



Native Plants in Forest Lake in August 2019

Curlyleaf Pondweed and Eurasian Watermilfoil Delineation, Treatment, and Assessment for Forest Lake, Washington County, 2019

	Delineation	Treatment	Assessment
CLP	May 1, 2019	May 20, 2019 (99.11 acres)	June 11, 2019
EWM	June 11, 2019	June 27 and 28, 2019 (49.34 acres treated)	August 12, 2019

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



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Curlyleaf Pondweed and Eurasian Watermilfoil Delineation, Treatment, and Assessment for Forest Lake, Washington County, 2019

Summary

Curlyleaf Pondweed (CLP) Delineation, Treatment, and Assessment: Forest Lake (MnDNR ID#82-015900) is a 2,271 acre lake in Washington County, Minnesota. Curlyleaf pondweed distribution and abundance were evaluated May 1, 2019.

In the delineation survey, heaviest potential curlyleaf growth was found in the First Lake (Figure S1) and potential early summer heavy growth was estimated at 99.1 acres. A total of 99.1 acres of curlyleaf areas were treated on May 20, 2019.

A post treatment curlyleaf assessment was conducted on June 11, 2019. The June curlyleaf assessment found curlyleaf growth was mostly light with some moderate growth in all 3 lake basins. The Third Lake had a few areas of heavy curlyleaf growth but overall control in the treated areas was excellent (Figure S1).

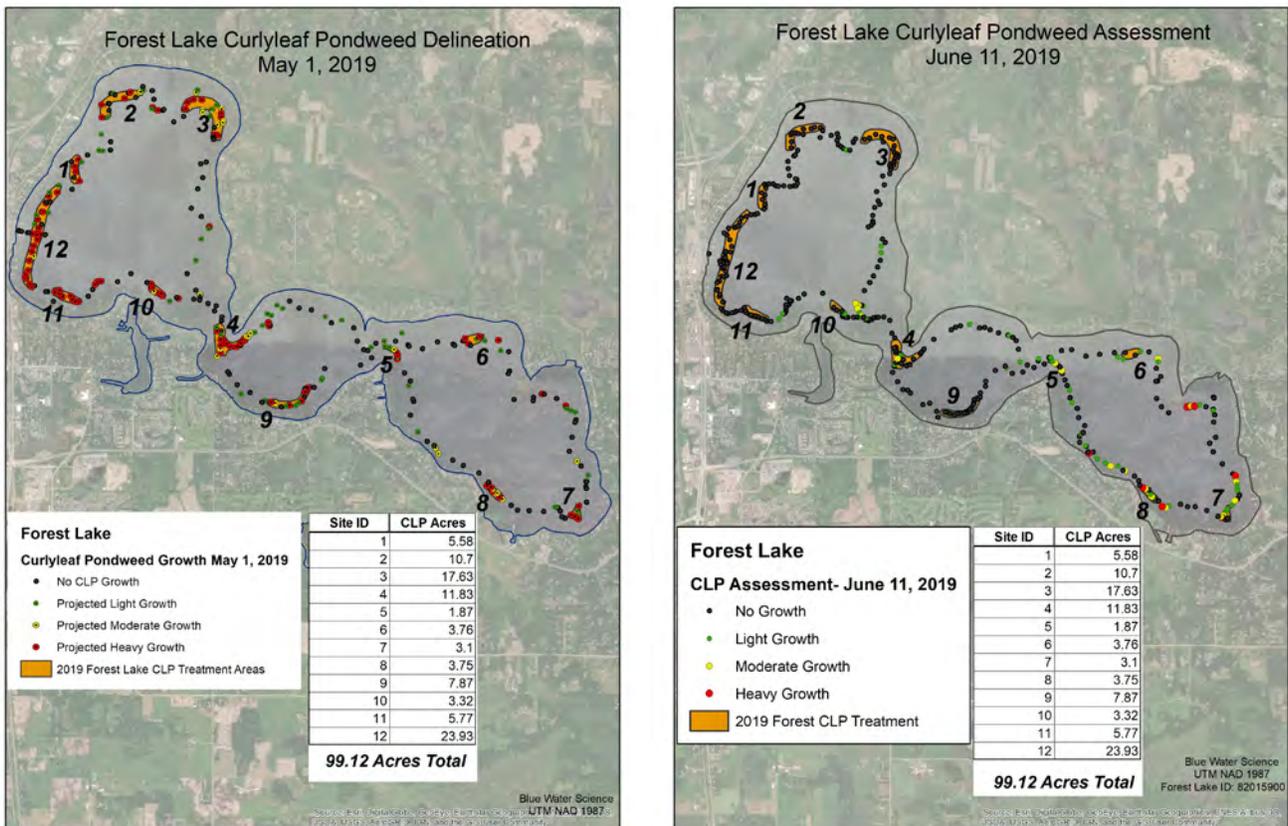


Figure S1. [top-left] DELINEATION: Map of curlyleaf pondweed distribution from the May 1, 2019 survey. Approximately 99.11 acres were delineated for CLP treatment. Treatment areas are outlined in red. **[top-right] ASSESSMENT:** Map of curlyleaf pondweed assessment sites for June 11, 2019. **Key:** green dots = light growth, yellow dots = moderate growth, red dots = heavy growth, and black dots = no curlyleaf growth. Orange shaded areas indicates treatment areas.

Eurasian Watermilfoil (EWM) Delineation, Treatment, and Assessment: EWM distribution and abundance were evaluated June 11, 2019. Based on that delineation, a total of 49.34 acres of the 2,271 acre lake were treated in June to control heavy growth of Eurasian watermilfoil.

Later in the summer, after the EWM treatment, an EWM assessment on August 12, 2019 found good control in the treated areas with growth in only a few scattered areas within the treatment polygons (Figure S2).

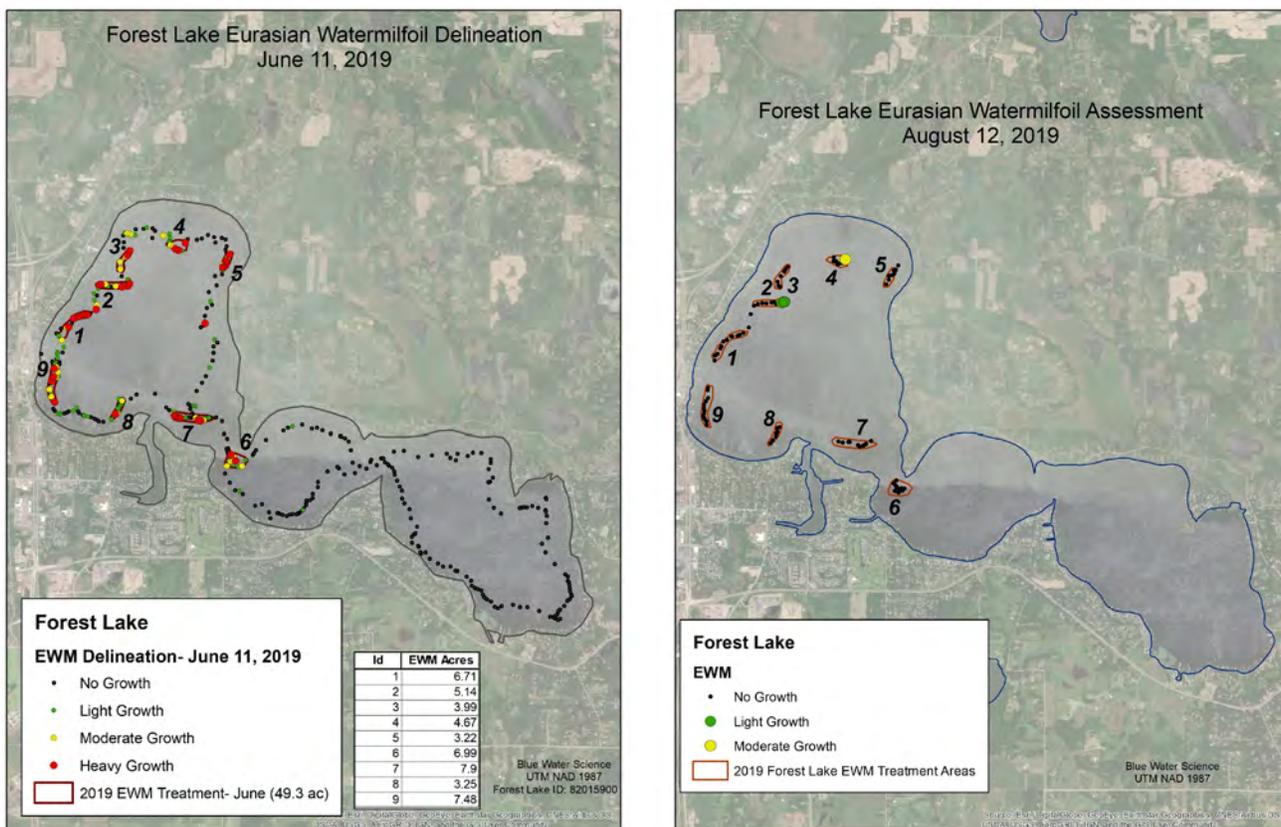


Figure S2. [top-left] DELINEATION: Map of EWM distribution from the June 11, 2019 survey. Approximately 49.35 acres were delineated for EWM treatment.

[top-right] ASSESSMENT: Map of EWM assessment on August 12, 2019.

Summary of CLP and EWM Treatments from 2009 - 2019: Two non-native submerged aquatic plants were treated with herbicides in 2019 (Table S1 and Figure S3). Curlyleaf pondweed treatments have ranged from 16 to 169 acres from 2009 through 2019 with variability from year to year.

Eurasian watermilfoil was discovered in Forest Lake in 2015 and 30 acres were treated in the first year. In 2016, 13.9 acres of EWM were treated, in 2017, 33.35 acres were treated, in 2018, 40.74 acres were treated, and in 2019, 49.34 acres were treated (Table S1 and Figure S3). Eurasian watermilfoil has been confined mostly to the first lake at the end of 2019. Aggressive treatments have kept EWM from spreading to 2nd and 3rd lakes, but that is likely to happen in the future.

Table S1. Acres of non-native plants treated from 2009 through 2019.

	CLP (acres)	EWM (acres)
2009	98	
2010	155	
2011	168	
2012	155	
2013	60	
2014	101	
2015	88	30
2016	114	13.9
2017	169	33.35
2018	16.59	40.74
2019	99.11	49.34

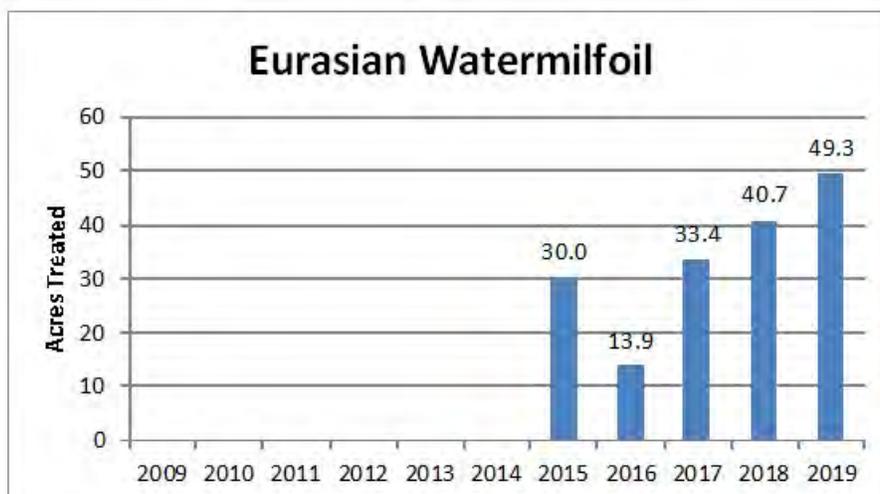
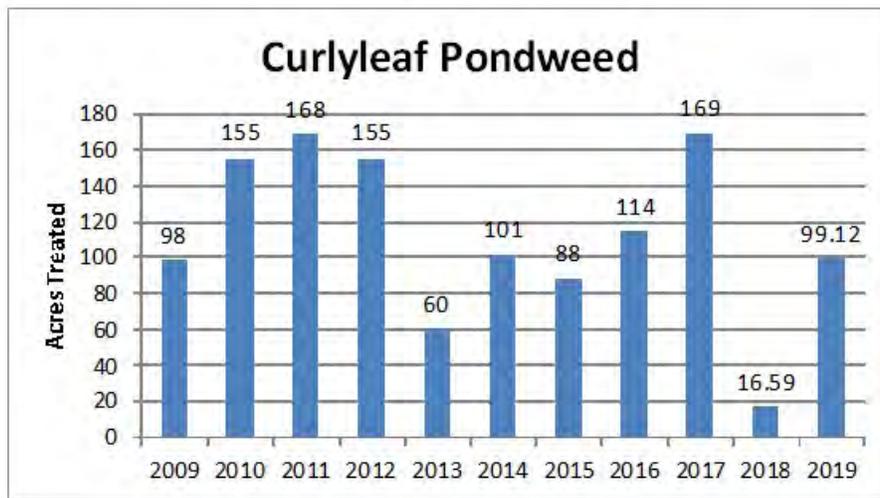


Figure S3. [top] Curlyleaf pondweed treated from 2009-2019. [bottom] Eurasian watermilfoil treated from 2015-2019. Eurasian watermilfoil was first found in Forest Lake in 2015.

A hotspot map of curlyleaf pondweed treatment areas over the last 6 years is shown in Figure S3. There appears to be about 100 acres of persistent curlyleaf in the same areas. The actual acreage of curlyleaf treated varies from year to year based on climatic factors. A hotspot map of EWM areas that have been treated from 2015 to 2019 is shown in Figure S3. EWM is found primarily in the 1st lake.

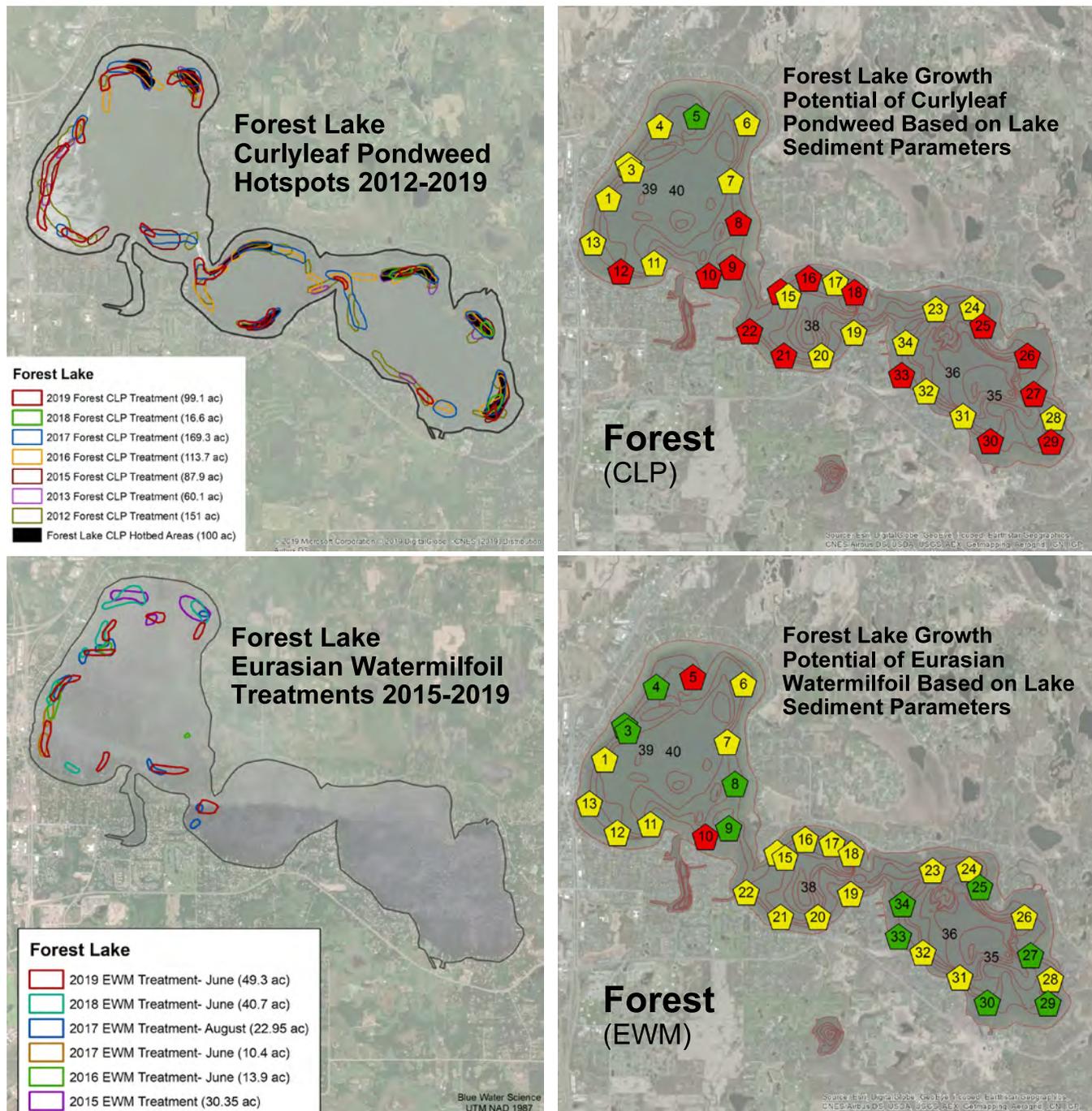


Figure S4. [top-left] Map of historical treatment of curlyleaf pondweed in Forest Lake, 2012-2019 with hotspot areas shaded black.

[top-right] Curlyleaf potential growth based on lake sediment analyses for Forest Lake.

Key: green = light growth, yellow = moderate growth, and red = heavy growth.

[bottom-left] Map of historical treatment of Eurasian watermilfoil in Forest Lake, 2015-2019.

[bottom-right] Eurasian watermilfoil potential growth based on lake sediment analyses for Forest Lake.

Key: green = light growth, yellow = moderate growth, and red = heavy growth.

Curlyleaf Pondweed and Eurasian Watermilfoil Delineation, Treatment, and Assessment for Forest Lake, Washington County, 2019

Introduction

Forest Lake has an area of 2,271 acres with a littoral area of 1,531 acres (MnDNR). The maximum depth of Forest Lake is 37 feet. Heavy growth of curlyleaf pondweed (CLP) has occurred in the past and control methods have been implemented. In 2015, Eurasian watermilfoil (EWM) was discovered in Forest Lake and about 30 acres of EWM were treated. The objectives of the delineation and assessment surveys in 2019 were to determine the acreage of CLP and EWM to treat and then after treatment, evaluate the effectiveness of the treatments.

An initial curlyleaf pondweed delineation was conducted on May 1, 2019. A total of 99.11 acres of curlyleaf pondweed were treated with an endothall herbicide on May 20, 2019. A follow-up curlyleaf pondweed assessment was conducted on June 11, 2019 to characterize the status of CLP at its peak growing period. Curlyleaf growth conditions in May are shown in Figure 1. Eurasian watermilfoil distribution and abundance were delineated on June 11, 2019 and 49.34 acres were treated in 2019. An EWM assessment for all treatment areas occurred on August 12, 2019.



Figure 1. [left and right] If the curlyleaf pondweed stem count is greater than 4 stems on a sample rakehead the area would be treated. These areas would be treated in 2019.

Methods

Curlyleaf Pondweed: At the time of the spring CLP delineations, only a fraction of the peak curlyleaf biomass is present. For spot treatments, the areas to be treated should be delineated prior to curlyleaf developing peak biomass. Curlyleaf stem counts on a rake sampler were used to identify areas that had a potential to produce dense curlyleaf. After a short sweep of about 1-foot (30 cm), 4 curlyleaf stems or more per rake sample generally indicated some CLP plants had developed runners and would likely produce heavy growth in the next few weeks. Alternatively, sites where 3 stems or less were collected per rake sample were not predicted to produce dense growth at the peak growing period. These areas were not treated. This delineation method was used for spot lake treatments in Gleason Lake and has worked for other lakes as well (McComas et al, 2015*).

Eurasian Watermilfoil: A Eurasian watermilfoil delineation was conducted by Blue Water Science on June 11, 2019. The delineation involved surveying the entire lake nearshore area, observing milfoil growth, and sampling aquatic plants with rakes. Areas to be treated were selected based on the growth status of milfoil in mid June, the known previous occurrence of EWM and the importance for navigation and/or recreation in the area.

An herbicide application was conducted by Clarke Aquatic Services Inc and a total of 49.34 acres were treated. A follow-up EWM assessment was conducted by Steve McComas, Blue Water Science, on August 12, 2019 to evaluate the effectiveness of the herbicide treatment for EWM control. A total of 98 sites were checked on the August 12 assessment. EWM density ratings used in the June delineation and August assessment are shown in the chart below.

Chart of Density Ratings for Plant Growth



Aquatic plant density ratings from 1 to 3.

**McComas, S.R., Y.E. Christianson, and U. Singh. 2015. Effects of curlyleaf pondweed control on water quality and coontail abundance in Gleason Lake, Minnesota. Lake and Reservoir Management. 31:109-114.*

Curlyleaf Pondweed Delineation on May 1, 2019

A curlyleaf delineation was conducted using rake sampling on May 1, 2019. A total of 310 sites were sampled and 12 areas of significant curlyleaf growth were delineated (outlined in orange shading in Figure 2) totaling about 99.11 acres. At this time of the year curlyleaf was found at low to high densities but with the potential to produce heavy growth in a number of areas by mid-June (Table 1 and Figure 3).

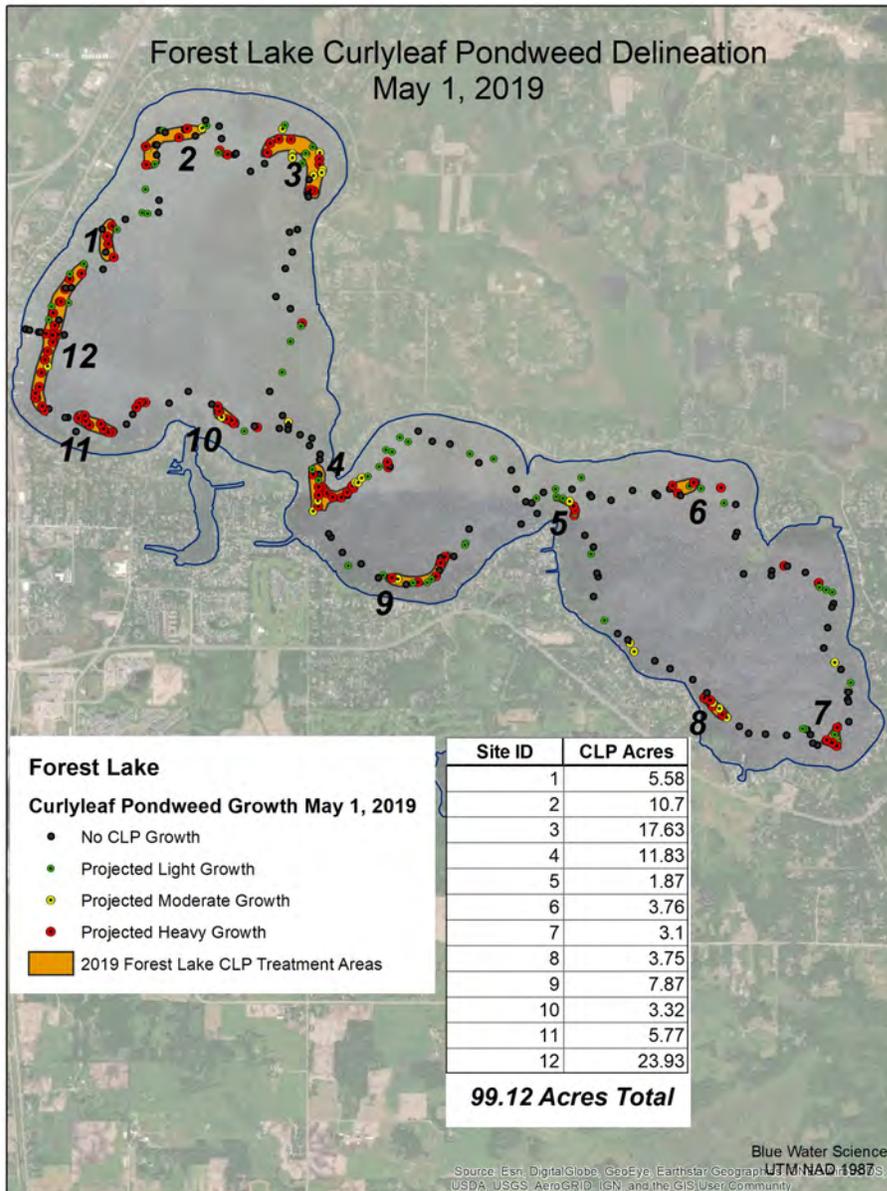


Figure 2. Map of curlyleaf delineation in Forest Lake on May 11, 2019.
Key for future potential CLP growth: green dots = light, yellow dots = moderate, and red dots = heavy. Orange shaded areas indicates treatment areas.

Curlyleaf Pondweed Treatment, May 20, 2019

A total of 99.11 acres of CLP were treated on May 20, 2019 using Aquathol K at 1.25 ppm. Treatment information by area is summarized in Table 1.

Table 1. The 2019 curlyleaf pondweed herbicide treatment in Forest Lake. Target concentration was 1.25 ppm and 8.8 gallons per acre was applied based on an average depth of 11 feet for each treated area.

Treatment Area	Acres	Gallons Used
Lake 1		
1	5.58	49.1
2	10.7	94.1
3	17.63	155.1
10	3.32	29.2
11	5.77	50.7
12	23.93	210.5
Total for Lake 1	66.93	589
Lake 2		
4	11.83	104.1
9	7.87	69.2
Total for Lake 2	19.7	173
Lake 3		
5	1.87	16.4
6	3.76	33.0
7	3.1	27.2
8	3.75	33.0
Total for Lake 3	12.48	110
Total for Forest Lake	99.11	872

*based on assessment survey map, Figure 4.

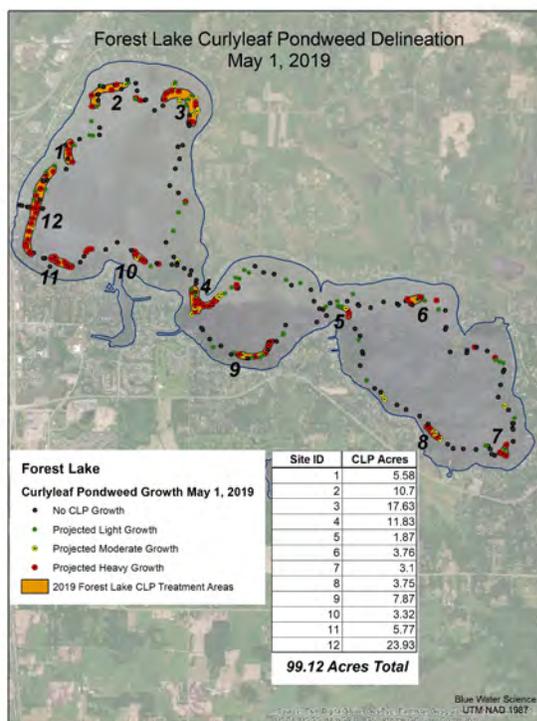


Figure 3. Site map of curlyleaf treatment areas in Forest Lake in 2019.

Key for future potential CLP growth: green dots = light, yellow dots = moderate, and red dots = heavy. Orange shaded areas indicates treatment areas.

Curlyleaf Pondweed Assessment on June 11, 2019

Curlyleaf pondweed control results for the 99.11 acres that were treated on May 20, 2019 were poor to excellent (Figure 4). A few patches of moderate to heavy CLP growth were found in third lake (Figure 4).

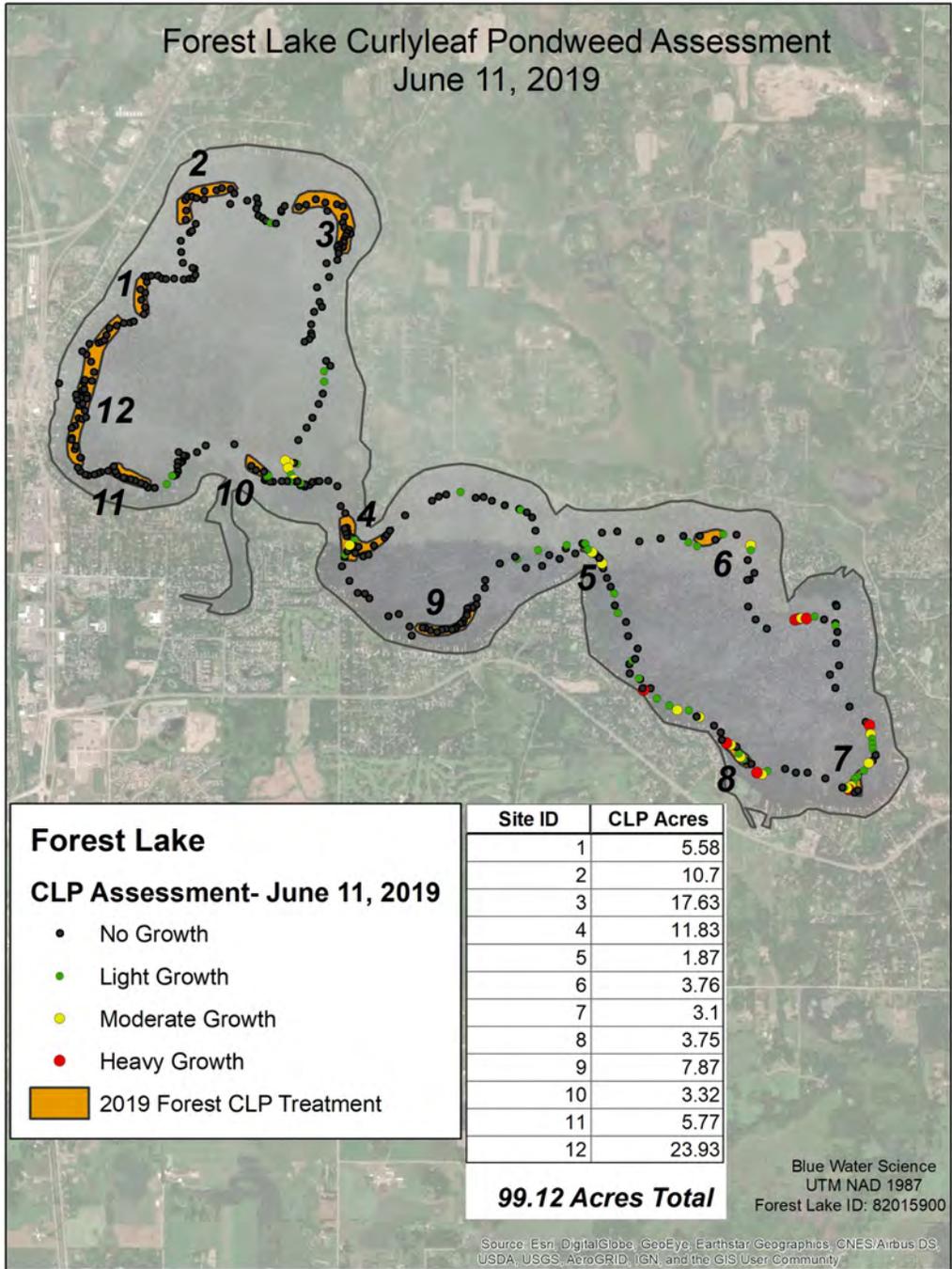


Table 2. Forest Lake, 2019 curlyleaf pondweed herbicide treatment. Target concentration was 1.25 ppm and 8.8 gallons per acre was applied based on an average depth of 11 feet for each treated area.

Treatment Area	Acres	Curlyleaf Control*
Lake 1		
1	5.58	Excellent
2	10.7	Excellent
3	17.63	Excellent
10	3.32	Excellent
11	5.77	Excellent
12	23.93	Excellent
Total for Lake 1	66.93	
Lake 2		
4	11.83	Excellent
9	7.87	Excellent
Total for Lake 2	19.7	
Lake 3		
5	1.87	Excellent
6	3.76	Excellent
7	3.1	Good
8	3.75	Poor
Total for Lake 3	12.48	
Total for Forest Lake	99.11	

*based on assessment survey map, Figure 4.

Figure 4. Map of curlyleaf distribution in Forest Lake on June 11, 2019. Key: green dots = light growth, yellow dots = moderate growth, red dots = heavy growth, and black dots = no curlyleaf.

Comparison of Early Season to Late Season Curlyleaf Growth

A total of 99.11 acres of curlyleaf pondweed was delineated in the May 1 delineation. After a herbicide treatment on May 20, a curlyleaf assessment on June 11 found curlyleaf was controlled in most of the treatment areas (Figure 5).

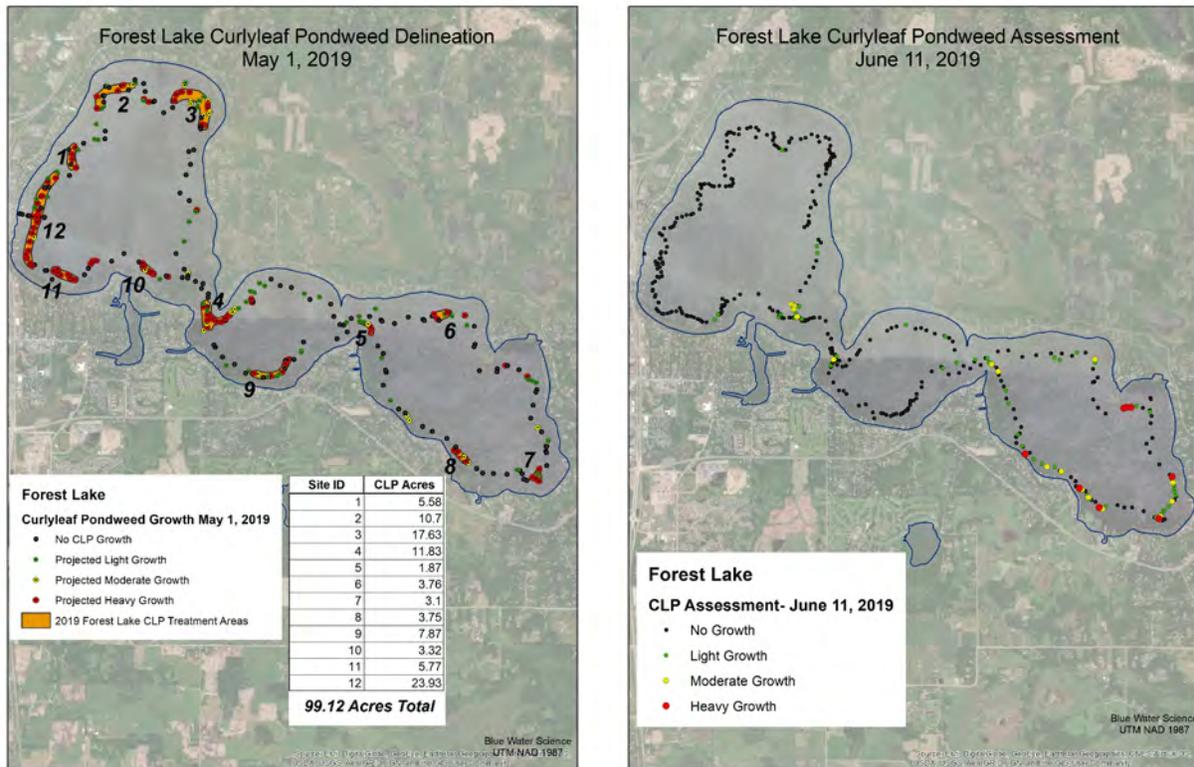


Figure 5. [top-left] **DELINEATION:** Map of curlyleaf pondweed distribution from the May 1, 2019 survey. Approximately 99.11 acres were delineated for CLP treatment. Treatment areas are outlined in red. [top-right] **ASSESSMENT:** Map of curlyleaf pondweed assessment sites for June 11, 2019. Key: green dots = light growth, yellow dots = moderate growth, red dots = heavy growth, and black dots = no curlyleaf growth. Orange shaded areas indicates treatment areas.



Figure 6. Curlyleaf pondweed in Forest Lake on June 11, 2019. Curlyleaf pondweed on a sample rakehead was found at low (left) to high (right) densities.

Forest Lake Curlyleaf Treatment Areas for 2009-2019

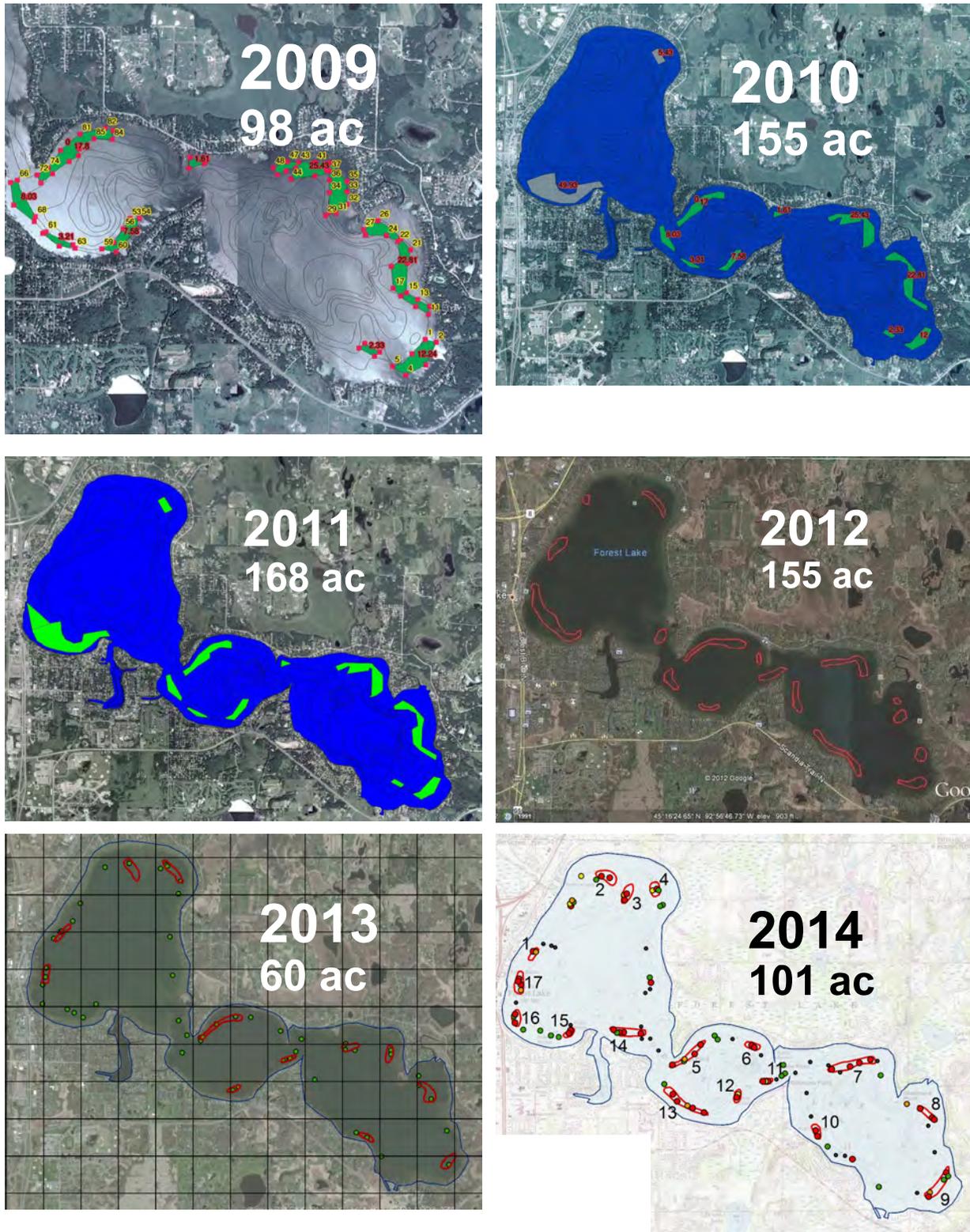


Figure 7. Curlyleaf treatment areas in 2009 through 2014.

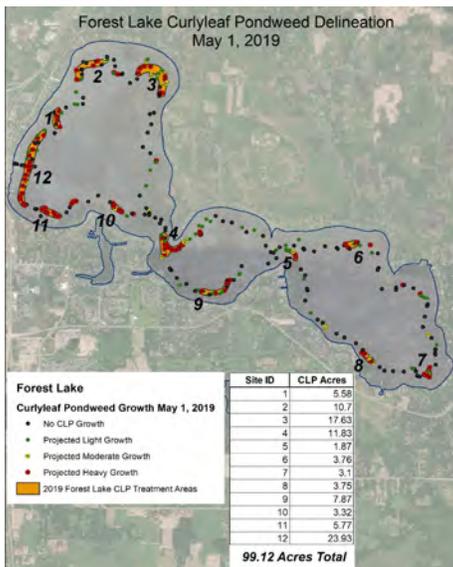
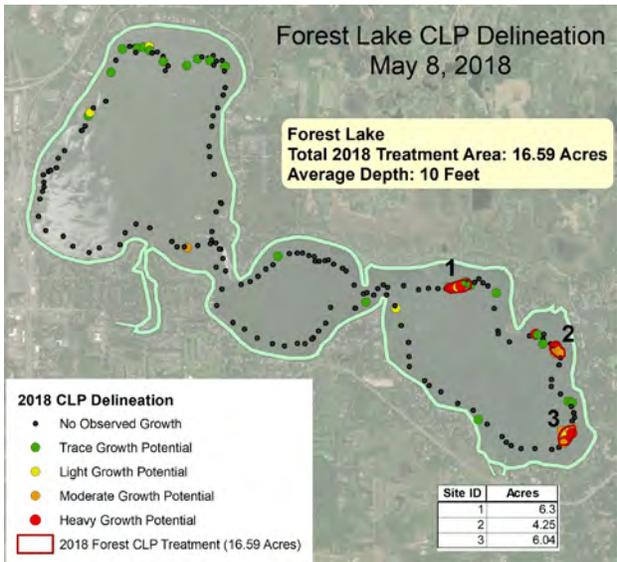
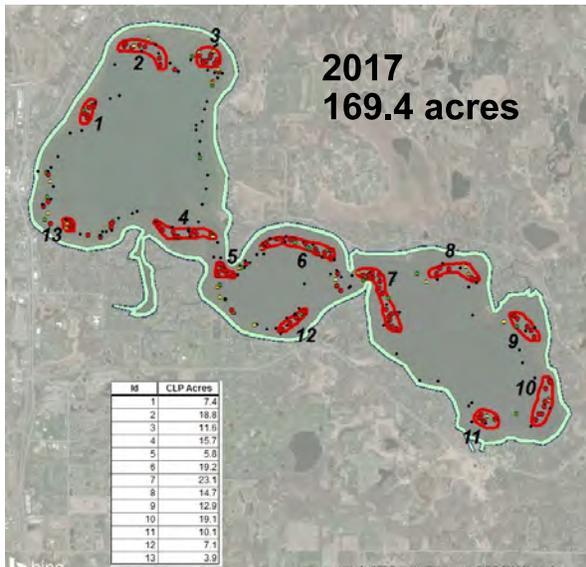
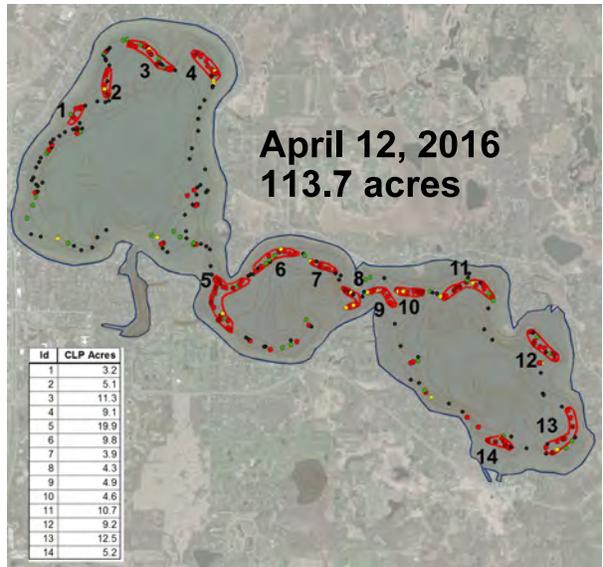
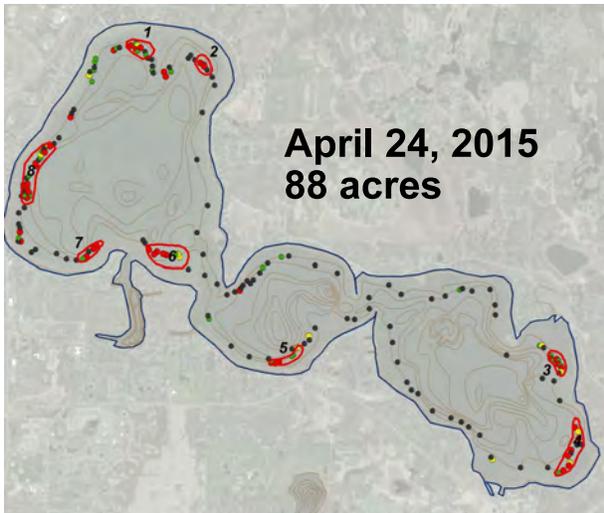


Figure 7. Curlyleaf treatment areas in 2015 through 2019.

Compilation of Curlyleaf Treatment Areas from 2012 through 2019

Curlyleaf pondweed growth patterns are somewhat established in Forest Lake. All treatment areas from 2012 through 2019 are compiled in Figure 8. Treatment areas with 3 or more years of treatment are shaded black. These “hotspot” areas represent about 100 acres of curlyleaf growth. The curlyleaf growth pattern varies from year to year. Some years there will be more than 100 acres and other years there will be less than 100 acres to treat (Table 3). Variables to growth include previous treatments, snow cover, ice off, sunny days, and water temperatures.

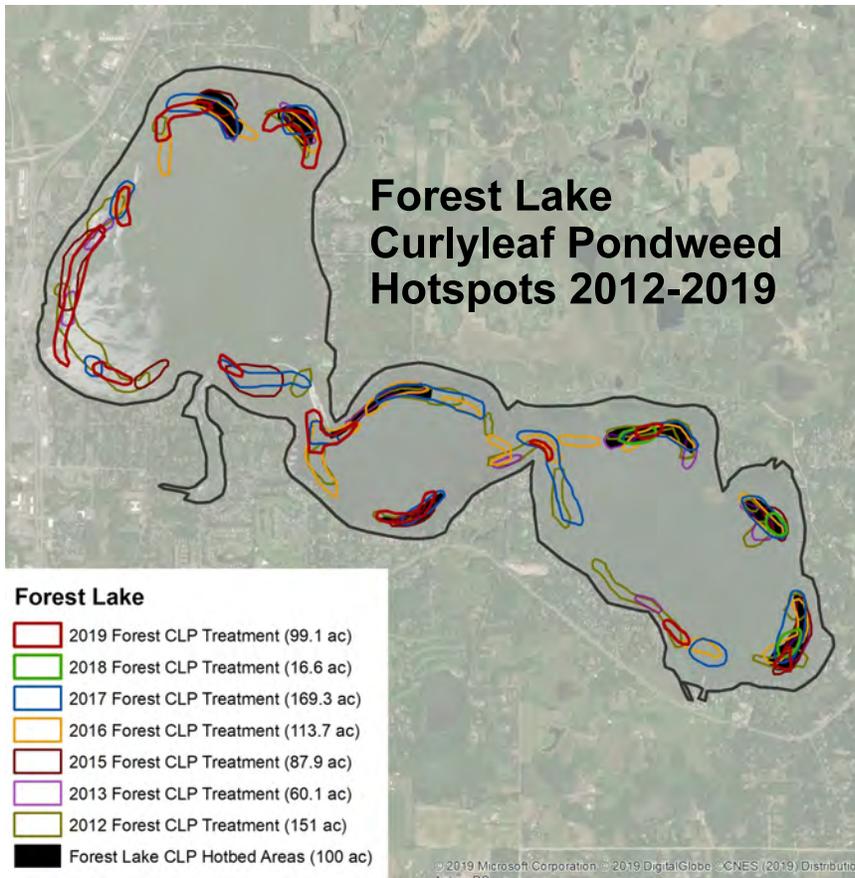


Figure 8. Map of historical treatment of curlyleaf pondweed in Forest Lake, 2012-2019, with hotspot areas shaded black.

Table 3. Acres of non-native plants treated from 2009 through 2019.

	CLP (acres)	EWM (acres)
2009	98	
2010	155	
2011	168	
2012	155	
2013	60	
2014	101	
2015	88	30
2016	114	13.9
2017	169	33.35
2018	16.59	40.74
2019	99.11	49.34

Eurasian Watermilfoil Delineation on June 11, 2019

Eurasian watermilfoil growth was delineated on June 11, 2019 and 382 sites were sampled. EWM was found at 125 out of the 382 sites (33% occurrence with EWM found mostly in the first lake). Nine areas totaling 49.34 acres were treated in 2019 (Figure 9).

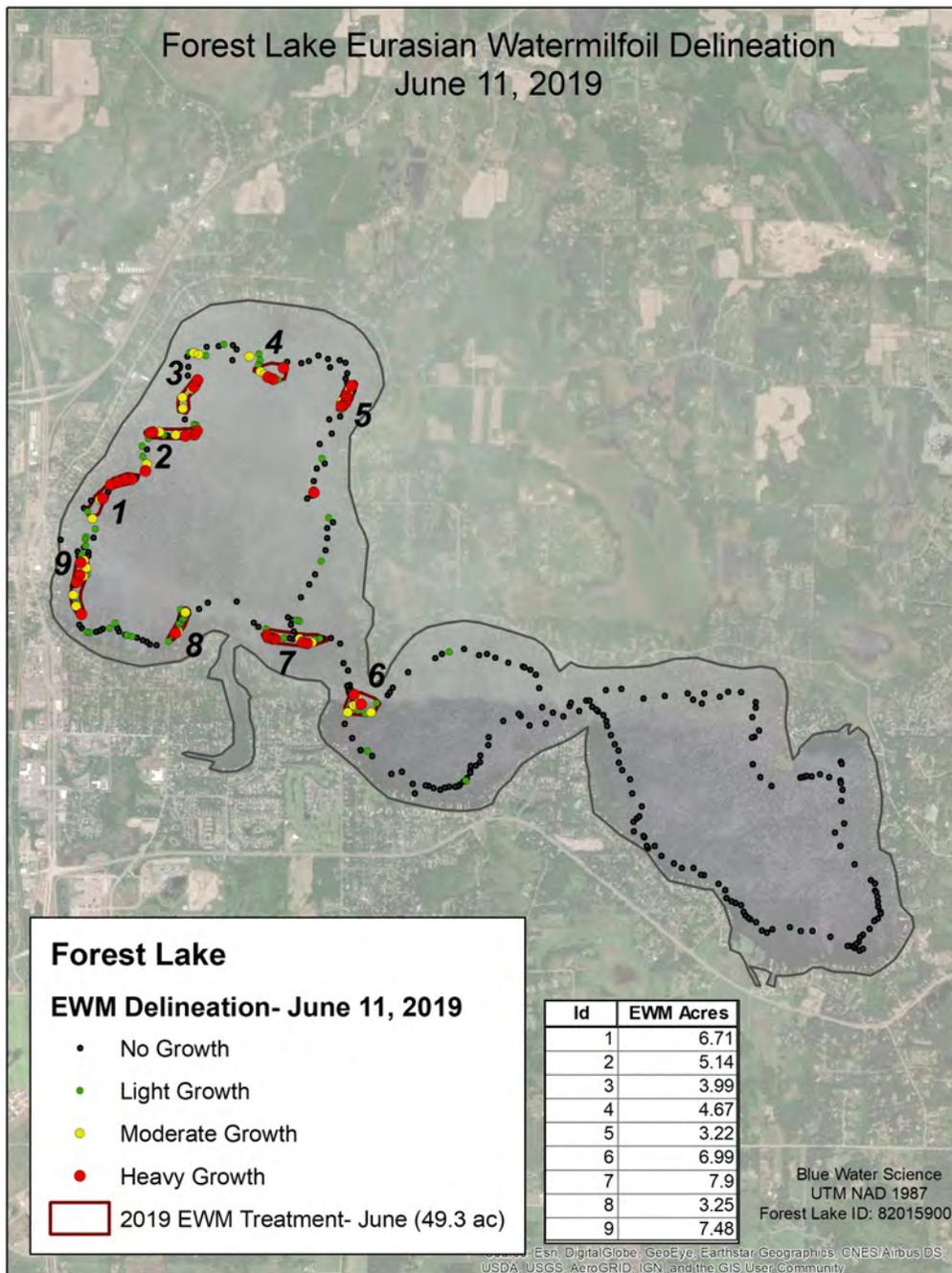


Figure 9. DELINEATION: Map of EWM distribution from the June 11, 2019 survey. Approximately 49.34 acres were delineated for EWM treatment.

EWM Treatment on June 27-28, 2019: Alligare 2-4,D was applied over 2 days. On June 27, 9 treatment areas of 24.675 acres were treated at 4 ppm (477 gallons). On June 28, the other half of the 9 treatment areas were treated (24.675 acres) at 4 ppm (477 gallons).

Eurasian Watermilfoil Assessment on August 12, 2019

After the herbicide treatments of EWM, an EWM assessment that sampled 98 points was conducted on August 12. EWM was controlled in the treatment areas, with light to moderate EWM present at a few locations (Figure 10). No EWM was observed in 2nd and 3rd lakes.

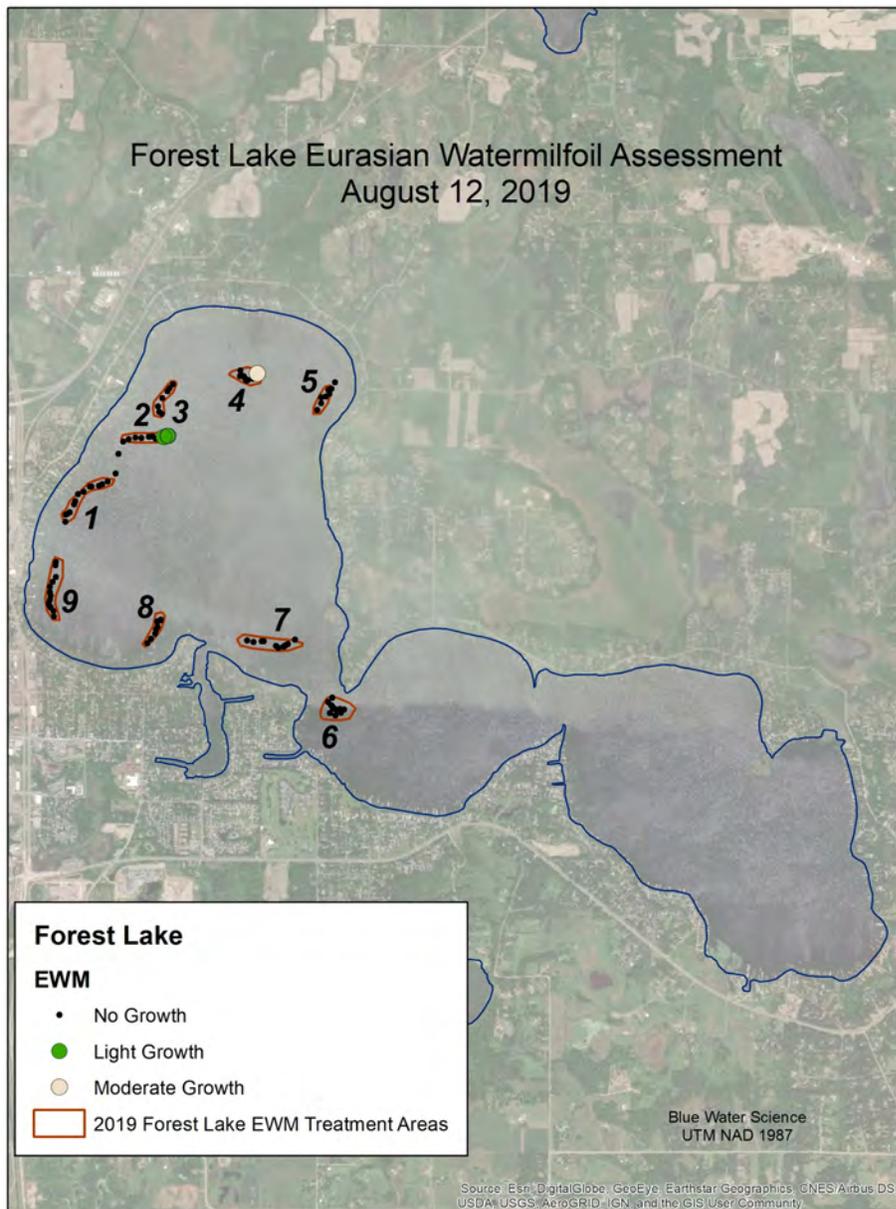


Table 4. Forest Lake, 2019 Eurasian watermilfoil herbicide treatment

Treatment Area	Acres	EWM Control
1	6.71	Excellent
2	5.14	Excellent
3	3.99	Excellent
4	4.67	Excellent
5	3.22	Excellent
6	6.99	Excellent
7	7.90	Excellent
8	3.25	Excellent
9	7.48	Excellent
Total	49.35	

Figure 10. ASSESSMENT: Map of EWM assessment on August 12, 2019.

Key: green dots = light growth, yellow dots = moderate growth, and black dots = no EWM growth. Red outline = treatment area.

Eurasian Watermilfoil Treatments from 2015-2019

Eurasian watermilfoil was first observed in Forest Lake in 2015. EWM treatments have occurred in 2015 through 2019. All areas that have been treated are shown in Figure 11. EWM is found primarily in the first lake with a couple of small areas in second lake at the end of 2017. These areas in 2nd lake were not observed in 2018.

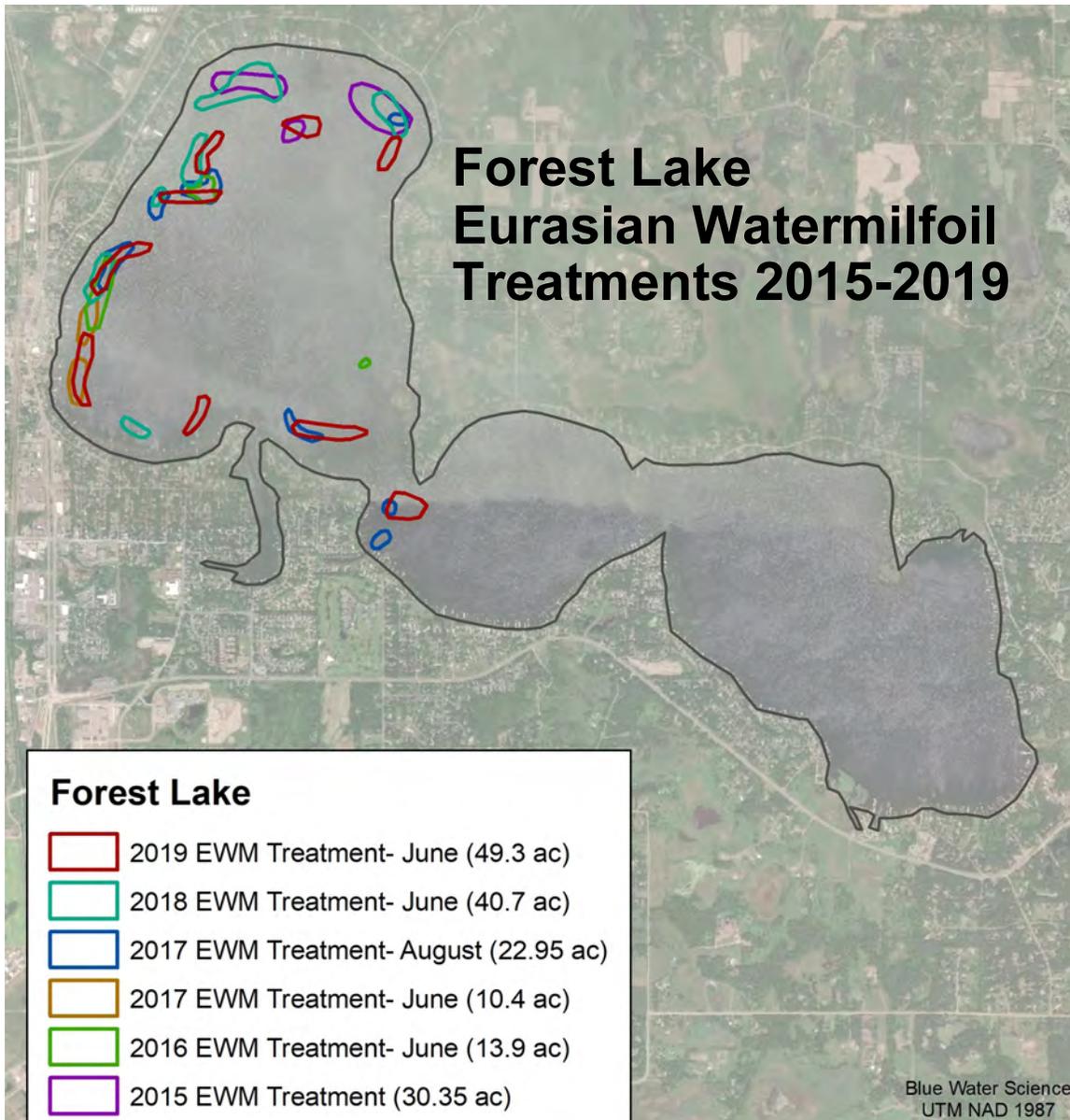


Figure 11. Map of Eurasian watermilfoil treatment areas in Forest Lake, 2015-2019.

What's Next for 2020?

Curlyleaf Pondweed: Treating heavy growth of curlyleaf pondweed based on early season curlyleaf distribution is a challenge. Curlyleaf in early May has just started to go into a rapid growth phase. However, not all early season curlyleaf growth will result in heavy curlyleaf growth in June. It appears there are factors that limit curlyleaf growth and significant variables are associated with sediment conditions. The question is how to best delineate areas to treat what could be heavy growth in June but not overtreat areas where growth wouldn't be a nuisance for the season. Currently, for Forest Lake, the method has been to use past treatment history combined with early season scouting and then a recheck after treatment to evaluate treatment effectiveness and see if curlyleaf areas were missed. Using this technique, most of the heavy growth of curlyleaf pondweed was treated in 2019.

In 2020, the same techniques will be applied that were used in 2019. Treatment areas in 2020 will likely be in the range of areas treated from 2009 through 2019.

Eurasian Watermilfoil: Two passes with a liquid 2,4-D herbicide for EWM control prevented the occurrence of heavy EWM growth in 2016. The first pass treats half the area and the second pass treats the other half of the area. The same basic approach for EWM control was using in 2017 through 2019. After delineations, this treatment approach would appear to be suitable for 2020.