Aquatic Enhancement
& Survey, Inc.

Aquatic Vegetation Management Plan Update 2009

Atwood Lake, LaGrange County

Prepared for the Atwood Lake Association
By
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December 7, 2009

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Acknowledgements

This work was made possible through cost-share funding provided by a grant from the Indiana Department of Natural Resources, Division of Fish and Wildlife, Lake and River Enhancement (LARE) Program and the Atwood Lake Association. I would like to thank the following persons who contributed time, data, and literature necessary for the preparation of this update: Ted A. Kirschner, John Lordier and the other officers and members of the Atwood Lake Association, Neil Ledet, Larry Koza and Gwen White and Angela Sturdevant of the Indiana Department of Natural Resources Division of Fish and Wildlife, Dr. Robin Scribailo and Mitchell Alix of Purdue University North Central. Field work for this document was performed by Scott Banfield and Joseph Closson of Aquatic Enhancement & Survey, Inc.

Scott Banfield, Aquatic Enhancement & Survey, Inc.

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Executive Summary

Atwood Lake is a kettle lake of approximately 170 acres located in south central LaGrange County, Indiana. The lake is roughly oval in shape and is relatively shallow with an average depth of 9 feet and a maximum depth of 33 feet. In 2003 water quality data collected gave the lake a "mesotrophic" status indicating a moderate amount of nutrient enrichment and average water quality. The majority of the lake's shoreline has been developed with cottages, single family homes, and a campground.

At some point in the past the non-native invasive aquatic plants Eurasian watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*) found their way into Atwood Lake. By 2004, the invasive Eurasian watermilfoil had heavily colonized much of the lake's littoral zone creating a major hindrance to recreational activities and threatening the ecological integrity of the lake's plant community. Curlyleaf pondweed has also been hindering recreational use in some of the lake's shoreline and channel areas until mid-summer after which this pondweed naturally declines for the remainder of the season. In 2004, it was necessary for the Atwood Lake Association (ALA) to fund the treatment of 28 acres of dense Eurasian watermilfoil growth.

For the 2005 season the ALA applied to the Indiana Department of Natural Resources (IDNR) Lake and River Enhancement Program (LARE) for cost-share funding to develop an aquatic plant management plan and perform a "whole lake" treatment with a fluridone herbicide. Weed Patrol Inc. was contracted for both tasks. The whole lake treatment performed well, controlling both exotic plants by the end of the 2005 season. Assay data indicates that an average fluridone concentration of approximately 3 parts per billion was present for a period of 40 days after initial treatment. The plan developed by Weed Patrol did not, however, gain full approval by the Indiana Department of Natural Resources (IDNR). In 2006 and 2007, no treatment was needed for either Eurasian watermilfoil or curlyleaf pondweed. Another consultant was retained to complete a plant plan utilizing ALA and LARE funding in 2007 but the plan was not completed. Activities in 2008 were cost-share funded by the ALA and LARE and included plant surveys, treatment of 4 acres of Eurasian watermilfoil, and other activities performed to prepare a plan drafted to supplant the one done in 2005. The 2008 plan established the following primary goals for Atwood Lake:

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

2. Direct efforts to prevent and/or control the negative impacts of aquatic invasive species.

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

In the 2009 season the ALA was granted funding for Eurasian watermilfoil control and an update of their aquatic plant management plan. Aquatic Enhancement & Survey, Inc. was contracted to perform the update while Aquatic Weed Technology was contracted to perform application work for exotic plant control. Exotic plant growth was mapped on June 6, 2009. Approximately 19 acres of dense Eurasian watermilfoil growth was present. Approximately 2.5 acres of the lake contained dense growth of Curlyleaf pondweed. The Eurasian watermilfoil was controlled with an application of DMA4® 2,4-D liquid aquatic herbicide to all 19 acres of growth on June 12. An application of Aquathol® K at the rate of 1 parts per million (ppm) was utilized to control all 2.5 acres of dense Curlyleaf pondweed growth that same day.

A tier II aquatic plant survey was performed on Atwood Lake on August 11. Water clarity was much improved over 2008. In August 2008, a summer Secchi depth of only 4.3 feet was recorded, while the August 2009 measurement was 8.3 feet. Overall plant community diversity was good with 10 species noted. Eight native species were collected in the survey. Whitestem pondweed, a beneficial native species, was noticeably more common than in 2008 and occurred at 11.8 percent of Tier II sites.

Treatment success objectives established for 2009 included the elimination of all densely growing curlyleaf pondweed stands by mid-may and a late-season Tier II occurrence of Eurasian watermilfoil of 5 % or less. The curlyleaf objective was not reached as the growth of this plant was not controlled until June. Eurasian watermilfoil control was initiated with cost share assistance from LARE on June 12. Control was successful and the milfoil objective was reached with Eurasian milfoil occurring at only 2% of Tier II sampling sites. Total costs for planning and treatment in 2010 are expected to be $27,150.00. A task schedule and breakdown of costs is listed in the table one.

Month	Activity	Cost
April	Map Curlyleaf pondweed And Eurasian watermilfoil growth.	700.00
May	Apply Fluridone at 6 ppb with a bump back to 6 ppb as needed at two weeks. (includes assays)	23,100.00
July	Tier II Survey	1200.00
As arranged	Public Meeting	350.00
October/November	Permit Meeting	200.00
December	Plan Update Document Due	1600.00
	Total Cost	**27,150.00**

***Table 1*. Task and Cost Schedule for Atwood Lake in 2010.**

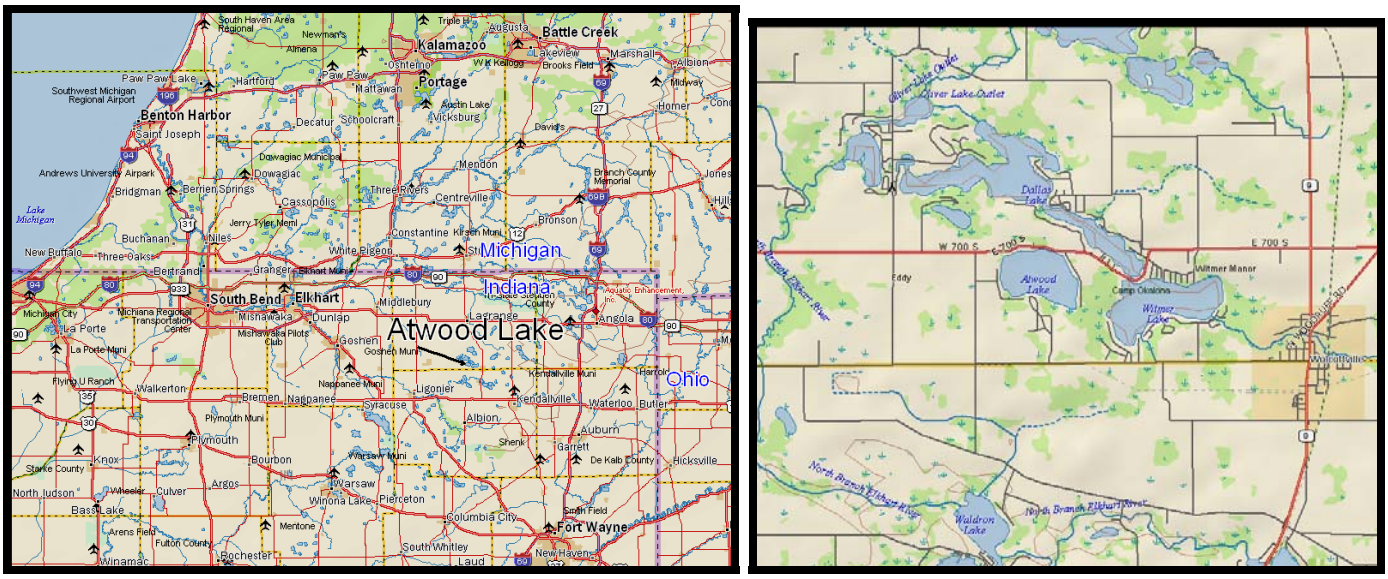


***Figure 1*. Scale maps showing general location of Atwood Lake, Scale 1,200,000 (left) and 68,750 (right).**

1. Problem Statement

At some point in the past the non-native, potentially invasive, aquatic plant Eurasian watermilfoil (*Myriophyllum spicatum*) found its way into Atwood Lake. Because Eurasian watermilfoil can be spread by fragments carried on boat trailers it's no surprise that Eurasian watermilfoil ended up in Atwood Lake. There is an IDNR public access ramp located in the southwest corner of the lake where many area residents and lake users launch boats. By 2004, the invasive milfoil had heavily colonized much of the lake's littoral zone creating a major hindrance for recreational activities like swimming, fishing, and boating. When colonization of a lake is extensive, boaters tend to hasten spread by creating new plant fragments trying to navigate through thick milfoil growth with outboard motors. Eurasian milfoil often outgrows native species, sometimes developing a thick shading canopy by growing laterally at the surface. This growth pattern threatened to affect the diversity and health of Atwood Lake's beneficial native plant community, radically changing aquatic habitat and potentially negatively affecting its value to fish and wildlife. Curlyleaf pondweed, another non-native invasive plant is also present in Atwood Lake, hindering navigation and recreational use in some of the lake's shoreline and channel areas until mid-summer.

A 2005 treatment of the whole lake utilizing Sonar® A.S. fluridone herbicide provided excellent selective control of both non-native plant species by the end of that season. Treatment results carried over into 2006 and 2007. The growth of both species was reduced to insignificant levels during that time period and no treatment for non-native aquatic plants took place. In 2008, treatment for a returning colonization of Eurasian watermilfoil began with four acres treated with Navigate granular 2, 4-D aquatic herbicide. Curlyleaf pondweed was also noted and 7.5 acres were treated.

In 2009, the recolonization by Eurasian watermilfoil accelerated, with 19 acres treated to maintain control. Treatment for curlyleaf pondweed took place on 2.5 acres of the lake. The rapid recolonization of the lake by Eurasian watermilfoil is expected to continue in 2010 if an aggressive management program is not maintained. Atwood Lake will probably return to pre 2005 growth levels exhibiting dense colonization on approximately 28 acres of the lake with serious recreational and ecological impairments resulting.

2. Management History and Goals

Comprehensive non-native plant management at Atwood Lake has been ongoing since 2004 (Table 3). In that year it was necessary for the ALA to fund the treatment of 28 acres of dense Eurasian watermilfoil growth. For the 2005 season the ALA applied to the IDNR LARE program for cost-share funding to develop an aquatic plant management plan and perform a "whole lake" treatment with a fluridone herbicide. Cost-share funds were provided for both planning and treatment. On 27 May 2005 the lake was treated with Sonar A.S. liquid fluridone at a dose rate calculated to produce a concentration of 6 parts per billion (ppb) in the lake. On June 16, 2005; 20 days after treatment (DAT) the lake was "bump" treated at a rate calculated to take the concentration back to 6 ppb. Assay data indicates that an average fluridone concentration of 3 ppb was present for a period of approximately 40 days after initial treatment. Assay data is displayed in figure 2 and table 2. For additional information see the original plant management plan draft for Atwood Lake see *Atwood Lake Aquatic Plant Management Plan 2005-2008* (Weed Patrol Inc. 2005).

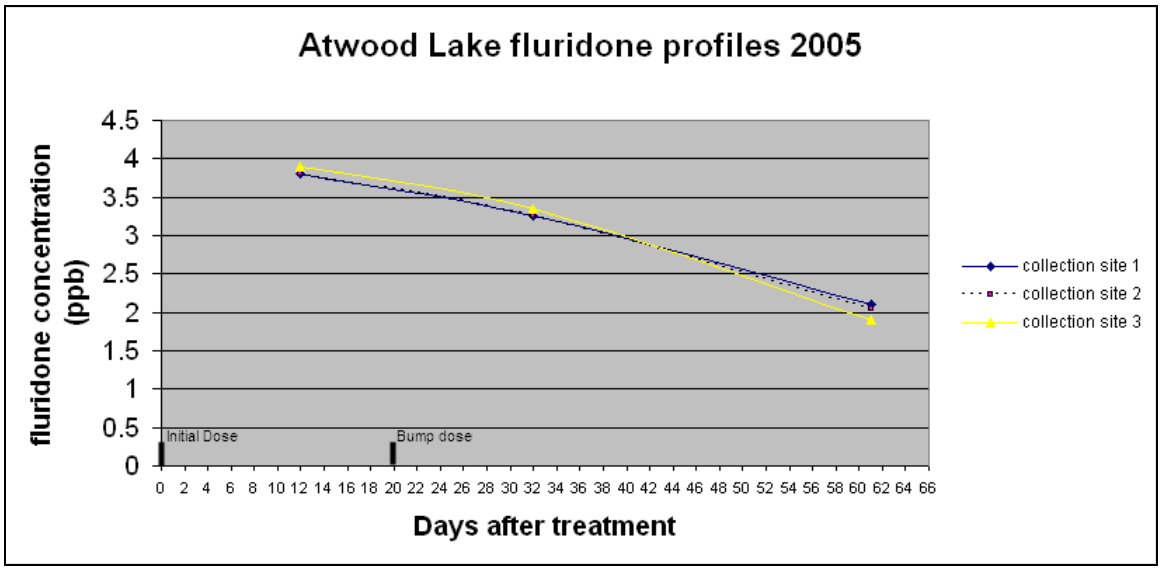


Figure 2. **Fluridone assay curves for Atwood Lake 2005.**

Treated 5/27/05, Bump treatment 6/16/05				
Bump Treatment 6/16/05	6/8/2005	6/28/2005	7/27/2005	Mean for 61 day period (ppb)
Days after treatment	12	32	61	
collection site 1 large basin (ppb)	3.8	3.25	2.1	3
collection site 2 small basin (ppb)	3.8	3.25	2.05	3
collection site 3 small basin (ppb)	3.9	3.35	1.9	3
Mean of both sites	4	3	2	**3**

Table 2. **Assay data table for Atwood Lake 2005.**

Atwood Lake Goals

The initial plant plan established the following goals for exotic plant management at Atwood Lake (specified by IDNR):

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species.

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

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

Weed Patrol Inc. was contracted for both tasks. The "whole lake" treatment performed well, controlling both exotic plant species by the end of the 2005 season. The plan developed by Weed Patrol did not, however, gain full approval by IDNR. In 2006 and 2007 no treatment was needed for either Eurasian watermilfoil or curlyleaf pondweed. Another consultant was retained to complete a plant plan utilizing ALA and LARE funding in 2007 but the plan was not completed. Activities in 2008 were cost-share funded by the ALA and LARE and included plant surveys, treatment of 5 acres of Eurasian watermilfoil, and other activities performed to prepare a new plan drafted to supplant the one done in 2005. A small area of the lake was also treated for curlyleaf pondweed growth with private funding (IDNR did not provide curlyleaf pondweed control funding in 2008). The new plan was completed by Aquatic Enhancement & Survey, Inc. in 2008.

Specific Management Objectives

To compliment the original three goals established in the 2005 plan the new plan established the following management objectives:

1. Elimination of all densely growing curlyleaf pondweed strands within two weeks of treatment.

2. A late-season Tier II occurrence of Eurasian watermilfoil of 5% or less

In 2009, the ALA again received funding for planning activities and treatment of Eurasian watermilfoil. Aquatic Enhancement & Survey, Inc. was contracted to complete the planning activities while Aquatic Weed Technology was contracted to complete treatment. It had been estimated that 8 acres of Eurasian watermilfoil would need treatment. However, the area of milfoil growth was found to have increased dramatically in 2009 resulting in the treatment of 19 acres. The Eurasian watermilfoil was controlled with an application of DMA 4 IVM 2, 4-D liquid aquatic herbicide to all 19 acres of growth on June 12. Utilizing ALA funding an application of Aquathol K at the rate of 1 ppm was utilized to control 2.5 acres of dense curlyleaf pondweed growth. Management objective one was reached in the treated curlyleaf areas. Management objective two was also achieved. In an August Tier II plant survey Eurasian watermilfoil occurred at only 2% of sampling sites.

Year	Consultant Activity	funding	Treatment Activity	Date	funding	Results
2004	Exotic plant survey by applicators (Not LARE funded)	ALA	28 acres Eurasian watermilfoil (Navigate 2,4-D granular 100 lbs per acre)	6/2/04	ALA	Good, no significant milfoil growth observed post-treatment
2005	Surveys and Plan development (Weed Patrol, Inc.) (not approved by IDNR)	LARE/ALA	6 bump 6 whole lake fluridone treatment (170 acres) 3.28ppb 32 DAT	5/27/05 initial 6/16/05 bump	LARE/ALA	Good, O% occurrence of milfoil in 9/7/05 Tier II sampling
2006	None	LARE/ALA	1.25 acres treated twice for misc. natives	7/5/06 7/12/06	ALA	Good, treatment achieved control of target natives
2007	Surveys and Plan development (Kennedy) Not completed	None, work not completed	4.65 acres treated for misc. natives	7/9/07	ALA	Good, treatment achieved control of target natives
2008	Surveys and Plan developed (Aquatic Enhancement, Inc.)	LARE/ALA	4 Acres Eurasian watermilfoil treated, (2,4-D granular) 7.5 acres of Curlyleaf pondweed treated (Aquathol K) 4.42 acres treated for misc. natives (Reward/Hydrothol191 1 gal/ac. each/Cygnet plus surfactant)	6/9/08 6/9/08 6/19/08	LARE/ALA ALA ALA	Good, milfoil occurrence at 6% of sites in late season Tier II sampling Good, Curlyleaf plants eliminated in treated areas Good, treatment achieved control of target natives
2009	Surveys and Plan developed (Aquatic Enhancement, Inc.)	LARE/ALA	19 Acres Eurasian watermilfoil treated, (2,4-D granular) 2.5 acres of Curlyleaf pondweed treated (Aquathol K)	6/12/09 6/12/09	LARE/ALA ALA	Good, milfoil occurrence at 2% of sites in late season Tier II sampling Good, Curlyleaf plants eliminated in treated areas

***Table 3*. Six year aquatic plant management history for Atwood Lake.**

3. Watershed and Water Body Characteristics

3.1 General Morphometry and Physical Characteristics

Atwood Lake is glacial "kettle" lake of approximately 170 acres located in LaGrange County in northeast Indiana (Figure 1). The estimated residence time for waters in Atwood Lake is 4.26 years. Residents reported that in the 2009 season a small tributary entering the lake through a channel on the lake's west side resulted in a brown plume of suspended sediment entering the lake suggesting that there may have been a change in land-use in the area of the watershed draining to the tributary. This could have resulted from a change in farming practices, new construction, or other changes in that tributary's watershed. The Atwood Lake Association was advised to contact LaGrange County Soil and Water Conservation District personnel to work toward investigating whether opportunities exist to improve land uses upstream of this tributary. Ultimately reducing the amount of soil and nutrients entering the lake will be beneficial in terms of the management of aquatic plants. Aquatic Enhancement & Survey, Inc. is unaware of any new relevant studies or additional information compiled on Atwood Lake or the Atwood Lake watershed in 2009 that could impact plant management activities.

3.2 Water Quality

Atwood Lake generally exhibits low to moderate midsummer water clarity and moderate to good water quality. It is notable that water clarity was significantly improved in 2009 over previous seasons (Figure 3). A Secchi depth of 8.3 feet was recorded during the August 11 Tier II survey. This represented a significant improvement over 2008 season water quality when an August Secchi measurement of 4.3 feet was taken. Overall plant growth appeared to do well in Atwood Lake as a result of improved clarity, especially whitestem pondweed, a beneficial native species

that was much more numerous in 2009 than in 2008. Unfortunately, Eurasian watermilfoil grew especially well in the clear waters as well. This provides evidence that working to maintain this good water clarity in the future while selectively controlling the Eurasian watermilfoil should be an effective way to restore beneficial native plant growth and achieve Atwood Lake's plant management goals.

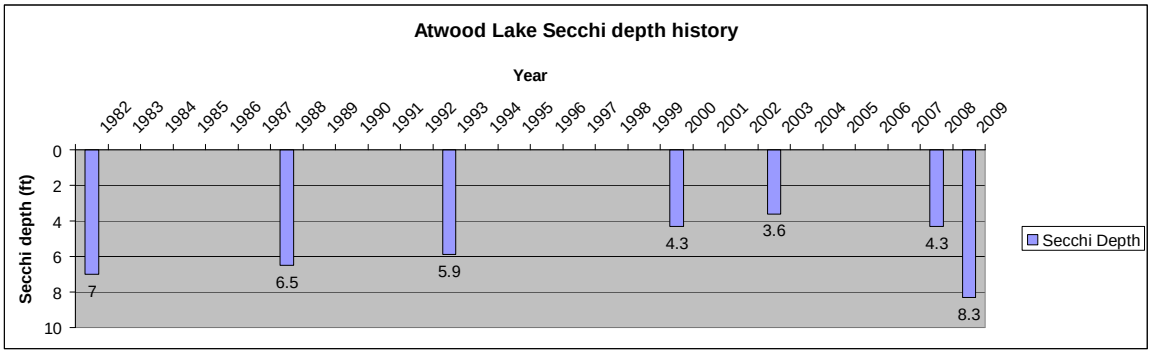


***Figure 3*. Atwood Lake Secchi Data.**

4. Present Water Body Uses

Fishing, swimming, and boating remain the most common recreational uses of Atwood Lake. There have been no significant changes in lake uses, important habitat areas, or the Atwood Lake fish community. No new fisheries data was compiled for Atwood Lake during the 2009 season. For more information see the 2008 Atwood Lake Aquatic Plant Management Plan (APMP) (Aquatic Enhancement, Inc. 2008).

5.0 Plant Community Characterization

5.1 Methods

Two primary methods of observation were used to characterize the Atwood Lake's plant community during the 2009 season. Exotic plant growth was mapped mainly by visual observation from the boat on June 11. During visual observation extensive time was spent running a zigzag pattern over the lake's littoral zone to establish the boundaries for dense exotic plant growth. The second primary method of observation was the collection of Tier II quantitative survey plant data. These methods were complimented by prior knowledge of typical plant growth patterns, and a contour map. A handheld Wide Area Augmentation System (WAAS) Enabled GPS unit was also helpful in marking the general boundaries of exotic plantbeds for mapping. The Tier II survey provided information to characterize the lake's plant community quantitatively and produce objective data for analysis and tracking of overall plant community composition. The Tier II Plant survey was utilized as described in the Atwood Lake APMP (Aquatic Enhancement, Inc. 2008). The Tier II aquatic plant sampling protocol used was established by IDNR and is available in full in *Tier II Aquatic Vegetation Survey Protocol, May 2007* (IDNR 2007).

The June 11 visit revealed approximately 19 acres of significant Eurasian watermilfoil growth and approximately 2.5 acres of dense Curlyleaf pondweed growth (Figure 4).

5.1.1 Tier II Survey Results

Tier II stratified random sampling was utilized on August 11, 2009 in good weather conditions. The Tier II sampling points (50 in Atwood Lake) used were identical to the 2008 season sampling points (figure 5). A summary of results is contained in Table 4. Water clarity was considered to

be good with a Secchi depth of 8.3 feet recorded. Plants were found to a depth of 10 feet. Ten species were identified in the survey including whitestem pondweed (*Potamogeton praelongus*) a state "threatened" species. This is slightly above the average number of 8 species for a set of 21 other Northern Indiana lakes compiled by IDNR (Pearson 2004). The highest occurrence was chara (65.7 %) followed by slender naiad (*Najas flexilis*) (29.4 %) and spiny naiad (*Najas marina*) (23.5 %). Curlyleaf pondweed occurrence was 3.9 % and Eurasian watermilfoil occurrence was 2 %. Overall the Atwood Lake plant community appeared to be of slightly above average diversity and was solidly dominated by native species. Plant maps for chara, slender naiad, spiny naiad, curlyleaf pondweed, and Eurasian watermilfoil are in figures 6 through 10.

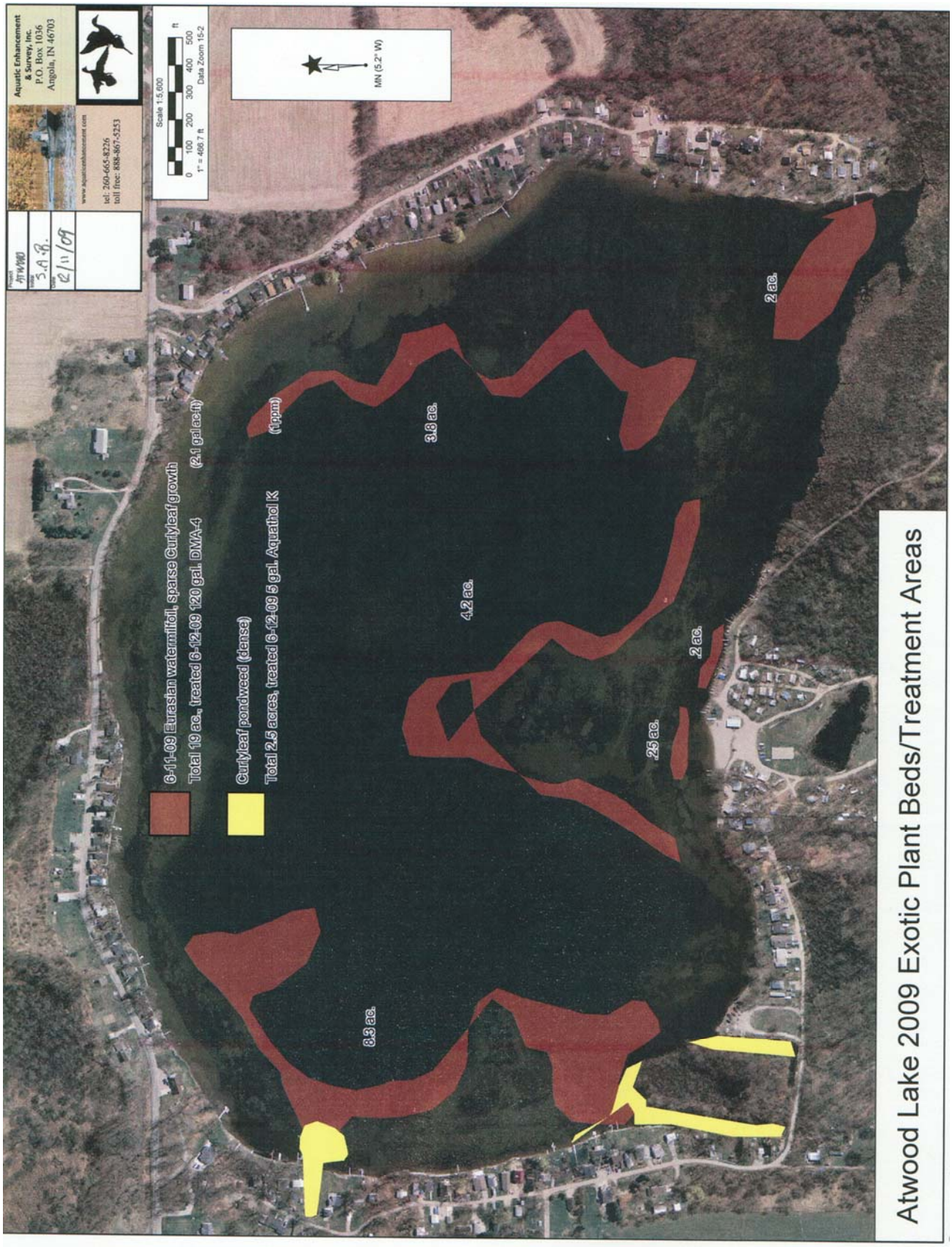


***Figure 4*. June 11 Exotic Plant Map for Atwood Lake (Also indicates treatment areas for both exotic species).**

***Figure 5*. Tier II sampling points for Atwood Lake.**

Occurrence and Abundance of Submersed Aquatic Plants in Atwood Lake			
County: LaGrange	Total Sites: 50	Mean species/site: 1.54	
Date: 8/11/2009	Sites with plants: 43	SE Mean species/site: 0.14	
Secchi (ft): 8.3	Sites with native plants: 43	Mean native species/site: 1.48	
Maximum Plant Depth (ft): 10.0	Number of species: 10	SE Mean natives/site: 0.13	
Trophic Status: Mesotroph.	Number of native species: 8	Species diversity: 0.75	
	Maximum species/site: 4	Native species diversity: 0.73	

All Depths (0 to 15 ft)	Frequency of	Rake score frequency per species				Plant
Species	Occurrence	0	1	3	5	Dominance
chara	64.0	36.0	18.0	4.0	42.0	48.0
slender (common) naiad	30.0	70.0	20.0	4.0	6.0	12.4
spiny naiad	24.0	76.0	22.0	0.0	2.0	6.4
whitestem pondweed	12.0	88.0	4.0	6.0	2.0	6.4
variable pondweed	10.0	90.0	10.0	0.0	0.0	2.0
coontail	4.0	96.0	0.0	0.0	4.0	4.0
curlyleaf pondweed	4.0	96.0	2.0	2.0	0.0	1.6
elodea	2.0	98.0	2.0	0.0	0.0	0.4
water stargrass	2.0	98.0	0.0	0.0	2.0	2.0
Eurasian watermilfoil	2.0	98.0	2.0	0.0	0.0	0.4
Depth: 0 to 5 ft	Frequency of Occurrence	Rake score frequency per species				Plant
Species		0.0	1.0	3.0	5.0	Dominance
chara	60.5	39.5	13.2	5.3	42.1	47.9
slender (common) naiad	34.2	65.8	23.7	5.3	5.3	13.2
spiny naiad	18.4	81.6	18.4	0.0	0.0	3.7
variable pondweed	13.2	86.8	13.2	0.0	0.0	2.6
coontail	5.3	94.7	0.0	0.0	5.3	5.3
curlyleaf pondweed	2.6	97.4	2.6	0.0	0.0	0.5
Depth: 5 to 10 ft	Frequency of Occurrence	Rake score frequency per species				Plant
Species		0.0	1.0	3.0	5.0	Dominance
chara	75.0	25.0	33.3	0.0	41.7	48.3
whitestem pondweed	50.0	50.0	16.7	25.0	8.3	26.7
spiny naiad	41.7	58.3	33.3	0.0	8.3	15.0
slender (common) naiad	16.7	83.3	8.3	0.0	8.3	10.0
elodea	8.3	91.7	8.3	0.0	0.0	1.7
water stargrass	8.3	91.7	0.0	0.0	8.3	8.3
Eurasian watermilfoil	8.3	91.7	8.3	0.0	0.0	1.7
curlyleaf pondweed	8.3	91.7	0.0	8.3	0.0	5.0

***Table 4*. Summary of 8/11/09 Tier II data for Atwood Lake.**

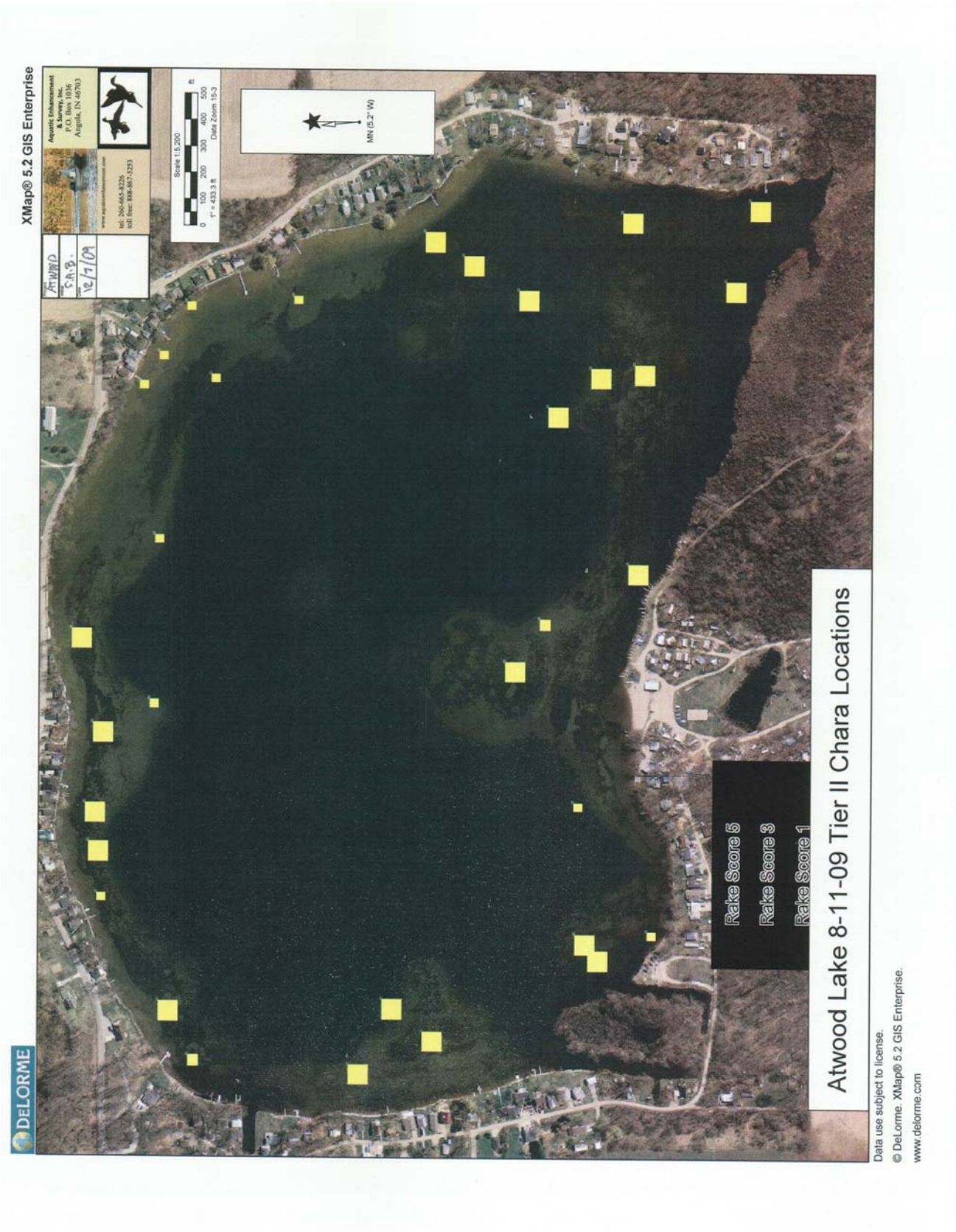


***Figure 6*. Tier II chara map for Atwood Lake.**

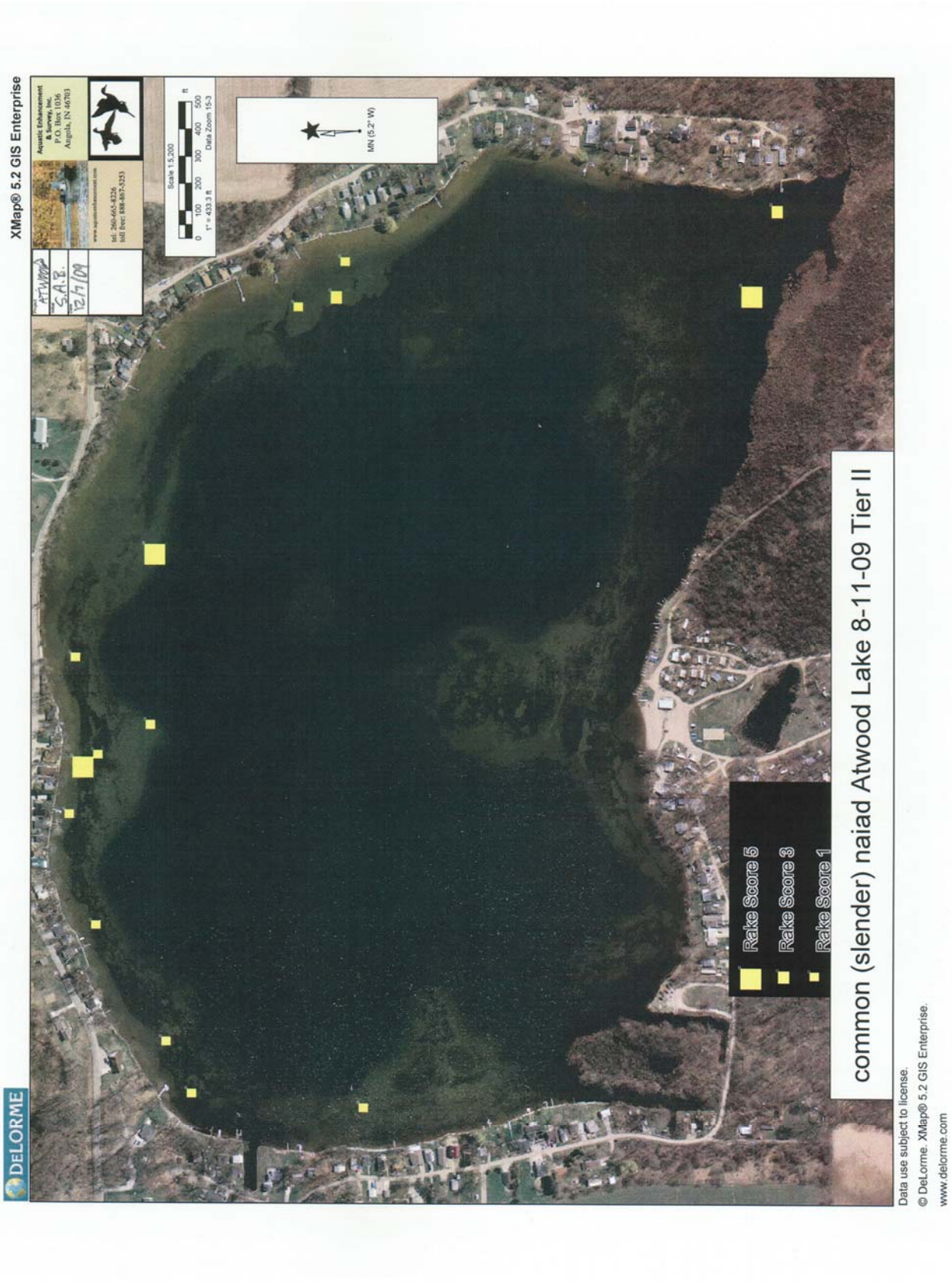


***Figure 7*. Tier II slender naiad map for Atwood Lake.**

***Figure 8*. Tier II spiny naiad map for Atwood Lake**

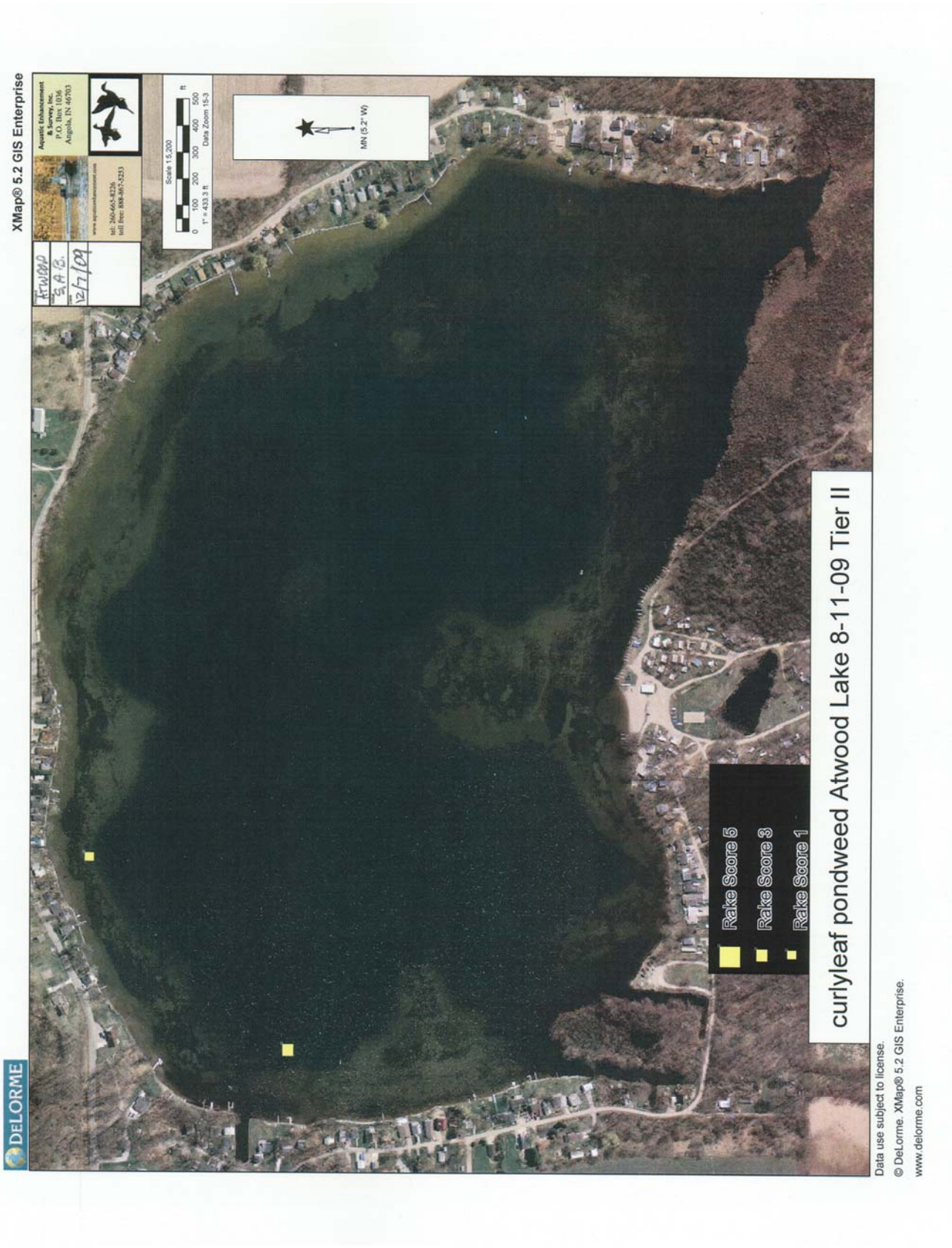


***Figure 9*. Tier II curlyleaf pondweed map for Atwood Lake**

Figure 10. **Tier II Eurasian watermilfoil map for Atwood Lake.**

Summary of Season's Treatments									
Eurasian watermilfoil	Flurid. 6 ppb (28 ac.)	2,4-D (4 acres)	2,4-D (28 acres)	Flurid. 6 ppb (28 ac.)	Flurid. 6 ppb (28 ac.)		2,4-D (4 acres)	2,4-D (19 acres)	
Curlyleaf pondweed	Flurid. 6 ppb (unk.ac.)	Aquathol K, 7.5 acres		Flurid. 6 ppb (unk.ac.)	Flurid. 6 ppb (unk.ac.)		Aquathol K, 7.5 ac.	Aquathol K, 2.5 ac.	
Atwood Lake	WPI	AES	WPI	IDNR	WPI	IDNR	AES	AES	
Date	5/5/05	6/14/08	8/9/04	8/3/05	9/7/05	8/9/06	8/19/08	8/11/09	
IDNR protocol 1 or 2	1	2	1	1	1	2	2	2	
Depth range (ft)	0-12	0-10	0-20	0-20	0-10	0-20	0-10	0-10	
Sample sites (n)	43	50	50	50	43	50	50	51	
Secchi (ft)	6.6	4.3	6.6	9.0	5.7	5.0	4.3	8.3	
Littoral depth (ft)	12.0	13.5	13.0	15.0	6.0	15.0	10.0	10.0	
Occurence (%)	81.4	92.0	84.0	84.0	63.0	64.0	88.0	86.0	
Species (N)	6	9	10	7	4**	9	14	10	
Native species (N)	4	7	9	6	4	7	13	8	
Species/site (max)	5	4	5	3	4	5	4	4	
Mean species/site	1.71	1.92	1.44	1.02	1.11	1.68	1.92	1.55	
Mean Native species/site	1.26	1.63	1.08	0.94	1.11	1.60	1.86	0.13	
Species diversity	n/d	0.83	n/d	0.60	n/d	0.74	0.85	0.75	
Native diversity	n/d	0.79	n/d	0.53	n/d	0.71	0.84	0.73	
Species occurrence									
Chara	72.1	54.0	72.1	59.2	39.5	50.0	44.0	64.7	
Coontail		10.0	4.7	4.1			4.0	3.9	
Eurasian watermilfoil	27.9	10.0	20.9	8.2		2.5	6.0	2.0	
Flatstem pondweed		12.0	2.3	2.0	7.0		4.0		
Sago pondweed	7	32.0	2.3	2.0	37.2	7.5	12.0		
Water Bulrush				2.0		2.5			
Illinois pondweed				24.5		25.0	16.0		
Spiny naiad		4.0	34.9*			62.5	50.0		
Curlyleaf pondweed	9.3	18.0				7.5		3.9	
Whitestem pondweed		18.0	18.6			2.5	4.0	11.8	
Slender naiad						5.0	18.0	29.4	
Variable pondweed		30.0					16.0	11.8	
Richardson's pondweed			2.3				6.0		
Small pondweed							6.0		
Water Stargrass							4.0	2.0	
Elodea	2.3						2.0	2.0	
Nitella			4.7						
Bladderwort			2.3						
Spiny naiad								23.5	
n/d denotes no data									
** Stats listed for 3 species, 4th is unknown									
Algae occurrence (%)									
Species dominance* **									
Chara		26.8		22.0		19.0	29.6	47.5	
Coontail		4.4		1.2			2.4	3.9	
Eurasian watermilfoil		2.0		2.4		0.5	6.0	0.4	
Flatstem pondweed		2.4		2.0			0.8		
Sago pondweed		8.8		0.4		1.5	2.4		
Water Bulrush				0.8		0.5			
Illinois pondweed				4.9		6.0	4.0		
Spiny naiad		0.8				27.0	22.0	3.6	
Curlyleaf pondweed		8.4				1.5		1.6	
Whitestem pondweed		8.4				0.5	1.6	6.3	
Slender naiad						1.0	10.0	12.2	
Variable pondweed		9.2					7.2	2.4	
Richardson's pondweed							2.0		
Small pondweed							1.2		
Water Stargrass							1.6	2.0	
Elodea							2.0	0.4	
Nitella									
Bladderwort									
Spiny naiad								6.3	
*** Dominance is not provided for WPI data									

***Table 5*. Summary of Tier II data for Atwood Lake 2004 to 2009.**

5.2 Overall Plant Community History

Table 5 contains a summary of Tier II plant survey data collected from Atwood Lake since 2004. Plant occurrence in late season Atwood Lake Tier II data (the percent of sites where at least one species of plant was collected) has shown an increasing trend since a low of 63 % occurred in late 2005. In 2004, before the 2005 fluridone treatment, the occurrence was 84 %. In 2009 plants occurred at 86 percent of sites showing that the lake's plant community has rebounded from the 2005 low. This trend may have resulted from an overall decrease in vegetation produced by the 2005 fluridone treatment. Species number, especially native species, can be a useful indicator of diversity. In general a larger number of species indicates a healthier or more stable system. The total number of native species noted in all six late season surveys performed on Atwood from 2004 through 2008 has varied from 4 to 13 with an average of 7.8 between the six surveys. Overall, it appears that diversity in terms of native species number is in line with other northern Indiana lakes. The average native species number for a set of 21 northern Indiana lakes surveyed is eight (Pearson 2004).

After the 28 acre treatment for Eurasian watermilfoil with 2, 4-D in 2004 the number of Tier II native species noted was nine. After the whole lake fluridone treatment in 2005 this number dropped to four in the Weed Patrol, Inc. data and six in the 2005 IDNR data. It is possible that this is a result of the effects of the fluridone treatment on non-target native species. In the 2006 IDNR data this had increased to seven native species and by the time of the 2008 late season survey by Aquatic Enhancement & Survey, Inc. 13 native species were noted in the Tier II sampling. In 2009 10 native species were noted. This pattern suggests that the lake has fully recovered from a loss in native species number. Overall, it appears that the lake's native plant community has not been permanently damaged by the course of plant management followed thus far. This has been supported by metrics for species diversity and native diversity which have been higher in 2006, 2008, and 2009 than in 2005. Mean species per site for late season Atwood Lake data has also shown a trend toward reduction in the wake of the 2005 treatment, starting at 1.44 in 2004, dropping to 1.02 in September of 2005 and rebounding to 1.68 in 2006. The mean species per site in 2009 was 1.55.

6. Threatened and Endangered Species Surveys

Whitestem pondweed (*Potamogeton praelongus*) has been noted in both surveys in 2008 and again in 2009. In 2009, it was especially numerous, possibly as a result of the clear water conditions. It was collected at 11.8 % of sampling sites versus only 4 % of sites in 2008. Whitestem pondweed is listed on the IDNR Division of Nature Preserves list of Rare, Threatened, and Endangered species with a "threatened" status. Richardson's pondweed is also present in Atwood Lake was collected during the 2008 survey, but did not appear in the survey in 2009. Richardson's pondweed is listed as a "Rare" species. No voucher specimen's of these plants were collected for preservation during 2009. Samples of each should be collected for preservation and documentation as part of 2010 management activities. Both these native pondweeds can be considered to provide beneficial habitat in Atwood Lake. Because these plants are not generally tolerant of a high amount of cultural disturbance preserving and improving water quality, managing invasive competing species, and generally maintaining stable aquatic habitat and good water clarity at Atwood Lake will be key in preserving the presence of these species. A single plant specimen from the 2009 tier II survey was sent to Purdue University North Central for identification and voucher specimen preparation. The sample was identified as Nitella (*Nitella tenuissima*). Due to deterioration of the sample in storage and transit a voucher was not prepared.

7. Description of Beneficial and Problem Areas

Since the biological integrity of Atwood Lake will be maximized if native aquatic plants are preserved and allowed to dominate any areas of native plant growth are generally considered beneficial. Unfortunately, these are often the same areas where invasive non-native plants like Eurasian watermilfoil and Curlyleaf pondweed tend to colonize. Typically drop off areas where the littoral shelf angles down into deep water support much of a lake's plant growth so selectively controlling the growth of exotics in these areas to allow native plants to thrive will be a key to maintaining a healthy plant community. While Curlyleaf pondweed problem areas remain similar to 2008 the area of problem, Eurasian watermilfoil growth, increased substantially, occupying much of the area of beneficial growth along the lake's drop offs (Figure 4, page 13).

8. Aquatic Plant Management Alternatives

In the case of Atwood Lake the application of aquatic herbicides remains the most suitable management alternative because of the legality, relatively low cost, and selectivity of control. Native plant growth needs to be encouraged at Atwood Lake so non-selective controls are not a good option. Because the acreage of milfoil has increased significantly in 2009 another whole-lake treatment will be the best option in 2010. This will provide the necessary selectivity and completeness of control for both Eurasian watermilfoil and curlyleaf pondweed. If three years of good control are achieved as in 2005, the fluridone option will also be most cost effective.

As an alternative to the use of fluridone, effective seasonal control of Eurasian watermilfoil could be performed using Navigate 2, 4-D aquatic herbicide or a liquid 2,4-D herbicide such as DMA4-IVM. Because these herbicides typically only produce results lasting for a single season they are likely to produce less long-term cost effectiveness than the use of fluridone, but the expense for the 2010 season alone will be lower. The acreage in need of treatment is likely to be approximately 28. The pattern of growth and treatment under this regime must be determined by field observation in the 2010 season, but will be similar to the pattern of growth observed in 2004 (Figure 11).

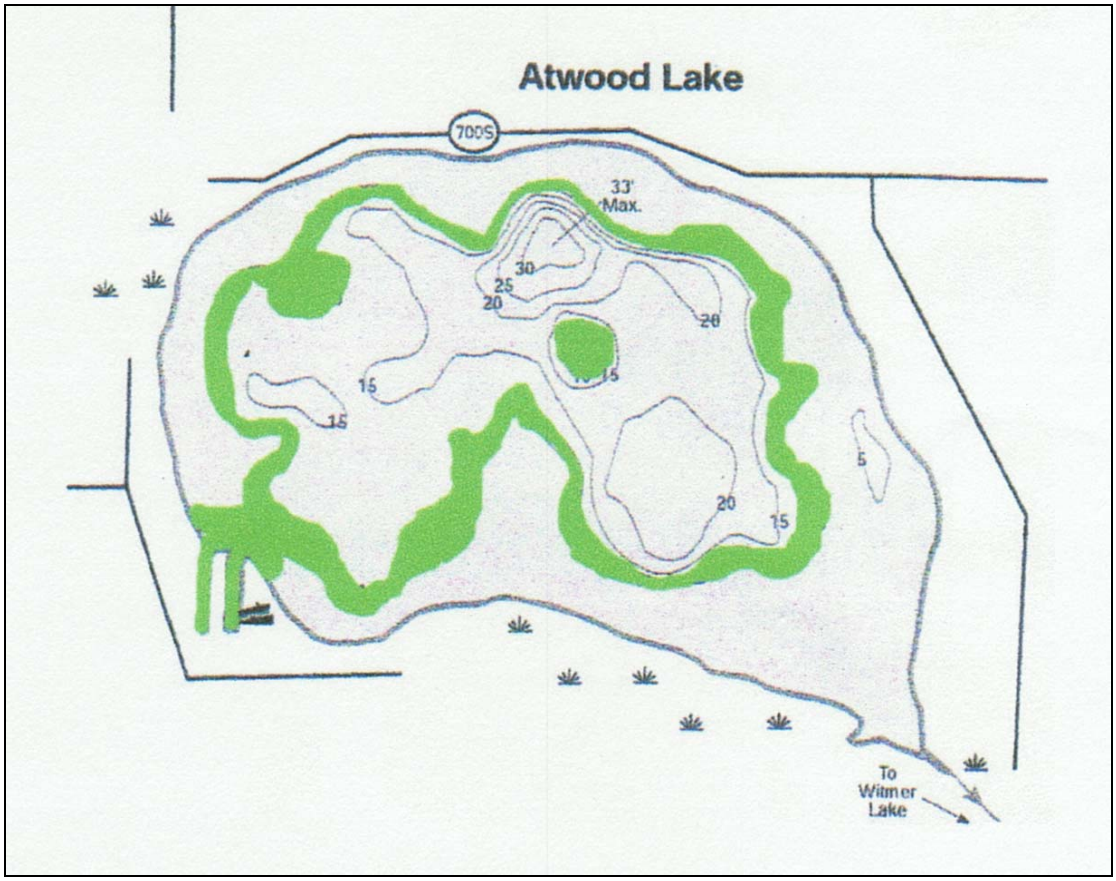


***Figure 11*. 2004 Treatment/milfoil growth map for Atwood Lake, (green shading represents milfoil growth pattern) (Weed Patrol, Inc.).**

Since over 20 acres of dense milfoil growth can realistically be expected through the 2010 season at Atwood Lake, exercising the option of doing nothing will severely limit recreational uses and could have a considerable negative impact on the ecology of the lake. Dense growth at or near the surface of the lake will provide a major hindrance for recreational activities like swimming, fishing, and boating. A large increase in milfoil biomass could significantly change aquatic

habitat and potentially negatively affect its value to fish and wildlife. Most plant and animal species utilizing Atwood Lake as habitat have evolved in association with the native plant community and are best adapted to utilizing native plant species as food and shelter. A shift to an aquatic habitat containing a dense growth of non-native plants can significantly decrease habitat suitability and affect populations of these species.

Atwood has progressed through a five year management cycle. This was characterized by a stabilization at 28 acres of dense milfoil growth in spring of 2005 followed by control of the milfoil for the following four years and presumably a return to its' full 28 acre milfoil colonization level in 2010 despite maintenance treatments. The control initiated in 2005 apparently also resulted in a reduction of the prominence of native species occurring in the survey for most of two seasons (2005 and 2006). Because of this IDNR reviewers have raised concerns about the loss of native species in the sampling following fluridone treatment verses the benefits of plant management using fluridone. Assuming that without the use of fluridone for management, the 9 native species figure recorded by Weed Patrol Inc. for 2004 (when only 2,4-D was used) would have held each season through 2009, a figure for native year-species (mean native species present per year times the number of years in the management cycle) can be produced. Based on that assumption a lack of fluridone management in the last five years would have produced a total of 45 native year-species (the presence of one native species for a single year). Under the fluridone/2,4-D management regime employed, the total native year-species in the five year term was 41. Since no data was collected in 2007 the native species number for that year was conservatively assumed to be equal to the 2009 figure of 8 species. Looking at the average numbers of native species present in a given season during the five year cycle may also be useful. Assuming 9 species per year if no fluridone based management was carried out, the "no fluridone" average annual species number would be 9. The average annual species number under the fluridone/2,4-D management regime employed (assuming 8 species in 2007) was 8.2.

If plant management decisions at the lake were to be made solely on the basis of maintaining the maximum cumulative number of native species sampled through the five year management cycle based on available data, a decision not to use fluridone would be rendered. It's probably safe to assume that the collection process employed contains significant error. Because the comparison figures are relatively close, the two regimes (fluridone verses no fluridone) are likely statistically identical in terms of year-species and mean species per year when possible error is considered. A more in-depth analysis of statistical error inherent in the Tier II survey method is beyond the scope of this work.

8.1 Fluridone Verses 2,4-D Granular Cost Analysis

A cost analysis was performed to compare the five year management costs of using 2,4-D granular to control all milfoil growth annually at Atwood Lake versus using fluridone in year one and 2,4-D granular in year five. For the purposes of the comparison a cost of 450.00 per acre was used for 2,4-D treatment. It was assumed that with a "2,4-D only" management regime 28 acres of Eurasian milfoil would be treated each season. The 28 acre figure is based on the amount of milfoil colonization present in 2004. It was assumed that in the fluridone management regime the rate of return of milfoil colonization would match that seen the five year cycle that began in 2005 with five acres needing treatment in the third year after fluridone and 19 acres needing treatment in the fourth year. The total projected five-year cost of milfoil management under the "2,4-D only" regime was 63,000.00. The total projected five-year cost of milfoil management under the fluridone/2,4-D maintenance regime was 33,600.00. The analysis indicates that over the five year period the fluridone regime will cost 29,400.00 less than the use of 2,4-D granular exclusively (Table 6).

Year	Acres 2,4-D treatment, maintenance regime	Annual treatment cost 2,4-D maintenance regime	Acres 2,4-D treatment, fluridone regime	Annual treatment cost fluridone regime
2010	28	12600.00	0	22800.00
2011	28	12600.00	0	0.00
2012	28	12600.00	0	0.00
2013	28	12600.00	5	2250.00
2014	28	12600.00	19	8550.00
5 year totals	**140**	**63000.00**	**24**	**33600.00**

Table 6. **Annual five-year management cost estimates and maintenance treatment acreage figures for Atwood Lake through 2014 for both fluridone and "2,4-D only" treatment regimes.**

To arrive at an approximate acreage figure of milfoil colonization at which fluridone becomes more cost effective than the use of 2,4-D granular alone in Atwood lake five year time period dollar costs of both options were plotted against acres of milfoil present (1-40 acres)(figure 12). This was based on the assumption that 100% of milfoil colonization would return each year and require treatment under the 2,4-D only treatment regime. It was also assumed that the return of milfoil under a fluridone/2,4-D regime would match rates experienced in the last five years, with 17% of the original colonization returning in year three, and 83% of the original colonization returning in year four. The intersection of the plots at just fewer than 11 acres indicates that a level of colonization of 11 acres or more in Atwood Lake justifies the use of fluridone on the basis of cost-effectiveness (Figure 12). If a fluridone treatment is performed at Atwood Lake again with a different rate of returning colonization, the new information should used to refine these cost analysis for making future management decisions.

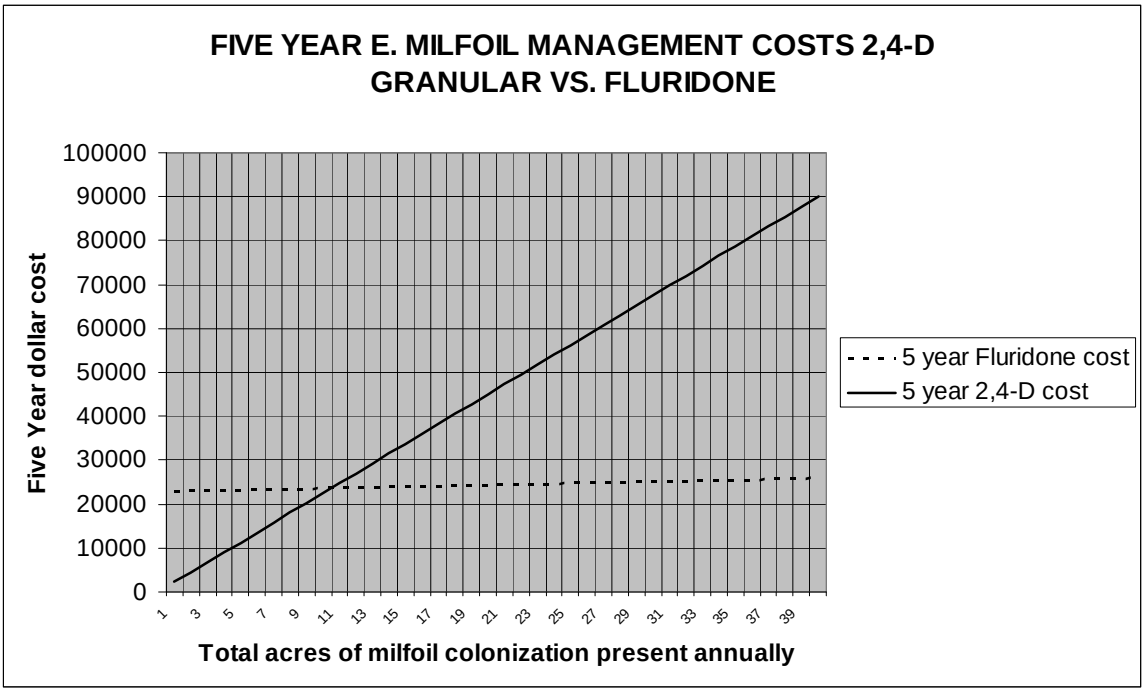


Figure 12. **Cost effectiveness plot for Atwood Lake, fluridone vs 2,4-D granular over five years.**

Acres of milfoil	5 year Fluridone/2,4-D cost	5 year 2,4-D only cost
1	22877.33	2250
2	22954.66	4500
3	23031.99	6750
4	23109.32	9000
5	23186.65	11250
6	23263.98	13500
7	23341.31	15750
8	23418.64	18000
9	23495.97	20250
10	23573.3	22500
11	23650.63	24750
12	23727.96	27000
13	23805.29	29250
14	23882.62	31500
15	23959.95	33750
16	24037.28	36000
17	24114.61	38250
18	24191.94	40500
19	24269.27	42750
20	24346.6	45000
21	24423.93	47250
22	24501.26	49500
23	24578.59	51750
24	24655.92	54000
25	24733.25	56250
26	24810.58	58500
27	24887.91	60750
28	24965.24	63000
29	25042.57	65250
30	25119.9	67500
31	25197.23	69750
32	25274.56	72000
33	25351.89	74250
34	25429.22	76500
35	25506.55	78750
36	25583.88	81000
37	25661.21	83250
38	25738.54	85500
39	25815.87	87750
40	25893.2	90000

Figure 13. **Five year cost projections for Eurasian milfoil management at Atwood Lake with fluridone vs 2,4-D only with various levels of colonization.**

It's the opinion of Aquatic Enhancement & Survey, Inc. that the theoretical loss of .8 native species per year or 4 native year-species during the five year management cycle is outweighed by the benefits provided by fluridone-based management in terms of public preference, recreational and aesthetic viability, management cost savings, and the potential ecological ramifications of either a complete discontinuance of management or continued annual maintenance treatments of 28 acres of dense milfoil growth. Fluridone application appears to be the best overall option at this time.

In terms of maintaining diversity regardless of which plant management regime is employed, one major step to be taken is to work toward preventing the increased presence of nutrients in the lake by working toward a healthy watershed. Lower nutrient levels typically mean better water clarity and more available light to spur the development of the lake's plant community. Persistent poor water clarity over time will limit the lakes plant community to the support of low-light tolerant species that thrive in high nutrient environments. The ALA should take care to try to preserve the good water clarity seen in 2009 and see that soil and nutrient sources in the watershed are minimized.

The ALA may wish to also continue with small treatments of native plants in high-use areas where they provide a hindrance to recreational activities so long as the treatment areas are not extensive enough to provide significant damage to the lake's overall native floral community.

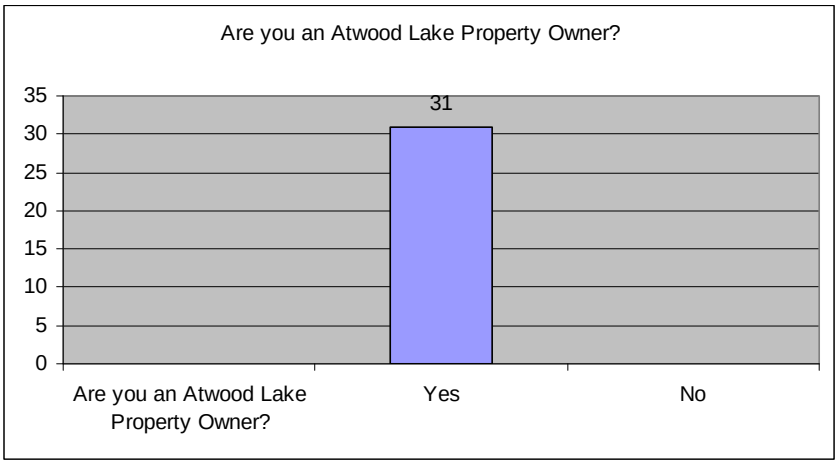
Because the management of the lake's shoreline, riparian wetlands, and watershed are crucial to maintaining a healthy aquatic plant community the ALA should consider seeking funding from the LARE program for a lake diagnostic study. The disappearance of cisco from Atwood Lake indicates that some degree of nutrient enrichment has occurred. Trophic state index scores and available water clarity data also suggest that changes toward a more nutrient-rich system may be occurring. A lake diagnostic study would help establish a set of directives toward improving and protecting the water quality of the lake. Tasks included in a LARE lake diagnostic study could include a detailed assembly and analysis of relevant historical water quality trends at Atwood Lake as well as characterization of land uses in the watershed. Preliminary field work performed could also help to locate watershed areas that are yielding eroded soils or nutrients to the lake. Local County Soil and Water Conservation District and United States Department of Agriculture, Natural Resources Conservation Service personnel may also be helpful in indicating possible changes in watershed land-management practices that may be helpful in protecting and improving water quality. It would also be helpful for the ALA to implement volunteer monitoring of water clarity through the Indiana Clean Lakes Program. This can help to establish and maintain a more complete record of water clarity to track trends accurately and help with future decision making. More information about the Clean Lakes Program can be found online at http://www.indiana.edu/~clp/.

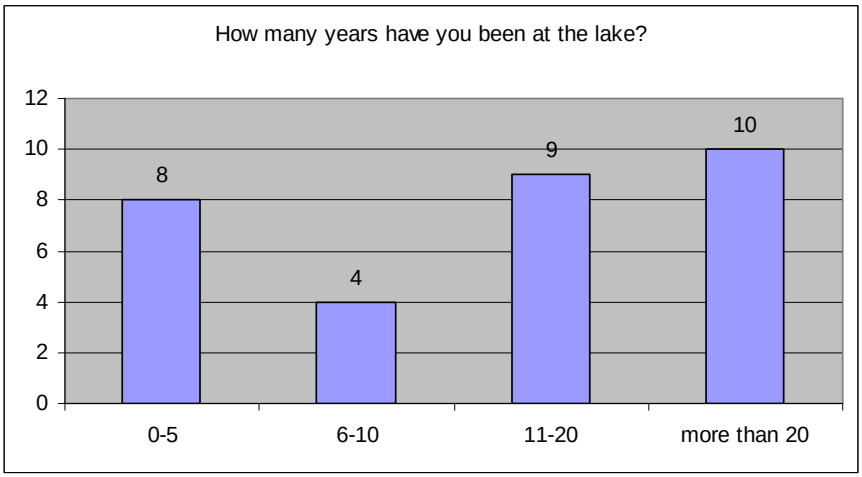
9. Public Involvement

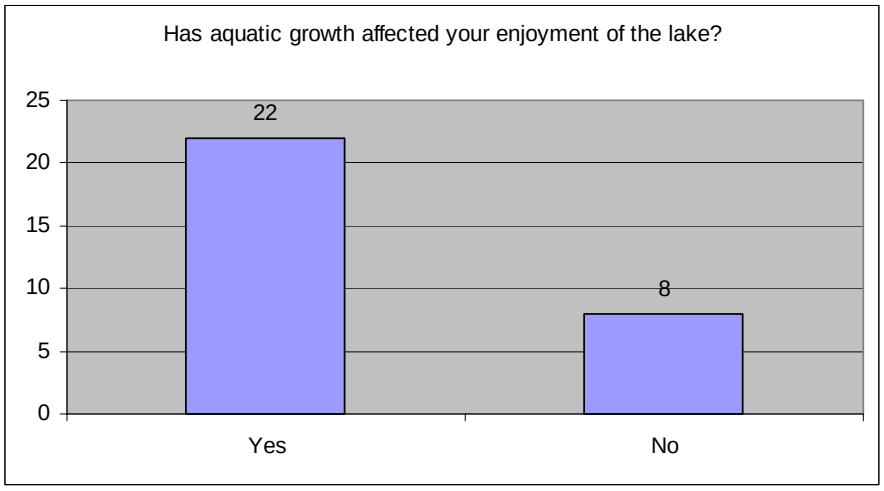
A public meeting for discussion of aquatic plant management at Atwood Lake was incorporated into the regular meeting of the ALA held on June 13, 2009 at the Atwood Lake Campground pavilion. Each year the ALA holds a meeting in June and another in August. Approximately 40 persons were in attendance. This was considered to be a well-attended meeting of the ALA. Survey results indicate that all were Atwood Lake property owners or their family members. Of approximately 123 households on the lake this represented 6% (assuming two members were present for each household represented). Information about ongoing plant management and monitoring efforts was presented by Aquatic Enhancement & Survey, Inc. A discussion was held about the status and goals of the Atwood Lake Plant Management Plan and opportunity was provided for lake residents to ask questions and provide input regarding the plant management

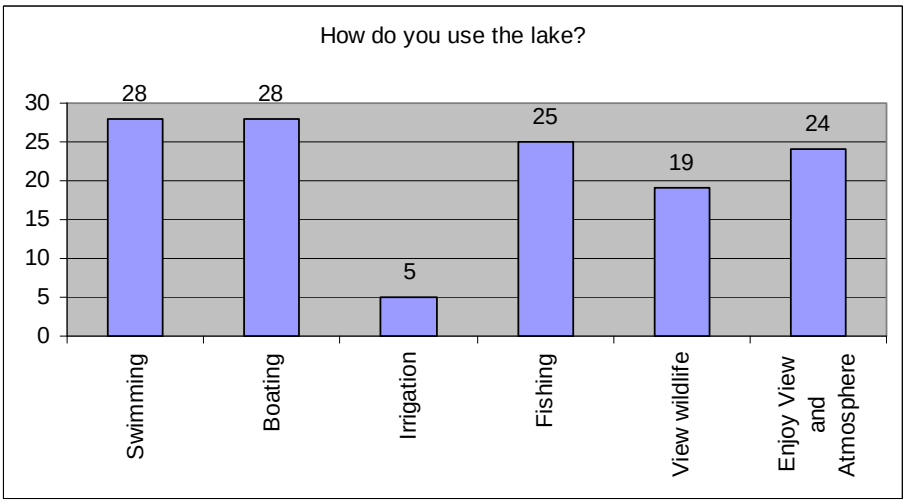
and water-use restrictions involved. Samples of Curlyleaf pondweed and Eurasian watermilfoil were provided to help the lake users to recognize these invasive plants. A Lake Use Survey was distributed to those present, filled out (one per household), and collected. Twenty-two surveys were completed and returned. Results are shown in the graphs below.

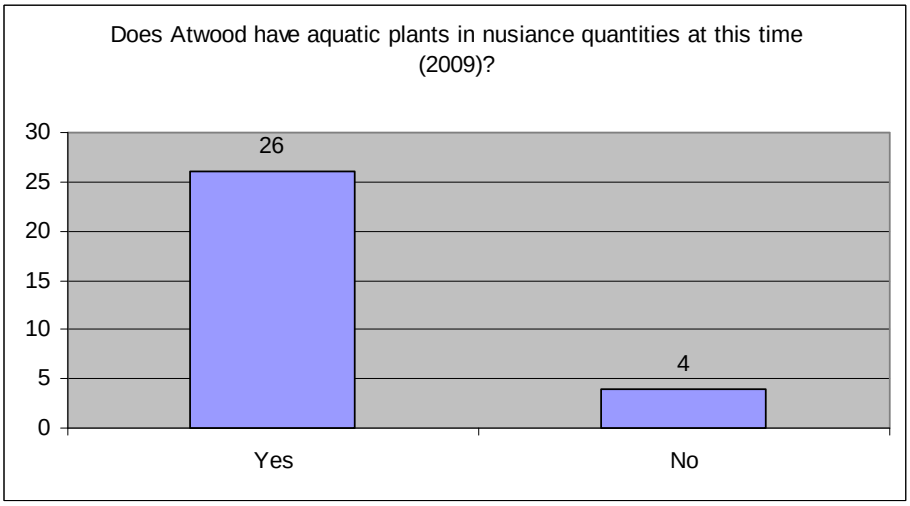
Overall, the meeting attendants were very interested in continuing efforts to manage exotic plants at the lake and were pleased with plant management results thus far. This was also indicated by comments made verbally at the meeting. Support for continued exotic plant management was not surprising considering that enjoying the view, boating, and swimming, were the most popular activities. Future ALA meetings should be announced in the local media with the public invited to attend. This will allow lake users to learn about ongoing management efforts at Atwood Lake and provide an opportunity for additional public comment.

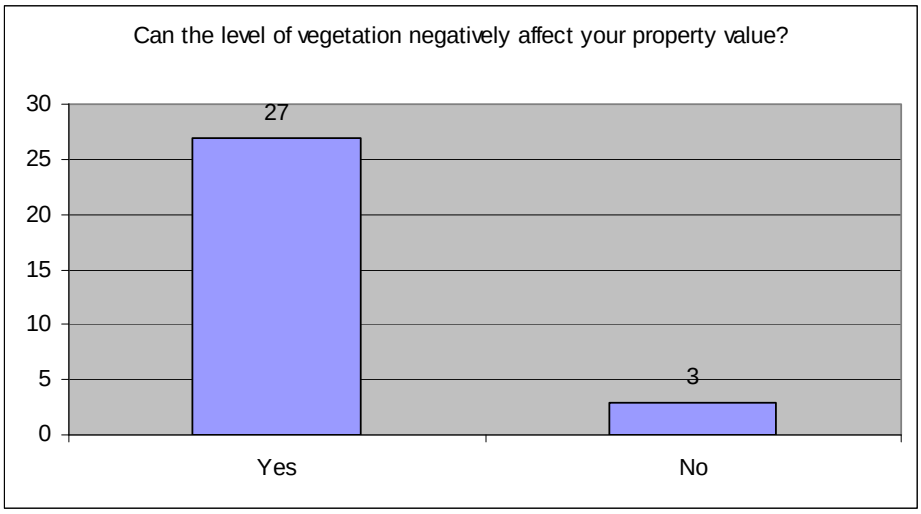


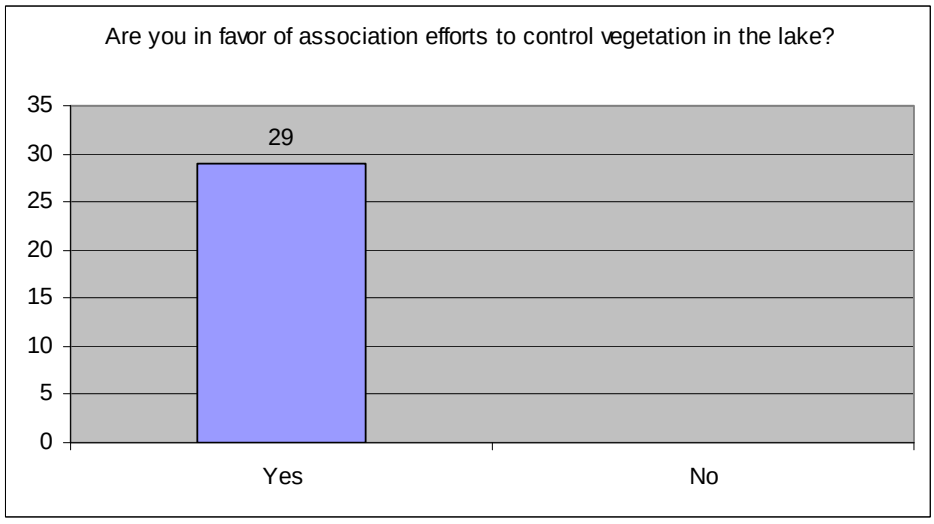


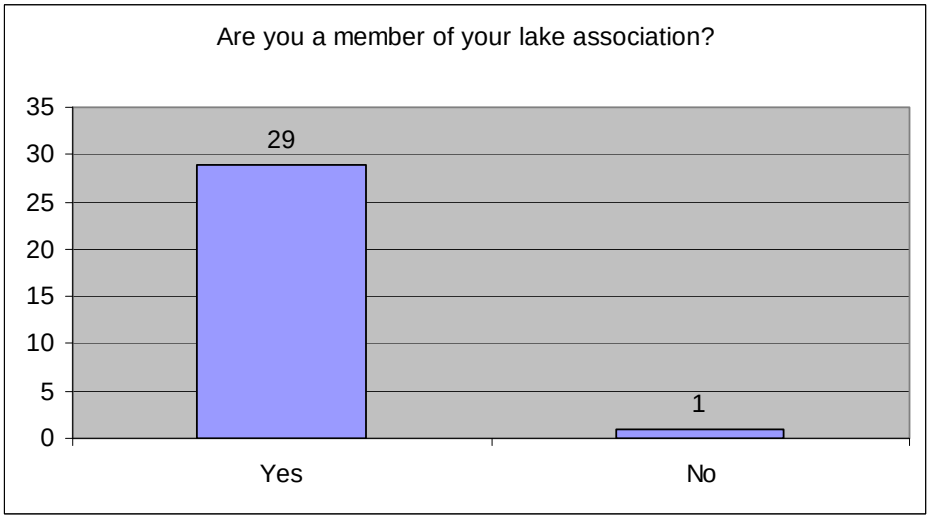

Has aquatic growth affected your enjoyment of the lake?
25
20
15
10
5
0
22
8
Yes
No

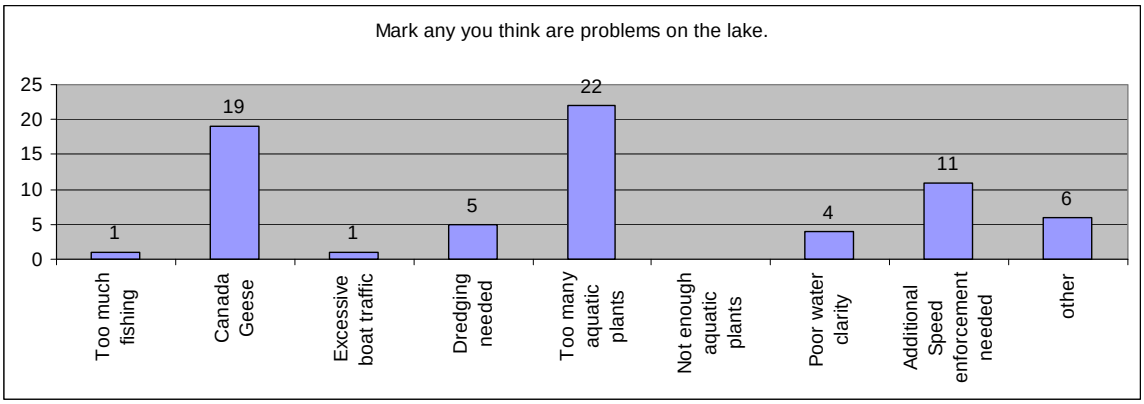

How do you use the lake?
30
25
20
15
10
5
0
28
28
5
25
19
24
Swimming
Boating
Irrigation
Fishing
View wildlife
Enjoy View and Atmosphere


Does Atwood have aquatic plants in nusiance quantities at this time (2009)?
30
25
20
15
10
5
0
26
4
Yes
No


Can the level of vegetation negatively affect your property value?
30
25
20
15
10
5
0
27
3
Yes
No


Are you in favor of association efforts to control vegetation in the lake?
35
30
25
20
15
10
5
0
29
Yes
No


Are you a member of your lake association?
35
30
25
20
15
10
5
0
29
1
Yes
No



10. Implementation Strategy, Timeline, and Cost Estimates

The recommended course of action is management of non-native aquatic plant growth with fluridone and is in keeping with the original five year plan developed in 2008. It should be noted that LARE funding may not be available to assist the ALA in any given year. Requests for funding from LARE far exceed available funds. The ALA should explore other avenues for generating revenue to continue with management efforts in the event that LARE funds become unavailable. Possibilities include the solicitation of volunteer donations from lake residents or businesses in close proximity to the lake, or the holding of dedicated fund raiser events. The formation of a conservancy district is also a potential pathway to securing funds. A conservancy district provides a taxing body that can assess lake or watershed residents to provide funding for a specified environmental mission.

Fluridone Application

Objectives:

1. Establish an initial target concentration of at least 6 ppb fluridone in Atwood Lake.
2. Maintain a concentration of at least 3 ppb for an additional 90 days after target is achieved.

The fluridone application should take place between April 15 and May 15 when aquatic plants have begun actively growing. An Environmental Protection Agency (EPA) approved liquid fluridone herbicide should be used with an active ingredient content of 41.7 % (four pounds active ingredient per gallon). A temperature profile should be taken over the deepest area of Atwood Lake prior to initial treatment. If a thermocline or significant thermal break is noted in the temperature profile the initial dose should be calculated to achieve the target concentration in the entire volume of the lake above that temperature break. Within two to five days of initial application two assays should be collected and shipped to a qualified laboratory facility for analysis (Figure 14). If lab analysis reveals an average target concentration below six ppb from the two sites an application should be performed as soon as possible to bring the lake to the 6 ppb target. Sampling should again be performed within two to five days to confirm that the target concentration has been reached. After establishment of the initial 6 ppb concentration monitoring will begin, with sample collection (2) to occur at 30, 60, and 90 days thereafter. Bump treatments should be scheduled and performed to maintain a concentration of at least 3 ppb fluridone for a period of 90 days after the six ppb target was achieved. Final fluridone treatment specifications will be provided by IDNR including a treatment specifications document if LARE cost-share funding is provided for Atwood Lake in the 2010 season.

***Figure 14*. Fluridone Assay Sites for Atwood Lake 2010.**

2010 ●**Objectives** Elimination of all densely growing Curlyleaf stands by mid-May. A late-season Tier II occurrence of Eurasian watermilfoil of 10% or less.	2011 ●**Objectives** Elimination of all densely growing Curlyleaf stands within two weeks of treatment. A late-season Tier II occurrence of Eurasian watermilfoil of 5% or less	2012 ●**Objectives** Elimination of all densely growing Curlyleaf stands within two weeks of treatment. A late-season Tier II occurrence of Eurasian watermilfoil of 5% or less	2013 ●**Objectives** Elimination of all densely growing Curlyleaf stands within two weeks of treatment. A late-season Tier II occurrence of Eurasian watermilfoil of 5% or less
Month/Activity	**Month/Activity**	**Month/Activity**	**Month/Activity**
April, Map Curlyleaf pondweed And Eurasian watermilfoil growth 700.00	April, Map Curlyleaf pondweed And Eurasian watermilfoil growth 700.00	April, Map Curlyleaf pondweed And Eurasian watermilfoil growth 700.00	April, Map Curlyleaf pondweed And Eurasian watermilfoil growth 700.00
May apply Fluridone at 6 ppb with a bump back to 6 ppb as needed at two weeks, (assays included) 23,100.00	April/May (H2O temp app. 50-55 F or soon after emergence) Treat Curlyleaf pondweed 8ac.as needed (1 ppm Aquathol K) 2800.00	April/May (H2O temp app. 50-55 F or soon after emergence) Treat Curlyleaf pondweed 8ac.as needed (1 ppm Aquathol K) 2800.00	April/May (H2O temp app. 50-55 F or soon after emergence) Treat Curlyleaf pondweed 8ac.as needed (1 ppm Aquathol K) 2800.00
	May, Eurasian treatment (approx. 2 ac.) 900.00	May, Eurasian treatment (approx. 4 ac.) 1800.00	May, Eurasian treatment (approx. 8 ac.) 3600.00
July, Tier II Survey 1200.00	July, Tier II Survey 1200.00	July, Tier II Survey 1200.00	July, Tier II Survey 1200.00
As arranged, Public Meeting 350.00	As arranged, Public Meeting 350.00	As arranged, Public Meeting 350.00	As arranged, Public Meeting 350.00
October/November, Permit Meeting 200.00	October/November, Permit Meeting 200.00	October/November, Permit Meeting 200.00	October/November, Permit Meeting 200.00
December, Plan Update Document Due 1600.00	December, Plan Update Document Due 1600.00	December, Plan Update Document Due 1600.00	December, Plan Update Document Due 1600.00
Total Cost **27,150.00**	**Total Cost** **7750.00**	**Total Cost** **8650.00**	**Total Cost** **10,450.00**

11. Integrated Management Action Plan

Exotic plant management at Atwood Lake should continue to take an approach consisting of three tiers of action working toward this plan's primary goals:

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

Tier 2: Public Education.
The educational points in the section below can potentially prevent a very costly infestation of new exotic plants and animals at the lake, saving resources that can be utilized to address current problems. This information should be shared with as many lake residents as possible.

Tier 3: Non-native Plant Control.
Addressing the submersed aquatic non-native plants present on a lake wide basis with professional applications of United States EPA approved aquatic pesticides and monitoring results closely can potentially limit their spread, and preserve the native plant community while

providing relief to lake users. The proposed treatment regime is detailed in the budget and timeline above. A treatment response benchmark of a reduction in Eurasian watermilfoil late-season Tier II occurrence to ten percent or below should be pursued for 2010. For Curlyleaf pondweed a goal of having all notable dense growth dropping out within 30 days a spring fluridone treatment is reasonable. This course of action appears to be agreeable to Atwood Lake Association and IDNR at this time. Whereas funding requests for LARE exceed available funding every applicant lake will not be funded each season. It is important for the ALA to remember that it may be necessary to plan alternate sources of funding for plant management activities during season's in which no funding is available.

Important program dates for the ALA in the 2010 season are below. These dates are based on a timeline needed if the ALA intends to have an early-season Curlyleaf treatment done. There is considerably more flexibility in timing if only a milfoil treatment is being performed as milfoil treatments generally do not begin until May.

March 1	Send in treatment permit form to IDNR
March 15	IDNR funding decisions
March 20	Send a request for proposals to planning and application contractors due in one week
March 27	Receive bids from contractors
March 31	Select and notify contractor(s) and call IDNR to have application contractor noted on permit (260-244-6805)
April 10	Obtain signed contract
May 15	Schedule Lake Association Meeting with contractor (s)
November 1	Last day for contractors to provide maps for management plan or plan updates and schedule a meeting with IDNR Fisheries and LARE biologists
December 15	First draft of management plan or plan updates due from contractors
January 15	Grant application due for current year funding
March 1	Final copy of revised plan or update due from contractors

12. Public Education

The ALA should set reasonable goals for increasing awareness among lake users about lake health issues. The association's summer meetings held in June and again in August can serve as the primary vehicles for disseminating information. This was done in 2009 when information about management efforts was presented at the June meeting. Information about non-native invasive species in general was also presented with live examples of Curlyleaf pondweed and Eurasian watermilfoil shown to attendees to familiarize them with these invasive plants. An association newsletter could also help reach those who do not attend the meetings in the future. An association website might be another way that relevant information can be shared with the public. The following areas should be addressed:

●Prevention of the spread of Exotic Invasive Aquatic and Wetland Species

An effort should be made to make lake users aware that their own boat trailers could have introduced Curlyleaf pondweed or Eurasian watermilfoil to Atwood Lake or could spread these plants to other lakes if care is not taken to remove vegetative debris at pull-out. Basic plant identification should be addressed including Hydrilla (*Hydrilla verticillata*), so new invasive species appearing can be spotted by the lake users at an early stage of colonization.

●Prevention of lake nutrient enrichment.
An effort should be made to encourage all lake residents to switch to no-phosphorus lawn fertilizers. Residents should also be made aware that soils lost through erosion in the watershed carry nutrients into the lake's waters as do sediments mobilized from the lake's bottom and shoreline by watercraft. Area residents should be aware of proper erosion control techniques needed at construction sites within the watershed. Residents should be aware that water quality can change with changes in the use of watershed lands. Local County Soil and Water Conservation District personnel could be a good source of information regarding farming and land-use practices in the watershed.

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

13. Monitoring and Plan Update Procedures

The Atwood Lake Association's aquatic plant management program should be monitored and updated on an annual basis. Monitoring will consist of monitoring not only the lake's plant community, but the thoughts and opinions of the lake's users. To monitor the lake's exotic growth remapping of growth should occur each spring with a comparison made with the previous season's growth pattern. A tier II survey in the late season after treatment has been initiated will serve to characterize the lake's overall plant community statistically and also gage if treatment success benchmarks from the implementation strategy have been attained. One change from success benchmarks proposed for 2009 is a bump of the target Tier II milfoil occurrence from five percent in 2009 to ten percent in 2010. Fluridone treatments, while providing very complete control of milfoil, are often slow acting in the season of application. A considerable amount of dying milfoil could be present in August. In addition to seeking a late-season Tier II occurrence of ten percent or less for Eurasian watermilfoil and seasonal elimination of dense stands of Curlyleaf pondweed the ALA should seek to maintain a late-season Tier II occurrence of at least 6 native species. This will provide a good basic indicator of plant community diversity. If treatment response benchmarks are not attained changes in the treatment timing, chemical(s) used, or integrated approach will all be options for setting a new course toward success. To monitor the thoughts and opinions of lake users at least one public meeting should be held annually and a survey distributed. An open forum at the meeting should exist to allow for discussion of water-use restrictions associated with treatments, new problems arising at the lake, or treatment effectiveness.

14. Literature Cited

Aquatic Enhancement, Inc. 2008, Aquatic Vegetation Management Plan 2008-2012 Atwood Lake, LaGrange County, Aquatic Enhancement & Survey, Inc., 5530 East Division, Angola, IN 46703

IDNR 2007. Tier II Aquatic Vegetation Survey Protocol, May 2007, Indiana Department of Natural Resources, Division of Fish and Wildlife, 402 W. Washington St. Rm W-273, Indianapolis, IN 46204

Pearson, J. 2004. A sampling method to assess occurrence, abundance and distribution of submersed aquatic plants in Indiana lakes, Indiana Department of Natural Resources, Division of Fish and Wildlife, Tri-Lakes Fisheries Station, 5570 North Hatchery Road Columbia City, Indiana 46725

Weed Patrol, Inc. 2005. Atwood Lake Aquatic Plant Management Plan 2005-2008, Weed Patrol, Inc., 1922 Fieldhouse Ave., Elkart, IN 46517

Appendix A
IDNR Aquatic Vegetation 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 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

Applicant's Name	Lake Assoc. Name	
Ted Kirchner	Atwood Lake Association	
Rural Route or Street		Phone Number
7160 S. 080E		260-854-2919
City and State		ZIP Code
Wolcottville, IN		46795
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)	Nearest Town	County
Atwood	Wolcottville	LaGrange
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 see map	
Total acres to be controlled up to 30	Proposed shoreline treatment length (ft) n/a	Perpendicular distance from shoreline (ft) n/a
Maximum Depth of Treatment (ft) 14 ft	Expected date(s) of treatment(s) 5/25/2010	

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. general seek and destroy of Eurasian watermilfoil, 2,4-D gran. or liquid

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

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian watermilfoil	x	10%
Chara		60%
Curlyleaf		10%
Sago		10%
whitestem pondweed		10%

Treatment Area # 2	LAT/LONG or UTM's general seek and destroy	
Total acres to be controlled up to 20	Proposed shoreline treatment length (ft) n/a	Perpendicular distance from shoreline (ft) n/a
Maximum Depth of Treatment (ft) 9ft	Expected date(s) of treatment(s) 4/25/2009	

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 (general seek and destroy)

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

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian watermilfoil		10%
Chara		60%
Curlyleaf	x	10%
Sago		10%
whitestem pondweed		10%

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

Treatment method: [ ] 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.

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

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community

Treatment Area # 3	LAT/LONG or UTM's general seek and destroy		
Total acres to be controlled up to 20	Proposed shoreline treatment length (ft) n/a	Perpendicular distance from shoreline (ft) n/a	
Maximum Depth of Treatment (ft) 9ft	Expected date(s) of treatment(s) 4/25/2009		

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. whole lake fluridone treatment 6 ppb initial, 3 ppb for 90 days

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

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian watermilfoil		10%
Chara		60%
Curlyleaf	x	10%
Sago		10%
whitestem pondweed		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.

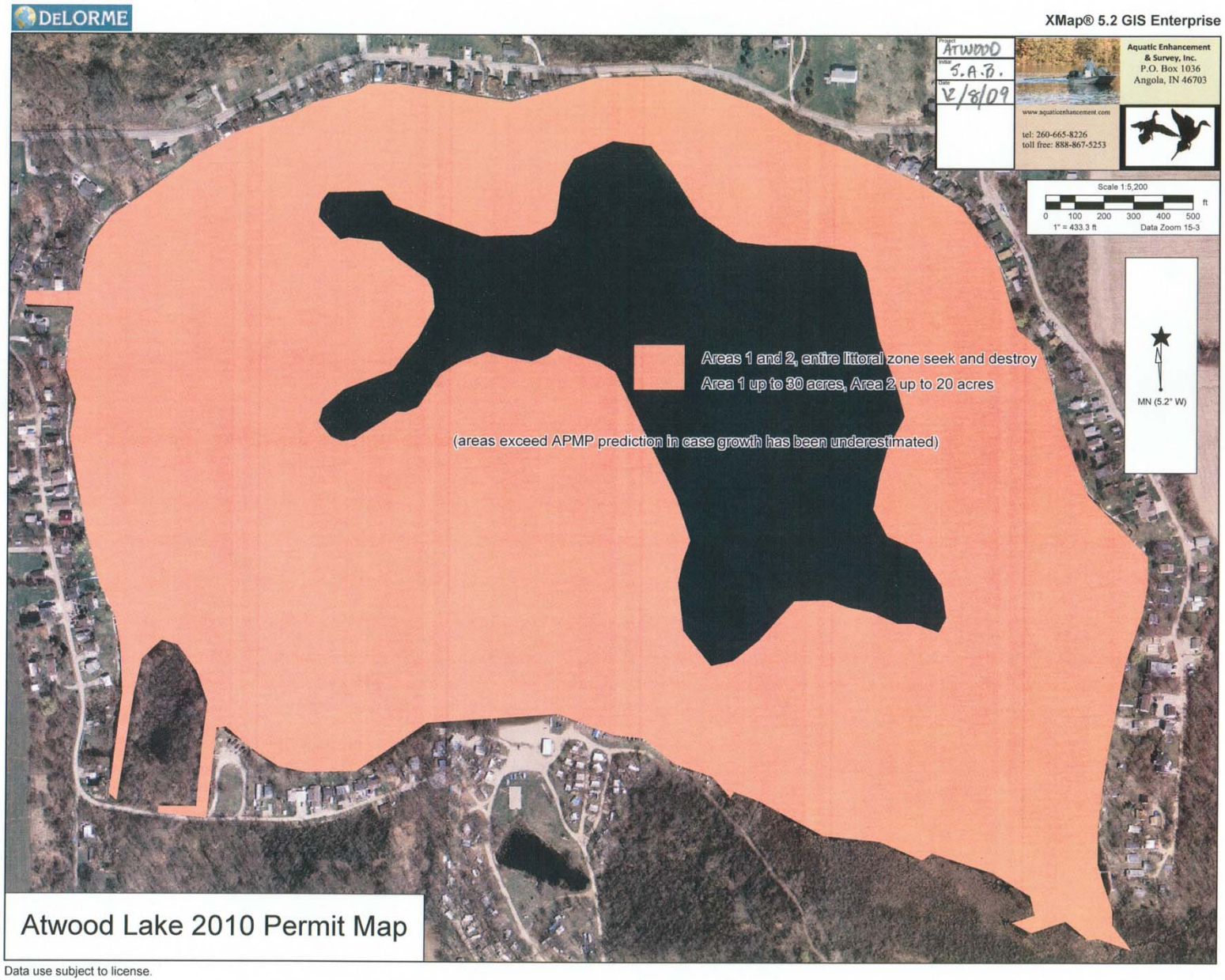
Applicant Signature	Date
Certified Applicant's Signature	Date

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



Appendix B
Tier II Plant Survey Data Sheets

Aquatic Vegetation Random Sampling (Tier 2)

Waterbody Cover Sheet

Surveying Organization: Aquatic Enhancement

Contact Information: (260) 665-8226

Waterbody Name: Atwood Lake Lake ID:

County(s): LaGrange Date: 8-11-2009

Habitat Stratum: IL Avg. Lake Depth (ft): Lake Level:

GPS Metadata

Crew Leader: Scott Banfield Datum: Zone: Accuracy:

Recorder: Joseph Closson Method:

Secchi Depth (ft): 8' 3" Total # of Points Surveyed: 50 Total # of Species: 10

Littoral Zone Size (acres):
- ☐ Measured
- ☐ Estimated

Littoral Zone Max. Depth (ft): 10
- ☐ Measured
- ☐ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions: WATER CLARITY MUCH IMPROVED OVER 2008

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 1 of ___

WATERBODY NAME: Atwood Lake	DATE: 8-11-2009
COUNTY: La Grange	SECCHI DEPTH (FT): 8'3"
SITE ID:	MAX PLANT DEPTH (FT):
SURVEYING ORGANIZATION: Aquatic Enhancement	WEATHER: Cloudy 75° Light west wind
CREW LEADER: Scott Bankell	COMMENTS (Include voucher codes - V1, V2...):
RECORDER: Joseph Closson	V1 N41 34.4466 Min W084 59.7892 Min
CONTACT INFO: (260) 665-8226	*Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.*

Point #	R/T	Latitude	Longitude	Depth	Species Codes: CHARA	POTGRA	CERDEM	NASMAR	POTPRA	NASFLE	HETDUB	POTCRI	MYRSPI Notes
2	T			4	5								
1	T			3	5	1							
3	T			4			5						
5	T			2									
6	T			3.5	5	1		1					
7	T			9	5				3				
8	T			4	5					1			
9	T			10				1			5	3	
10	T			4	3			1		1			
11	T			4	5					1			
12	T			10				1	3				1 → MYRSPI stems pres
V1→ 13	T	~~NW~~	~~34.~~	4	1					1			
14	T			5	5							1	
15	T			5	5								
16	T			4						1			
17	T			4.5		1				5			
18	T			4	5	1				1			
19	T			8	1					1			
20	T			4	5			1		1			
21	T			3				1					
22	T			3.5									
23	T			~~7.5~~ 7	1					5			
24	T			3.5									
25	T			3	1								
26	T			3	1			1					
27	T			6.5	1				5				
28	T			2.5	1			1					
29	T			4.5				1					
30	T			3									
31	T			4.5	1					1			
32	T			5						3			
33	T			3.5						1			
34	T			5.1	5								

Other plant species observed at lake:

Submersed Aquatic Vegetation Survey (Tier II) Datasheet

Page 2 of ___

WATERBODY NAME:	DATE:
COUNTY:	SECCHI DEPTH (FT):
SITE ID:	MAX PLANT DEPTH (FT):
SURVEYING ORGANIZATION:	WEATHER:
CREW LEADER:	COMMENTS (Include voucher codes - V1, V2...):
RECORDER:	
CONTACT INFO:	*Rake score (1, 3, 5). 9 = algae, emergent or species observed but not sampled.*

"ELOCAN POTRIC

Point #	R/T	Latitude	Longitude	Depth	Species Codes: CHARA	POTGRA	CERDEM	NASMIR	POTPRA	NASFLE	HETDUB	POTCRI	MYRSPI ~~Notes~~
35	T			1.75									
36	T			4.1	5								
37	T			5.1	5								
38	T			3.5	5								
39	T			3.1	5					3			
40	T			3.5	5					5			
41	T			4	5								
42	T			5.1	5								
43	T			~~10.5~~	5			1	1				
44	T			2			5						
45	T			3	5	1			9				
46	T			4.5	3								
47	T			4	5								
48	T			4									
49	T			8.5	1			5	3				
50	T			3									
51	T			8				1	1				
52	T			2.5	1	1							

1 1

Other plant species observed at lake:

Appendix C
Tier II Plant Survey Waypoint Coordinates

Deg. Lattitude	Deg. Longitude		Waypoint #
41.535114	-85.417385	Atwd t2 6-14-08 001	
41.535249	-85.417162	Atwd t2 6-14-08 002	
41.535818	-85.418270	Atwd t2 6-14-08 003	
41.536716	-85.419255	Atwd t2 6-14-08 005	
41.536824	-85.418500	Atwd t2 6-14-08 006	
41.537241	-85.418058	Atwd t2 6-14-08 007	
41.537585	-85.418968	Atwd t2 6-14-08 008	
41.538247	-85.418547	Atwd t2 6-14-08 009	
41.539300	-85.418788	Atwd t2 6-14-08 010	
41.539556	-85.418103	Atwd t2 6-14-08 011	
41.539181	-85.417578	Atwd t2 6-14-08 012	
41.540258	-85.416533	Atwd t2 6-14-08 013	
41.540286	-85.415905	Atwd t2 6-14-08 014	
41.540322	-85.415369	Atwd t2 6-14-08 015	
41.540527	-85.415042	Atwd t2 6-14-08 016	
41.540385	-85.414412	Atwd t2 6-14-08 017	
41.540242	-85.414240	Atwd t2 6-14-08 018	
41.539719	-85.413841	Atwd t2 6-14-08 019	
41.540468	-85.412949	Atwd t2 6-14-08 020	
41.540791	-85.412159	Atwd t2 6-14-08 021	
41.540403	-85.411181	Atwd t2 6-14-08 022	
41.539671	-85.411566	Atwd t2 6-14-08 023	
41.539933	-85.410128	Atwd t2 6-14-08 024	
41.539839	-85.409425	Atwd t2 6-14-08 025	
41.539635	-85.409022	Atwd t2 6-14-08 026	
41.539096	-85.409329	Atwd t2 6-14-08 027	
41.539348	-85.408333	Atwd t2 6-14-08 028	
41.538890	-85.408374	Atwd t2 6-14-08 029	
41.538529	-85.408035	Atwd t2 6-14-08 030	
41.538245	-85.408239	Atwd t2 6-14-08 031	
41.537866	-85.408114	Atwd t2 6-14-08 032	
41.537778	-85.407639	Atwd t2 6-14-08 033	
41.536829	-85.407434	Atwd t2 6-14-08 034	
41.536705	-85.406785	Atwd t2 6-14-08 035	
41.536425	-85.407758	Atwd t2 6-14-08 036	
41.535856	-85.408234	Atwd t2 6-14-08 037	
41.534785	-85.407155	Atwd t2 6-14-08 038	
41.533467	-85.406975	Atwd t2 6-14-08 039	
41.533714	-85.408097	Atwd t2 6-14-08 040	
41.534655	-85.409257	Atwd t2 6-14-08 041	
41.535107	-85.409306	Atwd t2 6-14-08 042	
41.535549	-85.409836	Atwd t2 6-14-08 043	
41.534308	-85.411477	Atwd t2 6-14-08 044	
41.534713	-85.412019	Atwd t2 6-14-08 045	
41.535679	-85.412724	Atwd t2 6-14-08 046	
41.535984	-85.413380	Atwd t2 6-14-08 047	
41.535076	-85.413903	Atwd t2 6-14-08 048	
41.535330	-85.415255	Atwd t2 6-14-08 049	
41.534797	-85.415378	Atwd t2 6-14-08 050	
41.535076	-85.416569	Atwd t2 6-14-08 051	
41.534561	-85.417036	Atwd t2 6-14-08 052	
END			