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MEMORANDUM

TO: **Friends of Beaver Lake**

DATE: **March 21, 2016**

SUBJECT: **Results of the August 6, 2015 aquatic plant surveys**

Two surveys were conducted on Beaver Lake on August 6, 2015. The first was a point-intercept survey to assess the aquatic plant community in the lake. The second was a meandering boat survey to determine the distribution and abundance of aquatic invasive species.

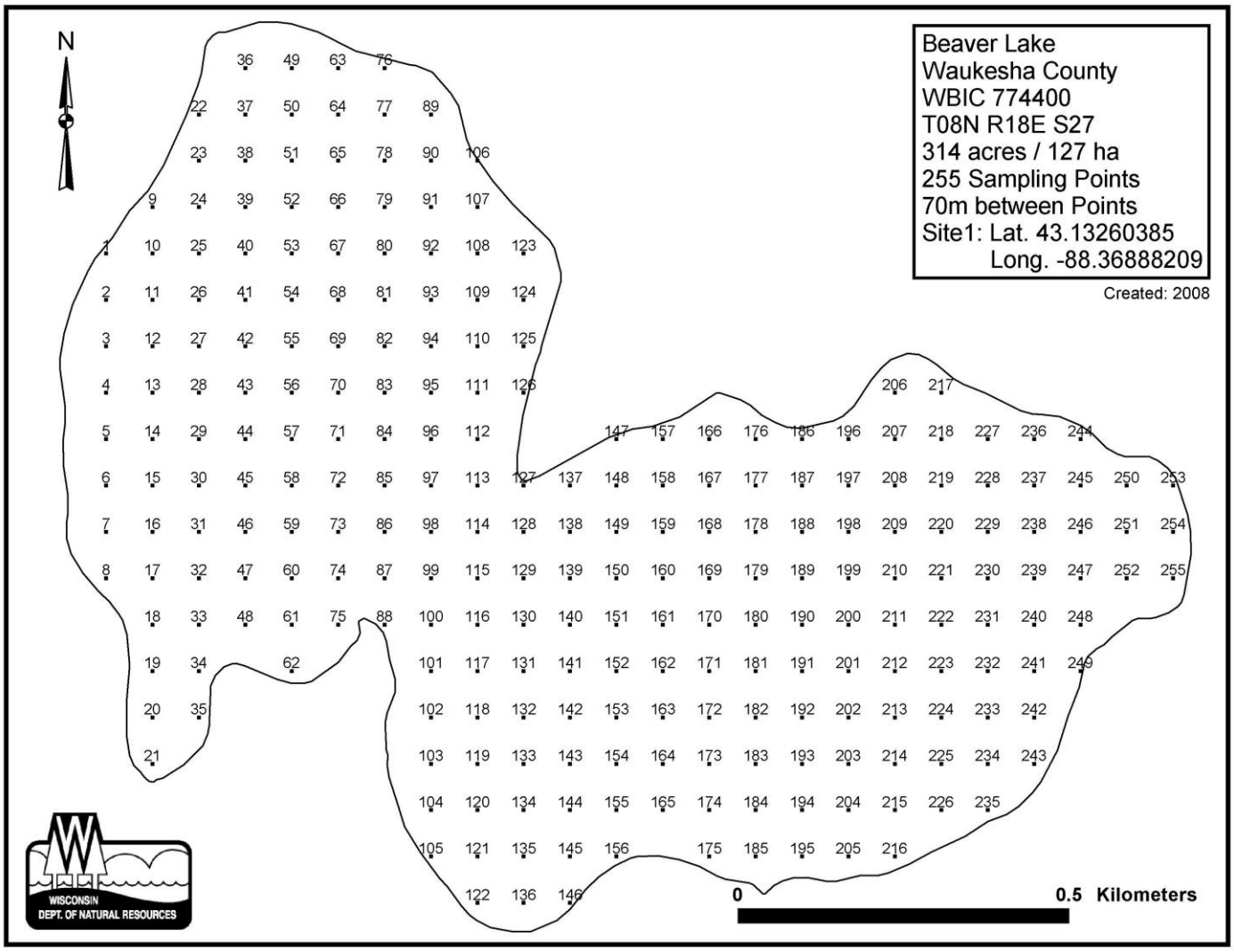
Recent Management Activity
In 2012 Cason & Associates, LLC conducted a survey of the fish community and a baseline survey of the lake's aquatic plant community. In 2013, Cason & Associates, LLC began assisting The Friends of Beaver Lake with managing invasive aquatic plants in Beaver Lake. An aquatic invasive species mapping survey on June 11, 2013 found Eurasian watermilfoil beds covering a total of 1.4 acres. On October 21, 2013, another aquatic invasive species mapping survey found six locations of Eurasian watermilfoil totaling 1.64 acres.

On June 6, 2014 the Eurasian watermilfoil beds mapped in 2013 were treated with a total of 275 lbs of Navigate® (granular 2,4-D). The application rates were 3 - 4 ppm (parts per million). A survey conducted in October 2014 found three beds of milfoil along with a small number of individual plants. Each of the three beds was approximately 0.1 acre in size. Plans were made to treat these areas in 2015. On May 8, 2015 and again on June 1, 2015 Cason and Associates' staff visited the lake with the intention to treat milfoil. On both occasions, the Eurasian watermilfoil identified the previous fall could not be located. It appeared the plants had died back over the winter. As a result, no treatment took place in 2015.

Submergent Aquatic Plant Survey

On August 6, 2015, a point-intercept survey of Beaver Lake was conducted in the same manner as the baseline survey conducted in 2012. At each of 255 grid points plotted across the lake (**Figure 1**), aquatic plant samples were collected from a boat with a single rake tow. The rake used consisted of two short-toothed garden rake heads welded together and attached to a rope. All plant samples collected were identified to *genus* and *species* whenever possible, and the information was recorded. An abundance rating was also given for each species. In addition to the plant data, water depths were recorded for each location. Data collected was used to determine species composition, percent frequency and relative abundance. Chi-square statistical analysis was used to determine if significant change took place between the 2012 and 2015 plant surveys.

Figure 1. Point-intercept aquatic plant survey map for Beaver Lake, Waukesha County, Wisconsin.



Aquatic Invasive Species Mapping Survey

The purpose of the second survey conducted on Beaver Lake on August 6, 2015 was to determine the distribution and abundance of Eurasian watermilfoil (*Myriophyllum spicatum*) and other aquatic invasive species. The survey was performed using surface observations, sonar and rake tows to verify locations of Eurasian watermilfoil. The locations of the beds were drawn on a lake map for reference. GPS waypoints were also recorded for each location to be used to accurately map the location and size of beds using ArcMap geospatial mapping software. Depth was also recorded for each location to be used to estimate treatment needs.

Prior to this survey, Friends of Beaver Lake expressed concern over the possible presence of starry stonewort (*Nitellopsis obtusa*), another invasive species recently identified in a small number of lakes in southeast Wisconsin.

Survey Results

A total of 148 locations had vegetation during the point-intercept survey. In 2012, during a similar survey, vegetation was found at 160 sites. Vegetation was found growing down to 24.8 feet in 2015 and 24.9 feet in 2012. A total of 10 aquatic plant species were found during the 2015 survey (**Table 1, Figure 2**). In 2012, 14 species were identified. The state-wide average is 13 species. Beaver Lake lies within the Southeastern Till Plain Forests region of Wisconsin. The average number of species found in lakes in this region is 14.

Table 1 shows the frequency of occurrence for plant species in the lake. Percent frequency values reflect the relationship between the number of locations where a particular species was found versus the total number of locations sampled shallower than maximum depth of plants. **Figure 2** shows the composition of the plant community. Percent composition values reflect the abundance of a particular species in relation to all other species found.

The most abundant plant species encountered in Beaver Lake during the 2015 survey were muskgrass (*Chara* spp.), a type of complex algae, slender naiad (*Najas flexilis*), and spiny naiad (*Najas marina*). Muskgrass was also the most abundant species in 2012 Muskgrass was found at nearly 75% of the locations with vegetation. **Figures 3-5** show the distribution of these three species throughout Beaver Lake.

In **Table 1** the asterisks indicate where statistically significant changes between 2012 and 2015 exist. The more asterisks represented for each plant species, the larger the significant change was. This change is also indicated as an increase or a decrease in change from 2012 to 2015. In the case of Beaver Lake, four species had significant declines in the past three years and one species experienced a significant increase.

Simpson Diversity Index

The plant data collected from Beaver Lake was used to calculate the Simpson Diversity Index (**Table 1**). In order to estimate the diversity of the aquatic plant community, this index takes in account both the number of species identified (richness) and the distribution or relative abundance of each species. As these parameters increase, so does the overall diversity. With the Simpson Diversity Index (D), 1 represents infinite diversity and 0, no diversity. That is, the bigger the value of D, the higher the diversity. The value of D calculated for Beaver Lake was 0.50 in 2015 and 0.61 in 2012. Although State-wide or regional averages for D are not available, data from lakes surveyed throughout the State have yielded values between 0.70 and 0.90. This suggests the diversity of Beaver Lake's aquatic plant community is relatively low.

Table 1. Results of the submergent aquatic plant surveys conducted on Beaver Lake in September 2012 and August 2015.

		Sept. 2012	Aug. 2015		
Common Name	**Scientific Name**	**Percent Frequency**	**Percent Frequency**	**Significant Change**	**Increase (I) or Decrease (D)**
Eurasian watermilfoil	***Myriophyllum spicatum***	**1.71**	**visual**		
Muskgrasses	*Chara spp.*	90.29	74.86	*	D
Slender naiad	*Najas flexilis*	18.29	13.41		
Spiny naiad	*Najas marina*	5.71	12.29	*	I
Variable pondweed	*Potamogeton gramineus*	20.00	5.03	***	D
Wild celery	*Vallisneria americana*	2.29	2.23		
Sago pondweed	*Stuckenia pectinata*	8.00	1.12	**	D
Filamentous algae	--	3.43	visual	*	D
Needle spikerush	*Eleocharis acicularis*	1.14	visual		
Spatterdock	*Nuphar variegata*	visual	visual		
Small bladderwort	*Utricularia minor*	0.57	--		
Common bladderwort	*Utricularia vulgaris*	0.57	--		
Thread-leaf pondweed	*Stuckenia filiformis*	0.57	--		
Small pondweed	*Potamogeton pusillus*	visual	--		
White water crowfoot	*Ranunculus aquatilis*	visual	--		

∗ significant change ($\alpha = 0.05$), ** more significant change ($\alpha = 0.01$), *** most significant change ($\alpha = 0.001$)

Number of Species (N)	*15*	*10*
Diversity Index (D)	*0.61*	*0.50*
Avg. Coefficient of Conservatism (C)	*6.7*	*5.7*
Floristic Quality Index (FQI)	*23.1*	*15.1*

Figure 2. Submergent aquatic plant community composition on August 6, 2015 in Beaver Lake, Waukesha County, Wisconsin.

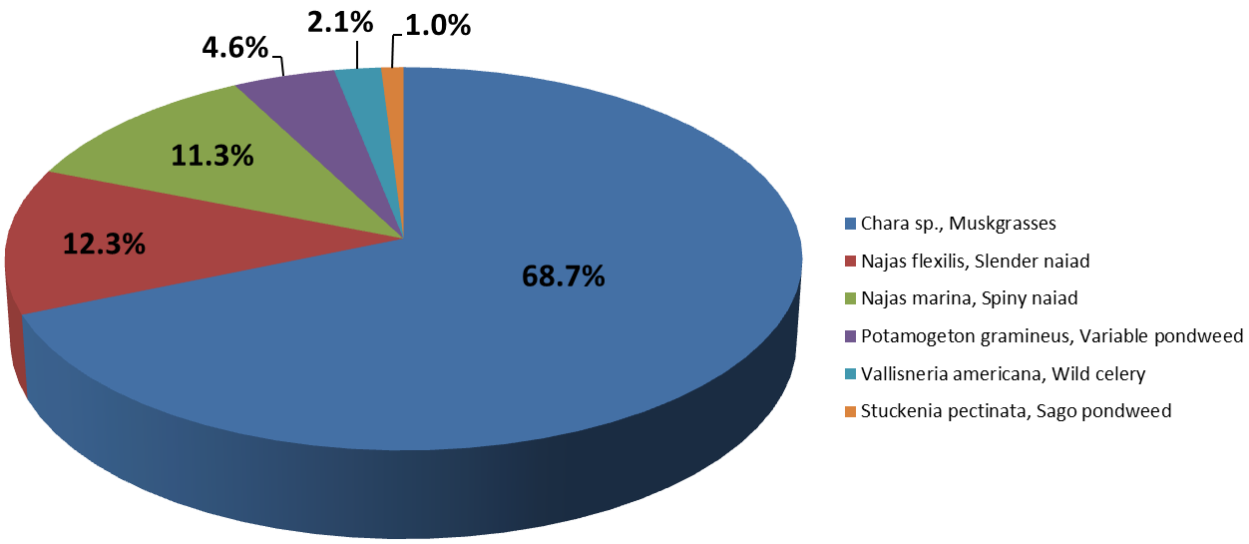


Figure 3. Distribution of muskgrass (*Chara* spp.), on August 6, 2015 on Beaver Lake, Waukesha County, WI.

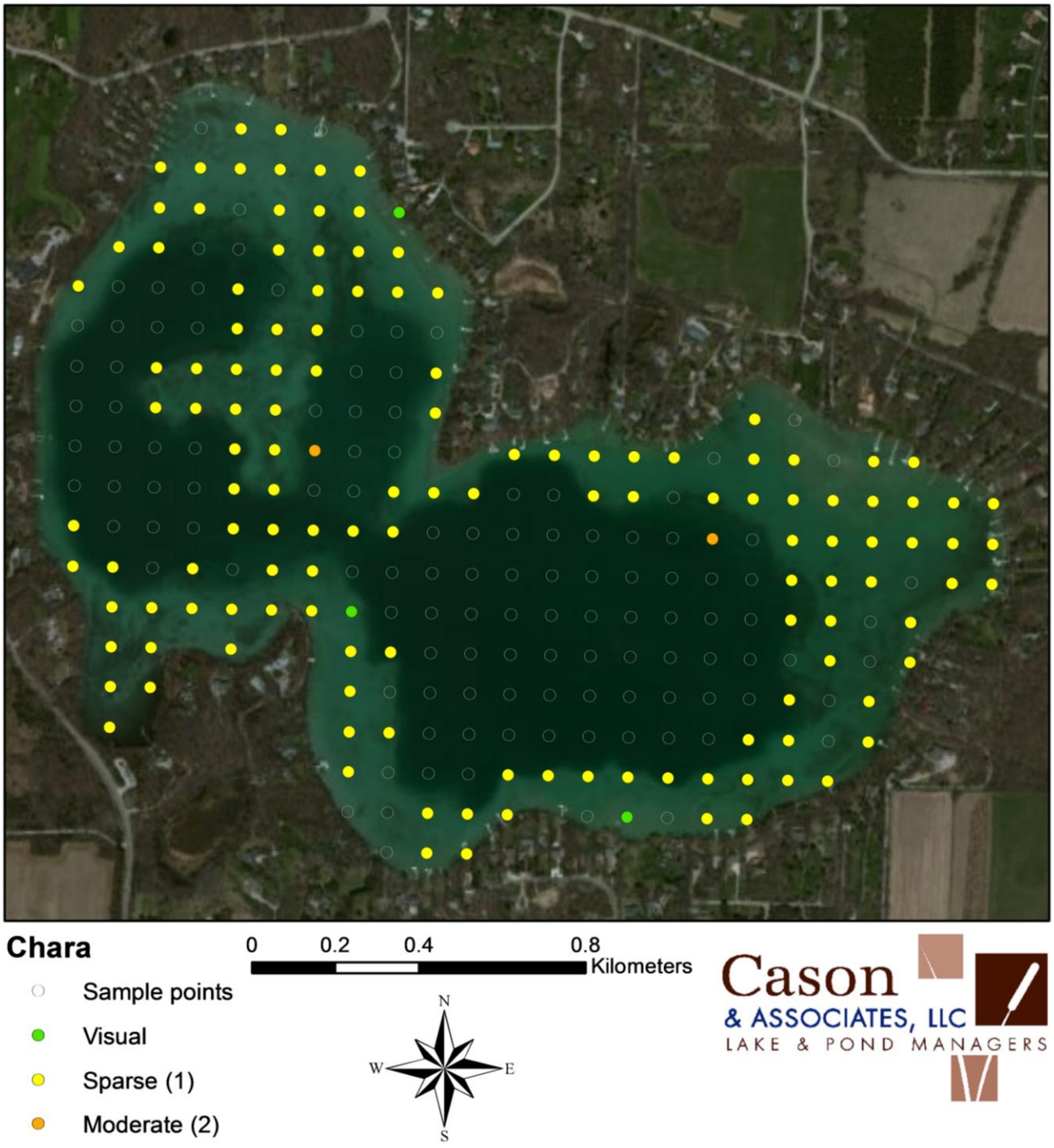


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Figure 4. Distribution of slender naiad (*Najas flexilis*), on August 6, 2015 on Beaver Lake, Waukesha County, WI.

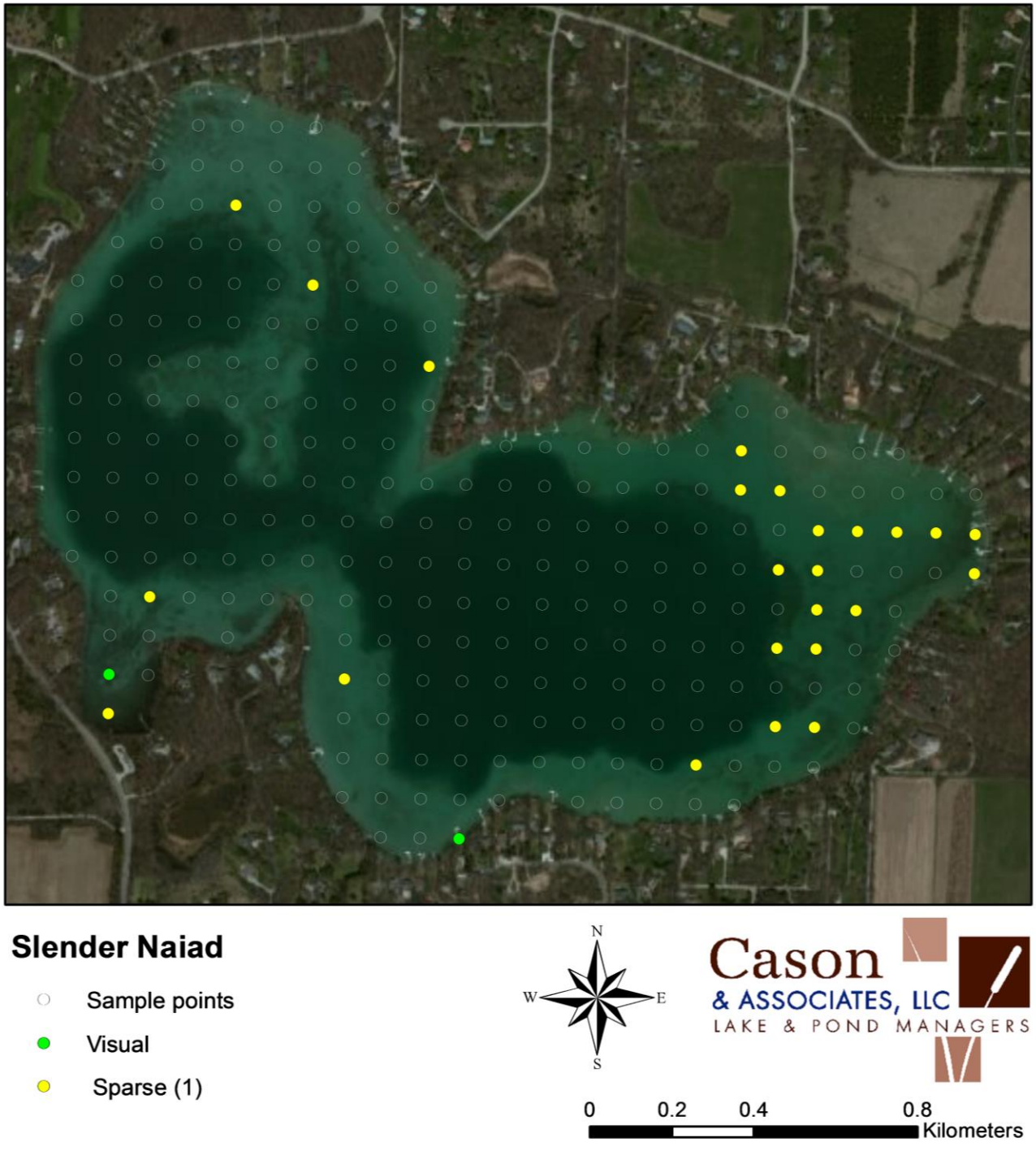

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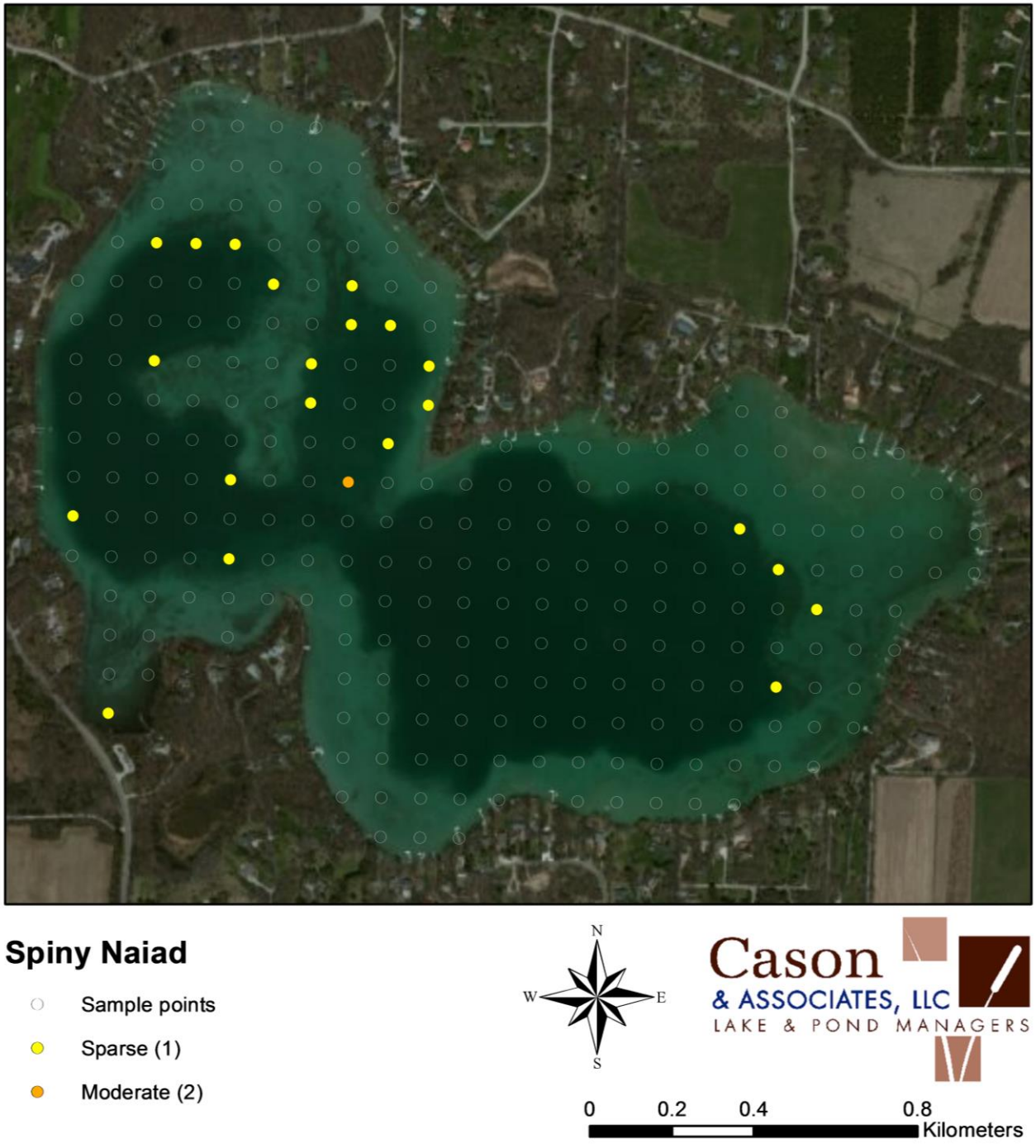
Figure 5. Distribution of spiny naiad (*Najas marina*), on August 6, 2015 on Beaver Lake, Waukesha County, WI.



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Assessment of Floristic Quality

Plant survey data were also used to assess the "floristic quality" of Beaver Lake. The method used assigns a value to each *native* plant species called a Coefficient of Conservatism (C). It does not take in account the presence of exotic species or filamentous algae. Coefficient values range from 0 - 10 and reflect a particular species' likelihood of occurring in a relatively undisturbed landscape. Species with low coefficient values, such as sago pondweed (*Stuckenia pectinata*) (C = 3), are likely to be found in a variety of habitat types and can tolerate high levels of human disturbance. On the other hand, species with higher coefficient values, such as variable pondweed (C = 7), are much more likely to be restricted to high quality, natural areas. By averaging the coefficient values available for the submergent and emergent species found in Beaver Lake, a value of 5.7 was calculated in 2015 and 6.7 in 2012 (**Table 4**). The average value for lakes in Wisconsin is 6.0 while the average for lakes in the Southeastern Till Plain region of Wisconsin is 5.6.

By utilizing the Coefficients of Conservatism for the plant species found in Beaver Lake, further assessment of floristic quality can be made. By multiplying the average coefficient values by the square root of the number of plant species found, a Floristic Quality Index (FQI) of 15.1 was calculated for Beaver Lake in 2015 and 23.1 in 2012. In general, higher FQI values reflect higher lake quality. The average for lakes in the Southeastern Till Plain region is 20.9. Both Coefficient of Conservatism and the Floristic Quality Index values suggest the quality of Beaver Lake, specifically in terms of the plant community, is currently below average. A significant portion of the lake contains marl sediments. These sediments tend to be high in alkaline minerals and often do not support a high diversity of plant growth. Given the lake's morphology, with its broad shallow expanses, the Beaver lake aquatic plant community may also be more susceptible to wave action from boat traffic.

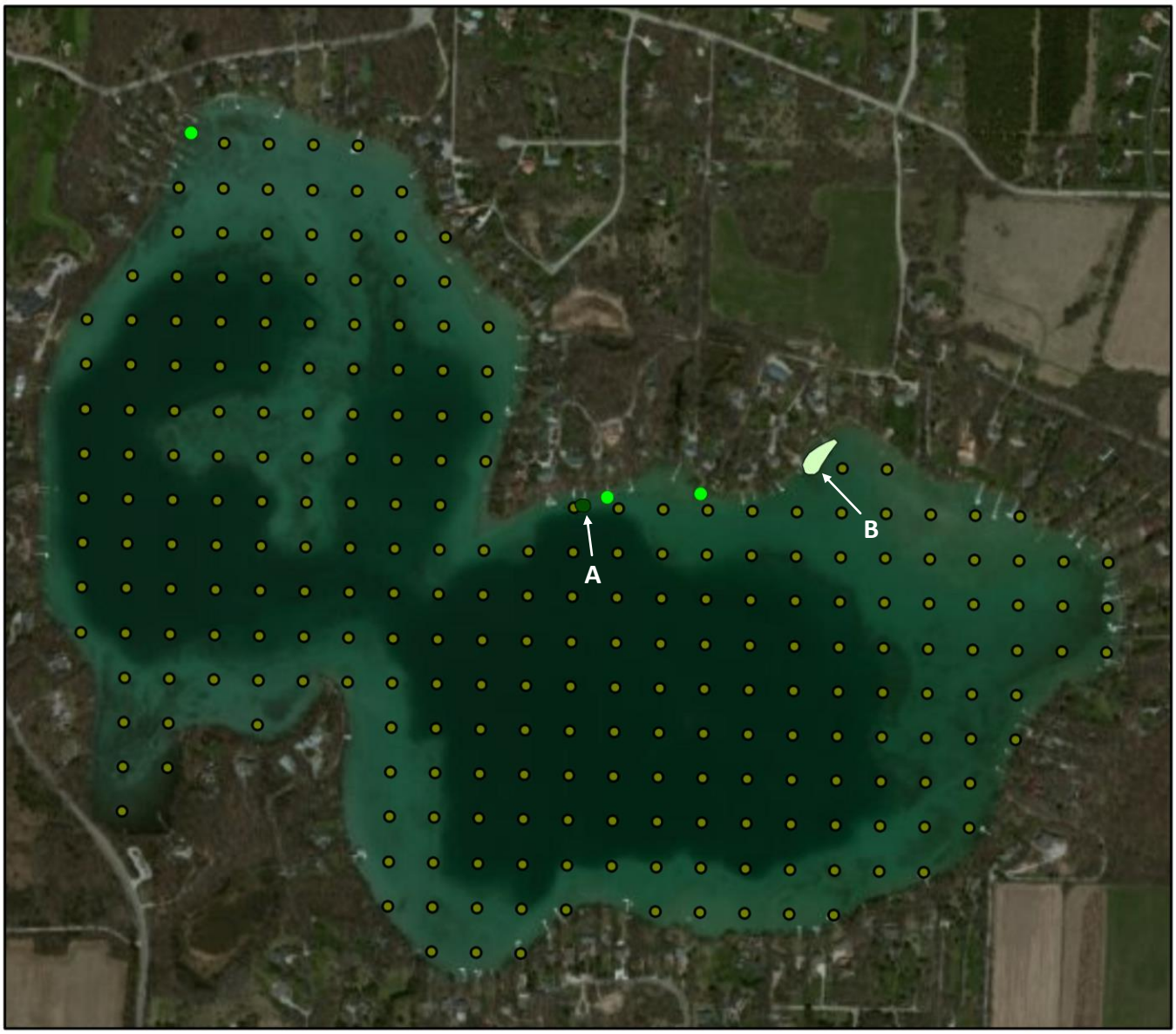
Aquatic plants serve an important purpose in the aquatic environment. They play an instrumental role in maintaining ecological balance in ponds, lakes, wetlands, rivers, and streams. Native aquatic plants have many values. They serve as buffers against nutrient loading and toxic chemicals, act as filters that capture runoff-borne sediments, stabilize lakebed sediments, protect shorelines from erosion, and provide critical fish and wildlife habitat. Therefore, it is essential that the native aquatic plant community within Beaver Lake be protected.

The raw data for the 2015 submergent aquatic plant survey can be found in **Appendix A.**

Invasive Species Mapping Results

Fortunately for Beaver Lake, Eurasian watermilfoil was identified in only five locations during the August 6, 2015 survey (**Figure 6**). Three of the locations consisted of an individual plant or a small group of plants. Plant growth in these areas was not abundant enough to warrant herbicide treatment. Only one of the two beds contained dense plant growth. The two plant beds contained enough plant growth to warrant treatment. Starry stonewort was not identified in Beaver Lake at the time of this survey.

Figure 6. Distribution of Eurasian watermilfoil in Beaver Lake, Waukesha County, WI found during the August 6, 2015 mapping survey.



Eurasian watermilfoil

- Individual plants, small groups of plants
- Highly scattered
- Dense
- Sample sites

N
W
E
S

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0 0.2 0.4 0.8 Kilometers

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Conclusions and Recommendations

Although treatment did not take place in 2015, Eurasian watermilfoil remained well below nuisance levels. In August 2015 additional areas of Eurasian watermilfoil growth were identified. It is important to continue to stay proactive with managing this invasive plant in order to keep the plant from spreading throughout the lake.

Eurasian Watermilfoil Management Options
Moving forward there are three options to consider in the future management of Eurasian watermilfoil in Beaver Lake.

Chemical treatment
Annual chemical treatments have been the tool of choice for managing Eurasian watermilfoil in Beaver Lake in recent years. In the spring of 2016, a chemical treatment could again be utilized. Eurasian watermilfoil beds should be targeted using Navigate®. The application rate for milfoil ranges from 2.0 to 4.0 ppm. For small, isolated beds, the maximum labeled rate of 4.0 ppm (56.8 lbs/acre-ft) is recommended. The higher concentration requires less contact time to be effective.

Chemical treatments can provide seasonal relief from Eurasian watermilfoil, but may not provide long-term control at these small scales. Often these beds are found in the same locations from year to year. These treatments did however serve to prevent or slow the further spread of Eurasian watermilfoil throughout the lake. While this approach rarely leads to eradication, these treatments can serve as a means to prevent wide-spread expansion of Eurasian watermilfoil. **Table 1** provides a breakdown of estimated treatment costs for 2016.

Table 1. Treatment cost estimate for Beaver Lake, 2016.

Bed	Acreage	Avg. Depth (ft)	Acre-ft	Rate	lbs	Cost/lb	Cost
A	0.1	4	0.4	56.8	22.7	$4.56	$104
B	0.4	4	1.6	56.8	90.9	$4.56	$414
Total	**0.5**		**2**		**113.6**		**$518**

Setup	$500
Labor	$100
Navigate	$518
Total	$1,118

Manual removal
Manually removing Eurasian watermilfoil plants can be an effective method for eliminating newly found single plants or small isolated beds. This can be done through a variety of approaches; however, the most appropriate approaches for the current situation are hand-pulling or diver-assisted suction harvesting (DASH). Hand-pulling is much easier to perform in shallow water, while DASH operations can be used in somewhat

deeper water. The DASH method employs a pump with a large hose mounted on a boat. The diver pulls the plants from the lake bed by hand and feeds them into the hose. The plant matter is pumped onto the boat where it is screened out. Currently, there are only a few companies in Wisconsin that offer DASH. To find out more about this option, the Association should contact the local Wisconsin Department of Natural Resources (WDNR) office.

If manual removal is utilized, it is important that lake residents and users know the difference between Eurasian watermilfoil and native northern watermilfoil (*Myriophyllum sibiricum*) and remove only Eurasian watermilfoil found around the lake. It would be wise to start by monitoring previous treatment locations to remove any surviving Eurasian watermilfoil. It is important to remove the entire plant (including fragments) and roots in order to keep it from spreading. This can be a great way to keep new infestations from becoming established.

No Management

The third option in managing Eurasian watermilfoil in Beaver Lake is to wait to see how the milfoil behaves. Recent WDNR research has suggested that in some lakes where Eurasian watermilfoil is introduced, it does not reach high enough levels to cause ecological or recreational harm. In these situations, the milfoil evidently remains at low occurrences and behaves like a native plant. However, this is not something that can be accurately predicted. If left unmanaged, Eurasian watermilfoil may or may not reach nuisance levels. If it did not, annual monitoring would still be needed to keep track of this species. However, if Eurasian watermilfoil increased significantly in the lake, it would likely mean returning to a more aggressive management approach, namely chemical treatments, which, on a larger scale, would also be more costly to conduct.

Monitoring Recommendation

It is recommended that The Friends of Beaver Lake continue sponsoring annual surveys to stay proactive in the management of Eurasian watermilfoil and other invasive aquatic plants in Beaver Lake. Locating and treating new Eurasian watermilfoil locations early is the best way to reduce the spread throughout the lake. The fall of the year is the ideal time to perform these surveys as milfoil is full grown and native plants have started to die back due to colder water temperatures. The annual cost for these surveys is $900.

Appendix A

Point-intercept aquatic plant survey data from August 6, 2015 on Beaver Lake, Waukesha County, Wisconsin.

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sampling point	Latitiude	Longitude	Depth (ft)	comments	Total Rake Fullness	*Chara* sp., Muskgrasses	*Najas flexilis* , Slender naiad	*Najas marina* , Spiny naiad	*Potamogeton gramineus* , Variable pondweed	*Stuckenia pectinata* , Sago pondweed	*Vallisneria americana* , Wild celery
1	43.1326	-88.3689	2.9		1	1					
2	43.1320	-88.3689	5.1	No plants							
3	43.1313	-88.3689	28.6	Deep							
4	43.1307	-88.3689	31.0	Deep							
5	43.1301	-88.3689	30.1	Deep							
6	43.1295	-88.3690	26.1	Deep							
7	43.1288	-88.3690	13.4		1	1		1			
8	43.1282	-88.3690	4.7		1	1			v		
9	43.1332	-88.3680	4.2		1	1					
10	43.1326	-88.3680	15.6	No plants							
11	43.1320	-88.3680	31.3	Deep							
12	43.1313	-88.3681	28.3	Deep							
13	43.1307	-88.3681	26.5	Deep							
14	43.1301	-88.3681	31.4	Deep							
15	43.1294	-88.3681	33.0	Deep							
16	43.1288	-88.3681	34.9	Deep							
17	43.1282	-88.3681	16.2		1	1					
18	43.1276	-88.3682	3.5		1	1					
19	43.1269	-88.3682	2.7		1	1					
20	43.1263	-88.3682	2.2		1	1	v				
21	43.1257	-88.3682	2.1		1	1	1	1		v	1
22	43.1345	-88.3671	2.0		1	1					
23	43.1338	-88.3671	3.5		1	1					
24	43.1332	-88.3671	9.4		1	1		1			
25	43.1326	-88.3672	31.9	Deep							
26	43.1319	-88.3672	30.4	Deep							
27	43.1313	-88.3672	8.9		1	1		1	1	1	
28	43.1307	-88.3672	4.3		1	1					
29	43.1301	-88.3672	27.3	Deep							
30	43.1294	-88.3672	31.9	Deep							
31	43.1288	-88.3673	34.4	Deep							
32	43.1282	-88.3673	31.2	Deep							
33	43.1275	-88.3673	4.6		1	1	1				
34	43.1269	-88.3673	2.4		2	1					
35	43.1263	-88.3673	1.2		2	1					
36	43.1351	-88.3662	2.2		1						
37	43.1345	-88.3663	3.4		1	1					
38	43.1338	-88.3663	5.0		1	1					
39	43.1332	-88.3663	14.3		1			1			
40	43.1326	-88.3663	26.3	Deep							

sampling point	Latitiude	Longitude	Depth (ft)	comments	Total Rake Fullness	*Chara* sp., Muskgrasses	*Najas flexilis* , Slender naiad	*Najas marina* , Spiny naiad	*Potamogeton gramineus* , Variable pondweed	*Stuckenia pectinata* , Sago pondweed	*Vallisneria americana* , Wild celery
41	43.1319	-88.3663	21.3	Deep							
42	43.1313	-88.3663	4.3		1	1					
43	43.1307	-88.3664	5.5		1	1					
44	43.1300	-88.3664	29.3	Deep							
45	43.1294	-88.3664	34.9	Deep							
46	43.1288	-88.3664	29.2	Deep							
47	43.1282	-88.3664	9.6		1	1					
48	43.1275	-88.3664	3.6		1	1					
49	43.1351	-88.3654	2.5		1	1					
50	43.1344	-88.3654	3.6		1	1					
51	43.1338	-88.3654	4.4		1		1				
52	43.1332	-88.3654	9.5		1			1			
53	43.1326	-88.3654	20.6		1	1					
54	43.1319	-88.3655	19.1		1	1					
55	43.1313	-88.3655	5.0		1	1					
56	43.1307	-88.3655	4.3		1	1					
57	43.1300	-88.3655	15.3		1	1					
58	43.1294	-88.3655	14.2		1	1		1			
59	43.1288	-88.3655	23.0		1	1					
60	43.1281	-88.3656	12.4		1			1			
61	43.1275	-88.3656	3.7		1	1					
62	43.1269	-88.3656	2.1		1	1					
63	43.1351	-88.3645	2.3		1	1					
64	43.1344	-88.3645	3.1		1	1					
65	43.1338	-88.3645	3.5		1	1					
66	43.1332	-88.3646	5.0		1	1					
67	43.1325	-88.3646	6.3		1			1			
68	43.1319	-88.3646	4.8		1	1					
69	43.1313	-88.3646	4.8		1	1					
70	43.1307	-88.3646	4.6		1	1					
71	43.1300	-88.3646	4.8		1	1					
72	43.1294	-88.3647	6.4		1	1					
73	43.1288	-88.3647	17.8		1	1					
74	43.1281	-88.3647	7.3		1	1					
75	43.1275	-88.3647	1.9		1	1					
76	43.1351	-88.3637	1.5	No plants							
77	43.1344	-88.3637	3.0		1	1					
78	43.1338	-88.3637	3.8		1	1					
79	43.1332	-88.3637	4.8		1	1					
80	43.1325	-88.3637	4.9		1	1	1				

sampling point	Latitiude	Longitude	Depth (ft)	comments	Total Rake Fullness	*Chara* sp., Muskgrasses	*Najas flexilis* , Slender naiad	*Najas marina* , Spiny naiad	*Potamogeton gramineus* , Variable pondweed	*Stuckenia pectinata* , Sago pondweed	*Vallisneria americana* , Wild celery
82	43.1313	-88.3638	9.5		1	1		1		1	
83	43.1306	-88.3638	14.1		1			1			
84	43.1300	-88.3638	9.4		2	2					
85	43.1294	-88.3638	12.0	No plants							
86	43.1287	-88.3638	15.4		1	1					
87	43.1281	-88.3638	5.3		1	1					
88	43.1275	-88.3639	2.6		1	1					
89	43.1344	-88.3628	2.1		1	1					
90	43.1338	-88.3628	3.1		1	1					
91	43.1331	-88.3628	4.9		1	1					
92	43.1325	-88.3629	6.6		1	1		1			
93	43.1319	-88.3629	12.3		1			1			
94	43.1313	-88.3629	22.0	Deep							
95	43.1306	-88.3629	21.5	Deep							
96	43.1300	-88.3629	19.8	Deep							
97	43.1294	-88.3629	12.6		2			2			
98	43.1287	-88.3630	17.3		1	1					
99	43.1281	-88.3630	21.9	Deep							
100	43.1275	-88.3630	4.5			v					
101	43.1268	-88.3630	4.8		1	1					
102	43.1262	-88.3630	4.3		1	1	1				
103	43.1256	-88.3630	4.1		1	1					
104	43.1250	-88.3631	2.7		1	1					
105	43.1243	-88.3631	2.0	No plants							
106	43.1338	-88.3620	1.6			v					
107	43.1331	-88.3620	3.0		1	1					
108	43.1325	-88.3620	4.4		1	1					
109	43.1319	-88.3620	13.6		1			1			
110	43.1312	-88.3620	22.7	Deep							
111	43.1306	-88.3621	21.8	Deep							
112	43.1300	-88.3621	13.1		1			1			
113	43.1294	-88.3621	6.9		1	1					
114	43.1287	-88.3621	11.2		1	1					
115	43.1281	-88.3621	38.2	Deep							
116	43.1275	-88.3621	32.0	Deep							
117	43.1268	-88.3622	8.4		1	1					
118	43.1262	-88.3622	5.0	No plants							
119	43.1256	-88.3622	4.9		1	1					
120	43.1249	-88.3622	4.5	No plants							
121	43.1243	-88.3622	3.6	No plants							

sampling point	Latitiude	Longitude	Depth (ft)	comments	Total Rake Fullness	*Chara* sp., Muskgrasses	*Najas flexilis* , Slender naiad	*Najas marina* , Spiny naiad	*Potamogeton gramineus* , Variable pondweed	*Stuckenia pectinata* , Sago pondweed	*Vallisneria americana* , Wild celery
122	43.1237	-88.3622	2.4	No plants							
123	43.1325	-88.3611	2.5		1	1			1		
124	43.1319	-88.3612	4.4	No plants							
125	43.1312	-88.3612	5.9		1	1	1	1			
126	43.1306	-88.3612	3.7		1	1		1			
127	43.1293	-88.3612	8.3		1	1					
128	43.1287	-88.3612	35.9	Deep							
129	43.1281	-88.3613	43.4	Deep							
130	43.1275	-88.3613	44.2	Deep							
131	43.1268	-88.3613	39.1	Deep							
132	43.1262	-88.3613	36.2	Deep							
133	43.1256	-88.3613	32.8	Deep							
134	43.1249	-88.3613	25.1	Deep							
135	43.1243	-88.3614	4.1		1	1					
136	43.1237	-88.3614	2.8		1	1					
137	43.1293	-88.3604	10.0		1	1			1		
138	43.1287	-88.3604	41.7	Deep							
139	43.1281	-88.3604	43.8	Deep							
140	43.1274	-88.3604	44.2	Deep							
141	43.1268	-88.3604	43.0	Deep							
142	43.1262	-88.3604	40.0	Deep							
143	43.1255	-88.3605	37.8	Deep							
144	43.1249	-88.3605	33.0	Deep							
145	43.1243	-88.3605	5.2		1	1					
146	43.1237	-88.3605	1.9		1	1	v				
147	43.1299	-88.3595	6.4		1	1					
148	43.1293	-88.3595	41.4	Deep							
149	43.1287	-88.3595	46.3	Deep							
150	43.1281	-88.3595	44.2	Deep							
151	43.1274	-88.3596	40.8	Deep							
152	43.1268	-88.3596	41.4	Deep							
153	43.1262	-88.3596	43.3	Deep							
154	43.1255	-88.3596	42.6	Deep							
155	43.1249	-88.3596	5.7		1	1					
156	43.1243	-88.3596	1.6		1	1					
157	43.1299	-88.3586	4.9		1	1					
158	43.1293	-88.3586	37.1	Deep							
159	43.1287	-88.3587	46.0	Deep							
160	43.1280	-88.3587	45.6	Deep							
161	43.1274	-88.3587	43.4	Deep							

sampling point	Latitiude	Longitude	Depth (ft)	comments	Total Rake Fullness	*Chara* sp., Muskgrasses	*Najas flexilis* , Slender naiad	*Najas marina* , Spiny naiad	*Potamogeton gramineus* , Variable pondweed	*Stuckenia pectinata* , Sago pondweed	*Vallisneria americana* , Wild celery
162	43.1268	-88.3587	41.4	Deep							
163	43.1262	-88.3587	43.5	Deep							
164	43.1255	-88.3587	44.8	Deep							
165	43.1249	-88.3588	6.4		1	1			1		
166	43.1299	-88.3578	4.5		1	1					
167	43.1293	-88.3578	5.4		1	1					
168	43.1287	-88.3578	41.4	Deep							
169	43.1280	-88.3578	45.6	Deep							
170	43.1274	-88.3578	45.5	Deep							
171	43.1268	-88.3578	43.8	Deep							
172	43.1261	-88.3579	45.8	Deep							
173	43.1255	-88.3579	43.7	Deep							
174	43.1249	-88.3579	5.6		1	1					
175	43.1243	-88.3579	2.5	No plants							
176	43.1299	-88.3569	3.9		1	1					
177	43.1293	-88.3569	5.5		1	1					
178	43.1287	-88.3569	26.7	Deep							
179	43.1280	-88.3570	36.6	Deep							
180	43.1274	-88.3570	41.5	Deep							
181	43.1268	-88.3570	45.7	Deep							
182	43.1261	-88.3570	44.4	Deep							
183	43.1255	-88.3570	38.3	Deep							
184	43.1249	-88.3570	6.1		1	1					
185	43.1242	-88.3571	2.5			v					
186	43.1299	-88.3560	5.2		1	1					
187	43.1293	-88.3561	9.4	No plants							
188	43.1286	-88.3561	26.4	Deep							
189	43.1280	-88.3561	33.4	Deep							
190	43.1274	-88.3561	39.6	Deep							
191	43.1267	-88.3561	44.6	Deep							
192	43.1261	-88.3561	40.0	Deep							
193	43.1255	-88.3562	38.4	Deep							
194	43.1249	-88.3562	9.1		1	1					
195	43.1242	-88.3562	2.7	No plants							
196	43.1299	-88.3552	4.5	No plants							
197	43.1293	-88.3552	6.0		1	1					
198	43.1286	-88.3552	21.6		2	2					
199	43.1280	-88.3552	28.9	Deep							
200	43.1274	-88.3553	35.5	Deep							
201	43.1267	-88.3553	37.8	Deep							

sampling point	Latitiude	Longitude	Depth (ft)	comments	Total Rake Fullness	*Chara* sp., Muskgrasses	*Najas flexilis* , Slender naiad	*Najas marina* , Spiny naiad	*Potamogeton gramineus* , Variable pondweed	*Stuckenia pectinata* , Sago pondweed	*Vallisneria americana* , Wild celery
202	43.1261	-88.3553	35.7	Deep							
203	43.1255	-88.3553	34.8	Deep							
204	43.1248	-88.3553	8.1		1	1	1				
205	43.1242	-88.3553	2.2		1	1			1		
206	43.1305	-88.3543	2.9		1	1			1		
207	43.1299	-88.3543	4.8		1	1	1				
208	43.1292	-88.3543	5.2		1	1	1				
209	43.1286	-88.3544	7.6		1			1			
210	43.1280	-88.3544	22.2		1						
211	43.1274	-88.3544	29.1	Deep							
212	43.1267	-88.3544	29.6	Deep							
213	43.1261	-88.3544	31.8	Deep							
214	43.1255	-88.3544	24.8		1	1					
215	43.1248	-88.3545	5.1		1	1					
216	43.1242	-88.3545	3.5		1	1					
217	43.1305	-88.3534	1.9	No plants							
218	43.1299	-88.3535	3.0		1	1					
219	43.1292	-88.3535	5.0		1	1	1				
220	43.1286	-88.3535	5.7		1	1					
221	43.1280	-88.3535	10.0		1	1	1	1			
222	43.1273	-88.3535	10.4		1	1					
223	43.1267	-88.3535	6.6		1		1				
224	43.1261	-88.3536	13.9		1	1		1			
225	43.1255	-88.3536	5.6		1	1	1				
226	43.1248	-88.3536	4.4		1	1					
227	43.1298	-88.3526	1.7	No plants							
228	43.1292	-88.3526	2.5		1	1					
229	43.1286	-88.3526	5.0		1	1	1				
230	43.1280	-88.3527	5.6		1	1	1				
231	43.1273	-88.3527	5.4		1	1	1	1			
232	43.1267	-88.3527	5.1		1	1	1				
233	43.1261	-88.3527	5.3	No plants							
234	43.1254	-88.3527	4.7		1		1				
235	43.1248	-88.3527	3.6		1	1			1		
236	43.1298	-88.3517	2.0		1	1					
237	43.1292	-88.3518	2.8		1	1					
238	43.1286	-88.3518	4.7		1	1	1				
239	43.1279	-88.3518	5.0		1	1					
240	43.1273	-88.3518	4.8		1		1				
241	43.1267	-88.3518	4.5	No plants							

sampling point	Latitiude	Longitude	Depth (ft)	comments	Total Rake Fullness	*Chara* sp., Muskgrasses	*Najas flexilis* , Slender naiad	*Najas marina* , Spiny naiad	*Potamogeton gramineus* , Variable pondweed	*Stuckenia pectinata* , Sago pondweed	*Vallisneria americana* , Wild celery
242	43.1261	-88.3518	4.1		1	1					
243	43.1254	-88.3519	4.3		1	1					
244	43.1298	-88.3509	1.2		1	1			v		
245	43.1292	-88.3509	2.7		1	1					
246	43.1286	-88.3509	4.6		1	1	1				
247	43.1279	-88.3509	4.3	No plants							
248	43.1273	-88.3510	3.2		1	1					1
249	43.1267	-88.3510	1.8		1	1					
250	43.1292	-88.3500	3.5		1	1			1		
251	43.1286	-88.3501	3.9		1	1	1				
252	43.1279	-88.3501	3.3		1	1			1		
253	43.1292	-88.3492	1.8		1	1			v		v
254	43.1285	-88.3492	2.5		1	1	1				1
255	43.1279	-88.3492	2.2		1	1	1				1