Lake in the past three seasons. This species was present in Griffy Lake prior to the fluridone treatments, but was not as abundant as Eurasian watermilfoil, curlyleaf pondweed, or Brazilian elodea. Due to this plants ability to reproduce through seed production it appears that it is replacing the other invasive species in many areas of the lake. This is exhibited by the five-fold increase in percent occurrence observed from July to August of 2008. Brittle naiad percent occurrence appears to have decreased in 2009 and may continue to decrease as native species become more abundant.

Several native species also increased in abundance this season. Chara is now present at a higher percentage of sample sites than it was prior to the whole lake treatment. Common coontail has increased since the treatment but is still not at pre-treatment levels. Flatstem pondweed, American elodea and southern naiad were detected post whole lake treatment, but were not detected prior to treatment. Overall, it appears that native species are recovering at a fairly rapid pace since the whole lake treatment while invasive species, with the exception of brittle naiad, are remaining under control (Table 8 & Figure 26).

Table 8. Percent occurrence of species in Griffy Lake in the last 12 Tier 2 surveys.

Species	July, 2004	Aug, 2004	July, 2005	Aug, 2006	April, 2007	Aug, 2007	May, 2008	July, 2008	Aug, 2008	May, 2009	June, 2009	Aug, 2009
Brazillian elodea	38%	32%	49%	10%	2%							
Eurasian watermilfoil	57%	55%	70%					2%	1%	16%	2%	1%
curlyleaf pondweed	11%	3%	16%		24%		23%			12%	1%	1%
brittle naiad	8%	21%	18%					10%	54%		35%	40%
common coontail	92%	81%	73%	38%	1%					4%	12%	18%
Chara	8%	3%	3%	10%	14%	28%	17%	15%	10%	23%	19%	8%
American elodea								1%		4%	6%	5%
southern naiad										14%	35%	56%
slender naiad	5%	3%	15%						10%			
sago pondweed	11%	8%	8%		4%			3%	9%	2%	3%	7%
small pondweed	3%	2%	8%									5%
leafy pondweed								5%	10%	4%		
American pondweed	5%	2%	3%									
flatstem pondweed												2%
horned pondweed	5%			2%			4%	3%	1%	4%	3%	
water stargrass					1%							

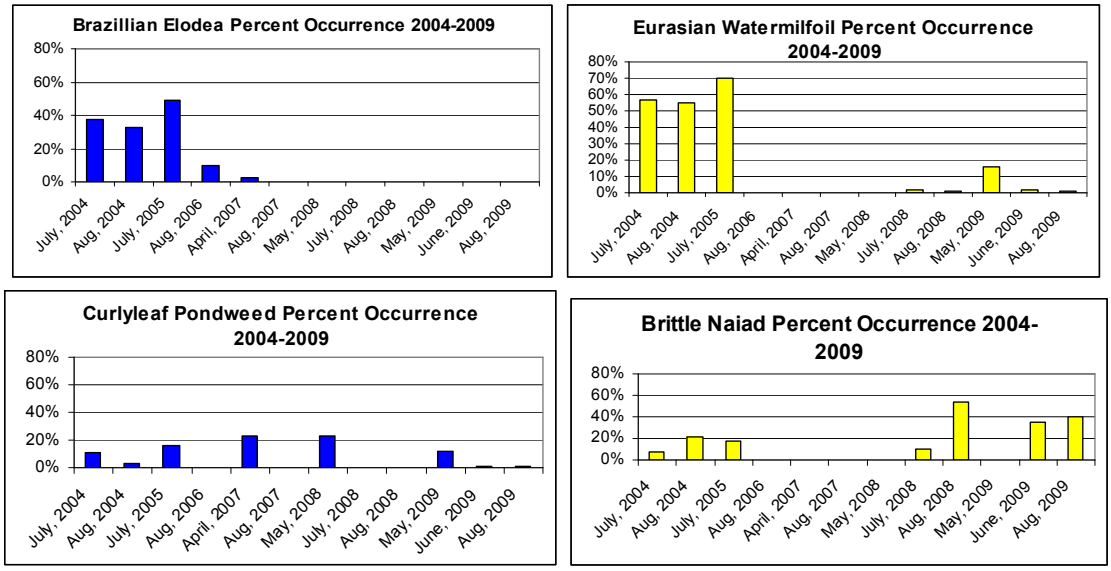


Figure 26. Percent occurrence of invasive species in Griffy Lake in the last 12 Tier 2 surveys (data from Table 8).

From the outset of the Brazilian elodea eradication project it was clear that there would be damage to the native plant population due to the need to use high rates of fluridone over extended periods of time. As previously discussed, there appears to be increases in percent occurrence of several species since the whole lake treatments in 2006 and 2007. A comparison of the plant community metrics illustrates this trend of increased diversity and abundance of native vegetation (Table 9 and Figure 27).

Table 9. Comparison of plant community metrics in the last 12 Tier 2 surveys.

Survey Date	Number of Sample Sites	Max Plant Depth	Secchi	% Sites With Vegetation	Number of Native Species	Native Species/Site	Native Diversity Index
July.04	40	18	7.8	94%	7	1.44	0.55
Aug.04	62	20	10	94%	6	1.52	0.57
July.05	72	18	7.5	87%	6	1.32	0.64
Aug.06	50	18	5.5	44%	3	0.50	0.43
April.07	82	9.5	5	41%	4	0.22	0.57
Aug.07	100	13	10	28%	1	0.28	0.00
May.08	100	12	9	39%	2	0.21	0.31
July.08	100	15	10	27%	5	0.27	0.63
Aug.08	100	15	12	58%	5	0.40	0.76
May.09	100	13	16	55%	7	0.74	0.74
June.09	100	14	11	58%	6	0.78	0.71
Aug.09	100	14	12	75%	7	1.01	0.64

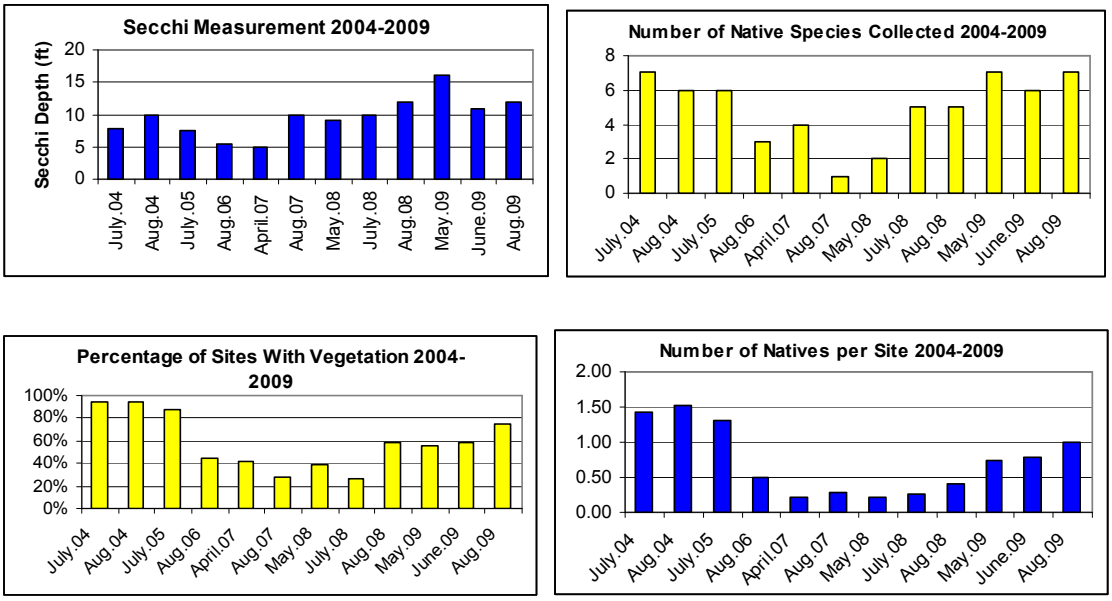


Figure 27. Comparison of Secchi measurements, percentage of sites with vegetation, number of species per site, and number of native species collected in the last 12 surveys (Data from Table 9).

One of the main concerns prior to the fluridone treatment was that once the plants were removed, Griffy Lake would become turbid due to an increase in nutrient levels. This did not occur. Secchi measurements taken since 2004 are graphically illustrated above in Figure 23. Secchi measurements can be highly variable due to many environmental factors, but it appears that there was not a negative trend in water clarity following the treatments.

7.0 2009 VEGETATION CONTROL

There were no treatments completed for Brazilian elodea control in 2008 or 2009 since this species was not detected. However, treatments were completed on the invasive species curlyleaf pondweed and Eurasian watermilfoil.

Invasive species mapping was completed on April 9 primarily as a way to accurately mark all areas of curlyleaf pondweed prior to treatment. A total of 17.8 acres of curlyleaf pondweed was treated on April 15 with 1.0 ppm of Aquathol K herbicide (Figure 28). A Tier 2 survey was completed two weeks following application. Curlyleaf was still detectable in the treated areas but appeared to be damaged. After discussion with the manufacturer of Aquathol K it was decided to retreat 12.7 acres (Figure 29). Follow-up inspections revealed that curlyleaf had been controlled. In hindsight, the initial treatment may have worked without the additional application. Plants tend to drop slower in cool water and the plants may have dropped in 1-2 more weeks, however the applicator didn't want to take any chances with a potential failure.

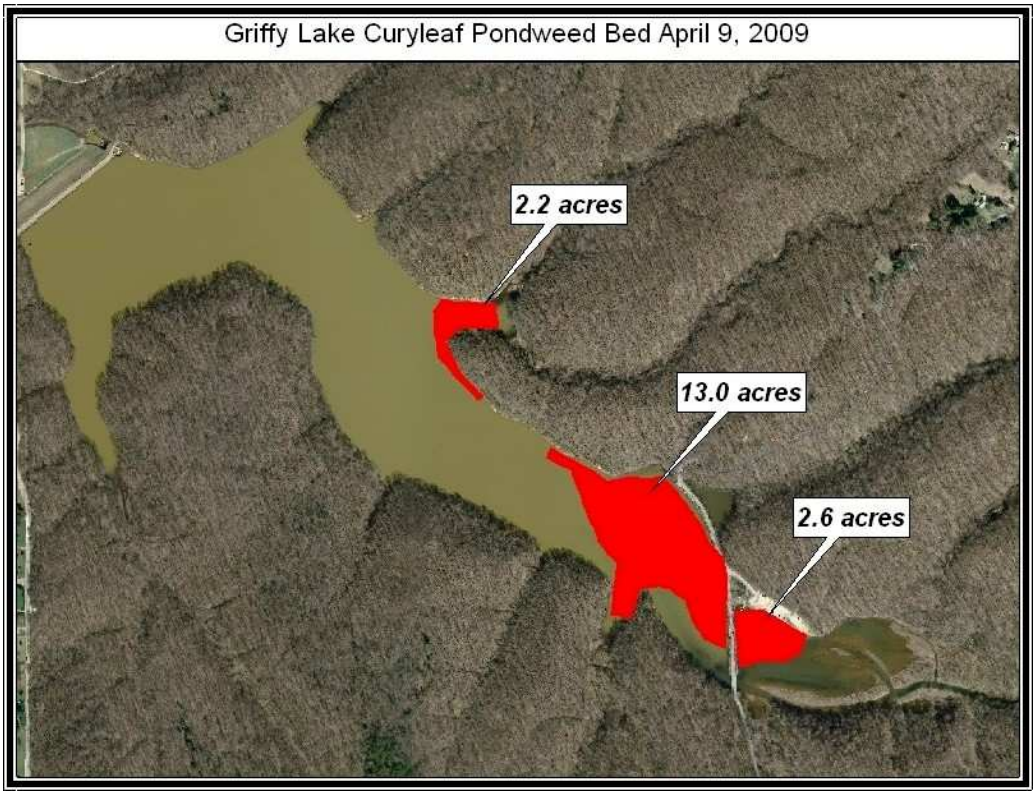


Figure 28. Griffy Lake curlyleaf pondweed treatment areas, April 15, 2009.

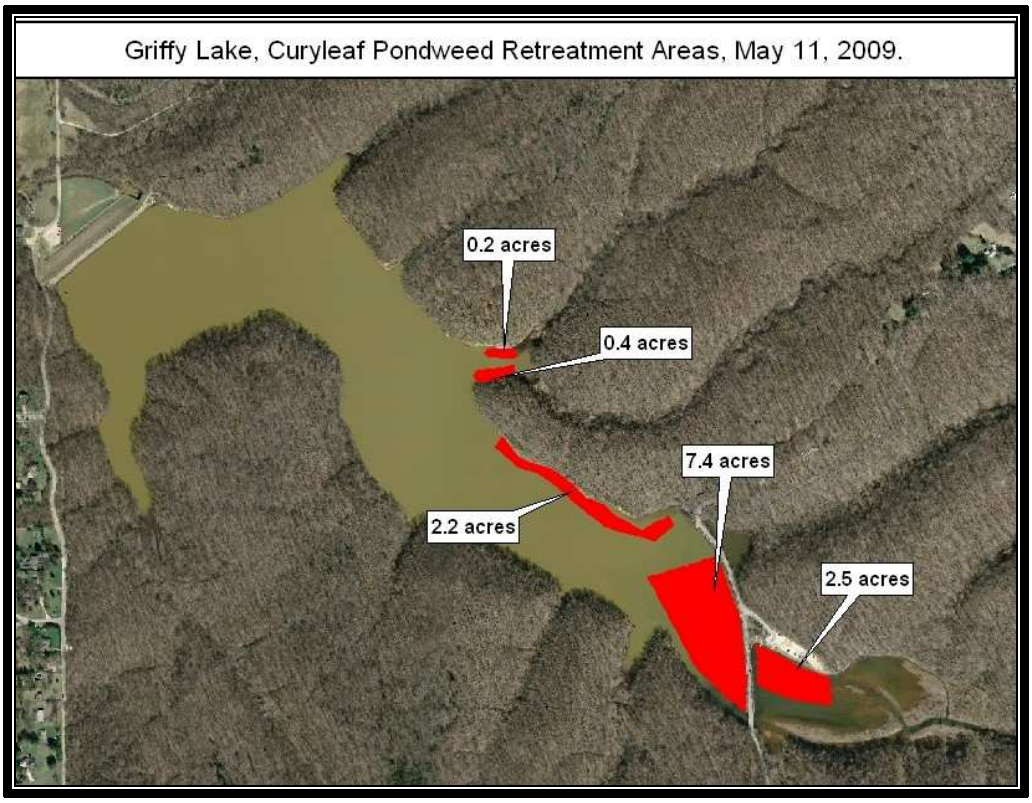


Figure 29 Griffy Lake, curlyleaf pondweed retreatment areas, May 7, 2009.

Eurasian watermilfoil was detected during the April invasive mapping survey. A small 0.25 acre area was treated on April 15th with Renovate herbicide (Figure 30). The May Tier 2 survey revealed that milfoil had greatly expanded to several new areas (Figure 31). These areas were treated on May 7th with a combination of Renovate 3 (liquid formulation) and Renovate OTF (granular formulation). The treatments effectively controlled milfoil as illustrated by the summer survey results. However, some milfoil was detected outside of the treatment areas by late summer.

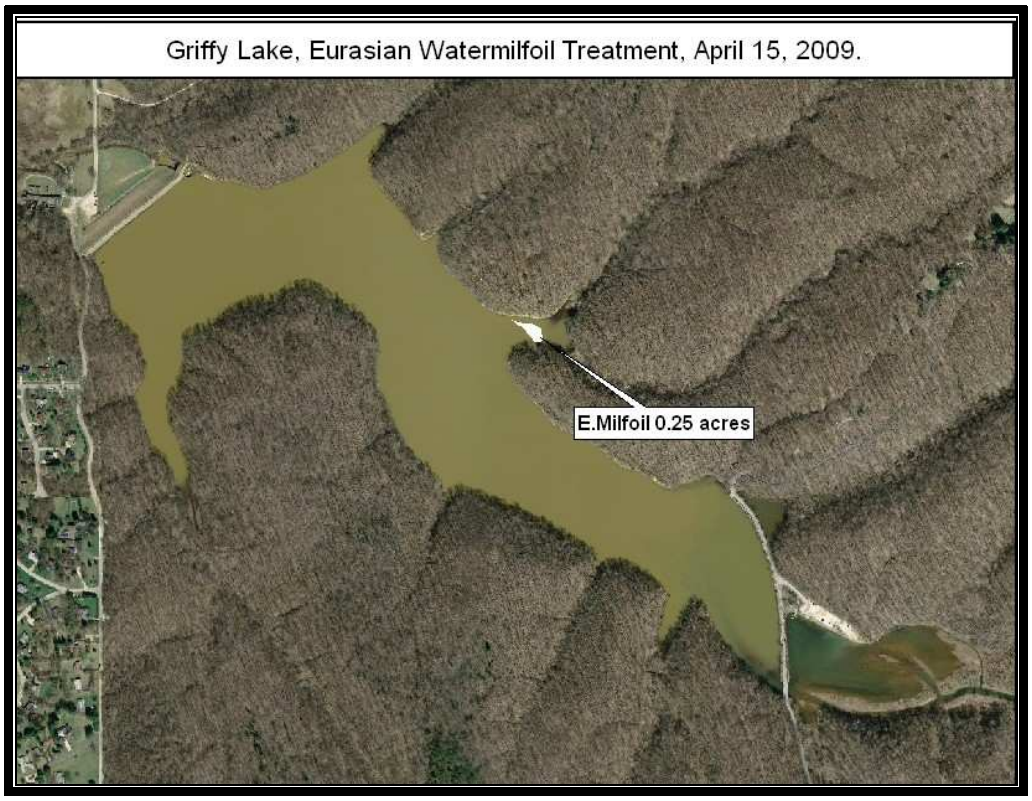


Figure 30. Griffy Lake, Eurasian watermilfoil treatment area, April 15, 2009.

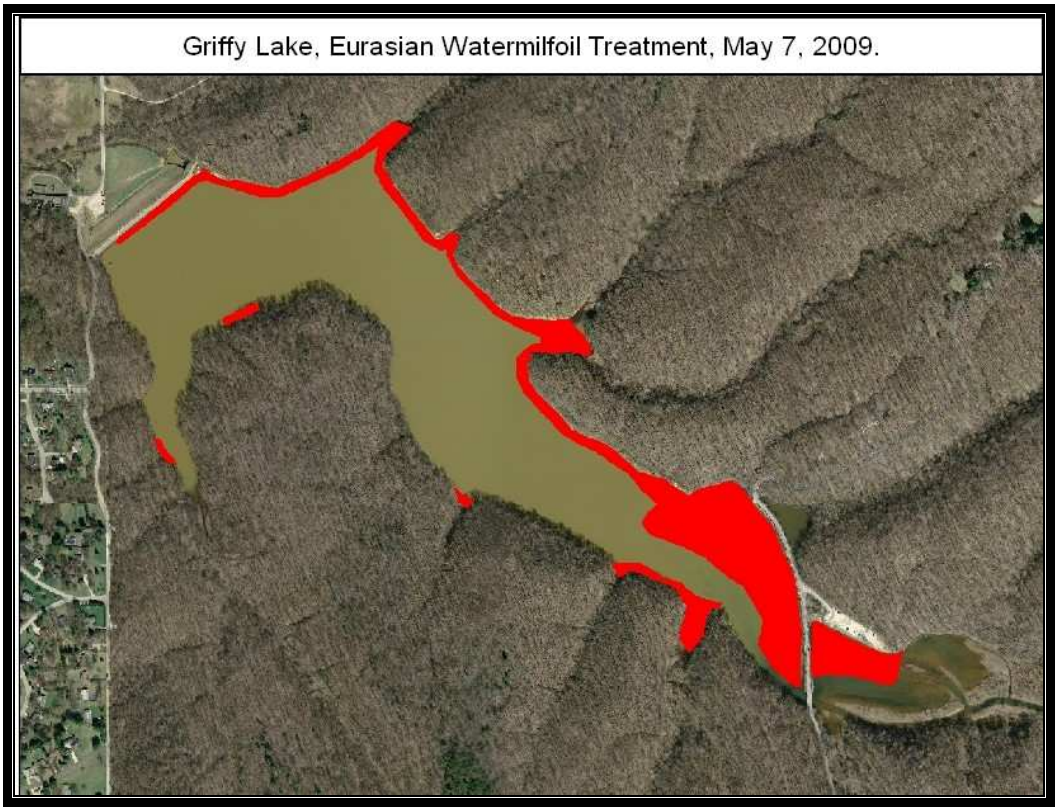


Figure 31. Griffy Lake, Eurasian watermilfoil treatment area, May 7, 2009.

It will be important to continue to monitor and control Eurasian watermilfoil in order to keep it from reaching pre-fluridone treatment levels. One of the main problems is that it appears that this plant is somewhere in the watershed (milfoil was found in an inflow creek and treated in 2007 leading one to believe that it is present upstream from Griffy Lake). Tamarron Lake was the suspected source of milfoil, but it was checked by Park personnel and none was found. It would benefit the parks department to check as many ponds as possible and work with the owners in an effort to reduce the amount of milfoil entering through the watershed. It may also be beneficial to walk the stream leading into Griffy Lake as it may be present is some of the pools.

8.0 AQUATIC PLANT MANAGEMENT ALTERNATIVES

Current vegetation management controls appear to be achieving the primary goal of eliminating Brazilian elodea and are controlling invasive species like Eurasian watermilfoil and curlyleaf pondweed while allowing native vegetation to return. Chemical control has been the primary action used to reach these goals. However, it is important to stay abreast of other control options. Sections 8.1-8.7 discuss the various options available for aquatic vegetation control in Griffy Lake.

8.1 No Action

Very little vegetation management was undertaken in Griffy Lake prior to 2006. This lack of action allowed invasive species to spread and dominate the Griffy Lake plant community (invasive species ranked 2nd, 3rd, 4th, and 6th in percent occurrence in the 2004 Tier 2 survey). In 2006 and 2007 IDNR spent nearly $150,000 in an effort to eradicate Brazilian elodea from Griffy Lake. In addition, the Parks department used LARE funds to manage areas of curlyleaf pondweed and Eurasian watermilfoil in 2008 and 2009. These actions have led to reductions in invasive species abundance and we are now seeing a resurgence of native vegetation. If these actions were not taken it is likely that Brazilian elodea would continue to spread in Griffy Lake and possibly to other lakes in the areas. In addition it is likely that Eurasian watermilfoil and curlyleaf pondweed would return to pre-fluridone treatment levels within 2-3 years. Historical plant abundance data should lead one to the conclusion that “no action” is an option that should be avoided.

8.2 Institutional-Protection of Beneficial Vegetation and Preventing Introduction of Invasive Species

Presence of beneficial vegetation can inhibit the growth of species which may be more prone to create nuisance conditions. Protection of beneficial vegetation should be part of any vegetation management plan. Unfortunately, due to the need to control Brazilian elodea with high rates of Sonar (active ingredient: fluridone), very little native submersed vegetation remained in Griffy Lake at the end of the 2007 season. Many of the native species have returned to pre-whole lake treatment levels.

It is vitally important that invasive species are not allowed to return to Griffy Lake. The public boat launch area is the most likely area for reintroduction to occur. It is recommended that the Parks Department institutes inspections on all boats entering or leaving Griffy Lake. This should help prevent the return of invasive species. In addition,

there appears to be a source of Eurasian watermilfoil upstream of Griffy Lake. It is recommended that Parks personnel continue to check the watershed in an effort to find the source of Eurasian watermilfoil.

8.3 Environmental Manipulation

8.3.1 Water Level Manipulation

Water level manipulation refers to lowering the water levels to control aquatic vegetation by exposing them to freezing, drying or heat. This technique can only be used if there is a water control structure that can be manipulated to lower lake levels. Griffy Lake has a control structure in place where lake lowering can be completed. In the Midwest, water level manipulation is usually attempted during winter months in order to avoid interfering with public lake use. The effectiveness of this technique is variable between species and is usually dependent on a hard sustained freeze. This technique has been effective at limiting Eurasian watermilfoil density at Lake Lemon which is also located in Monroe County (Personal Communication with Bob Madden, Lake Lemon Conservancy District Manager). Griffy Lake was scheduled for a drawdown for repairs during the winter of 2008-2009, but this was never completed.

8.3.2 Nutrient Reduction

Plant growth can be limited if at least one nutrient, which is critical for growth, is in short supply. Nitrogen, phosphorus or carbon are usually the nutrients limiting plant growth in lakes. Therefore, if at least one of these nutrients can be limited sufficiently so that plants do not grow to a nuisance level, this nutrient limitation can be used as a method of aquatic plant management. Generally, plants in Indiana can obtain the majority of necessary nutrients from the soil. However, in certain situations, nutrient reduction can be effective at controlling overabundant floating vegetation or microscopic algae blooms since they obtain nutrients from the water column. It appears that Griffy Lake has relatively low nutrient levels and continued watershed improvements should preserve the lake for future generations by limiting nuisance microscopic algae growth.

8.4 Mechanical Control-Harvesting, Cutting, Dredging

Mechanical control includes cutting and/or harvesting of aquatic vegetation or dredging the bottom sediments to eliminate aquatic plant growth. The main advantage to mechanical control is the immediate removal of the plant growth from control areas and the removal of organic matter and nutrients.

One of the most common mechanical control techniques used on larger lakes in Indiana is mechanical harvesting. Mechanical harvesting uses machines which cut plant stems and, in most cases, pick up the cut fragments for disposal. This type of mechanical control has little selectivity. Where a mix of Eurasian watermilfoil and native species exists, harvesting favors the plant species that grow back most rapidly following harvesting. In most cases, Eurasian watermilfoil recovers from harvesting much more rapidly than native plants. Thus, repeated harvesting hastens the replacement of native species by Eurasian watermilfoil and often leads to dense monocultures of Eurasian watermilfoil in

frequently harvested areas. Harvesting also stirs up bottom sediments thus reducing water clarity, kills fish and many invertebrates, and hastens the spread of Eurasian watermilfoil via fragmentation.

Dredging of shallow areas may reduce nuisance conditions caused by vegetation in the short-term, but studies and personal experience have shown that Eurasian watermilfoil is often the first species to colonize these disturbed areas. Dredging is expensive, especially if a nearby disposal sight is not available. Careful consideration to secondary environmental effects must be considered and permits from regulatory agencies are usually necessary before conducting dredging operations. There is the potential for dredging this winter while the lake is lowered. This would aid in navigation through the shallow areas east of the causeway and may also reduce the potential for invasive species like brittle naiad from reaching nuisance levels (brittle naiad grows in shallow water areas and making these areas deeper may prevent brittle naiad from reaching the surface and interfering with navigation).

8.5 Manual Control-Hand Pulling, Cutting, Raking

Removal of small amounts of vegetation by hand, which interfere with high use areas, may be the only vegetation control necessary in some areas. Of course, hand removal is labor intensive and must be conducted on a routine basis. The frequency and practicality of continued hand removal will depend on availability of labor, regrowth or reintroduction potential of the vegetation, and the level of control desired (Hoyer & Canfield, 1997). On a public lake, a 625 square foot area can be harvested without obtaining a permit from IDNR.

8.6 Biological Controls

Biological controls reduce aquatic vegetation using other organisms that consume aquatic plants or cause them to become diseased. The main biological controls for nuisance vegetation used in Indiana are the grass carp, milfoil weevil, and a variety of insects which prey upon purple loosestrife. Any use of biological controls or stocking fish in public waters in Indiana requires a permit from the IDNR Division of Fish and Wildlife.

8.6.1 Grass Carp

The grass carp (*Ctenopharyngodon idella)* is an herbivorous fish imported from Asia. Triploid grass carp, the sterile genetic derivative of the diploid grass carp, are legal for use in Indiana, but are not permitted for stocking in any natural lakes in the state. Grass carp tend to produce all or nothing aquatic plant control. It is very difficult to achieve a stocking rate sufficient to selectively control nuisance species without eliminating all submersed vegetation. They are not particularly appropriate for Eurasian watermilfoil control because this species is low on their feeding preference list; thus, they eat most native plants before consuming Eurasian watermilfoil (Smith, 2002). However, grass carp can be effective at controlling Brazilian elodea. Grass carp are difficult to remove from a lake once they have been stocked. Due to the legal concerns, all or nothing control, the difficulty in removing grass carp once stocked, and ineffectiveness of the

grass carp to correct many vegetation problems, grass carp are not recommended for nuisance vegetation control in Griffy Lake.

8.6.2 Milfoil Weevil

The milfoil weevil, *Euhrychiopsis lecontei,* is a native North American insect that consumes Eurasian and Northern watermilfoil. The weevil was discovered following a natural decline of Eurasian watermilfoil in Brownington Pond, Vermont (Creed and Sheldon, 1993), and has apparently caused declines in several other water bodies. Weevil larvae burrow in the stem of Eurasian watermilfoil and consume the vascular tissue thus interrupting the flow of sugars and other materials between the upper and lower parts of the plant. Holes where the larvae burrow into and out of the stem allow disease organisms a foothold in the plants and allow gases to escape from the stem, causing the plants to lose buoyancy and sink (Creed et al. 1992).

Concerns about the use of the weevil as a biological control agent relate to whether introductions of the milfoil weevil will reliably produce reductions in Eurasian watermilfoil and whether the resulting reductions will be sufficient to satisfy users of the lake (Smith, 2002). Following our research, no conclusive data concerning the role of weevils in reducing Eurasian watermilfoil populations has been made available. In 2003, Scribailo and Alix conducted a weevil release on Griffy Lake and had no conclusive evidence supporting the use of weevils in reducing milfoil populations. Weevils may reduce milfoil populations in some lakes, but predicting which lakes and how much, if any, control will be achieved has not been documented (Scribailo & Alix 2003).

8.7 Chemical Control

Chemical control uses chemical herbicides to reduce or eliminate aquatic plant growth. The main perceived disadvantage to the use of herbicides is the publics concern over safety. Extensive testing is required of aquatic herbicides to ensure that the herbicides are low in toxicity to human and animal life and they are not overly persistent or bioaccumulated in fish or other organisms. It often takes several decades of testing by the Environmental Protection Agency (E.P.A.) before an herbicide is approved for aquatic use. After E.P.A. approval and registration, the herbicide must go through the registration process in each state. In addition, commercial aquatic applicators must obtain a license to apply aquatic herbicides in the state of Indiana.

Most aquatic herbicides have water use restrictions following their use. These restrictions must be posted prior to treatment on a public body of water. Aquatic herbicides typically have a 0-1 day swimming restriction, 0-30 day irrigation restrictions, and 0-21 day drinking water restrictions.

Another potential drawback to herbicide use is the potential release of nutrients that can occur if large areas of vegetation are controlled. This can be avoided by early application that controls vegetation before it reaches its maximum biomass. These perceived disadvantages are often times out-weighed by this technique's documented rapid effectiveness and selectivity.

There are two different types of aquatic herbicides, systemic and contact. Systemic herbicides are translocated throughout the plants and thereby kill the entire plants. Fluridone (trade name Sonar & Avast!), 2,4-D (trade name Navigate, Aqua-Kleen, & DMA4 IVM), and triclopyr (trade name Renovate) are systemic herbicides that can effectively control Eurasian watermilfoil. Triclopyr, imazypry, and glyphosate are systemic herbicides that can control purple loosestrife.

Whole lake fluridone treatments have successfully controlled Brazilian elodea and Eurisan watermilfoil in Griffy Lake. When treating for control of Eurasian watermilfoil, an advantage to using fluridone over most contact herbicides is its selectivity. Most strains of Eurasian watermilfoil have a lower tolerance to fluridone than the majority of native species, so if the proper rates are applied Eurasian water milfoil can be controlled with little harm to the majority of native species. Unfortunately, when treating for control of Brazilian elodea, higher rates of fluridone are required thus limiting the selectivity of this herbicide.

Triclopyr is a systemic herbicide that has recently been approved for use in aquatics. Triclopyr typically is used for treating isolated Eurasian watermilfoil beds as opposed to whole lake treatments. This herbicide is very selective to Eurasian watermilfoil, and has no effect on Brazilian elodea or curlyleaf pondweed. A study was conducted in 1997 during the registration process of this herbicide. The study found Eurasian watermilfoil biomass was reduced by 99% in treated areas at 4 weeks post-treatment, remained low one year later, and was still at acceptable levels of control at two years post-treatment. Non-target native plant biomass increased 500-1000% by one year post-treatment, and remained significantly higher in the cove plot at two years post-treatment. Native species diversity doubled following herbicide treatment, and the restoration of the community delayed the re-establishment and dominance of Eurasian watermilfoil for three growing seasons (Getsinger et. al., 1997). Triclopyr is a good alternative to fluridone when Eurasian watermilfoil is not abundant throughout an entire water body. The primary water-use restriction following a triclopyr treatment is irrigation. An assay is needed to monitor the concentration in the water before irrigation can take place. One of the drawbacks to using triclopyr has been the fact that only a liquid formulation has been available. This can dramatically increase costs for treatment in deep water areas. In 2007, a granular formulation called Renovate OTF was approved for aquatic use in Indiana.

Applied properly, 2,4-D can also yield major reductions in the abundance of Eurasian watermilfoil. Much like triclopyr, treatments must be even and dose rates accurate. This formulation should be used much like triclopyr. Unlike triclopyr, 2,4-D can impact the native species coontail. This herbicide can be applied for less cost than triclopyr, but damage will likely occur to coontail. 2,4-D herbicide should be considered as an alternative to triclopyr applications if there are severe budget restrictions. 2,4-D is also available in liquid and granular formulations.

Contact herbicides can also be effective for controlling submersed vegetation in the short term. The three primary contact herbicides used for control of submersed vegetation are

diquat (trade name Reward), endothal (trade name Aquathol), and copper based formulations (trade names Komeen, Nautique, and Clearigate).

Historically, a drawback to the use of contact herbicides has been the lack of selectivity exhibited by these herbicides. However, a study completed by Skogerboe and Getsinger in 2002 outlines how endothal can be used for control of the exotic species curlyleaf pondweed and Eurasian watermilfoil with little effect on the majority of native species. They found early season treatments with endothall effectively controlled Eurasian watermilfoil and curlyleaf pondweed at several application rates with no regrowth eight weeks after treatment. Sago pondweed, eel grass, and Illinois pondweed biomass were also significantly reduced following the endothall application, but regrowth was observed at eight weeks post-treatment. Coontail and elodea showed no effects from endothall at three of the lower application rates. Spatterdock, pickerelweed, cattail, and smartweed were not injured at any of the application rates (Skogerboe & Getsinger 2002). This type of treatment strategy could be applied to lakes that have large areas of both curlyleaf pondweed and Eurasian watermilfoil. Endothal could also be effective the year after whole lake sonar treatments where curlyleaf pondweed typically returns the following season. Several years of application may be required to exhaust the curlyleaf pondweed turion supply.

Diquat and many of the copper formulations are effective fast acting contact herbicides. These formulations are typically used when control of all submersed vegetation is desired. These herbicides are commonly used for control of nuisance vegetation around docks and near-shore high-use areas. Diquat and the copper based herbicides are not as selective as many of the other herbicides and plants can often time recover in 4-8 weeks after treatment. There are no water use restrictions following the use of chelated copper based herbicide, which makes them popular choices for lakes used for irrigation or drinking water.

9.0 PUBLIC EDUCATION & INVOLVEMENT

The prevention of reintroduction of invasive exotic species is one of the most important actions that should be taken concerning aquatic plant management in Griffy Lake. The primary public access to Griffy Lake is at the public boat launch area. This area now contains easy to read and understand signage about the need to thoroughly clean boats and trailers prior to launch. If possible, it would be beneficial to have all boats and trailers visually inspected by the attendant prior to launch. These actions should reduce the chances of reintroduction of invasive species into Griffy Lake. A summary of vegetation management activities and future plans was presented to the public at a Bloomington Parks Board meeting on September 22, 2009. This meeting was attended by a wide variety of Bloomington Park's employees and concerned parties. There were very few questions or comments following the presentation. From the comments that were received, it appeared that concerned parties were understanding and supportive of the management plan.

10.0 ACTION PLAN AND BUDGET UPDATE

The primary goal of the vegetation management plan is the eradication of Brazilian elodea. Whole lake fluridone treatments in 2006 and 2007 appear to have successfully eradicated this plant. Extensive Tier 2 surveys were completed each of the three seasons in an effort to detect Brazilian elodea and none was found. With no Brazilian elodea detected since 2007, the IDNR has declared the plant eradicated from Griffy Lake.

In 2010, the focus of vegetation management should be controlling the remaining invasive species. It is recommended that the surveys be reduced to a single Tier 2 survey in late summer and an invasive mapping survey in mid-spring. An update to the vegetation management plan should also be completed at the end of the season. The estimated cost of completing the surveys with along with plan update is $3,500. Eurasian watermilfoil and curlyleaf pondweed are two other invasive species that have reached nuisance levels in Griffy Lake. Treatments in 2009 kept these species from returning to pre-fluridone treatment levels. The same area treated for curlyleaf pondweed in 2009 should be again treated in 2010. The estimated cost for treating curlyleaf in 2010 is $5,400.00. An invasive species mapping survey should be completed in May of 2010 in order to locate any areas of Eurasian watermilfoil. These areas should be treated in late May or early June in order to control milfoil. Renovate should be used in the treatment. The estimated cost of controlling 20 acres of milfoil in 2010 is $10,000.00. This treatment will likely become an annual maintenance expense unless the source of the infestation is found and controlled. The past several years have illustrated how rapidly this plant spreads in Griffy Lake following complete control. It is important that the watershed be checked for milfoil and controlled when it is discovered. The curlyleaf pondweed and potential Eurasian watermilfoil treatments would be eligible for funding from LARE and should be administered by the City of Bloomington Parks Department. Table 10 illustrates a predicted budget for plant management action on Griffy Lake for the next three years. It should also be noted that the invasive plant purple loosestrife (*Lythrum salicaria*) was found bordering Griffy Lake in 2009. The park should take quick action in eliminating any plants found to prevent further spreading. The preferred methods of control are spot spraying with a systemic herbicide or digging up the entire plant.

Table 10. Predicted budget for Griffy Lake plant management action plan.

Action	Potential Funding Source	2010	2011	2012
Point Sampling and Plan Update	Parks/LARE	$3,500.00	$3,500.00	$3,500.00
Milfoil Spot* Treatments (20 acres)	Parks/LARE	$10,000.00	$10,000.00	$10,000.00
Early Season Curlyleaf Treatments	Parks/LARE	$5,400.00	$1,000.00	$1,000.00

*Milfoil acreage may be reduced if source of infestation is discovered and controlled.

11.0 REFERENCES CITED

Aquatic Control, Inc. 2005 Griffy Lake Aquatic Vegetation Management Plan. Prepared for City of Bloomington Parks and Recreation. Bloomington, IN.

Aquatic Control, Inc. 2007. Griffy Lake Aquatic Vegetation Management Plan Update. Prepared for Indiana Department of Natural Resources. Indianapolis, IN.

Aquatic Control, Inc. 2008. Griffy Lake Aquatic Vegetation Management Plan 2007 Update. Prepared for the Indiana Department of Natural Resources. Indianapolis, IN.

Aquatic Control, Inc. 2009. Griffy Lake Aquatic Vegetation Management Plan 2008 Update. Prepared for the Indiana Department of Natural Resources. Indianapolis, IN.

Bouldan, B.R., G.C. Van Eeckhout, H.W. Wade and J.E. Gannn. 1994. *Potamogeton crispus*-The other invader. Lake and Reserv. Manage. 10(2): 113-125.

Commonwealth Biomonitoring, Inc. Griffy Lake Watershed GIS Mapping and Management Plan. Commonwealth Biomonitoring. Indianapolis, IN. 2000.

Creed, R.P., Jr. and S.P. Sheldon. 1994. The effect of two herbivorous insect larvae on Eurasian watermilfoil. Journal of Aquatic Plant Management 32:21-26.

Creed, R.P., Jr., S.P. Sheldon and D.M. Cheek. 1992. The effect of herbivore feeding on the buoyancy of Eurasian watermilfoil. Journal of Aquatic Plant Management 30:75-76.

Getsinger, K.D., Turner, E.G., Madsen, J.D., and M.D. Netherland. 1997. Restoring Native Vegetation in a Eurasian Water Milfoil-Dominated Plant Community Using The Herbicide Triclopyr. Regulated Rivers: Research & Management, Vol. 13, 357-375.

Hoyer, M.V. and D.E. Canfield, Jr., eds. 1997. Aquatic Plant Management in Lakes and Reservoirs. Prepared by the North American Lake Management Society and the Aquatic Plant Management Society for U.S. Environmental Protection Agency, Washington, D.C.

IDNR. 2003. Indiana Aquatic Nuisance Species Management Plan. Indiana Department of Natural Resources. Funded by Fish & Wildlife. Indianapolis, IN.

IDNR. 2007. Procedure Manual For Surveying Aquatic Vegetation: Tier 2 Reconnaissance Surveys. IN Department of Natural Resources, Division of Fish and Wildlife

JFNew 2009. Griffy Lake Nature Preserve Master Plan. Prepared for Bloomington

Parks and Recreation. Bloomington, IN.

Jones W.W., MacDonald, A., White, J.R., Wilder, M.G., and Willard, D.E. 1984. Griffy Lake Long-Range Use and Management Plant. Environmental Systems Application Center School of Public and Environmental Affairs, Indiana University. Bloomington, Indiana.

Poovey, A.G., Skogerboe, J.G., & Owens, C.S. 2002. Spring treatments of Diquat and Endothall for Curlyleaf Pondweed Control. Journal of Aquatic Plant management 40: 63-67

Scribalio, R.W., and M.S. Alix. 2003. Final Report on the Weevil Release Study for Indiana Lakes. Department of Botany and Plant Pathology. Purdue University. West Lafayette, IN.

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

Smith, C.S. 2002. Houghton Lake Management Feasibility Study. Prepared for the Houghton Lake Improvement Board. Remetrix LLC. Indianapolis, IN.

12.0 APPENDIX UPDATE

12.1 2009 Sampling Data

May 7, 2009

WPT	Lat	Long	Depth	Rake score	Curlyleaf pondweed	Eurasian watermilfoil	Fil. Algae	Horned pondweed	Elodea	Leafy pondweed	Chara	Sago Pondweed	Coontail	Southern naiad
1	39.197931	-86.513026	4	1	1		P							
2	39.197674	-86.512445	5	1			P	1						
3	39.197448	-86.511822	3	1	1		P	1						
4	39.197384	-86.510825	1	0			P							
5	39.197481	-86.512957	5	1			P	1	1					
6	39.197094	-86.512168	3	1			P			1				
7	39.197009	-86.51142	3	1			P				1			
8	39.196998	-86.512846	3	1			P			1				
9	39.197234	-86.513816	3	1			P				1			
10	39.197685	-86.514397	4	1	1		P				1			
11	39.198285	-86.514826	5	1			P					1		
12	39.198285	-86.515615	7	1									1	1
13	39.197888	-86.515837	5	3		3			1					1
14	39.199006	-86.515855	9	1										1
15	39.198983	-86.515242	8	1	1		P					1		
16	39.198843	-86.514563	7	1		1	P							
17	39.198425	-86.513968	7	0			P							
18	39.197942	-86.513746	7	1			P							1
19	39.199159	-86.51434	7	1	1		P							
20	39.199584	-86.514549	7	1			P							1
21	39.199573	-86.515145	7	1		1								
22	39.200099	-86.514771	5	0			P							
23	39.200045	-86.515338	7	1			P							1
24	39.199862	-86.515809	7	1		1								1
25	39.1996	-86.516325	10	1		1	P							1
26	39.200191	-86.516523	10	1	1									1
27	39.200549	-86.51711	12	1							1			
28	39.200878	-86.517545	10	1	1								1	
29	39.201171	-86.518163	9	1	1									
30	39.201464	-86.518813	11	1	1									
31	39.201837	-86.519229	13	1							1		1	
32	39.202218	-86.519549	12	1							1			
33	39.202673	-86.519298	5	5		1					5			
34	39.202759	-86.518782	4	3		1			1		1			
35	39.202888	-86.518301	2	1		1	P							
36	39.203185	-86.518164	1	0			P							
37	39.203092	-86.518703	5	1	1	1	P							
38	39.203189	-86.51918	9	1		1								
39	39.203253	-86.519866	11	0										
40	39.203714	-86.520538	9	1							1			
41	39.2041	-86.521056	5	5							5			
42	39.204414	-86.521167	11	1										
43	39.205085	-86.521964	9	1							1			
44	39.205474	-86.522413	11	1							1			
45	39.205829	-86.522645	12	0										
46	39.206309	-86.522309	5	1										1
47	39.206128	-86.522828	9	1							1			
48	39.205819	-86.523574	6	1							1			
49	39.205592	-86.524033	6	1			P				1			
50	39.205455	-86.524627	10	0										

May 7, 2009 Continued

51	39.205441	-86.525362	7	5							5			
52	39.205508	-86.525899	10	1	1	1					1			
53	39.20556	-86.526656	4	3		1				1	1			
54	39.205441	-86.526858	8	1										1
55	39.205225	-86.527157	6	5					1		5			
56	39.205055	-86.527481	7	3		1					3			
57	39.204718	-86.527915	7	3		3				1	3			
58	39.204615	-86.528187	6	1	1	1					1			1
59	39.204305	-86.528654	10	1									1	
60	39.203929	-86.52845	5	0										
61	39.203443	-86.528263	8	0										
62	39.203081	-86.528035	8	0										
63	39.202694	-86.527493	9	0										
64	39.202427	-86.527425	15	0										
65	39.20207	-86.527595	19	0										
66	39.201611	-86.527605	5	0										
67	39.201092	-86.527387	6	0										
68	39.200785	-86.527052	8	0										
69	39.200522	-86.526663	2	0										
70	39.201567	-86.52707	15	0										
71	39.202083	-86.52683	12	0										
72	39.202566	-86.526828	12	0										
73	39.202942	-86.526567	4	1				1						1
74	39.203125	-86.526318	10	0										
75	39.203264	-86.525875	10	1		1								
76	39.203411	-86.525412	8	0										
77	39.203411	-86.525412	6	0			P							
78	39.203596	-86.52474	6	1							1			
79	39.203767	-86.524187	10	0										
80	39.203736	-86.523701	12	0										
81	39.203585	-86.523263	8	0										
82	39.203457	-86.522926	9	0										
83	39.203251	-86.522479	7	0										
84	39.203006	-86.522289	15	0										
85	39.202603	-86.522241	16	0										
86	39.202019	-86.522344	12	0										
87	39.201135	-86.521939	18	0										
88	39.200689	-86.521403	12	0										
89	39.200437	-86.520714	16	0										
90	39.200131	-86.520711	6	0										
91	39.200036	-86.519881	6	0										
92	39.199905	-86.519312	10	0										
93	39.199712	-86.518735	10	0										
94	39.199541	-86.518412	8	0										
95	39.199415	-86.517907	9	0										
96	39.199262	-86.517679	5	0										
97	39.198875	-86.517293	1	0			P							
98	39.198972	-86.516876	8	0			P							
99	39.198868	-86.51648	8	0										
100	39.198629	-86.516003	5	1										1

June 30, 2009

WPT	Lat	Long	Depth	Rake score	Brittle naiad	Eurasian watermilfoil	Curlyleaf Pondweed	Fil. Algae	Elodea	Southern naiad	Coontail	Chara	Horned pondweed	Sago pondweed
1	39.197931	-86.513026	5	5					5	1				
2	39.197674	-86.512445	4	1	1					1	1			
3	39.197448	-86.511822	3	3	1			P		1				
4	39.197384	-86.510825	1	1	1			P	1	1		1	1	
5	39.197481	-86.512957	5	3				P		3				
6	39.197094	-86.512168	3	0				P						
7	39.197009	-86.51142	2	1					1	1		1		
8	39.196998	-86.512846	3	5	1			P	1	1		1	3	
9	39.197234	-86.513816	2	3	3					1		1		
10	39.197685	-86.514397	4	5	5									
11	39.198285	-86.514826	5	3										3
12	39.198285	-86.515615	7	5						5				
13	39.197888	-86.515837	4	5						5				
14	39.199006	-86.515855	9	1						1				1
15	39.198983	-86.515242	8	5	1	1				1				3
16	39.198843	-86.514563	6	1	1					1				
17	39.198425	-86.513968	6	1	1									
18	39.197942	-86.513746	7	1								1		
19	39.199159	-86.51434	7	3	3									
20	39.199584	-86.514549	7	3	3									
21	39.199573	-86.515145	7	5	3						3			
22	39.200099	-86.514771	6	1	1						1			
23	39.200045	-86.515338	7	1	1									
24	39.199862	-86.515809	8	3	3						1			
25	39.1996	-86.516325	10	3					1	3	1			
26	39.200191	-86.516523	9	3	3									
27	39.200549	-86.51711	12	1								1		
28	39.200878	-86.517545	13	1								1		
29	39.201171	-86.518163	13	0										
30	39.201464	-86.518813	15	0										
31	39.201837	-86.519229	16	0										
32	39.202218	-86.519549	14	0										
33	39.202673	-86.519298	6	1	1						1	1		
34	39.202759	-86.518782	5	5				P		5				
35	39.202888	-86.518301	2	1	1				1					
36	39.203185	-86.518164	2	3	1			P		3				
37	39.203092	-86.518703	4	3	3			P					1	
38	39.203189	-86.51918	9	1	1						1			
39	39.203253	-86.519866	13	0										
40	39.203714	-86.520538	15	0										
41	39.2041	-86.521056	13	3								3		
42	39.204414	-86.521167	11	1						1				
43	39.205085	-86.521964	15	0										
44	39.205474	-86.522413	14	5							1	5		
45	39.205829	-86.522645	21	0										
46	39.206309	-86.522309	6	5	1					5				
47	39.206128	-86.522828	11	1						1		1		
48	39.205819	-86.523574	15	0										
49	39.205592	-86.524033	14	0										
50	39.205455	-86.524627	9	5						5	1	1		

June 30, 2009 Continued

51	39.205441	-86.525362	8	1	1					1				
52	39.205508	-86.525899	14	0										
53	39.20556	-86.526656	12	1						1	1	1		
54	39.205441	-86.526858	9	5			1			5	1			
55	39.205225	-86.527157	9	3	1					3	1			
56	39.205055	-86.527481	10	5						5		1		
57	39.204718	-86.527915	13	1						1				
58	39.204615	-86.528187	11	0				P						
59	39.204305	-86.528654	9	1						1		1		
60	39.203929	-86.52845	15	0										
61	39.203443	-86.528263	10	1	1					1				
62	39.203081	-86.528035	19	0										
63	39.202694	-86.527493	11	0										
64	39.202427	-86.527425	13	0										
65	39.20207	-86.527595	15	0										
66	39.201611	-86.527605	9	1	1					1		1		
67	39.201092	-86.527387	6	3	1					3				
68	39.200785	-86.527052	7	3	1					3				
69	39.200522	-86.526663	4	3	3							1		
70	39.201567	-86.52707	15	0										
71	39.202083	-86.52683	15	0										
72	39.202566	-86.526828	18	0										
73	39.202942	-86.526567	6	3	1					3				
74	39.203125	-86.526318	9	3	3					1		1		
75	39.203264	-86.525875	10	3	1							3		
76	39.203411	-86.525412	15	0										
77	39.203411	-86.525412	8	3	3	1								
78	39.203596	-86.52474	15	0										
79	39.203767	-86.524187	14	0										
80	39.203736	-86.523701	15	0										
81	39.203585	-86.523263	12	0										
82	39.203457	-86.522926	12	0										
83	39.203251	-86.522479	15	0										
84	39.203006	-86.522289	20	0										
85	39.202603	-86.522241	20	0										
86	39.202019	-86.522344	15	0										
87	39.201135	-86.521939	19	0										
88	39.200689	-86.521403	8	0										
89	39.200437	-86.520714	13	0										
90	39.200131	-86.520711	8	1						1				
91	39.200036	-86.519881	14	0										
92	39.199905	-86.519312	14	0										
93	39.199712	-86.518735	12	0										
94	39.199541	-86.518412	12	0										
95	39.199415	-86.517907	12	0										
96	39.199262	-86.517679	6	0										
97	39.198875	-86.517293	4	1	1					1				
98	39.198972	-86.516876	10	0										
99	39.198868	-86.51648	10	0										
100	39.198629	-86.516003	8	1	1									

August 18, 2009

WPT	Lat	Long	Depth	Rake score	Brittle naiad	Curlyleaf pondweed	Eurasian watermilfoil	Fil. Algae	Coontail	Southern naiad	Small pondweed	Elodea	Sago pondweed	Flatstem pondweed	Chara
1	39.197931	-86.513026	5	3					3	1	1				
2	39.197674	-86.512445	4	5	1				1	5		1			
3	39.197448	-86.511822	2	5	5			P		5					
4	39.197384	-86.510825	1	5	1	1				5		1	1		
5	39.197481	-86.512957	5	5						5					
6	39.197094	-86.512168	3	3	3					1					
7	39.197009	-86.51142	2	5	1					5					
8	39.196998	-86.512846	2	5	3					5					
9	39.197234	-86.513816	3	5	5			P				1			
10	39.197685	-86.514397	3	5	3				1	5					
11	39.198285	-86.514826	5	5						3			5		
12	39.198285	-86.515615	7	5				P		5			1		
13	39.197888	-86.515837	4	5				P		5					
14	39.199006	-86.515855	9	5					1	5					
15	39.198983	-86.515242	6	5						5	5		5		
16	39.198843	-86.514563	6	1						1					
17	39.198425	-86.513968	7	1	1			P		1					
18	39.197942	-86.513746	7	3	1		1			3	1				
19	39.199159	-86.51434	8	1						1					
20	39.199584	-86.514549	7	5	5			P							
21	39.199573	-86.515145	8	5	5			P		1	1				
22	39.200099	-86.514771	6	5	5			P		1					
23	39.200045	-86.515338	7	1	1					1	1				
24	39.199862	-86.515809	8	1	1					1					
25	39.1996	-86.516325	9	5					5	1					
26	39.200191	-86.516523	10	3					1	1					
27	39.200549	-86.51711	12	0											
28	39.200878	-86.517545	14	0											
29	39.201171	-86.518163	11	1					1						
30	39.201464	-86.518813	15	0											
31	39.201837	-86.519229	11	1					1						
32	39.202218	-86.519549	12	1	1				1	1					
33	39.202673	-86.519298	8	1	1				1	1					
34	39.202759	-86.518782	4	5				P		5					
35	39.202888	-86.518301	2	5	1					3		3			
36	39.203185	-86.518164	1	5	5			P		1					
37	39.203092	-86.518703	5	5	5								1	1	
38	39.203189	-86.51918	8	5				P	5						3
39	39.203253	-86.519866	13	0											
40	39.203714	-86.520538	14	1					1						
41	39.2041	-86.521056	14	1					1	1					
42	39.204414	-86.521167	10	5				P		5					
43	39.205085	-86.521964	9	1						1					
44	39.205474	-86.522413	12	3						3					1
45	39.205829	-86.522645	12	3	1				3						
46	39.206309	-86.522309	5	5						5					
47	39.206128	-86.522828	10	5	5			P							
48	39.205819	-86.523574	8	5	1			P		5				1	
49	39.205592	-86.524033	13	0											
50	39.205455	-86.524627	14	1					1						

August 18, 2009 Continued

51	39.205441	-86.525362	10	5	1			P		5					1
52	39.205508	-86.525899	6	5	5			P		3					
53	39.20556	-86.526656	6	5	3			P		5					3
54	39.205441	-86.526858	6	5				P		5			5		3
55	39.205225	-86.527157	7	5	1			P		5					
56	39.205055	-86.527481	7	5						5					
57	39.204718	-86.527915	15	0											
58	39.204615	-86.528187	12	5				p		5					
59	39.204305	-86.528654	7	1						1			1		
60	39.203929	-86.52845	11	1						1					
61	39.203443	-86.528263	9	5	5			P							
62	39.203081	-86.528035	7	0											
63	39.202694	-86.527493	7	5	5			P							
64	39.202427	-86.527425	7	1						1					
65	39.20207	-86.527595	14	3	1					3					
66	39.201611	-86.527605	7	5	5					1					
67	39.201092	-86.527387	8	3	3										
68	39.200785	-86.527052	7	5	5			P							
69	39.200522	-86.526663	3	5	5			P							
70	39.201567	-86.52707	8	1											1
71	39.202083	-86.52683	6	5	5										
72	39.202566	-86.526828	10	3				P		3					
73	39.202942	-86.526567	3	5	5			P		3		1			
74	39.203125	-86.526318	14	0											
75	39.203264	-86.525875	6	5	1			P		5					5
76	39.203411	-86.525412	3	5	5			P	1	3					1
77	39.203411	-86.525412	4	5	5			P		3					
78	39.203596	-86.52474	10	0											
79	39.203767	-86.524187	18	0											
80	39.203736	-86.523701	5	0											
81	39.203585	-86.523263	9	0											
82	39.203457	-86.522926	11	1					1						
83	39.203251	-86.522479	10	0											
84	39.203006	-86.522289	18	0											
85	39.202603	-86.522241	20	0											
86	39.202019	-86.522344	14	0											
87	39.201135	-86.521939	19	0											
88	39.200689	-86.521403	14	0											
89	39.200437	-86.520714	13	0											
90	39.200131	-86.520711	5	1						1					
91	39.200036	-86.519881	13	0											
92	39.199905	-86.519312	11	0											
93	39.199712	-86.518735	10	0											
94	39.199541	-86.518412	10	0											
95	39.199415	-86.517907	11	0											
96	39.199262	-86.517679	5	0											
97	39.198875	-86.517293	2	1	1										
98	39.198972	-86.516876	9	5						5					
99	39.198868	-86.51648	9	1						1					
100	39.198629	-86.516003	7	5				P	3	3					

12.2 2010 Permit Application

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT
State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987
[ ] Whole Lake [x] 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: Page 1 of 4
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: Steve Cotter	Lake Assoc. Name: City of Bloomington Parks and Recreation	
Rural Route or Street: 401 N. Morton St. Suite 250		Phone Number: 812-349-3736
City and State: Bloomington, IN		ZIP Code: 47402
Certified Applicator (if applicable):	Company or Inc. Name:	Certification Number:
Rural Route or Street:		Phone Number:
City and State:		ZIP Code:

Lake (One application per lake): Griffy	Nearest Town: Bloomington	County: Monroe
Does water flow into a water supply	[ ] Yes	[x] 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 Center of bed @ N39.19752 W86.51263		
Total acres to be controlled 2.6	Proposed shoreline treatment length (ft) 756	Perpendicular distance from shoreline (ft) 250	
Maximum Depth of Treatment (ft) 5	Expected date(s) of treatment(s) early April or when water hits consistent 50 degrees		
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 at 1.0 ppm for early season control of curlyleaf pondweed

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

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Curlyleaf pondweed	x	20
Chara		20
horned pondweed		10
Coontail		5
Elodea		10
Sago pondweed		10
E. Milfiol		10
Brittle naiad		5
southern naiad		10

Treatment Area #	2	LAT/LONG or UTM's	Center of Bed at N39.19916 W86.51481		
Total acres to be controlled	13	Proposed shoreline treatment length (ft)	2069	Perpendicular distance from shoreline (ft)	460
Maximum Depth of Treatment (ft)	10	Expected date(s) of treatment(s)	early April or when water hits consistent 50 degrees		

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 at 1.0 ppm for early season control of curlyleaf pondweed

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

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Curlyleaf pondweed	x	20
Chara		20
horned pondweed		10
Coontail		5
Elodea		10
Sago pondweed		10
E. Milfiol		10
Brittle naiad		5
southern naiad		10

Treatment Area #	3	LAT/LONG or UTM's	Center of Bed @ N39.20288 W86.51907		
Total acres to be controlled	2.2	Proposed shoreline treatment length (ft)	1055	Perpendicular distance from shoreline (ft)	144
Maximum Depth of Treatment (ft)	8	Expected date(s) of treatment(s)	early April or when water hits consistent 50 degrees		

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 at 1.0 ppm for early season control of curlyleaf pondweed

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

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Curlyleaf pondweed	x	20
Chara		20
horned pondweed		10
Coontail		5
Elodea		10
Sago pondweed		10
E. Milfiol		10
Brittle naiad		5
southern naiad		10

AQUATIC CONTROL

Treatment Area #	4	LAT/LONG or UTM's	Will map prior to treatment, see 2009 AVMP update
Total acres to be controlled	?	Proposed shoreline treatment length (ft) ?	Perpendicular distance from shoreline (ft) ?
Maximum Depth of Treatment (ft)	20	Expected date(s) of treatment(s)	Spring 2010

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 for control of milfoil if it occurs

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

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Curlyleaf pondweed		20
Chara		20
horned pondweed		10
Coontail		5
Elodea		10
Sago pondweed		10
E. Milfiol	x	10
Brittle naiad		5
southern naiad		10

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.

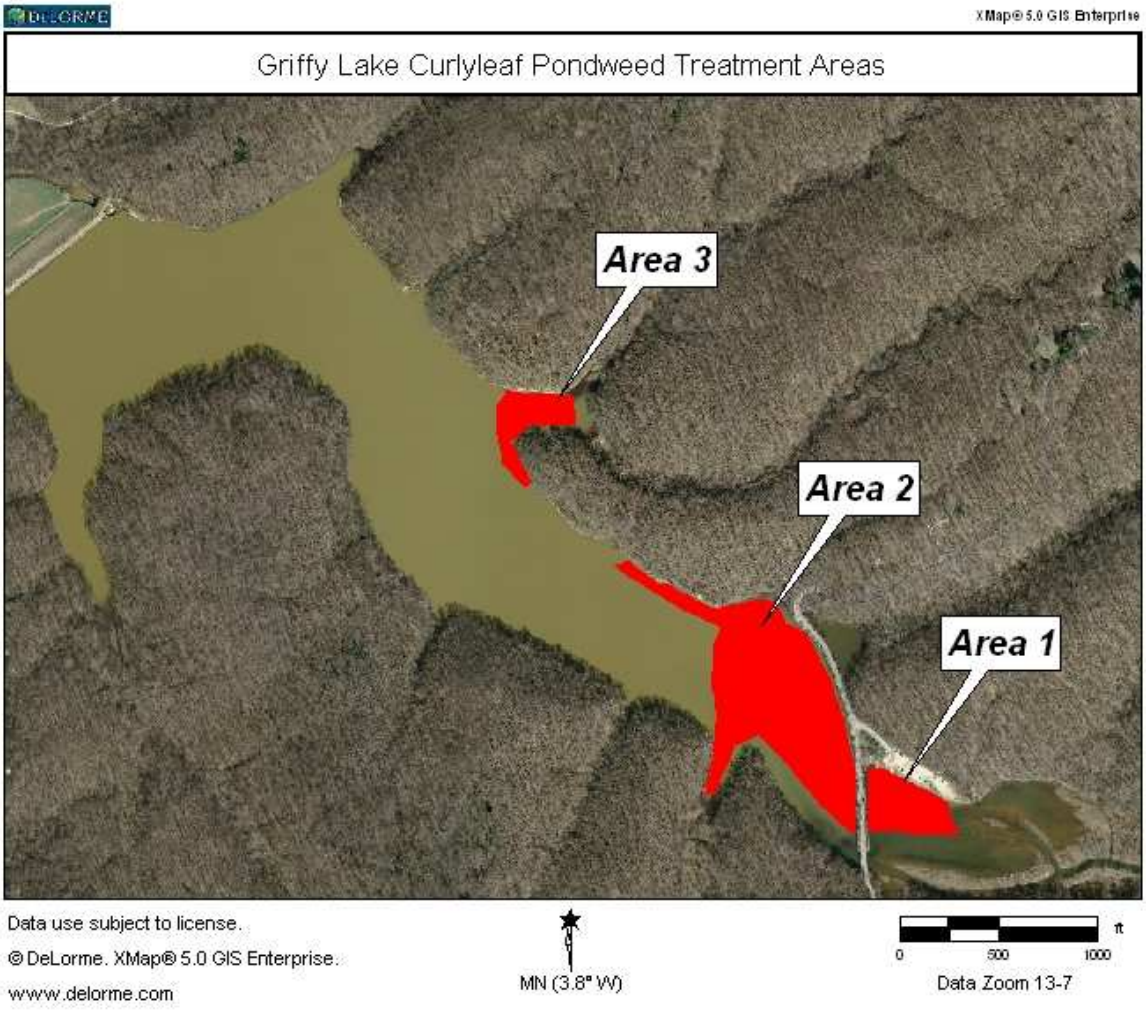
Applicant Signature	Date
Certified Applicant's Signature	Date

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

AQUATIC CONTROL

Permit Map for Curlyleaf Pondweed (Page 4 of 4)