Photo Credit: Jim Joyce

2023-27 AQUATIC PLANT MANAGEMENT PLAN

Callahan and Mud Lakes

Callahan Lake Protective Association

September 2022

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Acknowledgements:

Members of the Callahan Lake Protective Association who helped collect data, and contributed to discussions and recommendations presented in this plan.

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Executive Summary

Callahan and Mud Lakes are exceptionally beautiful and scenic lakes home to many species of birds, game fish, and a diverse aquatic plant community. Unfortunately, invasive Eurasian watermilfoil *Myriophyllum spicatum* (EWM) has become established in these lakes, threatening their biodiversity, recreational opportunities, and overall health as a functioning ecosystem. As such, management of EWM is necessary to protect this valuable resource and maintain its status as a high-quality waterbody. An integrated management approach that relies on a combination of manual and chemical control methods is recommended to continue for Callahan and Mud Lakes.

The Callahan Lake Protective Association (CLPA) takes an active role in managing both Callahan and Mud Lakes. The purpose of this Aquatic Plant Management Plan (APMP) is to outline a strategy meant to control EWM, protect native plant communities, and prevent the introduction of additional aquatic invasive species. Therefore, the primary goal of this plan is to protect Callahan and Mud Lakes' ecosystem and native plant community through management efforts to control EWM.

This goal will be accomplished through the following objectives:

1. **EWM Management.** Limit the spread of EWM through environmentally responsible methods to benefit the native plant community while maintaining EWM at manageable levels.

2. **Education and Awareness.** Continue to educate property owners and lake users on aquatic invasive species through public outreach and education programs to help contain EWM within the lake and prevent its spread further in the lake, as well as to other waterbodies.

3. **Research and Monitoring.** Develop a better understanding of the lake and the factors affecting lake water quality through continued and expanded monitoring efforts.

4. **Adaptive Management.** Follow an adaptive management approach that measures and analyzes the effectiveness of control activities and modify the management plan as necessary to meet goals and objectives.

Aquatic Plant Management (APM) Strategy

We recommend the continuation of a combination of chemical and manual control methods to curb the spread of EWM in Callahan and Mud Lakes and prevent it from dominating the lake. The overall goal of this plan is to protect this outstanding resource from degradation by maximizing prevention of new invasions and through the containment and control of existing aquatic invasive species while maintaining the health and recreational use of the lake.

This plan supports sustainable practices to protect, maintain and improve the native aquatic plant community, the fishery, and the recreational and aesthetic values of the lake. This plan is intended to be a living document that will be evaluated annually to determine if it is meeting stated goals and community expectations, and can it be revised if necessary. The CLPA sponsored the development of this APMP, funded through a WDNR Aquatic Invasive Species Education, Prevention, and Planning Grant and in-kind donations by CLPA volunteers.

APMPs developed for northern Wisconsin lakes are evaluated according to Northern Region APM Strategy goals developed by the WDNR (Appendix A). APMPs and the associated management permits (chemical or harvesting) are reviewed by the WDNR. Additional review may be completed by the Voigt Intertribal Task Force (VITF) in cooperation with the Great Lakes Indian Fish and Wildlife Commission (GLIFWC). WDNR aquatic plant management planning guidelines, the Northern Region Aquatic Plant Management Strategy (Appendix A), and the goals of the CLPA in conjunction with the current state of the lake formed the framework for the development of this APMP. This plan is designed to be implemented over the course of 5 years with goals and objectives to be met throughout that time frame.

Lake Information

Background

Callahan and Mud Lakes are drainage lakes on the North Fork of the Chief River located in Sawyer County (Figure 1). Mud Lake is approximately 464 acres with a maximum depth of 15 feet and an average depth of 6 feet, and Callahan Lake is 138 acres with a maximum depth of 18 feet and a mean depth of 11 feet; the two lakes are connected by several channels (Figure 2; Figure 3). Both lakes have primarily mucky substrate with some areas of sand (Figure 2; Figure 3). Water quality data collected by Citizen Lake Monitoring Network volunteers has determined that both lakes are borderline mesotrophic (relatively clear water and mid-range nutrient levels). Aquatic vegetation is abundant, supporting a fishery of musky, northern pike, walleye, bass, and panfish. The condition of these lakes provides a unique habitat that includes dark stained water, large bogs, abundant vegetation growth, a substantial amount of nearshore woody habitat, and an inlet (North Fork of the Chief River) and an outlet (controlled by a dam).

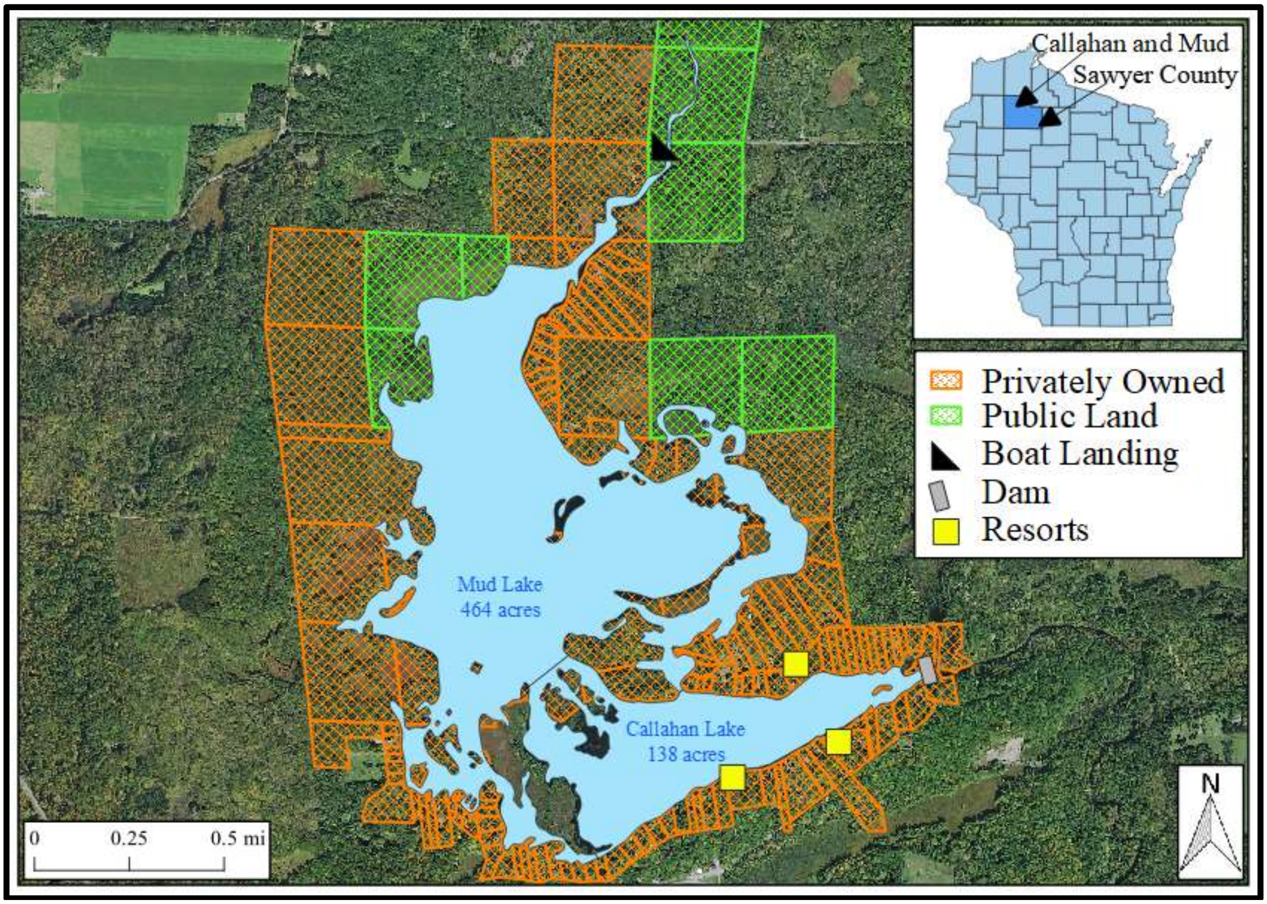

Figure 1: Location and land ownership of Callahan and Mud Lakes, Sawyer County, Wisconsin

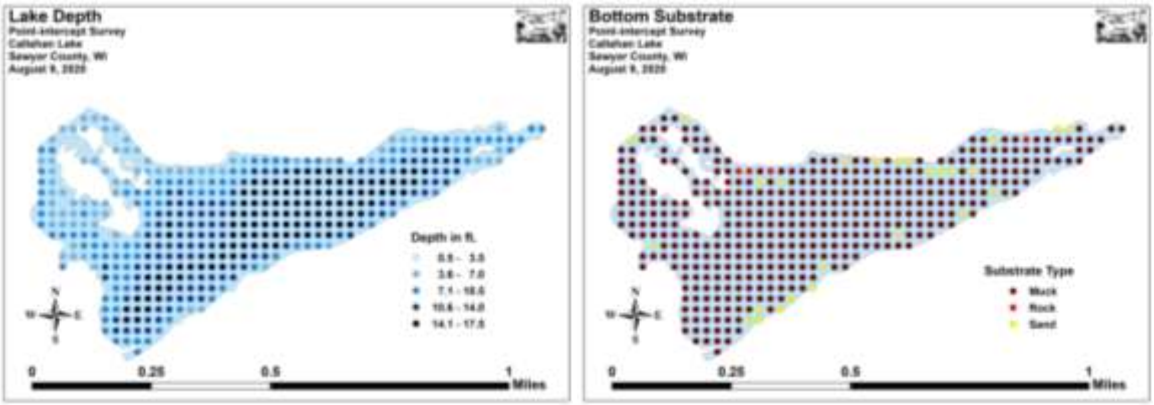

Figure 2: Callahan Lake depth and bottom substrate (Berg, 2020)

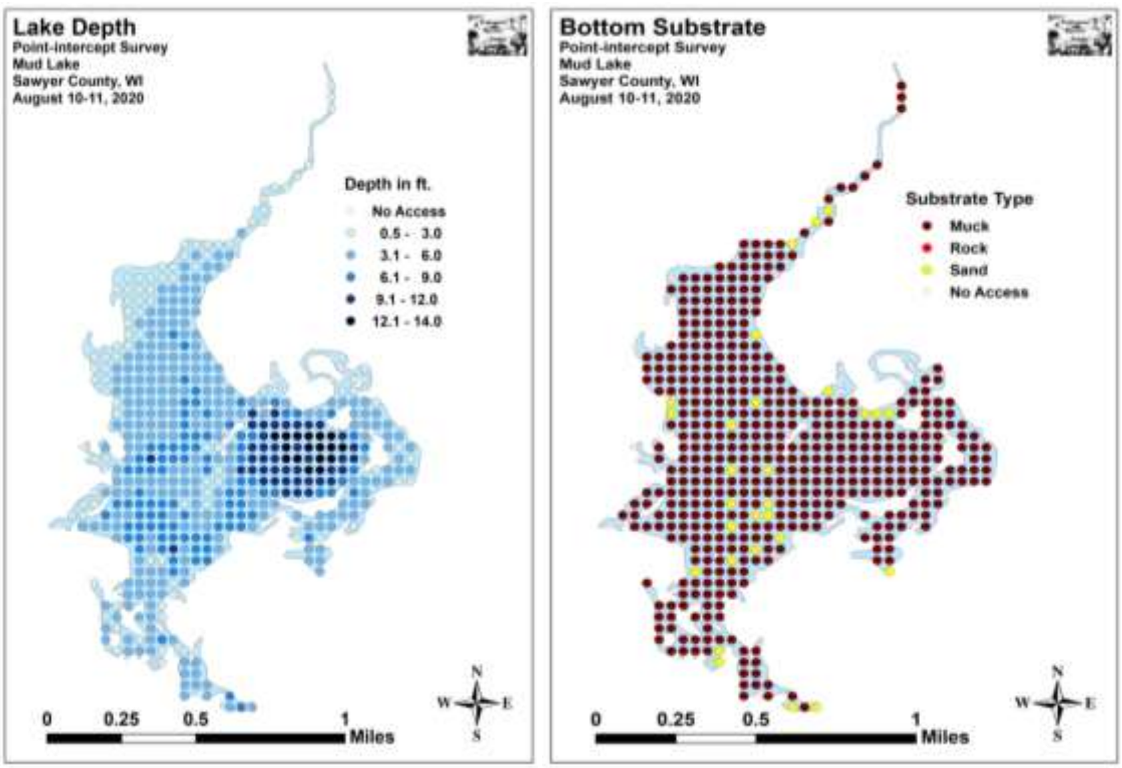

Figure 3: Mud Lake depth and bottom substrate (Berg, 2020)

Watershed Land Cover

A watershed is an area of land from which water drains to a common surface water feature such as a stream, lake, or wetland. Callahan and Mud are part of the Chief River watershed (27.04 mi^2) with the North Fork of the Chief River flowing into the north end of Mud Lake from the Tigercat Flowage, through Mud Lake into Callahan Lake, through the dam and back into the North Fork of the Chief River, and then to the Chippewa Flowage. Within 300 feet of Callahan and Mud Lakes is mostly mixed hardwood and pine forests and wetlands with a low amount of development (Figure 4). Bogs surround much of the lakes and floating bogs can be found in the channels dividing the lakes (Figure 4). The watershed is mostly forested with some large wetland complexes and some land used for crops and hay (Figure 5). The Chief River watershed is part of the larger Lake Chippewa watershed (182.90 mi^2), which is also primarily forested with several large wetlands (Figure 5). The Lake Chippewa watershed also contains the Chippewa Flowage, which is 15,300 acres with nearly 200 undeveloped islands. This area is rich in natural resources – including lakes, rivers, and forests – with relatively little development. When divided out, the Chief River watershed has about 5% more development related land uses than does the Lake Chippewa watershed (Figure 6).

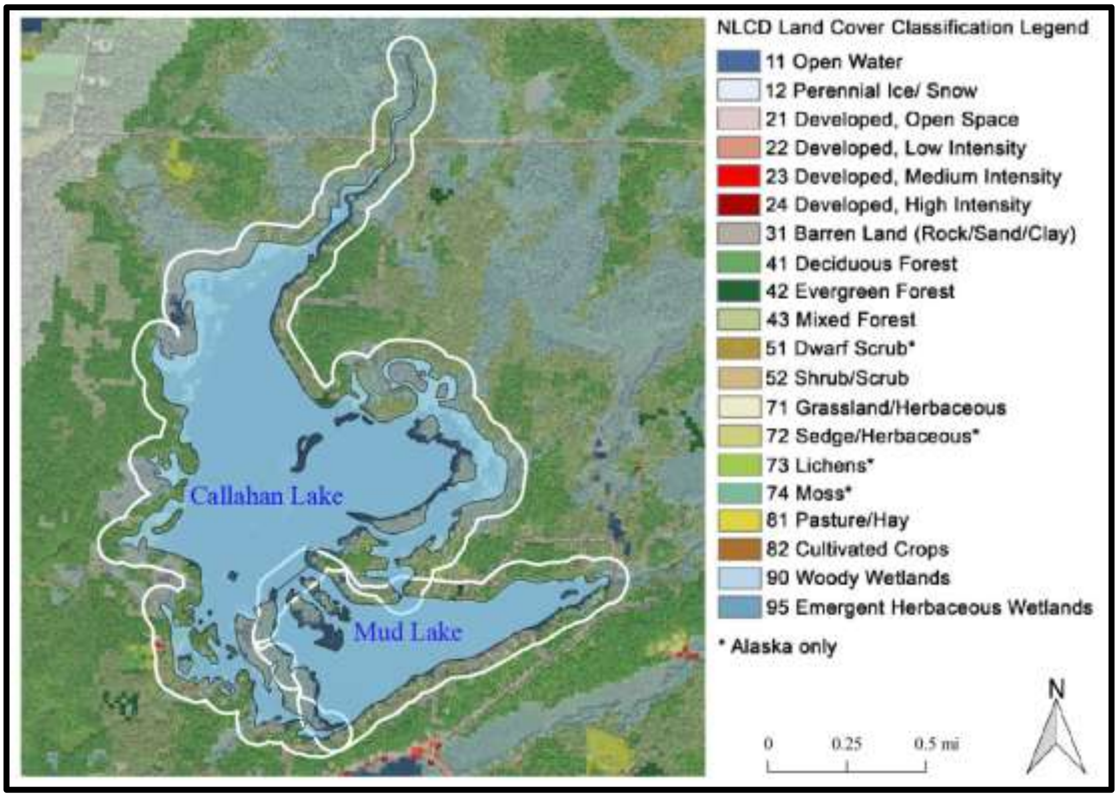

Figure 4: Land use within 300 feet of Callahan and Mud (NLCD, 2016)

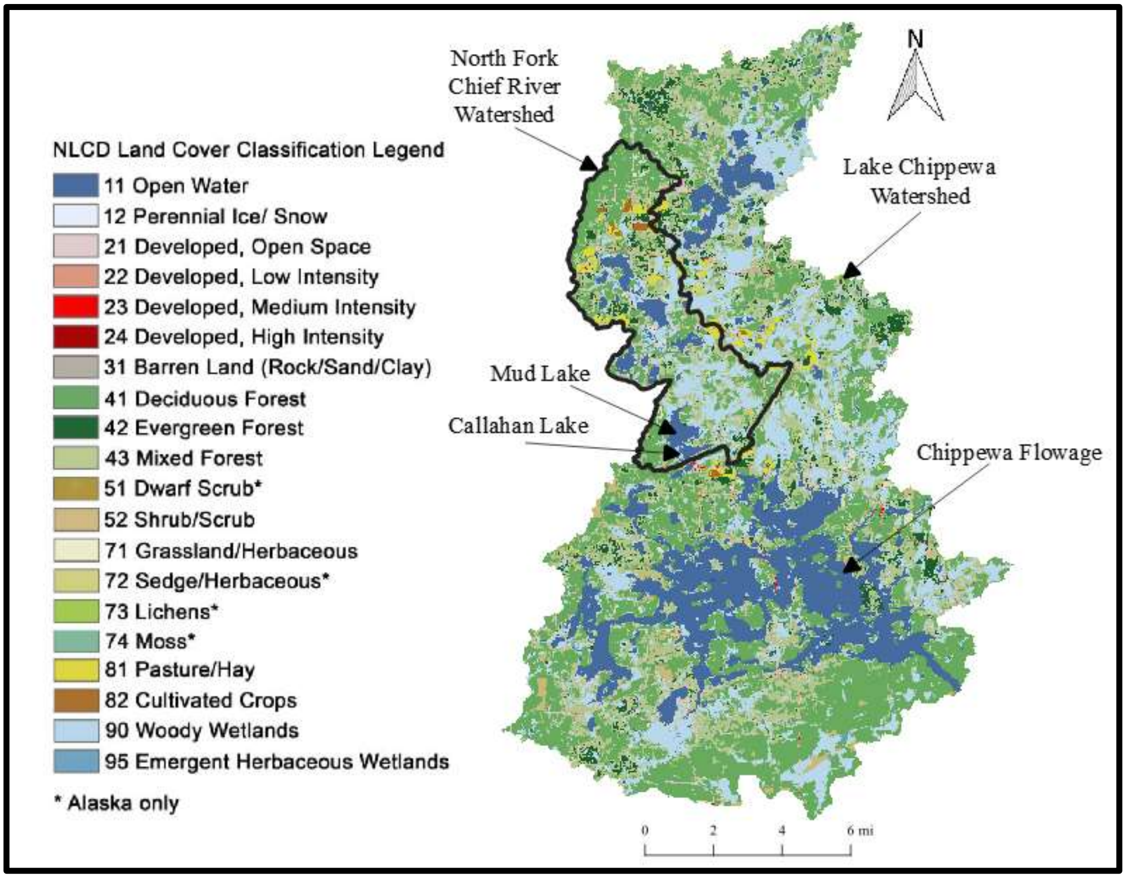

Figure 5: North Fork Chief River and Lake Chippewa watershed land cover (NLCD, 2016)

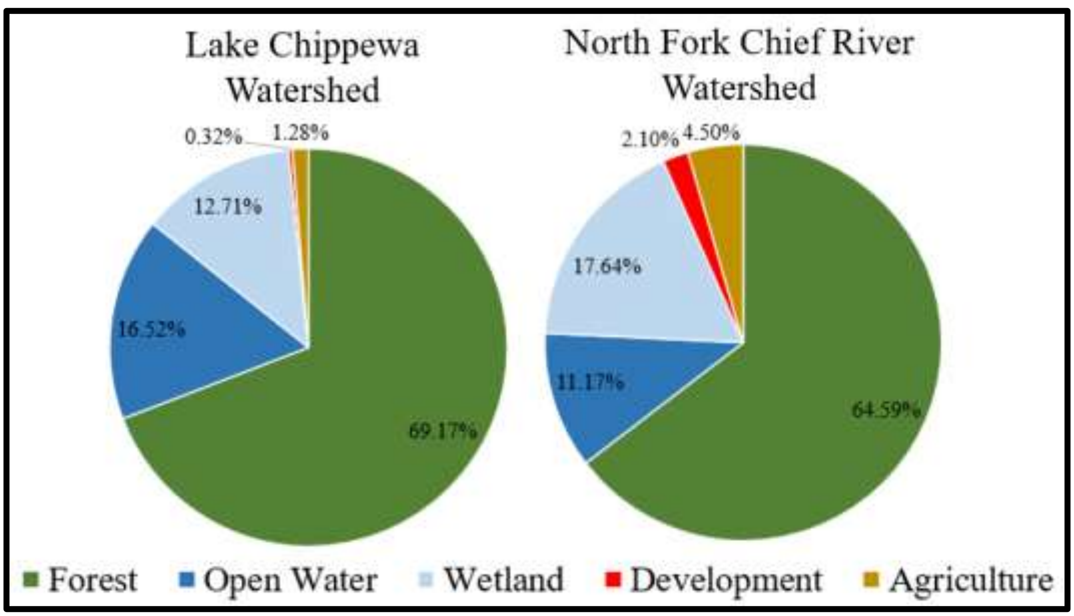

Figure 6: Lake Chippewa and North Fork Chief River Watershed Land Cover (WDNR)

Trophic State

Trophic state and water quality are often used synonymously; however, they are not the same. Trophic state describes the biological condition of a lake using a scale that is based on water clarity, total phosphorus, and chlorophyll-*a* (Carlson, 1977). Water quality is typically based on a perception of the lake, which may be subjective for different lake users. People who use the lake for primarily swimming usually classify lakes with clear water as having better water quality while the same lake might be classified as having poor water quality by a fisherman because the low productivity limits fish growth.

By combining data for water clarity, phosphorus, and chlorophyll-*a* in Callahan and Mud Lakes, the trophic state as determined by Carlson's Trophic Status Index (Carlson, 1977) is able to be determined (Figure 7). Eutrophic lakes typically have large amounts of aquatic plant growth, higher nutrient concentrations, low water clarity due to algae blooms, and oxygen-depleted bottom waters. On the other end of the spectrum, oligotrophic lakes are nutrient-poor, have clear and cold water, and oxygen throughout the water column continually. Mesotrophic lakes fall in the middle and have intermediate nutrient levels, occasional algal blooms, and may experience bottom water oxygen depletion in the summer (Red ovals in Figure 8 represent Callahan and Mud Lake ranges).

The specific measurements of water quality and trophic status in Mud Lake have remained relatively constant over time as measured by volunteers. Secchi depth (a measure of water clarity) in Mud Lake is only available in 2009, 2020, and 2021. Secchi readings average 10.5 feet, which is consistent with mesotrophic readings. Chlorophyll-*a* in those same years ranged from 1.86 to 5.45μg/L, averaging 3.14μg/L (trophic state value 43), which also classifies Mud as a mesotrophic lake (Figures 7 and 8). TP ranged from 15 to 25.2μg/L, averaging 19.6μg/L (trophic state value 53). Overall, Mud Lake is a mesotrophic lake with high water quality (Figure 7 and 8). More information can be found at: https://dnr.wi.gov/lakes/waterquality/Station.aspx?id=583216.

In Callahan Lake, water quality has also remained relatively constant over time. Secchi depth in Mud Lake is available in 2009, 2020, and 2021. Secchi readings average 9.4 feet, indicating that Callahan is also mesotrophic. Chlorophyll-*a* in those same years ranged from 2.46 to 7.28μg/L, averaging 3.85μg/L (trophic state value 44), which also classifies Callahan as a mesotrophic lake (Figure 7). TP ranged from 13 to 50.5μg/L, averaging 25.48μg/L (trophic state value 51). These higher nutrient levels place Callahan Lake as more eutrophic than Mud Lake. Overall, however, Callahan Lake is a mesotrophic lake with ideal water quality (Figures 7 and 8). More information can be found at: https://dnr.wi.gov/lakes/waterquality/Station.aspx?id=584005.

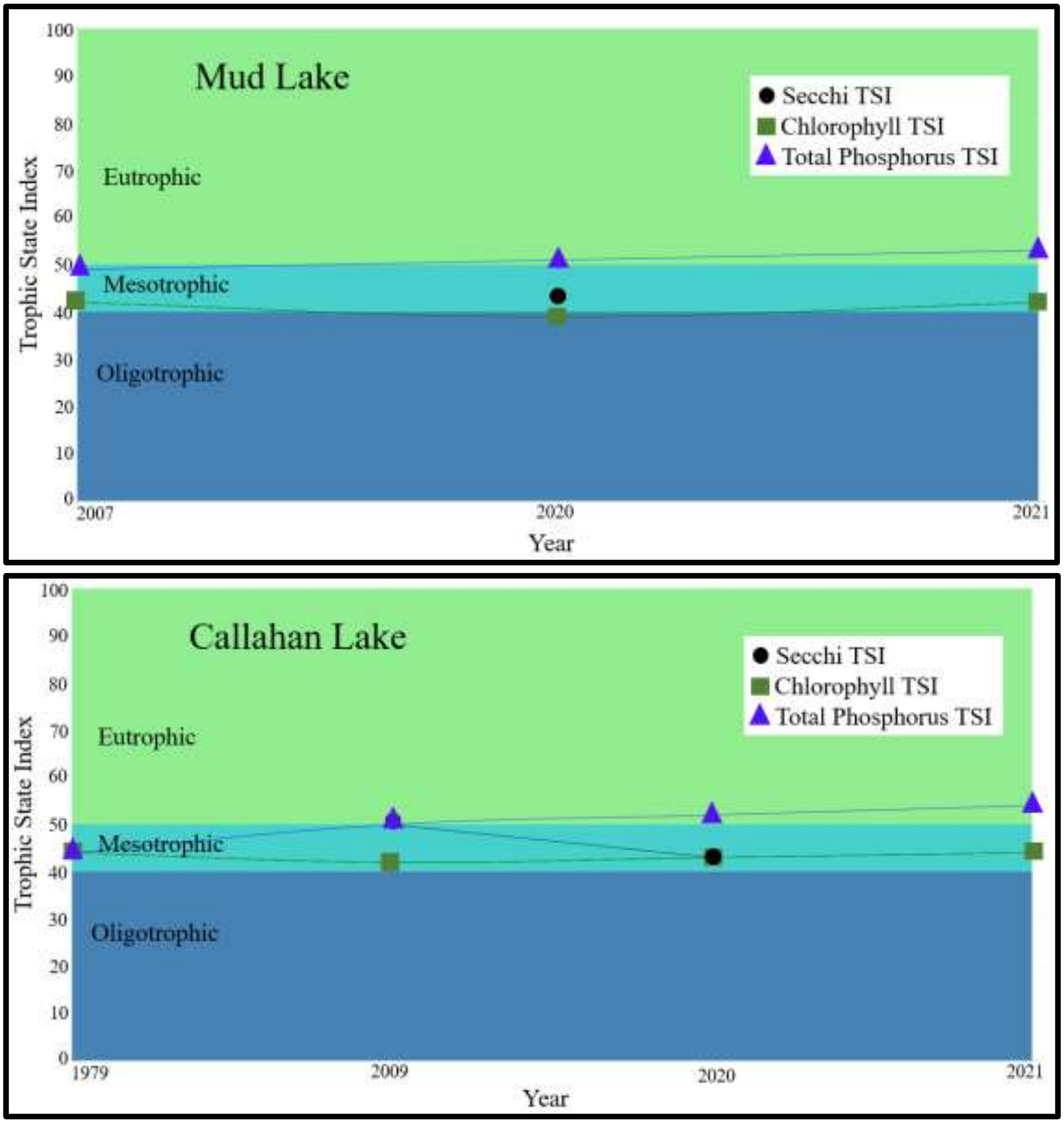

Figure 7: Mud and Callahan Lakes trophic status index data (WDNR)

TSI	Chlorophyll-a (ug/L)	Secchi Depth (ft)	Total Phosphorus (ug/L)	Classification	Attributes	Fisheries and Recreation
<30	<0.95	>26	<6	ULTRAOLIOGOTROPHIC	clear water, many algal species, oxygen throughout the year in bottom water, cold water	oxygen-sensitive, cold water fish species in deep lakes
30-40	0.95 -2.6	13 - 26	6 - 12	OLIGOTROPHIC	clear water, many algal species, oxygen throughout the year in bottom water except possibly in shallow lakes, cold water	oxygen-sensitive, cold water fish species in deep lakes only
40-50	2.6 - 7.3	6.5 - 13	12 - 24	MESOTROPHIC	water moderately clear, but increasing chance of low dissolved oxygen in deep water during the summer	walleye may dominate
50-60	7.3 -20	3 - 6.5	24 - 48	EUTROPHIC	decreased clarity, fewer algal species, oxygen-depleted bottom waters during the summer, plant overgrowth evident	warm-water fisheries (pike, perch, bass, etc.)
60-70	20 - 56	1.5 - 3	48 - 96	EUTROPHIC	blue-green algae become dominant and algal scums are possible, extensive plant overgrowth problems possible	thick aquatic vegetation and algal scums may discourage swimming and boating
70-80	56 - 155	0.75 - 1.5	96 - 192	HYPEREUTROPHIC	heavy algal blooms possible throughout summer, dense plant beds, but extent limited by light penetration (blue-green algae block sunlight)	summer fish kills possible, rough fish dominant
>80	>155	<0.75	192 - 384	HYPEREUTROPHIC	Algal scums, few plants	

Figure 8: Callahan and Mud trophic state summary

Circled values indicate the values and corresponding TSI scores for Callahan and Mud Lakes from data collected by citizen volunteers. Both lakes scored the same. This figure is adapted from Carlson and Simpson 1996, information from the WDNR and publicly available CLMN water quality data.

Oxygen

Dissolved oxygen is essential for the survival of most aquatic animals, just like atmospheric oxygen is essential for most terrestrial animals. Surface waters (also called the epilimnion) exchange oxygen with the atmosphere and are usually oxygen-rich. In deeper lakes, or smaller lakes that are generally sheltered from prevailing winds, the water in the lake stratifies (or separates) into distinct zones during the summer months, impacting water quality and affecting biota. These zones are the epilimnion (usually oxygen-rich surface waters), the thermocline (the layer separating the surface and bottom waters), and the hypolimnion (oxygen-depleted bottom waters; Figure 9).

Citizen Lake Monitoring dissolved oxygen and temperature profile data has not been consistently collected in Callahan and Mud; however, there is some evidence that shows Callahan thermally stratifies in the summer months. In Mud, the deepest part of the lake is the flooded river channel, which is approximately 10 feet deep. Because of this shallow depth and water flow through the channel, Mud Lake may not stratify. Callahan reaches up to approximately 18 feet in depth and is deep throughout a large portion of the lake. The limited profile data collected shows that in summer months Callahan does stratify and may experience hypolimnetic hypoxia (oxygen depletion). Any stratification that does occur is likely to be reversed during fall turnover as the warmer surface waters cool and mix with the colder bottom waters. Additionally, heavy boat traffic and large storm/wind events can re-mix the lakes at any point.

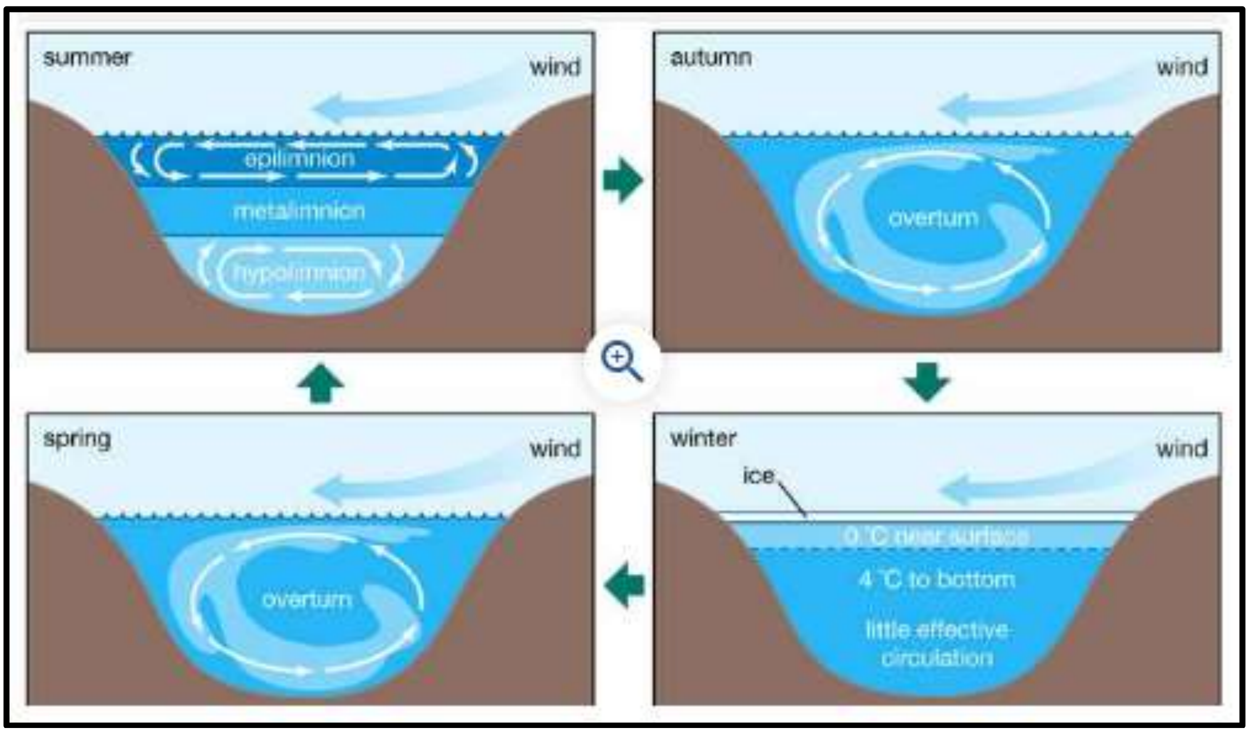

Figure 9: Seasonal thermal stratification in lakes (Encyclopedia Britannica)

Fisheries

Callahan and Mud Lakes support a warm water fishery primarily comprised of muskellunge, largemouth bass, bluegills, black crappies, pumpkinseeds, suckers and bullheads. Also present in lower numbers are walleyes and rock bass. It is suspected that northern pike were introduced to the lakes within the last few years, as they were not historically in the system and have been found in increasing numbers in WDNR surveys and angler catch (Figure 10). Anglers are encouraged by the WDNR and the CLPA to harvest northern pike in Mud and Callahan within the statewide daily bag limit of five pike per day per angler.

A 2019 spring fisheries survey conducted by the Hayward DNR Fisheries Management Team assessed the state of the fishery in Callahan and Mud. In May, they set five fyke nets overnight to survey muskie, northern pike, and black crappie. In June, they performed an electrofishing survey to document the status of bluegill, largemouth bass, and other non-game species. They found that muskies in the lakes are still present at a relatively high density compared to other lakes in the area. Although it appears the density and catch rates of muskies have been declining in Callahan and Mud, as well as in the Tiger Cat Chain and the Spider Chain which are all in the same drainage basin. It may be that the relatively recent discovery of northern pike in these systems is related to the decline in muskies, as it is thought that they compete for similar resources. Most muskies caught in the survey were in the 30-40 inch range. The majority of largemouth bass sampled were less than 12 inches in length, but several were between 16-18 inches. Panfish tend to grow slowly in these lakes, but are relatively abundant. Few black crappie were over 10 inches and there were no bluegills over 8 inches. This is a common trait of lakes in the North Fork of the Chief River drainage (WDNR, 2019). See Appendix B for the entire report.

There has been a limited amount of fish stocking in Callahan and Mud Lakes. In 1979, 250 muskie fingerlings were stocked in Callahan and 2,000 fingerlings were stocked in 1982; 19,860 walleye fingerlings were stocked in 1972 and 10,260 in 1979 (WDNR).

Figure 10: A juvenile northern pike captured in the 2019 spring fisheries survey (Photo by WDNR fisheries biologist Max Wolter)

A study from the University of Michigan delineated likely muskie spawning areas in Mud and Callahan Lakes as part of a larger study to test GIS-based models and their ability to predict the location of muskie spawning habitat (Nohner, 2009). They used known spawning locations and used characteristics like aquatic vegetation and substrate to inform their study (Nohner, 2009). They found that muskies prefer: areas with emergent vegetation or mat-forming vegetation; sand, cobble, and coarse organic matter; areas with high groundwater inflow potential; areas adjacent to wetlands; moderate to steep slopes; and locations near bays and points (Nohner, 2009). Using this information, they mapped potential musky spawning sites (Figure 11).

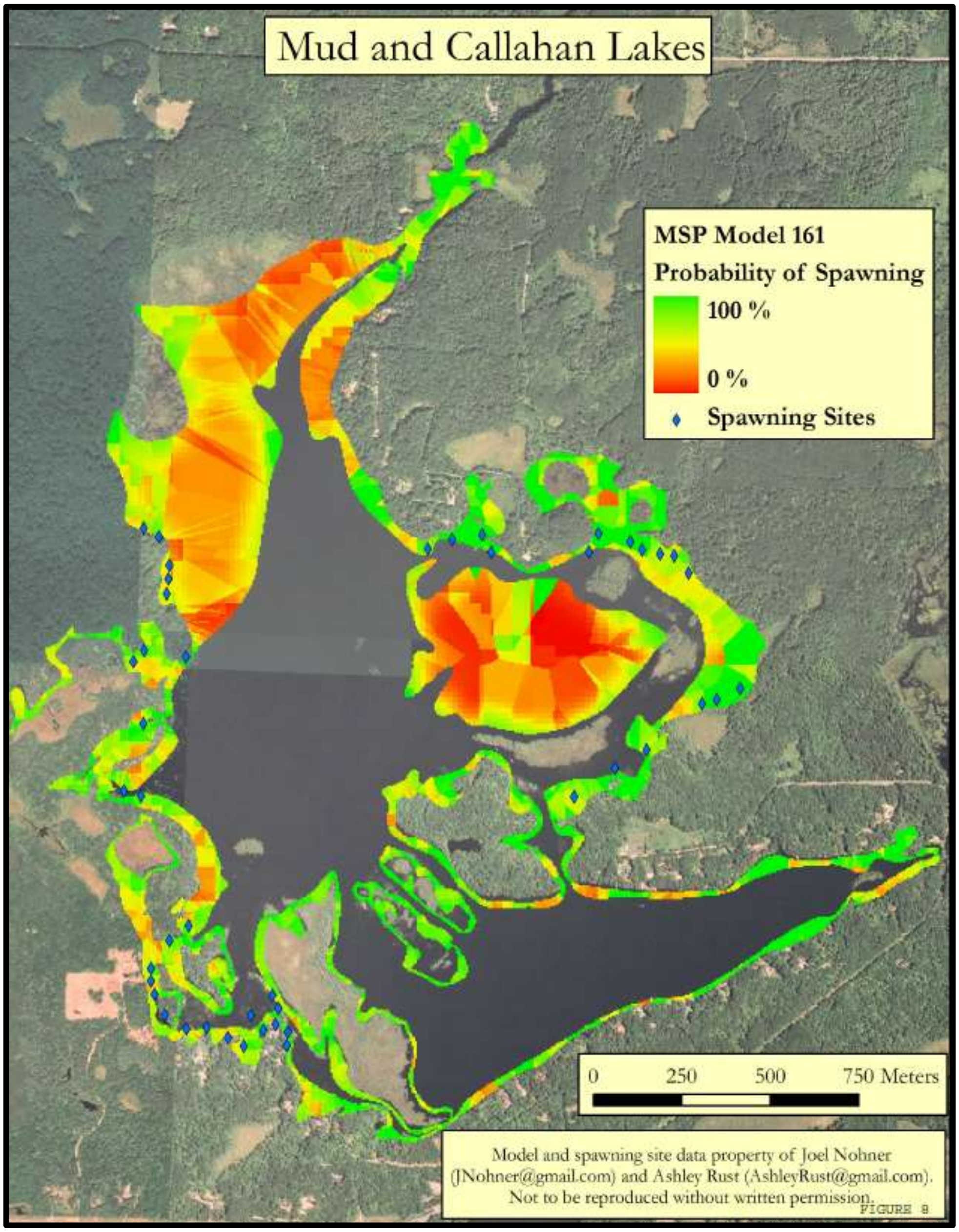

Figure 11: Potential muskie spawning sites (image used with written permission from Ashley Rust and Joel Nohner)

For more information on daily bag limits:
https://cida.usgs.gov/wdnr_regs/apex/f?p=wdnr_fishing_regulations:lake_regulations:0::NO:20:P20_WBIC:2434700#R770266518172521259

For more information on Wisconsin fish stocking:
https://cida.usgs.gov/wdnr_biology/Public_Stocking/StateMapHotspotsAllYears.htm

For the muskie spawning habitat paper from the University of Michigan:
https://deepblue.lib.umich.edu/bitstream/handle/2027.42/62090/NohnerThesis2009.pdf?sequence=1

An angler with a nice muskie (Photo credit: Jim Joyce)

Wildlife

The irregular shape of Mud and Callahan provides many bays and islands; and there are large floating tamarack bogs that appear in the channel between Mud and Callahan. Mallards, common loons, and Canada geese have been observed using these areas for nesting, and bald eagles are known to nest on the lakes. Great blue herons, green herons, sandhill cranes, and many other bird species have been observed around the lakes. Muskrats, beavers, and otters are also common visitors. Painted turtles, snapping turtles, and several snake species can also be found in the lakes. It is common to hear spring peepers in the spring and green frogs, American toads, and other frog species throughout the summer. Whitetail deer are common in the area and have been observed browsing near the lakes. The north end of Mud Lake is mapped by the WDNR as wolf territory.

A great blue heron stalking through emergent vegetation

A green heron on a log

A pair of sandhill cranes searching for prey

A pair of common loons

Otters on the bank

Painted turtle basking on a log

A green frog in vegetation

A white tailed doe near the lakes

All wildlife photos were contributed by Jim Joyce.

Public Use

There is one public boat landing located on the Chief River that allows access to the river and both lakes (Figure 1). Additionally, a resort on Callahan Lake has a private boat landing that is regularly used and preferred over the public launch site because it is well maintained and provides easy access to lakes rather than traveling through the shallow Chief River to reach the north end of Mud Lake.

Callahan and Mud are used for a wide range of recreational activities, including:

- Fishing for panfish species, bass, northern pike, musky, and walleye
- Using non-motorized boats while photographing or viewing nature
- Using motorized boats for recreational enjoyment of the lake
- Swimming

Enjoying the lakes Photo credit: Jim Joyce.

Public Input

Part of the 2020-21 aquatic plant management planning project included the preparation, distribution, and analysis of the public use survey of property owners and users of Callahan and Mud Lakes. The survey focused on six different topics: residency, lake use and issues, aquatic plant growth, aquatic invasive species, EWM management, and satisfaction with the Lake Association.

The survey was sent to all property owners on both lakes and made available to the resort owners to distribute to their long-term campers. Survey responses came back from 36 property owners equally divided between permanent residents, season residents, and second home owners. Two-thirds of the responses were from Callahan, one-third were from Mud Lake.

Wildlife viewing and rest/relaxation were the main activities enjoyed on the lake, followed by fishing and pontoon excursions. Respondents felt water quality was good and really hadn't changed since they had been using the lake. Most respondents felt aquatic plant growth in general had increased since their time on the lake, and that there was probably too much of it.

Almost all felt EWM was a large problem and it needed to be managed. The use of large-scale application of aquatic herbicides was the most supported management action, but not at the whole-lake management scale. Most respondents would like to see the amount of EWM in the entire lake reduced from current levels. More survey results are provided in Appendix C.

Since this project started the Callahan Lake Protective Association has met at least four different times, including two larger meetings of the constituency for AIS education and project updates.

Presentation of the Aquatic Plant Management Plan was completed on May 29, 2022 at the Memorial Day Weekend Annual Meeting. At least 30 people were in attendance at that meeting. LEAPS presented the APM Plan via handouts and discussion. During the meeting, the Constituency was informed that the APM Plan would be posted for review on the LEAPS webpage at www.LEAPSLLC.com so they could review the APM Plan. With this information, the Constituency was in favor of approving the APM Plan and a motion was made, seconded, and unanimously passed.

The APM Plan was posted on the LEAPS webpage in early June 2022. As of June 14, 2022, only one constituent had sent an email about the plan. That person's email stated his support for the Plan, it did not however, make any comments related to changes. After a full month, more than the required 21 days, not additional comments were received.

On July 29, 2022 the APM Plan was sent to the WDNR with an official request for review and approval. Unfortunately, the DNR Regional Coordinator did not open the email with the request until September 9, 2022. Comments were received by the CLPA and LEAPS on September 13, 2022. There comments were addressed and the revised APM Plan was sent to the DNR in late September.

Plant Community – Callahan

Summarized from Endangered Resource Services Warm-water Point-intercept Macrophyte Survey Callahan Lake (WBIC: 2434700) Sawyer County, Wisconsin 2020 (Berg, 2020A)

Callahan's plant community was originally surveyed in 2008. This survey was used by Ayres Associates to develop the lake's original Wisconsin Department of Natural Resources (WDNR) approved Aquatic Plant Management Plan (APMP) which outlined herbicide applications to control the infestation. As a prerequisite to updating the current plan, the CMLPA, under the direction of Lake Education and Planning Services, LLC – Dave Blumer, and the WDNR requested a warm-water full point-intercept survey of all aquatic macrophytes on August 9, 2020 performed by Endangered Resource Services, LLC (ERS).

During the 2020 survey, macrophytes were found growing at 230 sites which approximated to 53.0% of the entire lake bottom and 76.4% of the 13.5ft littoral zone (Table 1). This was a highly significant decline from 2008 when plants were found at 306 sites (72.2% of surveyed points and 97.1% of the then 14.0ft littoral zone) (Table 1). Overall diversity was very high with a Simpson Index value of 0.89 – almost unchanged from 0.90 in 2008 (Table 1). Total species richness was low with 26 species found in the rake (up from 20 in 2008; Table 1). This total jumped to 36 species when including visuals and species found during the boat survey (up sharply from 22 in 2008). There was an average of 2.74 native species/site with native vegetation – a highly significant decline from 3.46 species/site in 2008. In 2020, the mean total rake fullness was a moderate 2.10 (Table 1). The mean total rake full was not officially calculated during the 2008 survey, but a review of that data suggests it was moderately high at 2.30 indicating a decline in the density of the lake's vegetation between 2008 and 2020.

In 2008, Fern pondweed (*Potamogeton robbinsii*), Common waterweed (*Elodea canadensis*), Flat-stem pondweed (*Potamogeton zosteriformis*), and Large-leaf pondweed (*Potamogeton amplifolius*) were the most widely distributed species (63.07%, 52.29%, 42.48%, and 40.20% of survey points with vegetation/53.91% of the total relative frequency; Table 2). Fern pondweed, Flat-stem pondweed, Wild celery (*Vallisneria americana*), and Coontail (*Ceratophyllum demersum*) were the most common macrophyte species in 2020 (Table 3). Present at 49.57%, 47.83%, 36.09%, and 24.35% of sites with vegetation, they accounted for 56.02% of the total relative frequency (Table 3).

Filamentous algae were present at 30 points in 2020 with a mean rake fullness of 1.50 – a highly significant increase in both density and distribution compared to 2008 when these algae were found at six points with a mean rake fullness of 1.00.

Table 1: Aquatic Macrophyte PI Survey Summary Statistics Callahan Lake, Sawyer County August 1-2, 2008 and August 9, 2020

Summary Statistics:	2008	2020
Total number of points sampled	424	434
Total number of sites with vegetation	306	230
Total number of sites shallower than the max. depth of plants	315	301
Freq. of occur. at sites shallower than max. depth of plants	97.1	76.4
Simpson Diversity Index	0.90	0.89
Maximum depth of plants (ft)	14.0	13.5
Mean depth of plants (ft)	8.2	7.9
Median depth of plants (ft)	8.0	8.0
Number of sites sampled using rake on Rope (R)	186	0
Number of sites sampled using rake on Pole (P)	238	434
Ave. number of all species per site (shallower than max depth)	3.57	2.15
Ave. number of all species per site (veg. sites only)	3.67	2.82
Ave. number of native species per site (shallower than max depth)	3.37	2.10
Ave. number of native species per site (sites with native veg. only)	3.46	2.74
Species richness	20	26
Species richness (including visuals)	22	33
Species richness (including visuals and boat survey)	22	36
Mean rake fullness (veg. sites only)	(est.) 2.30	2.10

Table 2: Frequencies and Mean Rake Sample of Aquatic Macrophytes Callahan Lake, Sawyer County August 1-2, 2008

2008 Callahan Lake Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight
Potamogeton robbinsii	Fern pondweed	193	17.17	63.07	61.27	1.78	0
Elodea canadensis	Common waterweed	160	14.23	52.29	50.79	1.37	0
Potamogeton zosteriformis	Flat-stem pondweed	130	11.57	42.48	41.27	1.22	5
Potamogeton amplifolius	Large-leaf pondweed	123	10.94	40.2	39.05	1.28	5
Ceratophyllum demersum	Coontail	121	10.77	39.54	38.41	1.79	2
Potamogeton pusillus	Small pondweed	87	7.74	28.43	27.62	1.45	2
Vallisneria americana	Wild celery	81	7.21	26.47	25.71	1.44	1
Myriophyllum spicatum	**Eurasian water-milfoil**	**64**	**5.69**	**20.92**	**20.32**	**1.45**	**13**
Potamogeton gramineus	Variable pondweed	26	2.31	8.5	8.25	1.19	2
Bidens beckii	Water marigold	21	1.87	6.86	6.67	1.05	0
Najas flexilis	Slender naiad	20	1.78	6.54	6.35	1.05	1
Potamogeton richardsonii	Clasping-leaf pondweed	20	1.78	6.54	6.35	1.2	0
Myriophyllum sibiricum	Northern water-milfoil	18	1.6	5.88	5.71	1.11	4
Potamogeton praelongus	White-stem pondweed	17	1.51	5.56	5.4	1.06	5
Chara sp.	Muskgrass	9	0.8	2.94	2.86	1	1
Heteranthera dubia	Water star-grass	9	0.8	2.94	2.86	1.11	0
Brasenia schreberi	Watershield	8	0.71	2.61	2.54	1	4
Nuphar variegata	Spatterdock	8	0.71	2.61	2.54	1.38	7
	Filamentous algae	6	*	1.96	1.9	1	0
Nymphaea odorata	White water lily	5	0.44	1.63	1.59	1	6
Utricularia vulgaris	Common bladderwort	4	0.36	1.31	1.27	1	0
Polygonum amphibium	Water smartweed	**	**	**	**	**	1
Pontederia cordata	Pickerelweed	**	**	**	**	**	1

* Excluded from relative frequency analysis ** Visual only **Exotic species in bold**

Table 3: Frequencies and Mean Rake Sample of Aquatic Macrophytes Callahan Lake, Sawyer County August 9, 2020

2020 Callahan Lake Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight
Potamogeton robbinsii	Fern pondweed	114	17.59	49.57	37.87	1.6	0
Potamogeton zosteriformis	Flat-stem pondweed	110	16.98	47.83	36.54	1.65	16
Vallisneria americana	Wild celery	83	12.81	36.09	27.57	1.77	3
Ceratophyllum demersum	Coontail	56	8.64	24.35	18.6	1.46	2
Najas flexilis	Slender naiad	55	8.49	23.91	18.27	1.65	0
Potamogeton amplifolius	Large-leaf pondweed	51	7.87	22.17	16.94	1.35	5
Potamogeton pusillus	Small pondweed	36	5.56	15.65	11.96	1.42	0
Elodea canadensis	Common waterweed	30	4.63	13.04	9.97	1.13	0
	Filamentous algae	30	*	13.04	9.97	1.5	0
Myriophyllum spicatum	**Eurasian water-milfoil**	**17**	**2.62**	**7.39**	**5.65**	**1.41**	**12**
Bidens beckii	Water marigold	15	2.31	6.52	4.98	1.6	3
Potamogeton gramineus	Variable pondweed	12	1.85	5.22	3.99	1.5	4
Potamogeton vaseyi	Vasey's pondweed	12	1.85	5.22	3.99	1.25	0
Myriophyllum sibiricum	Northern water-milfoil	9	1.39	3.91	2.99	1.11	6
Chara sp.	Muskgrass	8	1.23	3.48	2.66	1.13	0
Nuphar variegata	Spatterdock	8	1.23	3.48	2.66	1.63	7
Nymphaea odorata	White water lily	7	1.08	3.04	2.33	1.43	3
Myriophyllum verticillatum	Whorled water-milfoil	5	0.77	2.17	1.66	1.6	0
Potamogeton praelongus	White-stem pondweed	5	0.77	2.17	1.66	1.4	5
Potamogeton richardsonii	Clasping-leaf pondweed	5	0.77	2.17	1.66	1.2	10
Utricularia vulgaris	Common bladderwort	3	0.46	1.3	1	1.33	1
Heteranthera dubia	Water star-grass	2	0.31	0.87	0.66	1	0
	Aquatic moss	1	*	0.43	0.33	1	0
Brasenia schreberi	Watershield	1	0.15	0.43	0.33	1	1
Pontederia cordata	Pickerelweed	1	0.15	0.43	0.33	3	0
Potamogeton epihydrus	Ribbon-leaf pondweed	1	0.15	0.43	0.33	1	1
Potamogeton natans	Floating-leaf pondweed	1	0.15	0.43	0.33	1	1
Utricularia gibba	Creeping bladderwort	1	0.15	0.43	0.33	1	0
Carex lasiocarpa	Narrow-leaved woolly sedge	**	**	**	**	**	1
Comarum palustre	Marsh cinquefoil	**	**	**	**	**	1
Iris versicolor	Northern blue flag	**	**	**	**	**	1
Myriophyllum heterophyllum	Various-leaved water-milfoil	**	**	**	**	**	1
Sagittaria graminea	Grass-leaved arrowhead	**	**	**	**	**	1
Schoenoplectus subterminalis	Water bulrush	**	**	**	**	**	1
Sparganium americanum	American bur-reed	**	**	**	**	**	1
Calamagrostis canadensis	Bluejoint	***	***	***	***	***	***
Eleocharis acicularis	Needle spikerush	***	***	***	***	***	***
Polygonum amphibium	Water smartweed	***	***	***	***	***	***

* Excluded from relative frequency analysis ** Visual only **Exotic species in bold**

Floristic Quality Index (FQI) – Callahan Lake

This index measures the impact of human development on a lake's aquatic plants. The 124 species in the index are assigned a Coefficient of Conservatism (C) which ranges from 1-10. The higher the value assigned, the more likely the plant is to be negatively impacted by human activities relating to water quality or habitat modifications. Plants with low values are tolerant of human habitat modifications, and they often exploit these changes to the point where they may crowd out other species. Statistically speaking, the higher the index value, the healthier the lake's aquatic plant community is assumed to be.

The 25 native index species found in the rake during the August 2020 survey (up from 19 in 2008) produced a just below average mean Coefficient of Conservatism of 6.6 (up from 6.2 in 2008). The Floristic Quality Index of 33.2 (up from 27.1 in 2008) is higher than the median FQI for this part of the state (Nichols, 1999).

Species Change – Callahan Lake

Lakewide, from 2008-2020, 15 species showed significant changes in distribution. Twelve species, Fern pondweed, Common waterweed, Large-leaf pondweed, Coontail, Small pondweed (*Potamogeton pusillus*), and Eurasian water-milfoil (*Myriophyllum spicatum*) all suffered highly significant declines; Clasping-leaf pondweed (*Potamogeton richardsonii*) experienced a moderately significant decline; and Variable pondweed (*Potamogeton gramineus*), White-stem pondweed (*Potamogeton praelongus*), Water star-grass (*Heteranthera dubia*), and Watershield (*Brasenia schreberi*) underwent significant declines (Figure 4). Conversely, three species, Slender naiad (*Najas flexilis*), Vasey's pondweed (*Potamogeton vaseyi*), and Whorled water-milfoil (*Myriophyllum verticillatum*) saw a highly significant or a significant increase (Figure 4).

Six of the 12 species that showed significant decreases were pondweed species (*Potamogeton spp.*). The aquatic herbicides used to control EWM in the lake (see p.37) are not normally associated with changes in pondweeds. According to the herbicide label, the aquatic plants most susceptible to Navigate®, a granular form of herbicide that incorporates the active ingredient 2,4D, are milfoils (Eurasian and native species) and Water stargrass. Both of these species saw a decline from 2008 to 2020. Other plants that could be impacted by Navigate, but are somewhat less susceptible include watershield, coontail, white water lily, yellow pond lily (spattedock), and bladderwort species. Of these coontail and watershield also saw some decline.

The other most commonly used herbicide in Callahan Lake, Shredder/24D Amine 4®, is a liquid form of herbicide using the active ingredient 2,4D. The aquatic vegetation impacted by it is about the same as for Navigate. The herbicide, 2,4D generally targets species classified as dicots (milfoils, coontail, bladderworts, watershield). Aquatic plants classified as monocots (common waterweed, wild celery, water lily, duckweed, pondweeds, water stargrass, watermeal) are generally not impacted, or not as highly impacted by its use. As such, it is unlikely that the use of aquatic herbicides to control EWM in the lake was the driving factor leading to the decline in the pondweed species, but the declines in coontail and watershield (and EWM) could be attributed to the herbicides used.

Table 4: Statistically Significant Changes in the Aquatic Plant Community of Callahan Lake from 2008 to 2020

CALLAHAN LAKE		2008	2020	Significant change	Pos (+) or Neg (-)	Monocot (m)/dicot(d)	2,4D Suscept (yes, no, ??)
Potamogeton robbinsii	Fern-leaf pondweed	193	114	***	-	m	??
Elodea canadensis	Common waterweed	160	30	***	-	m	yes
Potamogeton amplifolius	Large-leaf pondweed	123	51	***	-	m	no
Ceratophyllum demersum	Coontail	121	56	***	-	d	yes
Potamogeton pusillus	Small pondweed	87	36	***	-	m	no
Myriophyllum spicatum	Eurasian watermilfoil	64	17	***	-	d	yes
Myriophyllum sibericum	Northern watermilfoil	18	9	*	-	d	yes
Potamogeton gramineus	Variable pondweed	26	12	*	-	m	no
Najas flexilis	Slender naiad	20	55	***	+	m	yes
Potamogeton richardsonii	Clasping-leaf pondweed	20	5	**	-	m	no
Potamogeton praelongus	White-stem pondweed	17	5	*	-	m	no
Heteranthera dubia	Water stargrass	9	2	*	-	m	yes
Brasenia schreberi	Watershield	8	1	*	-	d	yes

Figure 12: 2008 – 2020 Macrophyte Differences for All Species

Changes in Eurasian Watermilfoil – Callahan Lake

In 2008, EWM was reported at 31 points (7.8% of surveyed points) with 69 additional visual sightings (Figure 13). One of these points had a rake fullness of 3, eight were a 2 (2.3% of surveyed points had a significant infestation), and 22 were a 1 (mean rake fullness of 1.32). In 2020, EWM was found in the rake at 13 points (2.6% of surveyed points) with 17 additional visual sightings (Figure 13). One point had a rake fullness of 3, three were a 2 (0.8% of surveyed points had a significant infestation), and nine were a 1 for a mean rake fullness of 1.38. Compared to the 2008 survey, this suggested EWM had undergone a highly significant decline in total distribution and visual sightings; a moderately significant decline in rake fullness 1; and a nearly significant decline in rake fullness 2. Although the mean density actually increased, this change was not significant.

Other than EWM, Hybrid cattail was the only other exotic plant found. It was present at 12 points with a mean rake fullness of 2.83 and formed nearly monotypic stands along the lake's northwest shoreline.

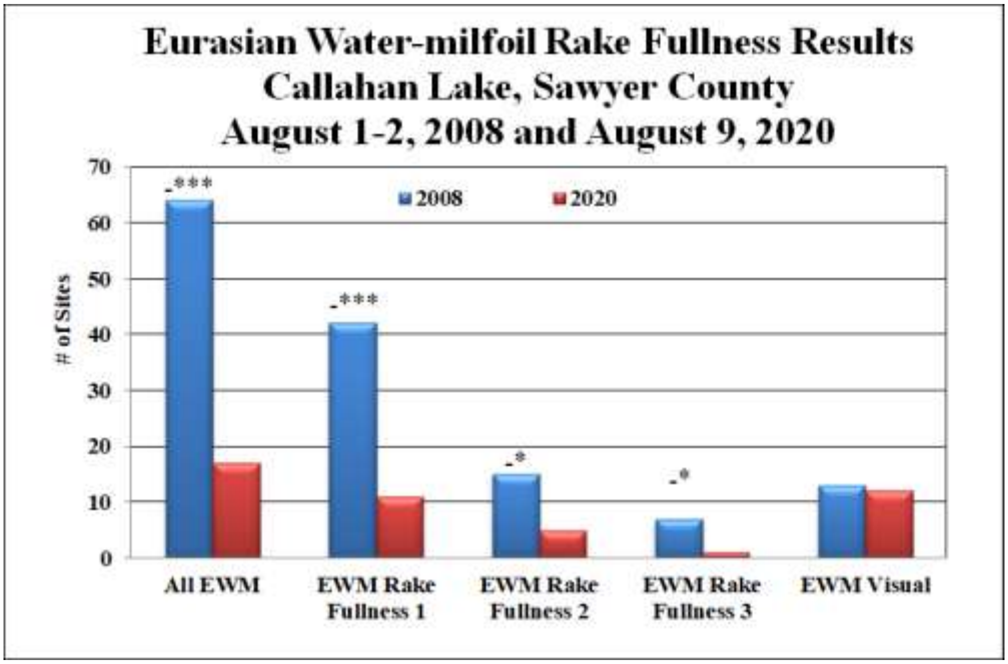

Figure 13: 2008 – 2020 Changes in Eurasian Water-milfoil Rake Fullness

Plant Community – Mud

Summarized from Endangered Resource Services Warm-water Point-intercept Macrophyte Survey Mud Lake (WBIC: 2434800) Sawyer County, Wisconsin 2020 (Berg, 2020B)

Mud's plant community was originally surveyed in 2008. This survey was used by Ayres Associates to develop the lake's original Wisconsin Department of Natural Resources (WDNR) approved Aquatic Plant Management Plan (APMP) which outlined herbicide applications to control the infestation. As a prerequisite to updating the current plan, the CMLPA, under the direction of Lake Education and Planning Services, LLC – Dave Blumer, and the WDNR requested a warm-water full point-intercept survey of all aquatic macrophytes on August 10-11, 2020 performed by Endangered Resource Services, LLC.

During the 2020 survey, plants were found growing at 484 sites which approximated to 96.6% of the entire lake bottom (Table 5). This was similar to 2008 when plants were found at 392 sites (99.2% of surveyed points). Overall diversity was exceptionally high with a Simpson Index value of 0.93 – up from 0.89 in 2008 (Table 5). Total species richness was also very high with 54 species found in the rake (up sharply from 24 in 2008). This total jumped to 64 species when including visuals and species found during the boat survey (up from 25 in 2008). There was an average of 3.95 native species/site with native vegetation – a highly significant increase from 3.51 species/site in 2008 (Table 5). In 2020, the mean total rake fullness was a moderately high 2.40 (Table 5). Although not calculated during the original survey, the mean total rake fullness was 2.25, suggesting there has been a highly significant overall increase in the density of the lake's vegetation. Visual analysis of the maps made by the aquatic plant surveyor suggested much of the "increases" in both localized richness and density were due to the 2020 survey accessing many more shallow areas than the original survey.

In 2008, Fern pondweed, Common waterweed, Flat-stem pondweed, and Large-leaf pondweed were the most widely-distributed species (72.19%, 56.38%, 48.98%, and 39.03% of survey points with vegetation/60.34% of the total relative frequency; Table 6). Fern pondweed, Coontail, Common waterweed, and Flat-stem pondweed were the most common macrophyte species in 2020 (Table 7). Present at 55.58%, 43.60%, 37.40%, and 34.50% of sites with vegetation, they accounted for 43.06% of the total relative frequency.

Filamentous algae were present at five points all with a rake fullness of 1. This was a non-significant increase in distribution compared to 2008 when these algae were found at a single point with a rake of 1.

Table 5: Aquatic Macrophyte P/I Survey Summary Statistics Mud Lake, Sawyer County August 2-3, 2008 and August 10-11, 2020

Summary Statistics:	2008	2020
Total number of points sampled	395	501
Total number of sites with vegetation	392	484
Total number of sites shallower than the max. depth of plants	395	501
Freq. of occur. at sites shallower than max. depth of plants	99.2	96.6
Simpson Diversity Index	0.89	0.93
Maximum depth of plants (ft)	14.5	14.0
Mean depth of plants (ft)	5.2	5.3
Median depth of plants (ft)	5.0	5.5
Number of sites sampled using rake on Rope (R)	383	485
Number of sites sampled using rake on Pole (P)	12	0
Ave. number of all species per site (shallower than max depth)	3.56	3.84
Ave. number of all species per site (veg. sites only)	3.59	3.97
Ave. number of native species per site (shallower than max depth)	3.48	3.81
Ave. number of native species per site (sites with native veg. only)	3.51	3.95
Species richness	24	54
Species richness (including visuals)	25	56
Species richness (including visuals and boat survey)	25	65
Mean rake fullness (veg. sites only)	(est.) 2.25	2.40

Table 6: Frequencies and Mean Rake Sample of Aquatic Macrophytes Mud Lake, Sawyer County August 2-3, 2008

2008 Mud Lake Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight
Potamogeton robbinsii	Fern pondweed	283	20.11	72.19	71.65	1.84	1
Elodea canadensis	Common waterweed	221	15.71	56.38	55.95	1.28	1
Potamogeton zosteriformis	Flat-stem pondweed	192	13.65	48.98	48.61	1.31	36
Potamogeton amplifolius	Large-leaf pondweed	153	10.87	39.03	38.73	1.35	30
Ceratophyllum demersum	Coontail	121	8.6	30.87	30.63	1.83	10
Vallisneria americana	Wild celery	85	6.04	21.68	21.52	1.65	5
Potamogeton praelongus	White-stem pondweed	67	4.76	17.09	16.96	1.37	47
Potamogeton pusillus	Small pondweed	49	3.48	12.5	12.41	1.55	2
Myriophyllum sibiricum	Northern water-milfoil	45	3.2	11.48	11.39	1.24	63
Najas flexilis	Slender naiad	36	2.56	9.18	9.11	1.22	1
Myriophyllum spicatum	**Eurasian water-milfoil**	**31**	**2.2**	**7.91**	**7.85**	**1.32**	**69**
Bidens beckii	Water marigold	19	1.35	4.85	4.81	1	7
Nymphaea odorata	White water lily	18	1.28	4.59	4.56	1.5	21
Potamogeton richardsonii	Clasping-leaf pondweed	16	1.14	4.08	4.05	1.19	15
Brasenia schreberi	Watershield	15	1.07	3.83	3.8	1.07	15
Spirodela polyrhiza	Large duckweed	14	1	3.57	3.54	1	5
Utricularia vulgaris	Common bladderwort	14	1	3.57	3.54	1.14	4
Nuphar variegata	Spatterdock	11	0.78	2.81	2.78	1.91	30
Chara sp.	Muskgrass	7	0.5	1.79	1.77	1.14	0
Potamogeton gramineus	Variable pondweed	3	0.21	0.77	0.76	1	2
Heteranthera dubia	Water star-grass	2	0.14	0.51	0.51	1	0
Pontederia cordata	Pickerelweed	2	0.14	0.51	0.51	1	4
Potamogeton natans	Floating-leaf pondweed	2	0.14	0.51	0.51	1	6
	Filamentous algae	1	*	0.26	0.25	1	1
Sparganium fluctuans	Floating-leaf bur-reed	1	0.07	0.26	0.25	1	1
Sparganium angustifolium	Narrow-leaved bur-reed	**	**	**	**	**	2

* Excluded from relative frequency analysis ** Visual only **Exotic species in bold**

Table 7: Frequencies and Mean Rake Sample of Aquatic Macrophytes Mud Lake, Sawyer County August 10-11, 2020

2020 Mud Lake Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake	Visual Sight
Potamogeton robbinsii	Fern pondweed	269	13.99	55.58	53.69	1.72	2
Ceratophyllum demersum	Coontail	211	10.97	43.6	42.12	1.34	2
Elodea canadensis	Common waterweed	181	9.41	37.4	36.13	1.32	0
Potamogeton zosteriformis	Flat-stem pondweed	167	8.68	34.5	33.33	1.37	16
Potamogeton amplifolius	Large-leaf pondweed	160	8.32	33.06	31.94	1.62	35
Vallisneria americana	Wild celery	140	7.28	28.93	27.94	1.64	4
Nymphaea odorata	White water lily	90	4.68	18.6	17.96	1.9	18
Myriophyllum verticillatum	Whorled water-milfoil	57	2.96	11.78	11.38	1.56	12
Najas flexilis	Slender naiad	56	2.91	11.57	11.18	1.3	2
Utricularia vulgaris	Common bladderwort	54	2.81	11.16	10.78	1.19	4
Potamogeton praelongus	White-stem pondweed	49	2.55	10.12	9.78	1.37	39
Nuphar variegata	Spatterdock	46	2.39	9.5	9.18	1.76	30
Potamogeton pusillus	Small pondweed	45	2.34	9.3	8.98	1.16	1
Pontederia cordata	Pickerelweed	39	2.03	8.06	7.78	1.74	11
Brasenia schreberi	Watershield	37	1.92	7.64	7.39	1.54	10
Potamogeton natans	Floating-leaf pondweed	28	1.46	5.79	5.59	1.61	7
Utricularia gibba	Creeping bladderwort	25	1.3	5.17	4.99	1.08	2
Bidens beckii	Water marigold	19	0.99	3.93	3.79	1.26	2
Chara sp.	Muskgrass	19	0.99	3.93	3.79	1.21	0
Dulichium arundinaceum	Three-way sedge	19	0.99	3.93	3.79	1.32	6
Potamogeton gramineus	Variable pondweed	18	0.94	3.72	3.59	1.33	8
Schoenoplectus subterminalis	Water bulrush	18	0.94	3.72	3.59	2	4
Eleocharis erythropoda	Bald spikerush	16	0.83	3.31	3.19	2.31	7
Carex lasiocarpa	Narrow-leaved woolly sedge	15	0.78	3.1	2.99	2.47	2
Spirodela polyrhiza	Large duckweed	14	0.73	2.89	2.79	1.14	0
Myriophyllum spicatum	**Eurasian water-milfoil**	**13**	**0.68**	**2.69**	**2.59**	**1.38**	**17**
Utricularia intermedia	Flat-leaf bladderwort	13	0.68	2.69	2.59	1.38	0
Typha* X *glauca	**Hybrid cattail**	**12**	**0.62**	**2.48**	**2.4**	**2.83**	**0**
Sparganium emersum	Short-stemmed bur-reed	11	0.57	2.27	2.2	1.27	7
Myriophyllum sibiricum	Northern water-milfoil	9	0.47	1.86	1.8	1.11	14
Heteranthera dubia	Water star-grass	7	0.36	1.45	1.4	1.29	1
Utricularia minor	Small bladderwort	7	0.36	1.45	1.4	1.29	1
Potamogeton richardsonii	Clasping-leaf pondweed	6	0.31	1.24	1.2	1.33	8
Lemna minor	Small duckweed	5	0.26	1.03	1	1	0
Schoenoplectus tabernaemontani	Softstem bulrush	5	0.26	1.03	1	1	0
Sparganium natans	Small bur-reed	5	0.26	1.03	1	1.4	3
	Filamentous algae	5	*	1.03	1	1	0
Potamogeton epihydrus	Ribbon-leaf pondweed	4	0.21	0.83	0.8	2	1
Sparganium americanum	American bur-reed	4	0.21	0.83	0.8	2	3
Typha latifolia	Broad-leaved cattail	4	0.21	0.83	0.8	1.25	1
	Freshwater sponge	4	*	0.83	0.8	1.25	0
Comarum palustre	Marsh cinquefoil	3	0.16	0.62	0.6	1	3
Myriophyllum heterophyllum	Various-leaved water-milfoil	3	0.16	0.62	0.6	1.67	2
Nitella sp.	Nitella	3	0.16	0.62	0.6	1	0
Potamogeton vaseyi	Vasey's pondweed	3	0.16	0.62	0.6	1.33	0
Sagittaria latifolia	Common arrowhead	3	0.16	0.62	0.6	1.33	1
Sagittaria graminea	Grass-leaved arrowhead	2	0.1	0.41	0.4	1.5	0
	Aquatic moss	2	*	0.41	0.4	1.5	0
Calamagrostis canadensis	Bluejoint	1	0.05	0.21	0.2	3	0
Carex comosa	Bottle brush sedge	1	0.05	0.21	0.2	1	3
Eleocharis acicularis	Needle spikerush	1	0.05	0.21	0.2	1	0
Lemna trisulca	Forked duckweed	1	0.05	0.21	0.2	1	0
Potamogeton alpinus	Alpine pondweed	1	0.05	0.21	0.2	2	0
Potamogeton nodosus	Long-leaf pondweed	1	0.05	0.21	0.2	3	0
Potamogeton strictifolius	Stiff pondweed	1	0.05	0.21	0.2	1	1
Sparganium fluctuans	Floating-leaf bur-reed	1	0.05	0.21	0.2	3	0
Zizania palustris	Northern wild rice	1	0.05	0.21	0.2	1	2
Polygonum amphibium	Water smartweed	**	**	**	**	**	1
Potamogeton illinoensis	Illinois pondweed	**	**	**	**	**	2
Carex canescens	Gray bog sedge	***	***	***	***	***	***
Carex echinata	Star sedge	***	***	***	***	***	***
Equisetum fluviatile	Water horsetail	***	***	***	***	***	***
Eriophorum gracile	Slender cotton-grass	***	***	***	***	***	***
Hypericum boreale	Northern St. John's-wort	***	***	***	***	***	***
Iris versicolor	Northern blue flag	***	***	***	***	***	***
Potamogeton obtusifolius	Blunt-leaf pondweed	***	***	***	***	***	***
Riccia fluitans	Slender riccia	***	***	***	***	***	***
Schoenoplectus acutus	Hardstem bulrush	***	***	***	***	***	***

* Excluded from relative frequency analysis ** Visual only **Exotic species in bold**

Floristic Quality Index (FQI) – Mud Lake

The 50 native index species found in the rake during the August 2020 survey (up from 23 in 2008) produced a just below average mean Coefficient of Conservatism of 6.6 (up from 6.3 in 2008). The Floristic Quality Index of 46.7 (up from 30.4 in 2008) was; however, nearly double the median FQI for this part of the state (Nichols, 1999).

Species Change – Mud Lake

Lakewide, from 2008-2020, 30 species showed significant changes in distribution. Fern pondweed, Common waterweed, Flat-stem pondweed, Northern water-milfoil (*Myriophyllum sibiricum*), and Eurasian water-milfoil all suffered highly significant declines; White-stem pondweed and Clasping-leaf pondweed experienced moderately significant declines; and Large-leaf pondweed underwent a significant decline. Conversely, Coontail, White water lily (*Nymphaea odorata*), Common bladderwort (*Utricularia vulgaris*), Spatterdock (*Nuphar variegata*), Pickerelweed (*Pontederia cordata*), Floating-leaf pondweed (*Potamogeton natans*), Whorled water-milfoil, Creeping bladderwort (*Utricularia gibba*), Three-way sedge (*Dulichium arundinaceum*), Water bulrush (*Schoenoplectus subterminalis*), Bald spikerush (*Eleocharis erythropoda*), and Narrow-leaved woolly sedge (*Carex lasiocarpa*) enjoyed highly significant increases; Variable pondweed, Flat-leaf bladderwort (*Utricularia intermedia*), Hybrid cattail (*Typha* X *glauca*), and Short-stemmed bur-reed (*Sparganium emersum*) saw moderately significant increases; and Wild celery, Watershield, Small bladderwort (*Utricularia minor*), Small duckweed (*Lemna minor*), Softstem bulrush (*Schoenoplectus tabernaemontani*), and Small bur-reed (*Sparganium natans*) had significant increases. It should be noted that many of these species were either not reported in 2008, or they were mostly found in shallow water – a habitat that was largely inaccessible by the original surveyor's boat. In Table 8, only the species that were in both the 2008 and 2020 survey are included for comparison purposes.

The impacts of the herbicides used for management of EWM in the past have had are similar to those in Callahan Lake. There are certain species like Northern watermilfoil, coontail, and common waterweed which are susceptible to these herbicides that have declined, but the decline in pondweeds is not so easy to explain. Other factors including water clarity are also likely contributing to declines. Also, many species that are supposedly susceptible to 2,4D based herbicides have actually increased in the lake, not decreased.

Table 8: Statistically Significant Changes in the Aquatic Plant Community of Mud Lake from 2008 to 2020

MUD LAKE		2008	2020	Significant change	Pos (+) or Neg (-)	Monocot (m)/dicot(d)	2,4D Suscept.
Potamogeton robbinsii	Fern-leaf pondweed	283	269	***	-	m	??
Elodea canadensis	Common waterweed	221	181	***	-	m	yes
Potamogeton zosteriformis	Flat-stem pondweed	192	167	***	-	m	no
Potamogeton amplifolius	Large-leaf pondweed	153	160	*	-	m	no
Ceratophyllum demersum	Coontail	121	211	***	+	d	yes
Vallisneria americana	Wild Celery	85	140	*	+	m	no
Potamogeton praelongus	White-stem pondweed	67	49	**	-	m	no
Myriophyllum sibiricum	Northern watermilfoil	45	9	***	-	d	yes
Myriophyllum spicatum	Eurasian watermilfoil	31	13	***	-	d	yes
Nymphaea odorata	White waterlily	18	90	***	+	m	yes
Potamogeton richardsonii	Clasping-leaf pondweed	16	6	**	-	m	no
Brasenia schreberi	Watershield	15	37	*	+	d	yes
Utricularia vulgaris	Common bladderwort	14	54	***	+	d	yes
Nuphar variegata	Spatterdock (yellow pond lily	11	46	***	+	m	yes
Potamogeton gramineus	Variable pondweed	3	18	**	+	m	no
Pontederia cordata	Pickerel weed	2	39	***	+	m	yes
Potamogeton natans	Floating-leaf pondweed	2	28	***	+	m	no

Changes in Eurasian Watermilfoil – Mud Lake

In 2008, EWM was reported at 64 points (15.1% of surveyed points) with 13 additional visual sightings (Figure 14). Seven of these points had a rake fullness of 3, 15 were a 2 (5.2% of surveyed points had a significant infestation), and 42 were a 1 (mean rake fullness of 1.45). In 2020, EWM was in the rake at 17 points (3.9% of the entire lake bottom and 5.6% of the littoral zone) with 12 additional visual sightings (Figure 14). One point had an EWM rake fullness of 3, five were a 2 (1.4% of the entire lake and 2.0% of the littoral zone had a significant infestation), and 11 were a 1 for a mean rake fullness of 1.41 (Figure 14). Compared to the 2008 survey, this suggested EWM had undergone a highly significant decline in total distribution and rake fullness 1; and a significant decline in rake fullness 2 and rake fullness 3. However, the decline in mean rake fullness was not significant. Other than EWM, there was no evidence of any other exotic plants.

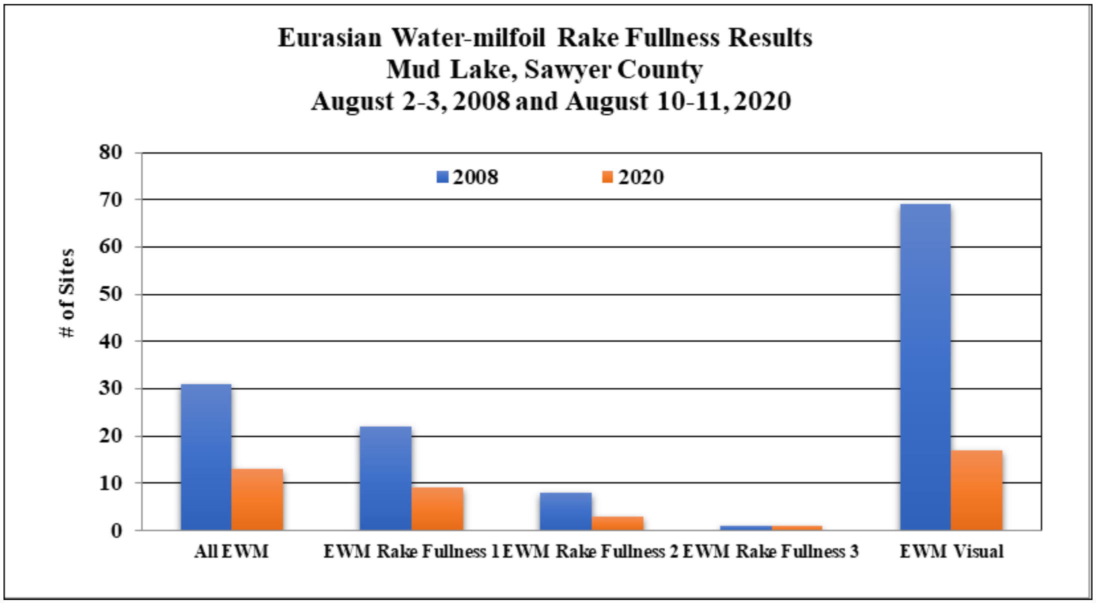

Figure 14: 2008 – 2020 Changes in Eurasian Water-milfoil Rake Fullness

Avoiding Future Negative Impacts to Native Aquatic Vegetation

There are several ways to minimize further impacts to certain native species that may or are being negatively impacted by the use of 2,4D based herbicides.

One is to treat as early in the season as possible to avoid actively growing native species. For several years prior to 2020, EWM treatment on Callahan and Mud Lakes was completed late in the treatment season. During this time frame, management plans were being put together by the herbicide applicator working with the CLPA. The applicator would come out late in the season, after much of his other work was completed, and based on a visual survey of the lakes, would recommend a management plan to the CLPA. As soon as WDNR permits were completed and approved, management would ensue, again usually very late in the treatment season, when native aquatic plants had already started to actively grow.

Another way is to use a different herbicide. In recent years, ProcellCOR® has been used to treat EWM. While this herbicide may still negatively impact similar native species like Northern watermilfoil, it has been shown to be more selective than 2,4D based herbicides.

And, of course, another way to minimize negative impacts to native aquatic plants is to not chemically treat at all. While this is not a realistic plan for the entirety of both lakes, it is a reasonable approach to certain areas of the lake where the presence of EWM is not interfering with lake use, and not causing significant interference with native aquatic plant growth. Also, using the most recent whole-lake, point-intercept survey, and/or prior year sub-basin PI surveys, if a possible treatment area shows a lot of native species most susceptible to the herbicides, additional caution can be used.

Wild Rice

A single Northern wild rice (*Zizania palustris*) plant was present in the rake at a single point and as a visual at two other points in the northwest bay. Fewer than 100 total rice plants were estimated to be in the entire area, and there was no place that would support human harvest (Figure 15).

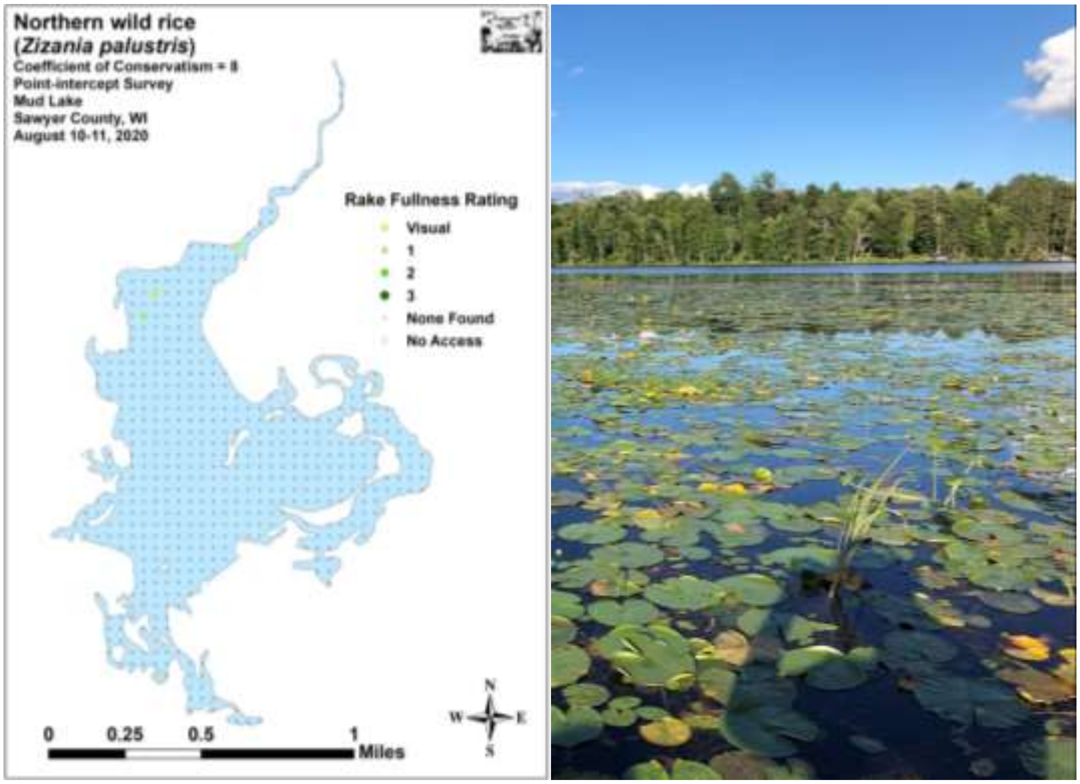

Figure 15: 2020 wild rice in Mud Lake

EWM Management History

It is currently unknown when EWM first entered the lakes, but it was discovered in 2005 occupying about 30 acres. In fall 2007, 2 acres of EWM were treated with granular 2,4-D. In 2008, 108 acres of EWM was mapped and an Aquatic Invasive Species Early Detection and Response grant was applied for and received by the CLPA. Under this grant, the group in cooperation with the Sawyer County Land Conservation Department treated 16 acres of dense EWM early in the growing season.

EWM has been consistently treated from 2007 to present using 2,4-D based products as approved by the WDNR (Table 9, Figure 16). These treatments, averaging approximately 13.4 acres per year between the two lakes, have been successful at reducing EWM in treated areas, although it does tend to reoccur after 1-3 years. In addition to herbicide treatments, volunteers have been hand pulling EWM around docks, swimming areas, and other small areas that do not warrant a chemical treatment.

Table 9: EWM treatment history in Callahan and Mud Lakes (Tyler Mesalk, WDNR)

Year	*Acres Treated	Herbicide	Rate (lbs/acre)	Rate (gal/acre)
2007	2	2,4-D	100-125	-
2008	16	2,4-D	150	-
2009	24	2,4-D	150	-
2010	14	Navigate	150	-
2011	16.9	Navigate	150	-
2012	14.93	Navigate	230	-
2013	10	Navigate	150	-
2014	15	Navigate	198	-
2015	18	Navigate	217	-
2016	12	Navigate	150	-
2017	5	Navigate	275	-
2018	12.55	Shredder Amine 4	-	14.5
2019	19.4	Shredder Amine 4	-	15.6
2020	9.81	2,4-D Amine 4	-	14.2
2021	12.69	2,4-D Amine 4	-	10.0

* = total combined for both lakes

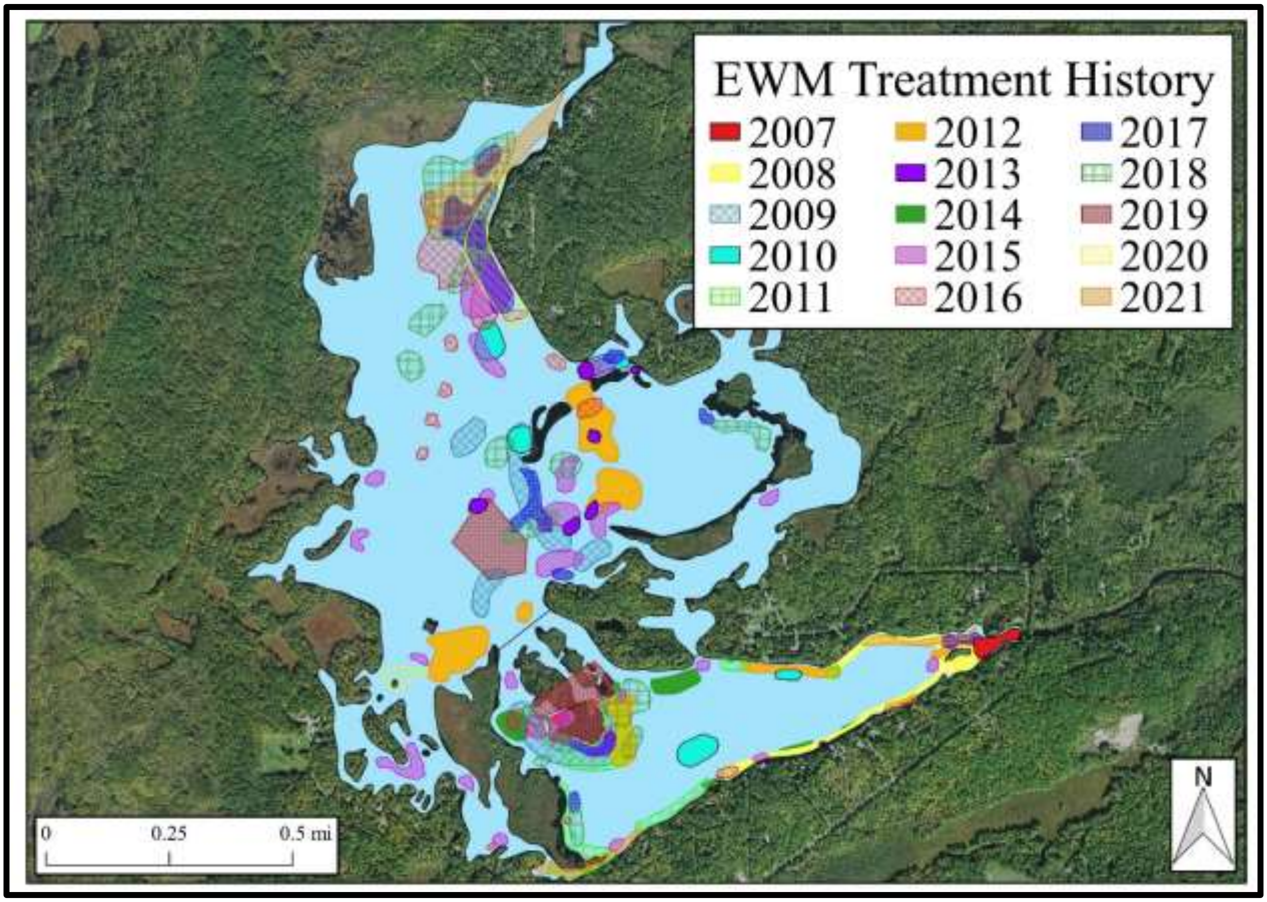

Figure 16: EWM treatment history, Callahan and Mud Lakes

Integrated Pest Management

Integrated Pest Management (IPM) is an ecosystem-based management strategy that focuses on long-term prevention and/or control of a species of concern. IPM considers all the available control practices such as: prevention, biological control, biomanipulation, nutrient management, habitat manipulation, substantial modification of cultural practices, pesticide application, water level manipulation, mechanical removal and population monitoring (Figure 17). In addition to monitoring and considering information about the target species' life cycle and environmental factors, groups can decide whether the species' impacts can be tolerated or whether those impacts warrant control. Then, an IPM-based plan informed by current, comprehensive information on pest life cycles and the interactions among pests and the environment can be formed.

After monitoring and considering information about the target species' life cycle and environmental factors, groups can decide whether the species' impacts can be tolerated or whether those impacts warrant control. If control is needed, data collected on the species and the waterbody will help groups select the most effective management methods and the best time to use them.

The most effective, long-term approach to managing a species of concern is to use a combination of methods. Approaches for managing pests are often grouped in the following categories:

- **Assessment** – is the use of learning tools and protocols to determine a waterbodies' biological, chemical, physical and social properties and potential impacts. Examples include: point-intercept (PI) surveys, water chemistry tests and boater usage surveys. This is the most important management strategy on every single waterbody.
- **Biological Control** – is the use of natural predators, parasites, pathogens and competitors to control target species and their impacts. An example would be beetles for purple loosestrife control.
- **Cultural controls** – are practices that reduce target species establishment, reproduction, dispersal, and survival. For example, a Clean Boats, Clean Waters program at boat launches can reduce the likelihood of the spread of species of concern.
- **Mechanical and physical controls** – can kill a target species directly, block them out, or make the environment unsuitable for it. Mechanical harvesting, hand pulling, and diver assisted suction harvesting are all examples.
- **Chemical control** – is the use of pesticides. In IPM, pesticides are used only when needed and in combination with other approaches for more effective, long-term control. Groups should use the most selective pesticide that will do the job and be the safest for other organisms and for air, soil, and water quality.

(Additional information on each method is outlined in the following section).

IPM is a process that combines informed methods and practices to provide long-term, economic pest control. A quality IPM program should adapt when new information pertaining to the target species is provided or monitoring shows changes in control effectiveness, habitat composition and/or water quality.

While each situation is different, eight major components should be established in an IPM program:

1. Identify and understand the species of concern
2. Prevent the spread and introduction of the species of concern

3. Continually monitor and assess the species' impacts on the waterbody
4. Prevent species of concern impacts
5. Set guidelines for when management action is needed
6. Use a combination of biological, cultural, physical/mechanical and chemical management tools
7. Assess the effects of target species' management
8. Change the management strategy when the outcomes of a control strategy create long-term impacts that outweigh the value of target species control.

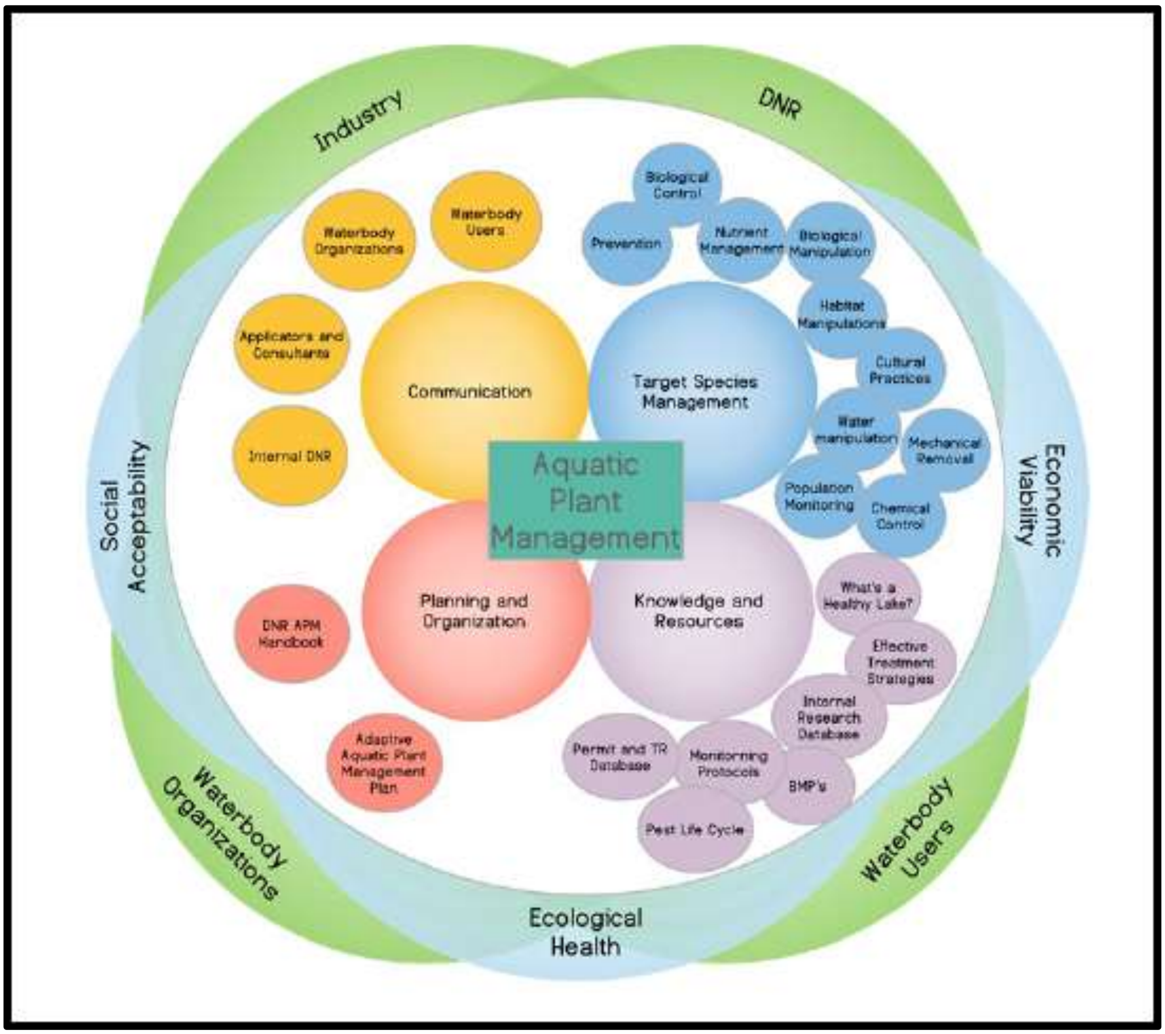

Figure 17: Wisconsin Department of Natural Resources: Wisconsin Waterbodies – Integrated Pest Management March 2020

Aquatic Plant Management Alternatives

Protecting native plants and limiting EWM through IPM is a primary focus of plant management in Callahan and Mud Lakes due to their diverse plant community and the benefits it offers. Generally, control methods for nuisance aquatic plants can be grouped into four broad categories:

- Chemical control: use of herbicides
- Mechanical/physical control: pulling, cutting, raking and harvesting
- Biological control: the use of species that compete successfully with the nuisance species for resources
- Aquatic plant habitat manipulation: dredging, flooding, and drawdowns

In many cases, an IPM approach to aquatic plant management is the best way to protect and enhance the native plant community while maintaining functional use of the lake.

Physical/Manual Removal: Recommended

Physical removal will be completed by educated landowners who monitor their own shorelines or by a trained EWM Management Team sponsored by the CLPA. There is no limit as to how far out into the lake this management activity can occur, provided the area cleared is no more than 30-ft wide. It limits disturbance to the lake bottom, is inexpensive, and can be practiced by many lake residents. Landowners should also continually monitor near their docks and swimming areas in the open water season and remove rooted plants as well as floating fragments that wash into their shoreline.

Pulling EWM while snorkeling or scuba diving in deeper water is also allowable without a permit and can be effective at slowing the spread of a new aquatic invasive species infestation within a waterbody when done properly. Diver removal will be completed by CLPA volunteers and/or resource professionals retained by the CLPA. These efforts will focus on smaller beds not treated with chemical herbicides in areas not directly adjacent to any landowner’s property. Diver Assisted Suction Harvesting (DASH), a hand removal method that requires a diver to handfeed EWM into a suction tube, is not recommended at this time on Callahan and Mud Lakes because the additional equipment, permitting, and overall cost is much greater compared to diver removal.

Chemical Herbicide Treatments: Recommended

Herbicides will be used to manage existing EWM and any existing or new areas with moderate to severe growth density and deemed too large for effective physical removal. Determining which herbicide to use (as approved by the state of Wisconsin) and at what concentration will be determined on a yearly basis during the treatment planning phase. Spring application of herbicides is preferred to reduce negative effects on native plants.

There are several chemical herbicide options currently available in the State of Wisconsin (as approved by the Environmental Protection Agency). There are two classes of aquatic chemical herbicides currently in use:

1) Systemic: moves through the entire plant. It is absorbed through the leaves or stem and moves through the entire plant and usually results in the death of the plant within two or more weeks

2) Contact: kills the plant at the point of contact. The entire plant may not be damaged, and the roots may still be viable for regrowth. Mostly used when an immediate removal of a plant is required.

Available aquatic herbicides for EWM include:

ProcellaCOR®

ProcellaCOR® is a relatively new systemic, selective herbicide that can be used to target EWM with limited impact to most native species. It is also very fast acting, making it an effective control measure on smaller beds like several located in Callahan and Mud, especially ones in high boat traffic areas and/or deeper water. In addition, applications rates are measured in ounces, not gallons as is common with almost all other liquid herbicides. And while it is more expensive to use than 2,4-D equivalents, it has been shown to provide 2 or more years of control without re-application. ProcellaCOR® is recommended for future EWM management implementation.

Triclopyr

Triclopyr is a selective, systemic herbicide used to control broadleaf plants like EWM by mimicking plant hormones. Liquid triclopyr (Renovate®) or granular triclopyr combined with granular 2,4-D (Renovate Max G®) may be an option in the lakes.

2,4-D (liquid)

2,4-D is a commonly used systemic herbicide that targets dicot plants (or broad-leaved plants) like EWM. Monocots (like pondweed species and water celery) are generally not affected by 2,4-D. Shredder Amine 4®, also referred to as 2,4-D Amine 4® is a liquid formulation of 2,4-D. The use of liquid 2,4-D products is supported by the WDNR.

ProcellaCOR has proven to be very effective on small, even deep-water treatment areas, often eliminating the need for re-application of herbicides for 2 or more years. It has been used effectively on very small treatment areas even less than 0.25 acres. On larger treatment areas, liquid 2,4-D, triclopyr, or a 2,4-D/triclopyr blend has been shown effective and will provide more than one year of control if minor control activities such as scuba or other forms of physical removal are completed in subsequent years.

Chemical Herbicide Treatments: Not Recommended

The following herbicides and/or herbicide formulations have also been used effectively for control of EWM but are not recommended for use in Callahan or Mud lakes. Additional management methods are also discussed, but again are not recommended for use in Callahan or Mud lakes.

2,4-D (granular)

Granular 2,4-D, under the trade name Navigate® or Sculpin G® has been effectively used in Callahan and Mud to treat EWM in the past, and its use may be warranted again in the future. However, granular formulations of 2,4-D based aquatic herbicides are generally more expensive than their liquid counterparts. Marketing for these granular herbicides suggest that they work better on small or micro-scale treatments because the herbicide is contained in a slow-release clay particle that dissolves slowly, prolonging the time that the herbicide can be in contact with the target plant. However, relatively recent research shows that the dissipation of the herbicide when using liquid or granular formulations is about the same (Nault, et al., 2015).

Fluridone (liquid)

Fluridone is also a non-selective, systemic herbicide often used for whole-lake treatment. It is slow-acting and can be selective to EWM at low concentrations; however, the contact time must be very long in order for this to be effective, which may not be practical in the lakes depending on water movement, wind and weather during and after applications. At the present time, whole-lake management of EWM is not a recommendation in this plan. As such, Fluridone is not appropriate for use in Callahan and Mud.

Endothall (liquid)

Endothall is a non-selective contact herbicide. This herbicide is generally recommended when EWM growth needs to be suppressed to allow native plants to recover and potentially reclaim the area. It is not recommended for cases when eradication is the goal. In Callahan and Mud, Endothall is not likely to be a viable option in the future in order to protect the native plant community and prevent EWM from re-growing in treated areas.

Diquat (liquid)

Diquat is another non-selective herbicide that is commonly used to control emergent and submersed aquatic vegetation. It is fast-acting and has no restrictions for swimming, fish, or wildlife, but there may be irrigation and drinking water restrictions for up to 5 days. Again, a non-selective contact herbicide is generally not going to be an option in these lakes where the native plant community is so valuable and the risk of stressing the native plants and allowing EWM to re-grow would be detrimental to the lake.

Mechanical Harvesting: Not Recommended

Harvesters can remove thousands of pounds of vegetation in a relatively short time period. They are not, however, species specific. Everything in the path of the harvester will be removed, including the target species, other plants, macro-invertebrates, semi-aquatic vertebrates, forage fishes, young-of-the-year fishes, and even adult game fish found in the littoral zone (Booms, 1999). Plants are cut at a designated depth, but the root of the plants are often not disturbed. Cut plants will usually grow back after time, and re-cutting several times a season is often required to provide adequate annual control (Madsen, 2000). Harvesting activities in shallow water can re-suspend bottom sediments into the water column releasing nutrients and other accumulated compounds (Madsen, 2000). Even the best aquatic plant harvesters leave some cutting debris in the water to wash up on the shoreline or create loose mats of floating vegetation on the surface of the lake. This “missed” cut vegetation can potentially increase the amount of EWM in a lake by creating more fragments that can go on to establish new sites elsewhere. A major benefit, however, of aquatic plant harvesting is the removal of large amounts of plant biomass from a water body. Mechanical harvesting is not recommended in Callahan and Mud due to the risk of releasing EWM fragments and further spreading it throughout the lake, and because of submerged obstacles including stumps and floating bogs.

Biological Control: Not Recommended

Biological control uses one or more living organisms to control, or suppress, another living organism. Milfoil weevils *Euhychiopsis lecontei* are one method used to manage EWM. Weevils are an alternative to chemical treatments and potentially damaging mechanical harvesting. However, they are expensive to rear, easily predated on by sunfish, and only suppress – not eliminate – EWM.

The milfoil weevil is native to North America is likely present at some level in the two lakes, naturally. Survey work could be completed to determine their presence or absence, however attempting to artificially increase their population as a biological control method is not recommended.

Habitat Manipulation: Not Recommended

Habitat manipulation can take the form of flooding, dredging and drawdowns. None of these options are recommended or viable in Callahan and Mud. Flooding and drawdowns are not possible because the dam at the outlet is not capable of manipulating water levels. Dredging is not recommended because the high-water quality and valuable habitat of the lakes would be jeopardized by removing large quantities of substrate and bottom materials.

No Management: Not Recommended

Regardless of the target plant species, native or non-native, sometimes no management is the best management option. Plant management activities can be disruptive to areas identified as critical habitat for fish and wildlife and should not be done unless it can occur without ecological impacts. This management alternative is not recommended for the lakes due to the excessive growth of EWM in some areas and restrictions to public and lake property owner access to the lake. Additionally, limiting the spread of EWM within the lake through management protects the ecological integrity of the lake long-term.

Aquatic Plant Management Discussion

Callahan and Mud Lakes support a valuable aquatic plant community with a number of uncommon species and a quality fishery valued by the lake community and the general public. The lake currently has only one known fully aquatic invasive species – Eurasian watermilfoil. Nuisance conditions and navigation impairment occur throughout the open water season as a direct result of the EWM infestation. The main goal of the APMP is to control EWM in a sound, ecological manner to minimize the effect on native plants while keeping EWM at acceptable levels.

In Callahan Lake, the frequency of occurrence for EWM in the littoral area of the lake was 5.65% in the 2020 PI survey. For Mud Lake, it was lower at 2.59%. During the 2008 PI survey the frequency of occurrence of EWM in Callahan was 20.32% and 7.85% in Mud.

On average between 2007 and 2021, 13.5 acres have been treated in both lakes combined in any given year. These management practices have brought the frequency of occurrence in the littoral area of the lake down to what it is now in the two lakes. A littoral frequency of 5.65% in Callahan Lake equates to 17 PI points or 5.4 acres of EWM. This plan recommends a goal of 3.0% for a littoral frequency which equates to only 9 PI points or 2.9 acres of EWM. With this in mind, the overall goal annually is to have <3.0 acres of EWM in the lake based on annual fall bedmapping. If 3.0 or more acres of bed-forming EWM are documented in fall bedmapping, the use of aquatic herbicides will be considered. If mapping reveals <3.0 acres of EWM, only physical removal/diver removal will be considered. At this level, EWM is generally not noticed by the constituency, recreation activities (fishing and others) are not negatively impacted, and negative impacts to the native aquatic plant community and water quality continue to be minimal.

A littoral frequency of 2.59% in Mud Lake equates to 13 PI points or approximately 12.1 acres of EWM. This plan recommends a goal of 2.0% for a littoral frequency which equates to only 10 PI points or 9.3 acres of bed-forming EWM. With this in mind, the overall goal annually is to have <9.5 acres of EWM in the lake based on annual fall bedmapping. If 9.5 or more acres of bed-forming EWM are documented in fall bedmapping, the use of aquatic herbicides will be considered. If mapping reveals <9.5 acres of EWM, only physical removal/diver removal will be considered. Mud Lake is much larger than Callahan, and has considerably less shoreland development and recreational use other than fishing. As such, a wider distribution of EWM, particularly in those areas that are not in the mainstream use area cause significantly less inconvenience. Large areas of EWM along developed shores and in main navigation areas will be the primary management areas.

When to Manage?

Any amount of EWM can be managed, albeit in different ways. A combination of manual/physical removal, diver/DASH removal, and chemical control methods are recommended for both lakes. Physical methods can be implemented at any time for any amount of EWM, but for the average lake steward it may be difficult to determine when the use of aquatic herbicides should be considered a priority.

Figure 18 provides a method to determine priority. Referred to as FLIPS, this management planning priority matrix involves evaluating each area of EWM in the lake in any given year based on when it was first discovered (**F**ormation), where it is located (**L**ocation), whether it is causing use issues (**I**mpairment), whether it was chemically treated in a previous year (**P**rior year), and whether it is negatively impacting the native aquatic plant community (**S**ensitive area). When evaluating a potential treatment area, the five questions in the FLIPS figure should be asked. If the answer to 3 or more of the questions is "yes" then herbicide use can be considered a priority. If the answer to 3 or more of the questions is "no" then herbicide use should not be considered a priority.

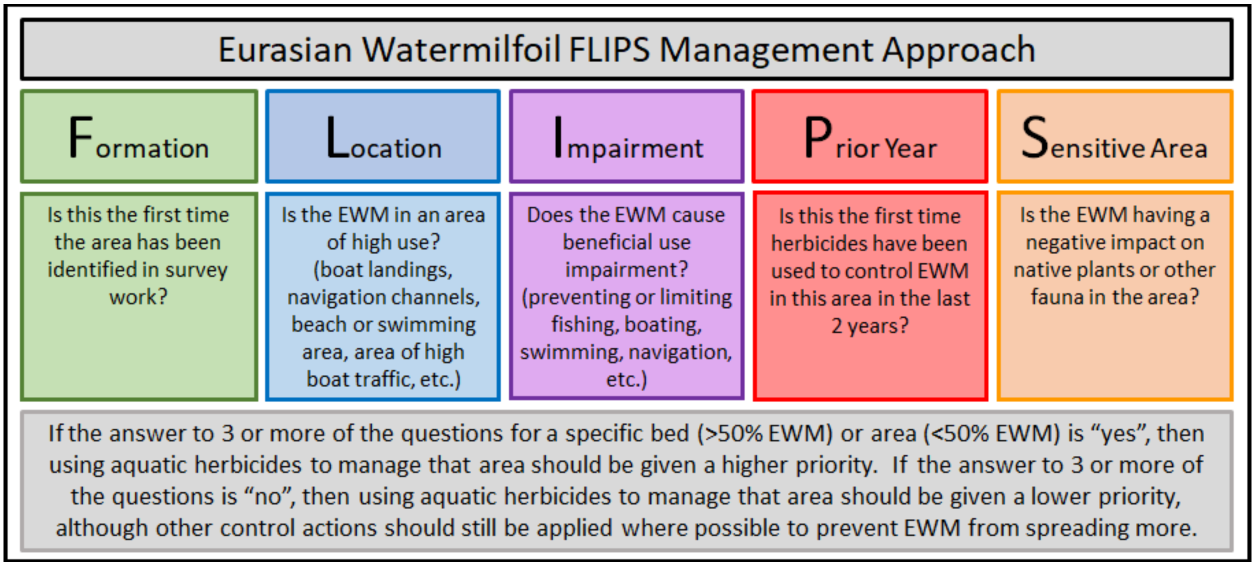

Figure 18: FLIPS Management Priority Matrix

A combination of manual/physical, diver/DASH, and herbicide application control methods are recommended for Callahan and Mud Lakes. Mechanical harvesting, artificially enhanced biological control (for EWM), habitat manipulation, and zero management are not recommended at this time.

In general, EWM management in both Callahan and Mud Lakes will be based on the following criteria.

1) EWM bedmapping will be completed every year.

2) Any amount of EWM in the lake can be managed at any time if chemical management is not used. Non-chemical management actions include hand pulling, rake removal, and snorkel/scuba diver removal, and/or DASH removal.

3) Chemical management of EWM may be implemented if prior year bed mapping identifies a total of 3.0 or more acres of EWM in Callahan Lake; and/or a total of 9.5 or more acres in Mud Lake.

4) An individual bed or combination of beds will only be chemically treated if it is at least 1.0 acres in size, unless the use of new herbicides like ProcellaCOR are approved for smaller treatment areas by the WDNR.

5) If an herbicide application proposal is less than 10.0 acres and a pre and post-treatment survey is not planned in support of the management action, a spring readiness survey will be completed in the proposed treatment areas prior to actual herbicide application, to determine if any modifications need to be made to what was proposed.

6) Herbicides applied to EWM beds that reach or exceed 10.0 acres in total will be considered large-scale chemical treatments. With a large-scale chemical treatment, the following activities will be added in support of that treatment.

a. Pre and post-treatment, point-intercept surveys following WDNR guidelines will be completed.

b. Herbicide concentration testing will be completed unless deemed unnecessary by the WDNR.

7) The same area will not be chemically treated with the same herbicide, two years in a row.

8) Areas where wild rice is present will not be chemically treated unless it is agreed upon by the CLPA, LCO Tribal Resources, and the WDNR that management will benefit wild rice.

Overuse of Aquatic Herbicides

Concerns exist when herbicide treatments using the same herbicide are done over multiple and subsequent years. Target plant species may build up a tolerance to a given herbicide making it less effective, susceptible plant species may be damaged and/or disappear from the lake (ex. water lilies), concerns over fish and other wildlife might occur, and concern over recreational use in chemically treated water may be voiced. By using several different aquatic herbicides interspersed with physical removal efforts between treatments, many of these concerns are minimized.

Aquatic Plant Management Plan

This Aquatic Plant Management Plan establishes the following goals for aquatic plant management in Callahan and Mud Lakes:

1. **EWM Management.** Limit the spread of EWM through environmentally responsible methods to benefit the native plant community while maintaining EWM at manageable levels.

2. **Education and Awareness.** Continue to educate property owners and lake users on aquatic invasive species through public outreach and education programs to help contain EWM within the lake and prevent its spread further in the lake, as well as to other water bodies.

3. **Research and Monitoring.** Develop a better understanding of the lake and the factors affecting lake water quality through continued and expanded monitoring efforts.

4. **Adaptive Management.** Follow an adaptive management approach that measures and analyzes the effectiveness of control activities and modify the management plan as necessary to meet goals and objectives.

Goal 1. EWM Management

An integrated management approach will be used to help minimize the negative impacts of EWM on native plants and water quality, and to provide relief for navigation impairment caused by EWM. The overall goal for EWM management is to keep the level of EWM that can be mapped from the surface of the lake at or below 0.95 acres or 1.2% of the surface area of the lake. EWM management options to be utilized include small-scale physical removal, diver removal, DASH, targeted use of aquatic herbicides through small and large-scale application, and possibly whole-lake/basin application of herbicide.

Pre and Post Treatment Surveys, Readiness Surveys, and Fall Bed Mapping

Management of EWM will be based on pre- and post-treatment surveys or management readiness surveys performed by resource professionals retained by the CLPA. Pre and post-treatment surveys following WDNR protocols, are point-intercept based and track changes in aquatic plants before and after herbicide application at individual points. A pre-treatment survey is best completed in the year prior to the planned chemical management. Post-treatment surveys should be performed within the same year of treatment and/or in the year following treatment. If resources are available, they can be completed in more than just the year after treatment, particularly if it is expected that management impacts will last more than two years.

Pre and post treatment surveys are not required by the WDNR unless the chemically treated area covers more than 10 acres or 10% of the littoral zone or in smaller areas if management is being funded in part by a WDNR grant. However, completing these tasks is highly recommended in any treatment program, as they provide a means to measure success.

Management readiness surveys are visual and rake-based surveys completed prior to actual management in the same year only to determine if a given management area is ready to be treated. Ready is defined as having target plants present in sufficient quantity and growth to go through with the proposed chemical treatment. Proposed treatment areas may be modified based on the results of the readiness survey but still must follow restrictions in the WDNR-approved chemical application permit. Readiness surveys provide a quick check and balance on a treatment proposal and are recommended in any year chemical treatment is to occur.

Bed mapping or reconnaissance surveys are completed in the summer or fall each year to help identify potential areas for management in the following year. These are visual and rake-based, meandering surveys of the lake's littoral zone. GPS tracking of individual plants, small clumps, and beds of EWM is completed. Using bed mapping survey data, proposed treatment maps can be created.

Herbicide Concentration Testing

Regardless of the size of a treatment area and the herbicide used for management of EWM, collecting herbicide concentration data is one way to track how the herbicide "acts" in the lake. With the presence of Northern wild rice in Mud Lake, it is possible that the WDNR at the request of LCO Tribal Resources will require concentration testing as a part of every proposed herbicide application. Concentration testing also provides a way to determine if the expected application concentrations were met and for how long a measureable amount of the herbicide remained in the water.

Goal 2. Education and Awareness

Aquatic invasive species (AIS) can be transported via a number of vectors, but most invasions are associated with human activity. It is recommended that that the CLPA continue to maintain and update signage at all private and public boat launches as necessary.

Early detection and rapid response efforts increase the likelihood that a new aquatic invasive species will be addressed successfully while the population is still localized and levels are not beyond that which can be contained. Once an aquatic invasive species becomes widely established in a lake, eradication is no longer possible, so attempting to partially mitigate negative impacts becomes the goal. The costs of early detection and rapid response efforts are typically far less than those of long-term invasive species management programs needed when an AIS becomes established.

It is recommended that the CLPA continue to implement a proactive and consistent AIS monitoring program. At least three times during the open water season, trained volunteers should patrol the shoreline and littoral zone looking for invasive species that are not currently known to be in the lakes (curly-leaf pondweed, purple loosestrife, Japanese knotweed, giant reed grass, zebra mussels). Free support for this kind of monitoring program is provided as part of the UW-Extension Lakes/WDNR Citizen Lake Monitoring Network (CLMN) AIS Monitoring Program. Any monitoring data collected should be recorded annually and submitted to the WDNR SWIMS database.

Providing education, outreach opportunities, and materials to the lake community will improve general knowledge and likely increase participation in lake protection and restoration activities. It is further recommended that the CLPA continue to cultivate an awareness of the problems associated with AIS and enough community knowledge about certain species to aid in detection, planning, and implementation of management alternatives within their lake community. It is also recommended that the CLPA continue to strive to foster greater understanding and appreciation of the entire aquatic ecosystem including the important role plants, animals, and people play in that system.

Understanding how their activities impact the aquatic plants and water quality of the lakes is crucial in fostering a responsible community of lakeshore property owners. To accomplish this, the CLPA should distribute, or re-distribute, informational materials and provide educational opportunities on aquatic invasive species and other factors that affect the lakes. At least one annual activity (picnic at the lake, public workshop, guest speakers, etc.) should be sponsored and promoted by the CLPA that is focused on AIS. Maintaining signs and continuing aquatic invasive species monitoring should be done to educate lake users about what they can do to prevent the spread of AIS. Results of water quality monitoring should be shared with the lake community at the annual meeting, or another event, to promote a greater understanding of the lake ecosystem and potentially increase participation in planning and management.

Goal 3. Research and Monitoring

Long-term data can be used to identify the factors leading to changes to water quality, such as aquatic plant management activities, changes in the watershed land use, and the response of the lakes to environmental changes. The CLMN Water Quality Monitoring Program supports volunteer water quality monitors across the state following a clearly defined schedule. In the first level of the program, Secchi disk readings are encouraged 2-3 times a month from ice out to ice on. In the CLMN expanded monitoring program, water samples are collected for analysis of TP two weeks after ice out, and once each in June, July and August. Water samples are collected and processed for chlorophyll-*a* once each in June, July, and August. Temperature profiles are encouraged anytime a Secchi reading is taken, but recommended to be done at the same time water samples for TP and chlorophyll-*a*. If the necessary equipment is available to collect dissolved oxygen profiles these are encouraged at least monthly as well.

Available data suggests that the CLPA has never had lake volunteers collect basic water quality data through the CLMN Water Quality Monitoring Program. Thus, it is recommended that the CLPA identify at least one volunteer and sign up for level one (collecting Secchi disk readings of water clarity) of the CLMN program. CLMN expanded monitoring parameters (temperature, dissolved oxygen, total phosphorus, and chlorophyll-*a*) should be added as soon as the lake can be enrolled by the WI-DNR. The intensity/success of water quality monitoring efforts should be evaluated at least every three years. The background information and trends provided by these data are invaluable for current and future lake and aquatic plant management planning.

An alternative to this approach is to work closely with LCO Tribal Resources to establish a regular, consistent, long-term trend water quality monitoring program.

To monitor any changes in the plant community, it is recommended that whole-lake point intercept aquatic plant surveys be completed at three to five-year intervals. This will allow managers to adjust the APMP as needed in response to how the plant community changes as a result of management and natural factors like water level.

At present, there is a “dike-type” dam at the outlet of Callahan Lake that controls the water level. It is in some level of disrepair due in part to the difficulty in establishing who owns, and therefore, is responsible for its upkeep. Over the years, there have been multiple discussions and attempts to determine ownership, and then to engineer a “better” structure in place of the existing one. All of these have been unsuccessful. At the end of the 2022 summer season, with water levels in both lakes much lower than people are used to, the issue of the dam came up again during the Labor Day Weekend meeting of the CLPA. Once again, efforts are being made to determine ownership and come up with a system that will better serve the lakes. In the interim, it may be beneficial for the CLPA to begin a water level monitoring program for at least Callahan Lake. CLMN, the same State program that provides water quality and AIS monitoring support can provide support for water level monitoring. The CLPA should be involved in this program.

Goal 4. Adaptive Management

This APMP is a working document guiding management actions on Callahan and Mud for the next five years. This plan will follow an adaptive management approach by adjusting actions as the results of management and data obtained deem fit following IPM strategy. This plan is therefore a living document, progressively evolving and improving to meet environmental, social, and economic goals, to increase scientific knowledge, and to foster good relations among stakeholders. Annual and end of project assessment reports are necessary to monitor progress and justify changes to the management strategy, with or without state grant funding. Project reporting will meet the requirements of all stakeholders, gain proper approval, allow for timely reimbursement of expenses, and provide the appropriate data for continued management success. Success will be measured by the efficiency and ease in which these actions are completed.

The CLPA and their retainers will compile, analyze, and summarize management operations, public education efforts, and other pertinent data into an annual report each year. The information will be presented to members of the CLPA, Sawyer County, and the WDNR and made available in hardcopy and digital format on the internet. These reports will serve as a vehicle to propose future management recommendations and will therefore be completed prior to implementing following year management actions (approximately March 31st annually). At the end of this five-year project, all management efforts (including successes and failures) and related activities will be summarized in a report to be used for revising the APMP.

Timeline of Activities

The activities in this APMP are designed to be implemented over a 5-year period beginning in 2022. The plan is intended to be flexible to accommodate future changes in the needs of the lake and its watershed, as well as those of the CLPA. Some activities in the timeline (Appendix D) are eligible for grant support to complete.

Potential Funding

There are several WDNR grant programs that may be able to assist the CLPA in implementing its new APMP. AIS grants are specific to actions that involve education, prevention, planning, and in some cases, implementation of AIS management actions. Lake Management Planning grants can be used to support a broad range of management planning and education actions. Lake Protection grants can be used to help implement approved management actions that would help to improve water quality.

In 2022, the CLPA will have to cover the cost of EWM management using their own funds. As such, management planning has been modified to account for limited resources. However, in the event the CLPA receives AIS Population Control grant funding starting 2023, management planning will be modified accordingly.

More information about WDNR grant programs can be found at:
https://dnr.wisconsin.gov/aid/SurfaceWater.html

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APPENDIX A

AQUATIC PLANT MANAGEMENT STRATEGY
Northern Region WDNR

APPENDIX B

2019 WDNR Fisheries Summary

APPENDIX C

Summary of the Public Lake Use Survey Results

APPENDIX D

Five Year Timeline of Management Actions