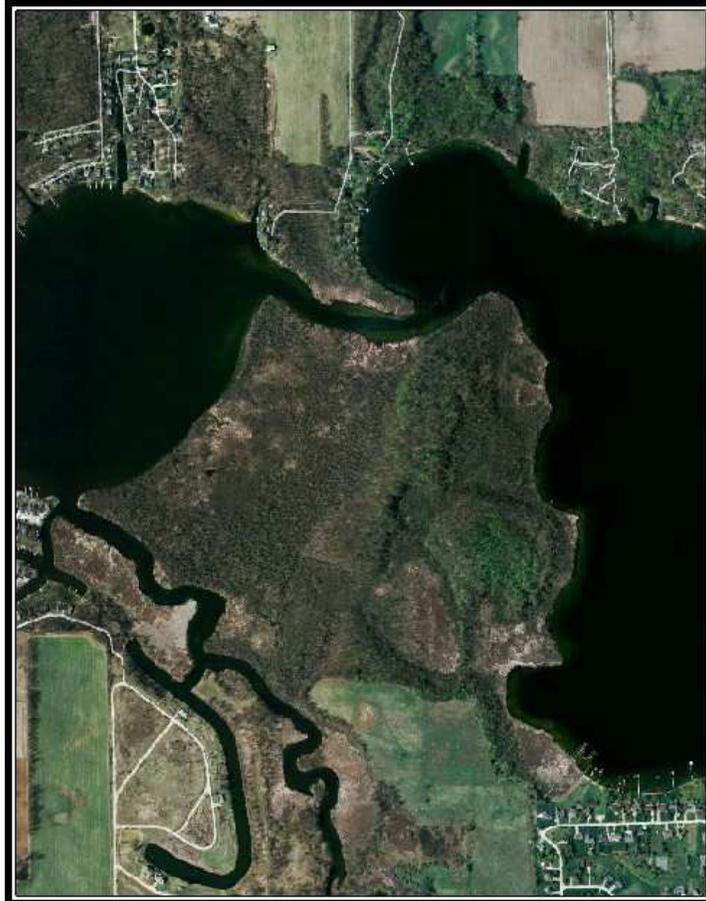


**Tippecanoe Chain**  
**2008 Ecozone Survey Report**  
Kosciusko County, Indiana

February 20, 2009



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## Executive Summary

This report was created in order to summarize 2008 vegetation sampling which was completed in the proposed Lake Tippecanoe Ecozone area. This proposed area is located along the eastern shore of Lake Tippecanoe and along the western shore of James Lake in Kosciusko County. The area was recommended following an Ecozone Feasibility Study completed in 2006 (Williams Creek 2006). The feasibility study was commissioned as a response to the increasing concern caused by algae growth and loss of native emergent and floating leaf vegetation in the Ball Wetlands area. The purpose of the 2008 sampling was to collect data on the submersed, floating leaf, and emergent vegetation community in the proposed Ecozone area in order to provide a baseline for tracking future changes in the vegetation community once the Ecozone has been established. Aquatic vegetation survey data collected in 2008 should provide baseline information that can be used to document potential impacts of the proposed Ecozone. Submersed vegetation was sampled using the Tier II survey protocol (IDNR 2007) and floating-leaf beds were sampled using a technique developed by IDNR fisheries biologists (Pearson 2004). Surveys were completed on August 28, 2008. The Tier II survey data revealed that there was a relatively diverse submersed native plant community present in this area, but vegetation was present at a lower than expected level, especially on the Lake Tippecanoe side. In addition, filamentous algae was present at 82.6% of sample sites within the Lake Tippecanoe area, but only 11.8% of sites in James Lake. Floating-leaf plant bed sampling revealed 10 beds totaling 13.25 acres within the proposed Ecozone areas. Spatterdock (*Nuphar lutea*) was the most common species observed during the floating-leaf plant bed survey. Data from these surveys should provide a baseline dataset that can be used to measure the effectiveness of the potential Ecozone.

## Acknowledgements

Funding for the vegetation sampling and the survey report was provided by the Indiana Department of Natural Resources (IDNR) Division of Fish and Wildlife Lake and River Enhancement Program and the Lake Tippecanoe Property Owners Association (LTPOA). Aquatic Control Inc. completed the field work, data processing, and map generation. Special thanks are given to Angela Sturdevant and Jed Pearson with the Indiana Department of Natural Resources for their assistance and review of this plan. Special thanks are also given to Holly LaSalle with the LTPOA for her assistance with this plan. Author of this report is Nathan Long of Aquatic Control. The author would like to acknowledge the valuable input from Brendan Hastie, Patrick Whitson, Joey Leach, and Barbie Huber of Aquatic Control for their field assistance, map generation, review, and editing of this report.

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## 1.0 INTRODUCTION

This report was created in order to summarize 2008 vegetation sampling which was completed in the proposed Lake Tippecanoe Ecozone area. The purpose of the sampling was to collect data on the submersed, floating leaf, and emergent vegetation community in the proposed Ecozone area in order to provide a baseline for tracking future changes in the vegetation community once the Ecozone has been established.

Lake Tippecanoe, including James and Oswego lakes, is a 1,110 acre chain of natural lakes located 2 miles west of North Webster, Indiana (Figure 1). It lies within the Tippecanoe River watershed and drains 72,320 acres. The water level is maintained by a dam built in 1936 at the west end of Oswego Lake. The main inlets enter from Lake Webster (Tippecanoe River), and the Barbee Lakes (Grassy Creek). With a maximum depth of 122 feet, Lake Tippecanoe is the deepest natural lake in Indiana. The Tippecanoe Lake basin is steep-sided and has an average depth of 37 feet. The combined volume of the three basins is 35,230 acre-feet and their hydraulic retention time is 175 days. James Lake covers 272 acres, drains 35,776 acres and has a retention time of 73 days. Farming is the major land use in the watershed, but small towns, woodlots, wetlands, and lakes are present (Jones 1986). Nearly the entire shoreline of the lakes is residentially developed with the exception of the Ball Wetland area which encompasses the perceived shoreline area of the proposed Ecozone.

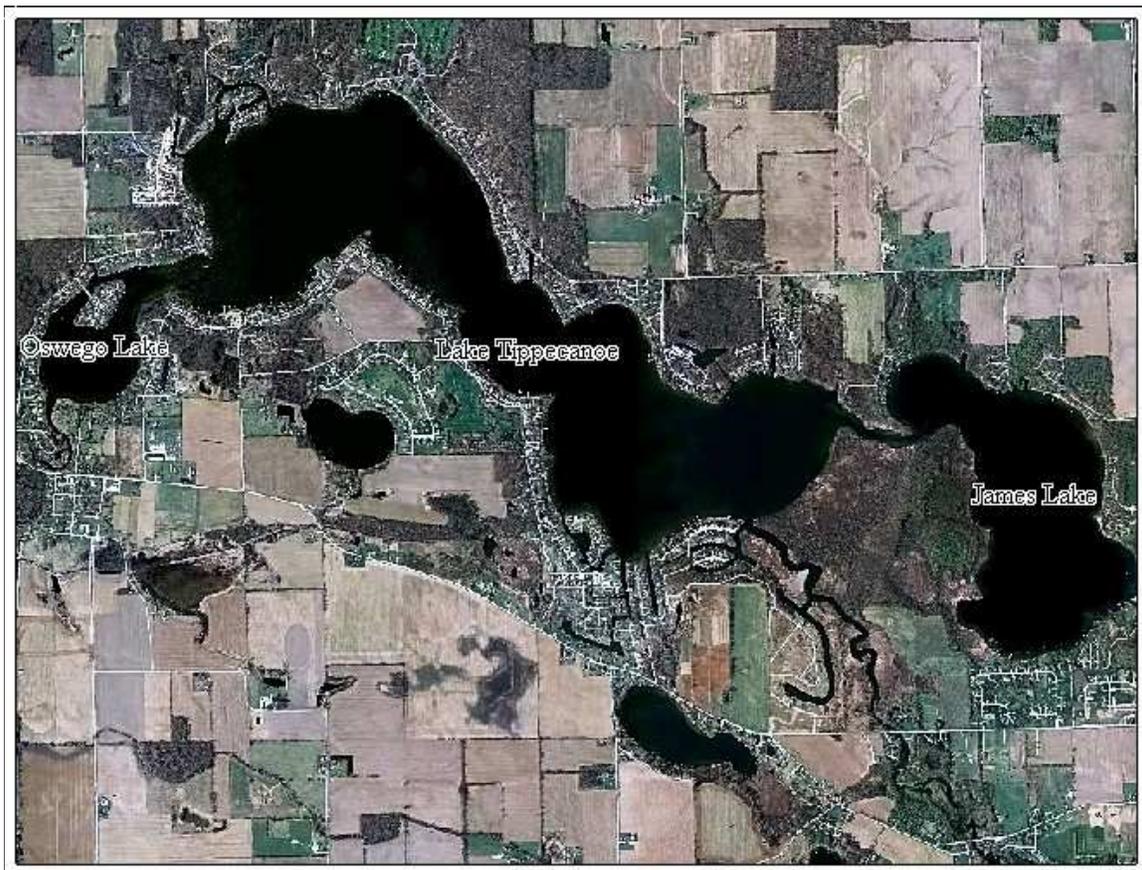


Figure 1. Lake Tippecanoe chain of lakes.

This proposed Ecozone area is composed of two sections. One section encompasses a large area along the eastern shore of Lake Tippecanoe which stretches 500 feet from the perceived shoreline. Grassy Creek enters Lake Tippecanoe at the southern edge of this area. The other section is located along the western shore of James Lake and encompasses an area 200 feet from shore (Figure 2). Two different methods of plant sampling were completed within these zones. Section 2.0 details the results of the surveys.

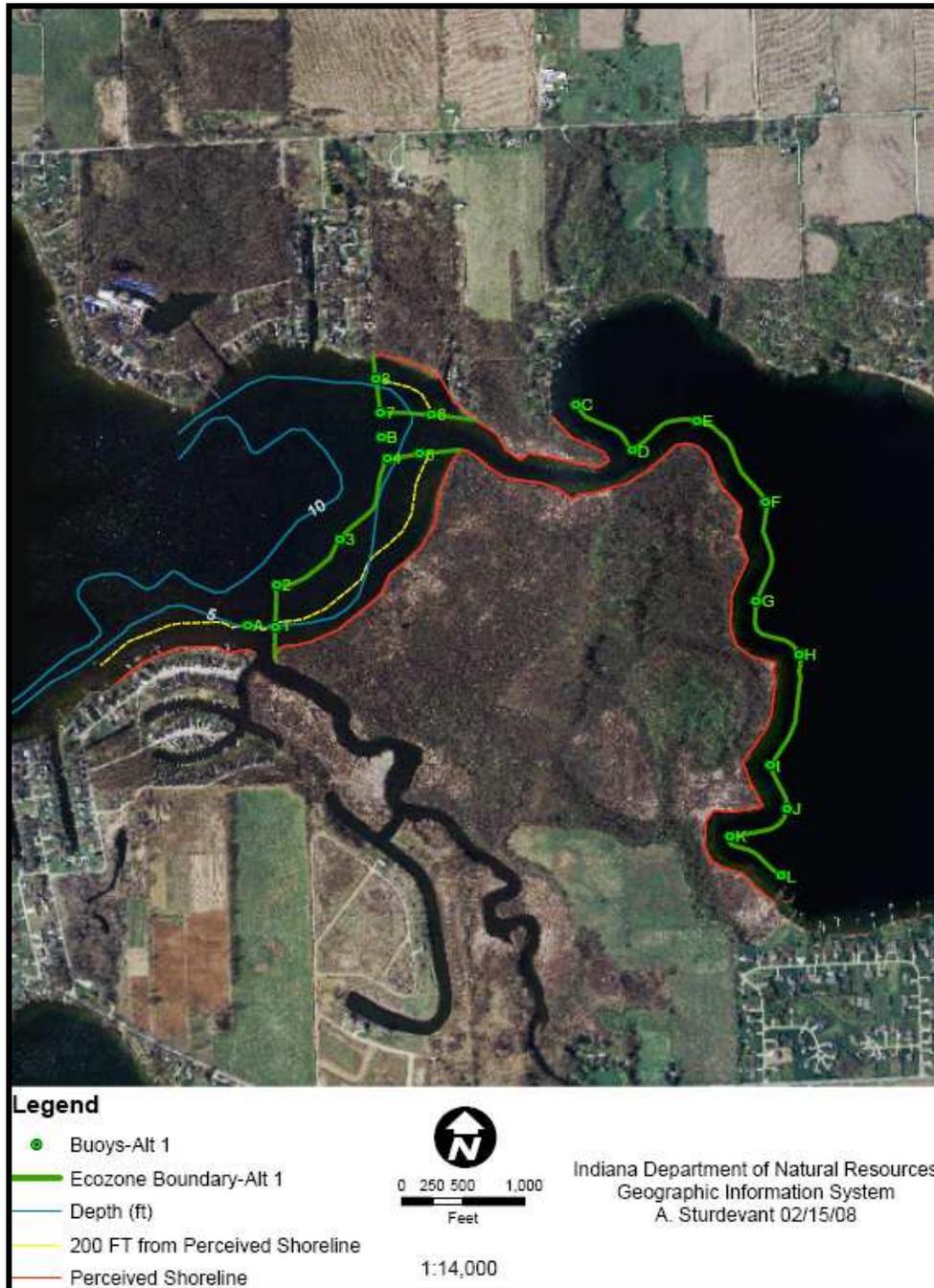


Figure 2. Tippecanoe Chain proposed Ecozone area.

## 2.0 AQUATIC VEGETATION SURVEYS

Two survey methods were utilized within the potential Ecozone area in 2008. The Tier II survey method (IDNR 2007) was used to document the submersed vegetation community while a technique created by IDNR District Fisheries Biologist, Jed Pearson was used for sampling floating-leaf emergent species (Pearson 2004).

### 2.1 Tier II Survey

A Tier II survey was completed on August 28, 2008 on both sections of the proposed Ecozone area. A total of forty sample sites were established within the proposed sites. Sample sites were spaced evenly throughout the potential Ecozone area (Figure 3). A Secchi measurement was taken near sample sites 39 and 40 on James Lake and found to be 9.0 feet (future surveys should include Secchi readings from Lake Tippecanoe as well). The deepest sample site was 9.0 feet with the majority of sites being 5.0 feet or less. Plants were present at 67.5% of sites (Figure 4). A total of 8 native species were collected and the maximum number of species per site was 4. A mean of 1.45 species were collected per site and the native species diversity index was 0.78. Eel grass (*Vallisneria americana*) was the most frequently occurring species (47.5%) within the Ecozone area and was most abundant species in water less than 5.0 feet deep (Figure 5). Common coontail (*Ceratophyllum demersum*) ranked second overall in percent occurrence (35.0%) and was the most commonly occurring species in 5-9 feet of water (Figure 6). Chara (*Chara spp.*), sago pondweed (*Potamogeton pectinatus*), and slender naiad (*Najas flexillis*) were all collected at more than 10% of sample sites (Figures 7, 8, & 9), while flatstem pondweed (*Potamogeton zosteriformis*), Richardson's pondweed (*Potamogeton richardsonii*), classified as a state imperiled species (Figure 10), and Illinois pondweed (*Potamogeton illinoensis*), were collected at less than 10% of sites. Filamentous algae was present at 48.6% of sample sites. No invasive submersed species were collected during the survey, but several stems of Eurasian watermilfoil were observed in Lake Tippecanoe (these areas have historically had abundant populations of both Eurasian watermilfoil and curlyleaf pondweed, however selective treatments were completed in this area for control of both species in the spring of 2008).

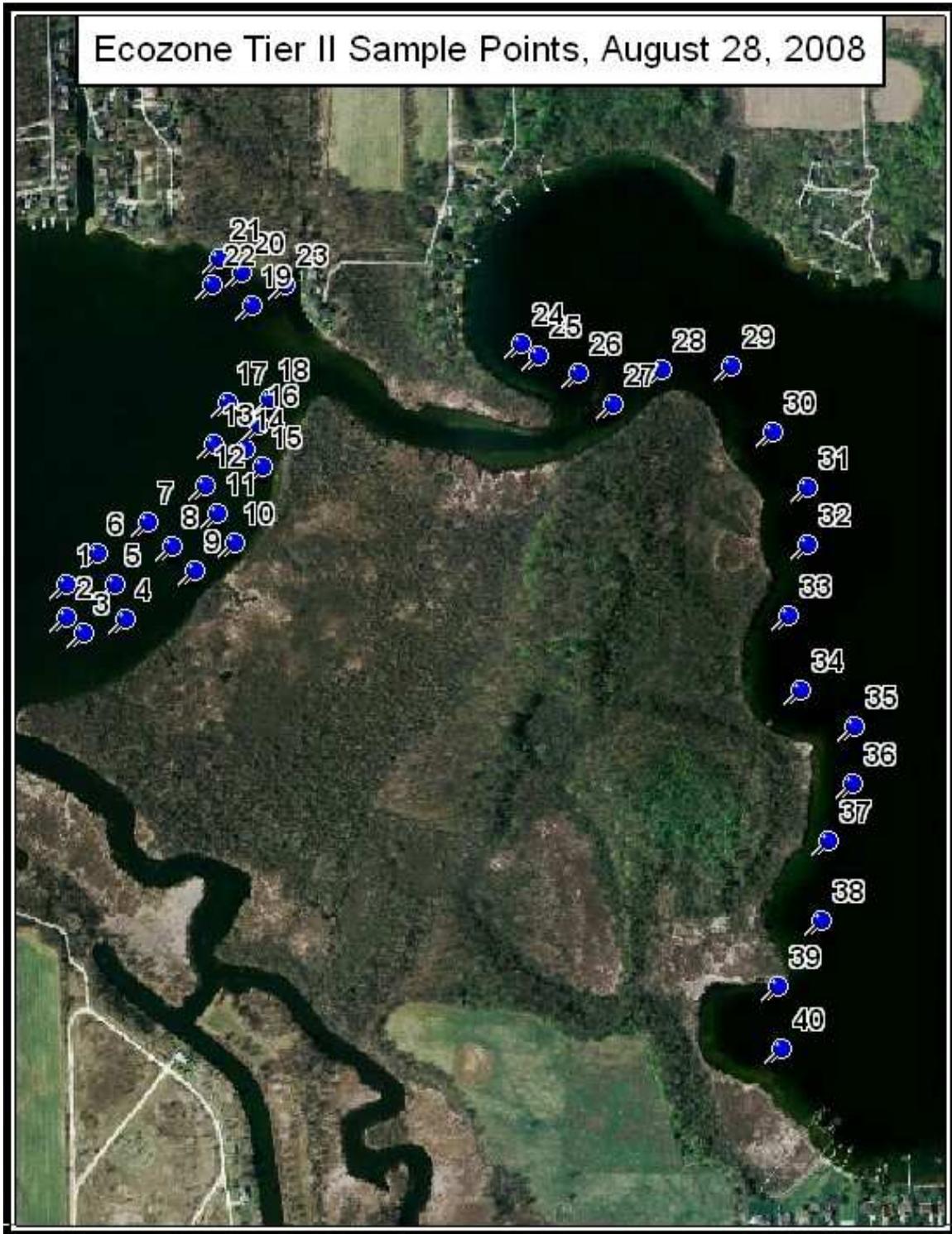


Figure 3. Tier II sample locations, Tippecanoe Chain, August 28, 2008.

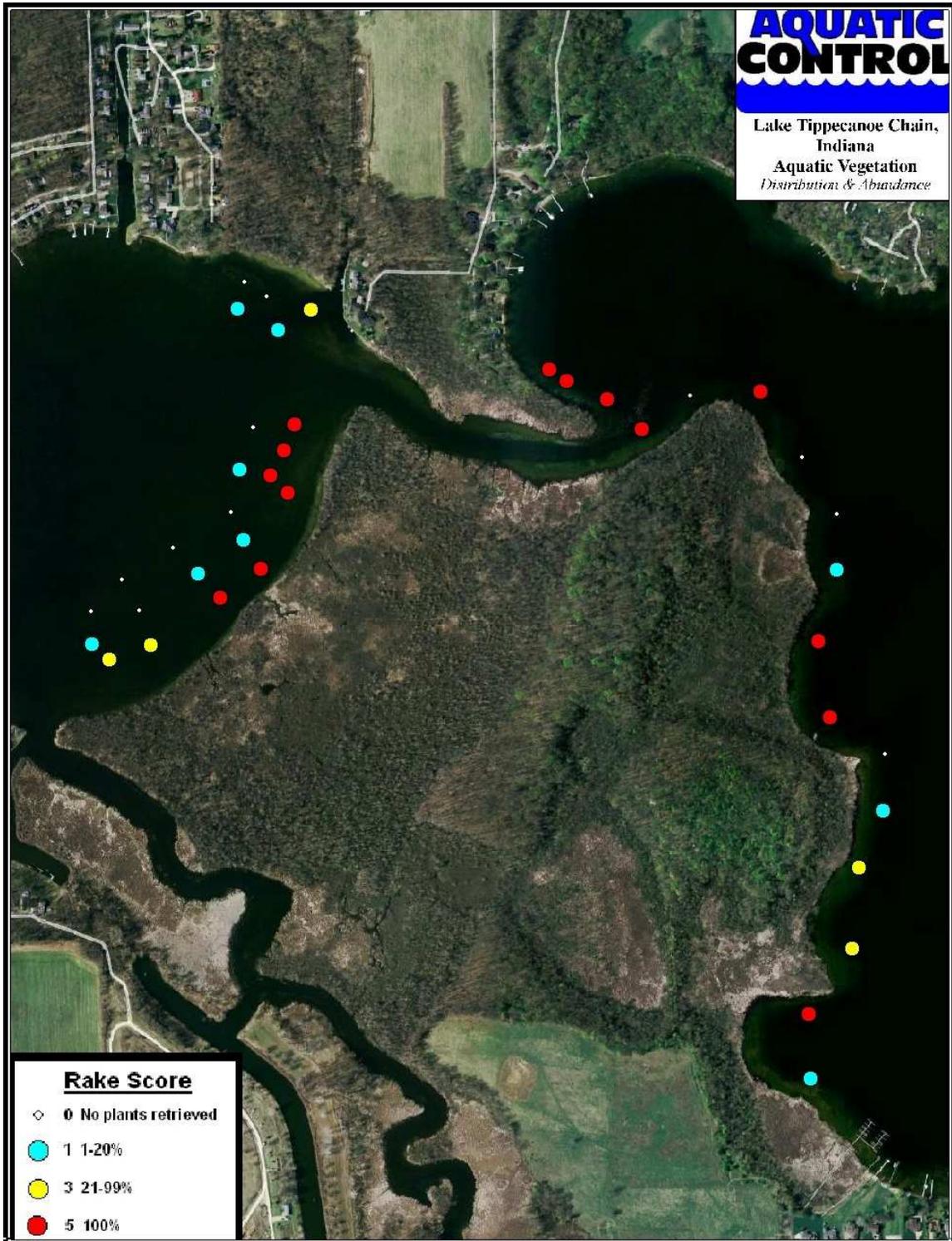


Figure 4. Submersed aquatic vegetation rake score and location, Tippecanoe Chain, August 28, 2008.

**Table 1. Tippecanoe Chain Proposed Ecozone Area, Occurrence and Abundance of Aquatic Plants August 28, 2008.**

<b>Occurrence and abundance of submersed aquatic plants in Tippecanoe Lake Ecozone</b>						
County: Kos	Sites with plants: 27	Mean species/site: 1.45				
Date: 8/28/2008	Sites with native plants: 27	Standard error (ms/s): 0.21				
Secchi (ft): 9	Number of species: 8	Mean native species/site: 1.45				
Maximum plant depth (ft): 9	Number of native species: 8	Standard error (mns/s): 0.21				
Trophic status Mesotrophic	Maximum species/site: 4	Species diversity: 0.78				
Total sites: 40		Native species diversity: 0.78				
<b>Depths 0 to 9 ft</b>		<b>Frequency of Occurrence</b>				<b>Plant Dominance</b>
<b>Species</b>	<b>Frequency of Occurrence</b>	<b>Rake score frequency per species</b>				
		<b>0</b>	<b>1</b>	<b>3</b>	<b>5</b>	
eel grass	47.5	52.5	22.5	2.5	22.5	28.5
common coontail	35.0	65.0	22.5	5.0	7.5	15.0
Chara	25.0	75.0	15.0	7.5	2.5	10.0
sago pondweed	15.0	85.0	12.5	2.5	0.0	4.0
slender naiad	12.5	87.5	12.5	0.0	0.0	2.5
flatstemmed pondweed	5.0	95.0	5.0	0.0	0.0	1.0
Richardson's pondweed	2.5	97.5	2.5	0.0	0.0	0.5
Illinois pondweed	2.5	97.5	2.5	0.0	0.0	0.5
Filamentous algae	52.5					
<b>Depths 0 to 5 ft</b>		<b>Frequency of Occurrence</b>				<b>Plant Dominance</b>
<b>Species</b>	<b>Frequency of Occurrence</b>	<b>Rake score frequency per species</b>				
		<b>0</b>	<b>1</b>	<b>3</b>	<b>5</b>	
eel grass	48.6	51.4	24.3	2.7	21.6	28.1
common coontail	32.4	67.6	21.6	5.4	5.4	13.0
Chara	27.0	73.0	16.2	8.1	2.7	10.8
sago pondweed	16.2	83.8	13.5	2.7	0.0	4.3
slender naiad	10.8	89.2	10.8	0.0	0.0	2.2
flatstemmed pondweed	5.4	94.6	5.4	0.0	0.0	1.1
Richardson's pondweed	2.7	97.3	2.7	0.0	0.0	0.5
Illinois pondweed	2.7	97.3	2.7	0.0	0.0	0.5
Filamentous algae	48.6					
<b>Depths 5 to 9 ft</b>		<b>Frequency of Occurrence</b>				<b>Plant Dominance</b>
<b>Species</b>	<b>Frequency of Occurrence</b>	<b>Rake score frequency per species</b>				
		<b>0</b>	<b>1</b>	<b>3</b>	<b>5</b>	
common coontail	66.7	33.3	33.3	0.0	33.3	40.0
slender naiad	33.3	66.7	33.3	0.0	0.0	6.7
eel grass	33.3	66.7	0.0	0.0	33.3	33.3
filamentous algae	33.3					

**Species Observed: Pickeral weed, white water lily, spatterdock, common cattail, arrow arum, arrowhead, hibiscus, and Eurasian watermilfoil.**

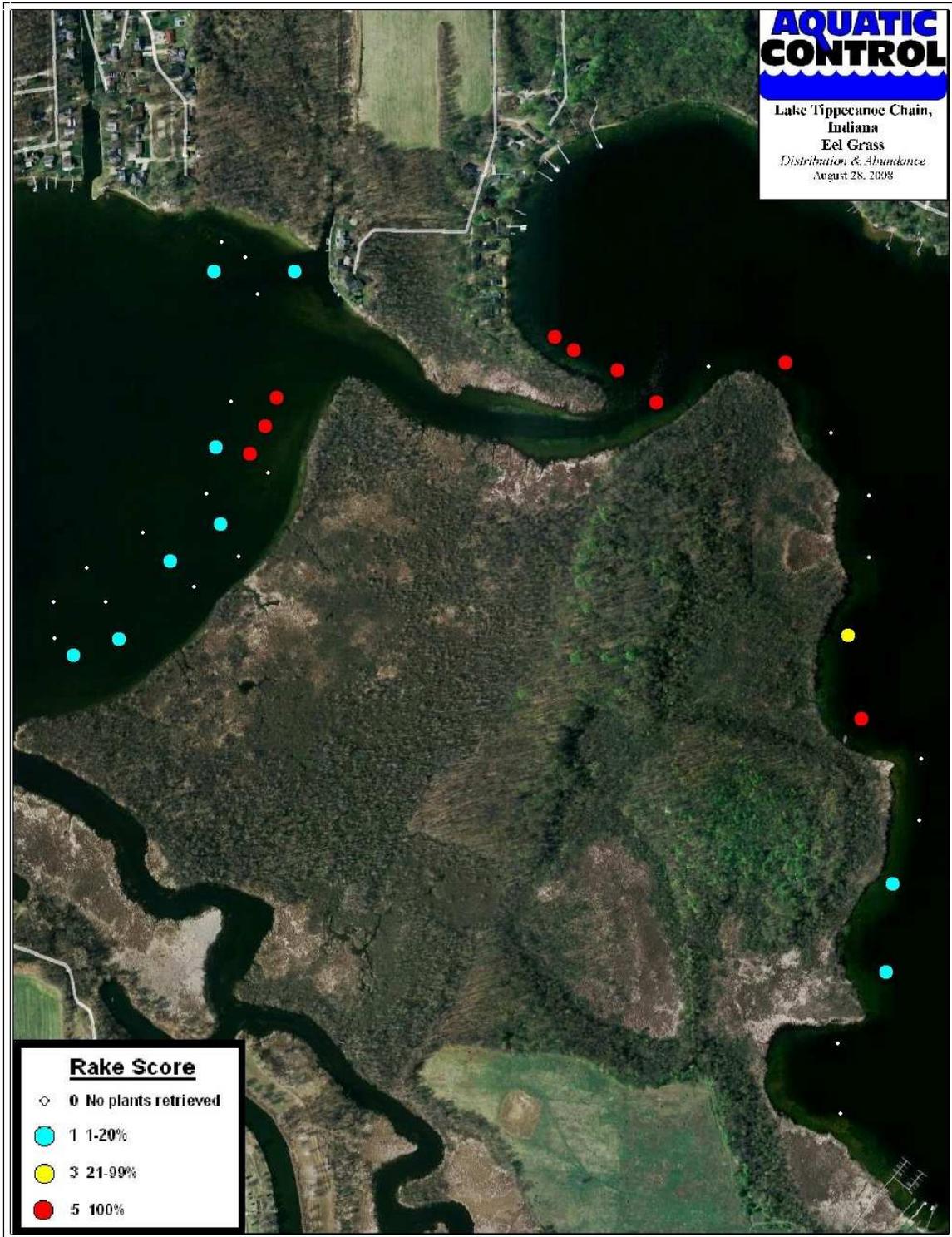


Figure 5. Tippecanoe Chain, eel grass distribution and abundance, August 28, 2008.

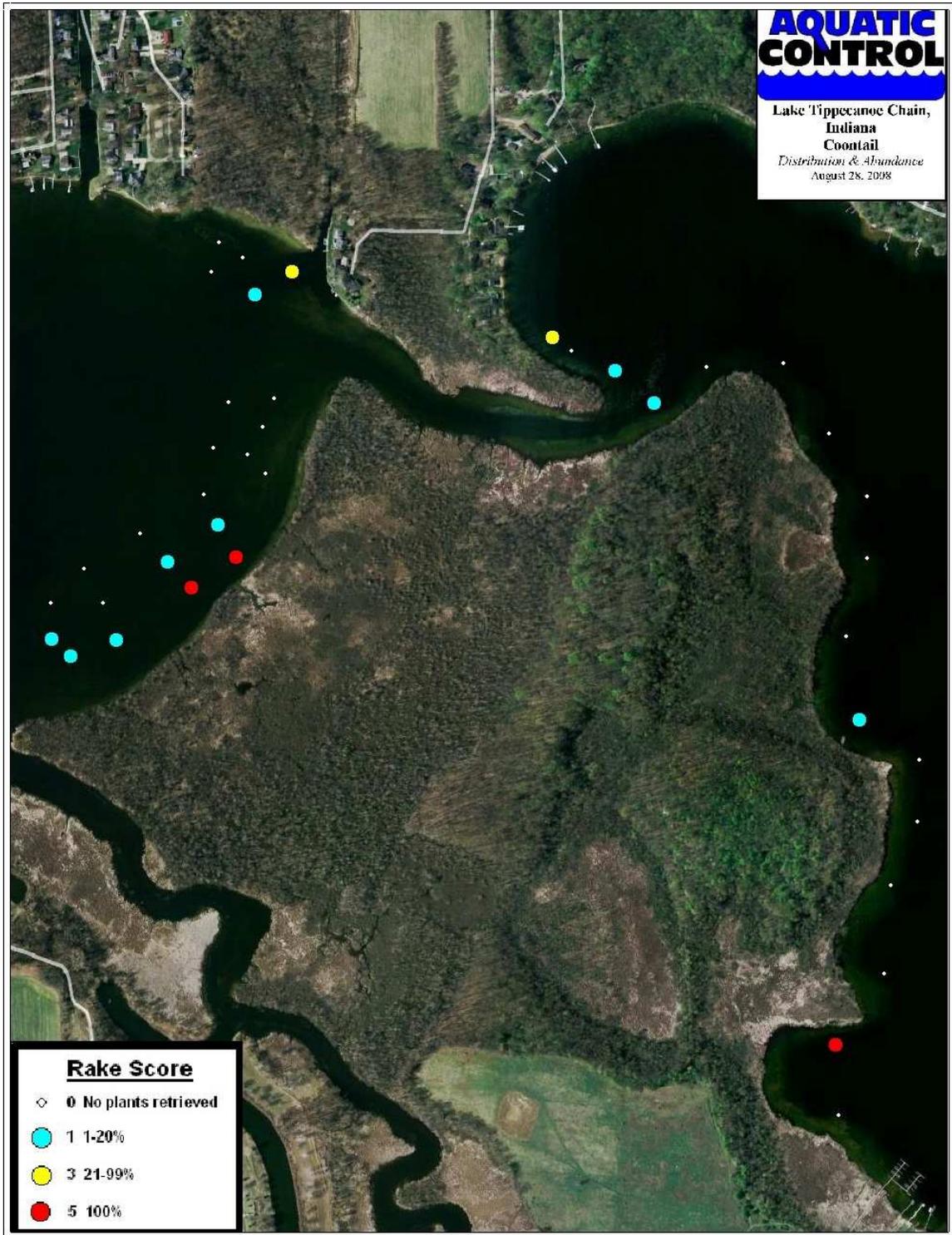


Figure 6. Tippecanoe Chain, common coontail distribution and abundance, August 28, 2008.

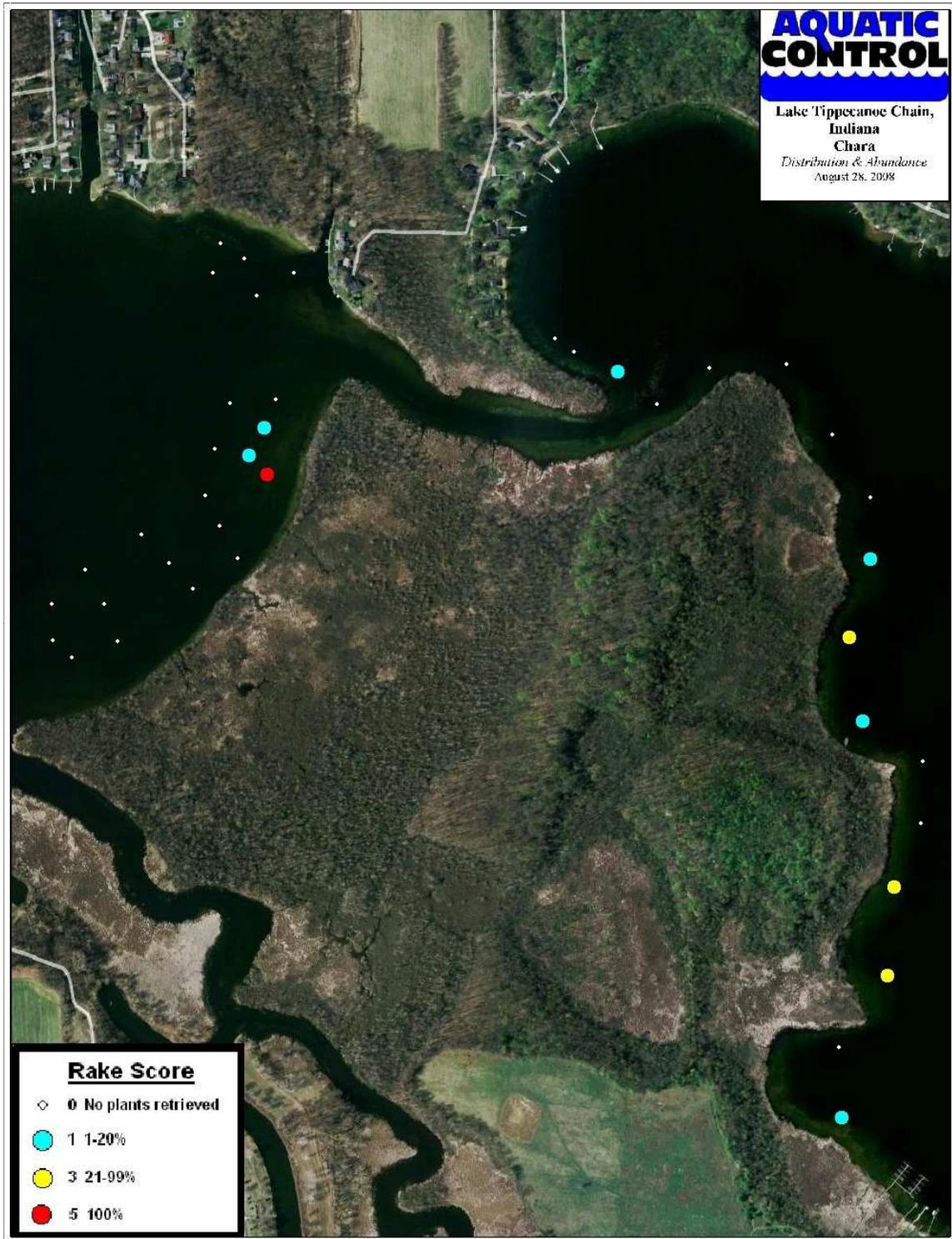


Figure 7. Tippecanoe Chain, chara distribution and abundance, August 28, 2008.



Figure 8. Tippecanoe Chain, sago pondweed distribution and abundance, August 28, 2008.

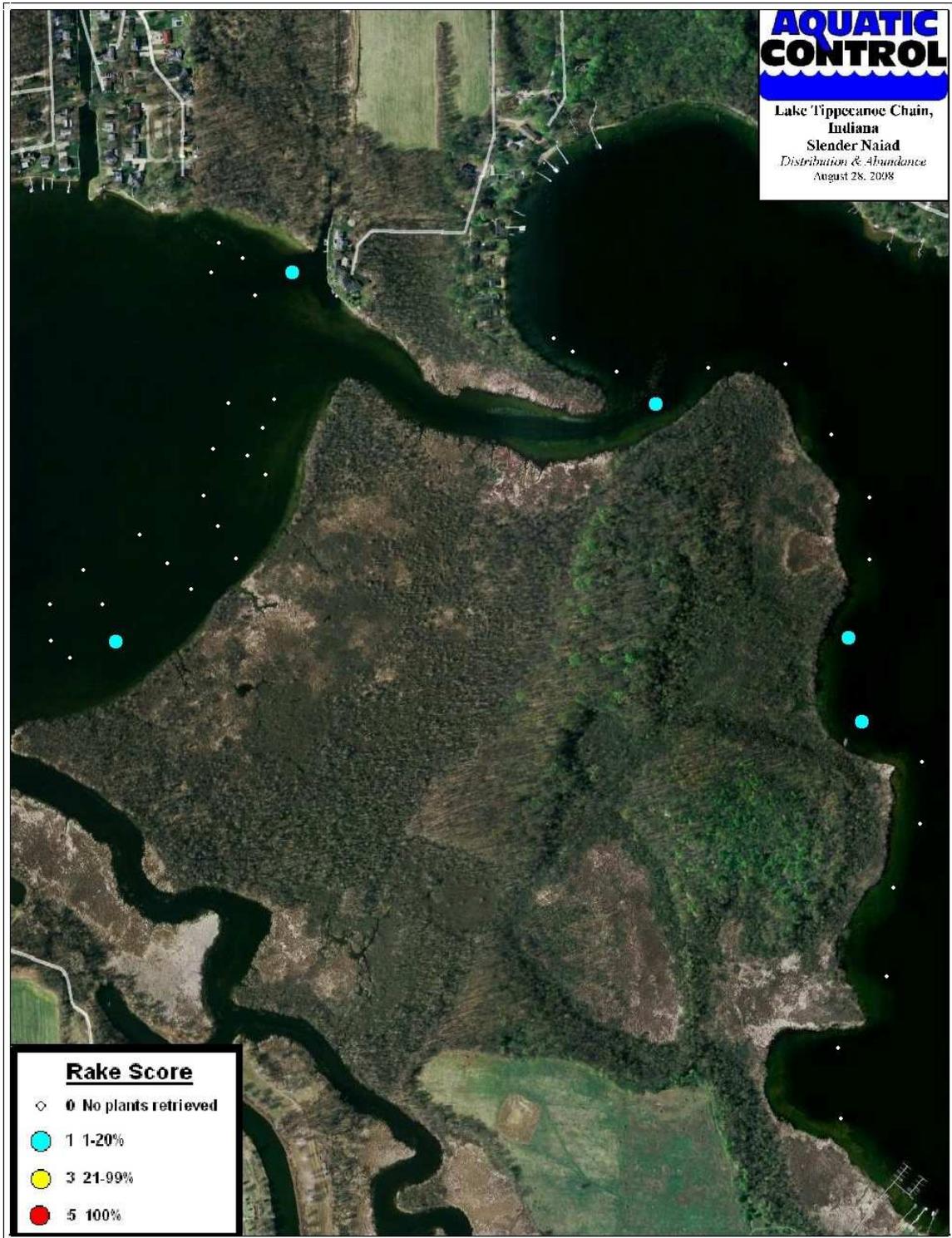


Figure 9. Tippecanoe Chain, slender naiad distribution and abundance, August 28, 2008.



Figure 10. Tippecanoe Chain, Richardson's pondweed distribution and abundance, August 28, 2008.

The two areas of the proposed Ecozone are ecologically different from each. In order to obtain more valuable baseline data it is important to break down Tier II data from each section. Data collected from Lake Tippecanoe is presented below in Table 2. Twenty-three sites were sampled from this area and vegetation was present at 15 sites. The deepest sample site was 5.0 feet. A total of 8 native species were collected and the

maximum number of species per site was 4. A mean of 1.43 species were collected per site and the native species diversity index was 0.79. Eel grass was the most abundant species collected (43.5%) followed closely by common coontail (39.1%). Sago pondweed, chara, slender naiad, flatstem pondweed, Richardson's pondweed, and Illinois pondweed made up the remainder of the sample. Filamentous algae was present on 82.6% of the rake tosses.

**Table 2. Lake Tippecanoe Proposed Ecozone Area, Occurrence and Abundance of Submersed Aquatic Vegetation, August 28, 2008.**

Occurrence and abundance of submersed aquatic plants in Tippecanoe Lake Ecozone						
County: Kos	Sites with plants: 15	Mean species/site: 1.43				
Date: 8/28/2008	Sites with native plants: 15	Standard error (ms/s): 0.29				
Secchi (ft):	Number of species: 8	Mean native species/site: 1.43				
Maximum plant depth (ft): 4	Number of native species: 8	Standard error (mns/s): 0.29				
Trophic status Mesotrophic	Maximum species/site: 4	Species diversity: 0.79				
Total sites: 23		Native species diversity: 0.79				
Depths 0 to 5 ft	Frequency of Occurrence	Rake score frequency per species				Plant Dominance
Species		0	1	3	5	
eel grass	43.5	56.5	30.4	0.0	13.0	19.1
common coontail	39.1	60.9	26.1	4.3	8.7	16.5
sago pondweed	21.7	78.3	17.4	4.3	0.0	6.1
Chara	13.0	87.0	8.7	0.0	4.3	6.1
slender naiad	8.7	91.3	8.7	0.0	0.0	1.7
flatstemmed pondweed	8.7	91.3	8.7	0.0	0.0	1.7
Richardson's pondweed	4.3	95.7	4.3	0.0	0.0	0.9
Illinois pondweed	4.3	95.7	4.3	0.0	0.0	0.9
filamentous algae	82.6					

Data collected from Lake James is presented on the following page in Table 3. Seventeen sites were sampled from this area and vegetation was present at 12 sites. The deepest sample site was 9.0 feet. A total of 5 native species were collected and the maximum number of species per site was 4. A mean of 1.47 species were collected per site and the native species diversity index was 0.74. Eel grass was also the most abundant species collected (52.9%) followed by chara (41.2%), common coontail (29.4%), slender naiad (17.6%) and sago pondweed (5.9%). Filamentous algae was present on only 11.8% of the rake tosses in the James Lake zone.

**Table 3. James Lake Proposed Ecozone Area, Occurrence and Abundance of Submersed Aquatic Vegetation, August 28, 2008.**

Occurrence and abundance of submersed aquatic plants in Lake James Ecozone						
County: Kos	Sites with plants: 12	Mean species/site: 1.47				
Date: 8/28/2008	Sites with native plants: 12	Standard error (ms/s): 0.31				
Secchi (ft): 9	Number of species: 5	Mean native species/site: 1.47				
Maximum plant depth (ft): 9	Number of native species: 5	Standard error (mns/s): 0.31				
Trophic status Mesotrophic	Maximum species/site: 4	Species diversity: 0.74				
Total sites: 17		Native species diversity: 0.74				
Depths 0 to 9 ft		Rake score frequency per species				Plant Dominance
Species	Frequency of Occurrence	0	1	3	5	
eel grass	52.9	47.1	11.8	5.9	35.3	41.2
Chara	41.2	58.8	23.5	17.6	0.0	15.3
common coontail	29.4	70.6	17.6	5.9	5.9	12.9
slender naiad	17.6	82.4	17.6	0.0	0.0	3.5
sago pondweed	5.9	94.1	5.9	0.0	0.0	1.2
filamentous algae	11.8					
Depths 0 to 5 ft		Rake score frequency per species				Plant Dominance
Species	Frequency of Occurrence	0	1	3	5	
eel grass	57.1	42.9	14.3	7.1	35.7	42.9
Chara	50.0	50.0	28.6	21.4	0.0	18.6
common coontail	21.4	78.6	14.3	7.1	0.0	7.1
slender naiad	14.3	85.7	14.3	0.0	0.0	2.9
sago pondweed	7.1	92.9	7.1	0.0	0.0	1.4
filamentous algae	7.1					
Depths 5 to 9 ft		Rake score frequency per species				Plant Dominance
Species	Frequency of Occurrence	0	1	3	5	
common coontail	66.7	33.3	33.3	0.0	33.3	40.0
slender naiad	33.3	66.7	33.3	0.0	0.0	6.7
eel grass	33.3	66.7	0.0	0.0	33.3	33.3
filamentous algae	33.3					

### 2.3 Floating Leaf Emergent Vegetation Survey

The sampling method used for the floating leaf emergent vegetation survey is described by IDNR fisheries biologist Jed Pearson in *Guidelines for Sampling Floating-Leaf Emergent Plants in Indiana Lakes*. This method was designed to delineate and characterize the species composition of floating-leaf emergent plant beds, primarily spatterdock (*Nuphar variegata*) and white water lily (*Nymphaea odorata*). Beds were delineated with a Global Positioning System (GPS) unit and range finder, while beds were characterized based on the dominance of floating-leaf species along transects within the beds. Supplemental data was also obtained on the presence of shallow-water emergent plants associated with floating-leaf beds (Pearson 2004).

Ten beds totaling 13.25 acres of floating-leaf plants were delineated within the proposed Ecozone area (Figure 11). Bed coverage represented 25.3% of the surface area of the proposed Ecozone. Of the 40 transects examined 70% contained spatterdock and 42.5% contained white water lily. Seven other shallow-water emergent and floating leaf species were associated with the plant beds. Table 4 describes each plant bed in more detail. Photographs of several plant beds are included following Table 4 (Figures 12-16).



Figure 11. Tippecanoe Ecozone, floating leaf plant bed location and dominant species, August 28, 2008 (CAT=cattail, WAL=white water lily, PIK=pickerel weed, SPA=spatterdock, ARA=arrow arum, HIB=hibiscus).

**Table 4. Tippecanoe Chain Ecozone Plant Bed Summary, August 28, 2008.**

Bed	# of Sites	Mean Latitude	Mean Longitude	Mean Width (ft)	Species Frequency of Occurrence										# of Species	#/Site	Acres	Shoreline Length (ft)
					SPA	WAL	ARA	SWL	CAT	PIK	PRL	BUL	HIB					
1	7	41.31374	-85.731	65.6	42.9	100.0		14.3	100.0	42.9			71.4	5	3.71	1.100	649	
2	2	41.31536	-85.73034	49.5	50.0	50.0	50.0		100.0	100.0				5	3.50	0.497	488	
3	7	41.3187	-85.73044	50.1	85.7		71.4		42.9	28.6		14.3	42.9	6	3.14	1.231	1063	
4	2	41.32038	-85.73058	36.0	50.0		50.0		100.0					3	3.00	0.169	197	
5	4	41.3216	-85.73099	33.5	50.0	25.0	50.0		50.0	25.0		25.0	50.0	6	2.75	0.458	585	
6	3	41.32222	-85.73347	74.0	100.0	66.7		33.3						3	2.00	0.888	795	
7	6	41.32276	-85.73519	53.5	66.7	16.7	100.0			16.7				4	2.00	0.966	674	
8	2	41.32307	-85.73936	132.0	100.0	100.0			100.0				100.0	4	4.00	2.109	1041	
9	3	41.32257	-85.73912	37.0	100.0						66.7		100.0	3	2.67	0.661	379	
10	4	41.31885	-85.744	142.8	75.0	75.0								2	1.50	5.168	2146	

SPA=Spatterdock, WAL=Water Lily, ARA=Arrow Arum, SWL=Swamp Loosestrife, CAT=Cattail  
 PIK=Pickeral Weed, PRL=Purple Loosestrife, BUL=Bulrush, HIB=Hibiscus

(8/28/08 gauge reading at Tippecanoe River Outflow: 6.50, legal level 6.40).



**Figure 12. James Lake, photograph of bed 1, August 28, 2008.**



**Figure 13. James Lake, photograph of bed 2, August 28, 2008.**



**Figure 14. James Lake, photograph of bed 3, August 28, 2008**



**Figure 15. Lake Tippecanoe, photograph of bed 8, August 28, 2008.**



**Figure 16. Lake Tippecanoe, photograph of bed 9, August 28, 2008.**

## 2.4 Plant Survey Discussion

Two survey methods were used in order to establish baseline data on the submersed vegetation community and the floating leaf and emergent plant community. The Tier II survey was used to sample the submersed community. Overall, data from the Tier II surveys indicate that the proposed Ecozone area contains a fairly diverse native submersed plant community with little observed negative impact from submersed invasive species. The lack of invasive species like Eurasian watermilfoil (*Myriophyllum spicatum*) may be due to actions taken by LTPOA to control this species. In 2008, a selective herbicide treatment was completed with Renovate herbicide (active ingredient: triclopyr) to control milfoil. On June 3, 2008, a total of 18.5 acres of milfoil was treated within the potential Ecozone area (Figure 17). This treatment was funded by the Lake and River Enhancement Program and LTPOA. In addition, non-native curlyleaf pondweed (*Potamogeton crispus*) has been targeted with early spring Aquathol (active ingredient: endothal) applications (Figure 18). Curlyleaf pondweed tends to senesce by late summer, so the fact that this species was not present in the survey cannot be directly attributed to the herbicide application. However, early season control of this species may open up areas allowing for increased abundance of beneficial native vegetation.



Figure 17. Lake Tippecanoe chain Eurasian watermilfoil treatment areas, June 3, 2008.

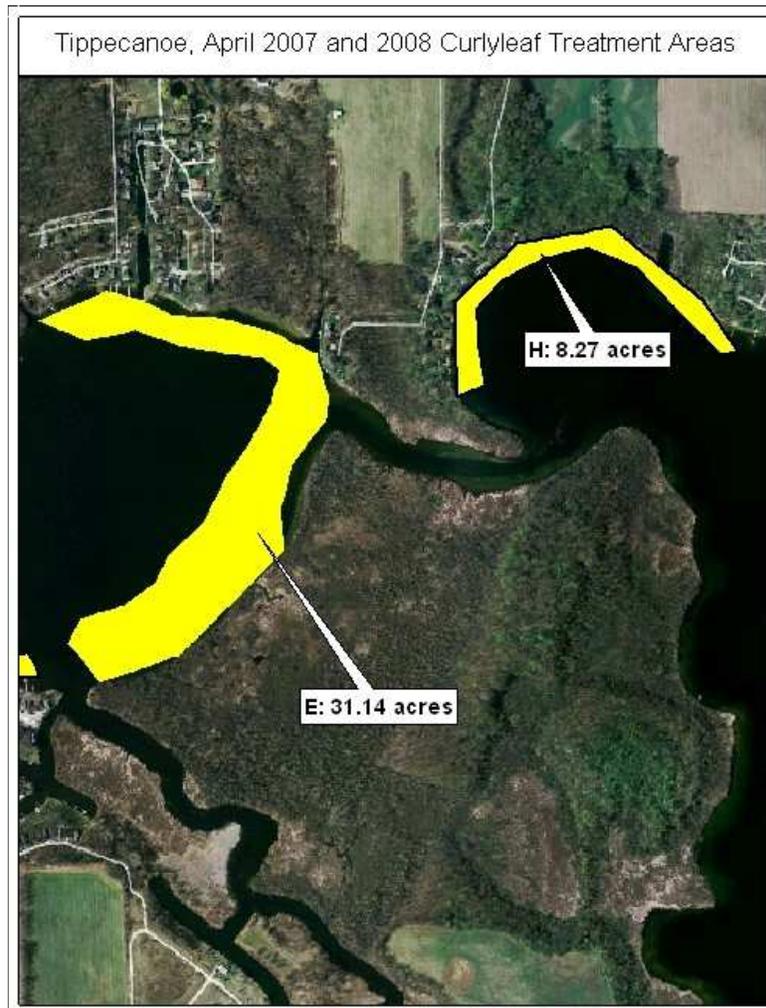


Figure 18. Lake Tippecanoe Chain curlyleaf pondweed treatment areas, April 2007 & 2008.

The best way to analyze the Tier II data is to separate the data from the two lakes. The two Ecozone areas differ a great deal. The Lake Tippecanoe area is a much wider and shallower area that receives a great deal of wave action from prevailing winds and boat traffic. In addition, the sediment in this area is primarily composed of organic muck and filamentous bluegreen algae mats. In contrast, the area in James Lake has deeper water nearby, is somewhat sheltered from prevailing winds, and has a sediment primarily composed of sand and silt. The abundance of filamentous bluegreen algae (identified as *Lyngbya wolleii* by Greenwater Labs, Palatka FL) in the Lake Tippecanoe zone is a primary concern of residents of the lake and one of the primary reasons for the proposed Ecozone (Williams Creek 2007). It is theorized that if native vegetation is allowed to return to this area that this will limit the amount of filamentous bluegreen algae growth. The Tier II survey confirmed that filamentous algae is abundant in this area of Lake Tippecanoe as it was detected on 82.6% of rake tosses. Despite the abundance of filamentous algae, there was still a fairly diverse population of native vegetation as exhibited by the native diversity index of 0.79 which varies little from the diversity indices calculated for the whole lake in 2004-2007 (Aquatic Control 2005-2008) (Table 5). However, there was a lower percent occurrence of vegetation compared to past surveys. For example, in previous surveys 83-91% of sample sites contained vegetation

while vegetation was only present in 65% of sites within the proposed Ecozone area. This leads one to believe that there are some issues leading to the lack of vegetation in this area. In addition, this region is very shallow and has an organic bottom that should be conducive to plant growth unlike most other littoral areas of Lake Tippecanoe which are deeper and contain sand or gravel bottoms. Determining the reason for the lack of vegetation in this region is beyond the scope of this report, however; increased wave action and mechanical damage by boat propellers is a common threat to native aquatic vegetation and may be a contributing factor in this shallow section of Lake Tippecanoe.

**Table 5. Comparison of Summer Tier II Surveys on Lake Tippecanoe 2004-2007 and the Lake Tippecanoe Proposed Ecozone Area in 2008.** (data collected by Aquatic Control Inc.).

Survey Date	Number of Sample Sites	Secchi	% Sites With Vegetation	Number of Native Species	Native Species/Site	Native Diversity Index
2004	119	6.0	88%	10	1.54	0.82
2005	119	6.0	83%	13	1.70	0.74
2006	90	7.0	87%	14	1.72	0.82
2007	89	6.0	91%	12	1.79	0.80
2008*	23	-	65%	8	1.43	0.79

\*2008 survey only included area of Lake Tippecanoe being considered for Ecozone while the previous four surveys included sample sites around the entire lake.

As previously mentioned the James Lake proposed Ecozone location has deeper water nearby, is somewhat sheltered from prevailing winds, and has sediment largely composed of sand and silt. Filamentous algae was only present at 11.8% of sample sites. James Lake also had a fairly diverse population of native vegetation as exhibited by the native diversity index of 0.74 which varies little from 2004-2007 (Aquatic Control 2005-2008) (Table 6). Aquatic vegetation was present at a higher percentage of sample sites in the James Lake area compared to the Lake Tippecanoe area, but was slightly lower than past Tier II surveys of the entire James Lake littoral zone.

**Table 6. Comparison of Summer Tier II Surveys on James Lake 2004-2008.** (data collected by Aquatic Control Inc.).

Survey Date	Number of Sample Sites	Secchi	% Sites With Vegetation	Number of Native Species	Native Species/Site	Native Diversity Index
2004	64	6.0	96%	11	1.91	0.82
2005	64	9.0	89%	13	1.59	0.79
2006	60	4.5	83%	13	1.43	0.77
2007	89	7.0	78%	8	1.37	0.74
2008*	23	9.0	71%	5	1.47	0.74

\*2008 survey only included area of James Lake being considered for Ecozone while the previous four surveys included sample sites around the entire lake.

Rooted floating beds, primarily made up of water lily and spatterdock, were fairly abundant along the shoreline of James Lake. These beds were rather narrow, but were scattered along more than two-thirds of the shoreline. Rooted floating vegetation in the

Lake Tippecanoe side of the proposed Ecozone was primarily composed of two fairly large beds (bed 8 & 10). There was a vast shallow water area between the beds that was void of rooted floating vegetation and primarily dominated by blue-green algae mats with scattered submersed vegetation (Figure 19). The presence of an Ecozone in this area may help increase the abundance of rooted floating vegetation.



**Figure 19. Lake Tippecanoe, large shallow area between beds 9 and 10 that is lacking rooted floating vegetation, August 28, 2008.**

This survey should provide good baseline data for assessing aquatic vegetation community variation within this area. If the Ecozone is adopted, future surveys should be completed using similar survey techniques in order to detect any changes within the affected area over time. A GPS line documenting the edge of the “perceived shoreline” should be included in future surveys. Future surveys and reports will likely cost between three and five-thousand dollars.

### **3.0 REFERENCES CITED**

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- Pearson, J. 2004. Guidelines for sampling floating-leaf emergent plant in Indiana lakes. IN Department of Natural Resources. Division of Fish & Wildlife. Indianapolis, IN.
- Williams Creek Consulting. 2006. Ecozone Feasibility Lake Tippecanoe Kosciusko County, Indiana. Report to Lake Tippecanoe Property Owners Association. Syracuse, Indiana.

## 4.0 APPENDIX

### Tier II Data

Lake	Date	Latitude	Longitude	Site	Depth	RAKE	CEDE4 common coontail ( <i>Ceratophyllum demersum</i> )	CH?AR Chara (Chara spp.)	NAFL Slender naiad ( <i>Najas flexilis</i> )	POPE6 sago pondweed ( <i>Potamogeton pectinatus</i> )	VAAM3 eel grass ( <i>Vallisneria americana</i> )	POZO flattened pondweed ( <i>Potamogeton zosteriformis</i> )	PORI2 Richardson's pondweed ( <i>Potamogeton richardsonii</i> )	POIL Illinois pondweed ( <i>Potamogeton illinoensis</i> )
Tippecanoe	8/28/08	41.319616	-85.743941	1	4.0	0								
Tippecanoe	8/28/08	41.319148	-85.743923	2	2.0	1	1							
Tippecanoe	8/28/08	41.318932	-85.7436	3	1.0	3	1			1	1			
Tippecanoe	8/28/08	41.319137	-85.742826	4	1.0	3	1		1		1			
Tippecanoe	8/28/08	41.319623	-85.743046	5	4.0	0								
Tippecanoe	8/28/08	41.320055	-85.743366	6	5.0	0								
Tippecanoe	8/28/08	41.320503	-85.742414	7	5.0	0								
Tippecanoe	8/28/08	41.320144	-85.741952	8	3.0	1	1				1			
Tippecanoe	8/28/08	41.319809	-85.741545	9	2.0	5	5							
Tippecanoe	8/28/08	41.320202	-85.740792	10	3.0	5	5			1		1		
Tippecanoe	8/28/08	41.320607	-85.741107	11	3.0	1	1				1			1
Tippecanoe	8/28/08	41.321004	-85.741344	12	4.0	0								
Tippecanoe	8/28/08	41.321588	-85.741178	13	4.0	1					1			
Tippecanoe	8/28/08	41.321511	-85.7406	14	2.0	5		1		1	5	1		
Tippecanoe	8/28/08	41.321257	-85.74029	15	1.0	5		5		3				
Tippecanoe	8/28/08	41.321863	-85.740352	16	3.0	5		1		1	5			
Tippecanoe	8/28/08	41.322178	-85.740924	17	4.0	0								
Tippecanoe	8/28/08	41.322222	-85.740154	18	2.0	5					5			
Tippecanoe	8/28/08	41.323539	-85.74047	19	4.0	1	1							
Tippecanoe	8/28/08	41.32401	-85.740678	20	3.0	0								
Tippecanoe	8/28/08	41.324206	-85.741089	21	2.0	0								
Tippecanoe	8/28/08	41.323828	-85.741214	22	4.0	1					1			
Tippecanoe	8/28/08	41.323826	-85.739849	23	4.0	3	3		1		1		1	
Tippecanoe	8/28/08	41.322157	-85.733716	24	6.0	5	1		1		5			
Tippecanoe	8/28/08	41.322576	-85.734369	25	5.0	5	1	1			5			
Tippecanoe	8/28/08	41.322831	-85.735119	26	4.0	5					5			
Tippecanoe	8/28/08	41.322991	-85.735437	27	5.0	5	3				5			
Tippecanoe	8/28/08	41.322624	-85.73282	28	4.0	0								
Tippecanoe	8/28/08	41.322673	-85.731518	29	5.0	5					5			
Tippecanoe	8/28/08	41.32177	-85.730751	30	6.0	0								
Tippecanoe	8/28/08	41.320977	-85.730112	31	5.0	0								
Tippecanoe	8/28/08	41.320189	-85.730102	32	3.0	1		1						
Tippecanoe	8/28/08	41.319182	-85.730454	33	4.0	5		3	1		3			
Tippecanoe	8/28/08	41.318128	-85.730238	34	4.0	5	1	1	1		5			
Tippecanoe	8/28/08	41.31761	-85.72922	35	3.0	0								
Tippecanoe	8/28/08	41.316827	-85.729252	36	3.0	0								
Tippecanoe	8/28/08	41.316023	-85.729697	37	2.0	3		3			1			
Tippecanoe	8/28/08	41.314896	-85.729822	38	4.0	3		3			1			
Tippecanoe	8/28/08	41.313982	-85.730635	39	9.0	5	5							
Tippecanoe	8/28/08	41.31309	-85.730591	40	2.0	1		1		1				

**Floating-leaf emergent plant data**

Date	Site	Point	Latitude	Longitude	Wid_ft	SPA	WAL	ARA	SWL	CAT	PIK	CMR	PRL	BUL	ARH	SMW	BUB	PHR	YPL	WAW	HIB	Spe	Bed	Area	Segment len	
8/28/08	1	s	41.313	-85.73087	45	9	1			9	1											9	5	1		0
8/28/08	2		41.31324	-85.7313	69	9	1			9	9											9	5	1	0.195701	149.556397
8/28/08	3		41.31358	-85.73148	84	9	1		9	9	9											9	6	1	0.235559	134.130192
8/28/08	4		41.31383	-85.73138	111		1			9												9	3	1	0.210016	93.828709
8/28/08	5		41.31406	-85.73112	75		1			9												9	3	1	0.237346	111.169736
8/28/08	6		41.31422	-85.73058	45		1			9												2	1		0.221435	160.762014
8/28/08	7	e	41.31425	-85.73029	30		1			9												2	1			
8/28/08	8	s	41.31516	-85.73039	54	1		9		9	9											4	2		0.321632	333.57839
8/28/08	9	e	41.31557	-85.73029	45		1			9	9											3	2		0.175285	154.251174
8/28/08	10	s	41.31775	-85.72966	54	1				9				9								9	4	3		
8/28/08	11		41.31788	-85.73023	51	1		9		9												9	4	3	0.197119	163.552624
8/28/08	12		41.318	-85.73067	54	1		9		9	9						9					9	6	3	0.152341	126.399097
8/28/08	13		41.31853	-85.73079	72	1		9														2	3		0.286269	197.93452
8/28/08	14		41.31907	-85.73082	39	1		1			9											3	3		0.251701	197.551434
8/28/08	15		41.31963	-85.73054	39			9														1	3		0.19874	221.977529
8/28/08	16	e	41.32004	-85.73037	42	9								1								2	3		0.144536	155.456769
8/28/08	17	s	41.32024	-85.73056	36			1		9												9	3	4	0.08193	91.5099554
8/28/08	18	e	41.32052	-85.7306	36	1				9												9	3	4	0.08677	104.99199
8/28/08	19	s	41.32117	-85.73062	27									1								1	5		0.17122	236.772296
8/28/08	20		41.32152	-85.73096	30	1	1	9		9												9	5	5	0.104153	159.190018
8/28/08	21		41.32175	-85.73107	62	1				9	9											9	4	5	0.093702	88.7317539
8/28/08	22	e	41.32195	-85.73131	15			1														1	5		0.088944	100.63422
8/28/08	23	s	41.32243	-85.73298	54	1																1	6		0.389031	491.193886
8/28/08	24		41.32216	-85.73348	69	1	9		9													3	6		0.238791	169.133856
8/28/08	25	e	41.32206	-85.73395	99	1	9															2	6		0.259834	134.742495
8/28/08	26	s	41.32233	-85.73437	45	1		9														2	7		0.251492	152.152786
8/28/08	27		41.32261	-85.7346	81	1		9														2	7		0.171112	118.312038
8/28/08	28		41.32278	-85.73519	69	1		9														2	7		0.299992	174.235529
8/28/08	29		41.32286	-85.73548	48	1		9														2	7		0.116558	86.790517
8/28/08	30		41.32288	-85.73567	30			9			1											2	7		0.046138	51.5324022
8/28/08	31	e	41.32309	-85.73585	48		1	9														2	7		0.081118	90.6030902
8/28/08	32	s	41.32302	-85.7391	114	1	9			9												9	4	8	1.659505	892.444852
8/28/08	33	e	41.32312	-85.73962	150	1	9			9												9	4	8	0.449631	148.378107
8/28/08	34	s	41.32258	-85.73894	30	1							9									9	3	9	0.566615	274.241647
8/28/08	35		41.32257	-85.7391	45	1							9									9	3	9	0.038818	45.0914653
8/28/08	36	e	41.32257	-85.73932	36	9																9	2	9	0.055153	59.3204752
8/28/08	37	s	41.31882	-85.74366	155		1															1	10		3.995568	1822.48118
8/28/08	38		41.31907	-85.74374	191	9	1															2	10		0.363103	91.4263022
8/28/08	39		41.31877	-85.74415	150	9	1															2	10		0.612257	156.421824
8/28/08	40	e	41.31876	-85.74443	75	1																1	10		0.196705	76.1643209