Water Lilies were Common in Comfort Lake on August 8, 2023

Curlyleaf Pondweed and Eurasian Watermilfoil Management and Point Intercept Surveys for Comfort Lake, Chisago County, 2023

June 2, 2022: Whole Lake Fluridone Treatment

	Delineation	Treatment	Assessment
CLP	April 24, 2023	No Treatment	June 2, 2023
EWM	April 24, 2023	September 19, 2023 (2.77 ac)	June 2 and August 8, 2023

Meander Surveys: April 24 and August 8, 2023
Point Intercept Survey: June 2, 2023

Prepared for:
Comfort Lake/Forest Lake Watershed District
Forest Lake, Minnesota

December 6, 2023

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Curlyleaf Pondweed and Eurasian Watermilfoil Management and Point Intercept Surveys for Comfort Lake, Chisago County, 2023

Summary

Surveys were conducted on 3 dates in Comfort Lake in 2023. On April 24, 2023 a meander survey was completed, on June 2, 2023 a meander survey was combined with a point intercept survey, and on August 8, 2023 a meander survey was conducted.

Curlyleaf Pondweed Delineation and Assessment Surveys: Curlyleaf pondweed delineation for distribution and abundance was conducted on April 24, 2023. A follow-up curlyleaf assessment was conducted on June 2, 2023.

In the delineation survey, curlyleaf was found in Comfort Lake at 4 sites (Figure 1) and a few native plants were sampled as well.

Curlyleaf pondweed was not treated in 2023.

A little over a month later, the June curlyleaf assessment included a point intercept survey combined with a meander survey. Curlyleaf was found at a total of 32 sites and growth was mostly light (Figure 1).

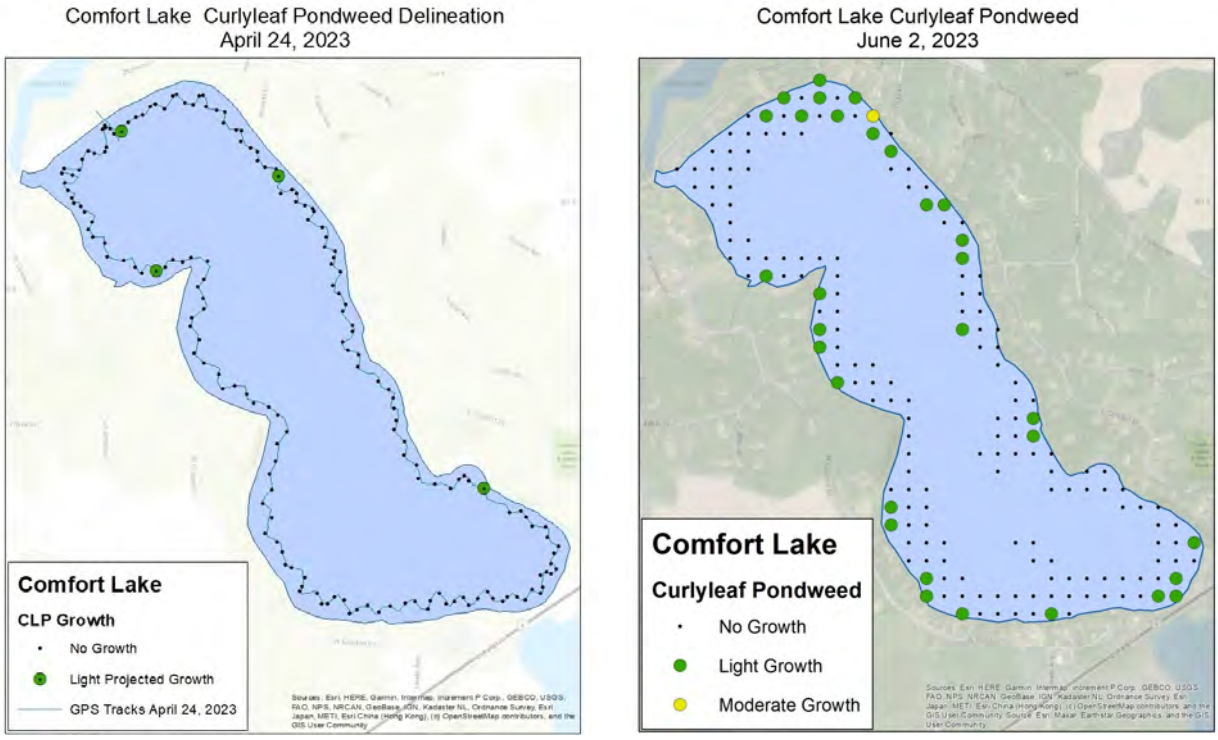


Figure 1. [left] DELINEATION: Map of curlyleaf pondweed distribution from the April 24, 2023 meander survey. Key: black dots = sample locations and green dot = light growth potential.
TREATMENT: No curlyleaf pondweed treatment occurred in 2023.
[right] ASSESSMENT: Map of curlyleaf pondweed assessment sites for June 2, 2023 included a point intercept combined with a meander survey. Key: black dots = no curlyleaf growth, green dots = light growth, and yellow dots = moderate growth.

Eurasian Watermilfoil Delineation, Treatment, and Assessment Surveys: A whole lake EWM treatment using Fluridone was conducted on June 22, 2022. Surveys in 2023 were intended to assess results from the 2022 whole lake treatment and delineate and assess 2023 EWM growth. An EWM delineation for distribution and abundance was conducted on April 24, 2023 and EWM was not observed at any of the sample sites. A point intercept survey combined with a meander survey was conducted on June 2, 2023. Eurasian watermilfoil was found at 3 meander sites and 1 point intercept site on June 2, 2023 (Figure 2). Another meander survey was conducted on August 8, 2023 and EWM was sampled at 21 sites. Based on the August findings, 2.77 acres of EWM were delineated for treatment.

A treatment of 2.77 acres of EWM was conducted on September 19, 2023 in 2 areas on Comfort Lake using ProcellaCOR (Figure 2).

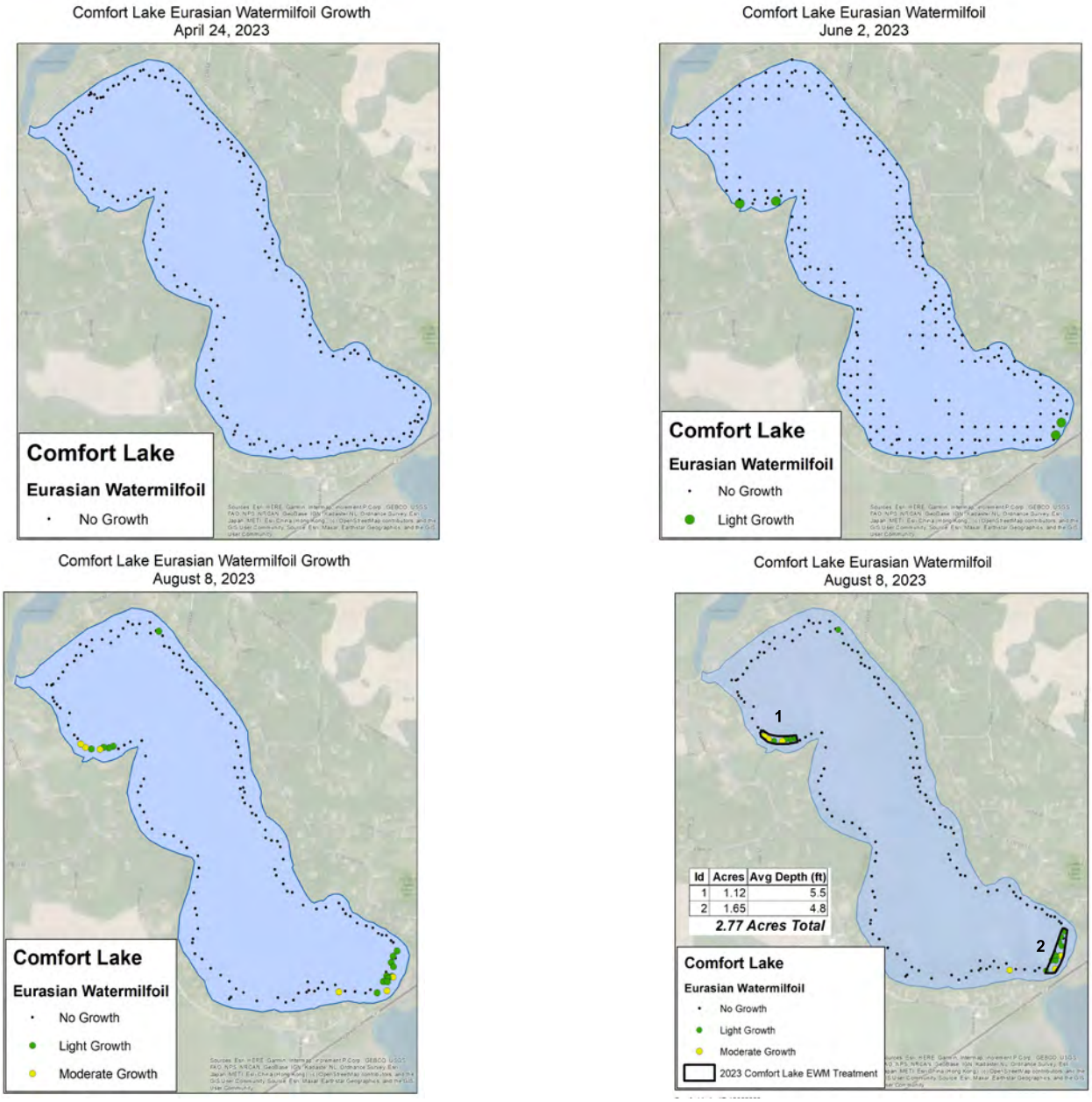


Figure 2. [top-left] DELINEATION: Map of EWM distribution from the April 24, 2023 survey. No EWM was sampled. [top-right] ASSESSMENT: Map of point intercept and meander survey for June 2, 2023. EWM was found at 4 sites and all light growth. [bottom-left] DELINEATION/ASSESSMENT: Map of a meander survey on August 8, 2023. EWM was found at 21 sites. [bottom-right] TREATMENT: Map of meander survey for August 8, 2023 showing the two treatment areas. EWM was treated on September 19, 2023.

Curlyleaf Pondweed and Eurasian Watermilfoil Treatments from 2014 Through 2023: A summary of CLP and EWM treatments from 2014-2023 is shown in Figure 3. Curlyleaf was only treated at 1 acre in 2015. Curlyleaf has been sparse in Comfort Lake since then. EWM was first observed in 2014 and it has spread around the lake in the last few years. A total of 7.5 acres was treated in 2016 and 3.2 acres were treated in 2017. Spot herbicide treatments were conducted from 2018 to 2021 in nearshore areas by the Comfort Lake Association. On June 22, 2022 a whole lake fluridone treatment of 218 acres was conducted and on September 19, 2023 two areas totaling 2.77 acres were treated.

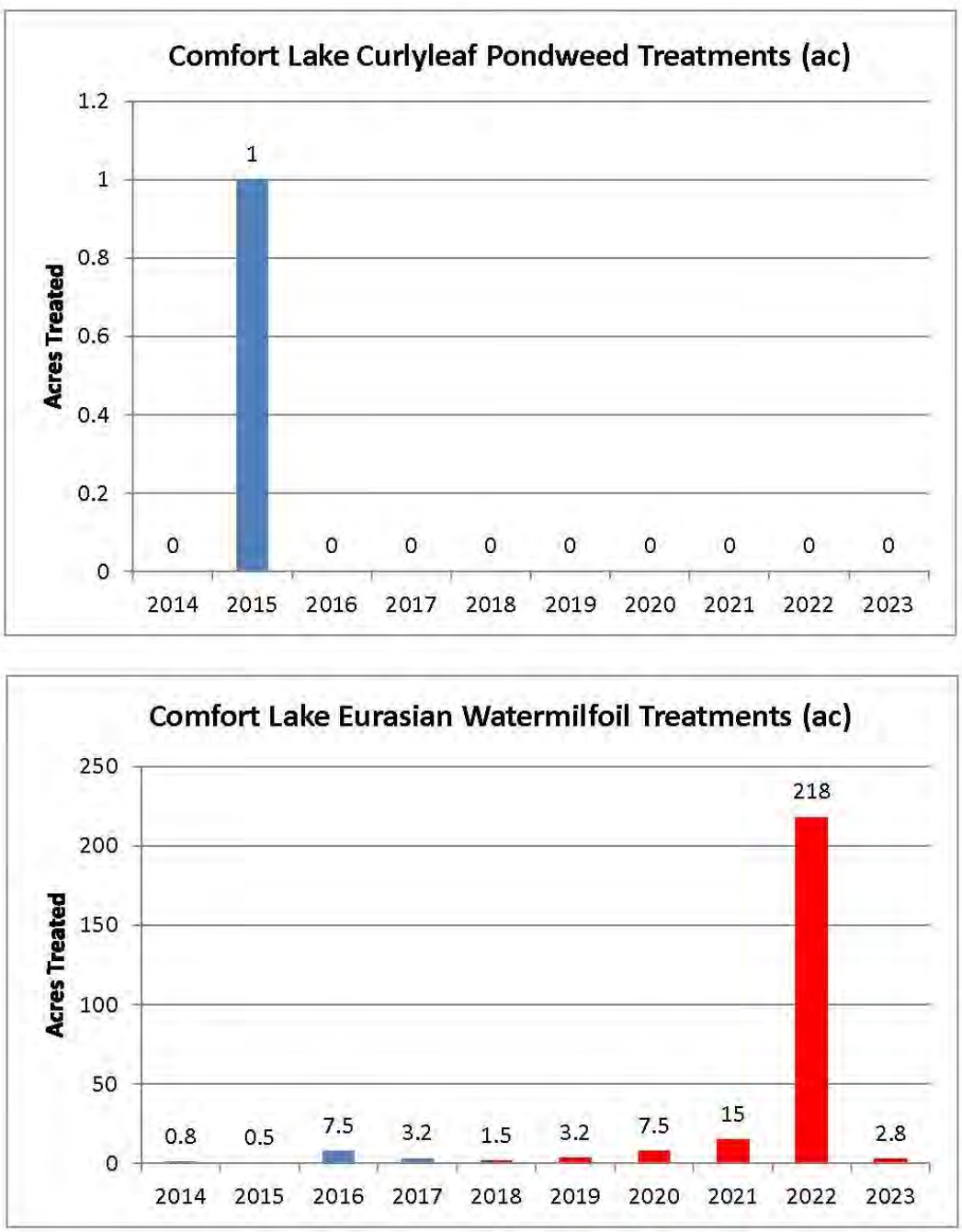


Figure 3. CLFLWD Sponsored Treatments with blue bars and Comfort Lake Association sponsored treatments with red bars: [top] Curlyleaf pondweed treated in 2014-2023. [bottom] Eurasian watermilfoil treated in 2014-2023 (2018 is estimated based on individual permits and 2019, 2020, and 2021 treatments were by the Comfort Lake Association). A full lake fluridone treatment was conducted in 2022. An EWM treatment of 2.77 acres occurred in 2023.

Comparison of Point Intercept Surveys in 2022 and 2023: Results of aquatic plant occurrence for the 2022 and 2023 point intercept surveys are shown in Table 1. A whole lake fluridone herbicide treatment was conduced on June 22, 2022. The results of the September 2022 point intercept survey which reflects the impact of the fluridone treatment showed a significant decrease in EWM. Several other aquatic plant species also decreased in occurrence in September of 2022 compared to the June 10, 2022 survey.

A point intercept survey conducted on June 2, 2023 showed a decrease in EWM compared to June 10, 2022. An increase in submerged aquatic plants was observed compared to the September 15, 2022 survey. Eurasian watermilfoil was found in 1 sample site on June 2, 2023 point intercept survey growing at light conditions. The fluridone treatment reduced EWM in 2022 and through June of 2023. Future surveys will track EWM occurrences.

Table 1. Comfort Lake aquatic plant occurrences for the two point intercept surveys in 2022 and one survey in 2023. All three surveys used the same sample grid based on 180 sample sites.

	June 10, 2022	Sept 15, 2022	June 2, 2023
Bulrush (*Typha sp*)	2	1	2
Spatterdock (*Nuphar advena*)	25	51	6
White lilies (*Nymphaea odorata*)	35	19	28
Cabbage (*Potamogeton amplifolius*)	3	2	13
Chara (*Chara sp*)	18		5
Coontail (*Ceratophyllum demersum*)	26	3	6
Curlyleaf (*P. crispus*)	26		32
Elodea (*Elodea canadensis*)	16		
EWM (*Myriophyllum spicatum*)	35		1
Flatstem (*P. zosteriformis*)	9	1	7
Illinois (*P. illinoensis*)	2		
Naiad (*Najas sp*)	7		
Narrowleaf (*P. sp*)			1
NWM (*M. sibiricum*)	1		
Sago (*Stuckenia pectinata*)		2	7
Stringy (*P. sp*)	10		29
Water celery (*Vallisneria americana*)	1		
Water stargrass (*Heteranthera dubia*)			1
Total number of species	15	7	13

Figure 4. Eurasian watermilfoil on June 2, 2023.

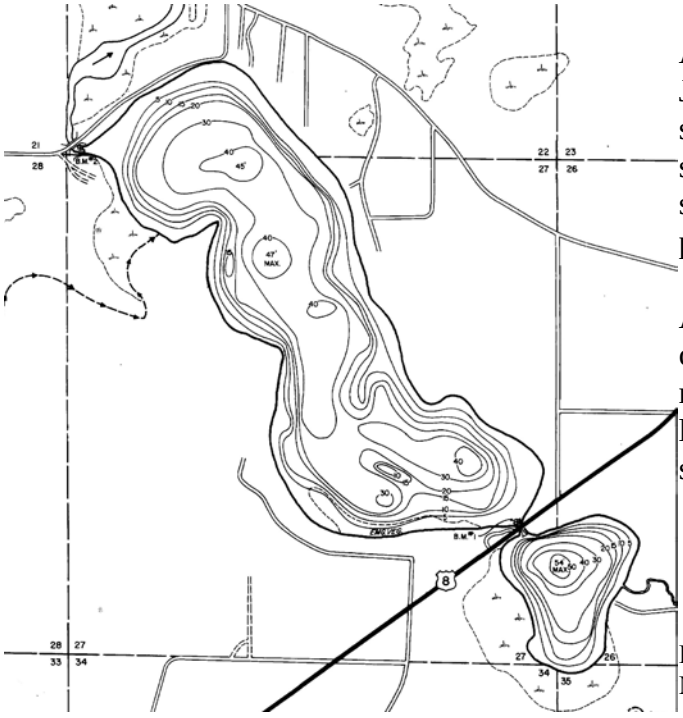
Curlyleaf Pondweed and Eurasian Watermilfoil Management and Point Intercept Surveys for Comfort Lake, Chisago County, 2023

Introduction and Methods

Comfort Lake has an area of 218 acres with a littoral area of 90 acres (MnDNR). The maximum depth of Comfort Lake is 37 feet. Curlyleaf pondweed (CLP) and Eurasian watermilfoil (EWM) have been managed in Comfort Lake since at least 2014. The objectives of the curlyleaf surveys were to delineate the acreage of curlyleaf pondweed to treat and then treat is necessary and then after treatment, assess the effectiveness of the treatment. The objectives of the Eurasian watermilfoil (EWM) surveys were to delineate the acreage of EWM to treat and then treat is necessary and then after treatment, assess the effectiveness of the treatment.

Curlyleaf Pondweed Delineation and Assessment Methods: An initial curlyleaf pondweed delineation was conducted on April 24, 2023. The entire perimeter of the lake was checked for curlyleaf pondweed. A total of 176 sites were sampled for aquatic plants. A follow-up curlyleaf pondweed assessment was conducted on June 2, 2023 to characterize the status of curlyleaf pondweed at it's peak growing period. The methodology that was used for the assessment included a point intercept survey combined with a meander survey. A total of 240 sites were sampled for aquatic plants.

Eurasian Watermilfoil Delineation and Assessment Methods: An initial EWM delineation was conducted on April 24, 2023 with a meander survey. The entire perimeter of the lake was checked for EWM. A total of 176 sites were sampled for aquatic plants.



An EWM assessment was conducted on June 2, 2023. In this survey a meander survey was combined with a point intercept survey. A total of 60 meander points were sampled along with 180 point intercept points for a total of 240 points.

An additional EWM assessment was conducted on August 8, 2023 with a meander survey. The entire perimeter of the lake was checked for EWM. A total of 150 sites were sampled for aquatic plants.

Figure 5. Contour map of Comfort Lake (source: MnDNR).

Point Intercept Survey Methods: A point intercept aquatic plant survey of Comfort Lake was conducted by Blue Water Science on June 2, 2023 and 180 points were sampled (Figure 6). The deepest depth of plant colonization in Comfort Lake was out to 8 feet on June 2, 2023. Sample points were placed 50 meters apart on a grid that covered the lake. Each sample point was equal to 0.62 acres. At each sample point, a sampling rake was lowered into the water and a plant sample was taken. The plant species were recorded and the density of each species was assigned. Densities were based on the coverage on the teeth of the rake. Density ratings were from 1 to 3 with 1 being sparse and 3 being a matted nuisance (Figure 7). Based on these sample sites, plant distribution maps were constructed.

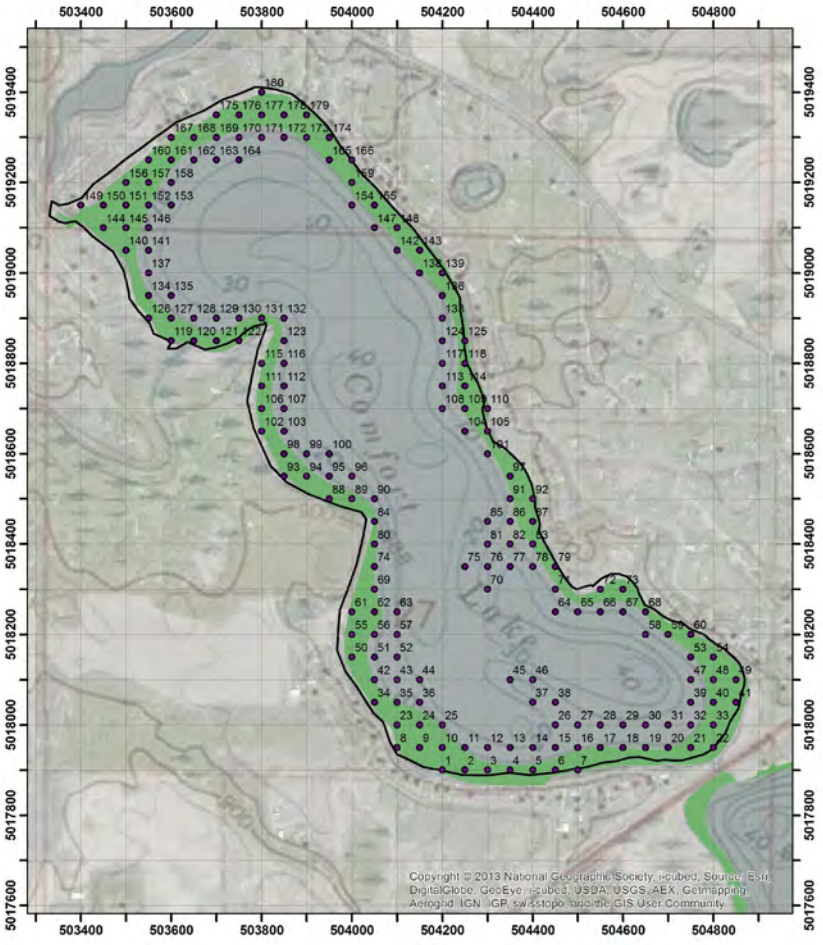


Figure 6. Sample location map for the aquatic plant surveys conducted on Comfort Lake. Green shading represents the littoral zone of Comfort Lake.

Chart of Aquatic Plant Density Ratings

Figure 7. Aquatic plant density ratings from 1 to 3.

Curlyleaf Pondweed Results

April 24, 2023 Delineation and June 2, 2023 Assessment

A curlyleaf delineation was conducted using a meander rake sampling survey on April 24, 2023 and 176 sites were examined. Curlyleaf was found at 4 sites in Comfort Lake (Table 2 and Figure 8). No curlyleaf treatment occurred in 2023.

A curlyleaf assessment occurred on June 2, 2023 using both a meander survey and a point intercept survey. A total of 240 sites were sampled. Curlyleaf was found at 32 sample sites in the point intercept survey (180 sample sites total). Curlyleaf growth was mostly light (Figure 8 and Table 2).

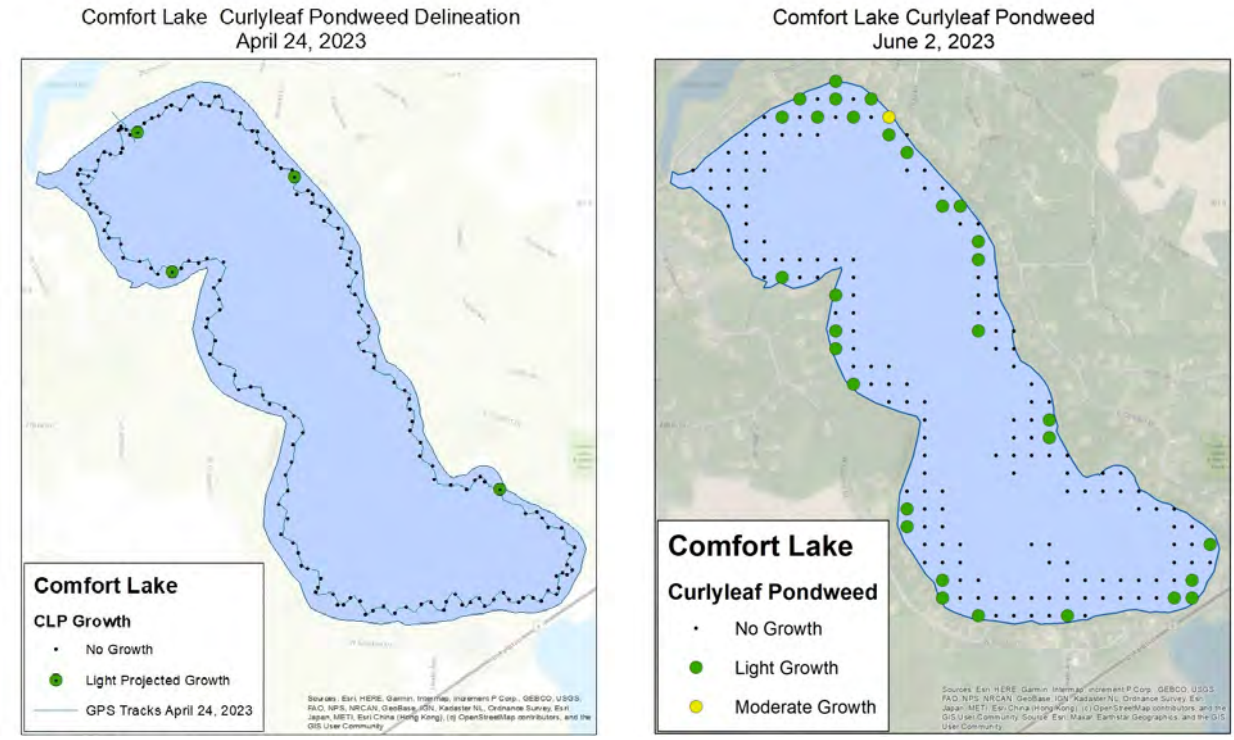


Figure 8. [left] DELINEATION: Map of curlyleaf pondweed distribution from the April 24, 2023 meander survey. Key: black dots = sample locations and green dot = light growth potential.
TREATMENT: No curlyleaf pondweed treatment occurred in 2023.
[right] ASSESSMENT: Map of curlyleaf pondweed assessment sites for June 2, 2023 included a point intercept combined with a meander survey. Key: black dots = no curlyleaf growth, green dots = light growth, and yellow dots = moderate growth.

Table 2. Occurrences of curlyleaf pondweed for the April 24, 2023 and delineation using a meandering survey. EWM was not sampled on April 24, 2023.

	Curlyleaf	EWM
April 24, 2023		
Occurrence (176 sites)	4	0
June 2, 2023		
Occurrence (240 sites)	32	4

Eurasian Watermilfoil Results

April 24, 2023 Delineation: An EWM delineation was conducted using a meander rake sampling survey on April 24, 2023 and 176 sites were examined. EWM was not found in Comfort Lake on April 24, 2023 (Table 3).

June 2, 2023 Assessment: On June 2, 2023, an EWM assessment survey using both a meander survey combined with a point intercept survey found EWM at 4 sample sites out of the 240 sites (Figure 9 and Table 3).

August 8, 2023 Assessment: On August 8, 2023, an EWM assessment survey using a meander survey found EWM at 21 sample sites out of the 150 sites (Figure 9 and Table 3).

September 19, 2023 EWM Treatment: An EWM treatment on 2.77 acres was conducted on September 19, 2023 using ProcellaCOR herbicide.

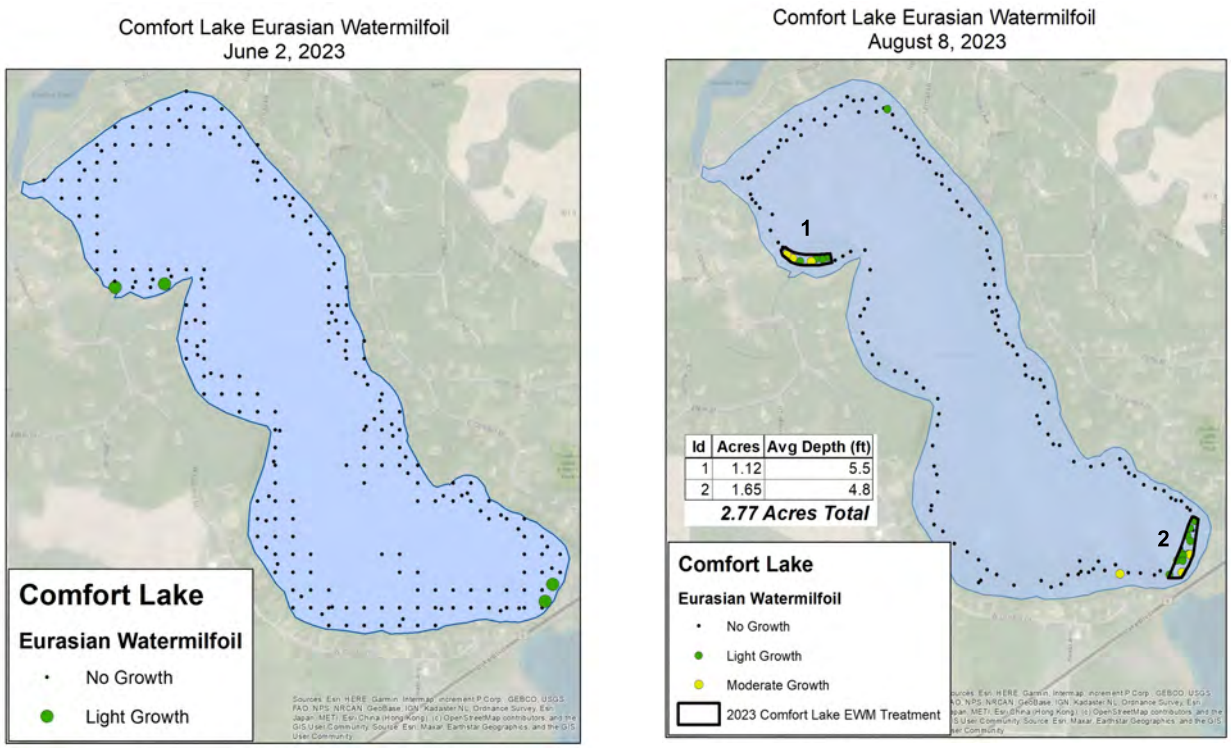


Figure 9. ASSESSMENT: Map of EWM distribution from the June 2, 2023 (left) survey. EWM was sampled at 4 sites. Map of EWM distribution from the August 8, 2023 (right) survey. EWM was sampled at 21 sites and 2 areas totaling 2.77 acres were treated on September 19, 2023.

Table 3. Eurasian watermilfoil occurrences from the EWM surveys.

Survey	April 24, 2023	June 2, 2023	August 8, 2023
Meander	0	3	21
Point Intercept	0	1	0
Total Sites	176	240	150

Point Intercept Survey of June 2, 2023

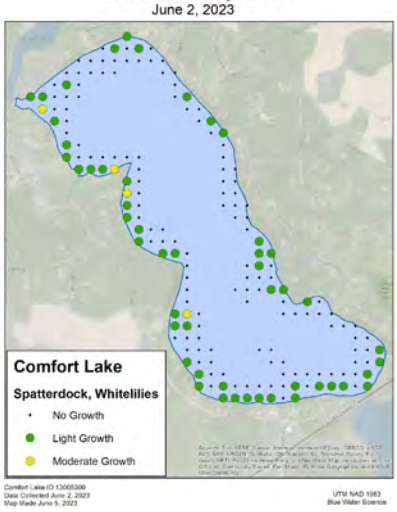
A whole lake fluridone herbicide treatment was conduced on June 22, 2022. The point intercept survey that was conducted on June 2, 2023 found 13 species of aquatic plants (Table 4). Eurasian watermilfoil was found at 1 sample site on June 2, 2023 growing at light conditions. The dominant plant in June was curlyleaf pondweed followed by a stringy pondweed (Table 4).

Table 4. Comfort Lake aquatic plant occurrences for the June 2, 2023 point intercept surv ey. Based on 180 sample sites.

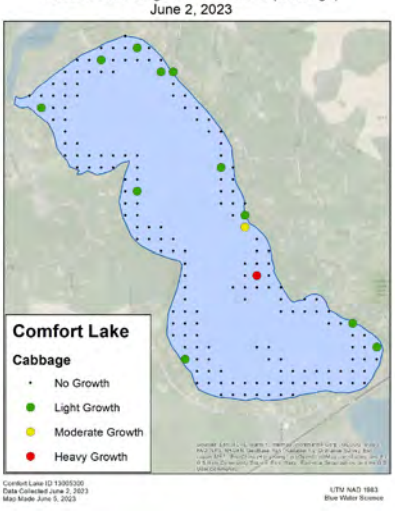
	June 2, 2023
Bulrush (*Typha sp*)	2
Spatterdock (*Nuphar advena*)	6
White lilies (*Nymphaea odorata*)	28
Cabbage (*Potamogeton amplifolius*)	13
Chara (*Chara sp*)	5
Coontail (*Ceratophyllum demersum*)	6
Curlyleaf (*P. crispus*)	32
EWM (*Myriophyllum spicatum*)	1
Flatstem (*P. zosteriformis*)	7
Narrowleaf (*P. sp*)	1
Sago (*Stuckenia pectinata*)	7
Stringy (*P. sp*)	29
Water stargrass (*Heteranthera dubia*)	1
Total number of species	13

Point Intercept Aquatic Plant Maps - June 2, 2023

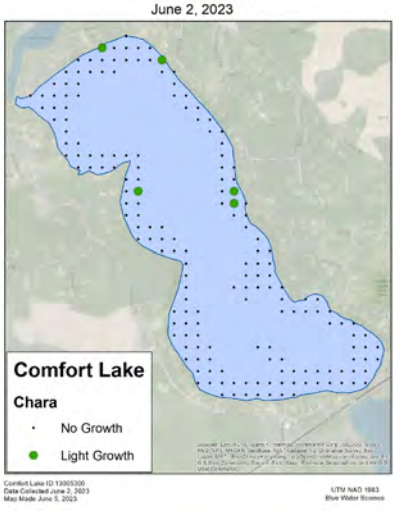
Comfort Lake All Lily Growth
June 2, 2023



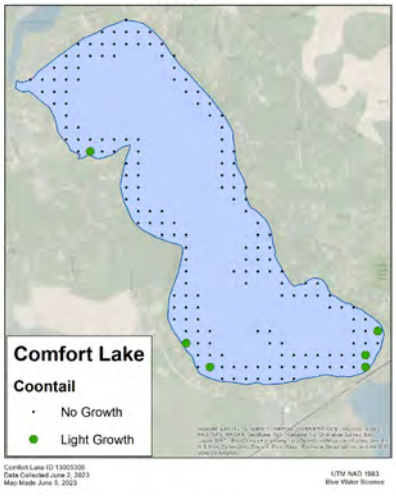
Comfort Lake Large-leaf Pondweed (Cabbage)
June 2, 2023



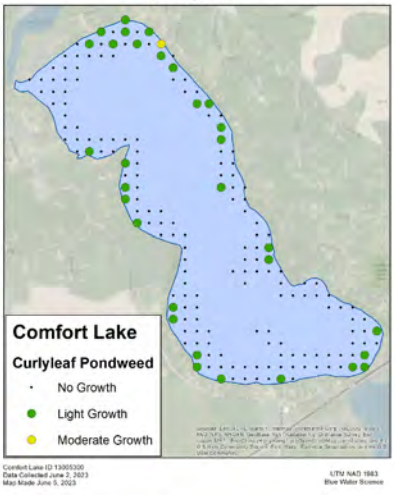
Comfort Lake Chara
June 2, 2023



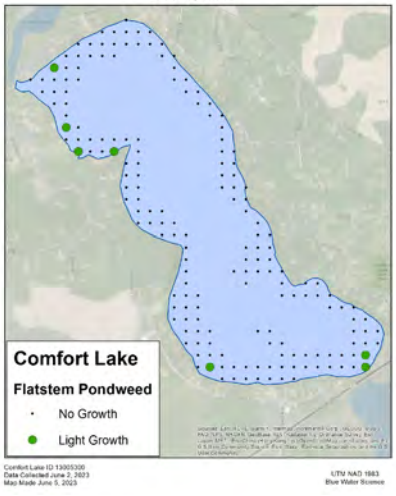
Comfort Lake Coontail
June 2, 2023



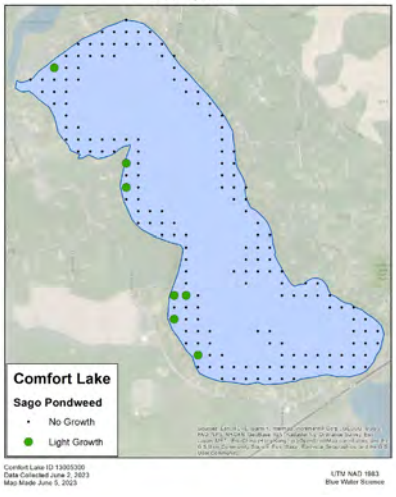
Comfort Lake Curlyleaf Pondweed
June 2, 2023



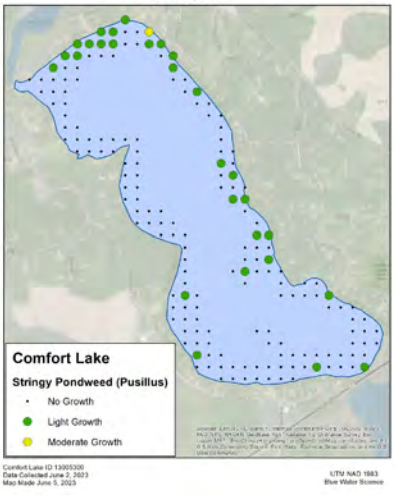
Comfort Lake Flatstem Pondweed
June 2, 2023



Comfort Lake Sago Pondweed
June 2, 2023



Comfort Lake Stringy Pondweed
June 2, 2023



Comparison of Point Intercept Surveys in 2022 and 2023

Results of aquatic plant occurrence for the 2022 and 2023 point intercept surveys are shown in Table 5. A whole lake fluridone herbicide treatment was conduced on June 22, 2022. The results of the September 2022 point intercept survey which reflects the impact of the fluridone treatment showed a significant decrease in EWM. Several other aquatic plant species also decreased in occurrence in September of 2022 compared to the June 10, 2022 survey.

A point intercept survey was conducted on June 2, 2023 showed a decrease in EWM compared to June 10, 2022. An increase in submerged aquatic plants was observed compared to the September 15, 2022 survey. Eurasian watermilfoil was found in 1 sample site on June 2, 2023 point intercept survey growing at light conditions. The fluridone treatment reduced EWM in 2022 and through June of 2023. Future surveys will track EWM occurrences.

Table 5. Comfort Lake aquatic plant occurrences for the two point intercept surveys in 2022 and one survey in 2023 based on 180 sample sites for each of the surveys.

	June 10, 2022	Sept 15, 2022	June 2, 2023
Bulrush (*Typha sp*)	2	1	2
Spatterdock (*Nuphar advena*)	25	51	6
White lilies (*Nymphaea odorata*)	35	19	28
Cabbage (*Potamogeton amplifolius*)	3	2	13
Chara (*Chara sp*)	18		5
Coontail (*Ceratophyllum demersum*)	26	3	6
Curlyleaf (*P. crispus*)	26		32
Elodea (*Elodea canadensis*)	16		
EWM (*Myriophyllum spicatum*)	35		1
Flatstem (*P. zosteriformis*)	9	1	7
Illinois (*P. illinoensis*)	2		
Naiad (*Najas sp*)	7		
Narrowleaf (*P. sp*)			1
NWM (*M. sibiricum*)	1		
Sago (*Stuckenia pectinata*)		2	7
Stringy (*P. sp*)	10		29
Water celery (*Vallisneria americana*)	1		
Water stargrass (*Heteranthera dubia*)			1
Total number of species	15	7	13

Point Intercept Survey Statistics (using the MnDNR format)

	June 10, 2022	Sept 15, 2022	June 2, 2023
Total # Points Sampled	155	116	149
Depth Range of Rooted Veg	1-9 feet	1-5 feet	1-8 feet
Maximum Depth of Growth (95%) in feet	7	5	6
# Points in Max Depth Range	99	92	108
# Points in Littoral Zone (0-15 feet)	135	114	141
% Points w/ Submersed Native Taxa	42	7	36
Mean Submersed Native Taxa/Point	0.7	0.1	0.5
# Submersed Native Taxa	11	4	9
# Submersed Invasive Taxa	2	0	2
Max Depth of EWM in feet	7	0	3
% Frequency of EWM	26	0	1
Mode Rake Abundance of EWM	1	0	1
Max Depth of CLP in feet	9	0	8
% Frequency of CLP	19	0	23
Mode Rake Abundance of CLP	1	0	1

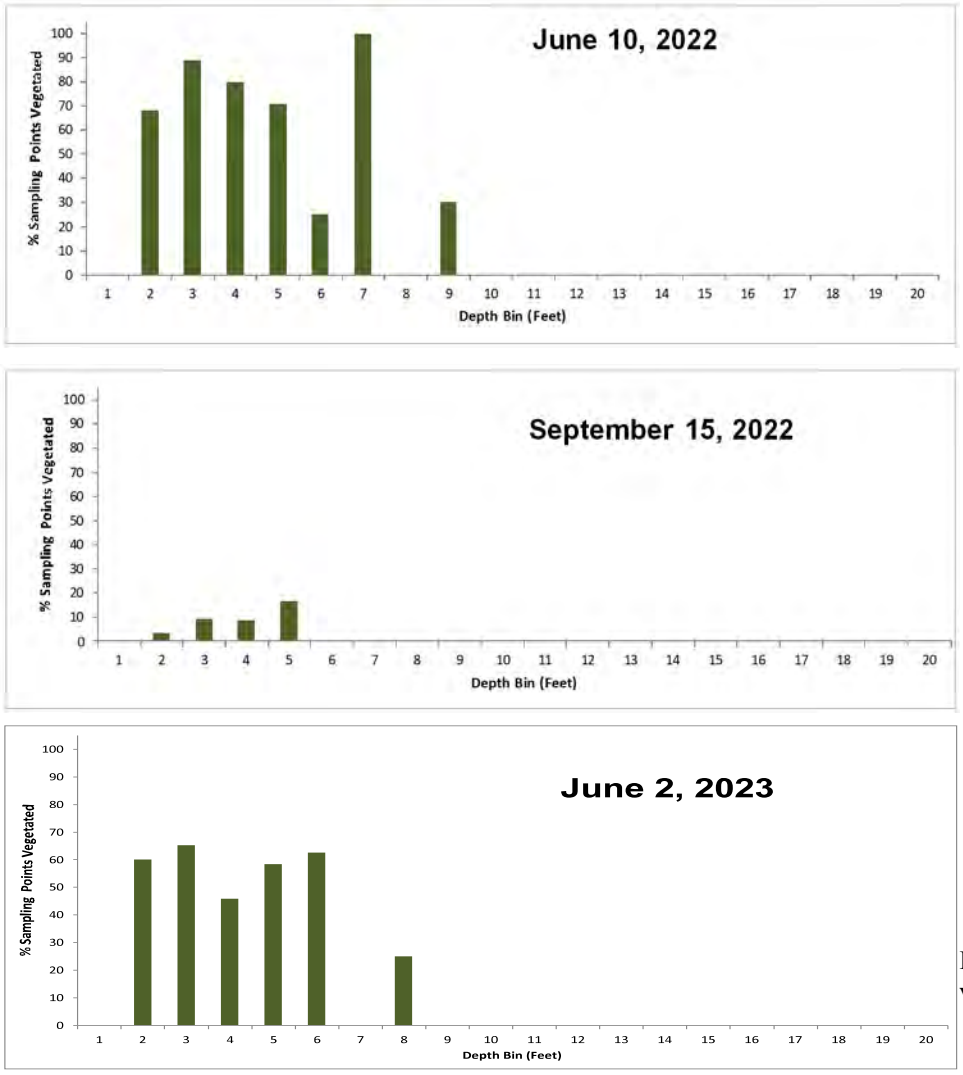


Figure 10. Number of vegetated sites by depth.

Milfoil Hotspots and Growth Potential in Comfort Lake: Eurasian watermilfoil was first observed in Comfort Lake in 2014. Areas of moderate and heavy growth of EWM for 2015 through 2022 are shown on the hotspot map in Figure 11. In the last couple of years EWM has nearly ringed the lake with growth (Figure 11). However lake sediment nitrogen concentrations collected in 2014 found mostly low nitrogen, except for 1 location near the Comfort Lake inlet (Figure 11). High nitrogen is correlated with heavy milfoil growth. EWM is still in a heavy growth mode that is typical of new invasive species. EWM growth will likely be reduced in the future but is difficult to pin down a year.

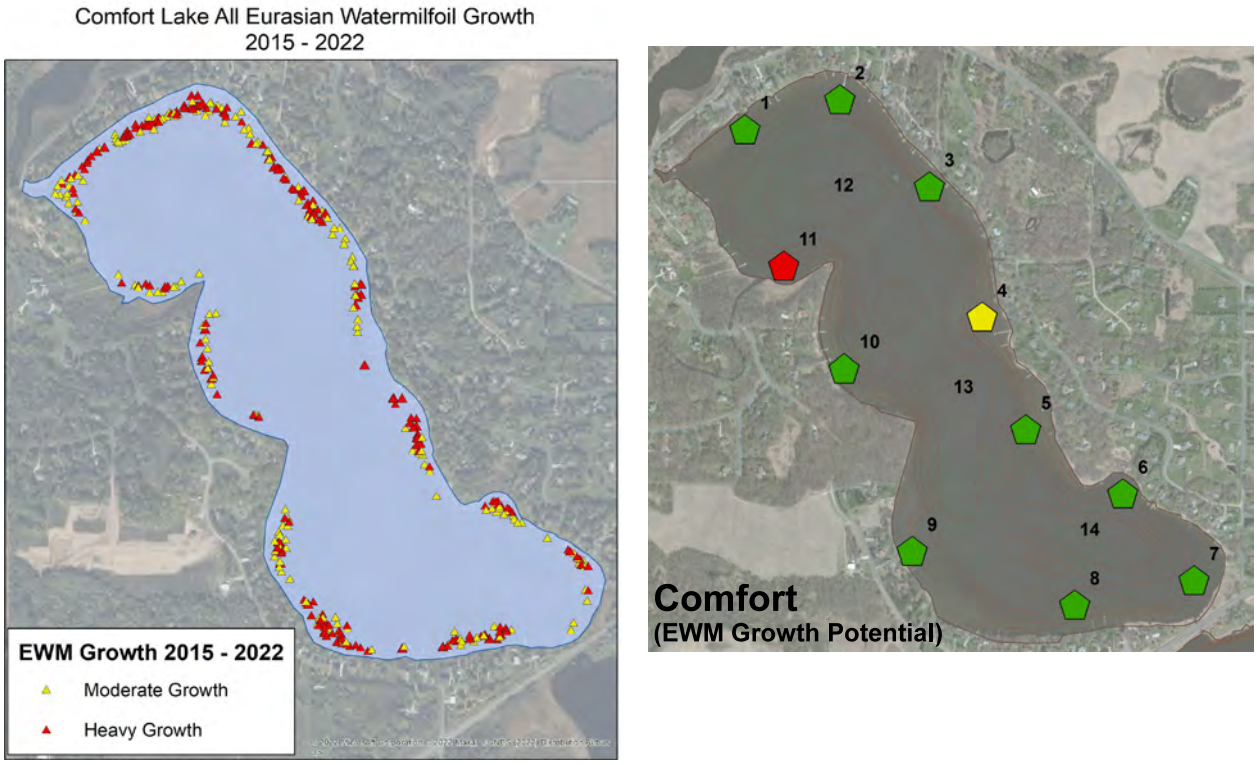


Figure 11. [left] EWM growth distribution and density for 2015-2022.
[right] EWM potential growth based on lake sediment analyses for Comfort Lake.
Key: green = light growth, yellow = moderate growth, and red = heavy growth.

APPENDIX

Point Intercept Individual Site Data for 2023

June 10, 2022

Site	Depth (ft)	Bulrush	Spatter dock	White lilies	Cab-bage	Chara	Coon-tail	CLP	EWM	Flat-stem	Narrow leaf	Sago	Stringy	Water star-grass	No plants
1	3			1				1							
2	2		1												
3	3		1												
4	3	1	1												
5	3			1											
6	2							1							
7	3			1											
8	2			1				1							
9	3						1			1					
10	4		1	1											
11	12														1
12	14														1
13	20														1
14	15														1
15	6														1
16	4			1											
17	4														1
18	3			1									1		
19	3			1											
20	3			1											
21	6							1							
22	3			1			1	1		1			1		
23	3			1				1				1	1		
24															1
25	10														1
26	20														1
27															1
28															1
29															1
30															1
31	19														1
32	14														1
33	3			1			1	1		1					
34	3			1	1		1								
35	7														1
36															1
37															1
38															1
39	15														1
40	7														1
41	3		1	1											
42	5														1
43	17														1
44															1
45															1
46															1
47	14														1
48	9														1
49	3			1	1		1	1							
50	3							1				1			
51	14														1
52															1
53	17														1
54	4														1
55	3			1				1							
56	3			1											
57															1
58	16														1
59	9														1
60	3				1										
61	2			1								1			
62	3			2								1	1		

June 10, 2022

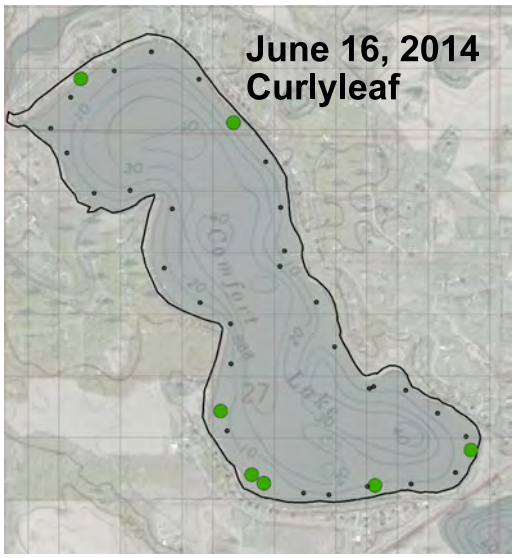
Site	Depth (ft)	Bulrush	Spatter dock	White lilies	Cab-bage	Chara	Coon-tail	CLP	EWM	Flat-stem	Narrow leaf	Sago	Stringy	Water star-grass	No plants
63															1
64	15														1
65	17														1
66	10														1
67	12														1
68	4												1		
69	5														1
70															1
71	4														1
72	3			1											
73	2														1
74	13														1
75															1
76	6												1		
77	13														1
78	4			1											
79	2			1											
80	10														1
81	8														1
82	5				3										
83	3							1					1		
84	4														1
85	20														1
86	5			1											
87	3							1							
88	3			1											
89	4	1		1											
90															1
91	4			1									1		
92	2			1									1		
93	3			1				1			1				
94	8														1
95	11														1
96															1
97	2		1	1											
98	4			1											
99															1
100															1
101	4				2										
102	2			1				1							
103	15														1
104	4												1		
105	3				1								1	1	
106	3			1				1				1			
107	12														1
108	6							1							
109	3					1									
110	2														
111	3			2											
112	4				1	1									
113	12														1
114	2					1							1		
115	2			1				1				1			
116															1
117	5												1		
118	2														
119	3		1	1					1	1					
120	1			1			1	1							
121	4			1											
122	3			2						1					
123															1
124	5				1										
125	3														
126	3			1											
127															1
128	12														1
129	11														1
130	4														1
131	7														1

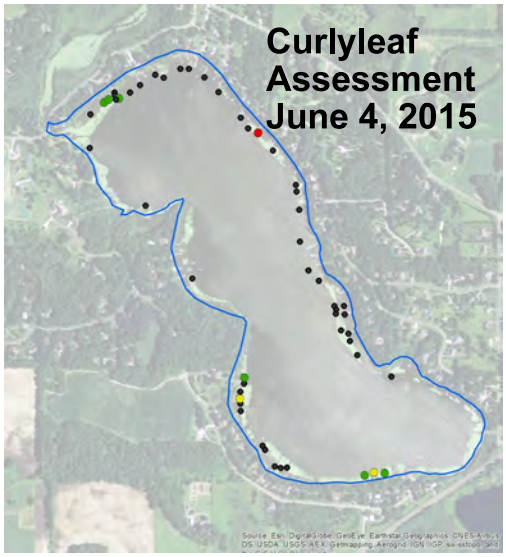
June 10, 2022

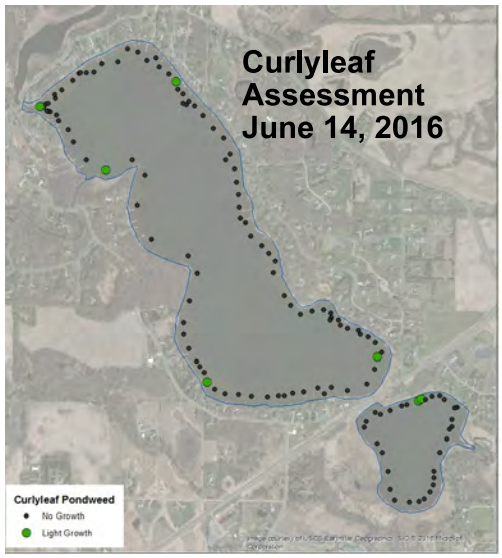
Site	Depth (ft)	Bulrush	Spatter dock	White lilies	Cab-bage	Chara	Coon-tail	CLP	EWM	Flat-stem	Narrow leaf	Sago	Stringy	Water star-grass	No plants
132															1
133	6							1							
134	4			1						1					
135															1
136	5							1							
137	5														1
138	4														1
139	2			1											
140	4		1	1											
141	15														1
142	4							1							
143	2		1	1				1							
144	3			2	1										
145	11														1
146															1
147	6														1
148	3												1		
149	3		1	1											
150	2			1											
151	5														1
152	15														1
153															1
154	10														1
155	3			1											
156	2									1		1	1		
157	6			1											
158															1
159	4							1					1		
160	3												1		
161	5												1		
162															1
163															1
164															1
165	4				1			1							
166	2				1								1		
167	3												1		
168	4							1					1		
169	5				1								1		
170	6							1					1		
171	8														1
172	8							1							
173	5												1		
174	3					1		2					1		
175	3					1		1					1		
176	3			1									1		
177	4							1							
178	3			1	1										
179	2							1					2		
180	2		1					1					1		
Average		1	1	1	1	1	1	1	1	1	1	1	1	1	
Occur (180 sites)		2	11	50	13	5	6	32	1	7	1	7	29	1	84
% occur		1	6	28	7	3	3	18	1	4	1		16	1	47

CLP and EWM Delineation or Assessments

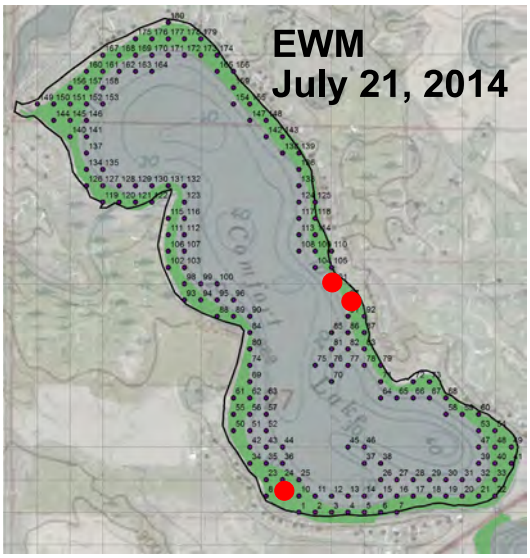
Curlyleaf Pondweed 2014-2023

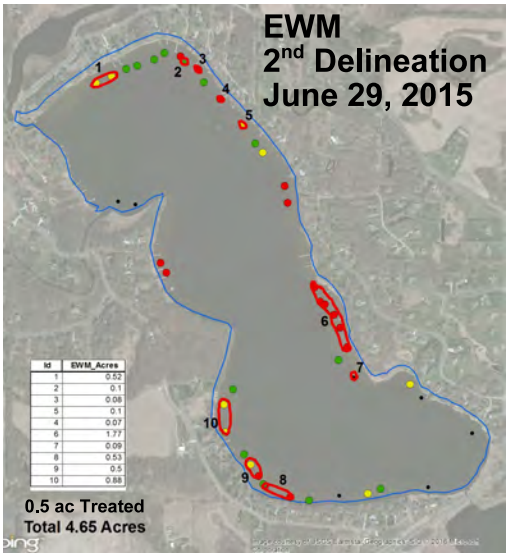


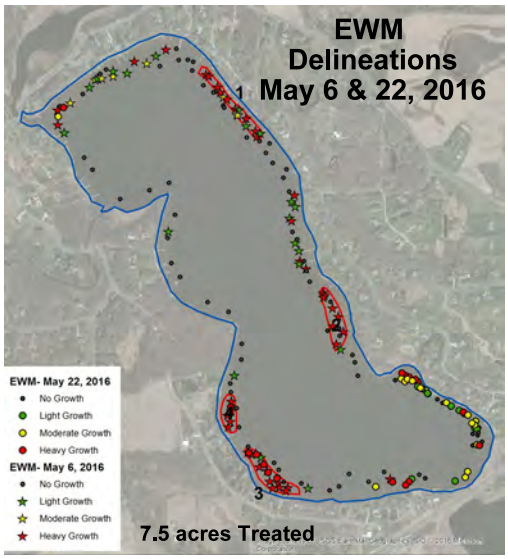




Eurasian Watermilfoil 2014-2023

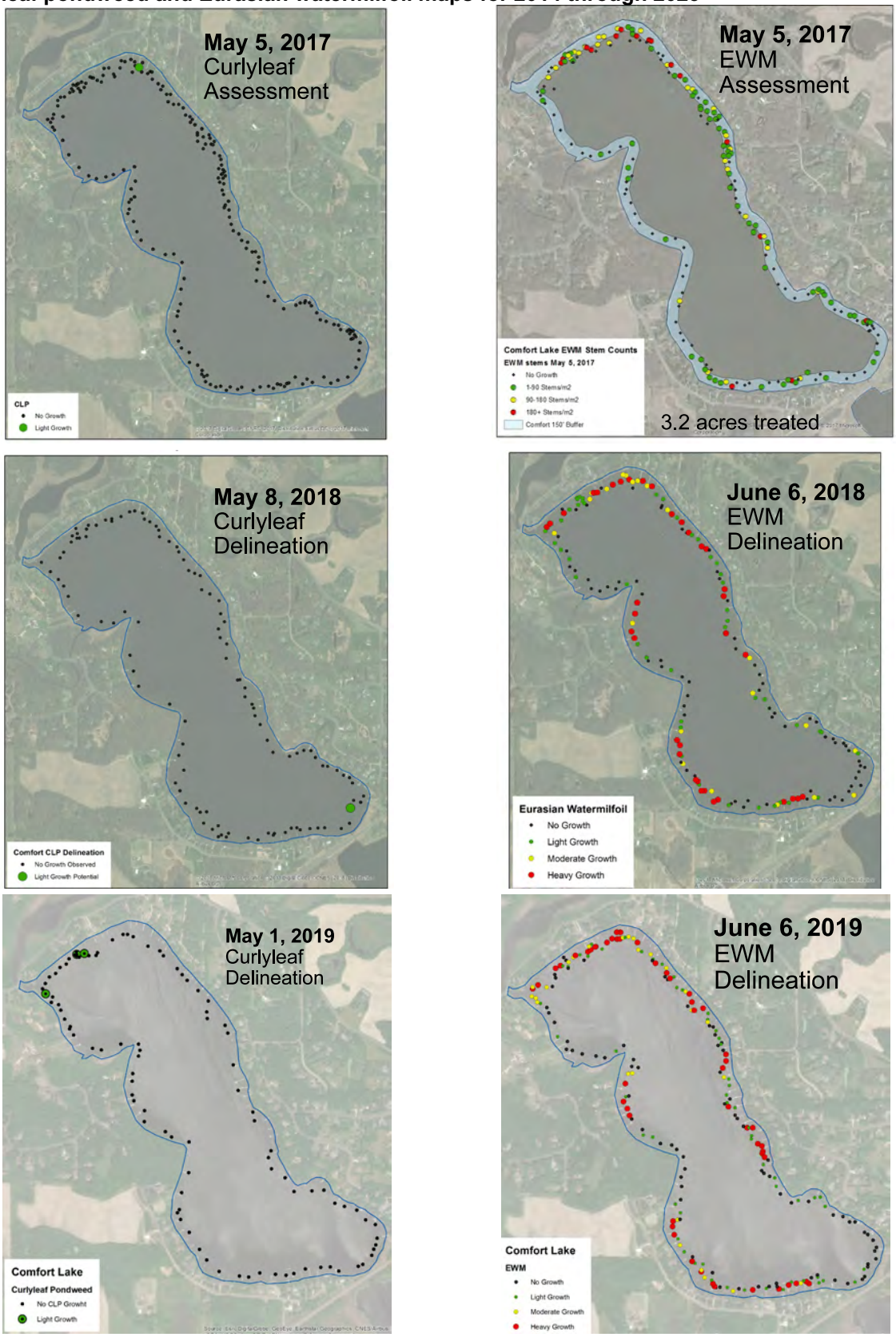






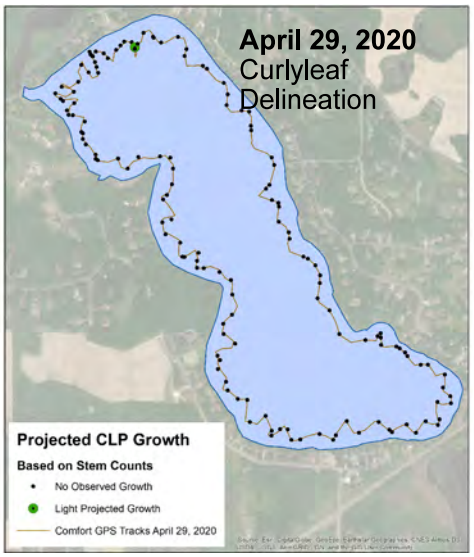
Curlyleaf Pondweed 2014-2023 Eurasian Watermilfoil 2014-2023

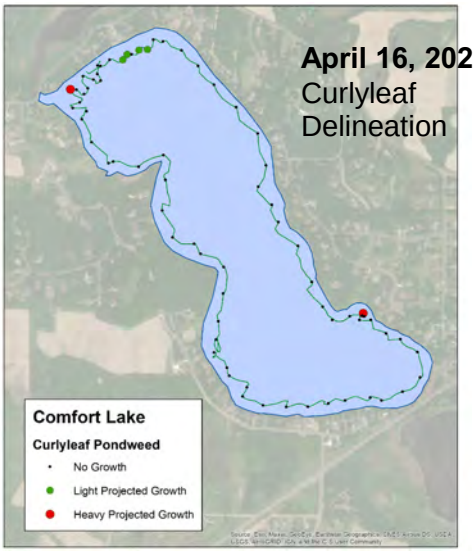
Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2023

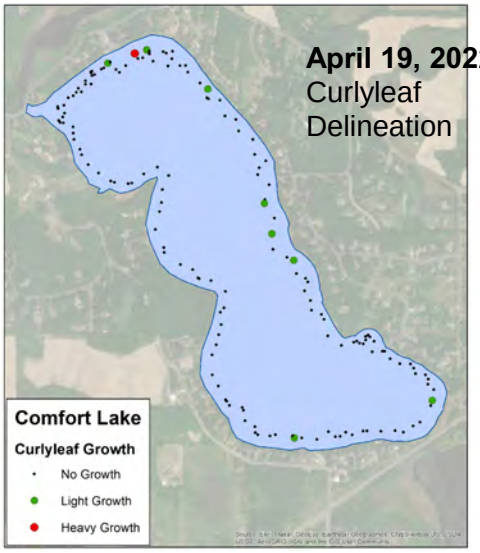


Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2023.

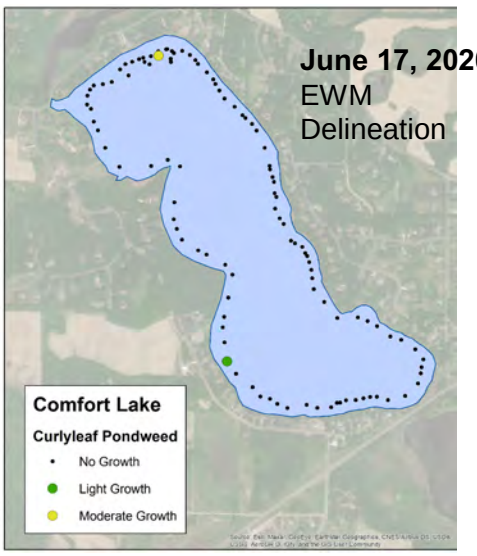
Curlyleaf Pondweed 2014-2023

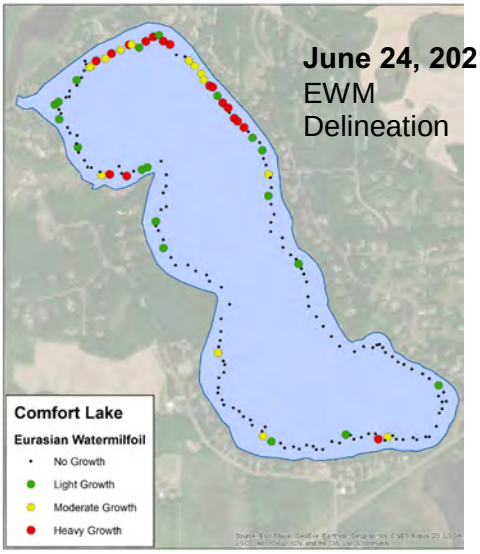


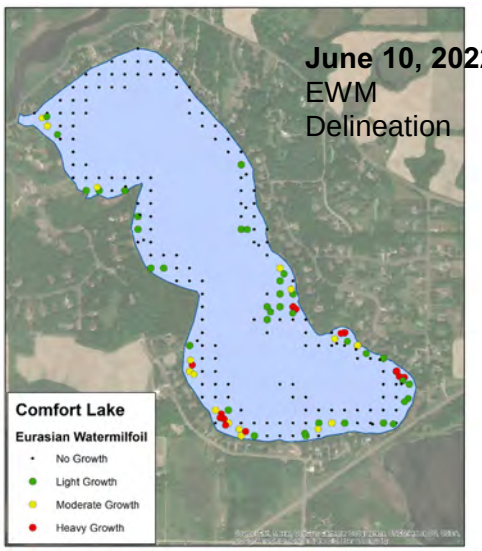




Eurasian Watermilfoil 2014-2023



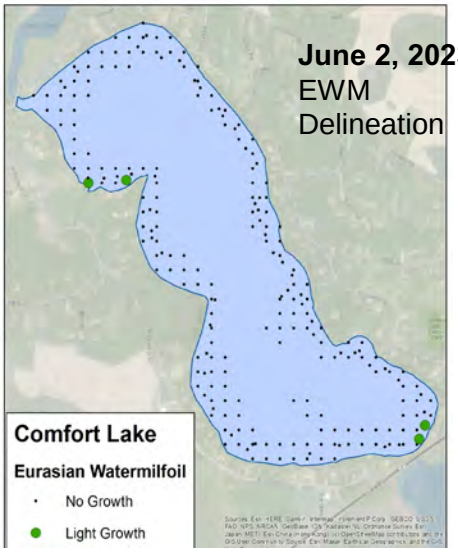




Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2023.

Curlyleaf Pondweed 2014-2023

Eurasian Watermilfoil 2014-2023



Curlyleaf pondweed and Eurasian watermilfoil maps for 2014 through 2023.