Lake Manitou Vegetation Management Plan Update
Fulton County, Indiana

2006

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Executive Summary

Two aquatic vegetation surveys were conducted on Lake Manitou in 2006. The first survey was conducted on June 1, 2006 and the second was conducted on August 4, 2006. The purpose of these surveys was to document any changes in the plant community from the 2005 surveys, and to monitor the lake's Eurasian watermilfoil population, along with the native plant community.

Approximately 95 acres of Lake Manitou were chemically treated with 2, 4-D on July 28 and 29, 2006. This treatment was designed to control the Eurasian watermilfoil population in Lake Manitou. A large portion of the south end of the lake was treated, as well as shoreline sections in the northwest corner of the lake.

The August 2006 survey found that Eurasian watermilfoil was effectively being controlled in the treatment areas, although there are still many areas of the lake where Eurasian watermilfoil is still present. The large littoral zone of Lake Manitou provides many areas of suitable habitat for invasive species in off shore areas where disturbance caused by boating may help to cut and distribute the weed throughout the lake.

Hydrilla (*Hydrilla verticillata*) was found in Lake Manitou very late in the summer of 2006. An IDNR vegetation survey conducted after Aquatic Weed Control's survey found small sprigs of hydrilla at 3 of 90 sample sites. Surveys even later in the growing season indicated that hydrilla appeared to be spreading rapidly to new parts of the lake. The heaviest infestation was found in the area surrounding Poet's Point, as well as the area adjacent to the city public access.

All LARE activities and funding will be dependent upon hydrilla management activities. Eurasian watermilfoil treatments will not be necessary should the entire lake be treated with fluridone in 2007 for the control of Hydrilla. Management decisions regarding hydrilla control will be made at the state and federal levels. This report will provide a brief summary of a proposed hydrilla management strategy, but all management decisions on Lake Manitou will be made by the IDNR.

Acknowledgements

Aquatic vegetation surveys conducted on Lake Manitou were made possible by funding from the Lake Manitou Association and the Indiana Department of Natural Resources through the Lake and River Enhancement Program. Aquatic Weed Control would like to extend special thanks to Indiana Department of Natural Resources (IDNR) District 3 biologist Jed Pearson for providing procedural training for both Tier I and Tier II aquatic vegetation surveys. Aquatic Weed Control would also like to thank District 1 Fisheries Biologists Bob Robertson and Jeremy Price for there help in developing this plan. They provided consultation, survey data, regarding the presence of hydrilla in Lake Manitou. Gwen White and Angela Sturdevant, aquatic biologists for the IDNR Division of Fish and Wildlife provided valuable consultation regarding the requirements and objectives of this lake management plan. Brad Fink, and Jason Doll provided assistance and training for data analysis computer programs. Aquatic Weed Control would also like to thank the members of the Lake Manitou Association for their commitment to improving the plant community and recreational availability of Lake Manitou.

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1.0 Introduction

Lake Manitou has been involved in the Lake and River Enhancement Program (LARE) since 2004, when the first LARE funded aquatic vegetation survey took place on August 30, 2004. Based on the results of this survey Eurasian watermilfoil was very prevalent throughout Lake Manitou, and the heaviest areas of infestation were targeted for herbicide treatments. The following chart summarizes all LARE funded activities on Lake Manitou.

Late in the summer of 2005, Hydrilla, a federally listed noxious aquatic plant was found in Lake Manitou. Lake Manitou was the first lake in the upper Midwest to become infested with this weed. Before its discovery in Lake Manitou, the closest bodies of water infested with hydrilla were in Tennessee and Pennsylvania.

The discovery of Hydrilla in Manitou will drastically change the current management strategy for Eurasian watermilfoil. Treatment of Eurasian watermilfoil will not be necessary at least for the next 3-5 years, as the proposed hydrilla treatment plan will greatly reduce the Eurasian watermilfoil population as well. More information about hydrilla and the tentative treatment plan is included in sections 11.0 and 12.0 of this report.

Table 1 summarizes all LARE funded activities on the lake since 2004.

Table 1: Lake Manitou LARE History

Year	Action	Date	Funding Source
2004	Fall Aquatic Vegetation Survey. Lake Management Plan Development	Fall Survey August 30, 2004	Lake and River Enhancement Lake Manitou Association
2005	Spring and Fall Aquatic Vegetation Surveys as well 2, 4-D application and Management Plan Update	Spring Survey May 12, 2005 2, 4-D Application ~ 45acres July 13, 2005 Fall Survey August 1, 2005	Lake and River Enhancement Lake Manitou Association
2006	Spring and Fall Aquatic Vegetation Surveys as well 2, 4-D application and Management Plan Update	Spring Survey June 1, 2006 2, 4-D Application ~ 95 acres - June 28, 29, 2006 Fall Survey August 4, 2006	Lake and River Enhancement Lake Manitou Association

The following chart is part of the IDNR aquatic vegetation sampling protocol and includes common and scientific names for most aquatic plants found in Indiana. This chart may be a useful reference for common and scientific plant names mentioned in this report or other publications in years to come.

Appendix C. Species Codes

Species Code	Scientific Name	Common Name	Vegetation Type
ALGA	Any species of filamentous alga (incl. Spyrogyra, Cladophora, Hydrodictyon)	algae	NV
AZ?OL	*Azolla* sp.	A mosquito fern sp.	NV
AZCA	*Azolla caroliana*	Carolina mosquito fern	NV
AZME	*Azolla mexicana*	Mexican mosquito fern	NV
CEDE4	*Ceratophyllum demersum*	coontail	SB
CH?AR	*Chara* sp.	A chara sp.	SB
ELCA7	*Elodea canadensis*	Canadian waterweed	SB
ELNU2	*Elodea nuttalli*	western waterweed	SB
LEMN	Species within the Lemnaceae	duckweeds	NV
LEMI3	*Lemna minor*	small or common duckweed	NV
LETR	*Lemna trisulca*	star duckweed	NV
LUDE4	*Ludwigia decurrens*	primrose-willow	FL
LVWORT	*Riccia* sp., *Ricciocarpus* sp.	A liverwort species	NV
MYSI	*Myriophyllum sibiricum*	northern watermilfoil	SB
MYSP2	*Myriophyllum spicatum*	Eurasian watermilfoil (exotic)	SB
MY?RI	*Myriophyllum*, unidentified species	a watermilfoil sp.	SB
NAFL	*Najas flexilis*	slender naiad (exotic)	SB
NAGR	*Najas gracillima*	slender waternymph	SB
NAGU	*Najas guadalupensis*	southern waternymph	SB
NAMI	*Najas minor*	brittle waternymph	SB
NLPW	*Potamogeton foliosus*, *P. pusillus*, or other unidentified narrow-leaved pondweeds	narrow-leaved pondweeds	SB
NELU	*Nelumbo lutea*	American lotus	FL
NI?TE	*Nitella* sp.	A nitella sp.	SB
NOAQVG		no aquatic vegetation at site	NV
NULU	*Nuphar variegetum* (formerly N. luteum)	yellow pond lily	FL

NYTU	*Nymphaea tuberosa*	white water lily	FL
POAL8	*Potamogeton alpinus*	red or alpine pondweed	SB
POCR3	*Potamogeton crispus*	curly-leaf pondweed (exotic)	SB
POEP2	*Potamogeton epihydrus*	ribbon-leaf pondweed	SB
POFO3	*Potamogeton foliosus*	leafy pondweed	SB
POGR8	*Potamogeton gramineus*	variable pondweed	SB
POIL	*Potamogeton illinoensis*	Illinois pondweed	SB
PONO2	*Potamogeton nodosus* (formerly *P. americanus*)	American pondweed	SB
POPE6	*Potamogeton pectinatus*	sago pondweed	SB
POPR5	*Potamogeton praelongus*	white-stemmed pondweed	SB
POPU7	*Potamogeton pusillus*	small pondweed	SB
PORI2	*Potamogeton richardsonii*	Richardson's pondweed	SB
POZO	*Potamogeton zosteriformis*	flat-stemmed pondweed	SB
RAFL	*Ranunculus flabellaris*	yellow water-cup (yellow water buttercup)	SB
RALO2	*Ranunculus longirostris* (incl. *R. trichophylus*)	white water-cup (rigid white water buttercup)	SB
SPPO	*Spirodela polyrhiza*	greater duckweed	NV
UNKN01		Unknown specimen No. 1	
UNKN02		Unknown specimen No. 2	
UTMA	*Utricularia vulgaris* (also known as *U. macrorhiza*)	common bladderwort	SB
VAAM3	*Vallisneria americana*	wild celery	SB
WO?LF	*Wolffia*, unidentified sp.	A watermeal sp.	NV
WOCO	*Wolffia columbiana*	watermeal	NV
ZAPA	*Zannichellia palustris*	horned pondweed	SB
ZODU	*Zosterella dubia* (also known as *Heteranthera dubia*)	water stargrass	SB

2.0 Watershed and Lake Characteristics Update

(See 2004 Lake Management Plan)

Secchi disk readings at Lake Manitou can fluctuate greatly, depending on weather and especially precipitation. Significant rainfall events decrease water clarity, as sediment flows through the lake. Zebra Mussels are in Lake Manitou, and water clarity is likely to increase.

3.0 Lake Uses Update

(See 2004 Lake Management Plan)

Access to Lake Manitou was discontinued in fall of 2006 after the discovery of hydrilla. Both the IDNR and the city access ramps were chained off to prevent boats from carrying hydrilla fragments to other lakes. Lake residents were permitted to use the ramps to take out boats and docks that would otherwise be damaged by ice during the winter months. Public access to Lake Manitou will be restricted until further notice from the IDNR.

Access to the lake will be very limited in 2007. Residents will have the opportunity to launch boats in Lake Manitou with the understanding that these boats may not be removed from the lake for the use in another body of water.

4.0 Fisheries Update

The latest fisheries survey on Lake Manitou took place in 2003. The following table was provided by District 3 Fisheries Biologist Jed Pearson and contains length weight and number of all fish species collected on Lake Manitou.

Relative Abundance, Size and Estimated Weight of Fish Collected at Lake Manitou

Common Name*	Number	Percent	Minimum Length (in)	Maximum Length (in)	Weight (lb)**	Percent
Bluegill	1118	53.4	1.4	8.6	131.85	14.6
Gizzard shad	360	17.2	10.5	15.2	267.99	29.7
Largemouth bass	141	6.7	4.3	15.6	102.51	11.4
Redear	127	6.1	3.3	10.2	59.1	6.5
yellow perch	114	5.4	2.9	9.5	18.50	2.0
Spotted gar	61	2.9	11.2	27.9	86.25	9.6
Black crappie	35	1.7	2.7	13.7	13.41	1.5
Rock bass	19	0.9	2.7	9.0	4.72	0.5
Yellow bullhead	18	0.9	8.9	13.0	13.07	1.4
White sucker	16	0.8	15.0	19.8	36.03	4.0
Warmouth	16	0.8	2.5	9.0	1.81	0.2
Brook silverside	16	0.8	3.0	3.9	0.08	0.0
Brown bullhead	15	0.7	3.0	14.0	15.12	1.7
Carp	11	0.5	13.4	29.1	71.29	7.9
Bowfin	10	0.5	21.4	32.0	64.00	7.1
White crappie	7	0.3	2.7	12.4	2.75	0.3
Pumpkinseed	5	0.2	2.9	4.8	0.27	0.0
Golden shiner	3	0.1	4.0	9.1	0.40	0.0
Northern pike	1	0.0	33.1		8.41	0.9
Longnose gar	1	0.0	40.5		5.38	0.6
TOTAL	2094				902.94	

5.0 Problem Statement

In addition to Eurasian watermilfoil, hydrilla control will become the major challenge in maintaining a healthy plant community at Lake Manitou. The biggest challenge may be to prevent the spread of hydrilla to other lakes in the area. A multi-year fluridone treatment plan will likely be implemented to provide control of the hydrilla.

6.0 Management Goals and Objectives

The management goals outlined by the IDNR Division of Fish and Wildlife have not changed. They are restated below:

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 and wildlife resources.

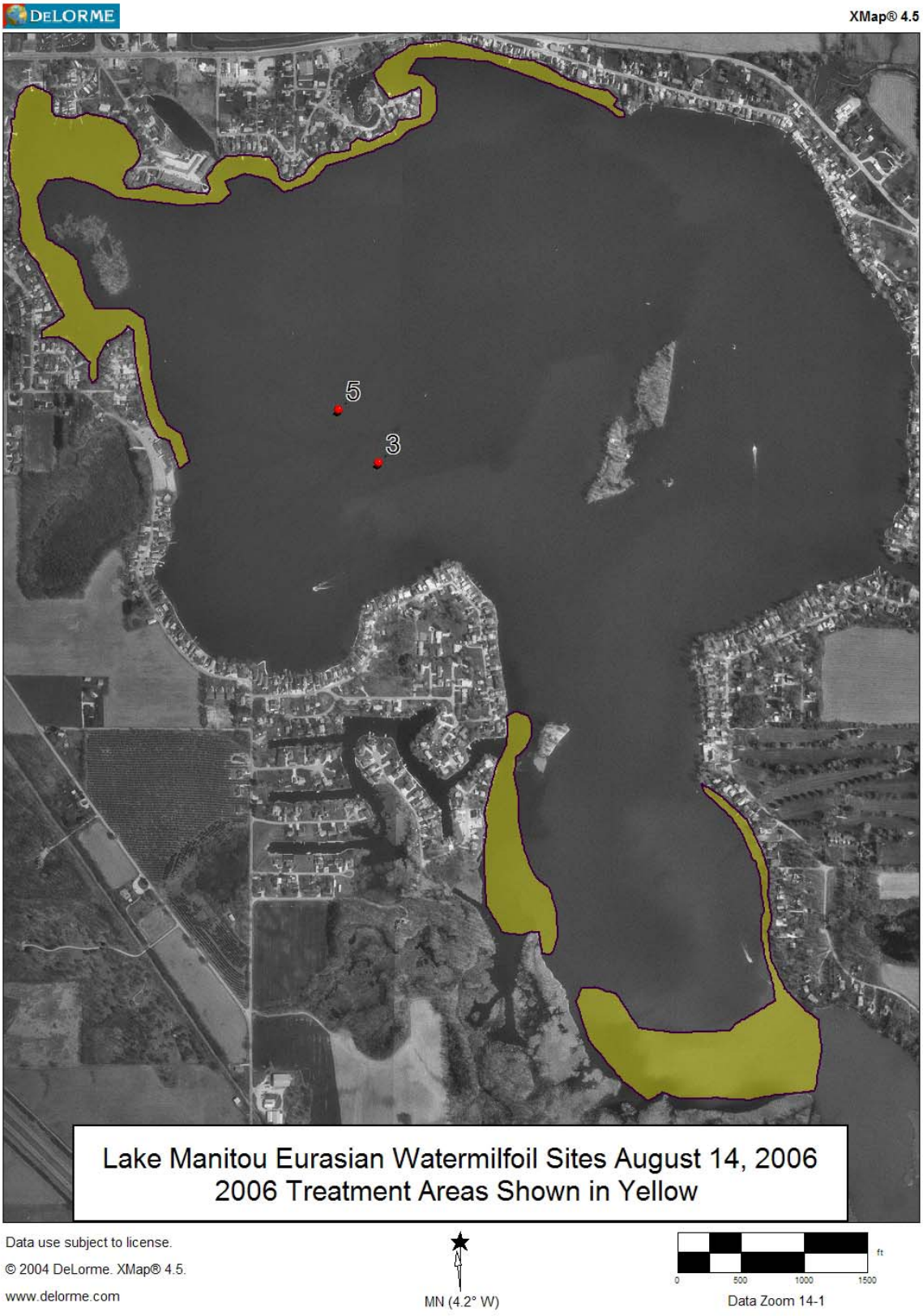
7.0 Plant Management History Update

The major changes to the plant management history have been the increase in acreage for LARE funded herbicide treatments from 45 acres (July 13, 2005) to approximately 95 acres (June 28-29, 2006).

The spring 2006 Tier I survey found dense beds of Eurasian watermilfoil mixed with coontail at the south end of the lake. Prior to 2006 Eurasian watermilfoil was found sparingly in this area (rake scores of 1 and 2). The south end of the lake had not been treated before 2006. The long stretch of shoreline in the northwest corner of the lake had been treated in 2005, and was treated again in 2006 to further reduce the milfoil population.

Permit acreages for the treatment of private lots have not changed significantly. A treatment map is included (Figure 1) that shows an outline of the 2006 LARE funded treatment areas, along with each sample site where Eurasian watermilfoil was collected after treatment in fall of 2006.

Figure 1: Fall 2006 (Post Treatment) Eurasian Watermilfoil Sites



8.0 Aquatic Plant Community Characterization Update

Two major changes have been adopted in LARE protocol that change the process of characterizing the plant community of Indiana lakes.

The first change is the switch from 2 Tier II surveys each year to just one Tier II survey per year. Prior to 2006, both a Tier I and a Tier II survey were required in both spring and fall. This year's protocol changed to require a Tier I survey each spring, and A Tier II survey if the fall, accompanied by a Tier I fall survey to document any changes in the to plant community from spring to fall.

The second change is in the formation of a new Tier II protocol. These changes are outlined in the methods section (8.1).

8.1 Methods Update

The Tier II survey protocol was changed by the IDNR in 2006. New LARE Tier II protocol requires that sample sites be stratified by depth contour. Prior to 2006 sites were to be spaced evenly through the littoral zone.

Before 2006, the number of sample sites required each lake were determined strictly by lake size. In the 2006 protocol, the number of sample sites needed is based on both lake size and trophic state. Trophic state describes the productivity of a lake and is correlated with plant growth, secchi disk, and nutrient availability. There are 4 different trophic states listed by the IDNR: Oligotrophic, Mesotrophic, Eutrophic, and Hypereutrophic. Oligotrophic Lakes usually have clear water and few nutrients, while Hypereutrophic lakes usually have deeply stained water and are nutrient rich. Table 2 is taken from the IDNR 2006 Tier II protocol and shows the maximum depth that must be sampled for a lake in each trophic state. In oligotrophic lakes, where water is clear, plants may be able to grow in up to 25 feet of water because sunlight may still reach the lake bottom in deep water. In hypereutrophic lakes where water is turbid, lack of sunlight will prevent plants from growing in deep water, so the maximum sampling depth is only 10 feet.

Table 2: Sample Depth by Trophic State

Trophic State	Maximum Depth of Sampling (ft)
Hypereutrophic	10
Eutrophic	15
Mesotrophic	20
Oligotrophic	25

Table 3 is used to calculate the number of sample sites need in each depth contour by using lake size and trophic status. The new protocol attempts to more accurately describe the entire littoral zone of a lake and provide more detailed data analysis by separating the littoral zone into 5 foot depth segments.

Table 3: Sample Sites by Lake Size and Trophic State

Table 3. Sample size requirements as determined by lake size, trophic state, and apportioned by depth class.

		Hypereutrophic		Eutrophic			Mesotrophic				Oligotrophic				
Lake Acres	Total # of Sites	0-5 foot contour	5-10 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	0-5 foot contour	5-10 foot contour	10-15 foot contour	15-20 foot contour	20-25 foot contour
<10	20	10	10	10	7	3	10	5	3	2	10	4	3	2	1
10-49	30	20	10	10	10	10	10	10	7	3	10	10	5	3	2
50-99	40	30	10	17	13	10	10	10	10	10	10	10	10	7	3
100-199	50	40	10	23	17	10	14	14	12	10	10	10	10	10	10
200-299	60	50	10	30	20	10	18	16	16	10	14	12	12	12	10
300-399	70	60	10	37	23	10	22	20	18	10	17	15	14	14	10
400-499	80	70	10	43	27	10	25	23	22	10	19	18	17	16	10
500-799	90	80	10	50	30	10	29	27	24	10	22	21	19	18	10
>=800	100	90	10	57	33	10	33	31	26	10	25	23	22	20	10

8.2.1 Tier I Results

Eelgrass is by far the most dominant plant in Lake Manitou and is present in most areas where water depth is 6 feet or below. Chara is also fairly abundant in the lake, and slender naiad also becomes abundant each year in July and August. Eurasian watermilfoil and coontail are both very prevalent in the south end of the lake, and coontail dominates the plant community in depths of 10 - 12 feet.

During the 2006 Tier I surveys, 6 major plant beds were identified. The composition of these plant beds show slight changes from spring to fall. Eelgrass becomes much more prevalent in the fall. It dominates much of the littoral zone of the lake, and causes some recreational problems as well. Curly leaf pondweed drops out of many plant beds as water temperatures rise, and Eurasian watermilfoil is usually most prevalent in late spring and early summer (see figure 2 and table 4).

Problem Plant Areas:

In late fall hydrilla was observed in plant beds #1, #2, #5, and #6 on the 2006 major plant bed map (Figure 2). It was most abundant in bed #1 and bed #6. Hydrilla has not yet been observed or collected in the south end of the lake, though it is expected to spread, as fragments are cut and drift throughout the lake (see figure 4).

Eurasian watermilfoil was found in very low abundance in fall of 2006. Areas of infestation and re-growth will not be evident until spring of 2007.

Beneficial Plant Areas:

One of the most beneficial plant areas in Lake Manitou is the wetland in the south end of the lake. It is one of the only undeveloped areas of the lake and provides filtration and shoreline stability for Lake Manitou. This is also the only area of the lake where hydrilla has not yet been observed.

Another beneficial plant area is the large, protected prairie in the middle of Lake Manitou. Motorized boat travel and anchoring are not permitted in this area. It is hoped that the few small patches of bulrushes in this area will expand if they are protected from excessive wave action

and disturbance caused by boats. Figure 2 shows the locations and acreages for the major Tier I plant beds in Lake Manitou.

Figure 2: 2006 Major Plant Beds

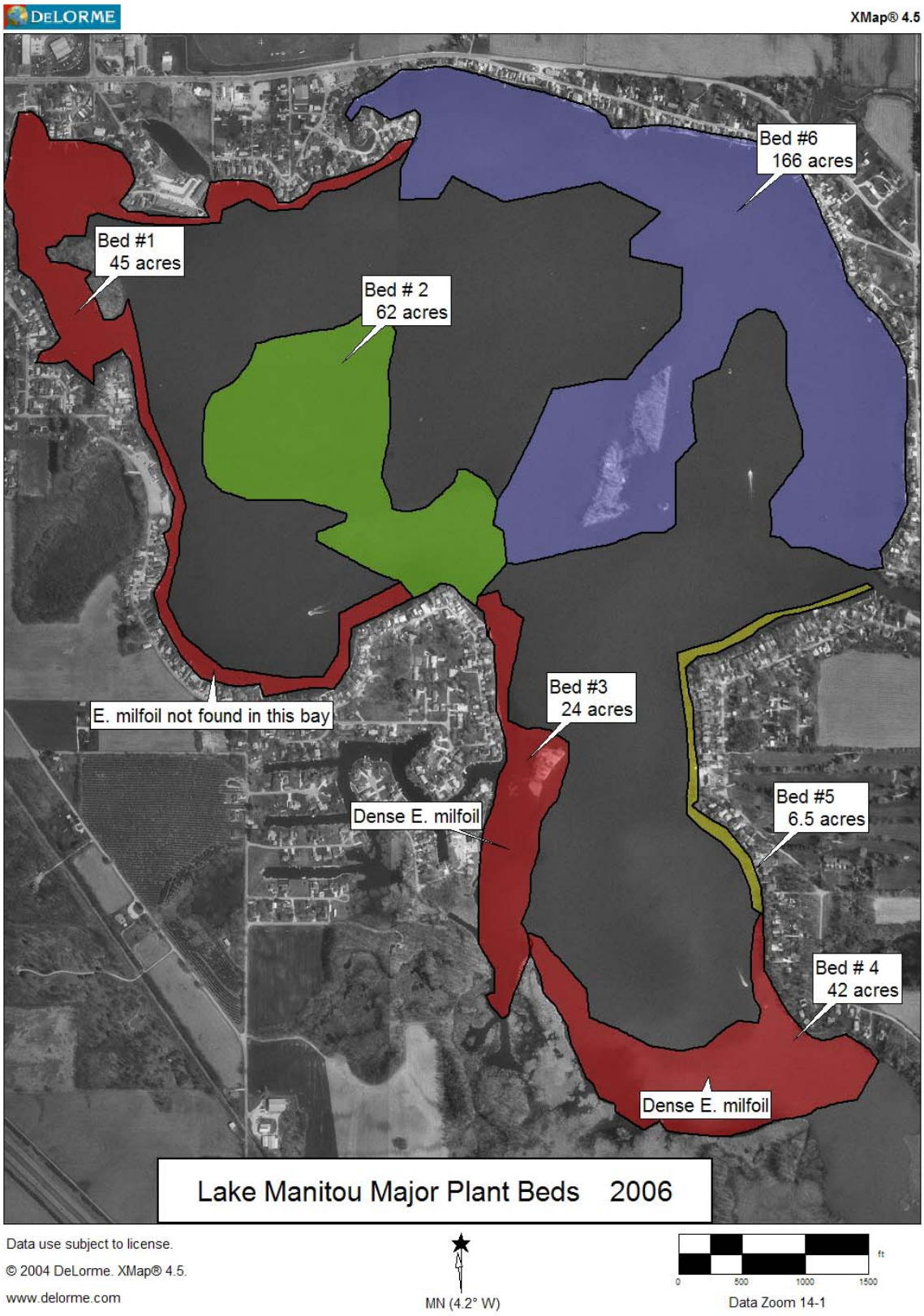


Table 4 shows all of the plant species found in the Tier I survey and there abundance rating for each plant bed. Blanks indicated that the plant was not present in a particular bed.

Table 4: Tier I Plant Bed Summary

Lake Manitou 2006 Tier I Submersed Plants

Species Abundance by Plant Bed #

	#1	#2	#3	#4	#5	#6
Plant Species						
Eurasian Milfoil	3	2	3	3	2	2
Slender Naiad		1				
Eelgrass	4	4				4
Sago Pondweed	1	1			1	2
Duckweed			1	1		
Watermeal				1		
Coontail			3	3	3	2
Total # of Species	**3**	**4**	**3**	**4**	**3**	**4**
Size (Acres)	*45*	*62*	*24*	*42*	*6.5*	*166*

Plant Bed #1
Size: 45 acres
Substrate: Silt/Sand
Number of Species: 3
Description: This plant bed covers the majority of the shoreline area along the northwest section of the lake. All of the shoreline in this bed is developed. Eelgrass is the dominant plant in this bed, and Eurasian watermilfoil is still found in moderate abundance. Sago pondweed was also observed in lower abundance. Hydrilla was observed in this plant bed late in fall of 2006.

Plant Bed #2
Size: 62 acres
Substrate: Silt/Sand
Number of Species: 4
Description: This plant bed is made up of the large protected prairie in the middle of Lake Manitou Lake. In addition to the bulrushes that are found here, 4 species of submersed plants were observed in spring of 2006. Eelgrass was dominant, and Eurasian watermilfoil was very dense in some areas of this bed. Sago pondweed and slender naiad were also present in low abundance. Only fragments of hydrilla were found on the prairie in fall of 2006.

Plant Bed #3
Size: 24 acres

Substrate: Silt
Number of Species: 3
Description: This plant bed along the southwest shoreline of the lake has bottom content that is significantly more silted than the north sections of the lake. Coontail and Eurasian watermilfoil dominate this bed in equal abundances. Duckweed is also present in this bed, indicating high nutrient levels in this area of the lake. Hydrilla was not found in this bed in 2006.

Plant Bed #4
Size: 42 acres
Substrate: Silt/Sand
Number of Species: 4
Description: This plant bed is almost identical in composition to bed #3. Bottom content is silted and coontail and Eurasian watermilfoil are the dominant plants. Duckweed and watermeal are also present in this bed. Hydrilla was not found in this bed in 2006.

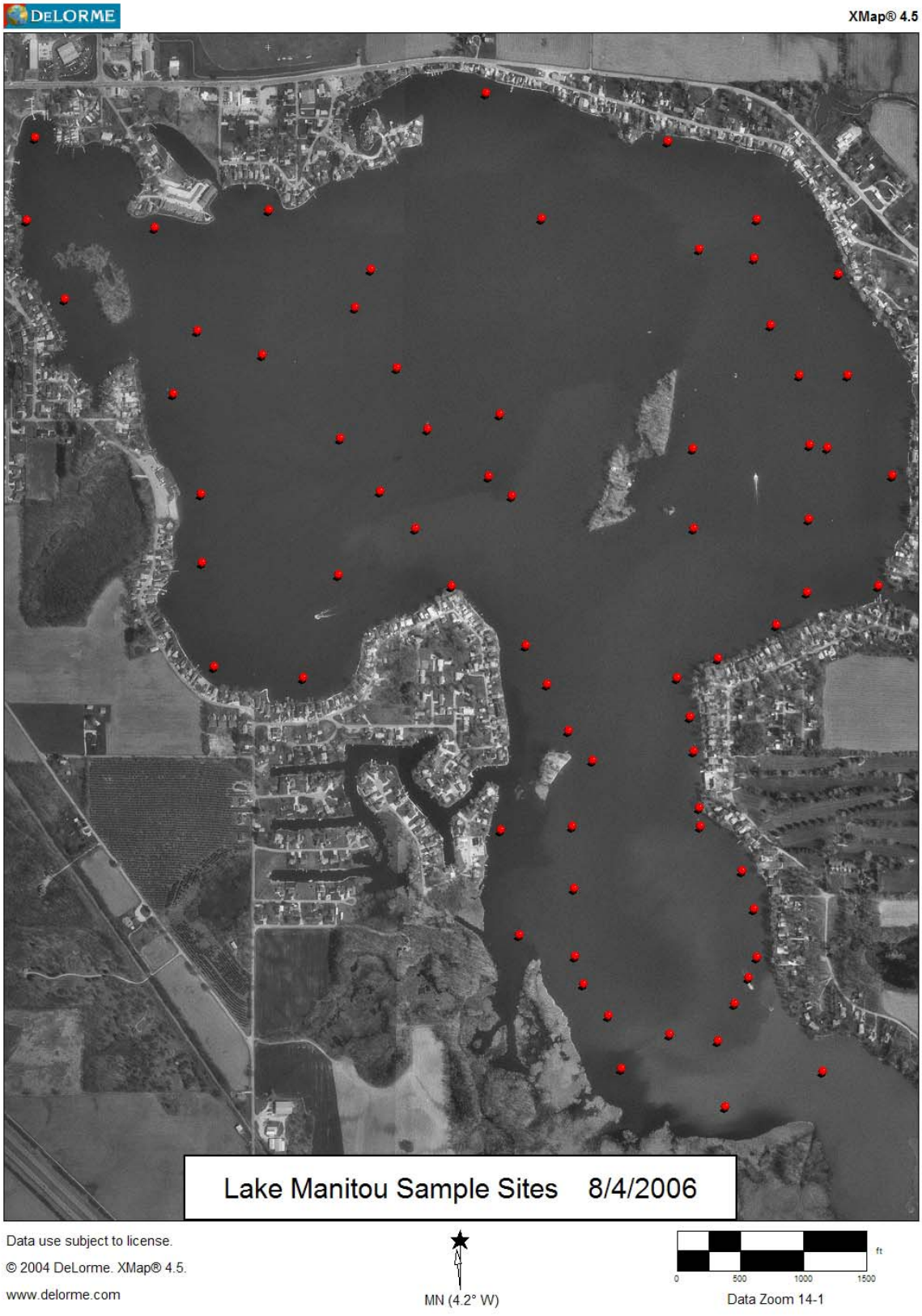
Plant Bed #5
Size: 6.5 acres
Substrate: Silt/Sand
Number of Species: 3
Description: This plant bed runs along the southeast shoreline of the lake and the drop-off in this area is fairly abrupt, making this bed very long and narrow. Bottom content is not as silted as beds #3 and #4. Coontail was the dominant species in this bed, and Eurasian watermilfoil is present in moderate abundance. Sago pondweed was also observed in spring of 2006. Hydrilla was not found in the north section of this bed near the channel to the IDNR public access site.

Plant Bed #6
Size: 166 acres
Substrate: Sand/Silt
Number of Species: 4
Description: This large plant bed covers a large section of shoreline in the northeast section of the lake, as well as a large offshore shallow shelf. In spring of 2006, eelgrass was already the dominant plant in this bed. Eurasian watermilfoil was present in moderated abundance, along with coontail and sago pondweed. Hydrilla was found in this bed in fall of 2006 and was especially heavy in the area surrounding Poet's Point.

8.2.2 Tier II Results

Historical secchi depth in Lake Manitou is 5.0 feet (Tyllia, 2002) although it can vary greatly after a significant rainfall. Seventy rake samples were distributed throughout each 5 foot depth contour of the littoral zone. A total of 8 species of submersed aquatic plants were collected during this survey, with 7 of the 8 species being native plants. The following map shows the locations of all sample sites during the 2006 Tier II survey. Sample sites differ from 2005, reflecting the change in Tier II protocol for 2006.

Figure 3: Fall 2006 Sample Sites



Fall Data Analysis

Tables 5 through 8 are data summaries for the 2006 aquatic vegetation survey. These tables help to describe the plant community, and will help identify any changes that take place in the years to come. Table 5 describes every sample site in the Tier II survey, while the other tables describe each depth contour of the lake's littoral zone (0-5 feet, 5-10 feet, etc).

Table 5: Fall 2006 Date Analysis: All Sites

Occurrence and Abundance of Submersed Aquatic Plants

Date:	8/14/06	Littoral sites with plants:	39	Species diversity:	0.75
Littoral depth (ft):	20.0	Number of species:	8	Native diversity:	0.74
Littoral sites:	70	Maximum species/site:	4	Rake diversity:	0.69
Total sites:	70	Mean number species/site:	1.06	Native rake diversity:	0.67
Secchi:	4.0	Mean native species/site:	1.03	*Mean rake score:	2.21

Common Name	Site frequency	Rel. Freq.	Relative density	Mean density	Dominance
Eel Grass	42.9	40.5	1.40	3.27	28.0
Coontail	24.3	23.0	0.70	2.88	14.0
Chara	10.0	9.5	0.16	1.57	3.1
Sago Pondweed	10.0	9.5	0.16	1.57	3.1
Slender Naiad	8.6	8.1	0.23	2.67	4.6
Illinois Pondweed	5.7	5.4	0.11	2.00	2.3
Eurasian Watermilfoil	2.9	2.7	0.11	4.00	2.3
Flat-stemmed Pondweed	1.4	1.4	0.01	1.00	0.3

Table 6: Fall 2006 Data Analysis: 0-5 foot Depth Contour

Occurrence and Abundance of Submersed Aquatic Plants

Date:	8/14/06	Littoral sites with plants:	22	Species diversity:	0.76
Littoral depth (ft):	5.0	Number of species:	7	Native diversity:	0.75
Littoral sites:	22	Maximum species/site:	4	Rake diversity:	0.71
Total sites:	22	Mean number species/site:	2.23	Native rake diversity:	0.69
Secchi:	4.0	Mean native species/site:	2.18	*Mean rake score:	4.64

Common Name	Site frequency	Relative density	Mean density	Dominance
Eel Grass	90.9	3.00	3.30	60.0
Coontail	36.4	1.36	3.75	27.3
Chara	31.8	0.50	1.57	10.0
Sago Pondweed	27.3	0.45	1.67	9.1
Slender Naiad	22.7	0.59	2.60	11.8
Illinois Pondweed	9.1	0.27	3.00	5.5
Eurasian Watermilfoil	4.5	0.14	3.00	2.7

Table 7: Fall 2006 Data Analysis: 5-10 foot Depth Contour

Occurrence and Abundance of Submersed Aquatic Plants

Date:	8/14/06	Littoral sites with plants:	13	Species diversity:	0.68
Littoral depth (ft):	10.0	Number of species:	7	Native diversity:	0.64
Littoral sites:	20	Maximum species/site:	3	Rake diversity:	0.59
Total sites:	20	Mean number species/site:	1.05	Native rake diversity:	0.51
Secchi:	4.0	Mean native species/site:	1.00	*Mean rake score:	2.15

Common Name	Site frequency	Relative density	Mean density	Dominance
Eel Grass	50.0	1.60	3.20	32.0
Coontail	25.0	0.45	1.80	9.0
Eurasian Watermilfoil	5.0	0.25	5.00	5.0
Flat-stemmed Pondweed	5.0	0.05	1.00	1.0
Illinois Pondweed	5.0	0.05	1.00	1.0
Sago Pondweed	5.0	0.05	1.00	1.0
Slender Naiad	5.0	0.20	4.00	4.0

Table 8: Fall 2006 Data Analysis: 10-15 foot Depth Contour

Occurrence and Abundance of Submersed Aquatic Plants

Date:	8/14/06	Littoral sites with plants:	4	Species diversity:	0.00
Littoral depth (ft):	15.0	Number of species:	1	Native diversity:	0.00
Littoral sites:	17	Maximum species/site:	1	Rake diversity:	0.00
Total sites:	17	Mean number species/site:	0.24	Native rake diversity:	0.00
Secchi:	4.0	Mean native species/site:	0.24	*Mean rake score:	0.59

Common Name	Site frequency	Relative density	Mean density	Dominance
Coontail	23.5	0.59	2.50	11.8

No plants were collected in the 15-20 foot contour.

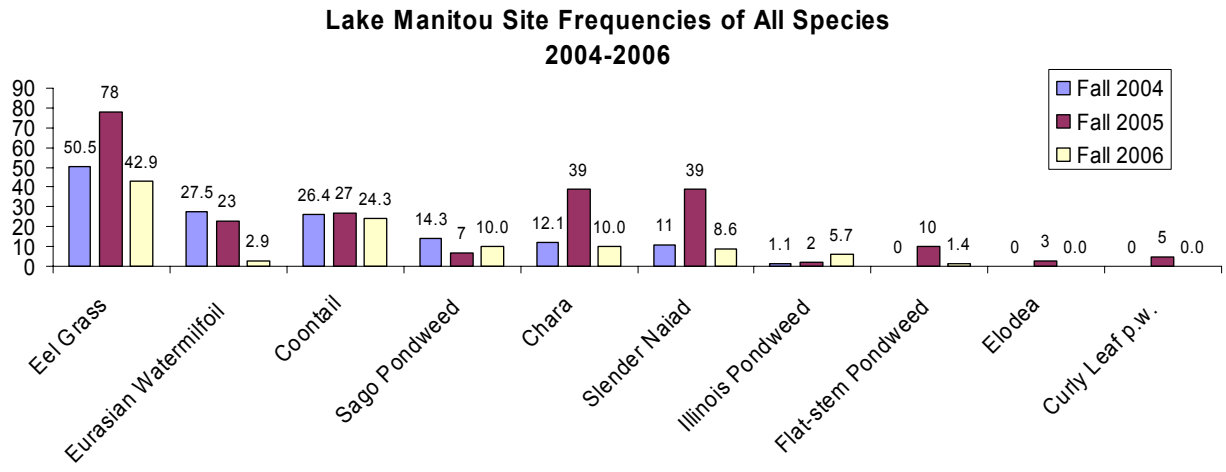
Site Frequency

Site frequency is a measure of how often a species was collected during the Tier II survey. It can be calculated by the following equation:

$$\text{Site Frequency} = \frac{(\text{\# of sites where the species was collected})}{\text{Total \# of littoral sample sites}} \times 100$$

Table 9 shows site frequencies for every plant collected in any of the fall Tier II surveys since the lake was involved in the LARE program. Eurasian watermilfoil dominance has decreased throughout the lake's involvement in the LARE program. Eelgrass remains one of the most frequently collected plants in each vegetation survey. Changes in site frequency of many plants were affected in fall 2006 by the IDNR survey protocol change. Plants found in shallow water such as chara and slender naiad will be collected less frequently, and plants growing in deeper water such as coontail and Eurasian watermilfoil will be collected more frequently with the new protocol.

Table 9: 2004-2006 Site Frequencies



Mean Density and Relative Density

Mean Density is a measure the abundance of a species in areas where it is growing. For example, a species can have a high site frequency, but still have a very low mean density. This means that a species may be prevalent throughout an entire lake, but it may also be sparsely scattered. Mean density can be calculated using the following equation:

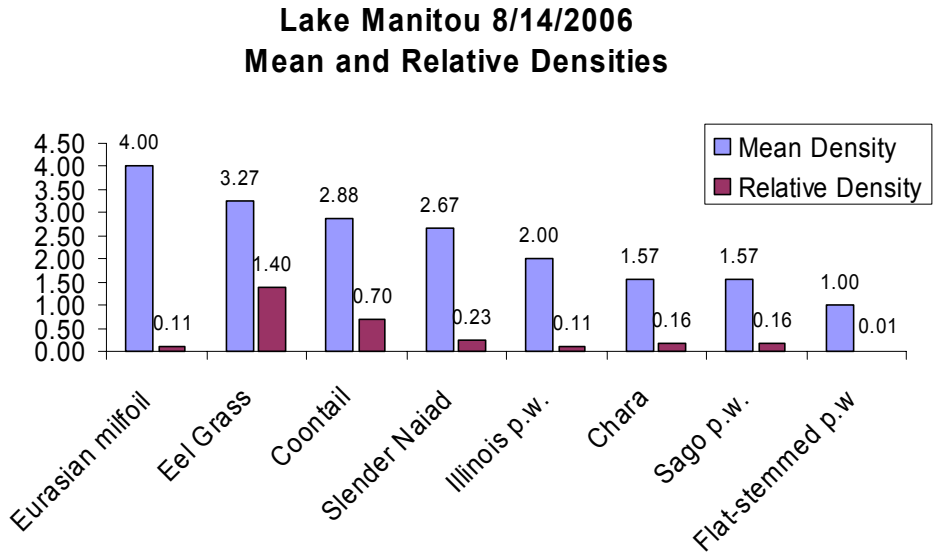
$$\text{Mean Density} = \frac{\text{(The sum of all rake scores for a species)}}{\text{(Total \# of sites where the species was collected)}}$$

Relative Density is calculated much like mean density, only in this case, the sum of the rake scores for a species is divided by the total number of sample sites in the survey. Unless a species was collected at every sample site, the relative density will always be smaller than the mean density.

$$\text{Relative Density} = \frac{\text{(The sum of all rake scores for a species)}}{\text{(Total \# of littoral sample sites)}}$$

Table 10 shows mean and relative densities for each plant found in the fall 2006 Tier II survey. Although Eurasian watermilfoil had the highest mean density, its relative density was very low because it was collected at only 2 sample sites. Eelgrass had the second highest mean density at 3.27 and had by far the highest relative density at 1.4.

Table 10: Fall 2006 Mean and Relative Densities



Species Diversity

The species diversity indices listed in Tables 5 through 8 help to describe the overall plant community. A species diversity index is actually measured as a value of uncertainty (H). If a species is chosen at random from a collection containing a certain number of species, the diversity index (H) is the probability that a chosen species will be different from the previous random selection. The diversity index (H) will always be between 0 and 1. The higher the H value, the more likely it is that the next species chosen from the collection at random will be different from the previous selection (Smith, 2001). This index is dependent upon species richness and species evenness, meaning that species diversity is a function of how many different species are present and how evenly they are spread throughout the ecosystem.

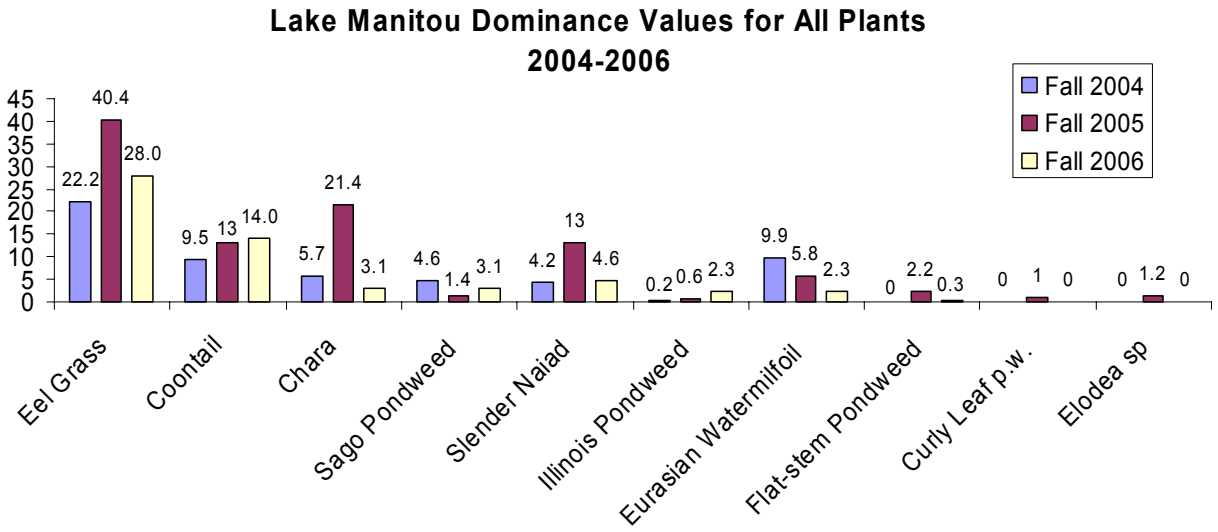
The species diversity index for Lake Manitou in fall of 2006 was 0.75 which is about average when compared with other northern Indiana lakes. Native plant diversity in fall of 2006 was 0.74 which indicates that most species collected in the survey were native plants. Rake diversity was 0.69 and native rake diversity was 0.67.

Species Dominance

Species dominance is dependent upon how many times a species occurs, and its relative coverage area or biomass within the system. In this survey, the abundance rating given to each species at each sample site was used to determine dominance. The dominance of a particular species in this Tier II survey increases as its site frequency and relative abundance increase.

Table 11 tracks dominance values for each plant collected at Lake Manitou during its involvement in the LARE program. Trends are similar to sight frequency, with eelgrass being dominant in each survey. Coontail also had high dominance values in each survey. Eurasian watermilfoil dominance has decreased since 2004.

Table 11: 2004-2006 Dominance Values



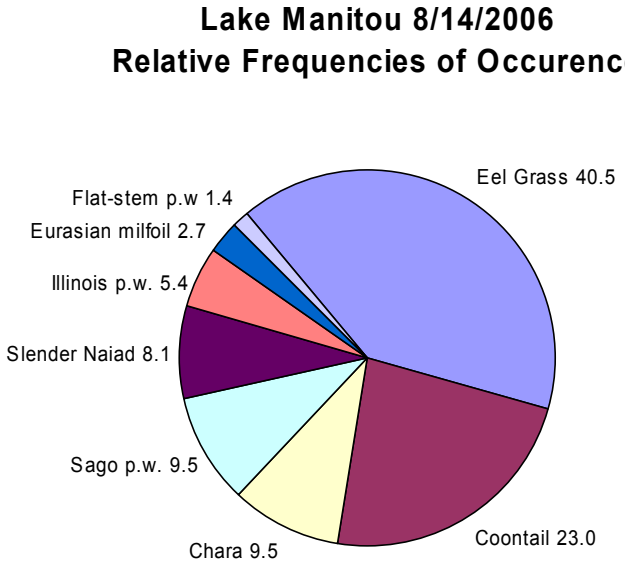
Relative Frequency of Occurrence

Relative frequency of occurrence is a measure of how often a plant is collected in relation to all of the other plants collected in a Tier II survey. It is demonstrated with the following equation:

$$\text{Relative Freq. of Occurrence} = \frac{\text{The site Frequency for a species} \quad X\ 100}{\text{The sum of all site frequencies including the species in question}}$$

The sum of all relative frequency of occurrence values will always add up to 100. For this reason it is displayed in a pie graph. Table 12 shows relative frequency of occurrence values for each plant collected in the fall 2006 survey. Eelgrass had the greatest relative frequency at 40.5. Coontail was second at 23.0. Chara and sago pondweed each had relative frequency values of 9.5.

Table 12: Fall 2006 Relative Frequencies of Occurrence



8.3 Macrophyte Inventory Discussion

The submersed plant community of Lake Manitou covers roughly 345 acres of the Lake Manitou. This large littoral zone, along with silted bottom content, high nutrient availability, and intense recreational use make Lake Manitou very susceptible to exotic invaders.

Based upon 2006 survey data, Lake Manitou has a submersed aquatic plant community with average diversity when compared with many area lakes. Species richness in Lake Manitou was 8 species in the fall of 2006. The plant community is dominated by eelgrass, which is a native plant. Hydrilla was found in the lake in fall of 2006, making it the first lake in the Midwest to be infested by the weed.

In summary, Lake Manitou is characterized by a submersed plant community with moderate diversity (0.75), moderate to low water clarity (secchi depth ~4 ft.), pockets of heavy Eurasian watermilfoil, and the increasing presence of hydrilla.

9.0 Aquatic Vegetation Management Alternatives

(See 2004 Lake Management Plan)

Major Eurasian watermilfoil control practices have not changed significantly from the 2004 Alternatives. Hydrilla control practices are being discussed by the IDNR and will be implemented in 2007.

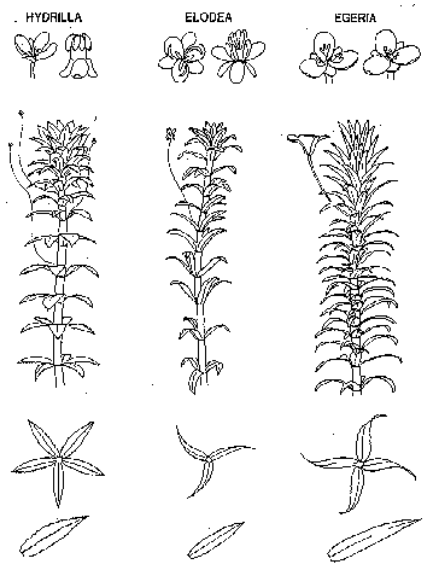
10.0 Public Involvement

No LARE meeting was held in 2007 as decisions have not yet been made as to the nature of herbicide treatments that may take place in 2007 to help control hydrilla. When a treatment plan is developed, a public lake meeting will be held to discuss the hydrilla management options.

11.0 Public Education

11.1 Hydrilla

In fall of 2006, Hydrilla (*Hydrilla verticillata*) was found in Lake Manitou, in Rochester, Indiana. Hydrilla is an invasive aquatic plant species common throughout the southern United States. It is federally listed as a noxious weed and causes severe ecological and recreational problems wherever it grows.

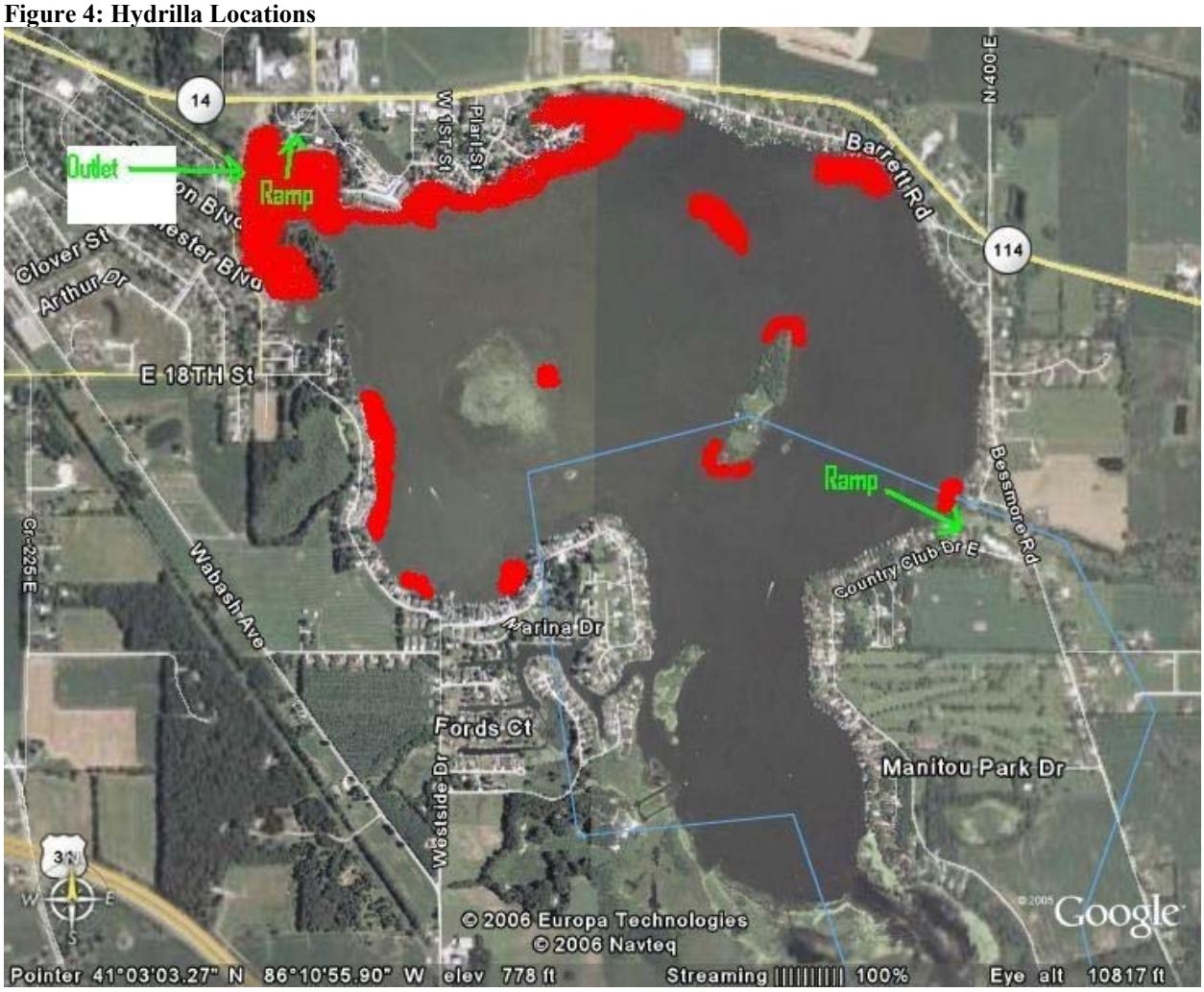


This is the first instance of hydrilla in the upper Midwest. Prior to its appearance in Lake Manitou, The closest infestations of hydrilla were in Tennessee and Pennsylvania.

It is considered to be much more destructive than other invasive plants like Eurasian watermilfoil and curly leaf pondweed because of its reproductive adaptations. It grows by fragmentation, as does Eurasian watermilfoil, but it also produces turions which can remain dormant in the sediment for 4 years or more (Van and Steward, 1990). It produces tubers at its root tips which can also reproduce after multiple years of dormancy. It can grow 1 inch each day and it quickly out-competes native plants. It forms dense beds that eliminate native plants, stunt fish populations, impede recreation and cause a drastic decrease in biodiversity (Colle and Shireman, 1980). Millions of dollars are spent each year for hydrilla maintenance each year in Florida alone. Eradication is unlikely once a population has been well established, although eradication has been achieved in newly infested waters using a herbicide called Sonar. Sonar is applied at a rate of 6 parts per billion and this concentration is maintained in the water for 180 days. Early detection can be crucial to an effective eradication program, and all lake associations, residents and users are encouraged to be on the look-out for this invader. Hydrilla can easily be confused with native elodea. The major difference is that elodea has sets of leaves on the stem in whorls of three, while hydrilla usually has whorls of 5 leaves, although 4 to 9 leaves per whorl are possible with hydrilla. Hydrilla will also have small serrations on the leaf edges. More information on hydrilla can be found at the University of Florida's Center for Aquatic Invasive Plants (http://plants.ifas.ufl.edu/). More general information on aquatic invaders can be found at www.protectyourwaters.net.

Figure 4 was provided by Doug Keller and shows current areas of known hydrilla infestation in Lake Manitou.

Figure 4: Hydrilla Locations



12.0 Integrated Management Action Strategy

No management of Eurasian watermilfoil will be necessary in 2007, as the tentative hydrilla management plan will reduce the Eurasian watermilfoil population dramatically.

Hydrilla Management Options Summary

Currently a 3 year herbicide treatment plan has been developed to address the hydrilla problem, although it may extend well beyond 3 years. Hydrilla will be chemically treated with Sonar herbicide (both granular and A.S.) at a concentration of 6 parts per billion. This Sonar concentration will be maintained for at least 180 days during the growing season in each year of the plan. Three applications will take place per year to maintain the proper concentration, although additional treatments may be necessary pending the results of water samples (FasTESTs) that will be collected approximately every 14 days. These water samples will be taken to monitor the concentration of Sonar in Lake Manitou.

The area around the IDNR public access site will be treated with contact herbicides for both invasive and native species. This area will be kept as devoid of vegetation as possible to reduce the potential for the spread of hydrilla on boats, trailers and vehicles.

Since Sonar is a very slow acting herbicide, areas of hydrilla that reach the surface of the lake may also be treated with contact herbicides. Treating these areas with fast-acting herbicides may prevent surface mats of hydrilla from being cut by boat traffic and spread to other areas of the lake.

13.0 Project Budget

The hydrilla management project is currently going through the public bidding process.

14.0 Monitoring and plan Update Procedures

Aquatic vegetation surveys will be used to track the distribution and abundance of hydrilla, along with Eurasian watermilfoil and the other native species. The timing of the surveys, as well as who conducts those surveys will depend upon the finalized hydrilla control plan.

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16.0 Appendices
16.1 Common Aquatic Plants of Indiana

The following appendix was compiled using information found in the 5th edition of How to Identify Water Weeds and Algae, edited by James C. Schmidt and James R. Kannenberg. All pictures, with the exception of Illinois pondweed and northern milfoil were taken from the Category 5 Aquatic Pest Control Management Manual, written by Dr. Carole Lembi, Head of the Department of Botany and Plant Pathology at Purdue University.

American Pondweed

Scientific name: *Potamogeton americanus*

Classification: Native to Indiana

Distribution: Common throughout the U.S.

Description: American pondweed can be identified by its oval shaped leaves floating on the top of the water. The base of each leaf tapers to a very long petiole that connects the leaf with the stem of the plant. Plant leaves are arranged alternately on the stem and leaves are usually sparsely scattered.

Chara

Scientific name: *Chara sp*.

Classification: Native to Indiana

Distribution: Extremely common worldwide. Usually found in hard water.

Description: Chara is often mistaken for a vascular plant, but it is actually an advanced form of algae. It can be gray, green or yellow in color and is usually forms extremely dense beds that may cover an entire lake. It can be identified by its distinct musky odor and calcium deposits on the algae's surface make it feel bristly to the touch. It possesses leaf-like structures that are whorled around the hollow stem, and it attaches itself to the lake bottom, although it has no actual roots. It usually grows in shallow, clear water.

Coontail

Scientific name: *Ceratophyllum demersum*

Classification: Native to Indiana

Distribution: Common throughout the U.S., usually in hard water.

Description: Coontail plants are submersed and have no roots, though they appear to be attached to the lake bottom when viewed from above the surface of the water. The free-floating nature of coontail allows it to colonize new areas of a lake quickly, and it often times forms extremely dense weed beds where sufficient light and nutrients are available. Coontail has dark green leaves arranged in whorls around the stem and usually grows in long, bushy strands resembling evergreen trees beneath the surface of the water. Coontail's structure is very similar to Eurasian milfoil but coontail has forked leaves, which distinguishes it from the feather-like projections of milfoil leaves.

Curley Leaf Pondweed

Scientific name: *Potamogeton crispus*

Classification: Exotic to Indiana

Distribution: Found throughout the U.S. in fresh and brackish water.

Description: Curley leaf pondweed usually grows and spreads rapidly in early spring and begins to dies out by midsummer as water temperatures approach 70 degrees Fahrenheit. Curley leaf has extremely thin, membranous leaves arranged alternately on the stem with small teeth-like projections visible along the edge of each leaf. A reproductive spike may be seen protruding from the surface of the water. Curley leaf pondweed may also leave small reproductive structures called turions in the sediment on the lake bottom that can lie dormant throughout the winter and then sprout when spring arrives.

Eel Grass (Wild Celery)

Scientific name: *Vallisneria Americana*

Classification: Native to Indiana

Distribution: Found from the Great Plains to the East Coast of the U.S.

Description: Eel grass has tufts of ribbon-like leaves with a horizontal stem embedded in the sediment connecting each tuft. This native plant grows thick weed beds anchored in the mud by roots. These dense beds often shade out other forms of weeds and provide excellent escape cover for small fish. The flowers of this plant are visible in late summer and sit on the top of a coiled structure protruding to the surface. This plant is found in both lakes and river, but is seldom found in stagnant systems. It is considered an extremely valuable plant to aquatic ecosystems.

Elodea

Scientific Name: *Elodea Canadensis*

Classification: Native to Indiana

Distribution: Common throughout the north and north central united states. Its ranges extends as far south as northern Tennnessee.

Description: Elodea grows in long strands resembling milfoil, but its leaves are broad and oval shaped. Leaves are arranged in whorls with three leaves usually occurring at each node. Leaves near the tip of the plant are closely packed together, with the distance between nodes increasing further down the stem.

Eurasian Milfoil

Scientific Name: *Microphyllum spicatum*

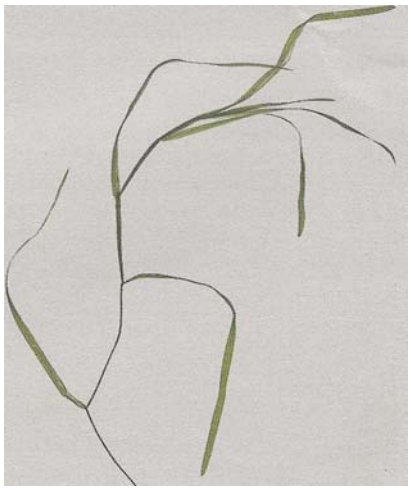
Classification: Exotic in Indiana

Distribution: Common in the Midwest and Eastern U.S. Also spreading along the Pacific coast

Description: This extremely aggressive and extremely destructive plant has leaves in whorls of 4 around a reddish stalk. This plant grows rapidly and can reach lengths of over 10 feet. This plant has the ability to over winter, meaning it can lie dormant during the winter months instead of dying out completely each year. This gives it a distinct advantage over many native species, as it competes for sunlight in early spring. The dormant milfoil plants reach the surface much faster than the native plants sprouting from the lake bottom. This enables the Eurasian milfoil to shade out other plants and form the dense beds that choke the littoral zone of many lakes.

A reproductive process called fragmentation aids the rapid dispersion of Eurasian milfoil. If a milfoil plant is damaged and some fragments are removed from the macrophyte, each small piece of the plant has the ability to grow roots and create a new milfoil plant. Eurasian milfoil is considered one of the most dangerous aquatic nuisance species because of its ability to rapidly disrupt and destroy lake ecosystems.

Flat-stemmed Pondweed



Scientific Name: *Potamogeton zosteriformis*

Classification: Native to Indiana

Distribution: Common throughout the northern half of the U.S.

Description: the most noticeable characteristic is the large, very flat stem. It cannot be rolled between the fingers easily. The ribbon-like leaves extend from the stem toward the surface of the water.

Illinois Pondweed

Scientific name: *Potamogeton illinoensis*

Classification: Native to Indiana

Distribution: Very widespread and very common throughout the upper Midwest and the U.S

Description: Illinois pondweed is common in Indiana, especially in the northern third of the state. This leafy weed has leaves with very broad bases that extend three-fourths of the way around the stem. The upper part of its slender stem is usually branched and very leafy.

www.wvu.edu

Large Leaf Pondweed

Scientific name: *Potamogeton amplifolius*
Classification: Native to Indiana
Distribution: Common throughout the upper Midwest and the northern United States in hard water.

Description: This plant has both submersed and floating leaves. The floating leaves are oval shaped and are similar to those of American pondweed. Submersed leaves are arranged alternately with each leaf becoming extremely narrow as it nears the stem of the plant. Mineral deposits on its leaves often give large leaf pondweed a dark brown appearance.

Naiad

Scientific name: *Najas minor* (brittle naiad)

Classification: Native to Indiana

Distribution: Common throughout the U.S.

Description: The leaves of naiad plants are usually widest at the base and gradually become thinner near the tip of the leaf. Plants are extremely leafy and appear bush-like when viewed from above the surface of the water. Many species of naiad are very common in this area. Plant structure often resembles chara, but the absence of calcium deposits on the surface of the plant help in identification. The leaves of brittle naiad have multiple spines along the margins that are visible to the naked eye.

Nitella

Scientific name: *Nitella sp.*

Classification: Native to Indiana

Distribution: Found worldwide, usually in hard water.

Description: Nitella is very similar to chara, and it is also an advanced form of algae. It has leaf-like projections that are whorled around the stem. It is often found growing in very thick patches, usually in shallow, clear water.

Northern Milfoil

Scientific name: *Myriophyllum sibericum*

Classification: Native to Indiana

Distribution: Found throughout the northern half of the U.S. and also in Europe and Western Asia

www.io.uwinnipeg.ca

Description: Northern milfoil has submersed, feather-like, whorled leaves that closely resemble the leaves of Eurasian milfoil. Distinguishing the native northern milfoil from Eurasian milfoil can be difficult. The leaflet pairs of northern milfoil are generally fewer and more widely spaced than those of Erasian milfoil. This plant is known to hybridize with Eurasian milfoil, and at times, chemical analysis is necessary to distinguish between the two plants.

Sago Pondweed

Scientific name: *Potemogeton pectinatus*

Classification: Native to Indiana

Distribution: Found throughout the U.S., Common in the northern 2/3 of Indiana.

Description: Sago Pondweed has a bushy appearance with narrow, thread-like leaves that spread out to resemble a fan. Leaves are usually 1/16 of an inch wide and 1 to 6 inches long. Nutlets are formed on a string-like structure and protrude from the surface of the water. While sago pondweed can form dense beds, many times it is found in sparse, loosely distributed arrangements.

16.2 Pesticide Use Restrictions Summary:

The following table was produced by Purdue University and included in the Professional Aquatic Applicators Training Manual. It gives a summary of water use restrictions on all major chemicals available for use in the aquatics market.

Table 13: Pesticide Use Restrictions

Table 1. Aquatic Herbicides and Their Use Restrictions. Always check the label because these restrictions are subject to change.

	Human			Animal	Irrigation		
	Drinking	Swimming	Fish Consumption	Drinking	Turf	Forage	Food Crops
	waiting period, in days						
Copper Chelate	0	0[a]	0	0	0	0	0
Copper Sulfate	0	0[a]	0	0	0	0	0
Diquat	1–3	0[a]	0	1	1–3	1–3	5
Endothall (granular)[b]	7	0[a]	3	0	7	7	7
Endothall (liquid)[b]	7–25	0[a]	3	7–25	7–25[d]	7–25	7–25
Endothall 191 (granular)[c]	7–25	0[a]	3	7–25	7–25	7–25	7–25
Endothall 191 (liquid)[c]	7–25	0[a]	3	7–25	7–25	7–25	7–25
Fluridone	0[e]	0[a]	0	0	7–30	7–30	7–30
Glyphosate	0[e]	0[a]	0	0	0	0	0
2,4-D (granular)	*	0[a]	0	*	*	*	*

[a]Although this compound has no waiting period for swimming, it is always advisable to wait 24 hours before permitting swimming in the direct area of treatment.

[b]Trade name is Aquathol®.

[c]Trade name is Hydrothol®.

[d]May be used for sprinkling bent grass immediately.

[e]Do not apply this product within 1/4 (fluridone) to 1/2 (glyphosate) mile upstream of potable water intakes.

*Do not use treated water for domestic purposes, livestock watering (2,4-D, dairy animals only), or irrigation.

16.3 Resources for Aquatic Management

In addition to the LARE Program, there are many other sources of potential funding to help improve the quality of Indiana Lakes. Many government agencies assist in projects designed to improve environmental quality.

The USDA has many programs to assist environmental improvement. More information on the following programs can be found at www.usda.gov.

Watershed Protection and Flood Prevention Program (USDA

Conservation Reserve Program (USDA)

Wetlands Reserve Program (USDA)

Grassland Reserve Program (USDA)

Wildlife Habitat Incentive Program (USDA)

Small Watershed Rehabilitation Program (USDA)

The following programs are offered by the U.S. Fish and Wildlife Service. More information about the Fish and Wildlife service can be found at www.fws.gov

Partners for Fish and Wildlife Program (U.S. Fish and Wildlife Service)

Bring Back the Natives Program (U.S. Fish and Wildlife Service)

Native Plant Conservation Program (U.S. Fish and Wildlife Service)

The Environmental Protection Agency, the Indiana Department of Environmental Management, and the U.S. Forest Service also have numerous programs for funding. A few of these are listed below. More information can be found at www.in.gov/idem and www.fs.fed.us/

U.S. Environmental Protection Agency Environmental Education Program (EPA)

NPDES Related State Program Grants (IDEM)

Community Forestry Grant Program (U.S. Forest Service)

16.4 State Regulations for Aquatic Plant Management

The following information is found on the IDNR website and outlines general regulations for the management of aquatic plants in public waters.

AQUATIC PLANT CONTROL PERMIT REGULATIONS
Indiana Department of Natural Resources

Note: In addition to a permit from IDNR, public water supplies cannot be treated without prior written approval from the IDEM Drinking Water Section. **Amended state statute adds biological and mechanical control (use of weed harvesters) to the permit requirements, reduces the area allowed for treatment without a permit to 625 sq ft, and updates the reference to IDEM.** *These changes become effective on July 1, 2002.*

Chapter 9. Regulation of Fishing
IC 14-22-9-10

Sec. 10. (a) This section does not apply to the following:
(1) A privately owned lake, farm pond, or public or private drainage ditch.
(2) A landowner or tenant adjacent to public waters or boundary waters of the state, who chemically, mechanically, or physically controls aquatic vegetation in the immediate vicinity of a boat landing or bathing beach on or adjacent to the real property of the landowner or tenant if the following conditions exist:
(A) The area where vegetation is to be controlled does not exceed:
(i) twenty-five (25) feet along the legally established, average, or normal shoreline;
(ii) a water depth of six (6) feet; and
(iii) a total surface area of six hundred twenty-five (625) square feet.
(B) Control of vegetation does not occur in a public waterway of the state.
(b) A person may not chemically, mechanically, physically, or biologically control aquatic vegetation in the public waters or boundary waters of the state without a permit issued by the department. All procedures to control aquatic vegetation under this section shall be conducted in accordance with rules adopted by the department under IC 4-22-2.
(c) Upon receipt of an application for a permit to control aquatic vegetation and the payment of a fee of five dollars ($5), the department may issue a permit to the applicant. However, if the aquatic vegetation proposed to be controlled is present in a public water supply, the department may not, without prior written approval from the department of environmental management, approve a permit for control of the aquatic vegetation.
(d) This section does not do any of the following:
(1) Act as a bar to a suit or cause of action by a person or governmental agency.
(2) Relieve the permittee from liability, rules, restrictions, or permits that may be required of the permittee by any other governmental agency.
(3) Affect water pollution control laws (as defined in IC 13-11-2-261) and the rules adopted under water pollution control laws (as defined in IC 13-11-2-261).
As added by P.L.1-1995, SEC.15. Amended by P.L.1-1996, SEC.64.

312 IAC 9-10-3 Aquatic vegetation control permits
Authority: IC 14-22-2-6; IC 14-22-9-10
Affected: IC 14-22-9-10

Sec. 3. (a) Except as provided under IC 14-22-9-10(a), a person shall obtain a permit under this section before applying a substance to waters of this state to seek aquatic vegetation control.
(b) An application for an aquatic vegetation control permit shall be made on a departmental form and must include the following information:
(1) The common name of the plants to be controlled.
(2) The acreage to be treated.
(3) The maximum depth of the water where plants are to be treated.
(4) The name and amount of the chemical to be used.
(c) A permit issued under this section is limited to the terms of the application and to conditions imposed on the permit by the department.

(d) Five (5) days before the application of a substance permitted under this section, the permit holder must post clearly, visible signs at the treatment area indicating the substance that will be applied and what precautions should be taken.

(e) A permit issued under this section is void if the waters to be treated are supplied to the public by a private company or governmental agency. *(Natural Resources Commission; 312*

16.5 Public Input Questionnaire

A public meeting will be held after a hydrilla control strategy has been finalized.

16.6 Species Distribution Maps

Figure 5: Fall 2006 Chara Sites

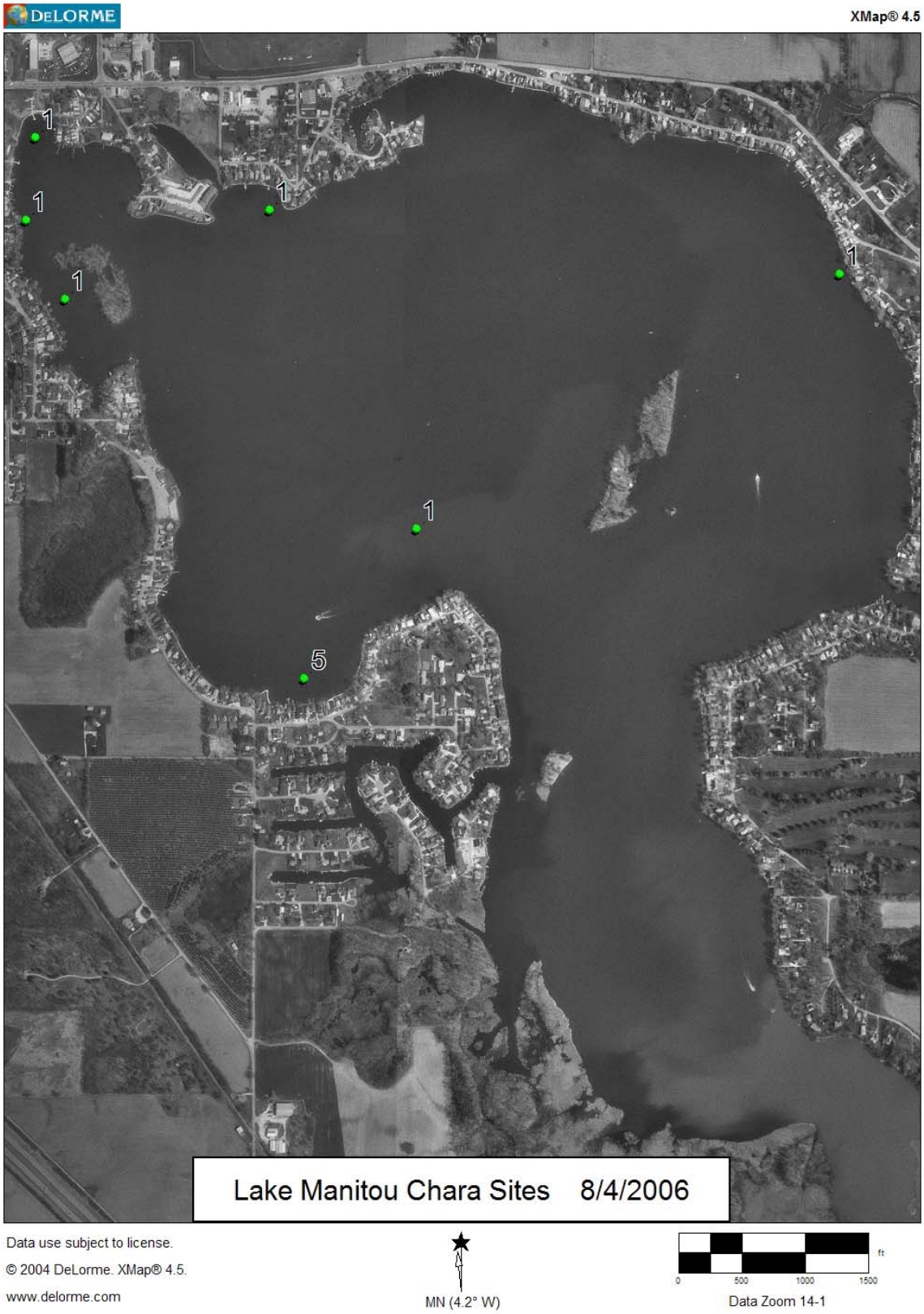


Figure 6: Fall 2006 Coontail Sites

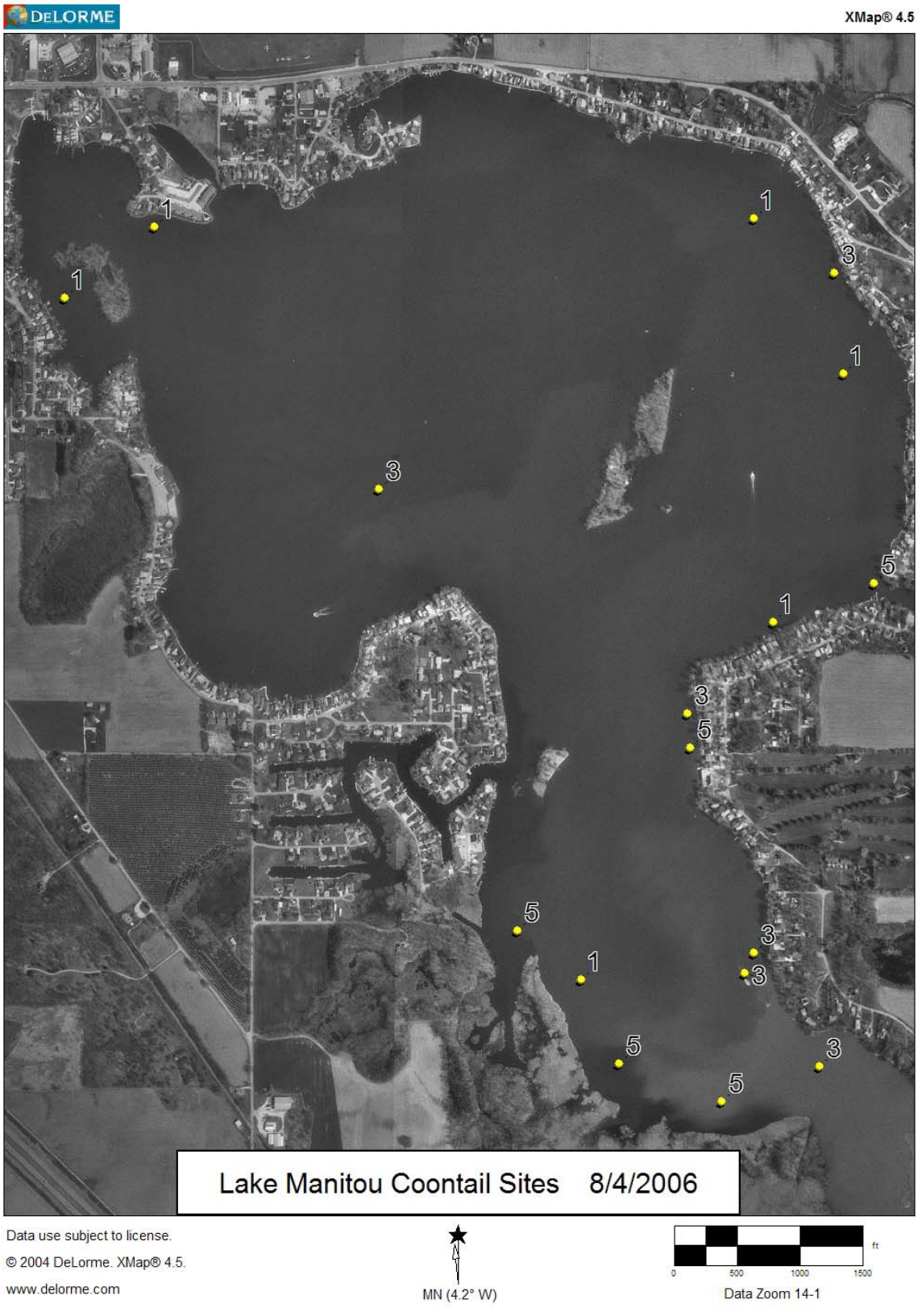


Figure 7: Fall 2006 Eelgrass Sites

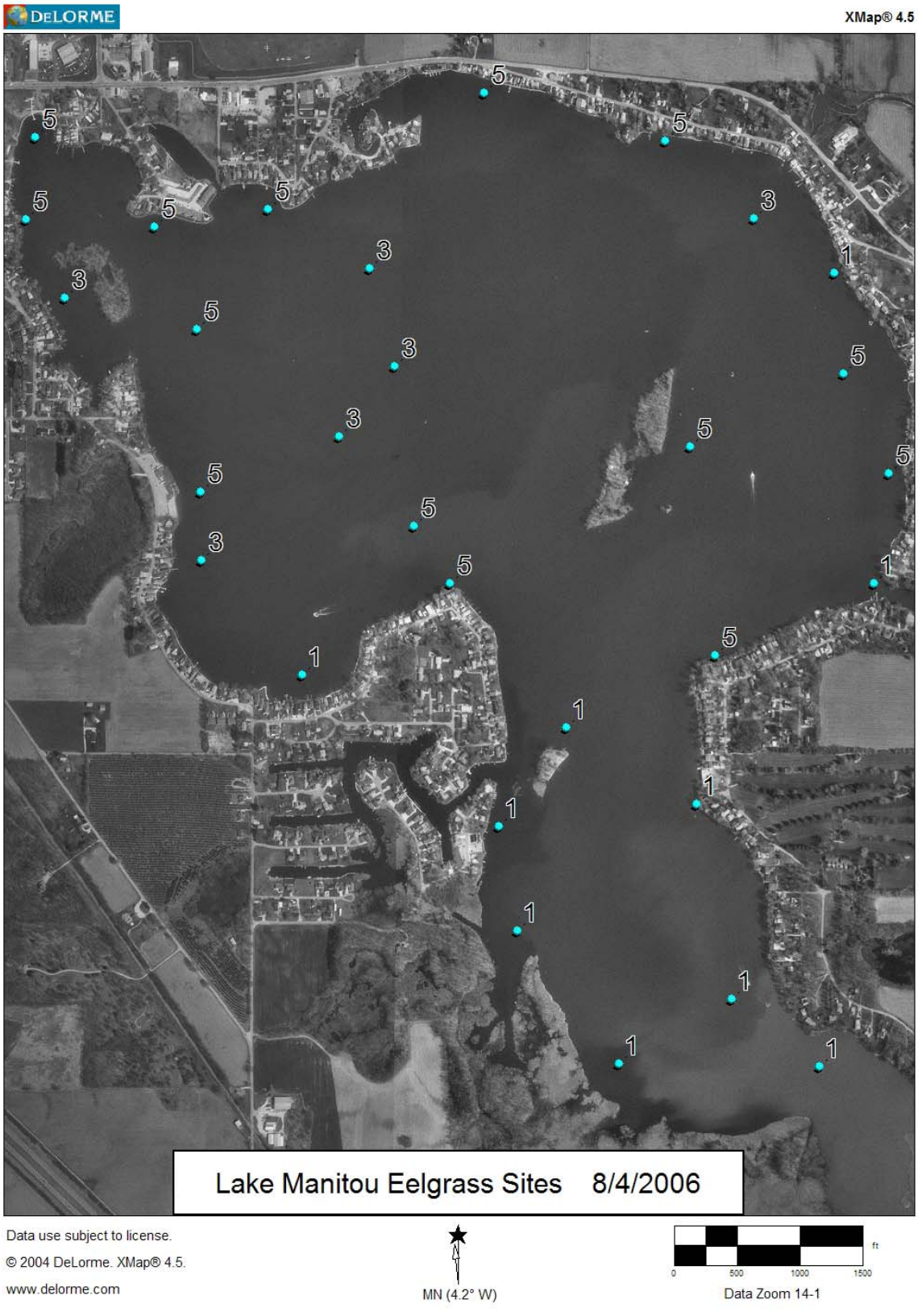


Figure 8: Fall 2006 Eurasian Watermilfoil Sites

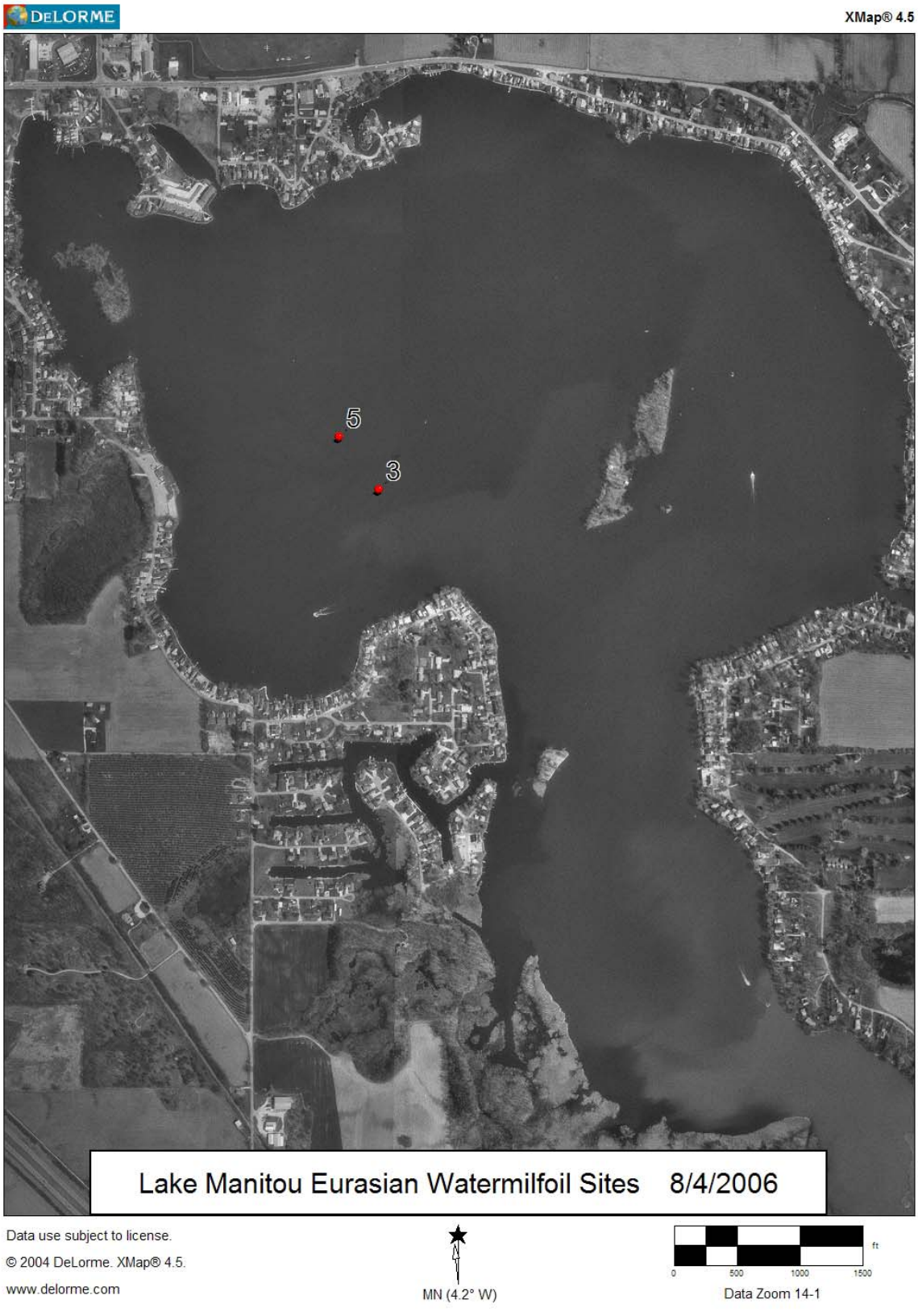


Figure 9: Fall 2006 Flat-stemmed Pondweed Sites

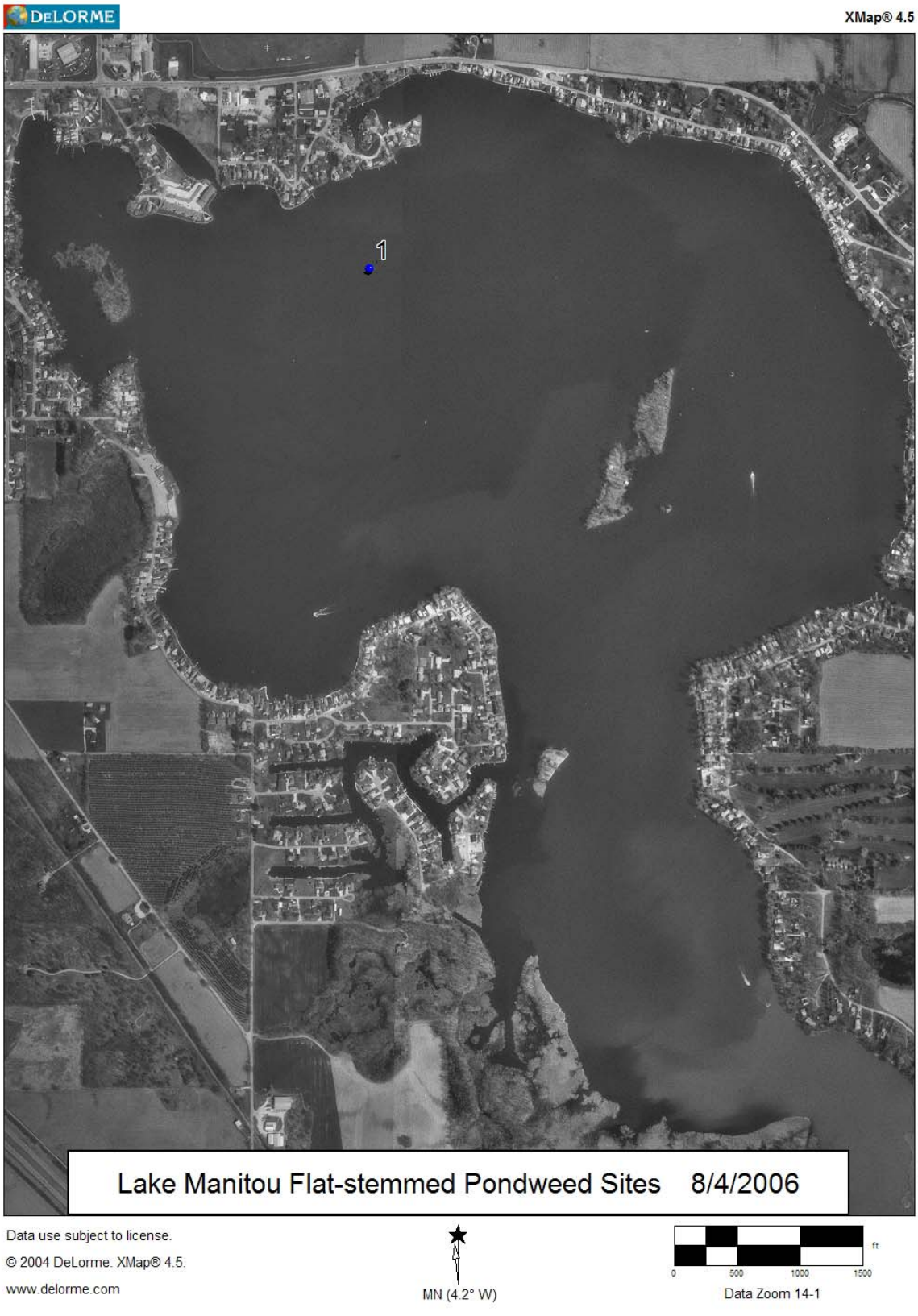


Figure 10: Fall 2006 Illinois Pondweed Sites

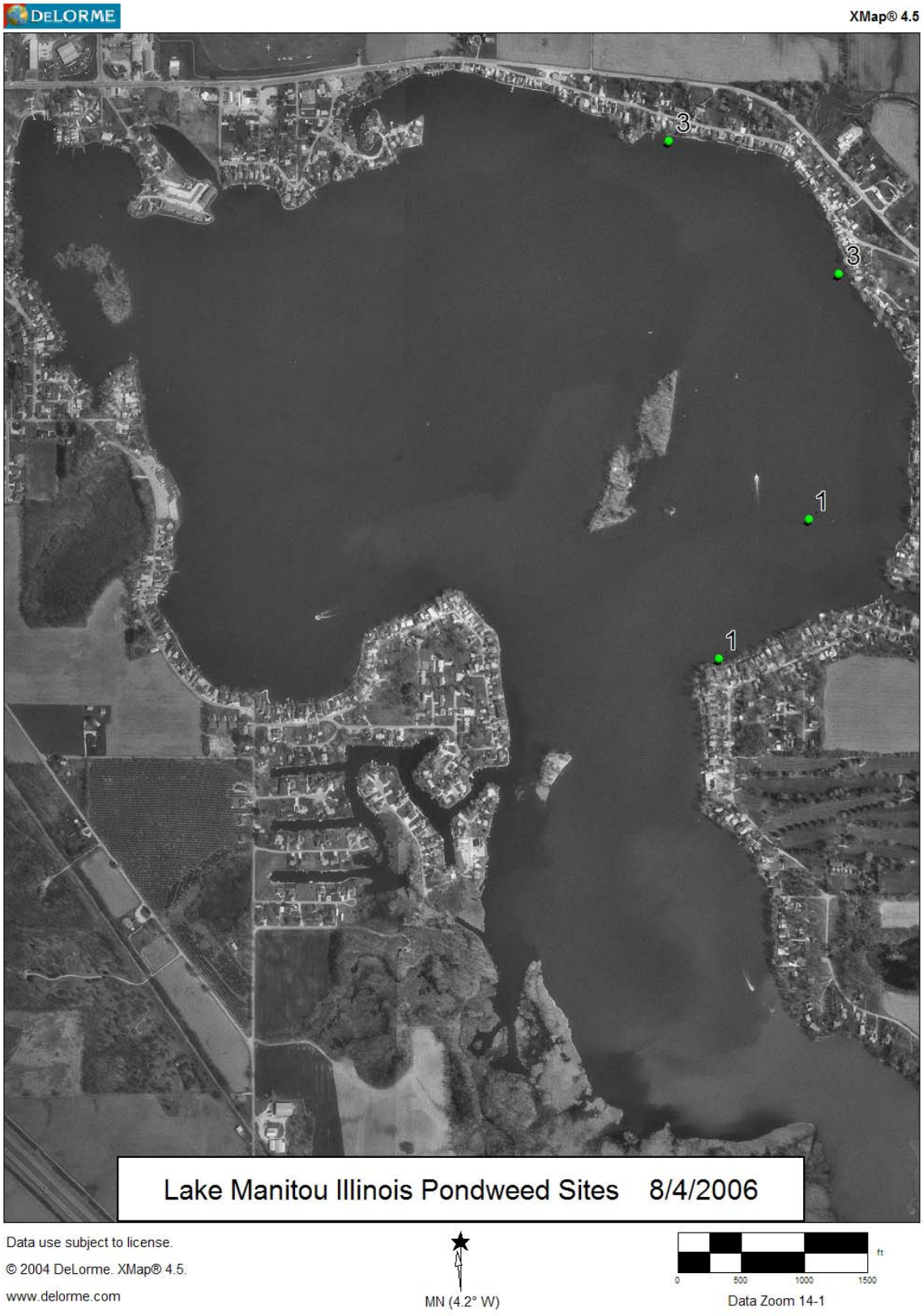


Figure 11: Fall 2006 Sago Pondweed Sites

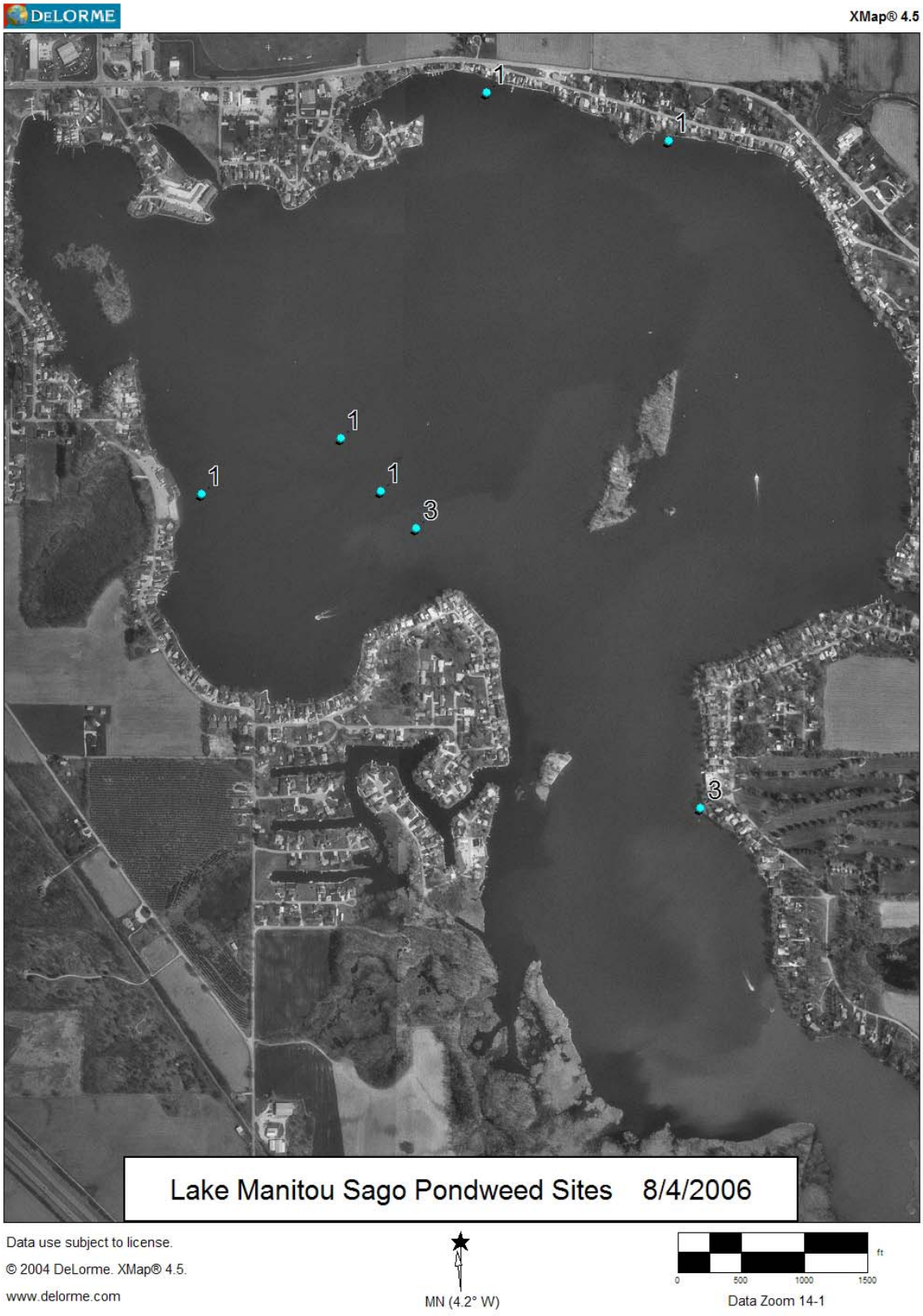
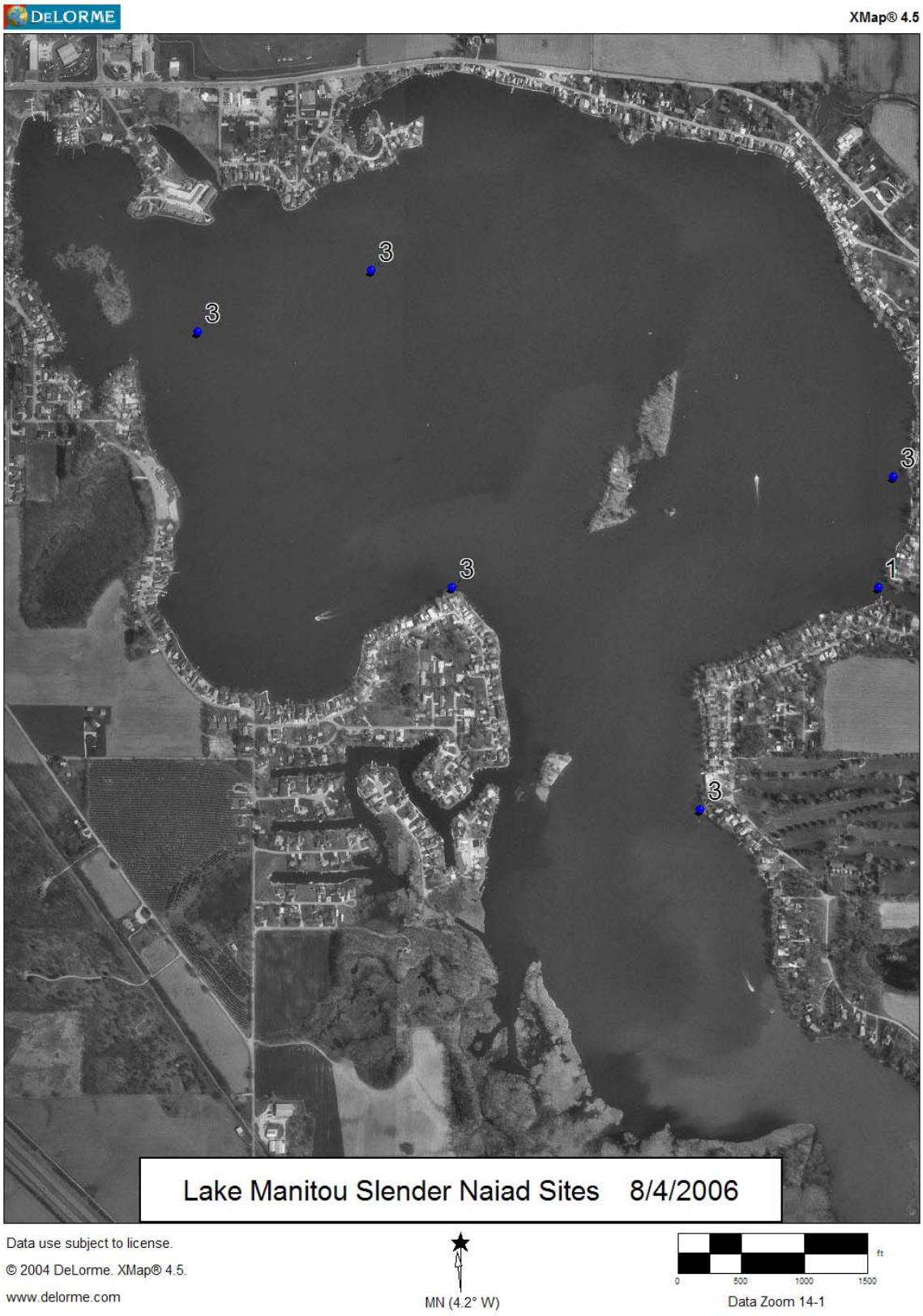


Figure 12: Fall 2006 Slender Naiad Sites



16.7 Data sheets

Table 14: Fall 2006 Data Sheet 1

Submersed Aquatic Plant Survey Form

Page 1 of 3

WATER BODY NAME Manitou
COUNTY Fulton/Miami
DATE August 4, 2006
CREW LEADER Dave
RECORDER Dan

SECCHI 3
MAX PLANT DEPTH 20 (12)
WEATHER Sunny hot upper 80s calm
COMMENTS water 7cm 83-84

334 M

Rake score (1, 3, 5), observed only (9), algae present (p)
Use acronyms for species, V1, V2...for voucher codes

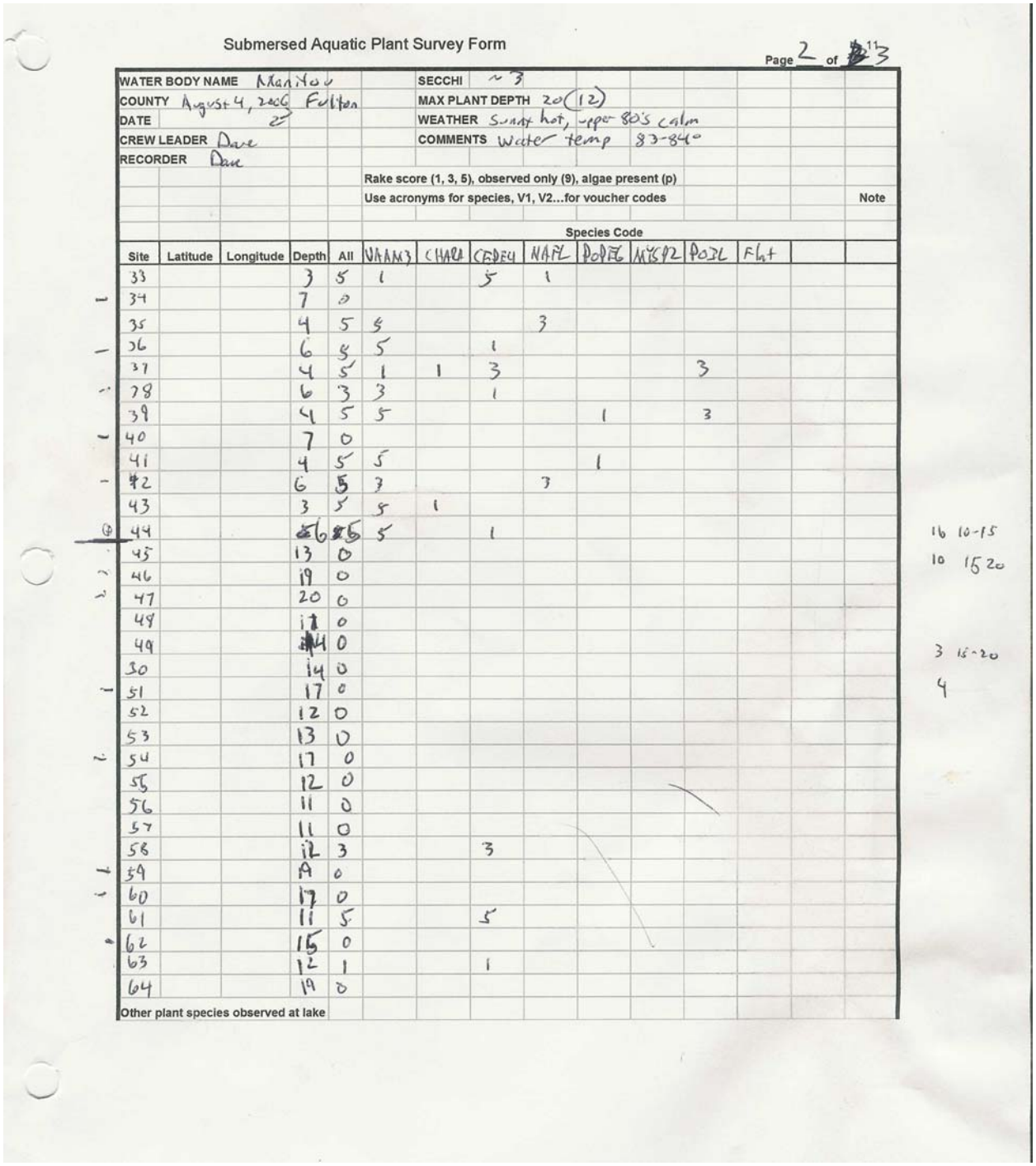
												0-5	5-10	10-15	15-20
												22	20	18	10
													9		
															Note
					Species Code								Po		
Site	Latitude	Longitude	Depth	All	UMAM3	CHARA	CEDE4	NAFL	POPE6	MYSP2	POIL	Flat			
1			4	5	5	1									
2			4	5	5	1									
3			3	3	3	1	1								
4			3	5	5			3							
5			8	0											
6			4	5	5				1						
7			9	3	3										
8			9	0											
9			4	5	1	5		1							
10			9	0											
11			4	5			3		1	3					
12			7	5	3				1	5					
13			6	3	3										
14	Antlers		3	5	5	1			3						
15			3	5	5			3							
16			10	0											
17			6	1	1										
18			3	1	1										
19			4	5	1		5								
20			10	1			1								
21			3	5	1		5								
22			4	5			5								
23			4	3	1		3								
24			10	1	1										
25			7	3			3								
26			6	0											
27			2	5	1			3	3						
28			9	3			3								
29			36	5	5						1				
30			6	0											
31			4	5	5										
32			6	1								1			

Other plant species observed at lake

15 5-10
18 5-10
2 10-15

milfoil Bed on Prairie ~4ac
South end of lake most cleaner - coontail coming up

Table 15: Fall 2006 Data Sheet 2



Submersed Aquatic Plant Survey Form

Page 2 of 13

WATER BODY NAME Manitou
COUNTY August 4, 2006 Fulton
DATE 2nd
CREW LEADER Dave
RECORDER Dave

SECCHI ~3
MAX PLANT DEPTH 20 (12)
WEATHER Sunny hot, upper 80's calm
COMMENTS Water temp 83-84°

Rake score (1, 3, 5), observed only (9), algae present (p)
Use acronyms for species, V1, V2...for voucher codes

Site	Latitude	Longitude	Depth	All	VAAM3	CHAR	CEDE4	NAFL	POPE6	MYSP2	POIL	Flt	Note
					Species Code								
33			3	5	1		5	1					
34			7	0									
35			4	5	5			3					
36			6	5	5		1						
37			4	5	1	1	3				3		
38			6	3	3		1						
39			4	5	5				1		3		
40			7	0									
41			4	5	5				1				
42			6	5	3			3					
43			3	5	5	1							
44			16	5	5		1						16 10-15
45			13	0									10 15-20
46			19	0									
47			20	0									
48			11	0									
49			14	0									3 15-20
50			14	0									
51			17	0									4
52			12	0									
53			13	0									
54			17	0									
55			12	0									
56			11	0									
57			11	0									
58			12	3			3						
59			A	0									
60			17	0									
61			11	5			5						
62			15	0									
63			12	1			1						
64			19	0									

Other plant species observed at lake

Table 16: Fall 2006 Data Sheet 3

Submersed Aquatic Plant Survey Form

Page 3 of 3 11

WATER BODY NAME	Manitou				SECCHI	~3									
COUNTY	Fulton				MAX PLANT DEPTH	20 (12)									
DATE	August 9, 2006				WEATHER										
CREW LEADER					COMMENTS										
RECORDER															
					Rake score (1, 3, 5), observed only (9), algae present (p)										
					Use acronyms for species, V1, V2...for voucher codes										Note
					Species Code										
Site	Latitude	Longitude	Depth	All											
65			15	0											
66			15	0											
67			20	0											
68			13	0											
69			14	0											
70			16	0											
Other plant species observed at lake															

1

2

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 6

State of Indiana Department of Natural Resources

ORGANIZATION: Lake Manitou

DATE: 6/1/06

SITE INFORMATION

Plant Bed ID: 01

Waterbody Name: Lake Manitou

Bed Size: 115 acres

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 3

High Organic? 1

Canopy Abundance at Site

S: 4 N: — F: — E: —

SITE COORDINATES

Center of the Bed

Latitude: N41 3.402

Longitude: W86 11.592

Max. Lakeward Extent of Bed

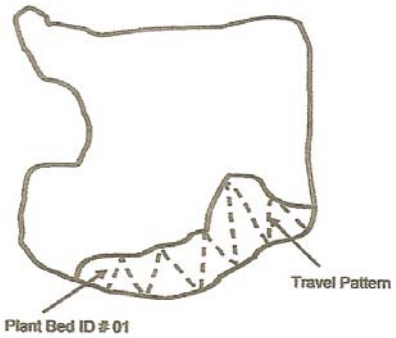
Latitude: N41 3.371

Longitude: W86 11.464

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3			
VAAM3	4			
DOPE6	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Weed Control

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 6

State of Indiana Department of Natural Resources

ORGANIZATION: Lake Manitou

DATE: 6/1/06

SITE INFORMATION

Plant Bed ID: 02

Waterbody Name: Lake Manitou

Bed Size: 62

Waterbody ID:

Substrate: 2

Total # of Species 5

Marl? 0

High Organic? 1

Canopy Abundance at Site

S: 4 N: F: E:

SITE COORDINATES

Center of the Bed

Latitude: N41 3.262

Longitude: W86 11.176

Max. Lakeward Extent of Bed

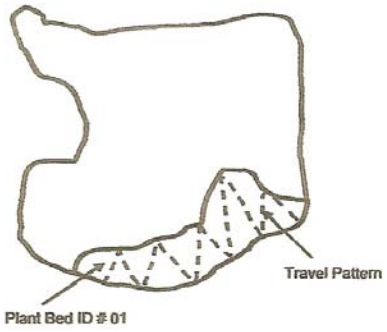
Latitude: N41 3.378

Longitude: W86 11.022

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
VAAM3	4			
POPE6	1			
NAFL	1			
MYSP2	2			
Also Bulrushes	1			

Individual Plant Bed Survey



Comments:

Prarie

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 6

State of Indiana Department of Natural Resources

ORGANIZATION: Lake Manitou

DATE: 6/1/06

SITE INFORMATION

Plant Bed ID: 33

Waterbody Name: Lake Manitou

Bed Size: 24 acres

Substrate: 1

Waterbody ID:

Marl? 0

Total # of Species 3

High Organic? 1

Canopy Abundance at Site

S: 4 N: 1 F: — E: —

SITE COORDINATES

Center of the Bed

Latitude: N41 2.700

Longitude: W86 10.839

Max. Lakeward Extent of Bed

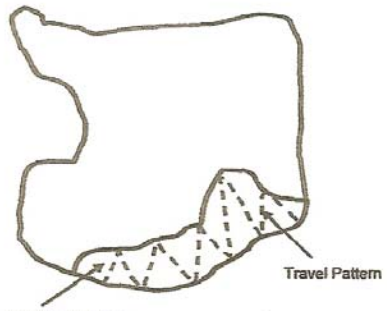
Latitude: N41 2.820

Longitude: W86 10.723

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3			
CEDEH	3			
LEMN	1			

Individual Plant Bed Survey



Comments:

50/50 mil-fo.l/coontail

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 6

State of Indiana Department of Natural Resources

ORGANIZATION: Lake Manitou

DATE: 6/1/06

SITE INFORMATION

Plant Bed ID: 54

Waterbody Name: Lake Manitou

Bed Size: 42 ac

Substrate: 1

Waterbody ID:

Marl? 0

Total # of Species 4

High Organic? 1

Canopy Abundance at Site: S: 4 N: 1 F: — E: —

SITE COORDINATES

Center of the Bed

Latitude: N41 2.408

Longitude: W86 10.435

Max. Lakeward Extent of Bed

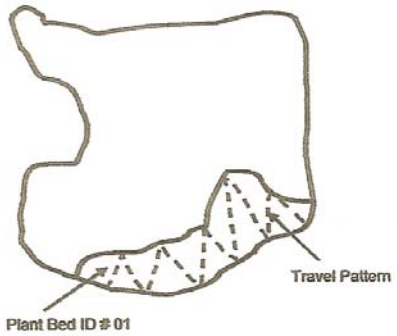
Latitude: N41 2.467

Longitude: W86 10.452

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3			
CEDE4	3			
LEMN	1			
Watermeal	1			

Individual Plant Bed Survey



Comments: More milfoil than 2005

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspt
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varified

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of 6

State of Indiana Department of Natural Resources

ORGANIZATION: Lake Manitou

DATE: 6/1/06

SITE INFORMATION

Plant Bed ID: 55

Bed Size: 6.5 ac.

Substrate: 1

Marl? 0

High Organic? 1

Waterbody Name: Lake Manitou

Waterbody ID:

Total # of Species 3

Canopy Abundance at Site

S: 4 N: — F: — E: —

SITE COORDINATES

Center of the Bed

Latitude: N41 2.735

Longitude: W86 10.478

Max. Lakeward Extent of Bed

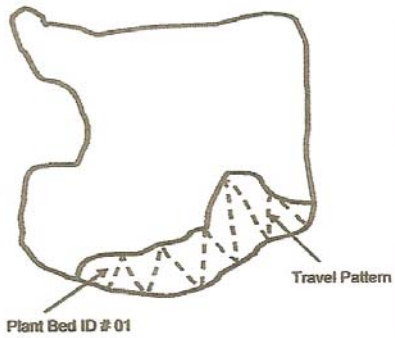
Latitude: N41 2.758

Longitude: W86 10.516

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	2			
CEDE4	3			
POPE6	1			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species susp
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 6 of 6

State of Indiana Department of Natural Resources

ORGANIZATION: Lake Manitou

DATE: 6/1/06

SITE INFORMATION

Plant Bed ID: S6

Bed Size: 166ac

Substrate: 2

Marl? 1

High Organic? 1

Waterbody Name: Lake Manitou

Waterbody ID:

Total # of Species 4

Canopy Abundance at Site: S: 4 | N: — | F: — | E: —

SITE COORDINATES

Center of the Bed

Latitude: N41 3.540

Longitude: W86 10.413

Max. Lakeward Extent of Bed

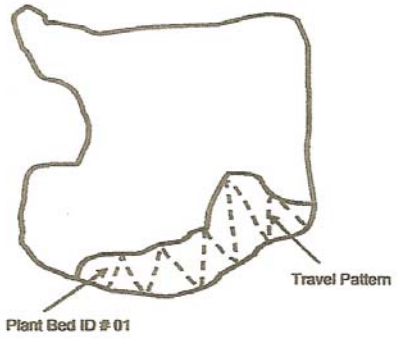
Latitude: N41 3.474

Longitude: W86 10.604

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
VAAM3	4			
MYSP2	2			
CEDE4	2			
POPE6	2			

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

16.8 IDNR Aquatic Vegetation Permit

There is no 2007 treatment permit. The whole lake will likely be treated pending the hydrilla control plan.