

**Pleasant and Riddles Lake Aquatic Vegetation
Management Plan
2009 Update
St. Joseph County, Indiana**

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Executive Summary

Pleasant and Riddles lakes are 29-acre and 77-acre lakes, respectively that lie south of Lakeville in St. Joseph County, Indiana. Aquatic Control was contracted by the Lakeville Business Owner's Association (LBOA) to complete aquatic vegetation sampling in order to update their aquatic vegetation management plan for Pleasant and Riddles Lakes. Funding for development of this plan was obtained from the Lakeville Business Owner's Association and the Indiana Department of Natural Resources-Division of Fish and Wildlife as part of the Lake and River Enhancement fund (LARE). The update serves as a tool to track changes in the aquatic vegetation community, to adjust the action plan as needed, and to maintain eligibility for additional LARE funds. Items covered include the 2009 sampling results, a review of the 2009 vegetation controls, and updates to the budget and action plans.

Native aquatic vegetation is an important component of Indiana Lakes. Native vegetation provides fish habitat, food for wildlife, prevents erosion, and can improve overall water quality. However, invasive species can negatively impact lake use, including fishing, boating, swimming, aesthetic, and lakefront property values. The primary species of concern within Pleasant and Riddles Lakes are the invasive plants Eurasian watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*).

The primary recommendation for plant control from the original plan was the use of a combination of herbicides for early season selective control of Eurasian watermilfoil and curlyleaf pondweed throughout the lakes with an objective of keeping these species at or below 5% frequency of occurrence in summer Tier 2 surveys. In addition, it was recommended to continue monitoring the aquatic vegetation with spring invasive species mapping and mid to late summer Tier 2 surveys. It was also noted in the original plan that the primary problem concerning Pleasant and Riddles Lake is their poor water quality. This has led to low levels submersed vegetation diversity, dissolved oxygen fluctuations, and dense microscopic algae blooms. Improvement of the water quality should take precedence over submersed vegetation controls. It is vitally important that the recommendations laid out in the diagnostic study be acted upon.

In 2009, the LBOA received an \$8,100 grant from LARE to carry out the Eurasian watermilfoil and curlyleaf treatments on Pleasant and Riddles Lakes. The funding was also to be used for spring and mid summer plant sampling and plan update. Spring invasive species mapping was completed by Aquatic Control on April 17, 2009. Eurasian watermilfoil was not detected on either lake. Curlyleaf pondweed was not detected on Pleasant Lake, but covered an area of 11.0 acres on Riddles. Curlyleaf pondweed was treated on April 28, 2009 with 1.0 ppm of Aquathol K (active ingredient: endothal). A Tier 2 survey was completed by Aquatic Control on August 19, 2009 to document changes in the native plant community and document the efficacy of the treatments on both lakes. Curlyleaf pondweed and Eurasian watermilfoil were not detected during this survey. Native vegetation remained at a low level of abundance and diversity.

A public meeting was held on November 23, 2009 at the Lakeville Conservation Club to inform the public of the management activities and gain their input on the plan. The group appeared pleased with results of the 2009 treatments and elaborated on a grant they received from the Michiana Area Council of Governments (MACOG) for creating a watershed management plan.

The following is a list of recommendations designed to decrease nuisance conditions caused by exotic species while trying to promote native species diversity in Pleasant and Riddles Lakes.

1. Treat Eurasian watermilfoil and curlyleaf pondweed wherever they are detected with a mixture of Renovate 3 (active ingredient triclopyr) and Aquathol K (active ingredient dipotassium endothall salt).
2. Complete a pretreatment invasive species mapping survey prior to any vegetation management in early spring 2010 and continue these surveys through 2011 in order to assess the effectiveness of control techniques and locate areas for treatment.
3. Complete Tier 2 surveys in mid to late summer in order to document changes in the native community.
4. Continue to assess, adjust, and update the Pleasant and Riddles Aquatic Vegetation Management Plan at least through 2011.
5. Continue to work with area residents, the business community, and local municipalities in an effort to improve watershed practices.

Acknowledgements

Funding for the vegetation sampling and preparation of an aquatic vegetation management plan update was provided by the Lakeville Business Owner's Association and the Indiana Department of Natural Resources Lake and River Enhancement Program. Aquatic Control, Inc. completed the fieldwork, data processing, and map generation. Special thanks are due to Bob Feitz and the Lakeville Business Owner's Association for his help in initiating and completing this project. Special thanks are given to Chip Long, Assistant Fisheries Biologists for the Indiana Department of Natural Resources-Division of Fish and Wildlife, for his assistance and review of this plan. Special thanks are also given to Gwen White and Angela Sturdevant, Aquatic Biologist from the Lake and River Enhancement Program (LARE) for their review and assistance on this plan. Nathan Long is the primary author of this report. The author would like to acknowledge the valuable input from Brendan Hastie, Joey Leach, Leif Wiley, and Nate Eddy of Aquatic Control for their field assistance, map generation, review, and editing of this report.

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1.0 INTRODUCTION

This report was created in order to update the Pleasant and Riddles Lakes Aquatic Vegetation Management Plan 2007-2011 (Aquatic Control 2007). The plan update was funded by the Indiana Department of Natural Resources Lake and River Enhancement Program (LARE) and the Lakeville Business Owner's Association. The update serves as a tool to track changes in the vegetation community, to adjust the action plan as needed, and to maintain eligibility for additional LARE funds. Items covered include the 2009 sampling results, a review of the 2008 and 2009 vegetation controls, and updates to the budget and action plans. Once reviewed and approved, the update should be included in the original vegetation management plan, following the reference section and prior to the appendix.

Pleasant and Riddles lakes are 29-acre and 77-acre lakes, respectively that lie south of Lakeville in St. Joseph County, Indiana. These lakes have been impacted by nuisance levels of aquatic vegetation. Aquatic vegetation is an important component of lakes in Indiana; however, as a result of many factors this vegetation can develop to a nuisance level. Nuisance aquatic vegetation, as used in this paper, describes plant growth that negatively impacts the present uses of the lake including fishing, boating, swimming, aesthetic, and lakefront property values. The primary nuisance species within Pleasant and Riddles Lakes are the invasive species Eurasian watermilfoil and curlyleaf pondweed. It is important to manage these lakes as a single entity since they are directly connected by a channel with boat traffic between the two lakes. Any improvements achieved in one lake can easily be negated by reintroduction of exotic invasive species from the other.

2.0 2009 PLANT SAMPLING

Two surveys were completed in 2009 by Aquatic Control in order to document changes in the plant community, map out treatment areas, and measure success or failure of the control techniques. Spring invasive species mapping surveys were completed on April 17, 2009 on both lakes. The purpose of the spring invasive mapping surveys was to identify areas where Eurasian watermilfoil and curlyleaf pondweed were growing so treatment areas could be confirmed and mapped. Tier 2 surveys were completed on August 19, 2009 on both lakes. These surveys were designed to monitor the health of the native plant community and measure the effectiveness of the herbicide treatments. No voucher samples were collected during the surveys.

2.1 Pleasant Lake Sampling Results

2.1.1 Spring Invasive Species Mapping Survey, Pleasant Lake

On April 17, 2009 a spring invasive species mapping survey was completed on Pleasant Lake. A Secchi reading was taken prior to the survey and found to be 2.5 feet. Water temperature was also recorded at 52.0 degrees Fahrenheit. No curlyleaf pondweed or Eurasian watermilfoil was detected (this is the second season in a row with no milfoil detection on Pleasant Lake and curlyleaf pondweed has never been detected since the LARE funded surveys began). The only submersed species observed was common

coontail (*Ceratophyllum demersum*). Spatterdock (*Nuphar sp.*) and pickerel weed (*Pontederia cordata*) were observed growing along the shoreline.

2.1.2 Tier 2 Survey, Pleasant Lake

Tier 2 sampling took place on August 19, 2009. A Secchi disk reading was taken prior to sampling and was found to be 2.5 feet. Plants were present to a maximum of 6.0 feet. The same 30 sites that were sampled in 2007 were sampled again in this survey. Plants were present at only 11 sites and the only species collected was common coontail. The average number of native species per site was 0.37 (Table 1). Coontail had a rake score of 1 at 33.3% of sites and a rake score of 5 at only a single site (Figure 1). Surveys designed to document changes in rooted floating or emergent vegetation were not completed on Pleasant Lake. However, spatterdock, pickerel weed, arrowhead (*Sagittaria latifolia*), common cattail (*Typha latifolia*), duckweed (*Lemna minor*), watermeal (*Wolffia sp.*), purple loosestrife (*Lythrum salicaria*), and white water lily (*Nymphaea odorata*) were observed growing along the shoreline margins (Figure 2). These plants likely provide good fish habitat in these areas and appeared to have changed little since 2006. However, no surveys have been completed to document this vegetation since the 2006 Tier 1 survey.

Table 1. Tier 2 survey results, Pleasant Lake (0-6 feet), August 19, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Pleasant Lake (overall).						
County:	St. Jos	Total Sites:	30	Mean species/site:	0.37	
Date:	8/19/09	Sites with plants:	11	SE Mean species/site:	0.09	
Secchi (ft):	3.5	Sites with native plants:	11	Mean native species/site:	0.37	
Max Plant Depth (ft):	6	Number of species:	1	SE Mean natives/site:	0.09	
Trophic Status:	Meso	# of native species:	1	Species diversity:	0.00	
		Maximum species/site:	1	Native species diversity:	0.00	
<hr/>						
All Depths (0 to 6 ft)	Frequency of Occurrence		Rake score frequency per sp.			Plant Dominance
Species			0	1	3	5
Common coontail	36.7		63.3	33.3	0.0	3.3
Filamentous Algae	16.7					
Other species observed: Arrowhead, common cattail, spatterdock, pickerel weed, duckweed, watermeal, purple loosestrife, white water lily						

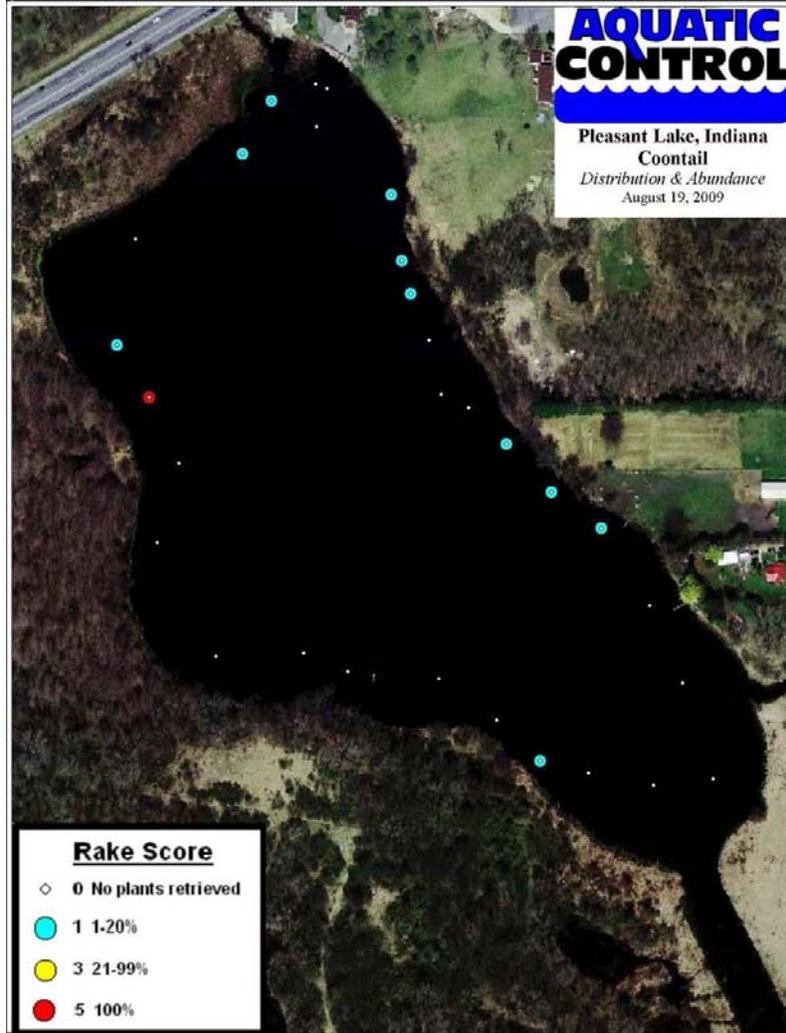


Figure 1. Pleasant Lake, common coontail distribution and abundance, August 19, 2009.



Figure 2. Pleasant Lake, white water lily, spatterdock, and other rooted floating and emergent species, August 19, 2009.

It is beneficial to look at the species distribution throughout different depth ranges. Twenty sites were sampled from 0-5 feet. Half of the sites contained vegetation. Coontail was the only species collected. The mean number of native species per site was 0.50. The remaining sites fell between 5.0 and 6.0 feet. Only a single site from 5.0-6.0 feet contained vegetation (Tables 2 & 3).

Table 2. Tier 2 survey results, Pleasant Lake (0-5 ft), August 19, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Pleasant Lake (0-5).								
County:	St. Jos	Total Sites:	20	Mean species/site:	0.50			
Date:	8/19/09	Sites with plants:	10	SE Mean species/site:	0.11			
Secchi (ft):	3.5	Sites with native plants:	10	Mean native species/site:	0.50			
Max Plant Depth (ft):	6	Number of species:	1	SE Mean natives/site:	0.11			
Trophic Status:	Meso	# of native species:	1	Species diversity:	0.00			
		Maximum species/site:	1	Native diversity:	0.00			
Depth: 0 to 5 ft		Frequency of Occurrence		Rake score frequency per specie		Plant Dominance		
Species				0	1	3	5	
Common coontail		50.0		50.0	45.0	0.0	5.0	14.0
Filamentous Algae		25.0						

Table 3. Tier 2 survey results, Pleasant Lake (5-6 ft), August 19, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Pleasant Lake (5-6).						
County:	St. Jos	Total Sites:	10	Mean species/site:	0.10	
Date:	8/19/09	Sites with plants:	1	SE Mean species/site:	0.10	
Secchi (ft):	3.5	Sites with native plants:	1	Mean native species/site:	0.10	
Max Plant Depth (ft):	6	Number of species:	1	SE Mean natives/site:	0.10	
Trophic Status:	Meso	# of native species:	1	Species diversity:	0.00	
		Maximum species/site:	1	Native diversity:	0.00	
Depth: 5 to 6 ft		Frequency of Occurrence	Rake score frequency per sp.		Plant Dominance	
Species			0	1	3	5
Common coontail		10.0	90.0	10.0	0.0	0.0
Filamentous Algae		0.0				
						2.0

2.2 Riddles Lake Sampling Results

2.2.1 Spring Invasive Species Mapping Survey, Riddles Lake

On April 17, 2009 a spring invasive species mapping survey was completed on Riddles Lake. A Secchi measurement was taken prior to the survey and found to be 2.5 feet. The water temperature was 52.0 degrees at the surface. No milfoil was detected during the survey. Curlyleaf pondweed was detected within the 11.8 acre area that had been treated for the two previous seasons. Curlyleaf plants that were found during the inspection were immature and scattered within these areas (Figure 3).

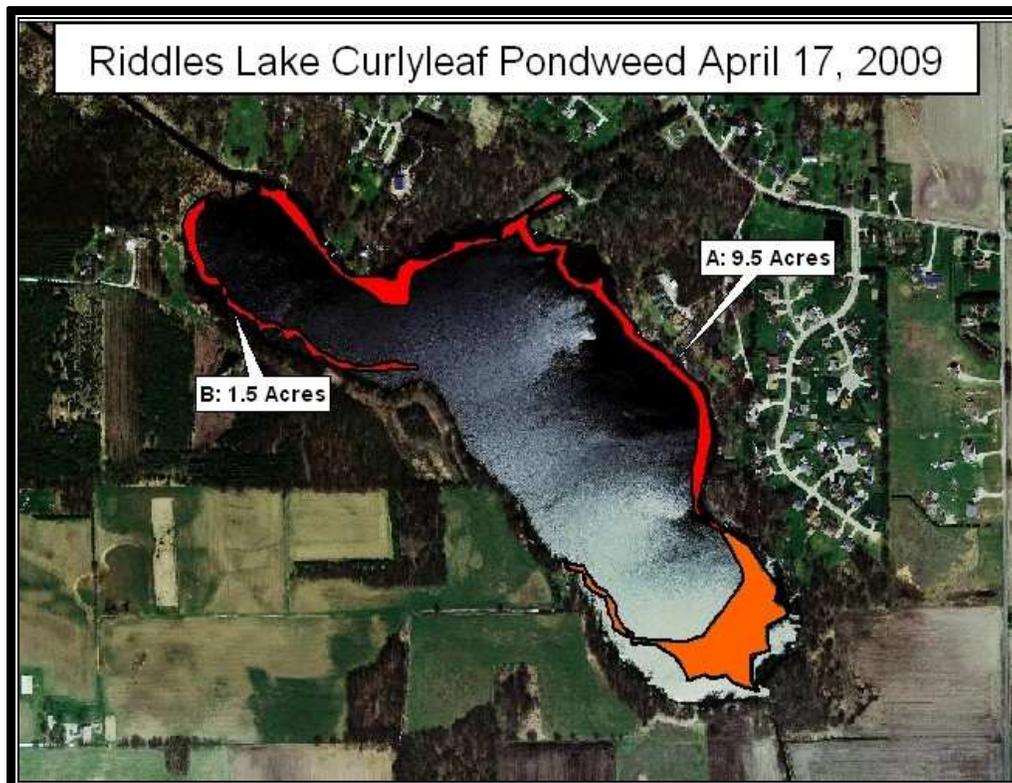


Figure 3. Riddles Lake, curlyleaf pondweed areas April 17, 2009

2.2.2 Tier 2-Riddles Lake

Tier 2 sampling took place on August 19, 2009. A Secchi disk reading was taken prior to sampling and was found to be 2.0 feet. Plants were present to a maximum of 6.0 feet. The same 40 sites that were sampled in 2007 were sampled again in this survey. Plants were present at 17 sites. Only two species were collected. The average number of native species per site was 0.45. Table 4 outlines the results from the Tier 2 survey for all depth ranges. Common coontail was the most frequently occurring species (Figure 4). Common naiad (*Najas flexilis*) was the only other species collected and was only found at a single site (Figure 5). Much like Pleasant Lake, Riddles Lake also supported abundant rooted floating and emergent vegetation along the shoreline. The same species observed in Pleasant were also observed in Riddles Lake. Figure 6 helps illustrate the abundance of these beneficial plants along the shallow shoreline areas. There appears to be little change in the abundance of rooted floating species in Riddles Lake, but there were no surveys designed to back these visual observations.

Table 4. Tier 2 survey results, Riddles Lake (0-6 ft), August 19, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Riddles Lake (overall).							
County:	St. Jos	Total Sites:	40	Mean species/site:	0.45		
Date:	8/19/09	Sites with plants:	17	SE Mean species/site:	0.09		
Secchi (ft):	2	Sites with native plants:	17	Mean native species/site:	0.45		
Max Plant Depth (ft):	6	Number of species:	2	SE Mean natives/site:	0.09		
Trophic Status:	Eutroph	# of native species:	2	Species diversity:	0.10		
		Maximum species/site:	2	Native species diversity:	0.10		
<hr/>							
All Depths (0 to 6 ft)		Frequency of Occurrence		Rake score frequency per specie		Plant Dominance	
Species			0	1	3	5	
Common coontail		42.5	57.5	30.0	2.5	10.0	17.5
Common naiad		2.5	97.5	0.0	2.5	0.0	1.5
Filamentous Algae		10.0					
Other species observed: Spatterdock, purple loosestrife, white water lily, common cattail, duckweed, watermeal							

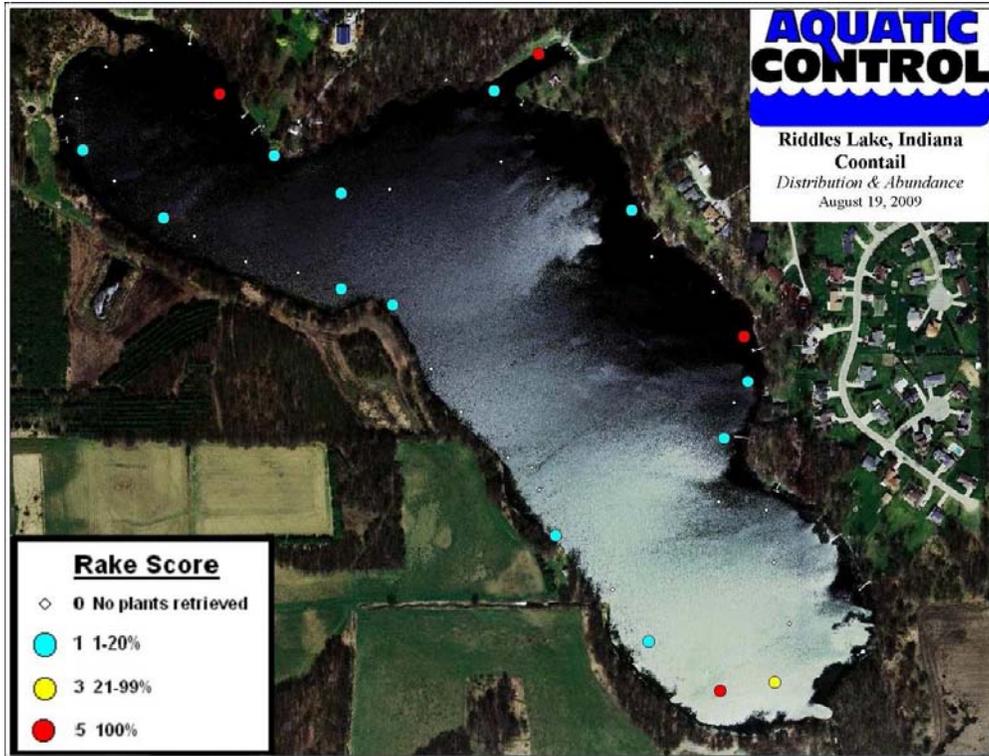


Figure 4. Riddles Lake, common coontail distribution and abundance, August 19, 2009.



Figure 5. Riddles Lake, common naiad distribution and abundance, August 19, 2009.



Figure 6. Riddle Lake, spatterdock bed along the southeast shore, August 19, 2009.

Twenty seven sites were sampled from 0-5 feet. Sixteen of the sites contained vegetation. Coontail was the most abundant species in the shallow water. Common naiad was also found at one of the shallow sites. The mean number of native species per site was 0.63. The remaining sites fell between 5.0 and 6.0 feet. Only a single site from 5.0-6.0 feet contained vegetation (Tables 5 & 6).

Table 5. Tier 2 survey results, Riddles Lake (0-5 ft), August 19, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Riddles Lake (0-5).						
County:	St. Jos	Total Sites:	27	Mean species/site:	0.63	
Date:	8/19/09	Sites with plants:	16	SE Mean species/site:	0.11	
Secchi (ft):	2	Sites with native plants:	16	Mean native species/site:	0.63	
Max Plant Depth (ft):	6	Number of species:	2	SE Mean natives/site:	0.11	
Trophic Status:	Eutroph	# of native species:	2	Species diversity:	0.11	
		Maximum species/site:	2	Native diversity:	0.11	
Depth: 0 to 5 ft		Frequency of Occurrence		Rake score frequency per sp.		Plant Dominance
Species				0 1 3 5		
Common coontail		59.3		40.7 40.7 3.7 14.8		25.2
Common naiad		3.7		96.3 0.0 3.7 0.0		2.2
Filamentous Algae		14.8				

Table 6. Tier 2 survey results, Riddles Lake, (5-6 ft), August 19, 2009.

Occurrence and Abundance of Submersed Aquatic Plants in Riddles Lake (5-6).						
County:	St. Jos	Total Sites:	13	Mean species/site:	0.08	
Date:	8/19/09	Sites with plants:	1	SE Mean species/site:	0.08	
Secchi (ft):	2	Sites with native plants:	1	Mean native species/site:	0.08	
MaxPlant Depth (ft):	6	Number of species:	1	SE Mean natives/site:	0.08	
Trophic Status:	Eutroph	# of native species:	1	Species diversity:	0.00	
		Maximum species/site:	1	Native diversity:	0.00	
Frequency of Occurrence						
Depth: 5 to 6 ft				Rake score frequency per sp.	Plant Dominance	
Species			0	1	3	5
Common coontail	7.7		92.3	7.7	0.0	0.0
Filamentous Algae	0.0					

2.3 Plant Sampling Discussion

2.3.1 Pleasant Lake Sampling Discussion

One of the primary objectives in the original aquatic vegetation management plan was to reduce the frequency of Eurasian watermilfoil to 5% or lower. Table 7 and Figure 7 illustrate the frequency of occurrence of species that were collected in the last three summer surveys on Pleasant Lake. Eurasian watermilfoil decreased from 23.3% frequency of occurrence in 2006 to not being detected in 2007 and 2009. Common coontail increased in frequency in 2007 but decreased in 2009. The reason for the shifts in coontail abundance is not clear. Common naiad is the only other species that has been collected from Pleasant Lake. It was collected at a single site in 2006 but hasn't been collected since that time.

Table 7. Pleasant Lake, percent occurrence of species in the last three summer surveys.

Species	% of survey sites (8/06)	% of survey sites (7/07)	% of survey sites (8/09)
Eurasian watermilfoil	23.3%	-	-
common coontail	40.0%	66.7%	36.7%
common naiad	3.3%	-	-

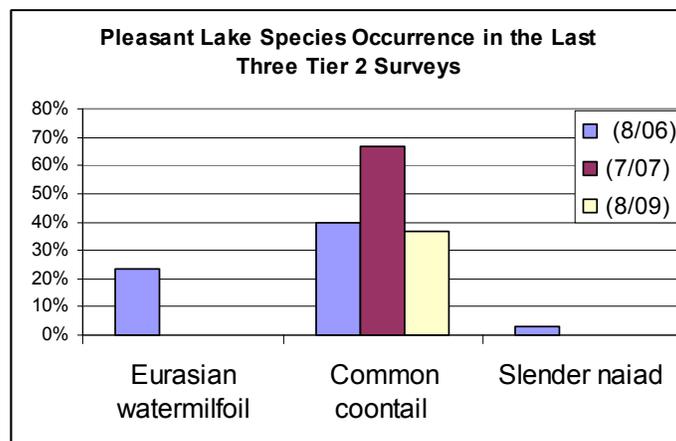


Figure 7. Pleasant Lake, species occurrence in the last three Tier 2 surveys (data from Table 7).

2.3.2 Riddles Lake Sampling Discussion

Table 8 and Figure 8 illustrate a comparison of species found in Riddles Lake over the past three surveys and the frequency at which they occurred. The comparison is from the summer Tier 2 surveys conducted in 2006, 2007, and 2009. Eurasian watermilfoil decreased from 17.5% in 2006 to no detect in 2007 and 2009. Common coontail appeared to have increased in 2007 and then decreased in 2009.

Table 8. Riddles Lake, percent occurrence of species in the last three summer surveys.

Species	% of survey sites (8/06)	% of survey sites (7/07)	% of survey sites (8/09)
Eurasian watermilfoil	17.5%	-	-
common coontail	40.0%	65.0%	42.5%
southern naiad (<i>Najas guadalupensis</i>)	2.5%	-	-
common naiad (<i>Najas flexilis</i>)	-	-	2.5%
leafy pondweed (<i>Potamogeton foliosus</i>)	2.5%	-	-
common bladderwort (<i>Utricularia vulgaris</i>)	2.5%	-	-

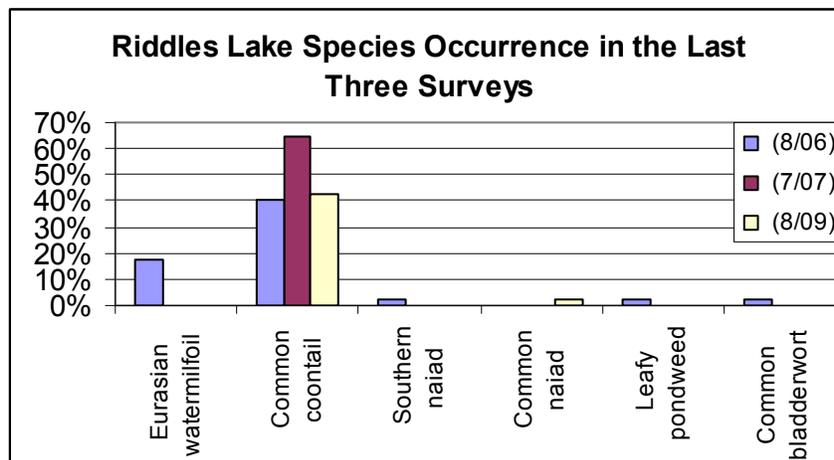


Figure 8. Riddles Lake, species occurrence in the last three surveys (data from Table 8).

Overall, there is very low diversity of submersed native vegetation in both of the lakes. Invasive species have been controlled thus reducing nuisance conditions experienced by lake users, but this reduction has yet to positively impact the submersed native plant community. It is unlikely that any increases in native diversity or abundance will take place until water clarity improved. Secchi readings have ranged from 2.0-3.0 feet in the last three surveys. This limits the depth at which vegetation can grow and can also limit diversity. In addition, shallow water areas are typically dominated by spatterdock. The presence of spatterdock may limit submersed vegetation growth by reducing light penetration. Improved water quality may enhance the submersed native plant community. Steps to improve the watershed may help increase water clarity, but it will take time to see changes within the plant community following watershed improvements.

3.0 VEGETATION CONTROL

Invasive species treatments began on Pleasant and Riddles Lakes in 2007 when 15.1 acres of milfoil and 11.0 acres of curlyleaf pondweed were treated. Two treatments have been completed on Riddles Lake since the 2007 update (no treatments were completed on Pleasant Lake since no curlyleaf pondweed or milfoil were detected in 2008 and 2009). Both treatments were completed for control of curlyleaf pondweed. The same 11.8 acre area that was treated in 2007 was again treated in 2008 and 2009 (Figure 9). The 2008 treatment was completed on May 12th and the 2009 treatment was completed on April 28th. Aquathol K (active ingredient: endothal) was applied evenly over these areas at a rate of 1.0 parts-per-million. The goal of the treatment was not only to control curlyleaf pondweed for the season, but to also control the plants prior to the development of turions, or reproductive structures, thus limiting the amount of curlyleaf returning the following season. Ideally, after three to four seasons of early season treatments, very little curlyleaf pondweed will remain. LARE funded plant management that has taken place since 2007 is summarized in Table 9.

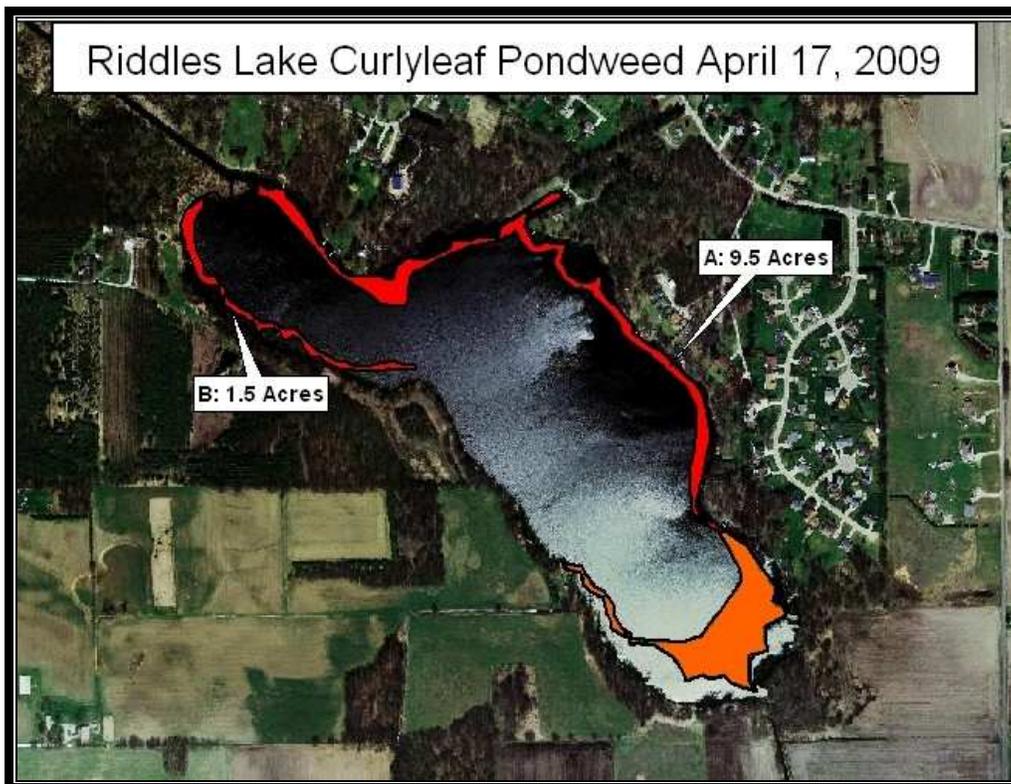


Figure 9. Riddles Lake, curlyleaf pondweed treatment areas, May 12, 2008 and April 28, 2009.

Table 9. Pleasant and Riddles Lakes Treatment History 2007-2009.

Year	Lakes Treated	Species Targeted	Acres	Products Used
2007	Pleasant & Riddles	Milfoil and Curlyleaf	15.1 (Milfoil) 11.0 (Curlyleaf)	Aquathol K & Renovate
2008	Riddles	Curlyleaf	11.0	Aquathol
2009	Riddles	Curlyleaf	11.0	Aquathol

4.0 ACTION PLAN AND BUDGET UPDATE

Actions taken over the last three seasons have effectively controlled invasive species in both lakes. No milfoil has been detected in either lake since the 2007 Renovate treatment. Curlyleaf pondweed is still present in Riddles Lake, but it appears to be occurring at a lower density than in the initial surveys. Vegetation management actions should be initiated in mid-April in an attempt to locate milfoil. Any milfoil areas should be treated with Renovate herbicide. It is difficult to predict whether any milfoil will be found, but if it is present it is unlikely that more than 3.0 acres would exist. In addition, the area that has traditionally been treated for curlyleaf control should be assessed. If curlyleaf is found throughout these areas they should be treated once the water temperature reaches 50 degrees and before the water reaches 57 degrees. Curlyleaf pondweed should be treated using Aquathol at a rate of one part per million. Long term control of curlyleaf pondweed will likely require one to two more seasons of early application to the same area. Tier 2 surveys should be conducted in late summer order to assess the effectiveness of the vegetation controls and monitor changes in native vegetation.

As noted in the original plan, the primary problem concerning Pleasant and Riddles Lake is their poor water quality. This has led to below normal submersed vegetation diversity, dissolved oxygen fluctuations, and dense microscopic algae blooms. Improvement of the water quality should take precedence over submersed vegetation controls. Recently, the town of Lakeville received a grant to install a new sewer line and lift stations. Runoff from the town was thought to be a contributor to above normal *e.coli* and nutrient levels found in the lake. In addition, a watershed management plan is scheduled for startup in March 2010 (Personal Communication, Mr. Bob Feitz, November 23, 2009). This plan should provide the groundwork for future improvements. The key will be acting on the recommendations that are laid out in this plan. If the water clears up in these lakes, native vegetation will likely colonize once barren areas without the need for human intervention.

A budget for the proposed applications and sampling is provided in Table 10. The budget includes the estimated cost of treatments that should be eligible for funding by LARE. The budget extends for the next two seasons. **It is recommended that LBOA requests \$5,000 for the treatment of Eurasian watermilfoil and curlyleaf pondweed. The association should also request \$4,000 for plant sampling and plan updates.** When making the funding decision, IDNR should keep in mind that the grant request includes vegetation control in two lakes. There are slight increases in the budget's cost of treatment due to a late curlyleaf treatment in 2008 that likely had little long-term impact on the population.

Table 10. Budget estimate for action plan.

Action	2010	2011
Selective treatment of Eurasian watermilfoil with Renovate herbicide (<3.0 acres)	\$1,400	\$1,000
Early season treatment of curlyleaf pondweed (11.0 acres)	\$3,600	\$3,600
Plant sampling and plan updates (potential LARE funding with 10% match)	\$4,000	\$4,000
Total:	\$9,000	\$8,600

The LARE program has several different steps that must be followed in order for a grant recipient and LARE contractor to fulfill all requirements and remain eligible for funding. Table 11 outlines the anticipated LARE schedule for the upcoming season. All grant recipient responsibilities are highlighted in yellow.

Table 11. LARE actions, due dates, and responsible parties (grant recipient actions highlighted in yellow).

Action	Due date	Responsible Party
IDNR funding decision	March 10, 2010	IDNR
Vegetation control & plan update bids sent out to eligible contractors	March 20, 2010	Grant Recipient
Grant recipient selects contractor(s)	April 15, 2010	Grant Recipient
Curlyleaf treatment	April, 2010	Contractor
Invasive plant mapping survey	May/June, 2010	Contractor
Invasive treatment	May/June, 2010	Contractor
Tier II survey	July/August, 2010	Contractor
Public meeting held to discuss 2010 results and future plans	August-October, 2010	Contractor
AVMP summary due to IDNR biologists	November 1, 2010	Contractor
Meeting with IDNR biologists	November 15, 2010	Contractor
First draft due	December 15, 2010	Contractor
LARE grant application due	January 15, 2011	Grant Recipient
Vegetation control permit submitted	January 15, 2011	Grant Recipient
IDNR review returned to contractor	February 1, 2011	IDNR
Revised plan/update due	March 1, 2011	Contractor

5.0 PUBLIC INVOLVEMENT

A public meeting was held at the Lakeville Conservation Club on November 23, 2009. The meeting was designed to educate lake users on the benefits of aquatic vegetation, 2009 vegetation controls, and the future of aquatic plant management on Pleasant and Riddle Lakes. The meeting was also used to gain input from lake users concerning their perceptions of aquatic vegetation and satisfaction or dissatisfaction concerning vegetation control techniques. Nine individuals were in attendance. Survey forms were given to those in attendance at the public meeting and later given to lake users at the Conservation Club's monthly meeting. A total of 25 individual lake users filled out the survey forms. Table 12 shows the results of the survey. Thirty-two percent of those surveyed owned property on the lakes and 44% had used the lakes for more than 10 years. Of those that

responded, 88% used the lakes for fishing, 56% for boating, and 20% used the lakes for swimming. Survey questions concerning problems on the lakes indicated that 48% believed that dredging was needed, 56% thought there was poor water quality, and 44% felt there were too many aquatic weeds. Questions concerning aquatic vegetation indicated that 76% believed vegetation interfered with their lake use, 52% believed there were nuisance levels of aquatic plants, 44% believed vegetation affected property value, and 96% were in favor of continuing vegetation control. Several of the respondents added comments about concerns over the high levels of *E. coli* and the need for dredging between the lakes. Mr. Bob Feitz informed the group on the town's efforts to improve the watershed by adding new sewer lines and lift stations along with plans for completion of a watershed management plan in the coming years.

Table 12. Results from the public meeting survey

Pleasant & Riddles Lake 11/23/09-25 Respondents		
Are you a lake property owner?	Yes: 32%	No: 68%
Are you currently a member of your lake association?	Yes: 52%	No: 32%
How many years have you been at the lake?	2 or Less: 8%	5 to 10: 20%
	2 to 5: 12%	Over 10: 44%
How do you use the lake (mark all that apply)	Swimming 20%	Irrigation 4%
	Boating 56%	Drinking water 0%
	Fishing 88%	Other 4% (hunting)
Do you have aquatic plants at your shoreline in nuisance quantities?	Yes: 52% No: 28%	
Does aquatic vegetation interfere with your use or enjoyment of the lake?	Yes: 76% No: 16%	
Does the level of vegetation in the lake affect your property values?	Yes: 44% No: 20%	
Are you in favor of continuing efforts to control vegetation on the lake?	Yes: 96% No: 0%	
Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded?	Yes: 72% No: 12%	
Were you satisfied with the results of the LARE funded invasive treatments this season?	Yes: 80% No: 4%	
Mark any of these you think are problems on your lake:		
4% Too many boats access the lake		
0% Use of jet skis on the lake		
0% Too much fishing		
28% Fish population problem		
48% Dredging needed		
0% Overuse by nonresidents		
44% Too many aquatic plants		
0% Not enough aquatic plants		
56% Poor water quality		
0% Pier/funneling problem		

It is also beneficial to examine the public perception of lake problems and management actions taken thus far over the course of the LARE funded AVMP project. Table 13 displays the results from the public surveys conducted in 2007 and 2009. There appears to have been little change in public perceptions in the past two surveys.

Table 13. Pleasant and Riddles Lakes, lake user survey results, 2007 and 2009.

Survey participant information	2007	2009
Is a lake property owner	50%	32%
Is a member of the lake association	33%	52%
Have been on the lake for more than 10 years	33%	44%
Uses of lake		
Swimming	0%	20%
Boating	50%	56%
Fishing	67%	88%
Irrigation	0%	4%
Drinking water	0%	0%
Other	17%	4%
Perception of aquatic vegetation and management		
Plants at shoreline in nuisance quantities	50%	52%
Vegetation interferes with lake use and enjoyment	67%	76%
Aquatic vegetation affects property values	50%	44%
In favor of continuing vegetation control on lake	83%	6%
Are aware that LARE funds are only for control of invasive plants	83%	72%
Are satisfied with results from LARE funded activities	67%	80%
Problems on lake		
Too many boats access the lake	0%	4%
Use of jet skis is a problem on the lake	0%	0%
Too much fishing	0%	0%
Fish population problems	0%	28%
Dredging is needed	100%	48%
Overuse by nonresidents	0%	0%
Too many aquatic plants in lake	67%	44%
Not enough aquatic plants in lake	0%	0%
Poor water quality	83%	56%
Pier/funneling problems exist on lake	0%	0%

Another topic discussed at the public meeting was the recent discovery of hydrilla (*Hydrilla verticillata*) in Lake Manitou. Hydrilla is an invasive aquatic species that was originally discovered in Florida in the 1960's. There are many characteristics of hydrilla that make it a threat to Indiana waterways. This species can grow in lower light conditions than most native species, grows faster than most native species, and can shade out other species by forming a surface canopy. Hydrilla can be easily confused with native elodea. The best way to distinguish hydrilla from native elodea is that hydrilla typically has five leaves along each whorl along with visible serrated edges along the leaf margin (Figure 10). What makes controlling the spread of hydrilla difficult is the fact that it can be spread by fragmentation. **That is why it is vitally important that lake users remove all plants and sediment from their boats when entering and leaving**

the Lakes. More information about controlling the spread of hydrilla can be found at www.protectyourwaters.net.



Figure 10. Illustration of hydrilla on the left compared to native elodea on the right. Hydrilla typically contains five toothed leaves per whorl while native elodea typically has three leaves per whorl and the teeth are not visible on the leaves (Illustrations provided by Applied Biochemist).

It will be important for the Association to continue to inform users of proper land management practices that have minimal negative impacts on the lakes water quality. This may include discouraging fertilizer use, not disposing of yard waste in or near the lake, and allowing natural vegetation to grow along the shoreline as opposed to concrete seawalls. Residents should also continue to be informed of the benefits of native vegetation on fish populations and water quality. These items can be reinforced in Association newsletters, websites, and at Association meetings. Reduction of nutrient levels in the lakes would likely create dramatic improvements in the diversity of native submersed vegetation.

6.0 REFERENCES CITED

Aquatic Control Inc. 2007. Pleasant and Riddles Lakes Aquatic Vegetation Management Plan 2007-2011. Prepared for Lakeville Business Owners Association. Lakeville, Indiana.

Aquatic Control Inc. 2008. Pleasant and Riddles Lakes Aquatic Vegetation Management Plan 2007 Update. Prepared for Lakeville Business Owners Association. Lakeville, Indiana.

JFNew and Associates. 2006. Pleasant and Riddles Lakes Watershed Diagnostic Study. Prepared for the Lakeville Business Owners Association, Lakeville, Indiana.

7.0 APPENDIX UPDATE

7.1 2009 Plant Sampling Data

7.1.1 Pleasant Sampling Data

WPT	Lat	Long	Depth	Rake score	Fil. Algae	Coontail
1	41.518637	-86.277384	2	1		1
2	41.518324	-86.277608	6	1		1
3	41.517825	-86.278446	5	0		
4	41.517204	-86.27859	5	1		1
5	41.516903	-86.278338	4	5		5
6	41.516514	-86.278103	6	0		
7	41.516043	-86.278273	5	0		
8	41.515382	-86.277815	5	0		
9	41.515401	-86.277135	7	0		
10	41.515295	-86.276785	6	0		
11	41.515249	-86.276077	6	0		
12	41.51501	-86.275626	5	0		
13	41.514771	-86.275286	4	1		1
14	41.5147	-86.274912	7	0		
15	41.514631	-86.274401	4	0		
16	41.514668	-86.273936	5	0		
17	41.515226	-86.274172	6	0		
18	41.515677	-86.274433	5	0		
19	41.516128	-86.274808	2	1	P	1
20	41.516347	-86.2752	3	1	P	1
21	41.51663	-86.275551	5	1	P	1
22	41.516841	-86.275845	5	0		
23	41.516919	-86.276058	7	0		
24	41.517236	-86.276151	6	0		
25	41.517508	-86.276294	4	1	P	1
26	41.517702	-86.276366	4	1	P	1
27	41.518085	-86.276448	4	1		1
28	41.518707	-86.27695	5	0		
29	41.518487	-86.277033	7	0		
30	41.518733	-86.277038	5	0		

7.1.2 Riddles Sampling Data

WPT	Lat	Long	Depth	Rake score	Fil. Algae	Coontail	Slender naiad
				Rake score	Fil. Algae	Coontail	Slender naiad
1	41.508091	-86.266953	6	0			
2	41.507912	-86.26758	7	0			
3	41.507581	-86.267996	7	0			
4	41.507043	-86.267902	5	1		1	
5	41.506718	-86.267464	5	0			
6	41.506328	-86.26678	6	1		1	
7	41.506137	-86.26635	5	0			
8	41.505869	-86.26563	5	0			
9	41.505759	-86.264897	5	0			
10	41.505586	-86.264295	3	1	P	1	
11	41.505422	-86.263567	4	1	P	1	
12	41.504753	-86.263032	6	0			
13	41.504292	-86.262608	5	0			
14	41.503818	-86.261951	6	0			
15	41.503708	-86.261627	6	0			
16	41.503475	-86.261517	5	0			
17	41.502999	-86.261291	2	1	P	1	
18	41.502441	-86.260487	5	0			
19	41.501901	-86.259989	5	1		1	
20	41.501383	-86.258987	3	5		5	
21	41.501468	-86.258218	2	5		3	3
22	41.502081	-86.25802	4	0			
23	41.502721	-86.258236	5	0			
24	41.503268	-86.258341	5	0			
25	41.503357	-86.259009	7	0			
26	41.504015	-86.258927	5	1		1	
27	41.504385	-86.258791	7	0			
28	41.504613	-86.258599	4	1		1	
29	41.505088	-86.25865	2	5		5	
30	41.505561	-86.259085	5	0			
31	41.505928	-86.259947	7	0			
32	41.50641	-86.26022	1	1		1	
33	41.506745	-86.261398	6	0			
34	41.506916	-86.262052	6	0			
35	41.507658	-86.262154	2	1	P	1	
36	41.508045	-86.261526	4	5		5	
37	41.506631	-86.263613	7	0			
38	41.506589	-86.264294	5	1		1	
39	41.506984	-86.265229	5	1		1	
40	41.507629	-86.265987	5	5		5	

7.2 2010 Vegetation Control Permit
7.2.1 2010 Pleasant Lake Permit



**APPLICATION FOR AQUATIC
VEGETATION CONTROL PERMIT**

State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987
 Whole Lake Multiple Treatment Areas
Check type of permit

INSTRUCTIONS: Please print or type information

FOR OFFICE USE ONLY	
License No.	
Date Issued	
Lake County	

Return to: Page 1 of 2
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 Bob Feitz		Lake Assoc. Name Lakeville Business Owner's Association	
Rural Route or Street PO Box 468		Phone Number 574-784-8989	
City and State Lakeville, IN		ZIP Code 46536	
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) Pleasant Lake	Nearest Town Lakeville	County St. Joseph
Does water flow into a water supply		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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 Treatment of EWM throughout lake (areas determined following survey, no more than 20 acres)	
Total acres to be controlled <20 acres	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft) 7	Expected date(s) of treatment(s) mid April to early May	
Treatment method: <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Physical <input type="checkbox"/> Biological Control <input type="checkbox"/> 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. No invasives observed in 2009 visual inspection, but just in case there is a return we want to be ready		
Plant survey method: <input checked="" type="checkbox"/> Rake <input checked="" type="checkbox"/> Visual <input type="checkbox"/> Other (specify) 2009 Visual and Rake Survey		

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Common coontail		70
Eurasian watermilfoil	x	0
Curlyleaf pondweed	x	0
Spatterdock		25
white water lily		5



7.2.2 2010 Riddles Lake Permit



**APPLICATION FOR AQUATIC
VEGETATION CONTROL PERMIT**

State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987
 Whole Lake Multiple Treatment Areas
Check type of permit

FOR OFFICE USE ONLY	
License No.	
Date Issued	
Lake County	

Return to: Page 1 of 3
DEPARTMENT OF NATURAL RESOURCES
Division of Fish and Wildlife
Commercial License Clerk
402 West Washington Street, Room W273
Indianapolis, IN 46204

FEE: \$5.00

INSTRUCTIONS: Please print or type information

Applicant's Name Bob Feitz		Lake Assoc. Name Lakeville Business Owner's Association	
Rural Route or Street PO Box 468		Phone Number 574-784-8989	
City and State Lakeville, IN		ZIP Code 46536	
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) Riddles Lake	Nearest Town Lakeville	County St. Joseph
Does water flow into a water supply		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

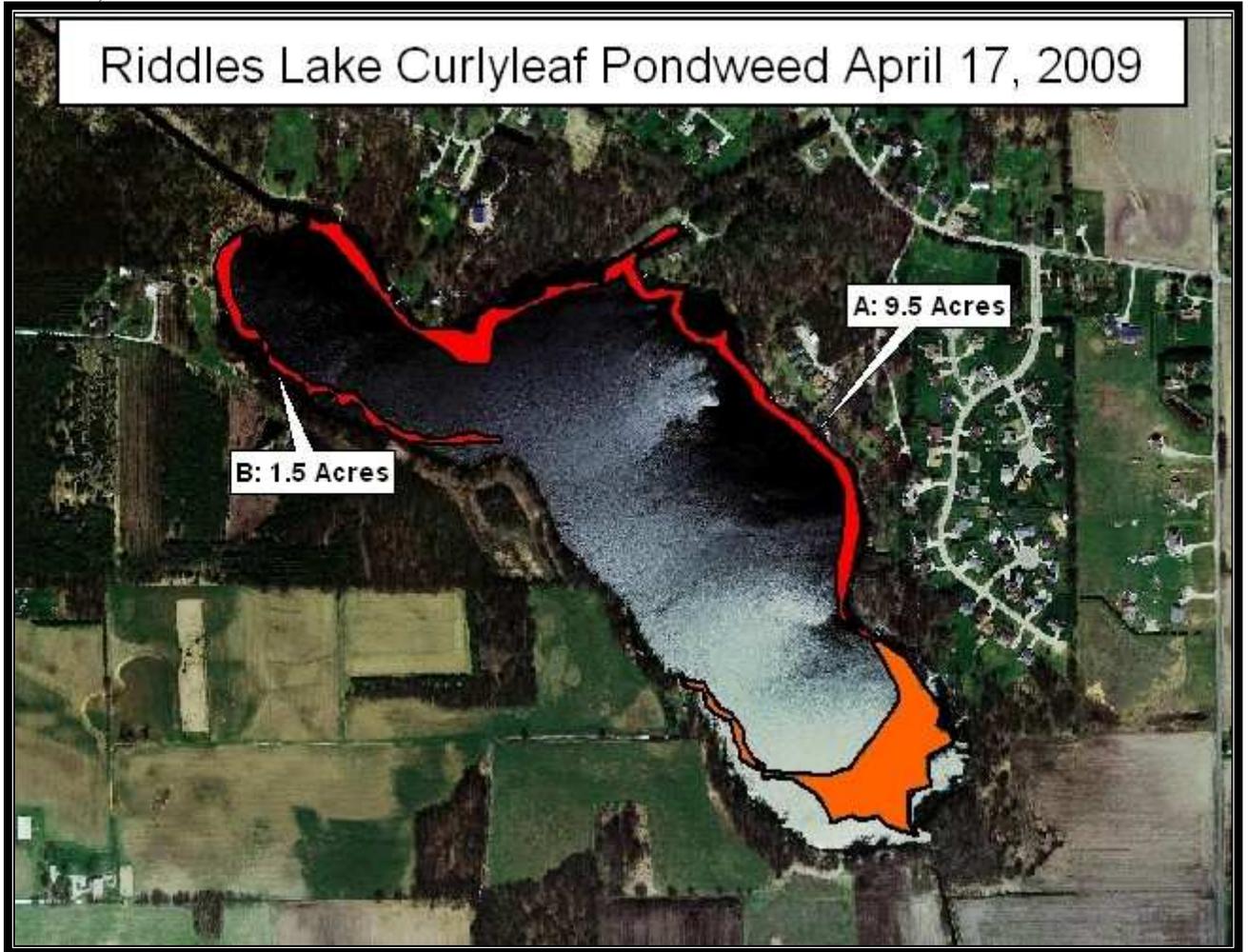
Please complete one section for EACH treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area # 1	LAT/LONG or UTM's Treatment of same CLP area as 08 and milfoil where it occurs	
Total acres to be controlled <20 acres	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft) 7	Expected date(s) of treatment(s) mid April to early May	
Treatment method: <input checked="" type="checkbox"/> Chemical <input type="checkbox"/> Physical <input type="checkbox"/> Biological Control <input type="checkbox"/> 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. Combination of Renovate and Aquathol for selective control of Curlyleaf pw and E. Milf. (see 2009 avmp update)		
Plant survey method: <input type="checkbox"/> Rake <input checked="" type="checkbox"/> Visual <input type="checkbox"/> Other (specify) 2009 Visual and Rake Survey		

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Common coontail		60
Eurasian watermilfoil	x	0
Curlyleaf pondweed	x	10
Spatterdock		20
white water lily		5
Common naiad		5



Page 3 of 3-Permit Map for Curlyleaf Pondweed Treatment on Riddles (same areas as 2009)



7.3 Public Meeting Presentation Outline

I. Intro

II. LARE Program

A. Description

1. Funds from boat registrations
2. Funds for control of invasive species
 - a. Must have plan in place
 - b. Must have LARE certified contractors
 - c. Must go out to bid each winter

B. 2010 LARE fund availability

C. LARE Schedule

1. AVMP Open House November 19
2. First draft of plan due Dec. 15
3. LARE grant application due Jan. 15
4. Final plan due March 1
5. Funding decision March 10

III. Aquatic Plant Ecology Review

A. Native aquatic plants occur naturally in your lake

1. Aquatic plants require proper substrate, food (nutrients), and sunlight to grow
2. Many nutrients already available in our natural sediments
3. Nutrient reduction can help prevent algae blooms and less desirable plant growth

B. Most plants are beneficial to your lake

1. Fish and wildlife cover
2. Slow erosion
3. Water clarity
4. Food for waterfowl

C. Some plants can cause problems

1. Nuisance defined differently by different user groups
2. Typically invasive species are primary nuisance (see handout)
 - a. Eurasian watermilfoil
 - b. Curlyleaf pondweed
 - c. Purple loosestrife
 - d. Hydrilla
3. Invasive controls
 - a. prevention
 - b. physical controls
 - c. biological controls
 - d. chemical controls



IV. Pleasant & Riddles Lakes Vegetation Management

A. History

1. Prior to LARE funding control nuisance areas with contact herbicides in Riddles Lake

2. LARE funding in 2006
 - a. 2006 surveys/plan
 - (1) Milfoil scattered around littoral area of both lakes
 - (2) Curlyleaf pondweed abundant in Riddles Lake especially in southeast
 - (3) Lack of clarity and diversity in both lakes
 - (4) Emergent/wetland plants around margins of both lake
 - (5) Recommended invasive mapping in spring, control both milfoil and curlyleaf with combination treatments, and focus on recommendations from diagnostic studies
 - b. Vegetation Controls 2007-2008
 - (1) LARE grants received
 - (2) 2007-Renovate only for milfoil in Pleasant/no curlyleaf present, total 3.4 acres, 11.8 combination curlyleaf and milfoil in Riddles
 - (3) 2008-no milfoil detected in spring in either lake
 - (4) 2008-only curlyleaf treated in Riddles
 - (5) No milfoil collected in summer 2008 survey
- B. 2009 Sampling and Controls (LARE \$4,500 treatment, \$3,600 plan)
 1. Invasive sampling completed on April 17th
 - a. No milfoil detected
 - b. Curlyleaf scattered within treatment area
 2. Curlyleaf treated on April 28th, 1.0 ppm Aquathol K (see map in back)
 3. Summer survey (Tables in back)
 - a. No milfoil collected
 - b. Water clarity unchanged
 - c. Coontail primary submersed species
 4. Questions from 2009
 - a. Have controls had long-term impact on milfoil?
 - b. How many more seasons of curlyleaf control needed?
- C. Future vegetation management
 1. Two more seasons of early season curlyleaf control (11.8 acres \$3,600)
 2. Treat milfoil if it is detected (\$1,400 < 3.0 acres)
 3. Water quality improvements
 - a. Diagnostic study recommendations
 - b. What has been completed?
- D. What's needed from you!
 1. Participation in meeting, input, survey completed
 2. Permit on time
 3. LARE application
 4. Invoicing changes

V. Questions/Discussion/Reminders/Other Meetings