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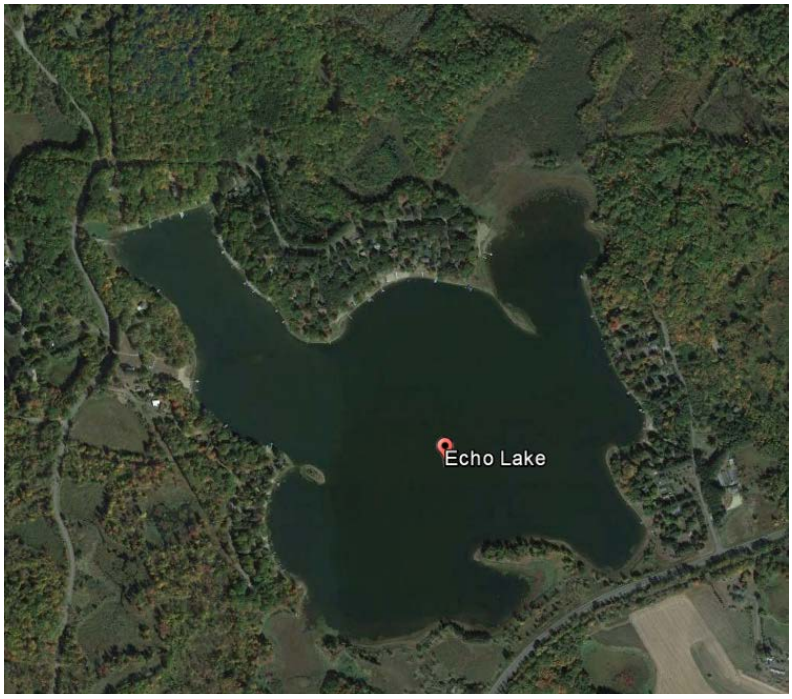
VERMILLION LAKES
BARRON COUNTY

2018 AQUATIC PLANT MANAGEMENT IMPLEMENTATION SUMMARY REPORT WDNR WBIC: LOWER VERMILLION 2098200; UPPER VERMILLION 2098800

Prepared by: Dave Blumer, Lake Educator

May 21, 2019



VERMILLION LAKES ASSOCIATION
CUMBERLAND, WI 54829

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PREPARED FOR THE VERMILLION LAKES ASSOCIATION

INTRODUCTION

This report discusses aquatic plant management activities completed by the Vermillion Lakes Association (VLA) and Lake Education and Planning Services (LEAPS) during the 2018 season and discusses Eurasian watermilfoil (EWM) and curly-leaf pondweed (CLP) management planning and implementation for 2019. In the spring of 2018, the Vermillion Lakes Association (VLA) was awarded a 3-yr AIS Control grant to manage CLP and EWM in both Lower (LVer) and Upper (UVer) Vermillion lakes. Chemical management of CLP and EWM in LVer; and CLP harvesting in UVer was included in the grant.

The following list of education and management actions were completed in 2018.

- 2018 EWM and CLP Management Planning and Implementation
- 2018 CLP Bed-Mapping and Fall EWM Fall Bed-Mapping
- 2019 CLP and EWM Management in the Vermillion Lakes
- 2018 Clean Boats Clean Waters
- 2018 AIS Education and Monitoring
- 2018 Citizen Lake Monitoring Network Water Quality Testing
- 2018 Annual Meeting/VLA Breakfast

Each of these actions will be summarized in the following sections of this report.

PROPOSED LVER EWM CHEMICAL TREATMENT

On October 8th, 2017, 13.6 miles of transects within the lake's littoral zone were searched for EWM. Three areas covering 0.12 acre were true beds in that they were dominated by EWM. Four other areas encompassing 0.19 acre were better defined as high EWM density areas as, although EWM was continuous, it was not the dominant plant. Collectively, these seven areas covered just 0.31 acre or 0.1% of the lake's surface area (Figure 1). This total represented a 0.06 acre increase (+24%) over the 0.25 acre found in 2016. Outside of these mapped areas, an additional 12 EWM plants were found.

This led to a 2018 preliminary EWM treatment proposal covering 4.54 acres. Initially the entire 4.54 acres were to be chemically treated with both endothall (for CLP) and 2,4-D (for EWM), but pre-treatment survey results changed the final treatment plan (Figure 3).

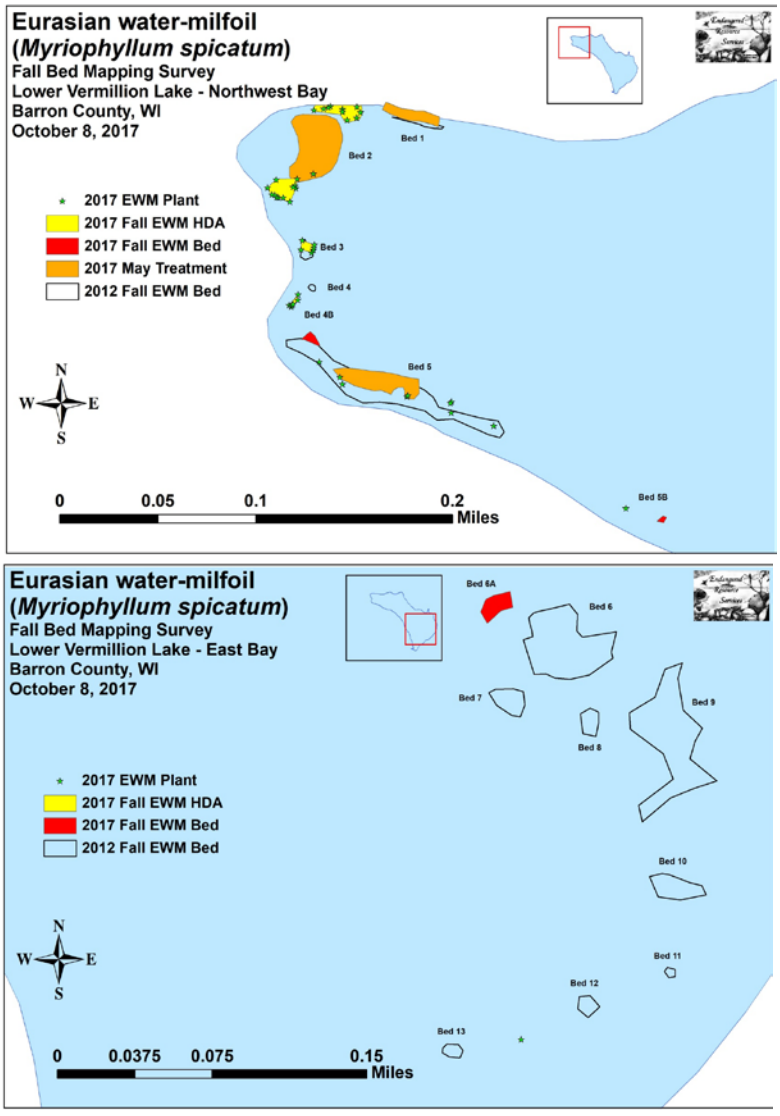


Figure 1: 2017 EWM fall bed mapping survey

2018 PROPOSED LVER CLP CHEMICAL TREATMENT

CLP management was included in the 2018 ACEI grant based on bed mapping last completed in the spring of 2016 (Figure 2). In the 2018 APM Plan, CLP management was to take place essentially in all those areas where EWM management took place, provided both species were identified in the area in the last applicable surveys. Such was the case for CLP in LVer, but because CLP was largely absent from the sand/gravel shorelines found in the northeastern and southeastern lobes of the main EWM treatment proposal area, chemical treatment of CLP was reduced to only two areas totaling 1.98 acres within the larger EWM treatment area; and in the small bed in the center of the east basin that was also proposed for chemical treatment of EWM (Figure 3).

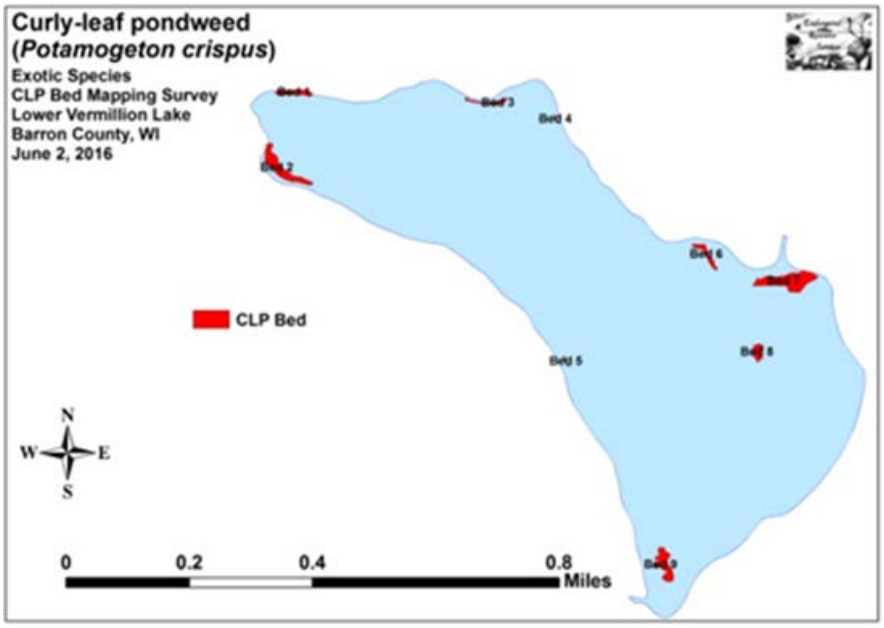


Figure 2: 2016 CLP bed mapping results

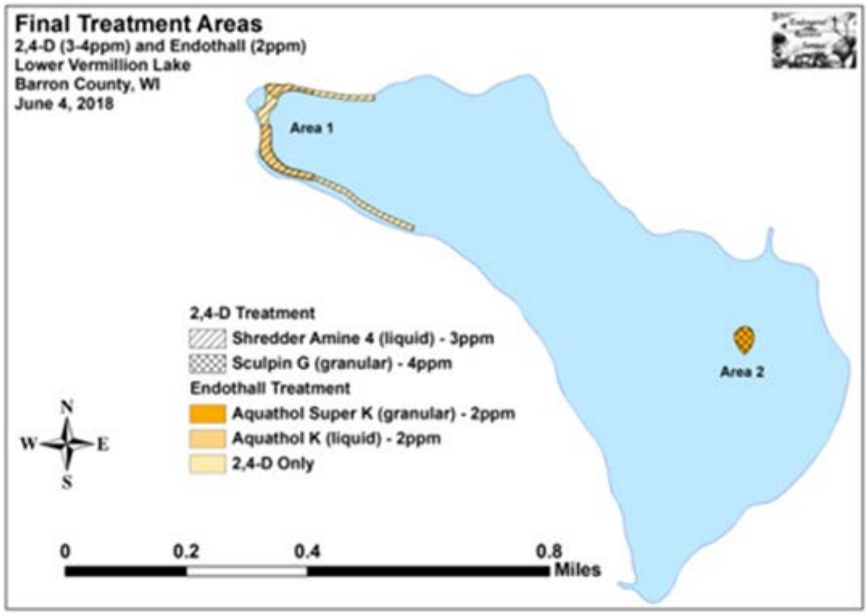


Figure 3: Final 2018 Chemical Treatment of CLP and EWM in Lower Vermillion Lake

2018 PRE-TREATMENT SURVEY

The final CLP and EWM treatment proposal for LVer was modified slightly after the pre-treatment aquatic plant survey as it showed a distinct lack of CLP along the northeastern shoreline. The pre-treatment aquatic plant survey was completed on June 4, 2018 by Endangered Resource Services (ERS). During the pre-treatment survey EWM was identified at 14 points with the treatment proposal areas. CLP was present at 37 points within the western treatment area and in the small treatment area in the east basin. Based on these results the proposed treatment was finalized.

2018 CHEMICAL TREATMENT OF CLP AND EWM IN LOWER VERMILLION LAKE

Chemical treatment was conducted by Northern Aquatic Services (Dresser, WI) on June 4th. The reported water temperature at the time of treatment was 66°F, with an air temperature of 75°F. Winds were out of the west at 3-6mph. Table 1 reflects the details of the 2018 spring CLP and EWM chemical treatments in LVer. Liquid herbicides were used in the western bay by the boat landing. Granular herbicides were used in the east basin due to the small size and depth of that treatment area.

Table 1: Final 2018 Spring Chemical Treatment Details for Lower Vermillion Lake

Lower Vermillion Lake 2018 Preliminary CLP-EWM Chemical Treatment Proposal (05-25-2018 LEAPS)									
Treatment Characteristics				CLP Control			CLP Control		
				Aquathol K (liqid endothall)			Aquathol Super K (granular endothall)		
Treatment Site	Acreage	Mean Depth (feet)	Volume (acre-feet)	Treatment a.i. ppm	Gallons	gallons/acre-ft	Treatment a.i. ppm	pounds*	lbs/acre-ft
Lver2-18/ESCLP-18	0.67	8.0	5.36				2.0	47.2	8.8
NSWBCLP-18	0.56	5.0	2.80	2.0	3.7	1.33			
SSWBCLP-18	1.42	4.0	5.68	2.0	7.6	1.33			
Total	***2.65***		***13.84***		***11.3***			***47.2***	
	CLP - 2.65 acres;								
Treatment Characteristics				Eurasian Watermilfoil Control			Eurasian Watermilfoil Control		
				DMA 4/ Shredder Amine 4 (liquid 2,4-D)			Sculpin G (granular 2,4-D)		
Treatment Site	Acreage	Mean Depth (feet)	Volume (acre-feet)	Treatment a.i. ppm	Gallons	gal/acre-ft	Treatment a.i. ppm	pounds*	lbs/acre-ft
LVer1-18	3.87	5.0	19.35	3.0	41.2	2.13			
Lver2-18/ESCLP-18	0.67	8.0	5.36				4.0	350.5	65.4
Total	***4.54***		***24.71***		***41.2***			***350.5***	
	EWM - 4.54 acres								

Both herbicides were applied on the same day with the intent of increasing the efficacy of both herbicides.

2018 HERBICIDE CONCENTRATION TESTING

Herbicide concentration testing is required on Lower Vermillion Lake due to there being wild rice near the outlet and downstream of the lake in the Vermillion River. Since both 2,4-D (EWM) and endothall (CLP) were used SLOH testing included an analysis of the presence of both herbicides in the water samples collected by VLA volunteers in 2018. Figure 4 shows the results of herbicide residual testing in 2018. Herbicide did reach the outlet in 2018 with both 2,4-D and endothall showing an increasing trend after 20 hours post-treatment (2,4-D 0.005-0.022 ppb; Endo 0.008-0.012 ppb). This suggests that if herbicide concentration testing is required in 2019, it should be extended out beyond 48 hours after treatment.

Herbicide concentrations in the treated areas of the lake reached above 700 ppb in the west basin along the south shore, but quickly dropped after that. Herbicide placed in the lake along the north shore of the west basin and in the east bay did not get anywhere close to the intended application rate of 2000-3000 ppb as planned. This likely explains the burned but not killed EWM in the east basin. Visual results suggest that the chemical treatments in the west basin were successful at providing seasonal relief, but it is likely that there will still be EWM plants growing in the 2018 treatment areas, in 2019.

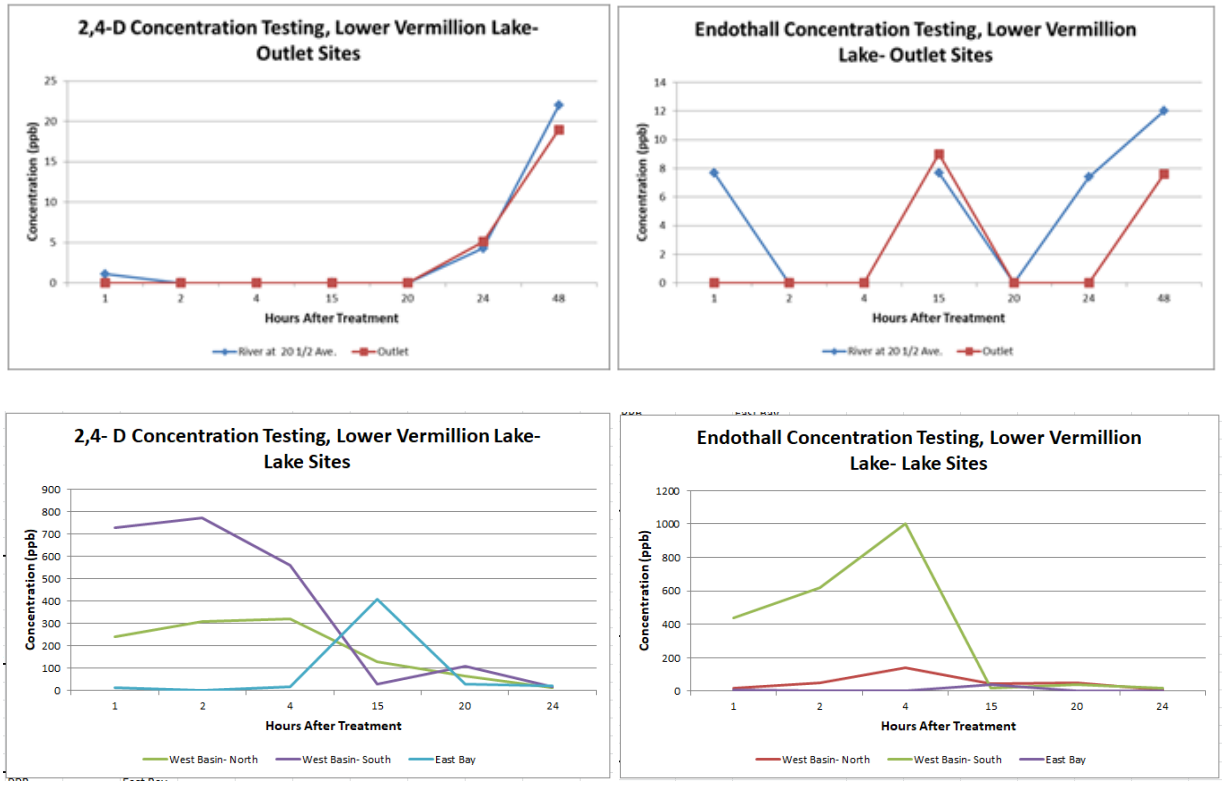


Figure 4: 2018 Herbicide concentration testing results on Lower Vermillion Lake

2018 POST-TREATMENT SURVEY

As mentioned, EWM was identified at 14 points during the pre-treatment survey, however only one of these points was actually on the rake. The rest were visual sightings. During the post-treatment survey, EWM was again found only at one point on the rake, and nowhere else in the lake. At that one point which was in the east bay treatment area, the EWM was chemically burned but showed significant regrowth. Statistically, these findings suggested there was no significant change in EWM although the decline in visual sightings within the treatment areas was highly significant (Figure 5).

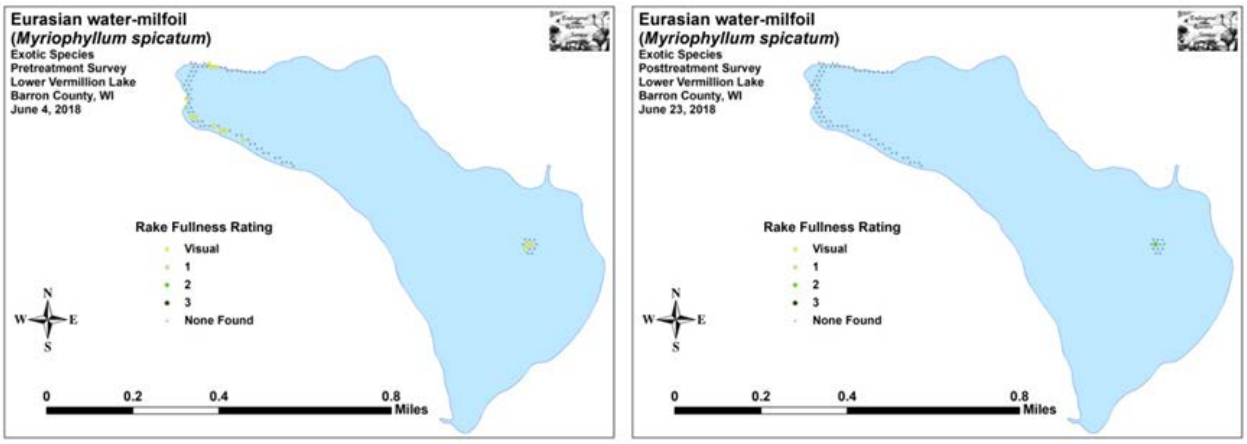


Figure 5: Pre and post distribution of EWM in Lower Vermillion Lake

During the posttreatment survey, CLP was found at just three points with one point. These results demonstrated a highly significant decline in total CLP distribution and visual sightings; a moderately significant reduction in rake fullness 2; and a significant decline in rake fullness 3 (Figure 6).

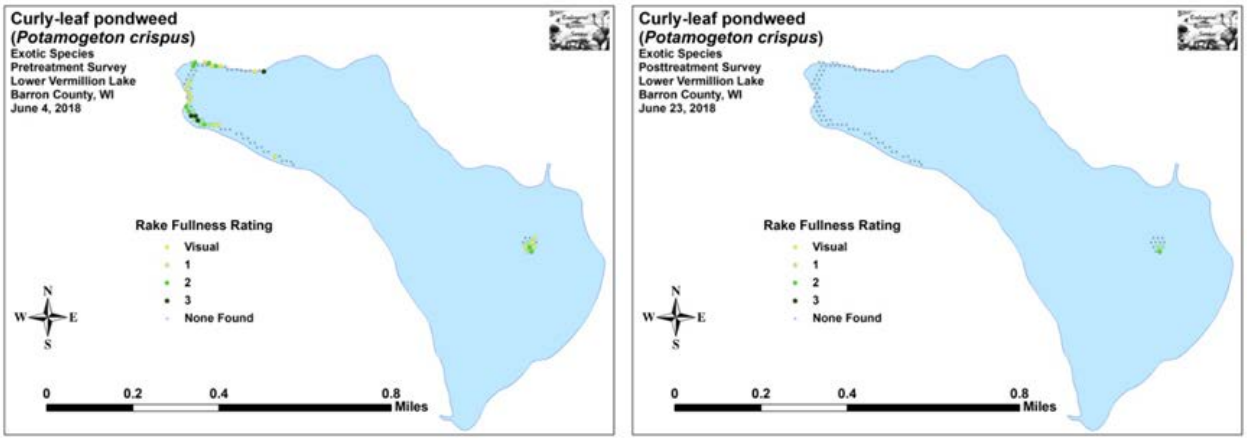


Figure 6: Pre and post distribution of CLP in Lower Vermillion Lake

PRE AND POST DISTRIBUTION OF NATIVE PLANTS

Table 2 reflects the statistics associated with the 2018 pre and post-treatment aquatic plant surveys. The average number of species per site was down, but values related to the health of the aquatic plant community (SDI, Mean C, FQI, Species Richness) were all the same or better during the post-treatment survey.

Table 2: Pre/Posttreatment Surveys Summary Statistics Lower Vermillion Lake, Barron County 6/4 & 6/23/2019

Summary Statistics:	Pre	Post
Total number of points sampled	80	80
Total number of sites with vegetation	69	65
Total number of sites shallower than the maximum depth of plants	75	72
Freq. of occur. at sites shallower than max. depth of plants (in percent)	92.0	90.3
Simpson Diversity Index	0.88	0.88
Mean Coefficient of Conservatism	5.8	5.9
Floristic Quality Index	23.3	29.2
Maximum depth of plants (ft)	11.0	10.5
Mean depth of plants (ft)	4.9	4.6
Median depth of plants (ft)	4.0	4.0
Average number of all species per site (shallower than max depth)	2.24	1.83
Average number of all species per site (veg. sites only)	2.43	2.03
Average number of native species per site (shallower than max depth)	1.95	1.78
Average number of native species per site (sites with native veg. only)	2.15	2.00
Species Richness	18	20
Mean Rake Fullness (veg. sites only)	1.49	1.52

Coontail and flat-stem pondweed were the two most common native species in both the pre and posttreatment surveys. Present at 40 sites during the pretreatment survey, coontail experience a non-significant decline in distribution to 36 sites posttreatment. It also saw a non-significant increase in mean rake fullness from 1.38 pre to 1.42 post. Flat-stem pondweed was present at 28 sites with a mean rake fullness of 1.11 during the pretreatment survey. Posttreatment, it was found at just 15 sites with a mean rake fullness of 1.00. This significant decline in both distribution and density is potentially tied to this species sensitivity to Endothall.

No other species showed a significant decline in distribution posttreatment, although Northern water-milfoil and small pondweed both declined sharply and were near significant (p=0.11/p= 0.051). Wild celery, a late-growing species, demonstrated the only significant increase in distribution posttreatment.

CLP HARVESTING ON UPPER VERMILLION LAKE

2018 marks the first year that harvesting of CLP and native vegetation was intended to be implemented on Upper Vermilion Lake. However, due to the type of spring that was had, essentially little to no CLP actually grew to nuisance levels in Upper Vermillion Lake so plans for harvesting were scrapped. Harvesting is again planned for 2019.

2018 CLP BED-MAPPING AND FALL EWM FALL BED-MAPPING

CLP bed mapping was planned in Lower Vermillion Lake in June 2018, but was not completed due to the fact that very few to no beds of CLP were visible at the surface in the month of June. CLP bed mapping will be completed in 2019.

Fall EWM bed mapping was completed by LEAPS on October 15, 2018. Four beds or high density areas were identified covering a total of 0.59 acres (Figure 7). An additional four points with EWM were identified outside of the high-density areas.

Figure 7: 2018 EWM bedmapping results (gray-beds or high-density areas; yellow dots-individual plants)

LOWER VERMILLION LAKE

Based on the CLP and EWM treatment plan for LVer and fall bed mapping results in 2018, a preliminary CLP and EWM treatment proposal was put together. This preliminary proposal included 2,95 acres of CLP in four beds, and 1.21 acres of EWM in four beds. Granular herbicide was again proposed for use in the east bay treatment area Table 3, Figure 8).

Table 3: 2019 Preliminary CLP and EWM treatment proposal for Lower Vermillion Lake

Lower Vermillion Lake 2019 Preliminary CLP-EWM Chemical Treatment Proposal (03-31-2019 LEAPS)									
Treatment Characteristics				CLP Control					
				Aquathol K (liquid endothall)					
Treatment Site	Acreage	Mean Depth (feet)	Volume (acre-feet)	Treatment a.i. ppm	Gallons	gallons/acre-ft			
EBCLP-19	0.67	8.0	5.36	4.0	13.9	2.60			
NSWBCLP-19	0.56	5.0	2.80	2.5	4.7	1.67			
SSWBCLP-19	1.42	4.0	5.68	2.5	9.5	1.67			
NSHRCLP-19	0.30	5.0	1.50	2.5	2.5	1.67			
Total	***2.95***		***15.34***		***30.6***				
	CLP - 2.95 acres;								
Treatment Characteristics				Eurasian Watermilfoil Control			Eurasian Watermilfoil Control		
				DMA 4/ Shredder Amine 4 (liquid 2,4-D)			Sculpin G (granular 2,4-D)		
Treatment Site	Acreage	Mean Depth (feet)	Volume (acre-feet)	Treatment a.i. ppm	Gallons	gal/acre-ft	Treatment a.i. ppm	pounds*	lbs/acre-ft
EBCLP-19/EWM-19	0.67	8.0	5.36				3.0	263.2	49.1
WBNSHR-19	0.18	5.0	0.90	4.0	2.6	2.84			
WBSSHR-19	0.26	4.0	1.04	4.0	3.0	2.84			
WBCENTER-19	0.10	4.0	0.40				4.0	26.2	65.4
Total	***1.21***		***7.70***		***5.5***			***289.3***	
	EWM - 1.21 acres								

Figure 8: 2019 Preliminary CLP and EWM chemical treatment map

Final 2019 CLP and EWM management plans for LVer will be completed after the official pre-treatment survey completed by ERS in May of 2019.

NOTE: A pre-treatment survey completed in the west basin in May of 2019 found EWM at only one point. CLP was still present in many points, but that is expected as it usually takes three or more years to reduce CLP turion densities far enough to see a reduction CLP abundance and density.

UPPER VERMILLION LAKE

As previously mentioned, a CLP and native aquatic plant harvesting proposal was put together for Upper Vermillion Lake in 2018. This proposal was not implemented due to a lack of CLP and native vegetation in general in 2018. The same proposal has been resubmitted for 2019. Three harvesting areas totaling 3.64 acres are proposed for early summer harvest to remove CLP and other nuisance aquatic plant growth. In addition, five navigation lanes from 20-40 feet wide, nearly 3500 feet in length, and totaling 2.12 acres is proposed for harvesting (Table 4, Figure 9). TSB Lakefront Restoration out of Chippewa Falls, WI has already been contracted by the VLA to complete one full day of harvesting in mid-June. While it is not expected that the entire proposed area will be harvested, the goal is to see how efficient harvesting can be, and how much can get done in a day, with the cost of about $2,000.00.

Table 4: 2019 Upper Vermillion CLP and native plant harvesting details

2018 Upper Vermillion Harvesting Plan							
Site	**Length (ft)**	**Width (ft)**	**Acres**	**Navigation Lanes**	**Open Water**	**Target Species**	**When**
MainChannel18	1126	40	1.03	yes	NA	CLP/Native	early June; July
NWNav18	158.5	20	0.07	yes	NA	CLP	early June
Majewski18	251.5	20	0.12	yes	NA	CLP	early June
SWNav18	1491.3	20	0.68	yes	NA	CLP/Native	early June; July
SEBayNav18	468.8	20	0.22	yes	NA	CLP	early June
PubAcc18	NA	NA	1.24	NA	yes	CLP/Native	early June; July
NWShore18	NA	NA	1.88	NA	yes	CLP/Native	early June; July
SEBay18	NA	NA	0.52	NA	yes	CLP/Native	early June; July
TOTALS			**5.76**				

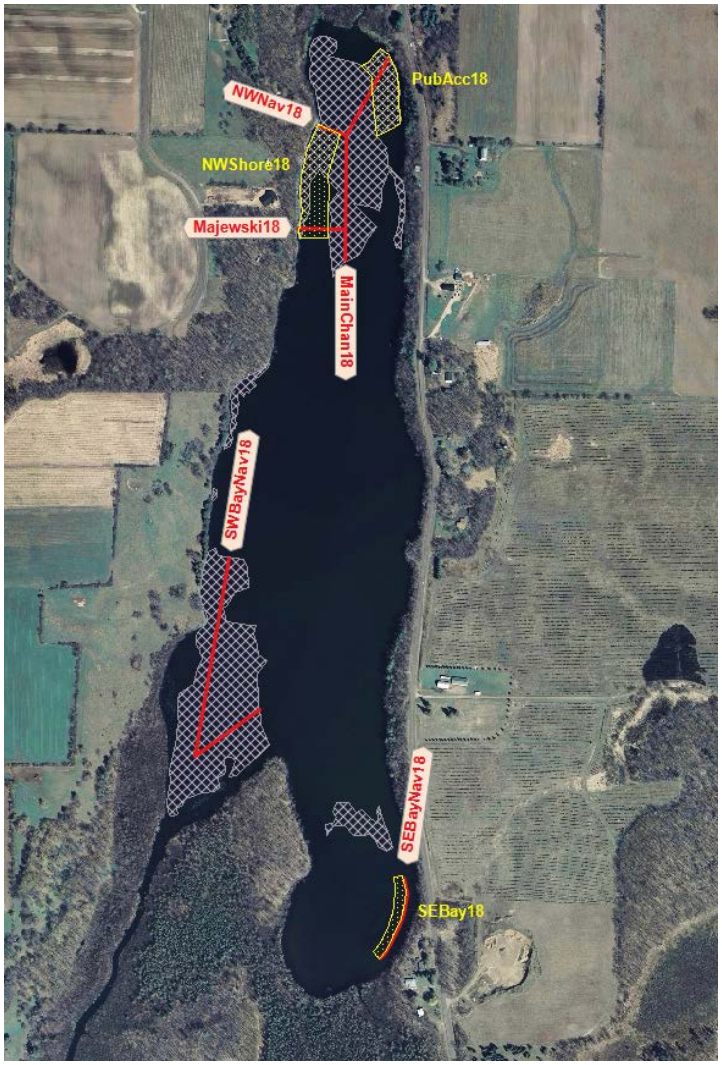


Figure 9: 2019 Upper Vermillion Lake CLP and native aquatic plant harvesting map

2018 CLEAN BOATS, CLEAN WATERS (CBCW)

In 2018, the VLA supported its own CBCW program due to a processing error with their annual CBCW grant application. Despite this, the VLA put in at least 160 hours at the Lower Vermillion Lake public access of 9th Street. All of this data has been submitted to the WDNR SWIMS database.

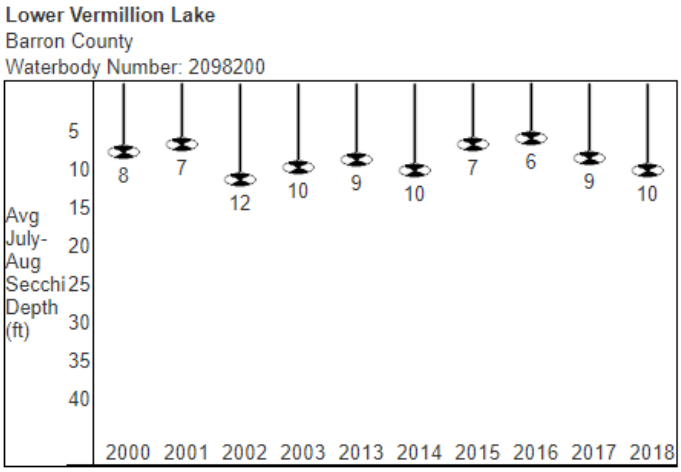
2018 AIS EDUCATION AND MONITORING

Aquatic invasive species including zebra mussels and EWM were the topic of an education event held by the VLA during its annual Breakfast Meeting on Memorial Day Weekend. Dave Blumer, from LEAPS brought in samples of the various AIS and discussed what to look for and how to remove anything that was found. Following the annual breakfast meeting, several smaller events were held at the residences of property owners on the lake (June 10 and 13th).

AIS monitoring was completed by Tom Margotto nearly every time he was on the water, at least several times a month. When on the water, the volunteer looked for new locations with CLP and EWM, and looked for other invasives including purple loosestrife. No new AIS were found in the lake. CLP and EWM continue to be in the places it has been found before.

2018 CITIZEN LAKE MONITORING NETWORK (CLMN) WATER QUALITY TESTING

Water /clarity quality in Lower Vermillion Lake in 2018 was exceptional, much better than it has been in the last few years. Lower Vermillion Lake at the Deep Hole was sampled 13 different days during the 2018 season. Parameters sampled included: water clarity, temperature, dissolved oxygen, total phosphorus, and chlorophyll. The average summer (July-Aug) Secchi disk reading for Lower Vermillion Lake - Deep Hole (Barron County, WBIC: 2098200) was 10.5 feet (Figure 10). The average for the Northwest Georegion was 8.5 feet. Typically the summer (July-Aug) water was reported as clear and blue.



Past secchi averages in feet (July and August only).

Year	Secchi Mean	Secchi Min	Secchi Max	Secchi Count
2000	8.13	5	9.75	4
2001	7.1	5	10.5	5
2002	11.89	10	15	9
2003	10.25	9.5	11	2
2013	9.1	8	9.75	5
2014	10.58	8	14.75	3
2015	7.25	5.25	10.25	3
2016	6.31	3.75	8.5	4
2017	9	7	11.5	3
2018	10.5	6.75	14.75	4

Figure 10: Average summer (July and August) Secchi disk readings at the Deep Hole

Chemistry data was collected on Lower Vermillion Lake - Deep Hole in 2018. The average summer Chlorophyll was 1.5µg/l (compared to a Northwest Georegion summer average of 16.1µg/l). The summer Total Phosphorus average was 17.4 µg/l. Lakes that have more than 20 µg/l and impoundments that have more than 30 µg/l of total phosphorus may experience noticeable algae blooms.

The overall Trophic State Index (based on chlorophyll) for Lower Vermillion Lake - Deep Hole was 38 (Figure 11). The TSI suggests that Lower Vermillion Lake - Deep Hole was oligotrophic. Oligotrophic means low phosphorus and chlorophyll values and deeper Secchi readings. Lower Vermillion has never been listed as an oligotrophic lake based on CLMN results since CLMN monitoring began back in 2000.

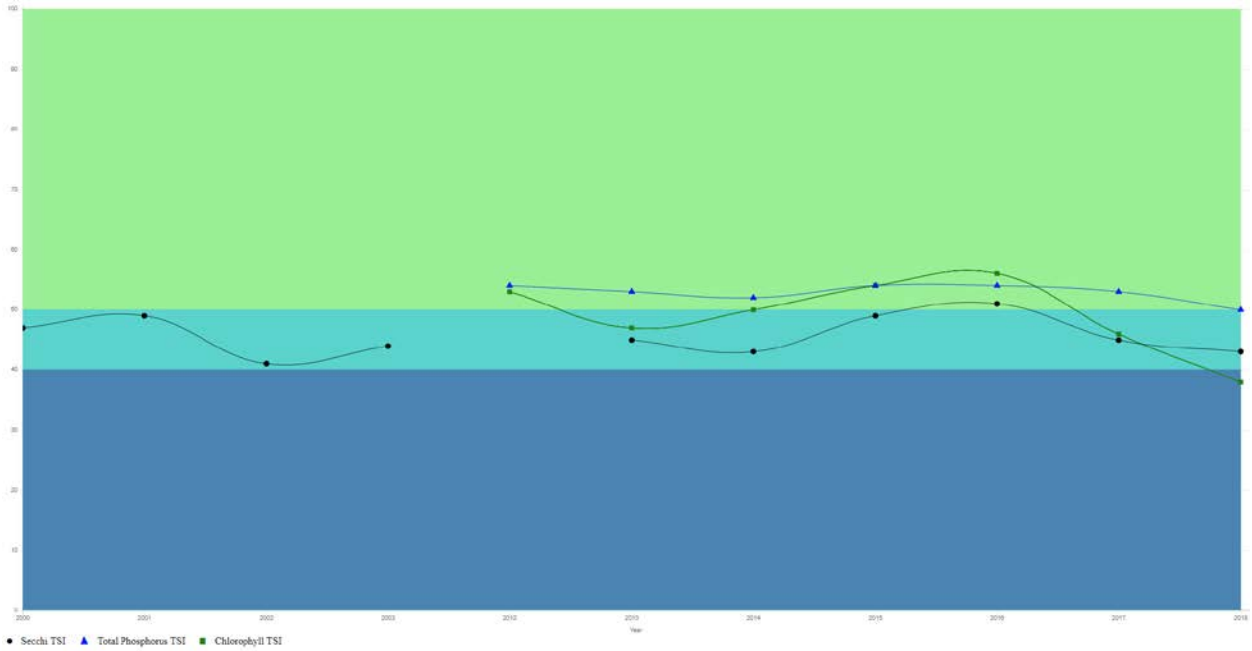


Figure 11: 2018 Summer (July and August) TSI values for total phosphorus and chlorophyll-a at the Deep Hole on Lower Vermilliion Lake

Dissovled oxygen and temperature profiles indicate that Vermilliion Lakes is dimictic meaning it has both a spring and fall turnover and stratifies in the summer. Stratification was documented in profiles taken by volunteers May-September. A thermocline was established in early June at a depth of about 27 feet. As the summer progressed the thermocline moved up to aroound 20 feet, with the waters below that point being mostly devoid of oxtgen. As of the middle of September when the last profile was taken, oxygen levels had still not improved (Figure 12).

05/20/2018		
Depth FEET	Temp. DEGREES F	D.O.
3	62	
6	61.5	
9	61.5	
12	58.2	
15	50	
18	44.6	
21	42.8	
24	41.7	
27	41	
30	40.6	
33	40.2	
36	39.9	
39	39.9	
42	39.9	
45	39.9	

06/07/2018		
Depth FEET	Temp. DEGREES F	D.O. MG/L
3	68.8	8.08
6	67.9	8.01
9	67.4	7.98
12	66.7	7.84
15	61.1	7.75
18	50	7.16
21	45.6	7.16
24	43.7	2.77
27	42.1	1.14
30	41.4	.47
33	40.8	.25
36	40.4	.17
39	40.2	.12
42	40	.08
45	39.9	.06

06/22/2018		
Depth FEET	Temp. DEGREES F	D.O. MG/L
3	73.8	8.44
6	73.8	8.68
9	73.6	8.7
12	72.4	8.65
15	67.3	8.1
18	57.2	7.52
21	50.3	6.24
24	45.9	3.21
27	43.8	1.09
30	42.8	.72
33	41.8	.46
36	41.2	.31
39	41	.23
42	40.7	.19
45	40.6	.16
48	40.4	.13
51	40.5	.11
54	40.5	.06
57	40.5	.02

07/06/2018		
Depth FEET	Temp. DEGREES F	D.O. MG/L
3	76	8.73
6	76.5	8.82
9	76.2	8.92
12	76	8.69
15	69.9	9.89
18	59.3	7.94
21	51	5
24	45.9	.82
27	44.5	.52
30	43.1	.38
33	42.4	.31
36	41.8	.26
39	41.3	.22
42	41	.19
45	40.8	.17
48	40.8	.16
51	40.7	.14
54	40.7	.11

07/25/2018		
Depth FEET	Temp. DEGREES F	D.O. MG/L
3	75.9	7.74
6	75.9	7.73
9	75.8	7.68
12	75.6	7.47
15	71.7	7.71
18	62.5	6.26
21	52.8	1.73
24	49.2	.86
27	45.9	.65
30	43.7	.46
33	42.8	.31
36	42.1	.22
39	41.7	.18
42	41.4	.14
45	41.1	.12
48	41.1	.11
51	41	.09
54	41.1	.07
57	41.1	.06

08/10/2018		
Depth FEET	Temp. DEGREES F	D.O. MG/L
3	76.5	8.88
6	75.7	8.9
9	74	9.29
12	72.7	8.83
15	70.5	7.85
18	62.4	3.97
21	55	1.04
24	51.5	.62
27	47.7	.44
30	45	.3
33	43	.2
36	41.9	.08
39	41.6	.07
42	41.3	.06
45	41.2	.05
48	41	.04
51	41	.03
54	41	.02

08/25/2018		
Depth FEET	Temp. DEGREES F	D.O. MG/L
3	73.1	7.69
6	72.3	7.72
9	71.8	7.58
12	71.6	7.33
15	70.3	6.61
18	65.9	2.8
21	56	.58
24	51.4	.34
27	47.1	.21
30	44.7	.15
33	43.4	.12
36	42.6	.1
39	42.1	.08
42	41.8	.07
45	41.5	.05
48	41.4	.04
51	41.3	.03

09/14/2018		
Depth FEET	Temp. DEGREES F	D.O. MG/L
3	71.6	9.25
6	70.7	9.25
9	70.2	9.04
12	69.9	8.78
15	69.6	8.49
18	66.1	4.76
21	57	1.24
24	52.3	.64
27	48.6	.4
30	44.9	.29
33	43.4	.23
36	42.7	.2
39	42.2	.16
42	42	.14
45	41.8	.12
48	41.7	.11
51	41.7	.09
54	41.7	.07
57	41.7	.06

Figure 12: Temperature and Dissolved Oxygen Profiles for Vermillion Lakes in 2018

2018 ANNUAL MEETING AND LAKE EVENT

The VLA held its annual breakfast meeting on membership meeting on May 26, 2018 from 9:00am to 12:00pm at the residence of one of the property owners on the lake. Each year, on Memorial Day Weekend, the Breakfast Meeting is held for all of the residents of both Lower and Upper Vermillion Lakes. A meet and greet with coffee and donuts is followed by a short VLA meeting, which is then followed up with a presentation on AIS. In 2018, LEAPS provided informational materials and samples of different AIS for breakfast participants to view. Monitoring was discussed and questions were asked and answered. The 2018 meeting also introduced the 3-year AIS Control grant project that had been awarded to the VLA for management of CLP and EWM between 2018 and 2021.

Another meeting of the VLA was held in the fall of 2018 at the Public Library in Cumberland. During this meeting, lake constituents were updated on the results of CLP and EWM management in both lakes, and given preliminary treatment proposals for 2019.